Summary and Findings

11.1 Introduction

The 2009 Regional Water Supply Outlook (2009 Outlook) provides a regional overview of municipal water demands in King, Pierce, and Snohomish Counties. The three-year effort to complete the 2009 Outlook also included an inventory of existing large municipal water supplies, identification and description of potential future water supply projects (including conservation), and includes a method that can be used to evaluate and compare future water supply alternatives.

This chapter describes the major findings of the 2009 Outlook and provides recommendations for planning and preparing future Outlooks.

11.2 Regional Water Demand Findings

Key Demand Findings:

- ***Under the Baseline Forecast, the Region's Municipal Water Demand is forecast to increase from 397 million gallons per day in 2005 to 609 million gallons per day in 2060.***

- ***Forecasted Demand ranges from 502 to 742 millions gallons per day in 2060 under different growth and climate change scenarios.***

- ***For the region's largest water systems conservation has resulted in less water was being used annually in 2005 than was used in 1960.***

- ***Average single-family water use has declined regionally from 280 gallons per day per household in 1990 to 200 gallons per day per household in 2005.***

The 2009 Outlook addresses only municipal water use. Other water uses, including agriculture, self-supplied commercial and, industrial users, and habitat needs are not included in this study. The 2009 Outlook only looks at total regional needs and does not address the sufficiency of existing facilities, or need for new facilities, to deliver the supplies to places where the water is or will be used.

Municipal water demand is very dynamic, and varies significantly between water utilities and counties. Water demands are primarily driven by:

- Demographics (population, households, employment, household income, water rates)
- Land Use (urbanization)
- Conservation
- Weather

Demographics

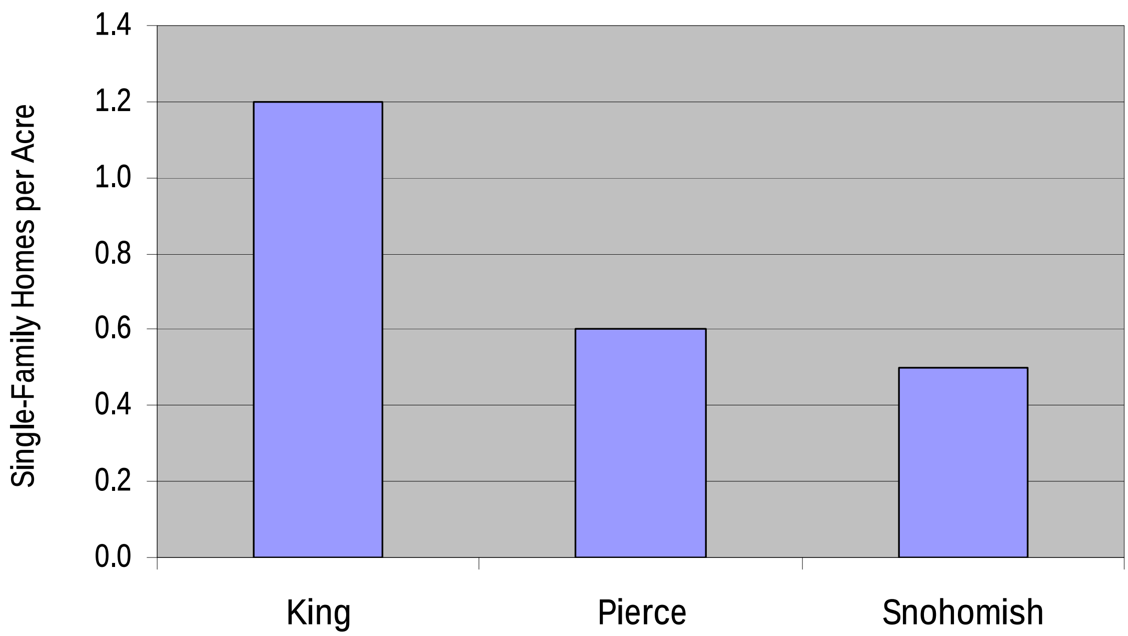
Population (more specifically the number of households) and levels of employment are the main drivers of water demand. Demographic projections for the region are developed by the Puget Sound Regional Council (PSRC). Population in the region (King, Pierce, and Snohomish Counties) grew 45 percent from 1980 to 2000. It is expected that growth will slow as cities are built out, although it will still be significant into the future. PSRC baseline projections predict that the region's population will grow by 26 percent from 2000 to 2020, and by 20 percent between 2020 and 2040. Snohomish and Pierce Counties are expected to grow more rapidly than King County, with Snohomish's population growth increasing almost twice as fast as King County's.

Price of water and household income also influence residential water use. There is generally an inverse (although small) relationship between price of water and water use – meaning when price is higher, water use is lower. On the other hand, when household income is greater, so is water use. This is because households with higher relative income tend to have larger lots with more extensive landscaping requiring irrigation, and the houses themselves have more water-using fixtures.

Land Use

Land use, specifically the degree of urbanization and the size of lots, is another factor that influences residential water demand. Households in suburban and rural communities tend to use more water than those in more dense, urban communities. This is primarily because suburban and rural households have larger lots with greater landscaping, and in some cases are supporting horses and other livestock. Housing density varies significantly in the region, depending on the utility and county. Figure 11-1 illustrates how housing density varied between the three counties in 2005.

Figure 11-1 Housing Density in 2005



Source: Puget Sound Regional Council (PSRC)

As shown in Figure 11-1, the single-family housing density is twice as high in King County than in Pierce and Snohomish Counties. While this is in part due to the density of existing development, the amount of vacant land in each county also significantly affects the densities shown.

Demographic and land use differences are the main reasons why residential water use between the three counties is significantly different. In more densely populated King County, the average single-family household uses 193 gallons per day (gpd); however, in Pierce and Snohomish Counties, which encompass more rural areas, the average single-family household uses 244 and 220 gpd, respectively.

Conservation and Demand Curtailment

Since the 1980s, several large water utilities in the region have implemented conservation programs as a way to stretch existing water supplies and defer system expansions that would be required to serve population growth. During this time, water use in many systems increased generally at the same rate as population growth. A severe drought in 1992 resulted in temporary mandatory water use restrictions (curtailment) by several of the region's utilities. This curtailment resulted in a sharp but temporary drop in summer water use. The drought campaign and public education associated with the curtailment also lowered water demands for other utilities that did not use curtailment as a demand management tool in the 1992 drought.

