Water Management and Conservation Plan for the City of Portland, Oregon

Final Report

July 2010

PORTLAND WATER BUREAU

FROM FOREST TO FAUCET

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Executive Summary

Context of this Water Management Conservation Plan

This Water Management Conservation Plan (WMCP) is based on the requirement of the Oregon Administrative Rules Chapter 690 Division 86 (Division 86 rules). This plan 1) updates the City of Portland's expired 2000 WMCP, 2) fulfills a condition placed on the City of Portland's assumed Powell Valley Road Water District groundwater right (#G-14007) and other rights granted to the City for wells under the administration of Portland Parks & Recreation (PP&R), and 3) fulfills any WMCP requirements that might be placed on extensions of other groundwater rights that the City of Portland owns or may apply for in the future during the period covered by this plan.

In May 2008, the Portland Water Bureau (PWB) submitted the Final Draft WMCP to the Oregon Water Resources Department (OWRD). After the public comment and review period, PWB received comments from WaterWatch of Oregon and a sufficiency review of the plan from OWRD.

2008 Final Draft WMCP Comments and Sufficiency Review

The comments received from WaterWatch Oregon covered five major areas:

1. The relationship of the WMCP to permit extensions and "green light" water
2. The relationship of the WMCP to requirements for groundwater rights that the City owns or may apply for in the future
3. Demand forecasting and projections
4. Water reuse and recycling opportunities
5. Bull Run surface water rights

One of WaterWatch's key comments was a concern regarding the request in the 2008 WMCP draft to develop additional water supply under groundwater permits for which it did not, at the time, have valid extension orders. The City of Portland had already submitted completed permit extensions for the four groundwater rights relied upon for the "green light" water request in the WMCP. In July 2008, PWB requested an administrative hold on completing the WMCP, per OAR 690-86-910, until PWB received a final order on the four pending water rights permit extensions. PWB received the final orders on October 6, 2009.

The other comments of WaterWatch have been addressed in the body of this WMCP. Details regarding the "green light" water and final orders issues are covered in sections 1.1.1, 1.1.2, and 5.6. The demand forecasting and projection comments have been addressed in sections 1.1.2, 5.1, and 5.3. The water reuse and recycling comment is covered in section 1.1.2, and the Bull Run surface water clarification is covered in a footnote in section 5.2.1.

The sufficiency review from OWRD covered seven major areas:

1. Water rights
2. The system schematic and interconnections
3. Current and future service areas
4. PWB's retrofit and replacement programs
5. The rate structure

6. Water reuse and recycling
7. Other conservation measures to improve water use efficiency

The two major issues of OWRD's sufficiency review involved providing information on average monthly and daily diversions under each water right and providing more information on PWB's rate structure. Section 2.3, Summary of Water Rights Held, includes additional tables that delineate monthly water use by right for the City of Portland's Columbia South Shore Well Field (CSSWF) and for the Portland Parks and Recreation (PPR) wells.

PWB's rate structure is discussed in two sections in Final WMCP. Section 3.4.4 discusses PWB's participation in, and the results of, an Environmental Protection Agency (EPA) submetering study. Section 3.5.4 describes the recent history of PWB's rates and rate structure, and provides comparisons to national and regional water providers. This section includes the results of a survey conducted by the Regional Water Providers Consortium on the rate structures of 23 regional water providers.

Clarifying and additional information for all additional OWRD sufficiency review comments have been integrated into the body of this WMCP as appropriate. Additional information on water rights is provided in section 2.3; system interconnections are shown in a new figure in section 2.9; PWB's current and future service areas are discussed in section 5.1 and 5.3; PWB's rate structure is discussed in section 3.4.4, 3.5.4, and 3.5.7; additional discussion of water reuse and recycling was added to sections 3.5.5 and 3.5.6; and other conservation measures (particularly PWB's requirement that its wholesale customers produce a WMCP) are outlined in section 3.5.4 and 3.5.6.

Changes Since 2008

Since the submittal of the Final Draft Report WMCP in March 2008, several key events and changes have had an effect on PWB's water supply program. The three most significant events that affect supply planning are 1.) OWRD's issuance of final orders for four groundwater rights permit extensions and a permit amendment in the CSSWF, 2.) the approval of the Bull Run Water Supply Habitat Conservation Plan (HCP), and 3.) the City's pursuit of dual tracks for compliance with the Long Term 2 Enhanced Surface Water Treatment Rule (LT2). In addition, PWB has changed its conservation program and accumulated more years of data on demand and consumption and the use of the groundwater supply.

In October 2009, OWRD provided the Final Orders on the extension of four primary groundwater rights and a permit amendment. Once PWB received these final orders, it began work on the addendum to the draft WMCP. The addendum responded to WaterWatch of Oregon and OWRD sufficiency review documents and was the source for the additions to this final plan.

The Bull Run Watershed Habitat Conservation Plan (HCP) provides for the implementation of 49 measures to conserve habitat for endangered fish. Key among those measures is a measure that provides instream flows in the lower Bull Run River (explained in greater detail in the next section). In April 2009, the Commissioner-in-Charge of the Water Bureau and the Acting Regional Administrator for the National Marine Fisheries Service signed an Incidental Take Permit (ITP), which was the final step in the development of the HCP.

Since 2008, Portland City Council has directed PWB to pursue two parallel tracks with regard to compliance with the EPA's Long Term 2 Enhanced Surface Water Treatment (LT2) Rule. A conventional treatment track would achieve compliance with the treatment portion of the LT2 rule as written. This includes the design of an ultraviolet (UV) water treatment facility for the Bull Run water source as directed by the Portland City Council in July 2009.[1] Under the treatment variance track, PWB seeks a variance to the treatment requirement of the LT2 rule under the Safe Drinking Water Act (SDWA). Under the conventional treatment track, PWB anticipates completion of the design for UV treatment facility in the first half of 2011. However, progressing to the construction phase is contingent on EPA's decision regarding PWB's application for a variance under the treatment variance track. Should the EPA deny the variance to PWB, construction of the UV treatment facility in the Bull Run watershed will move forward.

Although the UV treatment method is effective at disinfecting water for *Cryptosporidium*, it does not protect the water supply from elevated turbidity levels, as filtration would. Turbidity above a certain level requires that PWB discontinue use of Bull Run water and rely on groundwater from the CSSWF. The decision to implement UV treatment as part of PWB's conventional treatment track, therefore, means continued reliance on the CSSWF groundwater water supply when turbidity levels are elevated in the Bull Run watershed. The decision not to build filtration of the Bull Run also is likely to limit access to further supplies in the existing reservoirs and to make building further storage in the watershed a significant engineering challenge. As a result, as water demand increases over the next several decades within the retail and wholesale service areas, PWB's reliance on groundwater sources will also increase.

Municipal Water Supplier Description

Approximately 860,000 people living within a 225-square-mile service area around Portland are served by the Water Bureau's retail and wholesale water system. The Water Bureau delivered 36 billion gallons (BG) to customers during fiscal year (FY) 2006-2007. The bureau's 19 wholesale water customers are mostly contiguous to the retail service area and serve parts of Multnomah, Clackamas, and Washington counties. In FY 2006-2007, the Water Bureau supplied approximately 60 percent of its water to retail accounts and approximately 40 percent to wholesale customers.

Water Sources

The primary drinking water source for Portland is the Bull Run watershed, seasonally augmented by a groundwater supply from the Columbia South Shore Well Field (CSSWF) and potentially by wells in the former Powell Valley Road Water District (PVRWD). The Bull Run watershed is located approximately 30 miles east of Portland. The CSSWF is on the south shore of the Columbia River between the airport and Blue Lake Park; the former PVRWD is located in southeast Portland, west and north of Powell Butte.

[1] Portland City Council Resolution No. 36720 As Amended. July 29, 2009.

Bull Run Watershed

The Bull Run watershed provides the majority of Portland's total water supply. The water of the Bull Run River is primarily impounded in reservoirs 1 and 2. Periodically, the Water Bureau relies on storage capacity in Bull Run Lake to enhance the supply of the two reservoirs.

Regulations Affecting the Use of Bull Run Water

Provisions of a 1997 U.S. Forest Service easement, the Safe Drinking Water Act (SDWA), the Endangered Species Act, and the Clean Water Act are the four regulations that primarily affect the use of Bull Run water.

The provisions of a **1997 easement with the U.S. Forest Service** restrict the available capacity of Bull Run Lake through requirements that create incentives to limit the volume available, the timing of use, and the mitigation requirements for releases that limit the lake's refill the following spring.

The **Surface Water Treatment Rule** (SWTR) of the SDWA and SWTR enhancements require the Water Bureau to meet specific, measurable water treatment standards related to turbidity and other contaminants. Modifications that the bureau has made to the water treatment regime and the bureau's ability to use the City's groundwater supply have enabled Portland to remain in compliance with the SWTR.

Under the **Endangered Species Act** (ESA), the Water Bureau is preparing a habitat conservation plan (HCP) that outlines how the bureau will avoid, minimize, or mitigate take of the four fish species that use the lower Bull Run River: the fall and spring races of Lower Columbia River Chinook salmon *(Oncorhynchus tshawytscha)*, Lower Columbia River coho salmon *(O. kisutch)*, Columbia River chum salmon *(O. keta)*, and Lower Columbia River steelhead *(O. mykiss)* (Portland Water Bureau 2007c). Key proposals in the HCP that affect the bureau's management of the Bull Run water supply include measures to provide instream flows for fish in the lower Bull Run River. Under the proposed flow measures, the bureau will reduce the amount of Bull Run water that is diverted for municipal supply. This will increase the reliance on groundwater as a backup supply, especially during the period when the reservoirs are drawn down. The bureau plans to submit the HCP to the National Marine Fisheries Service in 2008.

The federal **Clean Water Act** (CWA) requires that states assess and regulate surface water quality according to the criteria outlined in the CWA. The Oregon Department of Environmental Quality (ODEQ) is responsible for monitoring water bodies according to the CWA. In a 2005 assessment called the Total Daily Maximum Load, ODEQ found the water in the lower Bull Run River (RM 0–RM 5.8) to be "water quality limited" with regard to the designated beneficial use as "core cold-water habitat" for salmonids. The Water Bureau has prepared a *Draft Temperature Management Plan* (TMP) for the lower Bull Run River. The TMP includes riparian forest protections, management measures for the temperature of the water, and measures to control the amount of flow released to the lower Bull Run River especially during the summer peak season. The TMP measures are included in the draft HCP. The TMP is anticipated to be submitted to ODEQ in 2008.

Hydrologic Limitations on Using Water from the Bull Run Watershed

The reservoirs in the Bull Run are recharged each year during the wet fall, winter, and spring. In the summer, when municipal water demand and releases into the lower Bull Run River are greater than the amount of water flowing into the reservoirs from tributaries and

rain, the surface elevation of the reservoirs is drawn down. During this time, the City may use its groundwater supply to augment the water from the Bull Run. During a long, dry season, the City may have to increase the proportion of groundwater that it uses to meet demand before the return of fall rains.

The City is preparing for climate change through research and monitoring, revising long-term planning models, working with other west coast cities on adaptation and mitigation strategies, developing its rights in the CSSWF to provide summer supply and emergency backup capacity, and implementing water conservation practices and programs.

Reliability of the Bull Run Supply

An analysis of seasonal (June-October) reservoir supply data from 1946-2004 shows a declining trend for total reservoir inflow for these months. The City is monitoring inflow data to determine whether the trend will continue.

Columbia South Shore Well Field

The CSSWF is the second-largest developed water source in the state, and the largest developed groundwater source. The wells in the 11-square-mile well field provide water when the Bull Run supply is shut down due to emergency conditions such as turbidity events, landslides, fires, or human-caused disruptions. The groundwater system is also a seasonal supply augmentation when the Bull Run supply cannot provide enough water to meet demands during the summer peak season. From 1985 to March 2008, the City used groundwater from CSSWF 7 times when the Bull Run supply was shut down, and 12 times to augment the Bull Run supply during the summer season.

As of December 2007, 26 active CSSWF wells draw on three aquifers: the Sand and Gravel Aquifer (SGA); the Troutdale Sandstone Aquifer (TSA), and the Blue Lake Aquifer (BLA). The sum of the nominal instantaneous pumping capacity for all of the active wells is approximately 103 to 118 million gallons a day (MGD). This figure is based on the maximum pumping rates of the individual wells. This rate is less than the four-hour pumping test rates which sum to approximately 136 MGD of four-hour instantaneous use. When all available wells are in use, the well field has an empirically determined initial 30-day operating capacity of approximately 102 MGD. A 112-MGD pump station moves the water 4.5 miles south and approximately 475 feet uphill to the City's Powell Butte Reservoir, where it is mixed with Bull Run water (unless the Bull Run supply is off-line).

In July 2005, the City annexed the former PVRWD. The installed capacity of the Powell Valley wells can be as much as 8.6 MGD, however, due to mechanical issues, only a portion of this capacity is currently available as noted in the 2007 Summer Supply Plan. Several capital improvement projects are planned to repair various facilities and fully integrate the wells into the Water Bureau system. These projects may be completed in three to ten years.

Groundwater Protection Programs

The Groundwater Protection Program for the CSSWF requires businesses and households that use, store, or transport hazardous material above a certain threshold amount to implement best management practices to prevent spills on the ground. The Wellhead Protection Program for the former Powell Valley Road Water District wells is being updated.

Regulations Affecting the Use of Groundwater

Although withdrawals from the CSSWF on the south shore of the Columbia River do not have a direct one-to-one relationship to the reduction in flow of the Columbia River, the City analyzed the potential effects from the long-term use of groundwater on flows in the river. The results of the analysis indicate that, under a worst-case scenario, the 151-day withdrawal rate is smaller than the margin of error for the U.S. Geological Survey gages that measure flows on the Columbia River. The use of CCSWF, therefore, does not measurably affect the flows in the Columbia River.

Operational Limitations and Reliability of the Current Groundwater System

There are three operational limitations on the reliability of the current groundwater operations at the Columbia South Shore Well Field: the pumping capacities of the aquifers that the wells draw from over extended periods of time, the mechanical reliability of the system and the need for continuing maintenance of the facilities, as well as the presence of manganese in some of the CSSWF wells. The presence of manganese reduces the value of the wells as a water supply; it is desirable to replace the capacity of these wells with new wells.

Although current well field capacity is sufficient to meet short-term (less than 30 days) emergency needs during the non-peak season, there is no additional reliable capacity. Depending on the demand pattern at the time of need, the current capacity of the well field system is not sufficient to meet demand during a full shutdown of the Bull Run system due to emergencies or catastrophic events, for events longer than 30 days.

The bureau has made assumptions about the ability to pump the well field over various periods based on drawdown data within the different aquifers utilized by the wells (Table ES-1). Pumping of the SGA may be limited in the future by the withdrawal from other users in Oregon and Washington.

Table ES-1. Potential Rate of Use and Peak-season Volume for CSSWF Wells[a]

Number of days	Potential rate of use (MGD)	Potential peak-season volume (BG)
<30	102	3.01
30-90	92	8.6
More than 90	82 or less	More than 8.6

[a]SGA, BLA, and TSA wells

High manganese concentrations in two of the BLA wells has limited the ability of the Water Bureau to utilize these wells. The Water Bureau avoids using the high-manganese wells unless no Bull Run supplies are available and the full capacity of the well field is needed.

System Service Area

Portland's system service area is characterized by higher summer-season and peak demand compared with the average daily demand. The summer season demand, typically occurring May through October, is usually 25 to 33 percent higher than average daily demand. The peak or maximum daily demand (which only occurs a few days in any given year) is almost twice as high as the average daily demand in some years.

Per capita consumption of water has generally been decreasing since the late 1980s despite an increase in the population served. Although the average daily demand has hovered

around 100 million gallons a day (MGD) since calendar year 2002, the average per capita use has declined since FY 2001-2002.

Overall consumption has also been declining since the late 1980s due to reductions in per capita use, off-loading of wholesale demands to other non-Portland sources, the loss of some large customers in the retail system, and switching to non-potable supplies by some customers (for example, the Port of Portland and the Portland Parks & Recreation).

Retail Customers

In FY 2006-2007, Portland served an estimated 545,300 people and businesses through 180,100 services in the retail sector. The average daily consumption per service was 325 gallons. Portland's retail customers are a mix of single- and multi-family residential retail and industrial, commercial, and institutional (ICI) customers. The average per capita consumption for retail single-family residential customers was approximately 66 gallons a day for FY 2006-2007. More than half of the retail consumption in Portland is from residential users living in single- or multi-family homes. Summer water use varies by the type of residential property; water use is higher for customers living in single-family households than for customers living in multi-family residential households.

Approximately 19.5 thousand retail industrial, commercial, and institutional (ICI) customers purchased water from the Water Bureau in FY 2006-2007. Examples of Portland's retail ICI water customers include health-care and building facilities, light and heavy manufacturing, and food service companies. ICI users consume nearly two-fifths (39 percent) of all retail water.

Wholesale Customers

Currently, the Water Bureau provides water to an estimated population of 314,700 people in the Portland metropolitan area through wholesale contracts. During FY 2006-2007, the average per capita consumption for wholesale customers was approximately 127 gallons a day.

The wholesale contracts signed in July 2006 are 10- and 20-year terms. The primary difference between the two types of contracts is the rate-of-return cost factor. The wholesale contracts specify the amount of water service the City will provide and include terms on guaranteed purchase obligations or interruptible water supplies. In addition, each water contract requires that the wholesale purchaser create a conservation and curtailment plan to be reviewed and approved by the Water Managers Advisory Board. A copy of Portland's wholesale contract is included as Appendix B of this plan.

Interconnections with Other Water Providers

The Water Bureau maintains 46 interconnections with other water suppliers. All of the wholesale customer connections have master meters to quantify the amounts of water sold. Very few of these interconnections with wholesale providers are capable of passing supply to Portland, either due to infrastructure issues or because those wholesale customers do not have other supplies available.

There are a few interconnections with water providers with whom Portland does not have wholesale contracts: Clackamas River Water, the City of Lake Oswego, Beaverton, and the City of Milwaukie. These interconnections have been used in the past for emergency provision of water supplies either from or to Portland. The total amount of water that can

be passed between non-contract customers and Portland is fairly limited at this time (around 6.5 MGD).

The City has been discussing interconnections with wholesale customers to move water from the Joint Water Commission system to Portland for emergency purposes, as well as other discussions with entities on the east side of the Portland service area. No projects are proposed at this time and no specific agreements exist.

Water Conservation Programs

The Portland Water Bureau has implemented residential and ICI water conservation programs since 1990. Several of the bureau's conservation efforts have been collaborations with other agencies, water providers, and City bureaus.

Residential Conservation Program

Providing information to residential customers through print and electronic media has been a major component of the bureau's conservation program since its inception. Print media has included bill stuffers, brochures that address indoor and outdoor water conservation practices, and youth education materials. Much of this information is also available on the bureau's web site. Conservation staff work with education staff and other stakeholders to provide robust youth education activities around water conservation including a self water audit and school assemblies with a puppet show and music presentation. Conservation staff also make presentations to a variety of audiences and participate in community events such as neighborhood street fairs; the Yard, Garden, and Patio Show; the Salmon Festival; and Fix-it Fairs.

The bureau distributes conservation devices at school events and to customers when they call or order online. Conservation kits are also distributed to targeted customers through a partnership with the Portland Department of Transportation, which distributes the kits by bicycle. Conservation staff also provide technical assistance to customers through publications and the web, providing information on leak detection and fixing toilet and faucet leaks. Workshops offering self-help for leak repair are offered by conservation staff at annual Fix-it Fairs.

ICI Conservation Program

The Water Bureau's Business, Industry, and Government (BIG) program has provided technical assistance for ICI customers since 1993. BIG staff evaluate uses of water and suggest various ways to improve water efficiency, including retrofitting or changing out water-using fixtures, improving HVAC systems, and eliminating single-pass cooling. BIG program staff have offered classes to building maintenance staff on cooling tower operations; to food service workers to reduce water use; and have partnered with others to provide information to landscaping staff to use water more efficiently outdoors. Special assistance has also been offered to Portland Public Schools and Parks to help reduce water use and save money. BIG staff will conduct landscape audits upon request.

Water Audit, Metering, and Billing

The Water Bureau conducts an annual audit of water metered at the sources and water billed to customers. The amount of water unbilled is a little over 5 percent—on the low end of an American Water Works Association benchmarking study. The bureau has a strong

commitment to leak detection and repair with a performance measure of "less than 5 percent of customers experiencing a cumulative outage of water for more than 8 hours a year."

All customers are fully metered and meter testing and maintenance is conducted on a periodic schedule. Customers receive bills based on metering. Billing is through a temporary uniform rate that was adopted in 2006 in conjunction with a new billing system. New rate structures are being studied for potential implementation as one of the 5-year benchmarks in this WMCP.

Technical Assistance, Retrofit, and Replacement Programs

As noted above, the Water Bureau provides technical assistance to both residential and ICI customers. Residential customers receive kits with indoor devices such as a low-flow showerhead (1.5 gallons per minute), a 5-minute shower timer, a 1.5 –gallon-per-minute kitchen faucet aerator and bathroom faucet aerators that flow between 0.6 gallons per minute (GPM) and 1.5 GPM. A toilet displacement bag and a fill-cycle diverter are also part of the kit. A recent study of customers who ordered and installed toilet displacement bags and aerators of almost 10,000 gallons per year.

In addition, the bureau offers brochures and web pages explaining how to use the household water meter to detect a leak, and how to repair some toilet and faucet leaks. In a partnership with another agency, the bureau is currently pilot-testing offering residential water surveys for its customers.

ICI customers receive detailed technical assistance, from leak identification to changing industrial processes to save or reuse water. Savings from this technical assistance varies by customer, depending on how they use water and how much water they use.

Much of the incentive to reduce indoor water use by both ICI and residential customer is due to the high rates associated with wastewater cleanup. The payback for these water savings, then, is the combination of savings from both water and wastewater (or sewer) charges—a much faster payback period than a payback period based on just water charges alone.

In the past, the Water Bureau has provided incentives to multi-family owners who provide housing to low-income customers. The incentives have been to replace high-flush-volume toilets (more than 1.5 gallons per flush) with low-flush models (1.6 gallons per flush). Evaluation of this program indicated a 25 percent reduction in water bills for multi-family units that took advantage of this program. Through the Customer Service work group, a low-income fixture repair program is also offered to customers who meet income guidelines.

The Water Bureau has also retrofitted municipal water fixtures to make them more efficient, including the free public drinking fountains—called "Benson Bubblers"—and City water fountains. The bureau has also worked closely with Portland Parks & Recreation (PP&R) to use non-potable water sources for irrigation of the many parks and golf courses in the City.

Curtailment Program

Portland has two high-quality sources of water: the Bull Run watershed and the Columbia South Shore Well Field. Each water source, however, is susceptible to different vulnerabilities. The Bull Run watershed is vulnerable to earthquakes, landslides, floods, droughts, wind or ice storms, forest fires, or acts of terrorism. Any of these could cause water quality problems including turbidity. Operations in the CSSWF are vulnerable to earthquakes, flooding of the Columbia River, fires, and acts of terrorism as well as

groundwater contamination and power outages. Because of these vulnerabilities and others, the bureau has an *Emergency Operations Plan*—last updated in 2002.

In addition, bureau staff also prepare an annual *Seasonal Water Supply Augmentation and Contingency Plan*—also referred to as the Summer Supply Plan (SSP). The SSP includes a tiered contingency plan. The contingency plan has been incorporated into the bureau's curtailment plan. The contingency plan and this curtailment plan take into account baseline primary supplies such as the Bull Run streamflow and water gained from conservation; augmentation resources such as the CSSWF supply and the first increment of Bull Run Lake; and contingency resources such as additional increments of Bull Run lake, voluntary curtailment, interconnections with area water providers, emergency wholesale demand offloads, and mandatory curtailment.

The tiered system describes the supply source, the potential rate of use, potential peak-season volume, and potential use period. The use of supply sources in the different tiers is tied to a measurable trigger that is associated with one of four stages of alert: Level 1–Mild Alert, Level 2–Voluntary Curtailment Measures, Level 3– Emergency Mandatory Curtailment Measures, and Level 4–Critical Water Shortage. The triggers are determined by the bureau's ability to meet the anticipated demand at the time of year and the terminal storage volume. See Tables 4-2 and 4-3 in the Curtailment section of the document for more detail.

The Water Bureau has had very few water shortages requiring the use of this curtailment plan—the most recent incident was in 1992 when Portland experienced a drought that drew the Bull Run reservoirs down to low levels at the same time that the groundwater supply was temporarily unavailable.

The most likely scenario that could disrupt distribution of water from both sources is a major earthquake. Seismic analyses of the Bull Run infrastructure indicate that the dams exceed requirements for safety. A project to protect a vulnerable conduit crossing of the Sandy River is currently underway. The project goal is to relocate the conduit under the Sandy River. An earthquake of sufficient magnitude to disrupt water service would affect all of the regional water providers. Therefore, Portland would have to rely more heavily on curtailment or alternate sources of water (e.g. bottled water or portable water distribution systems) to meet basic needs should both systems need repair.

The need to access more groundwater supplies for vulnerability purposes to meet the annual average demand is a significant conclusion of this WMCP.

Water Supply

The City of Portland is responsible for providing water to its retail and wholesale customers in the Portland metropolitan area. The purpose of this WMCP is to characterize Portland's population and water use to date, anticipate population growth and water use patterns, and plan for the anticipated growth through the use of water resources including conservation.

Population Growth and Water Use

Although the physical boundaries of the retail service area are not expected to be redefined beyond the limits of the urban growth boundary (UGB), vacant land and redevelopment lots within the retail service area are increasingly being developed with higher-density housing and more mixed-use development than in the past. In addition, several of the bureau's 19

wholesale customers have identified growth in existing service areas as well as some small additions to the UGB in 2004.

Historical water use, both retail-only and combined retail and wholesale demand, has not kept pace with the increase in the service area population. Since 1990, the number of gallons per capita per day for the entire retail and wholesale area has declined while the population has grown. Figures ES-1 and ES-2 show, respectively, the system service area population compared with the average daily demand and the demand in per capita gallons per day, for calendar years 1960–2007.