After the 1992 drought, public attitudes changed regarding water use and conservation. At about the same time, the Washington Department of Health adopted water conservation planning requirements for water systems. Utilities began implementing more aggressive long-term conservation programs such as low-flush toilet rebates and retrofits, low-flow showerhead replacements, water conservation pricing, landscape audits, system leak detection and repair, and other programs to reduce demand.

In 1993, a new state plumbing code established efficiency standards for all new toilets, urinals, showerheads, and faucets. As a result, all new construction and remodels have more water-efficient plumbing fixtures.

In 2003, the Municipal Water Law placed additional water conservation requirements on all water utilities in Washington. These included a requirement that water systems set water conservation goals and annually evaluate and report their progress in meeting their goals. Most large utilities in the region have conservation goals of about 10 percent between 2003 and 2020. These goals are in addition to historic reductions in water use.

Based on the response to 2009 Outlook utility survey, 36 of the region's largest utilities representing more than 78 percent of the region's water use reported a variety of conservation measures are currently being implemented:

Table 11-1 Conservation Measures Currently being Implemented

Conservation Measure	Utilities Implementing
Public Education	91%
Residential Plumbing Retrofits/Give-Aways	72%
System Leak Detection/Repair	71%
Conservation Goals	59%
Landscape Programs	49%

Source: Utility Survey Response and Water System Plan Information

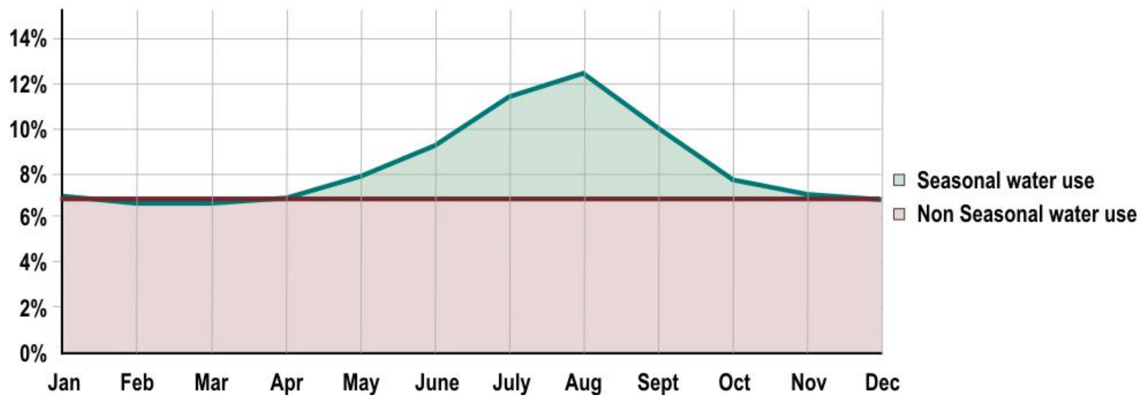
All of these conservation efforts have contributed substantially to a significant decrease in water use in the region since 1990. In fact, the Seattle, Tacoma, and Everett wholesale and retail systems each use less water today than they did 40 or more years ago.

Demand curtailments are different than long-term conservation programs because they are temporary and are often targeted during summer months due to extraordinary water supply situations such as droughts or water system emergencies.

Weather and Seasonality

As shown in Figure 11-2, approximately 84 percent of the annual regional water demand is non-seasonal (mostly indoor use), while 16 percent is seasonal or outdoor use. Monthly water use in the region is greater in the summer months, when temperatures are hotter and there is less precipitation.

Figure 11-2 Seasonality in Regional Water Use



Source: Utility Utility Survey Response and Water System Plan Information

Weather can vary from year to year in the region, and spatially across the region. When hot and dry conditions occur, regional water demands have been approximately 5 percent greater than average (based on 40 years of historical weather); cool and wet weather water demands have been about 4 percent lower than average.

Peaking (the ratio of the peak day demand to average annual demand) is also affected by weather, as well as demographics and land use. Table 11-2 summarizes the reported peaking factors based on the survey of utilities in the region.

Table 11-2 Peaking Factors for Select Utilities in the Region

Utility Name	Peak Day Factor	Utility Name	Peak Day Factor
Lynnwood	1.40	Puyallup	2.20
Seattle - Retail and Wholesale	1.70	Gig Harbor	2.21
Alderwood	1.78	Bonney Lake	2.23
Everett - Retail and Wholesale	1.80	Heights Water Association	2.30
Mukilteo	1.85	North Bend	2.30
Auburn	1.97	Spanaway	2.30
Edmonds	2.00	King County Water District No. 19	2.35
Snohomish County PUD	2.00	Steilacoom	2.44
Tacoma - Retail and Wholesale	2.01	Arlington	2.50
Lakehaven	2.10	Woodinville	2.50
Renton	2.14	Highline	2.50
King County Water District No. 111	2.17	Issaquah	2.50
Sumner	2.17	Olympic View	2.50
Cascade Winter Alliance	2.19	Cedar River	2.50
Soos Creek	2.20	King County Water District No. 90	2.51
Duvall	2.20	Snoqualmie Pass	3.00

Source: Utility Survey Response & Water System Plan Information

As seen in Table 11-2, peak day factors range from 1.40 (Lynnwood) to 3.0 (Snoqualmie Pass). Peaking factors are often greater in smaller water systems. Utilities that have dense urban development generally have lower peaking factors than utilities with more suburban or rural development. However, the mix of commercial and industry can also affect peaking.

For example, a suburban community with high single-family water use as well as large industrial users will experience lower overall system peaking because industrial users tend to raise the average annual use without increasing peak day demands. Such is the case with the City of Everett. Its single-family water use is 50 percent greater than Seattle Public Utilities, but its peak day factor is only 6 percent greater because also has large industrial water demands. Over the years, peaking factors have been reduced in the region as a result of conservation programs, including wholesale and retail conservation rates that have been implemented by many systems, which charge higher rates for water use during summer months. These seasonal water rates have been particularly effective at discouraging outdoor water use and reducing system peaks.