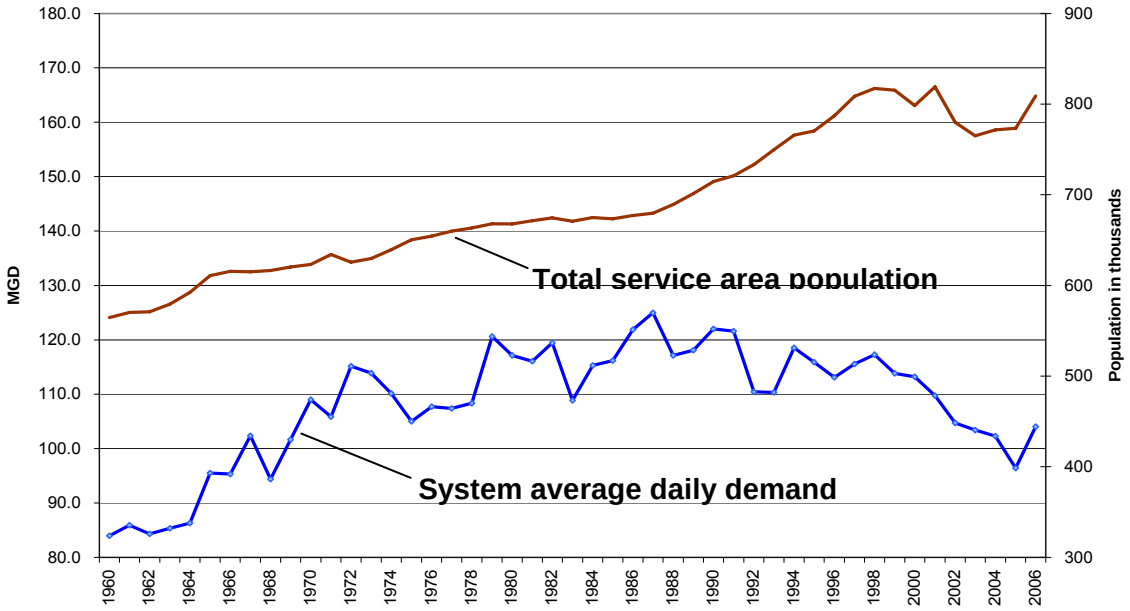

Figure ES-1. Historical Total System Service Area Population and Average Daily Demand, Calendar Years 1960-2006

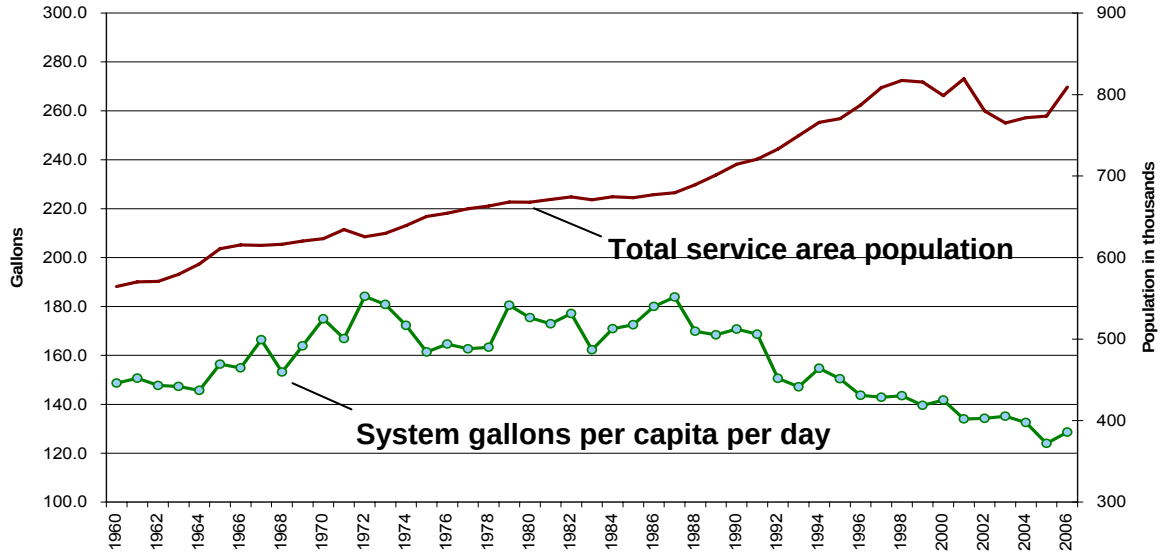

Figure ES-2. Historical Total System Service Area Population and Gallons per Capita per Day, Calendar Years 1960-2006

Demand Forecast

Using a single-equation econometric model, the Water Bureau has estimated the mathematical relationship between the overall demand for water and a series of explanatory variables including population change, weather factors such as precipitation and temperature, the average price of water, weekend use, and others. The result is a weather-normalized demand forecast for annual demand. The forecast also estimates demand under weather conditions that generated the highest average daily demand during the peak season (1967) and the highest single peak-day water demand (1981).

Although the growth in demand does not increase at the same rate as the growth in population, analysis of future demand and population shows that demand will increase over time. Figures ES-3 and ES-4 show forecasts for 2007-2030 of Portland's retail and wholesale annual average daily demand (ADD) for both weather-normalized and 1967 weather conditions for the entire year and for the peak season, respectively.

Population estimates were obtained from Metro. These forecasts were generated as a part of the population and allocation forecasts prepared for the Regional Transportation Plan. Estimates were made based on approximate service territories of Portland and each wholesale customer. No estimate for future growth outside the existing service territories was included, although some growth outside the existing service territory is likely for some providers as the UGB is expanded to accommodate the required 20-year land supply.

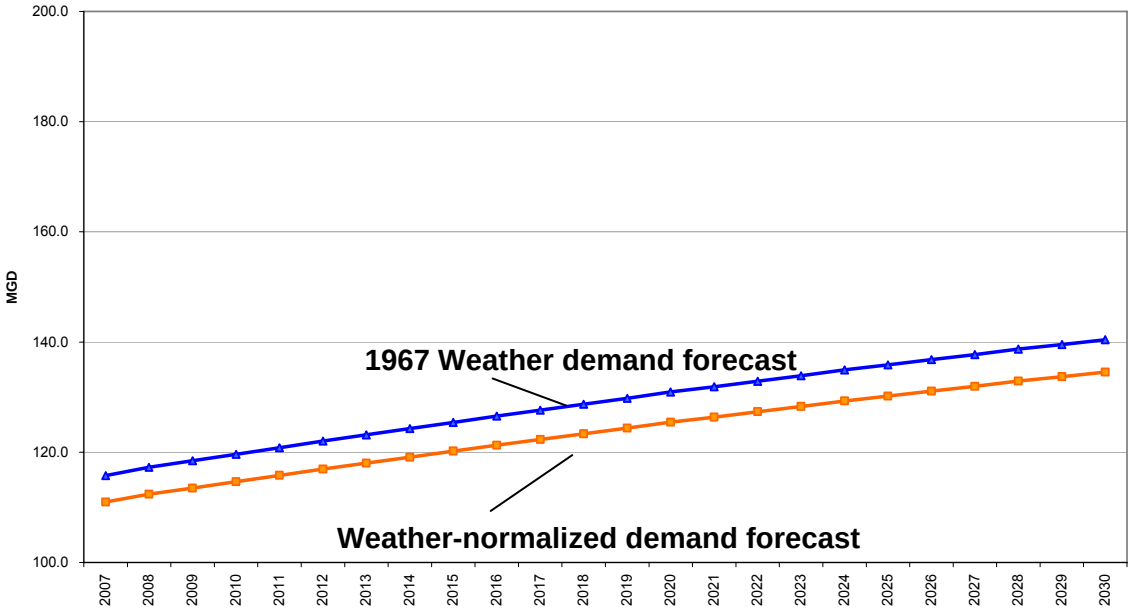

Figure ES-3. Total Annual Average Daily Demand Forecasts Under Weather-normalized and 1967 Weather Conditions, Calendar Years 2007-2030

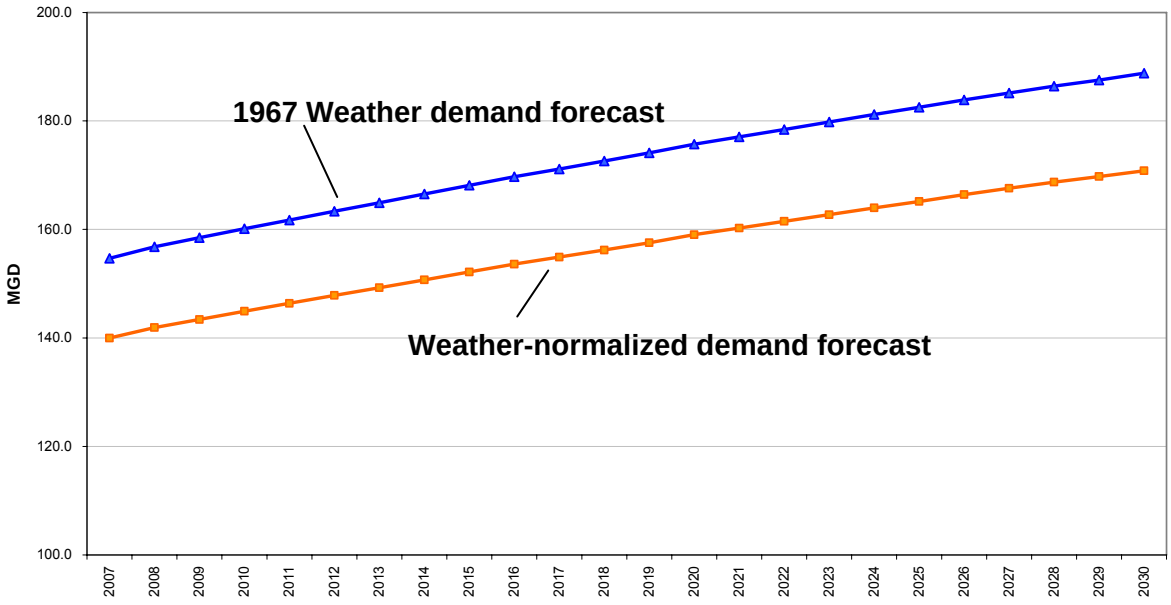

Figure ES-4. Total Peak-season Demand Forecasts Under Weather-normalized and 1967 Weather Conditions, Calendar Years 2007-2030

Table ES-2 shows the estimated demand and population for 2007 and the forecasted demand and population for 2028. The difference between the demand figures and the populations for 2028 and 2007 is the amount of the increase—labeled as 2028 Increase in the bottom row.

Table ES-2. Increase in Forecasted Retail-Wholesale Annual and Peak-season Demand—Calendar Years 2007 to 2028

	Annual (MGD)		Peak Season (MGD)			
Calendar Year	**ADDWN**	**ADDW67**	**ADDWN**	**ADDW67**	**MDDW81**	**Population**
2007	111.0	115.8	140.0	154.7	235.0	817,586
2028	132.9	138.7	168.7	186.4	282.8	982,442
2028 Increase	**21.9**	**22.9**	**28.7**	**31.7**	**47.7**	**164,856**

ADDWN - average daily demand, weather-normalized
ADDW67 - average daily demand under 1967 weather conditions
MDDW81 - maximum daily demand under 1981 weather conditions
Peak Season – 122 days, June 1 to September 30

The average annual daily demand for 2028 under 1967 weather conditions is estimated to be 138.7 million gallons a day (MGD), an increase of 22.9 MGD over the current demand. The Bureau has chosen to use the 1967 weather effects to account for the slight increase in average daily demand (ADD) because of the longer peak-season extensions into the spring and fall months.

Alternative Sources of Supply

Given the likelihood that population growth and increased demand will occur by the year 2028, the Water Bureau analyzed additional supply from existing water rights and supply from sources outside of those owned by the City of Portland.

Table ES-3 shows the potential additional sources of water supply that the City considered and the conclusions the City reached about the feasibility of developing or using those resources.

Table ES-3. Alternative Sources for Water Supply and Conclusions Regarding Development or Use

Alternative Source of Supply	Conclusion Regarding Development or Use
Supply from City Sources	
Bull Run Dam 3 and Related Facilities	The costs to develop this resource and avoid the potential impacts on the natural resources are greater than is necessary to meet the demand anticipated at this time.
Additional Storage in Reservoirs 1 and 2	The storage gained by raising the levels of the dams is not enough to offset the anticipated future demand and would trigger additional environmental impacts and costs.
Former Powell Valley Road Water District (PVRWD) Groundwater Wells	The City is in the process of evaluating the use of former PVRWD wells to determine how they can be utilized within the Portland water system. The assumed capacity of former PVRWD wells is accounted for in future supply planning.
Bull Run Groundwater	The quality and/or temperature of the groundwater in the Bull Run watershed was found to be not suitable for instream fish flows and is not suitable for municipal supply without further treatment and/or blending.
Aquifer Storage and Recovery	Upon partial implementation of a pilot program, the potential water produced did not justify the cost of the continuing with the project at that particular time. This concept could be revisited at a later time.
Non-potable Supplies	The potential costs of treating and/or transporting all identified non-potable water supplies is not feasible for development for municipal water supply except in selected areas of the City. Some future development may occur by the Port of Portland in the Rivergate area.
Willamette River	Although the City has made claims to the Willamette River to protect past usage of this source, the Portland City Council determined in 1996 that the City will not use the Willamette River as a source of municipal water without further action by the Council.

Table continued on next page.

Table ES-3. Alternative Sources for Water Supply and Conclusions Regarding Development or Use

Alternative Source of Supply	Conclusion Regarding Development or Use
Supply from Non-City Sources	
Existing or Expanded Interconnections with Other Providers	The City's Summer Supply Plan for 2007 identifies a total of 6.5 MGD as available through interconnections with other sources. However, reliable supplies through these interconnections is limited.
Columbia River	The City does not have water rights on the Columbia River. The CSSWF is a much more economical alternative.

Although there are some alternatives to the development of CSSWF groundwater rights to meet annual average demand, none of the alternative sources is feasible for reasons of cost, availability, environmental impacts, or quality of the water. Conservation savings are assumed to continue in the near future as a part of the demand forecast, but the per capita consumption rate will likely plateau as population growth continues.

Supply Management

Portland's water supply planning takes into account the system vulnerabilities and the reliability of the water supply sources. The Bull Run surface water supply is unfiltered, which results in vulnerabilities to events that can cause temporary elevations in the turbidity levels. The capacity of the CSSWF to yield at a given rate is reduced with the duration of pumping. Table ES-4 shows the estimated reliability and volume of groundwater production under different assumptions of pumping.

Table ES-4. Estimated Reliability of Supplies of CSSWF Groundwater in the 2007 Summer Supply Plan[a]

Number of Days of Pumping	Estimated Reliability in Millions of Gallons a Day	Estimated Volume in Billions of Gallons
Up to 30	102	3.1
30–90	92	8.6
More than 90	82 or less	More than 8.6

[a]Assumes 100% mechanical operation of all facilities

The estimated reliability figures in Table ES-4 were calculated assuming 100 percent mechanical operation of all facilities. Patterns of past production indicate that a reduction of 10 percent from these figures would more realistically account for out-of-service components. Reducing the 30–90-day reliability figure by 10 percent results in an estimated rate of 82.8 MGD. The 30–90-day interval is selected by the bureau as the planning scenario for the pumping duration for the CSSWF in the year 2028.

Undeveloped, Expanded, and New Water Rights

Request to Develop Additional Water Under Existing Permits

The City of Portland is requesting additional water in the amount under existing permits for the Columbia South Shore Well Field for the next 20 years, from the present to 2028.[2] This request is to develop an additional 48.54 MGD/53.39 maximum MGD of supply from the CSSWF water rights shown in Table ES-5.

Table ES-5. Requested Groundwater Supplies by Permit, to 2028

Permit #	Monthly Volume[a] (in BG)	Millions of Gallons a Day	Maximum Diversion Rate[b] (in MGD)
G-10124 & G-10455	.54	17.84	19.62
G-8755 & G-10479	.92	30.7	33.77
Totals	1.46	48.54	53.39

[a]30-90-day supply based on 30 days of pumping

[b]The maximum diversion rate is a 10 percent increase of the monthly volume to represent the capacity yield for a less-than-30-day pumping event.

The basis for the 48.54 MGD of additional supply comes from the materials presented in the supply and demand analysis (subsection 5.4) of this WMCP. This total is accounted for in Table ES-6.

Table ES-6. Accounting for Requested Groundwater Supplies

	Amounts in MGD	Maximum Diversion Rate
Total Annual ADD (1967 Weather Year) Demand Forecast for 2028	138.7[a]	
Minus CSSWF 30–90-day Reliable Supply	-82.8[b]	
Minus PVRWD Wells Supply Assumption	-7.36	
Total Requested over 20 Years (to 2028)	48.54	53.39[c]

[a]From the demand forecast for retail and wholesale service for the year 2028.

[b]This figure is based on a 10% reduction in yield capacity due to multiple well drawdown when all wells are in production, as well as a 10% out-of-service-calculation for mechanical or other operational considerations.

[c]The maximum diversion rate is a 10% increase over the total monthly volume requested to represent the capacity yield for a less-than-30-day pumping event.

The maximum diversion rate is 10 percent higher than the total volume requested to represent the less-than-30-day diversion amount. If the diversion amount is needed past 30 days, it will drop after the 30-day period to an average of the monthly production needed to meet 48.54 MGD of annual average supply. This is the same yield analysis that is applied to the reductions in overall CSSWF capacities in the summer supply planning process.

[2] On October 6, 2009, PWB received the Notice for Final Orders from OWRD for CSSWF permits G-8755, G-10479, G-10455, and G-10124 and for Permit Amendment T-10489 for Well #38 under G-8755.

Schedule and Budget for Development of New Water Rights

The amounts of the water supply will be developed over a 20-year period of time beginning in 2009 and progressing to 2028 at an estimated cost of $29.5 million (or approximately $750,000 per MGD). These estimates are in 2004 dollars. This $29.5 million does not include the cost for added infrastructure associated with pumping, pipeline upgrades, storage, or other distribution system costs not directly associated with the specific well sites.

The amounts for added infrastructure will be evaluated in future WMCP plan updates and revised as needed based on the following three elements:

- The factors associated with defining the amount of supply from the Powell Valley well system
- The amount of actual demand increments based on weather effects and conservation savings
- The status of wholesale contracting beyond the expiration of the first set of 10-year contracts as well as any new contracts that might be signed in the future

Increased costs will be defined for other infrastructure projects associated with pumping, transmission, and storage that may be necessary with an increased supply of groundwater from the CSSWF.

Conclusions Regarding the Need for Development of Groundwater Rights

This updated WMCP represents a continuation of Portland's commitment to proper management of its water resources. The Water Bureau relies on the well field for summer supply augmentation and as an emergency backup supply when the Bull Run surface water supply is unavoidably limited or unavailable. The well field infrastructure represents supply capacity already in place and ready to use. Other water-supply options of similar capacities will not be needed until demand (as moderated by conservation programs) grows enough to enable financing and construction of new storage or supply. Other major sources of supply that could make any further development of Bull Run storage unnecessary for a long time are being evaluated within the Portland region. Given uncertainties about future per capita demand, the pace of urban growth, future wholesale water customer behavior, requirements to provide instream flows for fish, and changes in weather or climate patterns that may reduce Bull Run yields during the peak season, the City anticipates a continuing need for the groundwater system to meet its responsibilities to its customers.

The City must plan and manage its resources in the most cost-effective manner possible. The development of four existing groundwater rights in the CSSWF would best leverage the existing infrastructure and subsurface hydrology, would create the least environmental impacts, and would meet vulnerability needs making it the most cost-effective and responsible option. The development of the groundwater source in the CSSWF can be done incrementally as needed and as fits with actual water demand, future wholesale contracting, conservation program success, and the development of non-potable supplies over time. For these reasons, continuing to use the groundwater system as backup supply and developing the conservation programs are the methods of choice for meeting future needs.

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1. Introduction

1.1 Context of the Final WMCP

The City of Portland is pleased to present this final *Water Management and Conservation Plan* (WMCP) based on the requirement of the Oregon Administrative Rules Chapter 690 Division 86 (Division 86 rules). This WMCP 1) updates the City of Portland's expired 2000 WMCP, 2) fulfills a condition placed on the City of Portland's assumed Powell Valley Road Water District groundwater right (#G-14007) and other rights granted to the City for wells under the administration of Portland Parks & Recreation (PP&R), and 3) fulfills any WMCP requirements that might be placed on extensions of other groundwater rights that the City of Portland owns or may apply for in the future during the period covered by this plan.[3]

This final version of the WMCP fulfills OWRD sufficiency review comments and the WaterWatch comments received during the public comment period, incorporates new information gathered since 2008, and represents a continuation of Portland's commitment to proper management of its water resources.

1.1.1 Comments on the 2008 Final Draft WMCP

The Portland Water Bureau (PWB) submitted the Final Draft of its Water Management and Conservation Plan to Oregon Water Resources Department in March 2008. On April 1, 2008, Oregon Water Resources Department (OWRD) provided notice and posted the plan on its file transfer protocol (FTP) site and opened a 30-day public comment period. OWRD received comments on the plan from WaterWatch of Oregon on May 1, 2008. In late June 2008, OWRD met with PWB to provide a sufficiency review of the plan and relay the comments from WaterWatch of Oregon. Appendix A is the sufficiency review worksheet from OWRD and the May 1, 2008 letter from WaterWatch of Oregon.

One of WaterWatch's key comments was a process concern regarding the request in the 2008 WMCP draft to develop additional water supply under groundwater permits that did not, at the time, have valid extension orders. This concern has now been addressed. The City of Portland had already submitted completed permit extensions for the four groundwater rights relied upon for the "green light" water request in the WMCP. OWRD held the completion of the processing of the four groundwater extensions pending the resolution of issues on changes to the statutes related to fish persistence. In July 2008, PWB requested an administrative hold on completing the WMCP, per OAR 690-86-910, until PWB had received a final order on the four pending water rights permit extensions. The final orders were received on October 6, 2009. Subsection 1.1.2 provides some of the details of the final orders; Appendix B is the Notice for Final Orders Received from OWRD for CSSWF G-8755,

[3] There was a prior condition in existing water in permit G-14007 for the Powell Valley wells, which were transferred to Portland upon dissolution of the Powell Valley Road Water District in 2005. On May 11, 2006, OWRD documented that the condition for this permit requiring a WMCP would be met upon approval of the City of Portland's WMCP.

G-10479, G-10455, and G-10124 and for Permit Amendment T-10489 for Well #38 under G-8755.[4]

1.1.2 Significant Changes Since 2008

Since the submittal of the Final Draft Report WMCP in March 2008, several key events and changes have had an effect on PWB's water supply program. The three most significant events that affect supply planning are 1.) OWRD's issuance of final orders for four groundwater rights and a permit amendment in the CSSWF, 2.) the approval of the Bull Run Water Supply Habitat Conservation Plan (HCP), and 3.) the City's pursuit of dual tracks for compliance with the Long Term 2 Enhanced Surface Water Treatment Rule (LT2). In addition, PWB has changed its conservation program and accumulated more years of data on demand and consumption and the use of the groundwater supply.

OWRD Issuance of Final Orders

On October 6, 2009, OWRD provided Final Orders on the extensions of the four primary groundwater rights permits in the Columbia South Shore Well Field (G-8755, G-10479, G-10455, and G-10124). OWRD also provided a Final Order on December 7, 2009 for Permit Amendment T-10489 approving an additional point of diversion (POD) for Well #38 under G-8755. These Final Orders are provided in Appendix B.[4] In October PWB notified OWRD that work would proceed on the Addendum to the March 2008 Draft Final WMCP to address the issues raised by OWRD's sufficiency review and any WaterWatch of Oregon comments that are within the purview of the City of Portland for response.

Habitat Conservation Plan Approval

The HCP was approved by Portland City Council Ordinance No. 182235 in October, 2008. The ordinance authorized the City to finalize an implementing agreement with the National Marine Fisheries Service (NMFS) for the HCP. In early April, 2009, Commissioner-in-Charge Randy Leonard and NMFS Acting Regional Administrator Barry Thom signed the Implementing Agreement and Incidental Take Permit to begin a 50-year period of implementation and monitoring for the 49 habitat conservation measures in the HCP. The Executive Summary of the HCP (Appendix C of this document) provides additional information on the measures.

LT2 Rule Compliance Tracks

In 2006, the Environmental Protection Agency (EPA) promulgated the Long Term 2 Enhanced Surface Water Treatment Rule (LT2 rule) in the Federal Register. The purpose of the LT2 rule is "to protect public health from illness due to *Cryptosporidium* and other microbial pathogens in drinking water" (FR 71 No. 3). In support of this purpose, sections of the LT2 rule articulate regulations for public water systems regarding treatment for the microbe *Cryptosporidium*.

In 2005, the Portland City Council directed PWB to pursue "regulatory or legislative alternatives to the *Cryptosporidium* treatment requirement" included in the proposed LT2 rule (Resolution No. 36297). In early 2006, the City filed a legal challenge to the rule in the

[4] Appendix B is provided in electronic format only, on CD with the printed version of this WMCP and on the PWB web site for this WMCP: www.portlandonline.com/water/WMCP.

Washington DC District Court of Appeals. In November 2007 the court issued a decision rejecting the City's challenge and upholding the rule (*City of Portland, Oregon v. EPA* 2007).

In response to the court ruling and the 2005 direction of City Council, PWB has pursued parallel compliance strategies. The conventional treatment track is to achieve compliance with the treatment portion of the LT2 rule as written. This includes the design of an ultraviolet (UV) water treatment facility for the Bull Run water source as directed by the Portland City Council in July 2009.[5] The Council also decided at this time that Portland would not pursue filtration as a treatment option. The treatment variance track is to seek a variance to the treatment requirement of the LT2 rule (40 CFR § 141.712), under Section 1415(a)(1)(B) of the SDWA.

Under the conventional treatment track, PWB anticipates completion of the design for UV treatment facility in the first half of 2011. However, progressing to the construction phase is contingent on EPA's decision regarding PWB's application for a variance (under the treatment variance track). Should the EPA deny the variance to PWB, construction of the UV treatment facility in the Bull Run watershed will move forward.

UV treatment consists of disinfecting water through exposure to UV light rays. The UV light renders *Cryposporidium* microbes incapable of reproducing. Although this treatment method is effective at disinfecting water for *Cryptosporidium*, it does not protect the water supply from elevated turbidity levels, as filtration would. Turbidity—suspended particles in the water—above a certain level requires that PWB discontinue use of Bull Run water and rely on groundwater from the Columbia South Shore Well Field, as described in subsection 2.4.2 of the WMCP. The decision to implement UV treatment as part of PWB's conventional treatment track, therefore, means continued reliance on the CSSWF groundwater water supply when turbidity levels are elevated in the Bull Run watershed. The decision not to build filtration of the Bull Run also is likely to limit access to further supplies in the existing reservoirs and to make building further storage in the watershed a significant engineering challenge. As a result, as water demand increases over the next several decades within the retail and wholesale service areas, PWB's reliance on groundwater sources will also increase.

Conservation Program Changes

Since March 2008, PWB's Conservation Program has launched several new programs. Two programs address high-efficiency toilet replacement; one pilot program tests a new technology in commercial landscape application. PWB's Business Industry and Government (BIG) program has increased the amount of technical assistance it provides to industrial, commercial, and institutional customers since March 2008.

In January 2009, PWB offered a $100 rebate to qualified retail residential customers for purchasing for high-efficiency toilets. Customers that replaced toilets that use at least 1.6 gallons per flush (gpf) with a WaterSense-labeled toilet that uses 1.28 gpf or less were eligible for the rebate. By early May, funds for the $50,000 replacement program were exhausted; PWB estimates that it awarded rebates for 503 toilets, saving an estimated 11,000 gallons of water per day.

In January of 2010, the Portland City Council approved a three-year grant for PWB to provide rebates to low-income housing providers for purchasing high-efficiency toilets (Ordinance 183440). The grant provides a total of $120,000 to be disbursed over three years.

[5] Portland City Council Resolution No. 36720 As Amended. July 29, 2009.

This program fulfills not only PWB's resource conservation goals, but also meets some of the affordable housing targets established by the Portland Housing Bureau.

PWB launched a pilot program in late January 2010 to evaluate the use of soil moisture-sensing equipment for five commercial and institutional customers. The program will gather data on water use for irrigation before and after testing soil moisture-sensing equipment. Results will be evaluated after the program has been completed in June 2012.

PWB's BIG program has provided technical assistance to 60 customers and made on-site visits to approximately 30 customers since March 2008. Highlights of BIG's major accomplishments include the following:

- In October 2009, BIG staff advised designers at Portland State University on retrofitting domestic water facilities in the Smith Memorial Student Union building.
- A 2009 review of operations at the Multnomah Athletic Club (MAC) yielded 11 primary suggestions for improving efficiency at the facility and for further research. Additionally, BIG staff completed a comprehensive water use review for the 50-meter pool. MAC continues to call on BIG for additional assistance.
- BIG staff reviewed water use at two University of Portland residential dormitories and created a list of recommendations for saving water. High-efficiency showerheads were provided so students could complete a pilot test. The university's Green Team indicated it would like BIG staff to review water use on the rest of the campus.
- Several Portland-area office buildings have requested water-use surveys from BIG staff. Recommendations have often included changes to building operations to reduce water use and operate building systems more efficiently.
- In 2009, BIG helped OHSU staff determine how much water was consumed by a water-cooled condenser. Knowing the actual use helped OHSU staff determine the cost effectiveness of replacing this older piece of equipment with a more efficient model. Replacement of a single water-cooled condenser would save OHSU about 703 ccf annually.
- BIG staff also provide technical assistance to Portland's Bureau of Planning and Sustainability, serve as liaisons to the Small Business Advisory Council, and provide guest lectures for Mt. Hood Community College's Sustainable Building Advisor Program.

Demand and Consumption Information

Since March 2008, PWB has compiled the statistics on retail and wholesale demand and consumption for fiscal years 2007-2008 and 2008-2009. Tables 1-1, 1-2, 1-3, and 1-4 show this updated information on the following pages.

Table 1-1. System Demand and Consumption for Fiscal Year 2007-2008

2007-08 Demand and Consumption Information
Portland Water Bureau

SYSTEM PRODUCTION DATA	07-08	06-07	05-06	04-05	03-04
Winter Flow Average in MGD (November through March)	85	84	80	83	83
Summer Flow Average in MGD (June through September)	135	140	127	123	142
Peak Day Flow	180 MG	182 MG	182 MG	187 MG	198 MG
Average Annual Production in MGD	103	106	99	97	106
SYSTEMWIDE DATA					
Total annual system consumption	35.5 BG	36.0 BG	33.9 BG	32.9 BG	37.0 BG
Total people served (a)	879,900	860,000	801,900	770,250	782,300
Per capita annual consumption in Gallons	40,300	41,800	42,200	42,700	47,300
Per capita daily consumption in Gallons	110	115	116	117	130
TOTAL RETAIL CUSTOMERS					
Total annual consumption	20.9 BG	21.4 BG	21.1 BG	20.1 BG	21.6 BG
# of services	179,600	180,100	178,500	166,250	165,350
Average daily consumption per service in Gallons	319	325	324	331	358
Retail Population (a)	550,900	545,300	539,200	494,200	488,800
SMALL METER (5/8" & 3/4") RESIDENTIAL CUSTOMERS – RETAIL					
Total annual consumption	8.7 BG	8.9 BG	8.3 BG	8.2 BG	9.0 BG
# of services	149,600	150,400	149,000	137,700	137,000
Average daily consumption per service in Gallons	159	162	153	163	180
Per capita daily consumption in Gallons (b)	64	66	62	66	73
LARGE METER RESIDENTIAL CUSTOMERS – RETAIL					
Total annual consumption	3.5 BG	3.6 BG	3.6 BG	3.1 BG	3.2 BG
# of services	10,400	10,400	10,300	8,650	8,600
COMMERCIAL, INDUSTRIAL , INSTITUTIONAL ACCOUNTS - RETAIL					
Total annual consumption	8.7 BG	8.9 BG	9.2 BG	8.8 BG	9.4 BG
# of services	19,600	19,400	19,150	19,850	19,750
Average daily consumption per service (adjusted to exclude services with minimal usage) in Gallons	1,640	1,690	1,780	1,630	1,740
TOTAL WHOLESALE CUSTOMERS					
Total annual consumption	14.6 BG	14.6 BG	12.8 BG	12.8 BG	15.4 BG
Wholesale consumption (as a % of total consumption)	41%	41%	38%	39%	42%
Population served (a)	329,000	314,700	262,700	276,050	293,500
Average daily per capita consumption in Gallons	122	127	133	127	144

NOTES:

BG = Billion Gallons MG = Million Gallons

(a) Population figures are based on PSU Population and Research Center estimates and METRO's population forecasts.
METRO refined its population estimates in 2005.
Wholesale population is adjusted to reflect the percent of total water purchased by wholesale customers from alternative sources.
Wholesale population served by Portland increased in FY 06-07 because wholesale customers signed a new contract with increased water purchases from Portland.
Retail population jumped in FY 05-06 because Powell Valley Road Water District merged with the Water Bureau on July 01, 2005.

(b) Recent METRO data identified 2.47 people per household. Pre-1992 water shortage residential water consumption was 90 gallons per day per capita based on 2.47 people per household.

Table 1-2. Wholesale Consumption for Fiscal Year 2007-2008

City of Portland Wholesale Customers' Statistics Fiscal Year ending June 30, 2008

Distributor	Consumption in 100 cubic feet	Revenue	Active Services (a)	Service Population		Contract Expires
				Regular	Intermittent	
Burlington Water District (c)	20,591	$19,797	118	534		2026
Gresham, City of	3,188,393	1,908,275	16,758	65,302		2026
Lake Grove Water District (b)	178,660	116,998	1,233	2,192	981	2016
Lusted Water District	71,985	64,583	410	1,226		2026
Palatine Hill Water District (c)	194,072	257,677	605	2,598		2027
Pleasant Home Water District	87,979	77,174	531	2,528		2016
Raleigh Water District (c)	269,936	202,847	993	5,413		2026
Rockwood Water PUD (b)(c)	2,949,288	1,555,773	13,189	39,130	11,927	2026
Tigard, City of (b)	2,520,796	1,985,866	18,018	50,076	4,488	2016
Tualatin, City of	2,808,598	1,704,749	6,642	24,328		2016
Tualatin Valley Water District (b)(c)	6,552,747	5,432,413	57,019	119,058	78,342	2016
Valley View Water District (c)	68,607	100,481	375	1,495		2026
West Slope Water District (c)	616,787	746,660	3,356	14,770		2026
Total - large users	19,528,439	$14,173,293	119,247	328,650	95,738	
GNR Water Company	2,845	1,570	25	9		2011
Green Valley Water Company	196	329	3	10		2011
Hideaway Hills Water Company	1,954	1,820	14	6		2011
Lorna Water Company	9,068	4,483	95	243		2011
Sky view Acres Water Company	11,361	5,559	76	43		2011
Two Rivers Water Association	1,275	834	4	6		2011
Small water companies	26,699	$14,595	217	317		
Total wholesale customers	19,555,138	$14,187,888	119,464	328,967	95,738	

NOTES:

(a) Number of active services as of June 30, 2008 data supplied by wholesalers.
(b) Population estimates are based on Metro's population forecasts or data supplied by wholesale customer. Customers with "Intermittent" population use water sources in addition to the City of Portland.
(c) Consumption and revenue figures are adjusted for water sales to City customers.

Table 1-3. System Demand and Consumption for Fiscal Year 2008-2009

2008-09 Demand and Consumption Information
Portland Water Bureau

SYSTEM PRODUCTION DATA	08-09	07-08	06-07	05-06	04-05
Winter Flow Average in MGD (November through March)	87	85	84	80	83
Summer Flow Average in MGD (June through September)	131	135	140	127	123
Peak Day Flow	162 MG	180 MG	182 MG	182 MG	187 MG
Average Annual Production in MGD	103	103	106	99	97
SYSTEMWIDE DATA					
Total annual system consumption	35.2 BG	35.5 BG	36.0 BG	33.9 BG	32.9 BG
Total people served (a)	884,300	879,900	860,000	801,900	770,250
Per capita annual consumption in Gallons	39,800	40,300	41,800	42,200	42,700
Per capita daily consumption in Gallons	109	110	115	116	117
TOTAL RETAIL CUSTOMERS					
Total annual consumption	20.7 BG	20.9 BG	21.4 BG	21.1 BG	20.1 BG
# of services (c)	183,300	182,450	180,100	178,500	166,250
Average daily consumption per service in Gallons (c)	309	314	325	324	331
Retail Population (a)	558,200	550,900	545,300	539,200	494,200
SMALL METER (5/8" & 3/4") RESIDENTIAL CUSTOMERS – RETAIL					
Total annual consumption	8.5 BG	8.7 BG	8.9 BG	8.3 BG	8.2 BG
# of services (c)	152,700	152,100	150,400	149,000	137,700
Average daily consumption per service in Gallons (c)	153	157	162	153	163
Per capita daily consumption in Gallons (b)	62	64	66	62	66
LARGE METER RESIDENTIAL CUSTOMERS – RETAIL					
Total annual consumption	3.5 BG	3.5 BG	3.6 BG	3.6 BG	3.1 BG
# of services (c)	10,600	10,550	10,400	10,300	8,650
COMMERCIAL, INDUSTRIAL , INSTITUTIONAL ACCOUNTS – RETAIL					
Total annual consumption	8.7 BG	8.7 BG	8.9 BG	9.2 BG	8.8 BG
# of services (c)	20,000	19,800	19,400	19,150	19,850
Average daily consumption per service (adjusted to exclude services with minimal usage) in Gallons (c)	1,590	1,610	1,690	1,780	1,630
TOTAL WHOLESALE CUSTOMERS					
Total annual consumption	14.5 BG	14.6 BG	14.6 BG	12.8 BG	12.8 BG
Wholesale consumption (as a % of total consumption)	41%	41%	41%	38%	39%
Population served (a)	326,100	329,000	314,700	262,700	276,050
Average daily per capita consumption in Gallons	122	122	127	133	127

BG = Billion Gallons, MG = Million Gallons, MGD=Million Gallons per Day

(a) Population figures are based on PSU Population and Research Center estimates and METRO's population forecasts. METRO refined its population estimates in 2005.

Wholesale population is adjusted to reflect the percent of total water purchased by wholesale customers from alternative sources. Wholesale population served by Portland increased in FY 06-07 because wholesale customers signed a new contract with increased water purchases from Portland.

Retail population jumped in FY 05-06 because Powell Valley Road Water District merged with the Water Bureau on July 01, 2005.

(b) Recent METRO data identified 2.47 people per household. Pre-1992 water shortage residential water consumption was 90 gallons per day per capita based on 2.47 people per household.

(c) FY 2007-08 numbers of retail meters updated and corresponding per capita or daily usage calculations changed.

Table 1-4. Wholesale Consumption for Fiscal Year 2008-2009

City of Portland Wholesale Customers' Statistics
Fiscal Year ending June 30, 2009

Distributor	Consumption in 100 cubic feet	Revenue	Active Services (a)	Service Population		Contract Expires
				Served by Portland	Served by Other Sources	
Burlington Water District (c)	23,378	22,889	118	547		2026
Gresham, City of	2,844,941	1,963,645	16,233	66,485		2026
Lake Grove Water District (b)	168,365	134,783	1,233	2,203	1,045	2016
Lusted Water District	77,076	74,589	410	1,308		2026
Palatine Hill Water District (c)	210,651	288,229	609	2,618		2027
Pleasant Home Water District	85,836	89,328	532	2,945		2016
Raleigh Water District (c)	262,403	236,163	998	5,433		2026
Rockwood Water PUD (b)(c)	3,146,955	1,801,637	13,025	38,270	12,798	2026
Tigard, City of (b)	2,517,159	2,253,784	17,848	45,216	10,253	2016
Tualatin, City of	2,772,672	1,968,839	6,658	24,563		2016
Tualatin Valley Water District (b)(c)	6,491,709	6,266,060	57,395	119,871	76,329	2016
Valley View Water District (c)	79,487	102,776	376	1,571		2026
West Slope Water District (c)	618,975	837,827	3,312	14,715		2026
Total - large users	19,299,607	16,040,549	118,747	325,745	100,425	
GNR Water Company	2,598	1,519	25	9		2011
Green Valley Water Company	248	349	3	10		2011
Hideaway Hills Water Company	3,362	1,899	14	6		2011
Lorna Water Company	9,132	4,773	95	246		2011
Sky view Acres Water Company	12,510	6,455	76	44		2011
Two Rivers Water Association	1,589	1,017	4	6		2011
Small water companies	29,439	16,012	217	321		
Total wholesale customers	19,329,046	$16,056,561	118,964	326,066	100,425	

(a) Number of active services as of June 30, 2009 data supplied by wholesalers.
(b) Population estimates are based on Metro's population forecasts or data supplied by wholesale customer.
(c) Consumption and revenue figures are adjusted for water sales to City customers.

Use of Groundwater

Since submittal of the Final Draft WMCP in March of 2008, PWB has used the CSSWF groundwater supply a total of four additional times: twice for maintenance (in August of 2008 and 2009), once for seasonal augmentation (September-October of 2009), and once as a backup to the Bull Run supply when turbidity threatened to exceed the allowable levels (November of 2008). The Tables 1-5 and 1-6 on the next two pages contain the additional data.

Table 1-5. Use of CSSWF Wells to Augment Bull Run Water, by Date

Start date	Days used	Average daily production	Approximate amount of water used (BG)
September 28, 2009	31	35.9	1.08
August 5, 2009	8	4.6	0.03
August 18, 2008	6	5.3	0.03
June 25, 2007	73	23.5	1.87
August 14, 2006	79	46.0	3.58
July 27, 2004	28	36.5	1.01
July 22, 2003	63	58.8	3.70
October 8, 2001	12	38.7	0.44
August 9, 2000	41	29.6	1.70
September 4, 1996	27	27.7	0.70
August 2, 1994	73	26.0	2.50
August 17, 1992	45	23.0	1.50
August 7, 1990	23	9.6	0.22
September 4, 1987	88	60.0	5.30
July 20, 1985	19	21.0	0.38
Average number of days per use	41	*Approximate total amount of water used 1985–2009*	24.04

Table 1-6. Use of CSSWF Wells During Shutdown of the Bull Run Supply, by Date

Start date	Days used	Average daily production	Approximate amount of water used (BG)	Reason
November 13, 2008	8	81	0.65	Turbidity
November 7, 2006	14	78.6	1.1	Turbidity
January 29, 2004	4	18.4	0.04	Turbidity
November 25, 1999	19	78.9	1.5	Turbidity
December 28, 1998	5	86.4	0.35	Turbidity
February 7, 1996	8	61.5	0.5	Turbidity
November 28, 1995	27	25.4	0.7	Landslide in Bull Run watershed disabled conduits
February 25, 1986	22	49.0	1.2	Turbidity
Average number of days per use	13	*Approximate total amount of water used 1985–2008*	6.04	

1.1.3 OAR Requiring Municipal Suppliers to Create a Plan

The Oregon Water Resources Department (OWRD) had adopted a statewide policy on Conservation and Efficient Water use. This policy is outlined in Oregon Administrative Rule (OAR) 690-410-0060. This policy requires major water users and suppliers to prepare water management and conservation plans (WMCPs). The OAR that defines, describes, and outlines the content of the WMCP is OAR 690-086. In this plan, each relevant section and subsection of OAR 690-086 is quoted in italics below the section heading and above the text that fulfills the requirements.

1.1.4 Prior WMCP and Conditions

The City of Portland obtained approval from OWRD of our first WMCP on February 22, 2001. This WMCP contained several conditions. The conditions are numbered below followed by a description of the City's subsequent actions in a bold, italic font.

1) Submission of a letter, within 30 days of issuance of any new water right permit issued to the City describing the City's schedule for developing and adding the new source to the delivery system. ***The City has not submitted any new water rights since the first WMCP was approved.***

2) The City shall consult with the Department to establish if interim adjustments to the plan are necessary as the result of any operational changes resulting from implementation of Endangered Species Act (ESA) requirements. ***Although the City has implemented interim operational instream flows for the lower Bull Run River, the City is still in the process of obtaining approval for its draft* Habitat Conservation Plan *(HCP) (Portland Water Bureau 2007c). The HCP includes measures to fulfill ESA requirements as part of the HCP Implementing Agreement with the National Marine Fisheries Service. No adjustments to the City's WMCP were deemed necessary during this time period.***

   Prior to requesting any permit extensions, the City shall consult with the Water Resources Department to establish if interim adjustments to the plan will be required. ***The City met with the Department on several occasions while preparing groundwater right permit extensions and to discuss the development of its WMCP. The City's groundwater permit extension requests are on hold at the current time awaiting clarification of the City's HCP process and state implementation processes for the new requirements under HB 3038.***[6]

3) The City shall include a summary of any new water service contracts and memorandums of understanding relating to the supply from the Bull Run system. The City shall include the summary of these actions in the next update. A larger group of the City and other metropolitan water providers are also updating the *Regional Water Supply Plan* (RWSP). The City shall report a summary of these actions in the next plan update. ***A) The City signed a new set of wholesale contracts on July 1, 2006 and will provide information regarding these contractual requirements in Elements 1 and 4 of this WMCP. In addition a copy of one of the wholesale contracts is included as Appendix D of this plan. The Regional Water Providers Consortium (RWPC) updated the RWSP in December 2004. The RWSP update will be discussed in the WMCP as it is relevant. B) The City signed an agreement with the USDA Forest Service, Mount Hood National Forest (Forest Service) on December 17, 2007. The Bull Run Watershed Management Unit Agreement (BRWMU Agreement) clarifies the roles and responsibilities of each agency and streamlines each agency's administrative function. The BRWMU Agreement lays the groundwork for the development of functional plans and/or contracts between the City of Portland and the Forest Service for security and access management; emergency planning and response; road maintenance and decommissioning; fire protection; water quality and quantity monitoring; natural resources management; conservation education; trail maintenance; and a simplification of the land ownership and occupancy.*** [7]

The prior WMCP contained an update period of June 20, 2005. The City of Portland asked for three extensions of this time period, one was granted by OWRD in writing on June 7,

[6] House Bill 3038, passed by the Oregon legislature in 2001, specifies that hatchery-produced fish are native fish for the purposes of the following: the Oregon Plan, the state threatened and endangered species lists, and any salmon enhancement programs.

[7] The full text of the agreement is posted on the Water Bureau's web site at www.portlandonline.com/water/index.cfm?c=44112.

2005; another on March 7, 2005; and a third on September 13, 2007 granted a submittal date of March 31, 2008.

1.2 Other Water Bureau and Regional Supply Planning Efforts

1.2.1 Regional Water Providers Consortium

The Regional Water Providers Consortium (RWPC) was formed in 1997 by Intergovernmental Agreement to coordinate the implementation of the *Regional Water Supply Plan* for the Portland metropolitan area. The City of Portland has been a member of the RWPC since its inception in 1997. The role of RWPC has evolved over the past ten years from one based on regional water supply planning to a forum for communication and collaboration on water supply, resource management, water policy and programs, emergency preparedness, and conservation program implementation throughout the region. Currently, 22 water providers and Metro participate in the RWPC. RWPC has adopted strategies on public involvement, source water protection, regional transmission and storage, and an update of the *Regional Water Supply Plan* in 2004.

Participation in the RWPC is voluntary and is funded through membership dues. Water providers retain full authority to manage their individual water systems. The RWPC is made up of a Board, Executive Committee, Technical Committee, Emergency Planning Committee, and Conservation Committee. The City of Portland provides staffing to the RWPC under a separate Intergovernmental Agreement.

1.2.2 Emergency Supply Planning

The City of Portland and the Portland Water Bureau have been involved in emergency planning and preparedness for many years. The Water Bureau participates in some emergency planning on its own authority and participates in RWPC activities for other planning efforts. The following is a summary of both types of planning activities.

Water Bureau Activities

The Water Bureau has its own emergency manager and emergency operations center. The Water Bureau participates in many regional efforts to ensure adequate coordination and communication during a regional event and to support other water providers.

The Water Bureau is currently working with other state water and wastewater agencies to promote and obtain signatories for an interstate mutual aid agreement called ORWARN (Oregon Water/Wastewater Emergency Response Network).

The Water Bureau, in partnership with the cities of Gresham and Fairview, implements the Columbia South Shore Well Field Wellhead Protection Program. The protection program regulates users of hazardous materials within the state-delineated groundwater protection area. This program is in place to help prevent contamination of our critical groundwater supply.

Both the Water Bureau and RWPC participate on the Regional Emergency Managers Technical Committee.

Regional Water Providers Consortium Activities

RWPC prepared a regional storage and transmission study in 1999 that identifies the importance of emergency backup supplies within the region. RWPC is currently working to assess the state of regional transmission lines and interconnections to identify gaps and explore options for strengthening our regional system. RWPC also maintains a list of regional emergency contacts.

RWPC's Emergency Planning Committee has sponsored several workshops and table-top exercises to improve water providers' readiness to respond and recover in an emergency. RWPC obtained an Urban Areas Security Initiative grant in 2007 to purchase three portable water distribution systems and has also budgeted to purchase one portable water distribution system; other water providers will also be purchasing their own systems.

1.2.3 Infrastructure Master Plan and Distribution System Master Plan

Infrastructure Master Plan

In 2001, the City of Portland prepared an *Infrastructure Master Plan* (IMP). The IMP included a summary, a background document, and a Supply and Transmission Model (STM) that was used to assess different long-range planning scenarios.

The IMP was prepared prior to the negotiation of the City's wholesale contracts. This long-term planning effort was based on assumptions about the extent of wholesale supply and early tests of the instream flow contributions necessary to protect listed fish species. The IMP was also developed, before the completion of a study on climate impacts on the Bull Run water supply (Palmer and Hahn, 2002). Water demands have been reduced since the drafting of the IMP.

As the result of these issues, the City has not fully followed the recommendations of the IMP. Instead, the City is in the process of developing a longer-term plan that may depend on potential future supply options not fully contemplated in the IMP.

To fulfill the City's obligation to provide an update of the earlier Division 86 WMCP in this plan, the current plans on future supply and the need for emergency and seasonal supply augmentation sources for the Portland system will be presented in this update.

Distribution System Master Plan

In 2007 the Water Bureau prepared a *Distribution System Master Plan*. Portland's water distribution system infrastructure—the pipelines, pump stations, tanks and other facilities—is largely unseen yet crucial to the health and well-being of the citizens of the greater Portland region. The infrastructure is vulnerable to aging, to natural disasters (e.g., earthquakes, landslides, ice storms, flooding), to vandalism, and to terrorism.

Replacing and maintaining the infrastructure is costly—the Portland Water Bureau water distribution infrastructure is valued at just under $3 billion. Over the last decade, the bureau has embarked on a series of studies and initiatives to assess the risks posed to the water system and determine how best to maintain reliable water service to residential and business customers through efficient investments. The *Water Distribution System Master Plan* provides a comprehensive look at the retail water system that serves more than 500,000 residents. The master plan addresses the hydraulic, operational and water quality issues to maintain reliable service into the future.

At the outset of the master planning process, customer service goals and project plan evaluation criteria were established for the distribution system. Next, the condition of pump stations and tanks—two significant classes of the distribution system assets —were assessed through field inspections. A risk-based metric, relating the physical condition of the assets to the consequences of deterioration was used to identify the most urgent renewal needs. A computer-based hydraulic model of the distribution was used to determine the effect of future customer demands and system performance. Based on model results, the bureau identified cost-effective ways to improve the system and provide reliable service through year 2030.

Multiple stakeholders from within the bureau participated in a facilitated process to identify stakeholder concerns and objectives, to review findings and to develop consensus on master plan decisions. Stakeholders included those with expertise in distribution system planning, design, water quality, finance, operations, and maintenance.