Trends in Historical Water Use

To illustrate the trend in regional water use, 36 of the largest utilities in the region, representing 78 percent of the region's residential water users, were analyzed. For these sampled utilities, the average single-family household water use decreased from 280 gpd in 1990 to 200 gpd in 2005, representing almost a 30 percent decrease in consumption. This water use efficiency trend was also observed in multi-family and non-residential water use. The reasons for this downward trend include utility conservation programs and plumbing code changes, as well as reductions in water use by the region's industries. From 1990 to 2005, the region lost 17 percent of its total manufacturing employment, with the biggest losses in heavy water-using industries such as paper/wood products. At the same time, remaining industries worked with water utilities to reduce their water use to achieve cost efficiencies.

Per capita water use (total municipal water use divided by population) is a common metric used by cities worldwide to evaluate trends. Care should be taken when comparing per capita water use from city to city since local conditions may significantly affect per capita water use; for instance, where industrial users make up a large portion of the water system's usage, comparing that system's per capita water use to a system dominated by residential users would not be appropriate. However, the metric can provide some interesting information. Table 11-3 presents per capita water use and average annual precipitation for several large cities, including Seattle. As shown, per capita water use for the Seattle retail and wholesale service area further demonstrates the region's water use efficiency. Seattle's per capita use is significantly lower than Atlanta, Chicago, and Los Angeles, and it is very similar to Hong Kong (where precipitation is more than double and the population and housing density is significantly greater) and Sydney (where the recent severe drought has resulted in mandatory and in some cases draconian extreme water use restrictions).

Table 11-3 Comparison of per Capita Water Use for Several Large Cities

City	Per Capita Water Use (gal/person/day)	Average Annual Precipitation (inches)
Sydney	103	46
Hong Kong	100	87
Atlanta	168	50
Chicago	194	35
Los Angeles	150	15
Seattle	101	38

Sources: Sydney Water – Annual Report 06-07; Hong Kong Water Supply Department 2006 Annual Report (data for 06/07); North Georgia Metropolitan Water District; Southern Illinois University – Public Water Supply – Cook County; Central Puget Sound Water Supply Forum Demand Survey for Seattle (direct service area) 2006; Metropolitan Water District of Southern California

Forecasted Water Demand

As part of the 2009 Outlook, a regional water demand forecast model was developed using actual water use factors from surveyed utilities. These water use factors were adjusted into the future to account for forecasted changes to price of water, household income, and conservation. Additional demand forecasts were prepared to test the sensitivity in water use resulting from alternative weather assumptions, different scenarios of demographic growth, and potential climate change.

Regional Demand Forecasts Differ from Utility Demands Forecasts

It should be emphasized that the demand forecast in the 2009 Outlook is a regional forecast. Its purpose is to present municipal water demands at a county and regional level as a planning tool. The features of a regional demand forecast are its consistency across the planning area and the direct linkage to regionally accepted data such as demographic data provided by the PSRC.

Regional forecast models are based on aggregate data and are not necessarily calibrated to specific local utilities. The regional forecast often has a longer planning horizon than utility level forecasts and is not designed to support capital facility decision-making. In a regional demand forecast, the actual location of development, within a given utility service area, makes little difference; while in a utility demand forecast, actual location of development can make a significant difference to the local system.

Consequently, the regional demand forecast should not be interpreted as a local or utility demand forecast. Utility forecast models are more specific, and calibrated to local conditions and can address planning issues not apparent at a regional level. This might include things such as accommodating a significant permitted planned unit development, or current utility system needs such as reliability or conservation planning, or evaluation of seasonal demand.

Regional Water Demand Forecast

The planning period for the 2009 Outlook is from 2010 to 2060, with an extended view to the year 2110. The accuracy of any forecast decreases the farther out projections are made. Extending beyond 2060 is useful, however, in order to get a "first look" at a longer-term regional water supply.

Under the baseline demand forecast, the region's water demands will increase from the 397 million gallons per day (mgd) in 2005 to 609 mgd in 2060. This forecast is based on active conservation programs that will ultimately save 12 percent region-wide; savings from the plumbing code and price effects; PSRC's baseline demographic growth projections (through 2040); and historic average weather conditions. This represents a 55 percent increase in demand over the 50-year planning period.

At the same time, population is expected to increase by 65 percent. Water demands in Pierce and Snohomish Counties are projected to increase by 63 percent over the next 50 years, while King County's water demand will increase by approximately 47 percent. The extended demand forecast for the region as a whole in the year 2110 is 980 mgd. This assumes growth continues as it was projected between now and 2060 and no additional conservation beyond the regional goal occurs.

The following summarizes the sensitivity that alternative demographic growth, historical weather variations, and climate change have on projected water demands in the year 2060:

- **Alternative demographic growth scenarios:** The high alternative demographic growth projections would increase water demands by 22 percent; the low alternative demographic growth would decrease water demands by 18 percent form the baseline forecast.

- **Historical variations in weather:** Hot and dry weather would increase water demands by 5 percent over the historical average weather demands; cool and wet weather would decrease water demands by 4 percent.

- **Climate change:** Using the warmest climate change model scenario, potential climate change could increase water demands by 12 percent over the historical average weather demands; while the warm climate change model scenario would increase water demands by 5 percent.

11.3 Existing Water Supply Findings

Key Water Supply Findings:

- ***There is currently sufficient municipal water supply to meet the region's needs through 2060 under baseline demand forecast conditions.***

- ***Municipal water supply available from all existing sources – fully developed – provides a firm yield of 648 mgd.***

The region uses a combination of groundwater and surface water to meet the municipal water supply needs. Groundwater provides approximately 35 percent of the total supply and surface water provides 65 percent.

The major surface water supplies are:

- Sultan River (City of Everett)

- South Fork Tolt River and Cedar River (City of Seattle)

- Green River (City of Tacoma)

The available water supply from all existing sources (defined as fully developed and usable on a firm yield basis) is approximately 648 mgd. It is important to note that some utilities have water rights that are in excess of the available supply; however, water that is not available has not been included in this assessment. The breakdown of existing supply by county is:

- King County: 309.1 mgd
- Pierce County: 177.5 mgd
- Snohomish County: 161.4 mgd