Based upon the distribution system master planning effort, capital projects were selected for the distribution system. Distribution improvements identified by other recent and ongoing bureau studies also were incorporated to develop a comprehensive list of recommended capital improvement projects.

1.3 Organization of this WMCP

This WMCP is organized into the four basic elements called for in OAR 690-086 on municipal water management and conservation plans:

Element 1 - Water System Description

The Water System Description comprises a description of the water sources, including the related transmission and distribution facilities, a list of the water rights for the sources, a delineation of current service areas, a description of customer characteristics (where possible), an assessment of the adequacy and reliability of the water supply, a quantification of the water delivered to the bureau's customers, and a description of accounted-for and unaccounted-for water.

Element 2 - Water Conservation

The Water Conservation Program section of this plan includes a progress report on conservation program activities since the prior WMCP; a description of current water conservation programs and activities including 5-year benchmarks; a description of the annual water audit, the meter testing and maintenance program, the rate structure for billing customers, the public education program to encourage efficient water use, the technical and financial assistance that the bureau makes available to customers, and the distribution program for residential water conservation kits.

Element 3 - Water Curtailment

The Water Curtailment section of this plan lists the type, frequency, and magnitude of the supply deficiencies for the past 10 years and a description of the bureau's tiered contingency plan for emergencies, including curtailment.

Element 4 - Water Supply

The Water Supply section of this plan includes a delineation of current and future service areas, an estimate of the supplier's demand projections, a comparison of the projected water needs and the available water sources, including conservation, interconnections, and other City water sources; and the time frame in which the bureau expects to fully exercise its water rights.

Appendixes

Material that is supplementary to the WMCP is provided in 12 appendixes. All but two of these appendixes appear behind the lettered tabs in the second half of this plan. Appendixes B and E (365 pages) are provided as electronic PDFs only. For the print version of the WMCP, these appendixes are provided on CD attached to the last page of the notebook. For all other readers, these files are provided on the PWB web site at www.portlandonline.com/water/WMCP.

Appendix A—OWRD Review and Public Comments on March 2008 WMCP

Municipal Water Management and Conservation Plan Review Worksheet from OWRD

May 1, 2008 Letter with Comments from WaterWatch of Oregon

Appendix B — Notice for Final Orders *(available on CD or PWB web site only)*

Appendix C—Executive Summary of the Bull Run Water Supply Habitat Conservation Plan

Appendix D—Wholesale Water Sales Contract

Appendix E—Additional City of Portland Well Use Data *(available on CD or PWB web site only)*

E-1. Annual Well Field Use Reports for Portland Water Bureau, Calendar Years 2004 and 2006–2008

E-2. City of Portland Groundwater Pumped for Blue Lake Refill, 2000-2009

E-3. City of Portland Annual Summary of Groundwater Pumped for UV Reactor Validation Testing, Calendar Years 2003-2009

E-4. Monthly Water Use for Portland Parks and Recreation Wells, Water Years 2004–2007

Appendix F—Conservation Program Materials

Appendix G—Evaluation of the Bathroom Kit Distribution Program

Appendix H—Summer Supply Plan 2007

Appendix I—Water Demand Forecast Methodology

Appendix J—Letters to Affected Local Governments and Water Providers Regarding

the Draft WMCP

Appendix K—Local Government Comments Regarding the Draft WMCP, January 2008

Appendix L—Literature Cited

Appendix M—Final Order from OWRD Approving the WMCP

2. Municipal Water Supplier Description

This section of the WMCP provides information about the sources and customers of Portland's water system. Subsection 2.1 provides an inventory of the sources of water and the facilities used to divert and treat the water. Subsection 2.2 is schematic of the water supply system, from the source to the distribution lines. Subsection 2.3 provides information about the water rights held by the City of Portland for municipal drinking water and the sources used by the Portland Parks & Recreation (PP&R) to irrigate parks and golf courses. Subsection 2.4 is an assessment of the adequacy and reliability of the supply. Subsections 2.5 and 2.6 comprise a description of system service area, the customers served, and a summary of water demand. Subsection 2.7 delineates the present and historical use of the water , and subsections 2.8 and 2.9 describe the transmission and distribution systems and the interconnections with other water providers.

2.1 Sources of Supply

This subsection addresses the requirements of OAR 690-086-0140 [1]: A *description of the supplier's source(s) of water; including diversion, storage and regulation facilities; exchange agreements; intergovernmental cooperation agreements; and water supply or delivery contracts*

The primary drinking water source for Portland is the Bull Run watershed, augmented by a groundwater supply from the Columbia South Shore Well Field (CSSWF) and the wells in the former Powell Valley Road Water District.[8] The Bull Run watershed is located east of Portland and just north of the western foothills of Mt. Hood; the CSSWF is south of the Columbia River and east of the Portland International Airport (see Figure 2-1). The former Powell Valley Road Water District is located in southeast Portland, near Powell Butte.

Several wells throughout the City supply non-potable water to PP&R for irrigation of public parks, golf courses, and other recreation facilities. These wells fall under the jurisdiction of PP&R but are reported in this section.

Table 2-1, in Section 2.2, Summary of Water Rights Held, provides details about the location and quantity of water diverted for use by the City of Portland.

[8] The Portland Water Bureau began serving the customers of the former Powell Valley Road District on July 1, 2005.

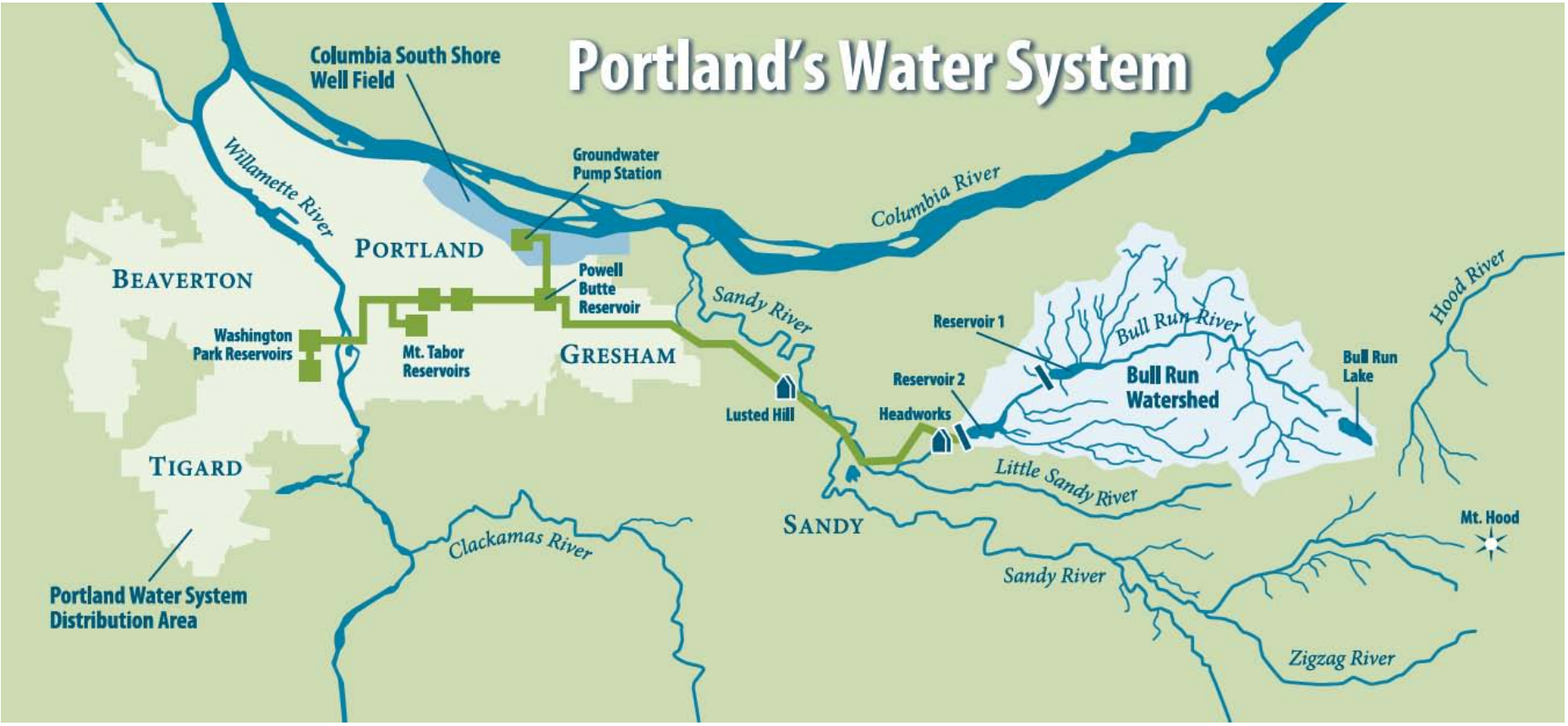


Figure 2-1. Map of the Portland Water System

The Water Bureau supplies water to its wholesale customers; the City of Portland does not receive water from any sources owned or operated by its wholesale customers. The City's water supply system is interconnected with other water suppliers including the City of Lake Oswego, the City of Milwaukie, and Clackamas River Water. Portland is able to receive water from these other sources on a limited basis for an emergency. For information on interconnections, see Table 2-22, in subsection 2.8. For a description of the regional emergency supply planning efforts, see subsections 4.2.4 and 4.2.5 and Table 4-3.

2.1.1 Bull Run Watershed

Diversion and Storage

The Bull Run watershed provides the majority of Portland's total water supply—an average of 180 billion gallons (BG) a year (measured at Headworks, river mile (RM) 5.9). The water of the Bull Run River is primarily impounded in two reservoirs: Reservoir 1, completed in 1929, and Reservoir 2, completed in 1962. Periodically, the Water Bureau relies on storage capacity in Bull Run Lake, a natural lake that is upstream of the headwaters of the Bull Run River, to enhance the supply of the two reservoirs (see Figure 2-2).

At the Headworks facility below Dam 2, the raw water is disinfected. The water then flows to the Lusted Hill facility for further treatment, and is fed by gravity to the "in-town" transmission and distribution system. The Bull Run water system includes facilities for hydropower and water treatment. The Portland Hydroelectric Project comprises hydropower facilities at Dam 1 and Dam 2 that generate electricity that the City sells to Portland General Electric (PGE).

Reservoir 1

The City relies most heavily on the storage in Reservoir 1 behind Dam 1. Bull Run Dam 1, a concrete gravity arch dam, is 195 feet high and located at river mile (RM) 11.1 (see Figure 2-2).

The reservoir behind the dam is about 4 miles long, as much as 180 feet deep, and occupies approximately 388 acres. The maximum capacity of the reservoir is 10 billion gallons—useable storage in the reservoir is approximately 7.3 BG. The surface elevation is raised in the spring by dropping gates in the spillway opening. This occurs after the winter storms are over because the gates are not sturdy enough to withstand overtopping. During the dry season, typically early July to mid-October, the City draws the reservoir down by as much as 75 feet from full pool. The surface elevation in Reservoir 1 varies between 970 and 1,045 feet above mean sea level (MSL).

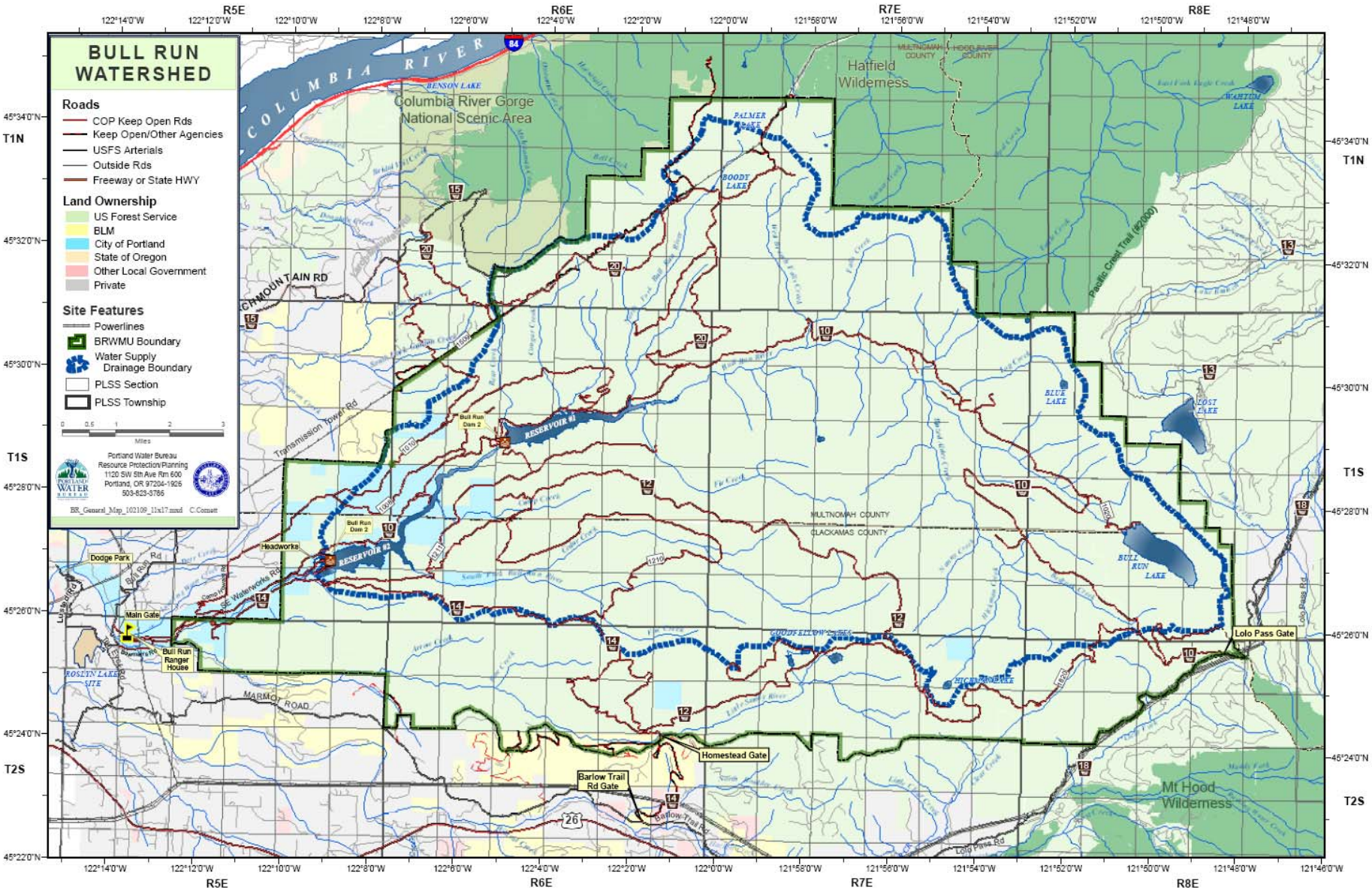


Figure 2-2. Map of the Bull Run Watershed Management Unit

Dam 1 has two intake structures that allow selective withdrawal at different water elevations in the reservoir.[9] The City can use the intake structures to withdraw the coldest water from the bottom of Reservoir 1 to flow into Reservoir 2. Water passes Dam 1 in one of three ways: through the penstocks in Powerhouse 1, through needle valves at the bottom of the dam, or over the spillway. Most of the time, water flows through the powerhouse. The needle valves are infrequently used. Water flows over the spillway during the few large winter storms that exceed the capacity of the powerhouse.

Reservoir 2

Dam 2 is an earthfill dam, located at RM 6.5 (see Figure 2-2). Reservoir 2, behind the dam, is about 4.5 miles long, as much as 130 feet deep, and occupies 443 acres. The maximum capacity of the reservoir is 6.8 billion gallons—usable storage of the reservoir is approximately 2.6 BG.

Water is withdrawn from elevations close to the bottom of Dam 2 at two intake towers, north and south. Water passes from the reservoir to Headworks or the diversion pool in one of four ways:

- through the north tower to the penstocks and Powerhouse 2 into the diversion pool
- through the north tower to the north Howell-Bunger valves into the diversion pool
- through a pressure-reducing valve (PRV) from the south intake tower directly into Headworks (bypassing the diversion pool)
- over the spillway bypass into the lower river

Water in the diversion pool is directed through the Headworks facility and into the transmission system, or it flows over the diversion dam into the lower Bull Run River.

The Bull Run is an unfiltered water supply. For this reason the Water Bureau attempts to keep the reservoir behind Dam 2 as full as possible throughout the year, including the summer months. The surface elevation varies between 840 and 860 feet above MSL. This strategy allows for upstream turbidity to dilute and settle out before the water is diverted for water supply.

Bull Run facilities related to Dam 2 include a spillway structure that allows winter storm flows to bypass Dam 2, a diversion dam below Dam 2, and a rock weir and pool below the spillway. At Headworks, the water is screened to remove debris, and chlorine is added to the water supply for disinfection. Operators staff the Headworks facility 24 hours a day/seven days a week.

Throughout the summer months, after drawdown of the storage reservoirs is sustained (when demands exceed inflow to the reservoirs, thus drawing them down), part of the summer supply is inflow into the reservoirs from the upper tributaries of the Bull Run River system.[10] This inflow averages to about 8.5 BG of the overall supply provided for fish flows or for municipal use in any given year.

[9] One intake structure is for the powerhouse and one intake structure is for the needle valves.

[10] Typically, drawdown starts after June 15.

Bull Run Lake

A natural lake upstream of the headwaters of the Bull Run River, Bull Run Lake is a supplemental water supply that may be used in unusually dry years. The lake is approximately 1.5 miles long and 0.5 mile wide and 273 feet deep at full pool, although the mean depth of the lake is 98 feet deep. Total storage of the lake is estimated at 14.8 billion gallons (BG); usable storage capacity is estimated at 4.3 BG.

The City maintains a small dam at Bull Run Lake that raises the level of the natural lake approximately 10 feet. Because Bull Run Lake is formed in part by a porous landslide, its surface elevation declines during the summer as water seeps through the landslide and emerges as springs to form the headwaters of the Bull Run River.

The provisions of a 1997 easement with the U.S. Forest Service restricts the available capacity of Bull Run Lake through requirements that create incentives to limit the volume available, the timing of use, and the mitigation requirements for releases that limit the lake's refill the following spring. The mitigation requirements allow for pumping with a minimum allowable lake elevation of 3140 feet—minimum annual lake levels may be below 3148 feet for no more than two years in the 20-year authorization and must be above 3148 feet for at least 18 years of the 20-year authorization.

The bureau's seasonal *Water Supply Augmentation and Contingency Plan* includes an allotment of up to 0.7 billion gallons (BG) of water from Bull Run Lake under normal circumstances, and up to an additional 1.8 BG of supply if conditions warrant voluntary curtailment for customers.

Water Treatment Facilities

Water from the Bull Run is diverted from the river at the Headworks facility, immediately downstream of Dam 2. At Headworks, the raw water is disinfected with chlorine. After leaving Headworks, the water flows 10 miles west to the Lusted Hill treatment facility, where the Water Bureau adds ammonia to form chloraminates to sustain the disinfection capability of the chlorine and sodium hydroxide for corrosion control.[11] From the Lusted Hill facility, the water flows approximately 11 miles downhill to Powell Butte, a 50-million-gallon underground reservoir. A schematic diagram of the water supply system is available in Section 2.2, System Schematic.

Hydropower Facilities

The City owns hydropower facilities that generate electricity at the two Bull Run dams. These facilities, under the title of the Portland Hydroelectric Project, are licensed by the Federal Energy Regulatory Commission (FERC) as FERC Project No. 2821. The Portland Hydroelectric Project (PHP) is operated under a long-term power sales agreement by Portland General Electric (PGE). The facility at Dam 1 (PHP Powerhouse 1) has an installed capacity of 24 megawatts. The facility at Dam 2 (PHP Powerhouse 2) has an installed capacity of 12 megawatts. Electric power generated by these facilities is sold directly to PGE. The City's current FERC license is valid until 2029.

[11] Sodium hydroxide is added at a rate sufficient to meet a target pH (typically in the range of 7.8-8.0) in order to reduce corrosion. Corrosion treatment began in 1997 to comply with the Environmental Protection Agency's (EPA's) Lead and Copper Rule of 1991.

Regulations Affecting the Use of Bull Run Water

Three regulations affect the use of Bull Run River water: the Surface Water Treatment Rule and enhancements, the Endangered Species Act, and the Clean Water Act.

Surface Water Treatment Rule and Enhancements

The Surface Water Treatment Rule The Surface Water Treatment Rule (SWTR), adopted by the Environmental Protection Agency in 1990, is a federal regulation that requires all drinking water systems in the nation drawing from surface water or groundwater under the direct influence of surface water to meet specific, measurable water treatment standards. Portland's main water supply sources, the Bull Run reservoirs, are surface water supplies and are subject to this rule.

Enhancements to the Surface Water Treatment Rule. In 1998, 2002, and 2005, EPA published enhancements to the SWTR, establishing maximum contaminant goals for several contaminants and requirements that include inspections, watershed control, additional reporting, treatment, and coverage of open reservoirs. EPA has granted filtration avoidance waivers to Portland and other unfiltered systems under the condition that Portland's water continue to meet the source water protection and water treatment standards of the SWTR.

Portland has been able to consistently meet the criteria of the SWTR, but it occasionally has to shut down the Bull Run system and operate from its back up groundwater supply when storms and other natural disturbances in the Bull Run reservoirs increase the turbidity—the amount of suspended sediments—in the water.[12] Modifications made to the water treatment regime in 1991 and the ability to use the CSSWF during events that affect the turbidity of the Bull Run system enabled Portland to remain in compliance with the regulations of the SWTR until November 2007 when a federal court of appeals rejected the City's request regarding the latest enhancement, the Long Term 2 Enhanced Surface Water Treatment Rule (LT2).

Long Term 2 Enhanced Surface Water Treatment Rule (LT2). On January 5, 2006, EPA issued changes to treatment requirements for unfiltered systems in its LT2 ruling. The rule requires unfiltered systems to provide additional treatment that inactivates or removes the protozoan parasite, *Cryptosporidium.* The rule also requires that open finished drinking water reservoirs either be covered or equipped with treatment facilities to remove or inactivate *Cryptosporidium*, *Giardia* and viruses. In February of 2006, the City of Portland filed a legal challenge to the final rule to seek alternative compliance options that would allow the City to avoid these treatment requirements.

On November 6, 2007, the Washington D.C. District Court of appeals rejected Portland's request to invalidate the LT2 requirements for surface water treatment in unfiltered drinking water systems and for open reservoirs. The City is now preparing to pursue a variance from these requirements directly with the federal EPA with the purpose of obtaining alternate means of compliance with the rule.

Simultaneous to pursuing a variance, the City is also preparing to develop plans and construct infrastructure to achieve compliance with the LT2 rule. Should Portland ultimately fail to obtain an alternative means of compliance with the rule through its variance

[12]The Surface Water Treatment Rule requires that the City not serve drinking water exceeding a turbidity level of 5 nephelometric turbidity units (NTU).

application, the first substantive deadline the City would need to comply with is submission of a state-approved plan by April 1, 2009. The plan would describe the City's intended actions to bring the City's five open reservoirs into compliance with the rule. Compliance with the source water treatment portion of the rule, which would require construction of a new water treatment facility, would be required by April 1, 2012 with the possibility of extension to April 1, 2014. Several alternative approaches could be used to meet the source water treatment requirement including ultra-violet light disinfection (UV), ozone disinfection, direct filtration and membrane filtration. The open reservoir portion of the rule would require the facilities to be either covered, buried or have one of the treatment regimes mentioned above installed at the outlets of the reservoirs.

Endangered Species Act

The Bull Run River provides habitat for several species of anadromous fish. Since 1998, four fish species that use the Bull Run River have been listed as threatened under the federal Endangered Species Act (ESA): the fall and spring races of Lower Columbia River Chinook salmon *(Oncorhynchus tshawytscha)*, Lower Columbia River coho salmon *(O. kisutch)*, Columbia River chum salmon *(O. keta)*, and Lower Columbia River steelhead *(O. mykiss)*.

The Water Bureau is preparing the draft *Bull Run Water Supply Habitat Conservation Plan* (HCP) that describes measures to meet the criteria for an Incidental Take permit to be issued by the National Marine Fisheries Service (NMFS), the agency with jurisdiction over anadromous fish (Portland Water Bureau 2007c). The bureau hopes to have the HCP approved by the City Council and by NMFS in 2008. The Executive Summary of the HCP appears as Appendix C of this WMCP.

Clean Water Act

The Oregon Department of Environmental Quality (ODEQ) is responsible for ensuring that bodies of water in Oregon comply with the criteria designated in the federal Clean Water Act. ODEQ's responsibilities are to determine whether water quality standards are being violated and whether the beneficial uses of the waters are impaired.

In 2005, ODEQ completed a *Total Maximum Daily Load* (TMDL) assessment and report for the Sandy River Basin—the area in which the Bull Run is located (ODEQ, 2005). ODEQ found the water in the lower Bull Run River (RM 0–RM 5.8) to be "water quality limited" with regard to the designated beneficial use as "core cold-water habitat" for salmonids.[13]

The Water Bureau has prepared a *Draft Temperature Management Plan* (TMP) for the lower Bull Run River. The TMP includes riparian forest protections, management measures for the temperature of the water, and measures to control the amount of flow released to the lower Bull Run River especially during the summer peak season. These measures are included in the draft HCP described above. The Water Bureau will submit the TMP to ODEQ for approval in 2008.

[13]Core cold-water habitat is defined as "waters that are expected to maintain temperatures within the range generally considered optimal for salmon and steelhead rearing…during the summer" [OAR 340-041-0002(13)].

2.1.2 Columbia South Shore Well Field

The Columbia South Shore Well Field (CSSWF) is the second-largest developed water source in the state, and the largest developed groundwater source. Located on the floodplain of the Columbia River northeast of downtown Portland, this eleven-square-mile area spans the boundaries of three cities: Portland, Fairview, and Gresham.

The wells in the well field provide water when the Bull Run supply is shut down due to emergency conditions such as turbidity events, landslides, fires, or human-caused disruptions. The groundwater system is a source of seasonal supply augmentation when the Bull Run supply cannot provide enough water to meet demands during the summer peak season.

Diversion and Storage

As of December 2007, there are 26 active wells in the CSSWF.[14] The wells draw on three aquifers: the Sand and Gravel Aquifer (SGA); the Troutdale Sandstone Aquifer (TSA), and the Blue Lake Aquifer (BLA). The sum of the nominal instantaneous pumping capacity for all of the active wells is approximately 103 to 118 million gallons a day (MGD), based on the maximum pumping rates of the individual wells. In use, the well field has an empirically determined initial 30-day operating capacity of approximately 102 MGD.

A 112-MGD pump station is equipped with six main pumps and two jockey pumps. This pump station moves the water 4.5 miles south and approximately 475 feet uphill to the City's Powell Butte Reservoir, where it is mixed with Bull Run water (unless the Bull Run supply is off-line).

Figure 2-3 is a map of the well field. Table 2-1 lists each well by number, location, the aquifer each well pumps, the well depth, screen interval, diameter, installed pumping capacity, and other production data.

[14]Well 17 is a 27th well, not counted among the 26 active production wells because it is rarely used due to high manganese concentrations in the aquifer.

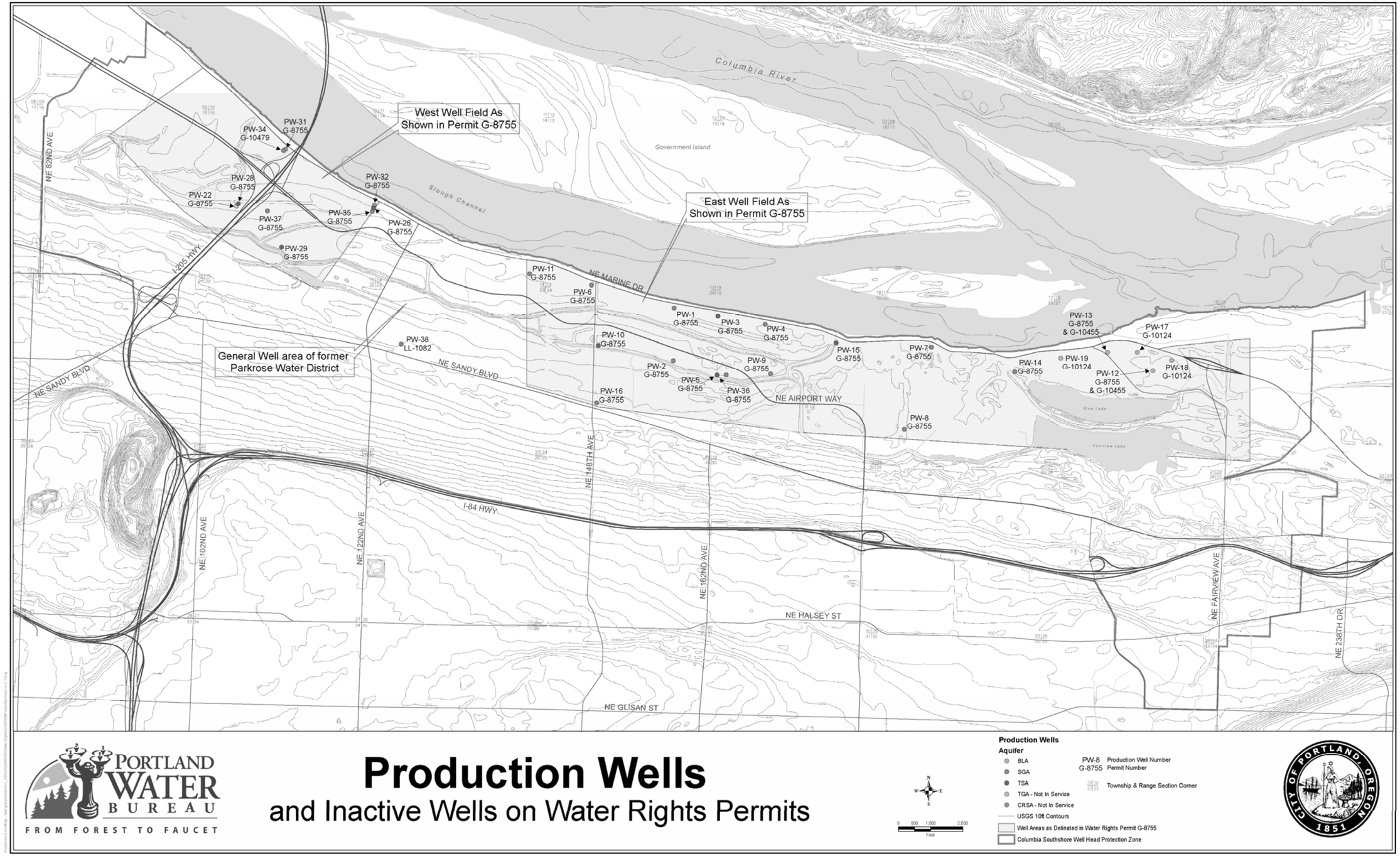


Figure 2-3. Map of the Columbia South Shore Well Field

Table 2-1. CSSWF Production Well Data

Well Number	Location T/R/S[a]	Aquifer	Drilled Depth (ft)	Top Screen Depth, ft.	Bottom Screen Depth, ft.	Nominal Screen Diam., in.	Nominal Well Capacity, gpm[b,c]	Pump Rating, gpm/TDH[d]	Specific Capacity gpm/ft[e]
1	1N/2E/24	SGA[f]	531	398	513	10	3,000	2300/423	17.0
2	1N/2E/24	SGA	538	453	504	12	3,400	2400/419	19.9
3	1N/3E/19	TSA[g]	317	238	287	12	1,150	1000/224	—
4	1N/3E/19	SGA	534	369	523	12	2000	2500/387	23.5
5	1N/3E/19	TSA	340	243	327	12	1,100	1000/256	—
6	1N/2E/13	SGA	568	485	559	12	3200	3000/490	15.8
7	1N/3E/20	SGA	450	325	430	12	1750	1500/341	—
8	1N/3E/20	SGA	450	345	440	12	1550	1500/347	11.5
9	1N/3E/19	SGA	495	376	485	12	2400	2500/397	32.3
10	1N/2E/24	TSA	375	282	365	12	1,950	1500/305	—
11	1N/2E/14	SGA	585	493.25	572.75	12	3200	3000/521	—
12	1N/3E/21	BLA[h]	123	60	118	22	4,500	5000/153.5	277
13	1N/3E/21	BLA	169	85	165	31.5	7000	7500/209	476
14	1N/3E/20	SGA	361	260	352	12	1,700	2000/264.5	—
15	1N/3E/19	TSA	287	195	278	12	1,200	1000/194	6.7
16	1N/2E/24	SGA	560	440	550	12	3,100	3000/450	—
17b[i]	1N/3E/21	BLA	165	80	160	31.5	3,000	3000	—
18	1N/3E/21	BLA	193	88	190	31.5	7000	7500/233	227
19	1N/3E/21	BLA	118	55	113	31.5	7000	7500/162	649
26	1N/2E/15	TSA	457	337	411	10	1,600	1500/259	—
28	1N/2E/15	TSA	431	375	421	10	2,000	2000/	20
29	1N/2E/15	TSA	457	377	438	10	1,000	1000/344	—
34	1N/2E/15	SGA	667	480	657	12	3,000	3000/440	20

Table 2-1. CSSWF Production Well Data

Well Number	Location T/R/S[a]	Aquifer	Drilled Depth (ft)	Top Screen Depth, ft.	Bottom Screen Depth, ft.	Nominal Screen Diam., in.	Nominal Well Capacity, gpm[b,c]	Pump Rating, gpm/TDH[d]	Specific Capacity gpm/ft[e]
35	1N/2E/15	SGA	624	480	609	12	2,800	2800/450	17
36	1N/3E/19	SGA	521	398	511	12	3,000	3000/334	35
37	1N/2E/15	SGA	623	493	609	12	3,500	3500/370	36
38	1N/2E/23	SGA	635	515	613	12	2,750	2500/475	14
Total							75,850[i,j]		

Source: Well Data SS.040406 PE update.xls

— data not available

[a]T/R/S – Township, range, section

[b]gpm – gallons per minute

[c]The nominal well capacity totals are unlikely to be reached with all wells running due to interference and pipeline capacity.

[d]TDH – total dynamic head, feet

[e]ft –feet

[f]SGA sand and gravel aquifer

[g]TSA Troutdale sandstone aquifer

[h]BLA Blue Lake aquifer

[i]Well 17 is rarely used due to high manganese concentrations in the aquifer. It is a 27th well, not counted among the 26 active production wells nor is its nominal well capacity included in the total capacity of all wells in the last record of this table.

[j]Note that the sum of the nominal well capacity of 75,850 gpm is more than the empirically determined initial 30-day operating capacity of approximately 102 MGD (which equals 71,105 gpm).

Aquifer Storage and Recovery

The bureau tested the use of aquifer storage and recovery (ASR) using four SGA wells under a Limited License pilot-testing permit issued by the Oregon Water Resources Department (OWRD). The bureau conducted a feasibility study in 2000, received its Limited License from OWRD and completed the necessary well field infrastructure in 2001. Injection of Bull Run water into the SGA aquifer occurred in 2002, 2003, and 2004.

In August 2006, the bureau voluntarily cancelled its Limited License after the program was stopped at request of the City Commissioner-in-Charge. The final step in the pilot testing program would have been to install and test a stand-alone injection well at the groundwater pump station site.[15]

Contamination and Remediation

Anthropogenic contamination was first discovered in shallow groundwater aquifers near the well field in the 1980s. Since the early 1990s, the City has worked closely with the Oregon Department of Environmental Quality (ODEQ) to expedite the discovery, assessment, and remediation of contaminant sources and plumes, and to keep the well field operational. Remediation technologies used to remove contaminants from soil and groundwater include pump-and-treat, soil vapor extraction, electro-resistive heating, air sparging, and in-situ chemical and biological treatment.

An extensive multi-aquifer monitoring well network is used by the bureau to track changes in groundwater levels and groundwater quality over time. Data from City groundwater quality monitoring indicate that the primary deep confined aquifers are free of contamination within the capture zones of active wells.

Groundwater Protection Program

The City's original Groundwater Protection Program, implemented in 1987, covered the six-square-mile Columbia South Shore Plan District Area. In 2000, the City began a planning process to strengthen and improve the original plan.

The Groundwater Protection Program that was adopted in July 2003 replaced existing programs in Portland and Fairview and initiated requirements for groundwater protection in Gresham. The new program improved upon the original program by

- expanding the protection area boundary to reflect a 30-year time-of-travel `
- extending the protection regulations to existing businesses within the area boundaries
- incorporating an inspection, enforcement, and reporting component
- changing the requirements for affected businesses operating within that boundary to make the regulations compatible with the sections of the Uniform Fire Code that govern use, storage, and transportation of hazardous material

[15]Stand-alone injection wells were determined to be necessary for ASR due to the cumulative progressive loss of specific capacity in all of the production wells that had been used for ASR test injections. The loss of capacity was believed to have been the result of low levels of turbidity present in the Bull Run water used as the source water.

The Groundwater Protection Program requires businesses that use, store, or transport hazardous material above a certain threshold amount to implement best management practices to prevent spills on the ground.[16]

The Water Bureau relies on the well field for summer supply augmentation and as an emergency backup supply when the Bull Run surface water supply is unavoidably limited or unavailable. The well field infrastructure represents supply capacity already in place and ready to use. Other water-supply options of similar capacities will not be available until demand (as moderated by conservation programs) grows enough to enable financing and construction of new storage or supply. Given uncertainties about future per capita demand, the pace of urban growth, future wholesale water customer behavior, requirements to provide instream flows for fish, and changes in weather or climate patterns, the City anticipates a continuing need for the groundwater system to meet its responsibilities to customers.

2.1.3 Former Powell Valley Road Water District Wells

On July 1, 2005, the City annexed the Powell Valley Road Water District (PVRWD) in southeast Portland, northwest of Powell Butte. The City took over all of the district's assets under an intergovernmental agreement. The PVRWD assets included water rights and water infrastructure.

The installed capacity of the Powell Valley wells can be as much as 8.6 MGD, however less than half of this capacity is currently available. Several capital improvement projects are planned to repair various facilities and fully integrate the wells into the Water Bureau system. These projects may be completed in three to ten years.

Two of the wells in PVRWD were developed in the 1960s by the older Gilbert Water District. The water rights for these wells were perfected in 1963 for 2.67 cfs. The Water Bureau is evaluating these wells to determine how best to use them in the future.

PVRWD obtained a groundwater permit in 2000 for wells at a new site, and subsequently developed four of the eight wells applied for. These wells account for a total of 6 MGD out of the 9.23 MGD listed in the right. These wells are located at SE Center Street near the 144th Avenue alignment in the Vivian well field.

The wells were put to beneficial use for a period of four years within the service territory of the old PVRWD. The Water Bureau is studying the wells, instrumentation, treatment, and booster pumps of the former PVWRD to best plan future integration and use. The bureau intends to utilize these wells as part of the seasonal supply augmentation system, and for emergencies, but will need to develop more improvements to the current piping system in order to blend the Gilbert and Vivian well water with water from other sources at Powell Butte.

Data for the six active production wells are shown in Table 2-2. Figure 2-4 is a map showing the locations of the wells.

[16] Best Management Practices (BMPs) are schedules of activities, maintenance procedures, and structural and/or managerial practices that, when used singly or in combination, prevent or reduce the release of hazardous materials or fuel to the groundwater of the wellhead protection area.

Table 2-2. Former Powell Valley Road Water District Wells

Well number	Location T/R/S[a]	Aquifer[b]	Depth Drilled (feet)	Casing Size (inches)	Screen Interval	SWL[c] (feet bgs)[d]	Capacity (gpm[e])	Specific Capacity[f] (gpm/ft)	Comments
Gilbert Well Field									
3	1S/2E/11	TGA	410	12-inch	Perf. 192-196, 210-215, 275-278, 285-291	40	615	4	Troutdale well—no seal between UG and Troutdale formation
4	1S/2E/11	UGA	104	12-inch	Perf. 65-74, 75-85	40	765	191	UG well—partial penetrated well
Vivian Well Field									
6	1S/2E/12	TGA	477	10-inch casing 5-inch liner	Screen 180-185, 190-244, 286-348, 357-368	43	500	41.6	Vivian TGA well—Sealed between UG and TGA at 146-189 ft bgs
7	1S/2E/12	TGA	512	16-inch to 200 ft, 10 to TD[g]	Multiple Frm 190-491 ft.	40	1000	26	TGA well—need seal information
8	1S/2E/12	UGA	194	16-inch	Screen 93-185	42.1	800	26.7	Vivian UG production—Well with high initial yield estimate
9	1S/2E/12	UGA	183	16-inch to 67, 14-inch to TD	Screen 67-92, 93-124, 143-174	42.1	3000	3000	Vivian UG production—Well with high initial yield estimate

Data source: Groundwater Solutions Powell_Valley_Wells.xls

[a]T/R/S—Township, range, section

[b]TGA is Troutdale Gravel Aquifer; UGA is the Upper Gravel Aquifer

[c]SWL—static water level

[d]bgs—below ground surface

[e]gpm—gallons per minute

[f]Test duration unknown

[g]TD—total depth

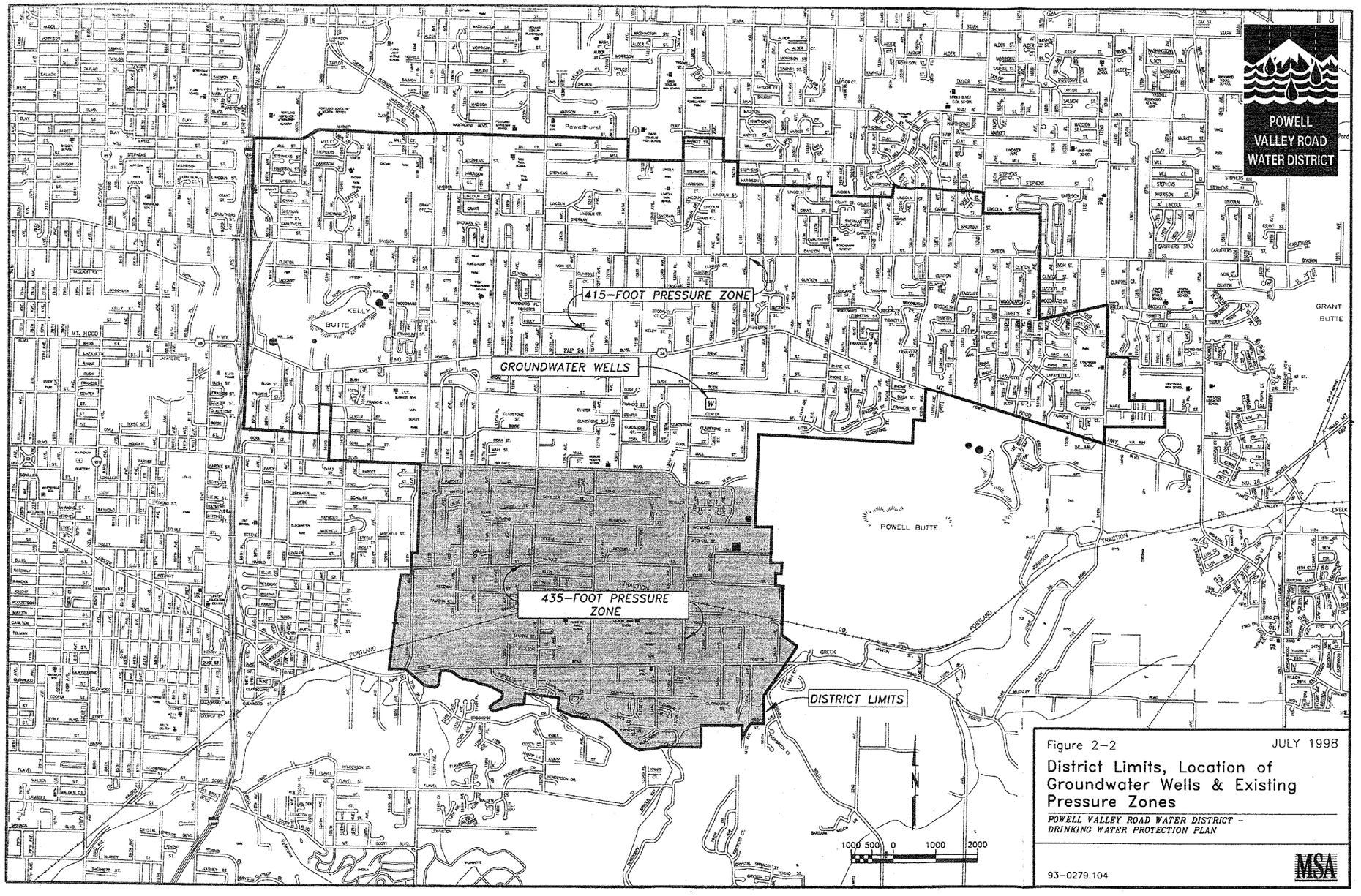


Figure 2-4. Map of Former Powell Valley Road Water District Wells

Wellhead Protection Program

The Powell Valley Road Water District Drinking Water Protection Program was created in 1998 to establish drinking water protections for the Powell Valley Road Water District groundwater wells in accordance with Oregon Administrative Rules (OAR) 340-40-140-210 and OAR 333-61-020, -050, -051, and -065. The program delineates a drinking water protection area (DWPA) using a minimum time of travel of 10 years for groundwater to reach the wells.

Currently, the DWPA comprises residential lands, park lands (Powell Butte Park, which includes the City's underground reservoir), and commercial or industrial land. The program presents management strategies for each of the major land uses. The strategies involve

- outreach to residents to increase public awareness of household and residential contaminants
- mitigation of potential sources of contamination, including hazardous materials spills and sump drain contaminants
- development of an outreach and education campaign to businesses regarding ODEQ programs for preventing groundwater contamination
- development of a business partners program to recognize business owners and operators that reduce the potential for groundwater contamination

With the assumption of operation of the PVRWD wells, the City of Portland has identified a work task to update its wellhead protection program to include the PVRWD wells. This will require updating the PVRWD delineation and applying the Water Bureau's regulations to the new delineated area. The anticipated date for the implementation of the updated wellhead protection program is sometime in 2008.

2.2 System Schematic

This subsection addresses the requirements of OAR 690-086-0140 [8]: A schematic of the system that shows the sources of water, storage facilities, treatment facilities, major transmission and distribution lines, pump stations, interconnections with other municipal supply systems, and the existing and planned future service area

The schematic diagram on the following page shows the sources of water, storage facilities, treatment facilities, major transmission and distribution pipelines, and pump stations for the existing system.

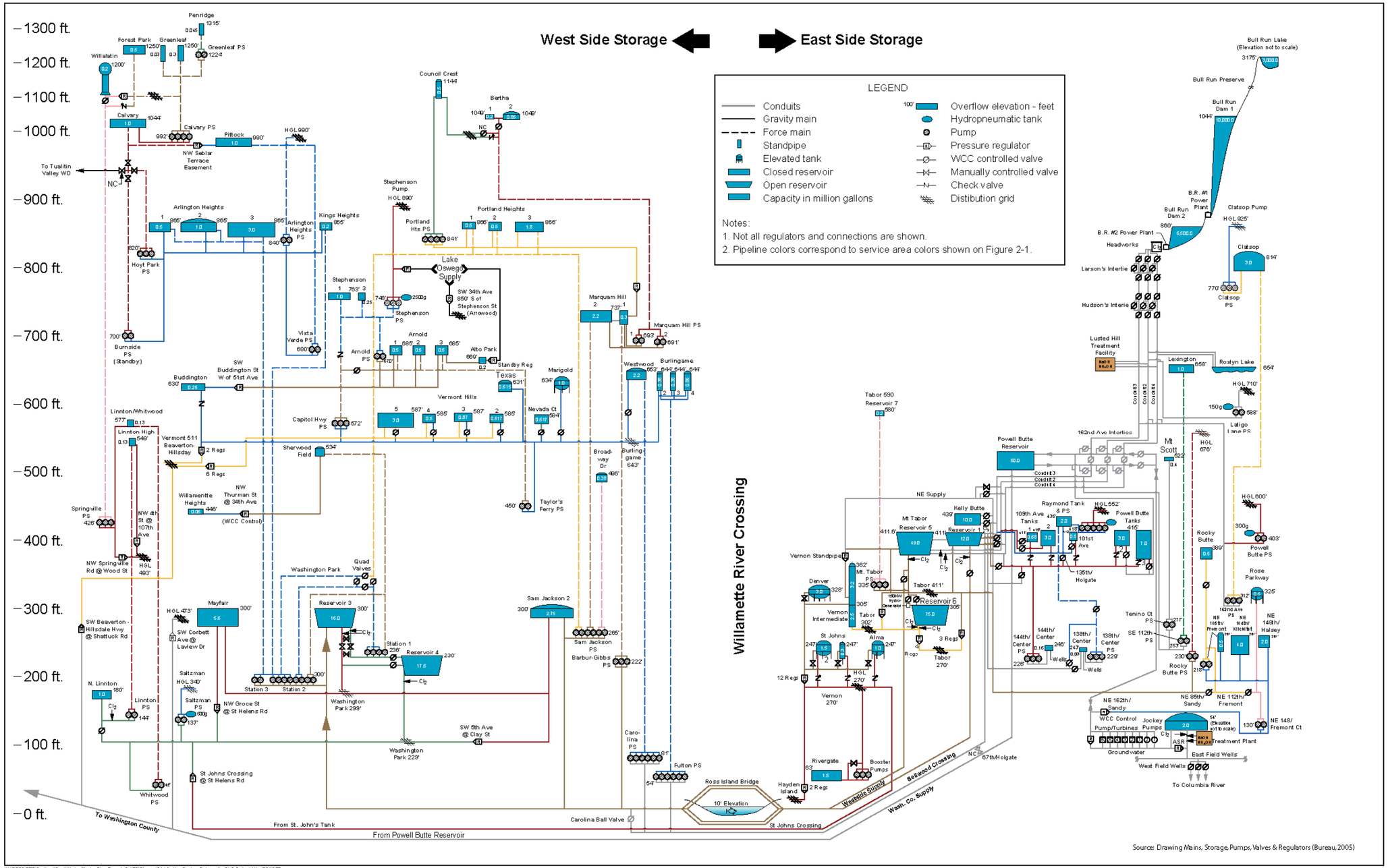


Figure 2-5. City of Portland Water Supply Schematic Diagram

2.3 Summary of Water Rights Held

This subsection addresses the requirements of OAR 690-086-0140 [5]: A tabular list of water rights held by the municipal water supplier that includes the following information: application, permit, transfer, and certificate numbers (as applicable); priority date(s); source(s) of water; type(s) of beneficial uses specified in the right; maximum instantaneous and annual quantity of water allowed under each right; maximum instantaneous and annual quantity of water diverted under each right to date; average monthly and daily diversions under each right for the previous year, and if available for the previous five years; currently authorized date for completion of development under each right; and identification of any streamflow-dependent species listed by a state or federal agency as sensitive, threatened or endangered that are present in the source, any listing of the source as water quality limited and the water quality parameters for which the source was listed, and any designation of the source as being in a critical ground water area.

The City of Portland holds water rights for several locations and types of beneficial use. The Water Bureau holds rights for municipal potable water supply and electricity generation. PP&R holds rights for sources throughout the city for its grounds and facilities. In fulfillment of OAR 690-086-0140 section 5, this subsection reports on water rights held by both the Water Bureau and by PP&R.

The Water Bureau holds surface water rights for municipal water supply in the Bull Run River, the Little Sandy River, and the Willamette River, and rights in the Bull Run River for the generation of electricity. The Water Bureau holds groundwater rights in the Columbia South Shore Well Field (CSSWF), in the former Powell Valley Road Water District (PVRWD), and in several other areas for small unused wells. PP&R has water rights in several locations in the Portland area, primarily to supply water for irrigation of several parks and golf courses.