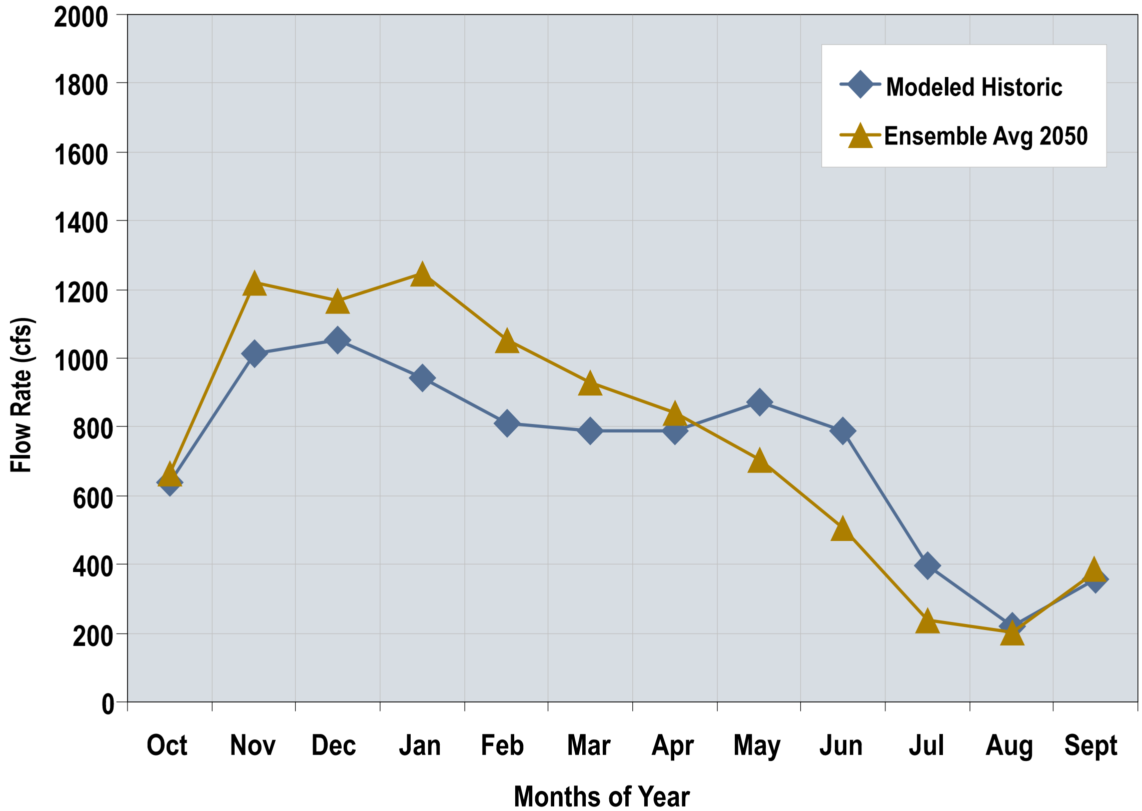
Challenges to developing additional water supply in the region include: (1) securing water rights, (2) environmental and tribal concerns, (3) water quality, (4) costs, (5) and the potential effects of climate change.

Impacts of Climate Change

As part of the 2009 Outlook, potential climate change impacts on existing water supply were identified. Potential changes to precipitation and temperature and resulting streamflow projections were obtained from the work conducted by the Climate Change Technical Committee. This committee, led by the University of Washington, included many of the same stakeholders that participated in the 2009 Outlook planning process.

Three global climate change model/emission-scenario pairs were selected to represent the range of potential impacts for the central Puget Sound region: warm (GISS model/B1 emissions scenario), warmer (ECHAM model/A2 emissions scenario), and warmest (IPSL model/A2 emissions scenario). Temperature and precipitation changes from these three model-scenario pairs were downscaled to the local watersheds in order to determine the potential impacts on streamflows. Figure 11-3 summarizes the estimated impact of climate change on the Sultan River for illustration. The figure compares modeled historical streamflow with the average modeled streamflow using data from three climate change models.

Figure 11-3 Impact of Climate Change on Sultan River for Year 2050



Source: Palmer, 2007

As shown in Figure 11-3, climate change is projected to increase streamflows (from historical average) during the fall and winter months, but decrease streamflows during spring and summer months.

Seattle Public Utilities, Tacoma Public Utilities, and the City of Everett used the climate change streamflow data in their water system models to assess the implications of climate change and associated changed streamflows on existing municipal water supplies. That information was used in making the assessment of future supply needs.

<u>Without</u> making system improvements or changing reservoir operations, the potential impacts of climate change in the year 2075 for the three utilities are estimated to be:

- Seattle – 13 to 25 percent decline in existing supply
- Tacoma – 4 to 8 percent decline in existing supply
- Everett – 6 to 13 percent decline in existing supply

11.4 Water Supply Outlook

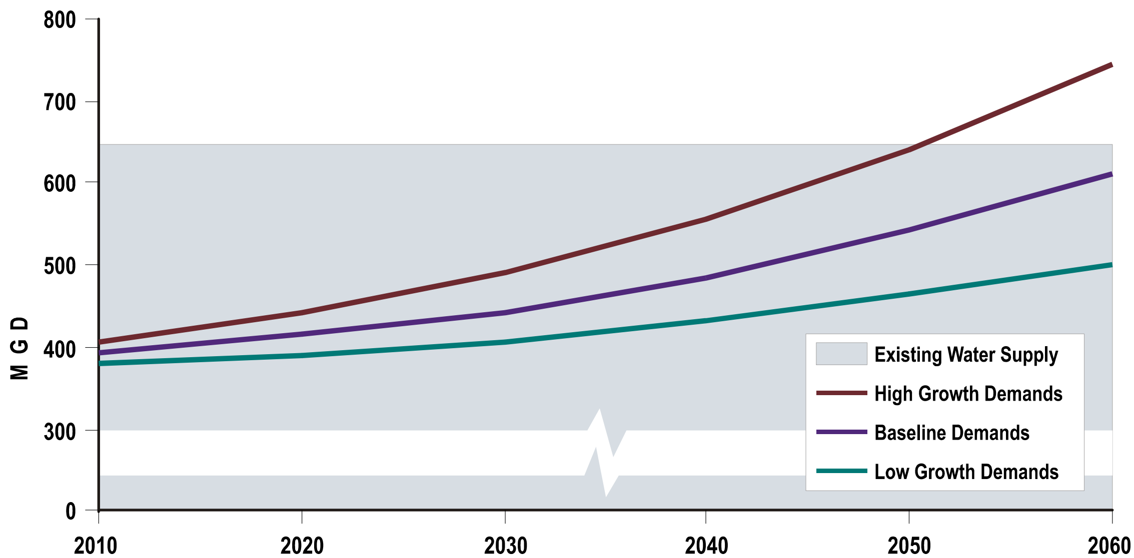
Key Water Supply Outlook Findings:

- ***There is currently sufficient municipal water supply to meet the region's needs through 2050 under high growth demand forecast conditions.***
- ***There is currently sufficient municipal water supply available to meet the regions needs through 2060 under hot/dry weather conditions.***
- ***There is currently sufficient municipal water available to meet the regions needs through 2050 under the warmest climate change scenario.***

Comparing the region's projected water demands to existing, firm water supplies can provide useful information for governments, utilities, and others interested in water supply. For the 2009 Outlook, this comparison was made for several different scenarios.