The City's statutory rights for the use of the Bull Run and Little Sandy Rivers are senior to all rights or claims other than those unadjudicated pre-1909 claims of Portland General Electric (PGE) for hydroelectric power on the Little Sandy River. PGE claims a priority date of 1907. The City has also made a pre-1909 claim for Little Sandy water with a priority date of 1892. In 2008, PGE is scheduled to decommission the Little Sandy Dam on the Little Sandy River, and transfer its hydroelectric water rights to the Oregon Water Resources Department as instream flow rights. The City has proposed, as part of the draft *Habitat Conservation Plan* (HCP) to forego any consumptive use of the Little Sandy River under either its 1892 claim or its 1909 statutory rights for the 50-year term of the HCP (Portland Water Bureau 2007c).

Table 2-3 lists the water rights held by the Water Bureau and PP&R by application, permit, and/or certificate number; priority date; source; type of beneficial use; maximum instantaneous quantity allowed; maximum instantaneous quantity diverted or produced; completion date; limitations on use; and location of the point of diversion.

Table 2-3. Water Rights Held by the City of Portland

Water Bureau Rights													
						Quantity of water (cfs unless noted)							
						Maximum instantaneous							
Application Number	**Permit Number**	**Certificate Number**	**Priority Date**	**Source**	**Use[a]**	**Allowed**	**Diverted**	**2006 Annual**	**Authorized date for completion of development**	**Use Limitations**	**Twp**	**Range**	**Section**
Surface water													
None		ORS 538.420	2/24/1909	Bull Run and Little Sandy rivers	M	Full flow	See below		N/A	See Regulations Affecting the Use of Bull Run Water in Section 2.1.1 for more information on streamflow-dependent species and water quality limitations[b]	See below		
Water right claim		SWR-390	8/6/1886	Bull Run River	M	Full flow	172		N/A	Same	1S	5E	25
Water right claim		SWR-391	6/17/1892	Little Sandy River	M	Full flow	None	None	N/A	Same	2S	5E	10
Water right claim		SWR-392	1884 1891	Willamette River	M	10 MGD 18 MGD	None	None	N/A	Not relevant[c]	1S	1W	35
S-57057	S-43857		02/07/1978	Bull Run River	E	2000			01/17/1982	Reservoir level fluctuation limited to 1,034 feet above mean sea level (MSL) and spillway crest	1S	6E	16
S-57056	43856		02/07/1978	Bull Run River	E	1500			12/31/1981	Reservoir level fluctuation limited to 1,034 feet above MSL and spillway crest	1S	5E	26

Table continued on next page.

Table 2-3. Water Rights Held by the City of Portland

						Quantity of water (cfs unless noted)							
						Maximum instantaneous							
Application Number	**Permit Number**	**Certificate Number**	**Priority Date**	**Source**	**Use[a]**	**Allowed**	**Diverted**	**2006 Annual**	**Authorized date for completion of development**	**Use Limitations**	**Twp**	**Range**	**Section**
Water Bureau Rights													
Groundwater[d]													
G-11354	G-10479		03/01/1985	CSSWF	M	8.4	4.75	140.65 MG	See subsection 5.2 of this report for information.	None	1N	2E	15
G-10906	G-10124		03/25/1983	CSSWF	M	100	62.04	1,065.61 MG		None	1N	3E	21
G-7578	G-8755		11/12/1976	CSSWF	M	390	147.08	3,519.19 MG		None	1N	3E	20
G-11306	G-10455[a]		08/17/1984	CSSWF	M	16.7	0	0		None	1N	3E	21
G-2156	G-2093[a]		11/8/1961	CSSWF	M	15.5	8.36	None		None	1N	2E	23
G-10566	G-9772		10/5/1981	Hazelwood Wells	QM	3.56	None	None	N/A	N/A	1N	2E	34
G-7446	G-6940		7/22/76		M	4.4	None	None	N/A	N/A	1N	2E	34
G-5966	G-5658	67340	12/29/72	Hayden Island Wells	GD, CM	1.1	None	None	N/A	N/A	2N	1E	34
G-5967	G-5659	67341	12/29/72		GD, CM	2.23	None	None	N/A	N/A	2N	1E	34
G-5678	G-5498	67339	12/01/71		GD, CM	4.45	None	None	N/A	N/A	2N	1E	33
G-8595	G-7954	67342	12/29/77		QM	1.19	None	None	N/A	N/A	1N	1E	3
G-2219	G-2043	35676	1/31/62	Alto Park Well	M	0.33	None	None	N/A	N/A	1S	1E	32
G-1431	G-1313	33195	4/03/59	Richland Wells	M	1.0	None	None	N/A	N/A	1N	2E	26
G-3354	G-3148	35594	1/26/66		QM	0.22	None	None	N/A	N/A	1N	2E	26
G-2606[c]	G-2421[c]	35779	5/01/1963	Former PVRWD Wells	M	2.67	2.67	None	N/A	None	1S	2E	11
G-15095[c]	G-14007[c]		2/28/2000		M	14.3	9.6 cfs	None	See subsection 5.2 of this report	None	1S	2E	12

Table continued on next page.

Table 2-3. Water Rights Held by the City of Portland

						Quantity of water (cfs unless noted)							
						Maximum instantaneous							
Application Number	**Permit Number**	**Certificate Number**	**Priority Date**	**Source**	**Use[a]**	**Allowed**	**Diverted**	**2006 Annual**	**Authorized date for completion of development**	**Use Limitations**	**Twp**	**Range**	**Section**
Portland Parks & Recreation Rights													
G-7140	G-6590	50730	10/23/75	Argay Park Wells	IR	0.11	0.19	6.23 acre feet (ac ft)	See subsection 5.2 of this report	None	1N	2E	23
G-16340	G-15899	82083	11/10/04	Cathedral Park Wells	M	0.56	0.71	8.53 ac ft		None	1N	1W	12
G-2304	G-2124	41717	04/23/62	East Delta Park Wells	IR	1.08	1.78	47.83 ac ft		None	1N	1E	3
S-41283	S-30829	82102	08/26/65	Eastmoreland G.C. Surface Water[e]	IR	1.24	1.60	90.58 ac ft		None	1S	1E	24
G-4886	G-4601	44646	05/20/69	Heron Lakes G.C. Wells	IR	1.37	3.77	112.62 ac ft		None	1N	1E	5
G-16387	G-16140		02/11/05		IR	1.11	0.61	230.01 ac ft		None	1N	1E	4
G-15980	G-15580	81283	04/14/03	Kelly Point Park Wells	M	0.45	0.52	10.28 ac ft		None	2N	1W	24
G-12139	G-11415	81315	06/07/90	Laurelhurst Park Wells	IR	0.36	0.58	6.57 ac ft		None	1N	1E	36
G-14132	G-13077	81167	07/20/95	Lents Park Wells	IR	0.45	0.66	27.03 ac ft		None	1S	2E	16
R-69704	R-11233	81311	09/02/88	Oaks Bottom Wildlife Refuge Surface Water	WI		—[f]	—		None	1S	1E	14
R-69704	R-11233	81311	10/19/88		WI					None	1S	1E	14
S-69705	S-51018	81312	09/02/88		WI	0.70				None	1S	1E	14
G-16195	G-15869		02/25/04	Parklane Park Wells	M	0.56	—	—		None	1S	2E	1
G-15866	G-15690		10/31/02	Portland International Raceway Wells	M	2.67	1.50	21.14 ac ft		None	1N	1E	4
G-2456	G-2272	81471	09/26/62	Redtail G.C. Wells and Surface Water	IR	1.34	2.01	110.60 ac ft		None	1S	1W	26
R-80117	R-11635	81472	03/13/95		IR/S					None	1S	1W	26
S-80118	51944	81473	03/13/95		IR	1.34		—		None	1S	1W	26
G-4015	G-3767	80592	08/02/67	Rose City G.C. Wells and Surface Water	IR	0.29	1.44	9.58 ac ft		None	1N	2E	29
G-4137	G-3773	80593	11/14/67		IR	0.338	0.94	95.88 ac ft		None	1N	2E	29
G-16038	G-15693		06/26/03		IR	0.75				None	1N	2E	29
R-85502	R-13804		03/20/03		M	—	—	—		None	1N	2E	29
S-85503	53984		03/20/03		M	—	—	—		None	1N	2E	29

Table continued on next page.

Table 2-3. Water Rights Held by the City of Portland

						Quantity of water (cfs unless noted)							
						Maximum instantaneous							
Application Number	**Permit Number**	**Certificate Number**	**Priority Date**	**Source**	**Use[a]**	**Allowed**	**Diverted**	**2006 Annual**	**Authorized date for completion of development**	**Use Limitations**	**Twp**	**Range**	**Section**
Parks & Recreation Rights													
G-16812	TBD[g]		02/26/2007	Rose City Park Wells	IR	0.06	—	—	See subsection 5.2 of this report	None	1N	2E	29
G-16341	G-15914	82734	11/12/04	Sellwood Park	M	0.56	0.60	7.09 ac ft		None	1S	1E	22
G-14498	G-13394	81318	04/14/97	Waterfront Park	M	0.56	0.57	26.25 ac ft		None	1S	1E	3
G-15957	G-15683		03/14/03	Westmoreland Park	M	0.41	—	—	10/01/08	None	1S	1E	23

[a]Use denotations are M = Municipal, IR = Irrigation, E = Electricity generation, QM = Quasi-municipal, CM = Commercial, GD = Group Domestic, WI = Wildlife habitat

[b]See the information under "Surface Water Treatment Rule and Enhancements," "Endangered Species Act," and "Clean Water Act" subsections in Section 2.1.1 for more information on regulations and Water Bureau management plans regarding streamflow-dependent species and water quality limitations.

[c]The Water Bureau does not currently exercise municipal water rights in the Willamette River and has not done so since the mid-1920s.

[d]Shaded records indicate small wells not currently in use by the Water Bureau.

[e]G.C. stands for golf course

[f]— records not maintained or records not available

[g]To be determined; permit number anticipated to be available in November 2007.

On the following pages, Tables 2-4 and 2-5 show monthly groundwater production in the Columbia South Shore Well Field (CSSWF) by permit for water years 2007-2008 and 2008-2009. Tables 2-6 through 2-12 show production well pumping data and monthly water use for the CSSWF by permit for calendar years 2003 through 2009. Table 2-13 is a crosswalk of Portland Parks and Recreation (PPR) well names and point-of-diversion numbers with water rights information such as permit numbers and use designations. Figure 2-6 shows the monthly usage log for PPR wells for October 2007 through September 2008.

More detail on groundwater use in the CSSWF is available in Appendix E. This appendix, available on CD and through the PWB web site only, is annual reports of PWB's well field use for calendar years 2004 through 2008.[17][18] The annual reports contain extensive diagrams and charts indicating the wells that were utilized in each aquifer and the dates of utilization. The reports indicate that the utilization of the well field relates to seasonal supply augmentation, emergency use, some non-potable water use, and maintenance runs. Usage can vary greatly in any given year for purpose and quantities. For instance, in calendar year 2008, the well field was utilized twice: in August for a maintenance run and again in November for a turbidity event.

The decision to utilize different wells at different times in any year is dependent on the specific need, mechanical issues, servicing of wells, and other operational issues that may exist at a well site. The information provided by production well for each day and gallons per minute allows a conversion to daily flows, if needed.

Appendix E also contains data on monthly water use by PPR wells for water years 2004-2005 through 2006-2007.

[17] Except calendar year 2005 when no groundwater was pumped from the CSSWF.

[18] The PWB web site for the Appendix E is www.portlandonline.com/water/WMCP.

Table 2-4. Water Year 2007-2008 City of Portland Columbia South Shore Well Field Production Well Discharges by Well, Aquifer and GW Rights Permit Number: Total Discharge by Month in Millions of Gallons

City Well #	PW-12	PW-13	PW-17	PW-18	PW-19	PW-3	PW-5	PW-10	PW-15	PW-26	PW-28	PW-29
Aquifer	BLA	BLA	BLA	BLA	BLA	TSA	TSA	TSA	TSA	TSA	TSA	TSA
GW Permit #	G-8755 / G-10455	G-8755 / G-10455	G-10124	G-10124	G-10124	G-8755	G-8755	G-8755	G-8755	G-8755	G-8755	G-8755
GW Permit Well #	E16 / 12	E15 / 13	17	18	19	E7	E8	E3	E11	W7	W9	W10
Oct 07, MG	61.29	108.86	0.00	0.00	0.00	0.17	6.46	0.17	0.00	12.30	0.00	0.00
Nov 07, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.85	0.00	0.00	0.00	0.00
Dec 07, MG	8.02	7.09	0.00	4.02	9.24	0.00	1.54	0.09	0.00	0.00	0.00	1.50
Jan 08, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb 08, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar 08, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr 08, MG	0.31	0.51	0.40	1.06	0.56	0.00	0.07	0.00	0.00	0.00	0.00	0.00
May 08, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jun 08, MG	0.28	0.00	0.00	0.00	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul 08, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug 08, MG	2.93	15.91	1.32	4.16	3.86	0.00	0.49	0.53	0.23	0.68	0.63	0.52
Sept 08, MG	4.30	4.99	0.00	0.60	9.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total 0708 Pumpage, MG	77.12	137.36	1.71	9.83	23.41	0.17	8.57	3.64	0.23	12.97	0.63	2.02

GW Permit #	G-8755	G-10124	G-10455	G-10479	LL-1082
Total 0708 Pumpage, MG	406.58	34.95	0.00	1.10	1.13
Avg. Monthly Pumpage, MG	33.88	2.91	0.00	0.09	0.09
Avg. Daily Pumpage, MG	1.114	0.096	0.000	0.003	0.003

Table 2-4. Water Year 2007-2008 City of Portland Columbia South Shore Well Field Production Well Discharges by Well, Aquifer and GW Rights Permit Number: Total Discharge by Month in Millions of Gallons

City Well #	PW-1	PW-2	PW-4	PW-6	PW-7	PW-8	PW-9	PW-11	PW-14	PW-16	PW-34	PW-35	PW-36	PW-37	PW-38
Aquifer	SGA	SGA	SGA	SGA	SGA	SGA	SGA	SGA	SGA	SGA	SGA	SGA	SGA	SGA	SGA
GW Permit #	G-8755	G-8755	G-8755	G-8755	G-8755	G-8755	G-8755	G-8755	G-8755	G-8755	G-10479	G-8755	G-8755	G-8755	LL-1082
GW Permit Well #	E5	E6	E9	E2	E13	E12	E10	E1	E14	E4	34	35	36	37	38
Oct 07, MG	0.00	0.00	0.00	0.00	**1.03**	0.00	0.00	0.00	0.00	**44.96**	0.00	**42.61**	0.00	**51.70**	0.00
Nov 07, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dec 07, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jan 08, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb 08, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar 08, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr 08, MG	0.00	0.00	0.00	0.00	**0.22**	0.00	0.00	0.00	0.00	**0.21**	0.00	0.00	0.00	0.00	0.00
May 08, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jun 08, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul 08, MG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug 08, MG	**0.99**	**1.14**	**0.86**	**1.18**	**0.60**	0.00	**0.97**	0.00	0.00	**2.48**	**1.10**	**1.21**	**1.22**	**1.80**	**1.13**
Sept 08, MG	0.00	**2.87**	0.00	0.00	0.00	0.00	**6.37**	0.00	0.00	0.00	0.00	0.00	**1.42**	0.00	0.00
Total 0708 Pumpage, MG	**0.99**	**4.02**	**0.86**	**1.18**	**1.85**	**0.00**	**7.34**	**0.00**	**0.00**	**47.65**	**1.10**	**43.82**	**2.64**	**53.50**	**1.13**

Table 2-5. Water Year 08-09 City of Portland Groundwater Use, Production Well Pumping Data by Water Rights Permit

GW Permit Number	City Well Number	GW Permit Well Number	Aquifer	Total Monthly Discharge by Well in Millions of Gallons												Water Year Total by Well
				Oct 08	Nov 08	Dec 08	Jan 09	Feb 09	Mar 09	Apr 09	May 09	Jun 09	Jul 09	Aug 09	Sep 09	
G-8755	**PW-01**	**E5**	SGA	0	27.760	0	0	0	0	0	0	0	3.004	0.884	11.719	43.367
G-8755	**PW-02**	**E6**	SGA	0	11.483	0	0	0	3.742	4.975	0	0	7.189	1.127	9.625	38.142
G-8755	**PW-04**	**E9**	SGA	0	24.209	0	0	0	0	0	0	0	1.362	2.528	0.124	28.223
G-8755	**PW-06**	**E2**	SGA	0	9.739	0	0	0	0	0	0	0	1.733	2.329	0.159	13.959
G-8755	**PW-07**	**E13**	SGA	0	15.422	0	0	0	2.790	0	0	0	0	0.599	5.970	24.781
G-8755	**PW-08**	**E12**	SGA	0	0	0	0	0.009	0	0.150	0	0	0	0.435	0	0.594
G-8755	**PW-09**	**E10**	SGA	1.953	20.691	2.359	0	0	1.042	0	0	0	2.423	0.805	9.829	39.102
G-8755	**PW-11**	**E1**	SGA	0	0	0	0.104	0	1.399	3.003	0	0	9.054	1.744	0.290	15.594
G-8755	**PW-14**	**E14**	SGA	0.025	0.069	0.124	0.339	5.781	0	0	0	0.102	15.021	0.589	0	22.049
G-8755	**PW-16**	**E4**	SGA	0	35.573	0	0	0	5.150	5.738	0	0	6.512	1.653	0.126	54.752
G-8755	**PW-35**	**35**	SGA	0	34.924	0	0	0	0	0	0	0	0	1.289	0	36.213
G-8755	**PW-36**	**36**	SGA	0.226	35.065	0	0	0	0	0	0	0	0.409	1.250	0.109	37.059
G-8755	**PW-37**	**37**	SGA	0	21.282	0	0	0	0	0	0	0	0	1.612	0	22.894
G-8755	**PW-03**	**E7**	TSA	0	0	0	0	0	0	0	0	0	0.032	3.282	0.010	3.324
G-8755	**PW-05**	**E8**	TSA	3.496	17.828	1.799	0	0	0.704	0.017	0	0	1.321	0.419	0	25.585
G-8755	**PW-10**	**E3**	TSA	0	15.926	0	0	0	2.185	0.620	0	0	0.901	0.735	0	20.367
G-8755	**PW-15**	**E11**	TSA	0.221	4.888	0.695	0	0	0.941	0.360	0	0	0.003	0.584	2.149	9.842
G-8755	**PW-26**	**W7**	TSA	0	7.242	0	0	0	0	1.296	0	0	0	0.575	0	9.113
G-8755	**PW-28**	**W9**	TSA	0	12.895	0	0	0	0	0.020	0	0	0	1.074	0	13.989
G-8755	**PW-29**	**W10**	TSA	0	13.299	0	0	0	0	0.987	0	0	0	0.440	0	14.726
G-8755/G-10455 *	**PW-12**	**E16/12**	BLA	4.467	56.367	4.249	0	0	4.585	6.492	0	0	2.399	6.439	17.148	102.147
G-8755/G-10455 *	**PW-13**	**E15/13**	BLA	0.018	85.824	7.079	0	1.138	0	0.871	0	0	5.083	10.685	16.461	127.158
		Monthly Totals, Permit G-8755		10.407	450.486	16.306	0.443	6.928	22.539	24.528	0	0.103	56.445	41.076	73.721	**702.981**
															Monthly Average, Permit G-8755	58.582
															Daily Average, Permit G-8755	1.926
G-10124	**PW-17**	**17**	BLA	0	0	0	0	0	0	0	0	0	0	1.137	0	1.137
G-10124	**PW-18**	**18**	BLA	0	29.579	0	0	0	0	0	0	0.350	11.008	12.297	0.447	53.680
G-10124	**PW-19**	**19**	BLA	3.439	62.631	0	0	0	6.205	9.852	0	0	12.863	18.771	13.950	127.713
		Monthly Totals, Permit G-10124		3.439	92.210	0	0	0	6.205	9.852	0	0.350	23.872	32.206	14.397	**182.531**
															Monthly Average, Permit G-10124	15.211
															Daily Average, Permit G-10124	0.500
G-10479	**PW-34**	**34**	SGA	0	25.992	0	0	0	0	0	0	0	0	1.146	0	27.139
		Monthly Totals, Permit G-10479		0	25.992	0	0	0	0	0	0	0	0	1.146	0	**27.139**
															Monthly Average, Permit G-10479	2.262
															Daily Average, Permit G-10479	0.074
LL-1082	**PW-38**	**38**	SGA	0	18.337	0	0	0	0	0	0	0	0	0.854	2.180	21.372
		Monthly Totals, Permit LL-1082		0	18.337	0	0	0	0	0	0	0	0	0.854	2.180	**21.372**
															Monthly Average, Permit LL-1082	1.781
															Daily Average, Permit LL-1082	0.059
		Monthly Totals, All Permits		13.846	587.026	16.306	0.443	6.928	28.744	34.379	0	0.453	80.317	75.282	90.298	**934.023**

Notes: All results are in Millions of Gallons, are based on individual well flow meters, and include all uses of water
* All pumpage attributed to permit G-8755, since flow rates did not exceed maximum allowed by Permit G-8755

Table 2-6. Calendar Year 2003 City of Portland Groundwater Use, Production Well Pumping Data by Water Rights Permit

GW Permit Number	City Well Number	GW Permit Well Number	Aquifer	Approximate Dates of Operation	Average Yield, GPM	Total 2003 Discharge, MG*
G-8755	**PW-1**	E5	SGA	7/22/ 03 to 9/17/03	2800	146.8
G-8755	**PW-2**	E6	SGA	7/22/03 to 9/16/03	2700	190.3
G-8755	**PW-4**	E9	SGA	7/22/03 to 9/3/03	1800	112.0
G-8755	**PW-6**	E2	SGA	7/22/03 to 9/22/03	2600	217.2
G-8755	**PW-7**	E13	SGA	7/22/03 to 9/22/03	1450	120.4
G-8755	**PW-8**	E12	SGA	7/25/03 to 9/22/03	1300	109.2
G-8755	**PW-9**	E10	SGA	7/22/03 to 9/8/03; 9/11/03 to 9/22/03	2200	184.0
G-8755	**PW-11**	E1	SGA	7/22/03 to 9/8/03; 9/13/03 to 9/22/03	3000	244.1
G-8755	**PW-14**	E14	SGA	7/22/03 to 9/8/03; 9/11/03 to 9/22/03	1700	134.5
G-8755	**PW-16**	E4	SGA	7/22/03 to 8/1/03; 8/11/03 to 9/22/03	2950	221.7
G-8755	**PW-35**	35	SGA	7/22/03 to 9/22/03	2450	221.1
G-8755	**PW-36**	36	SGA	7/22/03 to 9/22/03	2300	197.8
G-8755	**PW-37**	37	SGA	7/22/03 to 9/22/03	3450	306.1
G-8755	**PW-3**	E7	TSA	7/22/03 to 9/3/03	1350	83.2
G-8755	**PW-5**	E8	TSA	7/22/03 to 9/18/03, intermittent	1050	49.3
G-8755	**PW-10**	E3	TSA	7/22/03 to 9/17/03, intermittent	1350	65.9
G-8755	**PW-15**	E11	TSA	7/22/03 to 9/20/03, intermittent	475	23.1
G-8755	**PW-26**	W7	TSA	8/5/03 to 9/21/03, limited use	1800	6.3
G-8755	**PW-28**	W9	TSA	Not in Service		0
G-8755	**PW-29**	W10	TSA	8/5/03 to 9/5/03, limited use	1200	1.3
G-8755/G-10455 **	**PW-12**	E16/12	BLA	7/22/03 to 9/13/03, intermittent	4400	138.1
G-8755/G-10455 **	**PW-13**	E15/13	BLA	7/22/03 to 9/10/03, intermittent	6800	302.1
					Approximate Total Discharge, Permit G-8755, MG	**3074.5**
					Approximate Average Monthly Discharge, Permit G-8755, MG (Two Months of Well Field Use)	**1537.3**
					Approximate Average Daily Discharge, Permit G-8755, MG (62 Days of Well Field Use)	**49.6**
					Approximate Average Monthly Discharge, Permit G-8755, MG (Full Calendar Year)	**256.2**
					Approximate Average Daily Discharge, Permit G-8755, MG (Full Calendar Year)	**8.4**
G-10124	**PW-17**	17	BLA	Not Used		0
G-10124	**PW-18**	18	BLA	Not Used		0
G-10124	**PW-19**	19	BLA	7/24/03 to 9/8/03	7800	511.1
					Approximate Total Discharge, permit G-10124, MG	**511.1**
					Approximate Average Monthly Discharge, Permit G-10124, MG (Two Months of Well Field Use)	**255.6**
					Approximate Average Daily Discharge, Permit G-10124, MG (62 Days of Well Field Use)	**8.2**
					Approximate Average Monthly Discharge, Permit G-10124, MG (Full Calendar Year)	**42.6**
					Approximate Average Daily Discharge, Permit G-10124, MG (Full Calendar Year)	**1.4**
G-10479	**PW-34**	34	SGA	Not In Service		0
					Approximate Total Discharge, Permit G-10479, MG	**0**
					Approximate Average Monthly Discharge, Permit G-10479, MG (Two Months of Well Field Use)	**0**
					Approximate Average Daily Discharge, Permit G-10479, MG (62 Days of Well Field Use)	**0**
					Approximate Average Monthly Discharge, Permit G-10479, MG (Full Calendar Year)	**0**
					Approximate Average Daily Discharge, Permit G-10479, MG (Full Calendar Year)	**0**

Notes: * Does not include approximately 37.7 MG for refill of Blue Lake or _?_ MG for UV reactor validation testing
** All pumpage attributed to permit G-8755, since flow rates did not exceed maximum allowed by permit G-8755

Table 2-7. Calendar Year 2004 City of Portland Groundwater Use, Production Well Pumping Data by Water Rights Permit