Figure 11-4 shows the regional comparison of demands and existing supplies under different demographic growth scenarios.

Figure 11-4 Comparison of Demands and Supplies under Different Demographic Growth Scenarios



Source: Water Utility Survey Response, Utility Water Supply Plans and Water Forum Demand Model Forecast Data

As shown in Figure 11-4, there are no regional supply shortfalls expected to occur through 2060 under the baseline or low demographic growth demand forecasts. A regional shortfall in supply occurs after 2050 only for the high demographic growth scenario.

Figure 11-5 shows the regional comparison of demands and existing supplies for different historical weather conditions (based on 40 years of past weather). As shown in the figure, demands do not exceed existing water supplies during the planning period, even under hot/dry historical weather conditions, although by 2060 they converge.

Figure 11-5 Comparison of Demands and Existing Supplies for Different Historical Weather Conditions

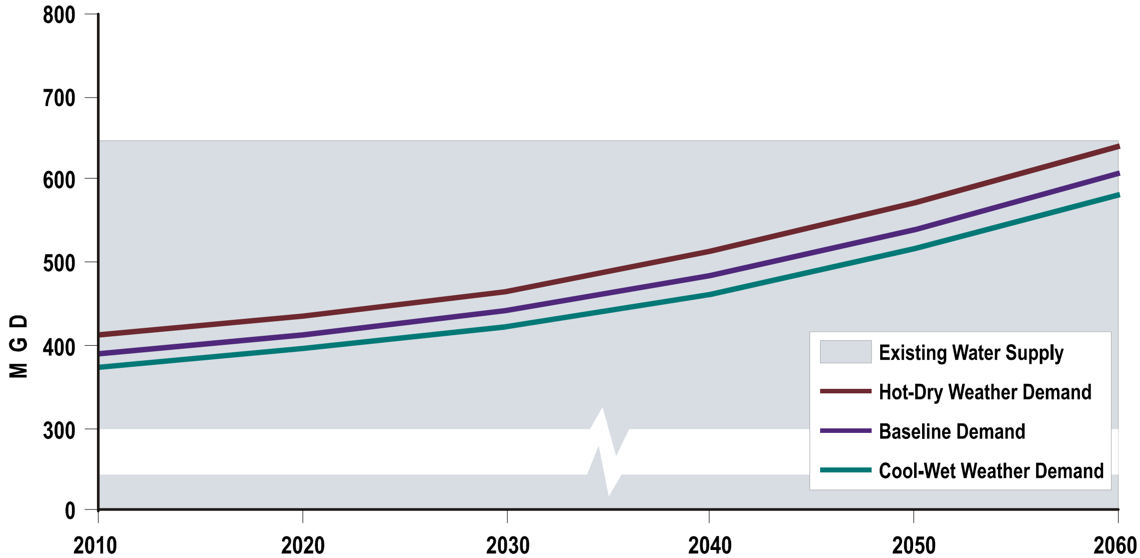
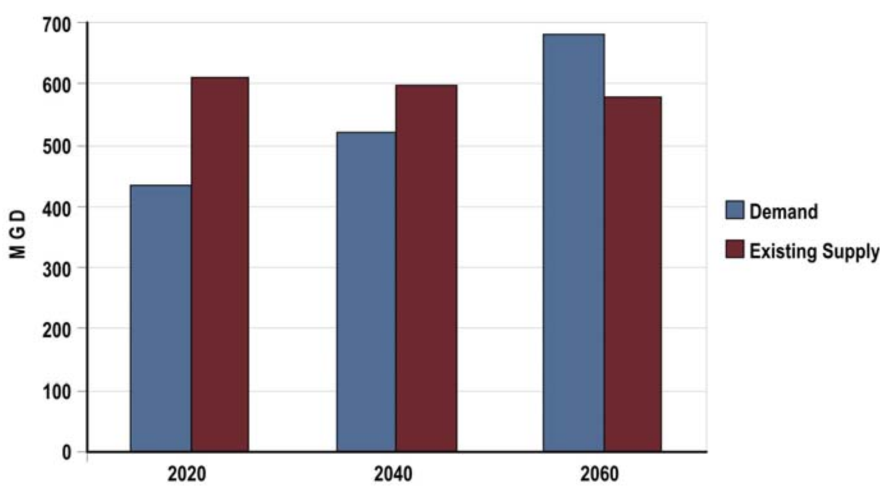


Figure 11-6 compares regional demands and existing supplies under the warmest climate change scenario (using the IPSL global climate model). This comparison assumes no utility system improvements or changes in reservoir operations are made, which would reduce potential shortfalls in supply. It is important to note that this analysis does not include several significant additional water supply sources currently under development.

Figure 11-6 Comparison of Baseline Demands and Supplies under the Warmest Climate Change Scenario



In the 50-year forecasting horizon, existing water supplies and practices are adequate to meet the region's municipal water demands. However, beyond 2050, existing supplies may be insufficient under some planning and climate change scenarios. The largest regional supply shortfall under these scenarios is approximately 100 mgd (about 15 percent) by 2060. The potential supply deficiency may be addressed by modifying operations of existing facilities, constructing system improvements, applying additional conservation, or developing additional water supply.

It should also be noted that these comparisons were evaluated on an average annual basis, assuming no system failure scenarios. During the next 50 years, peak day demands may exceed system capacity; however, these shortfalls could be addressed on the local level by adding treated water storage, installing more wells, or increasing pumping capacity.