GW Permit Number	City Well Number	GW Permit Well Number	Aquifer	Approximate Dates of Winter Operation	Average Yield, GPM	Total Winter, Discharge, MG	Approximate Dates of Summer Operation	Average Yield, GPM	Total Summer Discharge, MG	Total 2004 Discharge, MG*
G-8755	**PW-1**	E5	SGA	Not Used		0.0	7/27/04 to 8/24/04	2900	116.9	116.9
G-8755	**PW-2**	E6	SGA	Not Used		0.0	7/29/04; 8/3/04 to 8/24/04	2900	90.4	90.4
G-8755	**PW-4**	E9	SGA	Not Used		0.0	7/27/04 to 8/14/04; 8/18/04	2000	51.5	51.5
G-8755	**PW-6**	E2	SGA	Not Used		0.0	7/29/04 to 8/24/04	2300	78.4	78.4
G-8755	**PW-7**	E13	SGA	1/29/04 to 2/1/04	1700	4.3	8/4/04 to 8/24/04, intermittent	1625	23.3	27.6
G-8755	**PW-8**	E12	SGA	Not Used		0.0	Not Used		0.0	0
G-8755	**PW-9**	E10	SGA	Not Used		0.0	7/27/04 to 8/24/04	2400	92.4	92.4
G-8755	**PW-11**	E1	SGA	Not Used		0.0	8/3/04 to 8/24/04	3350	100.7	100.7
G-8755	**PW-14**	E14	SGA	1/29/04 to 2/1/04	1850	5.3	7/27/04 to 8/24/04	1850	74.5	79.8
G-8755	**PW-16**	E4	SGA	1/29/04 to 2/1/04	3250	10.9	7/27/04 to 8/4/04; 8/13/04 to 8/24/04	3050	82.9	93.8
G-8755	**PW-35**	35	SGA	1/29/04 to 2/1/04	3150	10.5	Not Used		0.0	10.5
G-8755	**PW-36**	36	SGA	1/29/04 to 2/1/04	3050	10.6	Not Used		0.0	10.6
G-8755	**PW-37**	37	SGA	Not Used		0.0	Not Used		0.0	0
G-8755	**PW-3**	E7	TSA	Not Used		0.0	8/15/04 to 8/24/04	1500	18.0	18.0
G-8755	**PW-5**	E8	TSA	Not Used		0.0	8/19/04 to 8/24/04	1075	7.5	7.5
G-8755	**PW-10**	E3	TSA	Not Used		0.0	7/29/04; 8/3/04 to 8/4/04; 8/21/04 to 8/24/0	1375	9.1	9.1
G-8755	**PW-15**	E11	TSA	Not Used		0.0	8/5/04 to 8/24/04, intermittent	700	11.0	11.0
G-8755	**PW-26**	W7	TSA	Not Used		0.0	8/3/2004 to 8/4/04	1800	1.0	1.0
G-8755	**PW-28**	W9	TSA	Not in Service		0.0	Not in Service		0.0	0
G-8755	**PW-29**	W10	TSA	Not Used		0.0	8/3/2004 to 8/4/04	1225	1.8	1.8
G-8755/G-10455 **	**PW-12**	E16/12	BLA	Not Used		0.0	7/27/04 to 8/20/04	4950	153.3	153.3
G-8755/G-10455 **	**PW-13**	E15/13	BLA	Not Used		0.0	Not Used		0.0	0
									Approximate Total Annual Discharge, Permit G-8755, MG	**954.3**
									Approximate Average Monthly Discharge, Permit G-8755, MG (One Month of Well Field Use)	**954.3**
									Approximate Average Daily Discharge, Permit G-8755, MG (31 Days of Well Field Use)	**30.8**
									Approximate Average Monthly Discharge, Permit G-8755, MG (Full Calendar Year)	**79.5**
									Approximate Average Daily Discharge, Permit G-8755, MG (Full Calendar Year)	**2.6**
G-10124	**PW-17**	17	BLA	Not Used			Not Used			0
G-10124	**PW-18**	18	BLA	Not Used			Not Used			0
G-10124	**PW-19**	19	BLA	Not Used			Not Used			0
									Approximate Total Annual Discharge, permit G-10124, MG	**0**
									Approximate Average Monthly Discharge, Permit G-10124, MG (One Month of Well Field Use)	**0**
									Approximate Average Daily Discharge, Permit G-10124, MG (31 Days of Well Field Use)	**0**
									Approximate Average Monthly Discharge, Permit G-10124, MG (Full Calendar Year)	**0**
									Approximate Average Daily Discharge, Permit G-10124, MG (Full Calendar Year)	**0**
G-10479	**PW-34**	34	SGA	Not in Service			Not In Service			0
									Approximate Total Annual Discharge, Permit G-10479, MG	**0**
									Approximate Average Monthly Discharge, Permit G-10479, MG (One Month of Well Field Use)	**0**
									Approximate Average Daily Discharge, Permit G-10479, MG (31 Days of Well Field Use)	**0**
									Approximate Average Monthly Discharge, Permit G-10479, MG (Full Calendar Year)	**0**
									Approximate Average Daily Discharge, Permit G-10479, MG (Full Calendar Year)	**0**

Notes: * Does not include approximately 37.8 MG for refill of Blue Lake or 131.8 MG for UV reactor validation testing
** All pumpage attributed to permit G-8755, since flow rates did not exceed maximum allowed by permit G-8755

Table 2-8. Calendar Year 2005 City of Portland Groundwater Use, Production Well Pumping Data by Water Rights Permit

GW Permit Number	City Well Number	GW Permit Well Number	Aquifer	Approximate Dates of Operation	Approx. Yield GPM	Total 2005 Discharge, MG*
G-8755	**PW-1**	E5	SGA	Not Used for Potable Supply		0
G-8755	**PW-2**	E6	SGA	Not Used for Potable Supply		0
G-8755	**PW-4**	E9	SGA	Not Used for Potable Supply		0
G-8755	**PW-6**	E2	SGA	Not Used for Potable Supply		0
G-8755	**PW-7**	E13	SGA	Not Used for Potable Supply		0
G-8755	**PW-8**	E12	SGA	Not Used for Potable Supply		0
G-8755	**PW-9**	E10	SGA	Not Used for Potable Supply		0
G-8755	**PW-11**	E1	SGA	Not Used for Potable Supply		0
G-8755	**PW-14**	E14	SGA	Not Used for Potable Supply		0
G-8755	**PW-16**	E4	SGA	Not Used for Potable Supply		0
G-8755	**PW-35**	35	SGA	Not Used for Potable Supply		0
G-8755	**PW-36**	36	SGA	Not Used for Potable Supply		0
G-8755	**PW-37**	37	SGA	Not Used for Potable Supply		0
G-8755	**PW-3**	E7	TSA	Not Used for Potable Supply		0
G-8755	**PW-5**	E8	TSA	Not Used for Potable Supply		0
G-8755	**PW-10**	E3	TSA	Not Used for Potable Supply		0
G-8755	**PW-15**	E11	TSA	Not Used for Potable Supply		0
G-8755	**PW-26**	W7	TSA	Not Used for Potable Supply		0
G-8755	**PW-28**	W9	TSA	Not Used for Potable Supply		0
G-8755	**PW-29**	W10	TSA	Not Used for Potable Supply		0
G-8755/G-10455 **	**PW-12**	E16/12	BLA	Not Used for Potable Supply		0
G-8755/G-10455 **	**PW-13**	E15/13	BLA	Not Used for Potable Supply		0
					Approximate Total Annual Discharge, Permit G-8755, MG	**0**
					Approximate Average Monthly Discharge, Permit G-8755, MG (No Months of Well Field Use)	**0**
					Approximate Average Daily Discharge, Permit G-8755, MG (No Days of Well Field Use)	**0**
					Approximate Average Monthly Discharge, Permit G-8755, MG (Full Calendar Year)	**0**
					Approximate Average Daily Discharge, Permit G-8755, MG (Full Calendar Year)	**0**
G-10124	**PW-17**	17	BLA	Not Used for Potable Supply		0
G-10124	**PW-18**	18	BLA	Not Used for Potable Supply		0
G-10124	**PW-19**	19	BLA	Not Used for Potable Supply		0
					Approximate Total Annual Discharge, permit G-10124, MG	**0**
					Approximate Average Monthly Discharge, Permit G-10124, MG (No Months of Well Field Use)	**0**
					Approximate Average Daily Discharge, Permit G-10124, MG (No Days of Well Field Use)	**0**
					Approximate Average Monthly Discharge, Permit G-10124, MG (Full Calendar Year)	**0**
					Approximate Average Daily Discharge, Permit G-10124, MG (Full Calendar Year)	**0**
G-10479	**PW-34**	34	SGA	Not Used for Potable Supply		0
					Approximate Total Annual Discharge, Permit G-10479, MG	**0**
					Approximate Average Monthly Discharge, Permit G-10479, MG (No Months of Well Field Use)	**0**
					Approximate Average Daily Discharge, Permit G-10479, MG (No Days of Well Field Use)	**0**
					Approximate Average Monthly Discharge, Permit G-10479, MG (Full Calendar Year)	**0**
					Approximate Average Daily Discharge, Permit G-10479, MG (Full Calendar Year)	**0**

Notes: * Does not include approximately 31.5 MG for refill of Blue Lake or 121.4 MG for UV reactor validation testing
** All pumpage attributed to permit G-8755, since flow rates did not exceed maximum allowed by permit G-8755

Table 2-9. Calendar Year 2006 City of Portland Groundwater Use, Production Well Pumping Data by Water Rights Permit

GW Permit Number	City Well Number	GW Permit Well Number	Aquifer	Approximate Dates of Operation	Initial Yield, GPM	30-Day Yield, GPM	Total 2006 Discharge, MG*
G-8755	**PW-1**	E5	SGA	8/31-10/03, 10/12-10/14, 10/18-10/22, 11/7-11/20	3150	3025	208.2
G-8755	**PW-2**	E6	SGA	8/28-9/15, 9/21-9/22, 10/3-10/31, 11/7-11/13	3150	2825	202.0
G-8755	**PW-4**	E9	SGA	8/15-9/30, 10/03-10/31, 11/7-11/20	2500	2200	265.1
G-8755	**PW-6**	E2	SGA	8/31-9/1, 11/11-11/20	2900	2400	34.7
G-8755	**PW-7**	E13	SGA	8/28-10/1, 10/5-10/28, 11/8-11/20	1580	1450	135.3
G-8755	**PW-8**	E12	SGA	11/8-11/20	1600	1425	25.1
G-8755	**PW-9**	E10	SGA	8/28-9/30, 10/5-10/31, 11/7-11/20	2600	2375	245.5
G-8755	**PW-11**	E1	SGA	9/1-9/30, 10/8-10/31, 11/7-11/20	3250	3200	285.2
G-8755	**PW-14**	E14	SGA	9/13-9/30, 10/14-10/30, 11/11-11/20	1900	1700	92.2
G-8755	**PW-16**	E4	SGA	8/28-10/8, 10/12-10/30, 11/7-11/20	3500	3075	306.8
G-8755	**PW-35**	35	SGA	8/15-8/31	3350	3050	75.5
G-8755	**PW-36**	36	SGA	8/28-9/30, 10/5-10/31, 11/7-11/20	2925	2525	261.9
G-8755	**PW-37**	37	SGA	8/28-8/31	3950	3700	16.8
G-8755	**PW-3**	E7	TSA	9/19-9/30, 10/12-10/22, 11/7-11/20	1440	1300	64.1
G-8755	**PW-5**	E8	TSA	8/28-10/22, 10/28-10/29, 11/7-11/20	1150	1120	97.4
G-8755	**PW-10**	E3	TSA	8/30-9/30, 10/13-10/20, 10/28-10/31, 11/7-11/20	1430	1325	103.1
G-8755	**PW-15**	E11	TSA	intermittent 8/18-10/7, 10/12-10/31, 11/7-11/20	850	625	28.6
G-8755	**PW-26**	W7	TSA	8/29-9/30, 10/5-10/31, 11/7-11/20	1750	1675	170.3
G-8755	**PW-28**	W9	TSA	8/28-9/30, 10/5-10/31, 11/7-11/20	1575	1460	147.4
G-8755	**PW-29**	W10	TSA	8/28-8/29, 9/16-9/20, 10/12-10/20, 10/23-10/30, 11/7-11/20	1250	1125	53.0
G-8755/G-10455 **	**PW-12**	E16/12	BLA	10/20-10/21, 11/8-11/20	4100	2600	64.6
G-8755/G-10455 **	**PW-13**	E15/13	BLA	10/05-10/28, 11/7-11/20	7700	6200	347.0
				Approximate Total Annual Discharge, Permit G-8755, MG			**3229.5**
				Approximate Average Monthly Discharge, Permit G-8755, MG (Three Months of Well Field Use)			**1076.5**
				Approximate Average Daily Discharge, Permit G-8755, MG (92 Days of Well Field Use)			**35.1**
				Approximate Average Monthly Discharge, Permit G-8755, MG (Full Calendar Year)			**269.1**
				Approximate Average Daily Discharge, Permit G-8755, MG (Full Calendar Year)			**8.8**
G-10124	**PW-17**	17	BLA	11/11-11/20	2500	2500	30.4
G-10124	**PW-18**	18	BLA	9/13-9/14, 11/11-11/20	6600	6400	93.7
G-10124	**PW-19**	19	BLA	8/28-9/30, 10/5-10/31, 11/7-11/20	8800	8500	806.5
				Approximate Total Annual Discharge, permit G-10124, MG			**930.6**
				Approximate Average Monthly Discharge, Permit G-10124, MG (Three Months of Well Field Use)			**310.2**
				Approximate Average Daily Discharge, Permit G-10124, MG (92 Days of Well Field Use)			**10.1**
				Approximate Average Monthly Discharge, Permit G-10124, MG (Full Calendar Year)			**77.5**
				Approximate Average Daily Discharge, Permit G-10124, MG (Full Calendar Year)			**2.5**
G-10479	**PW-34**	34	SGA	10/12-10/30, 11/7-11/20	3000	2850	129.1
				Approximate Total Annual Discharge, Permit G-10479, MG			**129.1**
				Approximate Average Monthly Discharge, Permit G-10479, MG (Three Months of Well Field Use)			**43.0**
				Approximate Average Daily Discharge, Permit G-10479, MG (92 Days of Well Field Use)			**1.4**
				Approximate Average Monthly Discharge, Permit G-10479, MG (Full Calendar Year)			**10.8**
				Approximate Average Daily Discharge, Permit G-10479, MG (Full Calendar Year)			**0.4**

Notes: * Does not include approximately 51.6 MG for UV reactor validation testing
** All pumpage attributed to permit G-8755, since flow rates did not exceed maximum allowed by permit G-8755

Table 2-10. Calendar Year 2007 City of Portland Groundwater Use, Production Well Pumping Data by Water Rights Permit

GW Permit Number	City Well Number	GW Permit Well Number	Aquifer	Approximate Dates of Operation	Approx. Yield GPM	Total 2007 Discharge, MG*
G-8755	**PW-1**	E5	SGA	8/8-8/14; 9/24; 9/26	2400	23.42
G-8755	**PW-2**	E6	SGA	Not Used		0
G-8755	**PW-4**	E9	SGA	6/25; 6/26-8/23, intermittent; 9/24	2400	152.59
G-8755	**PW-6**	E2	SGA	6/26; 8/8-8/14	3000	29.78
G-8755	**PW-7**	E13	SGA	6/27-7/2, int.; 8/8-8/17, int.; 9/30; 10/1	1500	16.33
G-8755	**PW-8**	E12	SGA	6/26-7/2; 8/9-8/12; 8/13	1550	24.77
G-8755	**PW-9**	E10	SGA	7/17-7/19; 8/8-8/14; 8/17-8/23	2550	54.67
G-8755	**PW-11**	E1	SGA	6/25-6/26; 7/8; 8/7-8/14; 8/16-8/17; 8/19	3500	43.09
G-8755	**PW-14**	E14	SGA	7/1-7/26, intermittent; 8/3; 8/8-8/13	2050	30.29
G-8755	**PW-16**	E4	SGA	6/25; 7/19; 8/7-8/14; 8/15-8/23; 9/24; 9/26; 9/28-10/10	3300	126.00
G-8755	**PW-35**	35	SGA	6/25-7/2; 8/7-8/13; 9/24; 9/26; 9/28-10/10	3100	111.39
G-8755	**PW-36**	36	SGA	6/25	3200	0.39
G-8755	**PW-37**	37	SGA	6/25-8/17; 8/17-8/23; 9/28-10/10	3850	391.34
G-8755	**PW-3**	E7	TSA	8/5-8/6; 8/8-8/15, intermittent	1450	12.20
G-8755	**PW-5**	E8	TSA	8/5-8/6; 8/7-8/16; 9/24-9/27, int.; 10/1-10/5	1150	23.57
G-8755	**PW-10**	E3	TSA	8/13; 10/1	1400	0.50
G-8755	**PW-15**	E11	TSA	8/9-8/20, intermittent	650	0.70
G-8755	**PW-26**	W7	TSA	8/8-8/14; 10/5-10/10	1775	27.90
G-8755	**PW-28**	W9	TSA	8/8-8/14; 9/26	1450	12.80
G-8755	**PW-29**	W10	TSA	8/8-8/15, intermittent	1200	3.02
G-8755/G-10455 **	**PW-12**	E16/12	BLA	7/2-8/12; 8/13; 8/14-8/16; 9/24; 9/26; 9/28-10/10	4900	364.74
G-8755/G-10455 **	**PW-13**	E15/13	BLA	7/2; 8/7-8/14; 8/16-8/17; 8/20; 9/24; 9/26; 9/28-10/10	8000	219.94
					Approximate Total Annual Discharge, Permit G-8755, MG	**1669.43**
					Approximate Average Monthly Discharge, Permit G-8755, MG (2.4 Months of Well Field Use)	**695.60**
					Approximate Average Daily Discharge, Permit G-8755, MG (72 Days of Well Field Use)	**23.19**
					Approximate Average Monthly Discharge, Permit G-8755, MG (Full Calendar Year)	**139.12**
					Approximate Average Daily Discharge, Permit G-8755, MG (Full Calendar Year)	**4.57**
G-10124	**PW-17**	17	BLA	Not Used		0
G-10124	**PW-18**	18	BLA	8/7-8/12	7000	41.92
G-10124	**PW-19**	19	BLA	8/7-8/13; 8/16-8/17; 8/20; 9/24; 9/26	9000	76.76
					Approximate Total Annual Discharge, permit G-10124, MG	**118.68**
					Approximate Average Monthly Discharge, Permit G-10124, MG (2.4 Months of Well Field Use)	**49.45**
					Approximate Average Daily Discharge, Permit G-10124, MG (72 Days of Well Field Use)	**1.65**
					Approximate Average Monthly Discharge, Permit G-10124, MG (Full Calendar Year)	**9.89**
					Approximate Average Daily Discharge, Permit G-10124, MG (Full Calendar Year)	**0.33**
G-10479	**PW-34**	34	SGA	8/8-8/13	2650	20.19
					Approximate Total Annual Discharge, Permit G-10479, MG	**20.19**
					Approximate Average Monthly Discharge, Permit G-10479, MG (2.4 Months of Well Field Use)	**8.41**
					Approximate Average Daily Discharge, Permit G-10479, MG (72 Days of Well Field Use)	**0.28**
					Approximate Average Monthly Discharge, Permit G-10479, MG (Full Calendar Year)	**1.68**
					Approximate Average Daily Discharge, Permit G-10479, MG (Full Calendar Year)	**0.06**

Notes: * Does not include approximately 53.0 MG for refill of Blue Lake or 75.5 MG for UV reactor validation testing
** All pumpage attributed to permit G-8755, since flow rates did not exceed maximum allowed by permit G-8755

Table 2-11. Calendar Year 2008 City of Portland Groundwater Use, Production Well Pumping Data by Water Rights Permit

GW Permit Number	City Well Number	GW Permit Well Number	Aquifer	Approx. Dates Aug. Operation	Average Aug. Yield, GPM	Total Aug. 2008 Discharge, MG	Approx. Dates Nov. Operation	Average Nov. Yield, GPM	Total Nov. 2008 Discharge, MG	Total 2008 Discharge, MG*
G-8755	**PW-1**	E5	SGA	8/25/08	2,750	0.99	11/13 to 11/21/08	2,426	27.80	28.79
G-8755	**PW-2**	E6	SGA	8/25/08	3,180	1.14	11/18 to 11/21/08	2,758	11.42	12.56
G-8755	**PW-4**	E9	SGA	8/18/08	2,400	0.86	11/13 to 11/21/08	2,136	24.22	25.08
G-8755	**PW-6**	E2	SGA	8/25/08	3,288	1.18	11/17 to 11/21/08	2,877	9.67	10.85
G-8755	**PW-7**	E13	SGA	8/18/08	1,653	0.60	11/13 to 11/21/08	1,452	15.42	16.01
G-8755	**PW-8**	E12	SGA	out of service			out of service			0
G-8755	**PW-9**	E10	SGA	8/26/08	2,697	0.97	11/15 to 11/21/08	2,430	20.70	21.67
G-8755	**PW-11**	E1	SGA	no data			no data			0
G-8755	**PW-14**	E14	SGA	out of service			out of service			0
G-8755	**PW-16**	E4	SGA	8/21, 8/26/08	3,445	2.48	11/13 to 11/21/08	3,091	35.42	37.90
G-8755	**PW-35**	35	SGA	8/25/08	3,371	1.21	11/13 to 11/21/08	3,005	34.98	36.19
G-8755	**PW-36**	36	SGA	8/20/08	3,383	1.22	11/13 to 11/21/08	3,020	34.97	36.19
G-8755	**PW-37**	37	SGA	8/19/08	4,284	1.80	11/17 to 11/21/08	3,472	21.25	23.05
G-8755	**PW-3**	E7	TSA	out of service			out of service			0
G-8755	**PW-5**	E8	TSA	8/19/08	1,173	0.49	11/13 to 11/21/08	1,100	11.48	11.98
G-8755	**PW-10**	E3	TSA	8/18/08	1,463	0.53	11/13 to 11/21/08	1,353	15.51	16.04
G-8755	**PW-15**	E11	TSA	8/19/08	644	0.23	11/14 to 11/21/08	558	4.82	5.05
G-8755	**PW-26**	W7	TSA	8/21/08	1,877	0.68	11/13 to 11/21/08	1,765	7.20	7.88
G-8755	**PW-28**	W9	TSA	8/20/08	1,500	0.63	11/15 to 11/21/08	1,447	12.85	13.48
G-8755	**PW-29**	W10	TSA	8/20/08	1,242	0.52	11/13 to 11/21/08	1,173	13.37	13.90
G-8755/G-10455 **	**PW-12**	E16/12	BLA	8/21/08	4,758	2.00	11/13 to 11/21/08	3,846	43.62	45.61
G-8755/G-10455 **	**PW-13**	E15/13	BLA	8/18/08	8,274	2.48	11/13 to 11/21/08	7,465	85.10	87.58
									Approximate Total Annual Discharge, Permit G-8755, MG	**449.83**
									Approximate Average Monthly Discharge, Permit G-8755, MG (0.5 Months of Well Field Use)	**899.66**
									Approximate Average Daily Discharge, Permit G-8755, MG (14 Days of Well Field Use)	**32.13**
									Approximate Average Monthly Discharge, Permit G-8755, MG (Full Calendar Year)	**37.49**
									Approximate Average Daily Discharge, Permit G-8755, MG (Full Calendar Year)	**1.23**
G-10124	**PW-17**	17	BLA	8/21/08	3,137	1.32	not used			1.32
G-10124	**PW-18**	18	BLA	8/20/08	8,607	3.62	11/18 to 11/21/08	7,090	29.35	32.97
G-10124	**PW-19**	19	BLA	8/19/08	9,183	3.31	11/15 to 11/21/08	6,998	62.56	65.86
									Approximate Total Annual Discharge, permit G-10124, MG	**100.15**
									Approximate Average Monthly Discharge, Permit G-10124, MG (0.5 Months of Well Field Use)	**200.30**
									Approximate Average Daily Discharge, Permit G-10124, MG (14 Days of Well Field Use)	**7.15**
									Approximate Average Monthly Discharge, Permit G-10124, MG (Full Calendar Year)	**8.35**
									Approximate Average Daily Discharge, Permit G-10124, MG (Full Calendar Year)	**0.27**
G-10479	**PW-34**	34	SGA	8/26/08	3,048	1.10	11/15 to 11/21/08	2,907	25.99	27.09
									Approximate Total Annual Discharge, Permit G-10479, MG	**27.09**
									Approximate Average Monthly Discharge, Permit G-10479, MG (0.5 Months of Well Field Use)	**54.17**
									Approximate Average Daily Discharge, Permit G-10479, MG (14 Days of Well Field Use)	**1.93**
									Approximate Average Monthly Discharge, Permit G-10479, MG (Full Calendar Year)	**2.26**
									Approximate Average Daily Discharge, Permit G-10479, MG (Full Calendar Year)	**0.07**
LL-1082	**PW-38**	38	SGA	8/26/08	3,136	1.13	11/13 to 11/21/08	2,851	32.67	33.80
									Approximate Total Annual Discharge, Permit LL-1082, MG	**33.80**
									Approximate Average Monthly Discharge, Permit G-10479, MG (0.5 Months of Well Field Use)	**67.59**
									Approximate Average Daily Discharge, Permit G-10479, MG (14 Days of Well Field Use)	**2.41**
									Approximate Average Monthly Discharge, Permit G-10479, MG (Full Calendar Year)	**2.82**
									Approximate Average Daily Discharge, Permit G-10479, MG (Full Calendar Year)	**0.09**

Notes: * Does not include approximately 15.1 MG for refill of Blue Lake or 80.0 MG for UV reactor validation testing
** All pumpage attributed to permit G-8755, since flow rates did not exceed maximum allowed by permit G-8755

Table 2-12. Calendar Year 2009 City of Portland Groundwater Use, Production Well Pumping Data by Aquifer and Use of Water