11.5 Future Water Supply Findings

Key Future Water Supply Findings:

- ***There are numerous new water supply alternatives (in various stages of development) available to utilities to consider for meeting future demand.***
- ***The Outlook identified five appropriate evaluation criteria for future water supply projects; 1) Supply Reliability, 2) Water Quality, 3) Environmental Impacts, 4) Implementation, and 5) Cost.***
- ***Multi-attribute evaluation approaches provide valuable tools for evaluating water supply options that allow differing stakeholders views to be considered.***

Many new water supply alternatives were identified by utilities during the 2009 Outlook process. In addition, several "green" alternatives were evaluated. Green alternatives differ from traditional water supply projects in that they are expected to have minimal impacts on the environment and often include only modest construction of new facilities. Table 11-4 summarizes the new alternatives that were evaluated for the 2009 Outlook. In all, there is over 400 mgd of new supply potential from the identified alternatives. Although the information on many of the projects is preliminary, or planning level, the fact that the potential supply identified is four times the largest potential shortfall should provide some assurance that future municipal water needs can be met.

Table 11-4 Summary of New Water Supply and Green Alternatives

Project Group	Project Type	Number	Average Annual Yield Range (mgd)
Traditional	Surface Water	8	8.0 - 65.0
	Ground Water	2	3.6 - 33.0
	Desalination	2	20.0 - 50.0
Reclaimed Water	Reclaimed Water	6	0.4 - 1.1
Green	Conservation	6	0.2 - 12.0

Notes:
Average yield used if supply project provided a range of yields
If supply project was phased, the yield for the fnal phase was used

Potential supply yield was estimated for each of these water supply and green alternatives, as were capital construction and annual O&M costs. In addition, a qualitative assessment was made for water quality, environmental impacts, and implementation issues.

11.6 Evaluation of Future Water Supplies

Historically, cost was a primary criterion for evaluation of water supply projects. More recently, water utilities and other stakeholders have concluded that cost is only one of several considerations when looking at future supply projects. These expanded evaluations are often described as a “triple bottom line” approach and include social, environmental and economic considerations in evaluation of alternatives.

The Water Supply Forum determined that future water supply projects should be evaluated using the expanded approach when determining which alternatives should be developed. In recognition of this, stakeholders participating in the 2009 Outlook Advisory Committee process developed a set of criteria for demonstrating an evaluation method to assess future water supply alternatives. Five criteria were selected:

1. Supply Reliability
2. Water Quality
3. Environmental Impacts
4. Implementation
5. Cost

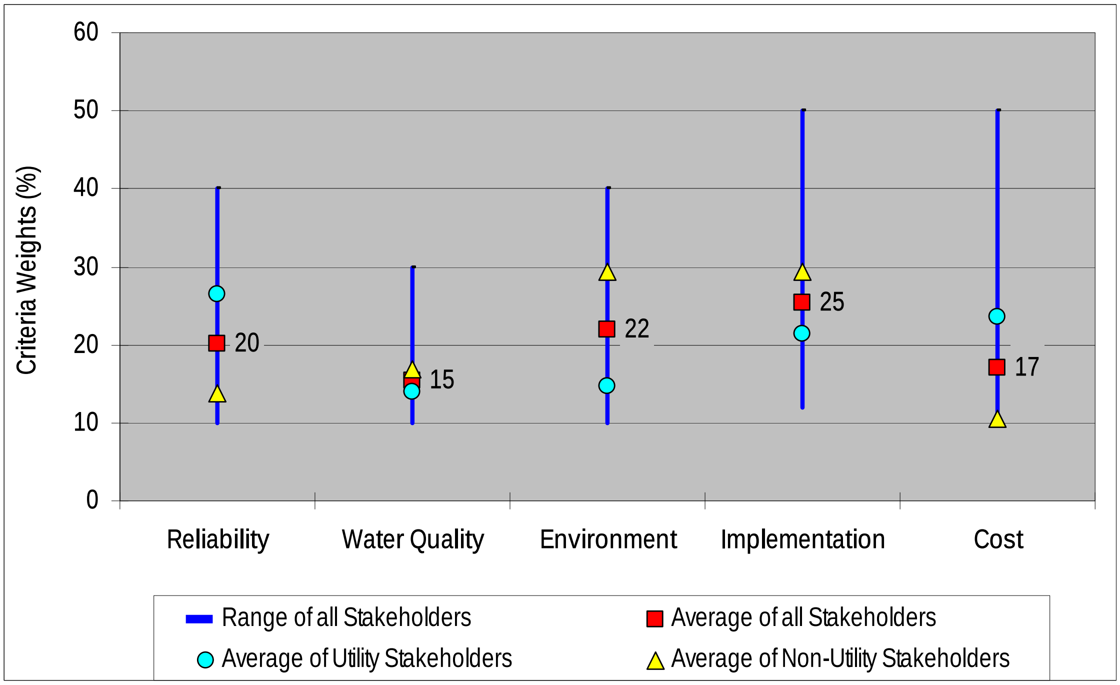
A technique called multi-attribute rating was used to compare several supply alternatives as a way to demonstrate its effectiveness and merit. It should be emphasized that the purpose of the 2009 Outlook is not to make any recommendations as to which future alternatives should be implemented, but rather to identify and demonstrate a water supply assessment method. This effort is intended to encourage local utilities and others to use a common approach to evaluating alternatives, which can then result in greater public and institutional support.

One important aspect of this assessment approach is the weighting of the criteria. While stakeholders may agree that all of the criteria are important, some place different levels of importance on certain criteria over others. By keeping track of stakeholder preferences, this method can show trade-offs and help identify where consensus may exist and why.

Figure 11-7 summarizes the criteria weighting for those stakeholders participating in the 2009 Outlook. As seen in this figure, there was a significant difference between the water utility stakeholders and the non-utility stakeholders. Utility stakeholders tended to place more weight on supply reliability, cost, and implementation while non-utility stakeholders tended to place more weight on environment and implementation.

Two alternative methods for applying the multi-attribute ratings were demonstrated. The first rates and applies weights to all five of the selected criteria at the same time. The weighted rankings are then summed to produce a total decision score by which projects are ranked. The second method rates and applies weights to criteria other than cost first and then plotting the result against cost. The methods are described in the following paragraphs.

Figure 11-7 Criteria Weighting for Stakeholders Participating in 2009 Outlook Process



To demonstrate this method, several water supply alternatives were selected. ***In this Chapter, the supply alternatives are examples and are identified as "Supply Example".*** These examples included a single water supply project or combinations of water supply projects. A hypothetical water supply target of 25 mgd was used. **It is important to note that the assumptions and supply examples are purely hypothetical and only used to demonstrate the evaluation method.**

The supply examples were:

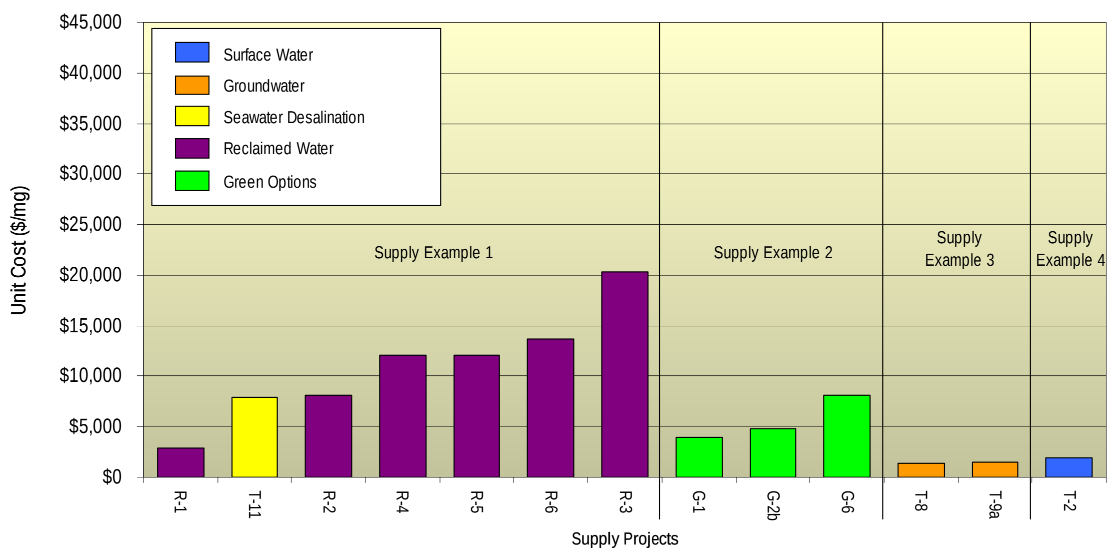
> **Supply Example 1 – Desalination.** Supply Example 1 includes all reclaimed water projects identified (totaling 4.5 mgd) and the north seawater desalination project (20 mgd).
>
> **Supply Example 2 – Green Projects.** Supply Example 2 includes sub-metering for all new multi-family homes (12 mgd), natural landscaping for all new single-family homes (7.5 mgd), and grey-water systems for existing single-family homes (5 mgd).

Supply Example 3 – Groundwater. Supply Example 3 includes the Snoqualmie Aquifer Project (18 mgd) and phases 1 and 2 of the OASIS Project (3.6 mgd).

Supply Example 4 – Surface Water. Supply Example 4 includes the Snohomish River Regional Water Authority (SRRWA) Project (23.4 mgd).

Figure 11-8 shows the individual unit costs of the projects that were grouped to make up the four supply examples. The four supply examples capture a little over half of the projects nominated by the forum and present the full variety of types of supplies (surface water, groundwater, reclaimed and desalination) reviewed under the supply analysis.

Figure 11-8 Unit Costs of Supply Projects Packaged into Supply Examples



For each alternative and criteria, scores were developed. For the non-cost criteria, qualitative scores were used (where 1 = poor performance and 5 = superior performance). Criteria performance for the example alternatives is summarized in Table 11-5.

Table 11-5 Criteria Performance for Supply Examples

Criteria	Supply Example 1 Desalination	Supply Example 2 Green Projects	Supply Example 3 Groundwater	Supply Example 4 Surface
Unit Cost ($/mg)	$12,340	$5,804	$1,358	$1,915
Reliability	5	4.5	4	3
Water Quality	4.5	4	3.5	3
Environment	3.5	5	4.5	4
Implementation	2.5	3.5	3.5	4

*A score of 1 to 5 was used for non-cost criteria (where 1 = poor performance and 5 = superior performance).

Using a standard software package for decision-making called Criterium DecisionPlus 3.0, these alternatives were ranked based on the criteria performance in Table 11-5 and the criteria weights developed by the Advisory Committee shown in Figure 11-7. Table 11-6 summarizes the ranking for the different stakeholder preferences using all criteria, including cost.

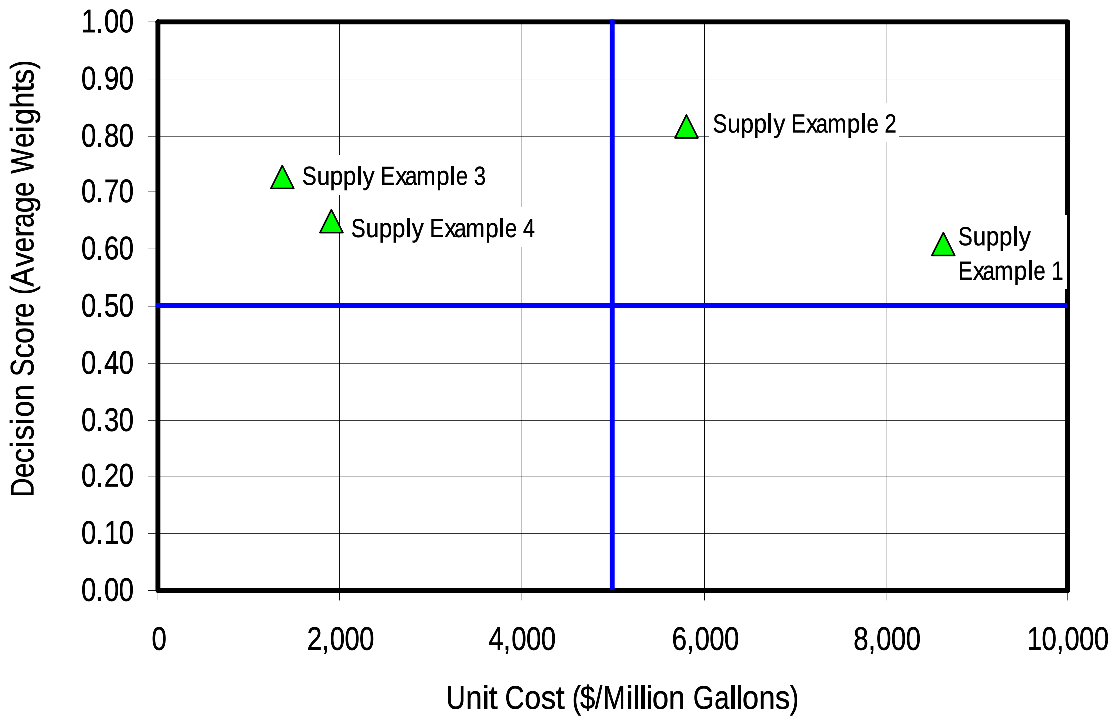
Table 11-6 Ranking of Alternatives for Different Stakeholders

Rank	Supply Example 1 Desalination	Supply Example 2 Green Projects	Supply Example 3 Groundwater	Supply Example 4 Surface
Utility Rank	4	2	1	3
Non-Utility Rank	4	1	2	3
Combined Rank	4	2	1	3

As shown in Table 11-6, there is consensus that Supply Example 1 and Supply Example 4 are ranked 4th and 3rd, respectively. Supply Example 3 is preferred over Supply Example 2 for the utility participants, while Supply Example 2 is preferred for non-utility participants. And when all participant weights are averaged, Supply Example 3 is ranked slightly higher than Supply Example 2 in their ranking for first and second.

The alternate evaluation method does not include cost in the multi-attribute rating; but rather after alternatives are scored using the non-cost criteria, cost is plotted on a quadrant graph to show relative benefit and cost. Figure 11-9 shows this quadrant analysis for the combined stakeholder weights.

Figure 11-9 Quadrant Analysis of Supply Examples (with Combined Stakeholder Weights)



Generally, those supply examples in the upper left quadrant of Figure 11-9 (higher benefits, lower costs) are generally preferred over alternatives in the lower right quadrant (lower benefits, higher costs). In this example, Supply Examples 3 and 4 are in the upper left quadrant and Supply Examples 1 and 2 are in the quadrant of high benefits with high costs. This method can show the relative trade-off between total benefits and cost, but usually requires judgment to determine a final ranking.

Regardless of which approach is taken, multi-attribute rating can be a powerful tool in applying weighted criteria and ranking water supply alternatives using a "triple bottom line" approach. Often both methods produce similar results. However, in the quadrant analysis, while Supply Example 2 has a higher total decision score, it has a unit cost that is three to five times higher than Supply Examples 3 and 4.

11.7 Recommendations for Future Outlooks

The 2009 Outlook was developed over a three year period, with input from stakeholders representing water utilities, county governments, state agencies, environmental groups, tribal interests and other public interest groups. Two advisory committees, one focused on water demand forecasting and the other on water supply assessment, provided input through professionally facilitated meetings throughout the process.

The following sections provide recommendations for future Outlooks based on stakeholder observations and input and observations from project consultants.

Overall Process and Stakeholder Participation

The dedicated participation of stakeholders over the 3-year process was key to the success of the 2009 Outlook. These stakeholders helped develop the scope of the project and selection of the technical consultant, reviewed technical memoranda, participated in facilitated monthly meetings, provided key input on demand forecasting and supply assessment approaches, and reviewed and provided comments on the draft report.

For future Outlooks, it is recommended that stakeholders again be involved, including involvement in scope development and consultant selection. It is also recommended that the process continue to be professionally facilitated by an independent consultant. All stakeholders appreciated the fact that an independent facilitator was used in the 2009 Outlook process. However, many stakeholders felt the technical process was too long and in some cases had difficulty making recommendations and proceeding forward. It is recommended that the number of meetings be reduced and that the committee review process for technical memoranda and the draft report be more streamlined. For example, meetings should be used to develop work products, rather than wordsmith documents. Comments on documents can be submitted electronically at specified points in the document preparation process.

It is also recommended that certain elements of the 2009 Outlook should be retained for the next Outlook. Elements such as the demand forecast model, the supply evaluation criteria, and climate change models represent good opportunities for fine -tuning rather than completely starting over.

Data Collection and Reporting of Information by Utilities

Just as in producing the 2001 Regional Water Supply Outlook, data collection was a time-consuming aspect of this project. One difficulty in collecting data is that each water system collects and maintains data in ways that meet its needs rather than regional needs. It is recommended that the Water Supply Forum encourage water systems to collect and maintain data in standardized formats. Data collection would then be more efficient for the next Outlook. Collected data should include information on billing, total production, and peaking. In addition, utilities should provide information that would help better understand the breakdown of non-revenue water (between system losses, legitimate un-metered uses, hydrant flushing, and reservoir management). Standardization might be achieved by working with the State through the framework for developing required comprehensive plans.

A select sample of large utilities was asked to provide monthly total production data during the 2009 Outlook process. This number should be expanded to include medium-size and even some smaller utilities. Monthly production was a key piece of data used to develop a statistical weather/water use model that resulted in a better understanding of how weather and climate change affect water demands.

Noting that there is value in doing model verification for a regional demand forecasting model, a database of historical information on billing data, accounts, income, price of water and conservation activities should be developed for the top 10 largest water utilities.

Demand Forecast Model

One of the key features of the 2009 Outlook was development of a comprehensive Municipal Water Demand Forecast Model (Demand Model). This Demand Model was developed with future enhancements in mind. Therefore, depending on when the next Outlook update is done, the task of demand forecasting might focus on updating the data and potential enhancements to the model rather than constructing a new model.

One enhancement that could add significant value is estimating the price and income effects (elasticities) for the region instead of relying on other econometric studies. The weather elasticities could also be determined for each county, rather than the entire region, because weather and climate differ somewhat throughout the region.

Variables such as household size and potentially housing density could be added to the Demand Model, assuming that predictive data are available for the parameters by the time the next Outlook is completed. For example, the PSRC has indicated that it may be possible to estimate future housing density by planning area as enhancements are made to its demographic modeling.

Water Supply Assessment

Given that the purpose of the Outlooks are not to replace local decision-making for evaluating and selecting water supply alternatives, the water supply assessment should continue to focus on identifying potential options and their attributes (e.g., supply yields, costs, water quality, impacts to the environment, and implementation issues). Future Outlooks should seek to refine, not rebuild, the evaluation method presented in this 2009 Outlook.

Additional information on the region's self-supplied water use would be helpful for more complete assessment of water use within the region.

Climate Change

Prediction of the implications of climate change is in its infancy. As the climate change models are refined and improved, future Outlooks will likely require refinement of the climate change inputs for revised temperature and precipitation forecasts.

An updated Outlook might also estimate the potential impacts of climate change on regional groundwater supplies if predictive information on groundwater becomes available.