City Well Number	GW Permit Number	Total Monthly Discharge by Well in Millions of Gallons												Calendar Year Total by Well
		Jan 09	Feb 09	Mar 09	Apr 09	May 09	Jun 09	Jul 09	Aug 09	Sep 09	Oct 09	Nov 09	Dec 09	
Blue Lake Aquifer (BLA)														
PW12	G-8755/G-10455 *	0	0	4.585	6.492	0	0	2.399	6.439	17.148	173.378	2.650	0.155	213.247
PW13	G-8755/G-10455 *	0	1.138	0	0.871	0	0	5.083	10.685	16.461	281.838	6.055	3.638	325.767
PW17	G-10124	0	0	0	0	0	0	0	1.137	0	0	0	0	1.137
PW18	G-10124	0	0	0	0	0	0.350	11.008	12.297	0.447	0.327	14.437	7.844	46.710
PW19	G-10124	0	0	6.205	9.852	0	0	12.863	18.771	13.950	0	15.354	2.171	79.167
	Aquifer Totals	0	1.138	10.790	17.214	0	0.350	31.354	49.329	48.006	455.543	38.495	13.808	**666.03**
Sand and Gravel Aquifer (SGA)														
PW1	G-8755	0	0	0	0	0	0	3.004	0.884	11.719	27.229	0.047	0	42.883
PW2	G-8755	0	0	3.742	4.975	0	0	7.189	1.127	9.625	1.382	1.960	0.089	30.090
PW4	G-8755	0	0	0	0	0	0	1.362	2.528	0.124	0	7.026	1.210	12.250
PW6	G-8755	0	0	0	0	0	0	1.733	2.329	0.159	0	1.560	0.595	6.376
PW7	G-8755	0	0	2.790	0	0	0	0	0.599	5.970	15.741	0.521	1.143	26.765
PW8	G-8755	0	0.009	0	0.150	0	0	0	0.435	0	0	0	0	0.594
PW9	G-8755	0	0	1.042	0	0	0	2.423	0.805	9.829	100.831	1.514	1.229	117.673
PW11	G-8755	0.104	0	1.399	3.003	0	0	9.054	1.744	0.290	128.258	2.699	1.719	148.269
PW14	G-8755	0.339	5.781	0	0	0	0.102	15.021	0.589	0	1.378	1.127	0.008	24.344
PW16	G-8755	0	0	5.150	5.738	0	0	6.512	1.653	0.126	2.816	2.305	0.582	24.883
PW34	G-10479	0	0	0	0	0	0	0	1.146	0	92.778	0	0	93.925
PW35	G-8755	0	0	0	0	0	0	0	1.289	0	9.581	0	0	10.870
PW36	G-8755	0	0	0	0	0	0	0.409	1.250	0.109	0	0	0	1.768
PW37	G-8755	0	0	0	0	0	0	0	1.612	0	12.398	0	0	14.009
PW38	LL-1082	0	0	0	0	0	0	0	0.854	2.180	5.102	0	0	8.137
	Aquifer Totals	0.443	5.790	14.124	13.865	0	0.102	46.706	18.843	40.133	397.495	18.759	6.577	**562.84**
Troutdale Sandstone Aquifer (TSA)														
PW3	G-8755	0	0	0	0	0	0	0.032	3.282	0.010	0	0	0	3.324
PW5	G-8755	0	0	0.704	0.017	0	0	1.321	0.419	0	0.070	0	0	2.531
PW10	G-8755	0	0	2.185	0.620	0	0	0.901	0.735	0	38.779	0.050	0	43.270
PW15	G-8755	0	0	0.941	0.360	0	0	0.003	0.584	2.149	4.430	0	0.020	8.487
PW26	G-8755	0	0	0	1.296	0	0	0	0.575	0	0	0	0	1.871
PW28	G-8755	0	0	0	0.020	0	0	0	1.074	0	0	0	0	1.094
PW29	G-8755	0	0	0	0.987	0	0	0	0.440	0	0	0	0	1.427
	Aquifer Totals	0	0	3.830	3.300	0	0	2.257	7.110	2.159	43.279	0.050	0.020	**62.01**
	Well Field Totals	0.44	6.93	28.74	34.38	0	0.45	80.32	75.28	90.30	896.32	57.30	20.40	**1290.87**

CY 2009 Total GW Discharge, All Wells, All Uses, Individual Well Flow Meters	**1290.87**
Maintenance Operations to Supply, 8/5 to 8/13/09, All Wells, Individual Well Flow Meters	**31.19**
Summer Supply Augmentation, 9/28 to 10/28/09, BLA Wells Only	**502.49**
Summer Supply Augmentation, 9/28 to 10/28/09, SGA Wells Only	**436.15**
Summer Supply Augmentation, 9/28 to 10/28/09, TSA Wells Only	**45.43**
Summer Supply Augmentation, 9/28 to 10/28/09, All Wells, Individual Well Flow Meters	**984.07**
CY 2009 Total GW Supply to Distribution System, All Wells, Individual Well Flow Meters	**1015.26**
Maintenance Operations to Distribution System, 8/5 to 8/13/09, GWPS Outlet Flow Meter	**32.28**
Summer Supply Augmentation to Distribution System, 9/28 to 10/28/09, GWPS Outlet Flow Meter	**1076.79**
CY 2009 Total GW Supply to Distribution System, GWPS Outlet Flow Meter	**1109.07**
UV Reactor Validation Testing, Mar, Apr, Jul, Aug, Nov, Dec 2009	**219.9**
Blue Lake Refill, Jul, Aug 2009	**30.4**
Miscellaneous Other Pumping (Approximate)	**25.3**

Notes: All Results in Millions of Gallons

Table 2-13. Portland Parks and Recreation Well Crosswalk

Well Information		Water Rights Summary				
Site	**POD-ID**	**Appl. #**	**Permit #**	**Cert. #**	**Priority**	**Use**
Argay Park	12520	G-7140	G-6590	50730	10/23/75	IR
Cathedral Park	47119	G-16340	G-15899	82083	11/10/04	M
East Delta Park	11985	G-2304	G-2124	41717	04/23/62	IR
Eastmoreland G.C.	11987	S-41283	S-30829	82102	08/26/65	IR
Eastmoreland G.C.	11988	S-41283	S-30829	82102	08/26/65	IR
Heron Lakes G.C.	11005	G-4886	G-4601	44646	05/20/69	IR
Heron Lakes G.C.		G-16387	G-16140		02/11/05	IR
Kelly Point Park	61682	G-15980	G-15580	81283	04/14/03	M
Laurelhurst Park	61922	G-12139	G-11415	81315	06/07/90	IR
Lents Park	51824	G-14132	G-13077	81167	07/20/95	IR
Portland Int. Raceway	61686	G-15866	G-15690		10/31/02	M
Redtail G.C.	11989	G-2456	G-2272	81471	09/26/62	IR
Redtail G.C.	11990	G-2456	G-2272	81471	09/26/62	IR
Rose City G.C.	11994	G-4137	G-3773	80593, 83555	11/14/67	IR
Rose City G.C.	11986	G-4015	G-3767	80592, 83554	08/02/67	IR
Sellwood Park	47120	G-16341	G-15914	82734	11/12/04	M
Waterfront Park	47117	G-14498	G-13394	81318	04/14/97	M
Westmoreland Park		G-15957	G-15683		03/14/03	M

USER-ID 1204

2007 **Oregon Water Resources Department**
October 2007 through September 2008
Monthly Water Use Form 2008

Facility →	Argay Park	Cathedral Park	East Delta Park	Eastmoreland	Eastmoreland
Report ID →	12520	47119	11985	11987	11988
October - 2007	0	0	1,735	4,759	7,770
November - 2007					
December - 2007					
January - 2008					
February - 2008				-	
March - 2008	266	6,870	27,449	2,336	126,030
April - 2008	0	2,751	2,377	902	16,400
May - 2008	181,673	17,164	675,010	218,897	1,683,300
June - 2008	265,536	525,838	2,062,941	292,701	4,288,500
July - 2008	472,474	1,184,394	5,172,876	366,907	7,515,000
August - 2008	709,329	750,286	3,365,882	422,764	5,111,000
September - 2008	247,207	372,328	2,449,940	270,172	3,922,000
TOTAL *	1,876,485	2,859,631	13,758,210	1,579,438	22,670,000

* Describe the units of measurement as G (gallons), KG (thousand gallons), MG (million gallons), CF (cubic feet), MCF (million cubic feet), or AF (acre-feet)

Describe the method of measurement used: Electronic Flow Meter **If used for irrigation, total number of acres irrigated:** _____

I certify this information is true and accurate to the best of my knowledge.

Signature: [signature] Title: Sr Eng Associate Reporting Entity: _____ Date: 2/23/09

Name: Lisa M. Cameron Mailing Address: 6437 SE Division Portland OR 97206 Phone Number: (503) 823-1610

Please complete and mail to: Oregon Water Resources Department; Water Use Reporting Program;
725 Summer Street NE, Suite A; Salem, OR 97301-1266.

Figure 2-6. Water Year 2007-2008, Monthly Water Use for Portland Parks and Recreation Wells

USER-ID 1204

2007 **Oregon Water Resources Department**
October 2007 through September 2008
Monthly Water Use Form 2008

Facility → Report ID →	Heron Lakes GC 11005	Heron Lakes GC	Kelly Point Park 61682	Laurelhurst Park 61922	Lents Park 51824
October - 2007	18,500	3,260,000	7	0	5
November - 2007					
December - 2007					
January - 2008					
February - 2008					
March - 2008	150,600	50,000	2	1,769,200	0
April - 2008	57,900	0	0	531,437	9
May - 2008	2,563,006	3,160,000	0	747,543	286,053
June - 2008	3,490,003	8,170,000	516,960	576,432	1,183,571
July - 2008	6,540,773	21,760,000	729,480	738,516	1,812,845
August - 2008	3,549,987	9,100,000	619,353	293,932	1,393,913
September - 2008	3,740,278	7,300,000	33,744	294,483	702,806
TOTAL *	20,111,047	52,800,000	1,899,546	4,951,543	5,379,902

* Describe the units of measurement as G (gallons), KG (thousand gallons), MG (million gallons), CF (cubic feet), MCF (million cubic feet), or AF (acre-feet)

Describe the method of measurement used: Electronic Flow Meter **If used for irrigation, total number of acres irrigated:** _____

I certify this information is true and accurate to the best of my knowledge.

[signature]	Sr Eng Associate		2/23/09
Signature	Title	Reporting Entity	Date
Lisa M. Cameron	6437 SE Division St Portland OR 97206		(503) 823-1610
Name	Mailing Address		Phone Number

Please complete and mail to: Oregon Water Resources Department; Water Use Reporting Program;
725 Summer Street NE, Suite A; Salem, OR 97301-1266.

Figure 2-6. Water Year 2007-2008, Monthly Water Use for Portland Parks and Recreation Wells

USER-ID 1204

2007 **Oregon Water Resources Department**
October 2007 through September 2008
Monthly Water Use Form 2008

Facility → Report ID →	P.I.R. 61686	Red Tail GC (N) 11989	Red Tail GC (S) 11990	Rose City GC (E) 11994	Rose City GC (W) 11986
October - 2007	170,501	1027	994	0	0
November - 2007					
December - 2007					
January - 2008					
February - 2008					
March - 2008	435,530	0	3408	8	1,834
April - 2008	81,944	1,463	1,883	0	0
May - 2008	226,072	0	1,439,961	368,467	0
June - 2008	2,376,773	472,346	4,390,950	3,495,422	0
July - 2008	2,247,038	0	9,982,264	11,593,253	3336
August - 2008	1,594,049	1,076,122	4,762,790	6,140,350	33,330
September - 2008	1,210,816	928,374	4,814,490	2,405,960	1,481,500
TOTAL *	8,342,723	2,479,332	25,396,740	24,003,460	1,520,000

* Describe the units of measurement as G (gallons), KG (thousand gallons), MG (million gallons), CF (cubic feet), MCF (million cubic feet), or AF (acre-feet)

Describe the method of measurement used: Electronic Flow Meter **If used for irrigation, total number of acres irrigated:** _____

I certify this information is true and accurate to the best of my knowledge.

Signature _____ Title Sr Eng Assoc Reporting Entity _____ Date 2/23/09

Name Lisa M. Comer Mailing Address 6437 SE Division Portland, OR 97206 Phone Number (503) 823-1610

Please complete and mail to: Oregon Water Resources Department; Water Use Reporting Program;
725 Summer Street NE, Suite A; Salem, OR 97301-1266.

Figure 2-6. Water Year 2007-2008, Monthly Water Use for Portland Parks and Recreation Wells

USER-ID 1204

2007 **Oregon Water Resources Department**
October 2007 through September 2008
Monthly Water Use Form 2008

Facility →	Sellwood Park	Waterfront Park	Westmoreland Park		
Report ID →	47120	47117			
October - 2007	0	288	0		
November - 2007					
December - 2007					
January - 2008					
February - 2008					
March - 2008	49	0	0		
April - 2008	0	0	0		
May - 2008	94,587	368,996	3,388,816		
June - 2008	307,645	622,776	3,810,377		
July - 2008	836,268	1,693,798	4,807,957		
August - 2008	429,478	607,981	1,851,280		
September - 2008	180,173	606,137	1,917,700		
TOTAL *	1,848,200	3,899,976	15,776,130		

* Describe the units of measurement as G (gallons), KG (thousand gallons), MG (million gallons), CF (cubic feet), MCF (million cubic feet), or AF (acre-feet)

Describe the method of measurement used: Electronic Flow Meter **If used for irrigation, total number of acres irrigated:** _____

I certify this information is true and accurate to the best of my knowledge.

Signature: [signature] Title: Sr Eng Associate Reporting Entity: _____ Date: 2/23/09

Name: Lisa M. Cameron Mailing Address: 6437 SE Division Portland OR 97206 Phone Number: (503) 823-1610

Please complete and mail to: Oregon Water Resources Department; Water Use Reporting Program; 725 Summer Street NE, Suite A; Salem, OR 97301-1266.

Figure 2-6. Water Year 2007-2008, Monthly Water Use for Portland Parks and Recreation Wells

2007-8 MONTHLY WATER USAGE LOG

OCTOBER, 2007 NOTE: FIRST ENTRY FOR NEXT WATERING SEASON

1500 **ARGAY** 0 (0)	1500 **CATHEDRAL** 0 (12,194)	1502 **EAST DELTA** 1735 (501,533)	1500 **EASTMORELAND** *Crystal Springs* 4759 (139,002)	1000 **EASTMORELAND** *Golf Course (North)* 298X10 (696x100)	1000 **EASTMORELAND** *Golf Course (South)* 479X10 (688x1,000)
1000 **HERON LAKES** *Well #2 East* 0 (0)	1000 **HERON LAKES** *Well #2 South* 1850X10 (996x1,000)	1000 **HERON LAKES** *Well #2 West* 0 (0)	1000 **HERON LAKES** *Vanport Well #4* 326X10000 (485x10,000)	1500 **KELLY POINT** 7 (0)	1500 **LAURELHURST** 0 (513)
1502 **LENTS** 5 (37,944)	**PARKLANE**	1500 **PIR** 170501 (234,735)	1500 **REDTAIL** *North* 1027 (1,149)	1500 **REDTAIL** *South* 994 (1,455,618)	220B **REDTAIL** *Pump Station* 9919 (1,063,610)
1500 **ROSE CITY** *Well #3 East* 0 (722,198)	1000 **ROSE CITY** *Well #2 North* 0 (0)	1000 **ROSE CITY** *Well #2 South* 0 (160x1,000)	220B **ROSE CITY** *Pump Station* 45012 (933,274)	1500 **SELLWOOD** 0 (8,407)	1500 **WATERFRONT** 288 (578,816)
WESTMORELAND 0 (3,460,172)					

Figure 2-6. Water Year 2007-2008, Monthly Water Use for Portland Parks and Recreation Wells

2007-8 MONTHLY WATER USAGE LOG

MARCH, 2008

POD-ID 12520 **ARGAY PARK** 266 1500	POD-ID 47119 **CATHEDRAL PARK** 6870 1500	POD-ID 11985 **EAST DELTA PARK** 29184 1502	POD-ID 11987 **EASTMORELAND** *Rhody Gardens* 7095 1500	POD-ID 11988 **EASTMORELAND** *Golf Course (North)* 321 X 100 1000	POD-ID 11988 **EASTMORELAND** *Golf Course (South)* 1017 X 100 1000
POD-ID 11005 **HERON LAKES** *Well #2 East* Green Well 0 1000	POD-ID 11005 **HERON LAKES** *Well #2 South* Green Well 169 1 X 100 1000	POD-ID 11005 **HERON LAKES** *Well #2 West* Green Well 0 1000	POD-ID ????? **HERON LAKES** *Vanport Well #4* Black Well 331 X 10000 1000	POD-ID 61682 **KELLY POINT** 9 1502	POD-ID 61922 **LAURELHURST** 1769200 1500
POD-ID 51824 **LENTS** 0 ~~1500~~ 1502	POD-ID 61919 **PARKLANE**	POD-ID 61686 **PIR** 606031 1500	POD-ID 11989 **REDTAIL** *North* 1027 1500	POD-ID 11990 **REDTAIL** *South* 4402 1500	POD-ID **REDTAIL** *Pump Station* 57540 220B
POD-ID 11984 **ROSE CITY** *Well #3 East* 8 1500	POD-ID 11986 **ROSE CITY** *Well #2 North* 0 1000	POD-ID 11986 **ROSE CITY** *Well #2 South* 1834 1000	POD-ID **ROSE CITY** *Pump Station* 90454 220B	POD-ID 11986 **ROSE CITY PARK**	POD-ID 47120 **SELLWOOD** 49 1500
POD-ID 47117 **WATERFRONT** 288 1500	POD-ID ????? **WESTMORELAND** Surface Water 0				

Figure 2-6. Water Year 2007-2008, Monthly Water Use for Portland Parks and Recreation Wells

2007-8 MONTHLY WATER USAGE LOG

APRIL, 2008

POD-ID 12520 **ARGAY PARK** 266 1500	POD-ID 47119 **CATHEDRAL PARK** 9621 1500	POD-ID 11985 **EAST DELTA PARK** 31561 1502	POD-ID 11987 **EASTMORELAND** *Rhody Gardens* 7997 1500	POD-ID 11988 **EASTMORELAND** *Golf Course (North)* 355 X 100 1000	POD-ID 11988 **EASTMORELAND** *Golf Course (South)* 1147 X 100 1000
POD-ID 11005 **HERON LAKES** *Well #2 East* Green Well 0.0 1000	POD-ID 11005 **HERON LAKES** *Well #2 South* Green Well 0.0 1000	POD-ID 11005 **HERON LAKES** *Well #2 West* Green Well 227 X 1000 1000	POD-ID ????? **HERON LAKES** *Vanport Well #4* Black Well 331 X 10000 1000	POD-ID 61682 **KELLY POINT** 9 1502	POD-ID 61922 **LAURELHURST** 2300637 1500
POD-ID 51824 **LENTS** 9 1500	POD-ID 61919 **PARKLANE**	POD-ID 61686 **PIR** 687975 1500	POD-ID 11989 **REDTAIL** *North* 2490 1500	POD-ID 11990 **REDTAIL** *South* 6285 1500	POD-ID **REDTAIL** *Pump Station* 135903 220B
POD-ID 11984 **ROSE CITY** *Well #3 East* 8 1500	POD-ID 11986 **ROSE CITY** *Well #2 North* 0.0 1000	POD-ID 11986 **ROSE CITY** *Well #2 South* 1834 1000	POD-ID **ROSE CITY** *Pump Station* 119330 220B	POD-ID 11986 **ROSE CITY PARK**	POD-ID 47120 **SELLWOOD** 49 1500
POD-ID 47117 **WATERFRONT** 288 1500	POD-ID ????? **WESTMORELAND** Surface Water 0				

Figure 2-6. Water Year 2007-2008, Monthly Water Use for Portland Parks and Recreation Wells

2007-8 MONTHLY WATER USAGE LOG

MAY, 2008

POD-ID 12520 **ARGAY PARK** 181939 1500	POD-ID 47119 **CATHEDRAL PARK** 26785 1500	POD-ID 11985 **EAST DELTA PARK** 706571 1502	POD-ID 11987 **EASTMORELAND** *Rhody Gardens* 226894 1500	POD-ID 11988 **EASTMORELAND** *Golf Course (North)* 1965X100 1000	POD-ID 11988 **EASTMORELAND** *Golf Course (South)* 1637X1000 1000
POD-ID 11005 **HERON LAKES** *Well #2 East* Green Well 0 1000	POD-ID 11005 **HERON LAKES** *Well #2 South* Green Well 249X10000 1000	POD-ID 11005 **HERON LAKES** *Well #2 West* Green Well 6.4 1000	POD-ID ????? **HERON LAKES** *Vanport Well #4* Black Well 647X10000 1000	POD-ID 61682 **KELLY POINT** 9 1502	POD-ID 61922 **LAURELHURST** 3048180 1500
POD-ID 51824 **LENTS** 286062 1500	POD-ID 61919 **PARKLANE** 	POD-ID 61686 **PIR** 914047 1500	POD-ID 11989 **REDTAIL** *North* 2490 1500	POD-ID 11990 **REDTAIL** *South* 1446246 1500	POD-ID **REDTAIL** *Pump Station* 1936280 220B
POD-ID 11984 **ROSE CITY** *Well #3 East* 368475 1500	POD-ID 11986 **ROSE CITY** *Well #2 North* 0 1000	POD-ID 11986 **ROSE CITY** *Well #2 South* 1834 1000	POD-ID **ROSE CITY** *Pump Station* 525748 220B	POD-ID 11986 **ROSE CITY PARK** 	POD-ID 47120 **SELLWOOD** 94636 1500
POD-ID 47117 **WATERFRONT** 369284 1500	POD-ID ????? **WESTMORELAND** Surface Water 3388816				

Figure 2-6. Water Year 2007-2008, Monthly Water Use for Portland Parks and Recreation Wells

2007-8 MONTHLY WATER USAGE LOG

JUNE, 2008

POD-ID 12520 **ARGAY PARK** 447475 1500	POD-ID 47119 **CATHEDRAL PARK** 552623 1500	POD-ID 11985 **EAST DELTA PARK** 2769512 1502	POD-ID 11987 **EASTMORELAND** *Rhody Gardens* 519595 1500	POD-ID 11988 **EASTMORELAND** *Golf Course (North)* 522X1000 1000	POD-ID 11988 **EASTMORELAND** *Golf Course (South)* 560X10000 1000
POD-ID 11005 **HERON LAKES** *Well #2 East* Green Well 0.0 1000	POD-ID 11005 **HERON LAKES** *Well #2 South* Green Well 598X10000 1000	POD-ID 11005 **HERON LAKES** *Well #2 West* Green Well 9.7 1000	POD-ID ????? **HERON LAKES** *Vanport Well #4* Black Well 1464X10000 1000	POD-ID 61682 **KELLY POINT** 516969 1502	POD-ID 61922 **LAURELHURST** 3624612 1500
POD-ID 51824 **LENTS** 1467633 1500	POD-ID 61919 **PARKLANE** 	POD-ID 61686 **PIR** 3290820 1500	POD-ID 11989 **REDTAIL** *North* 474836 1500	POD-ID 11990 **REDTAIL** *South* 5837196 1500	POD-ID **REDTAIL** *Pump Station* 7036971 220B
POD-ID 11984 **ROSE CITY** *Well #3 East* 3863897 1500	POD-ID 11986 **ROSE CITY** *Well #2 North* 0.0 1000	POD-ID 11986 **ROSE CITY** *Well #2 South* 1834 1000	POD-ID **ROSE CITY** *Pump Station* 3623040 220B	POD-ID 11986 **ROSE CITY PARK** 	POD-ID 47120 **SELLWOOD** 402281 1500
POD-ID 47117 **WATERFRONT** 992060 1500	POD-ID ????? **WESTMORELAND** Surface Water 7199193				

Figure 2-6. Water Year 2007-2008, Monthly Water Use for Portland Parks and Recreation Wells

2007-8 MONTHLY WATER USAGE LOG

JULY, 2008

POD-ID 12520 **ARGAY PARK** 919949 1500	POD-ID 47119 **CATHEDRAL PARK** 1737017 1500	POD-ID 11985 **EAST DELTA PARK** 7942388 1502	POD-ID 11987 **EASTMORELAND** *Rhody Gardens* 886502 1500	POD-ID 11988 **EASTMORELAND** *Golf Course (North)* 1067X1000 1000	POD-ID 11988 **EASTMORELAND** *Golf Course (South)* 1257X10000 1000
POD-ID 11005 **HERON LAKES** *Well #2 East* Green Well 0.0 1000	POD-ID 11005 **HERON LAKES** *Well #2 South* Green Well 1252X10000 1000	POD-ID 11005 **HERON LAKES** *Well #2 West* Green Well 783 1000	POD-ID ????? **HERON LAKES** *Vanport Well #4* Black Well 364X100000 1000	POD-ID 61682 **KELLY POINT** 1246449 1502	POD-ID 61922 **LAURELHURST** 4363128 1500
POD-ID 51824 **LENTS** 3282478 1500	POD-ID 61919 **PARKLANE** 	POD-ID 61686 **PIR** 5537858 1500	POD-ID 11989 **REDTAIL** *North* 474836 1500	POD-ID 11990 **REDTAIL** *South* 15819460 1500	POD-ID **REDTAIL** *Pump Station* 16474814 220B
POD-ID 11984 **ROSE CITY** *Well #3 East* 15457150 1500	POD-ID 11986 **ROSE CITY** *Well #2 North* 0.7 1000	POD-ID 11986 **ROSE CITY** *Well #2 South* 517X10 1000	POD-ID **ROSE CITY** *Pump Station* 14007880 220B	POD-ID 11986 **ROSE CITY PARK** 	POD-ID 47120 **SELLWOOD** 1238549 1500
POD-ID 47117 **WATERFRONT** 2685858 1500	POD-ID ????? **WESTMORELAND** Surface Water 12007150				

Figure 2-6. Water Year 2007-2008, Monthly Water Use for Portland Parks and Recreation Wells

2007-8 MONTHLY WATER USAGE LOG

AUGUST, 2008

POD-ID 12520 **ARGAY PARK** 1629278 1500	POD-ID 47119 **CATHEDRAL PARK** 2487303 1500	POD-ID 11985 **EAST DELTA PARK** 11308270 1502	POD-ID 11987 **EASTMORELAND** *Rhody Gardens* 1309266 1500	POD-ID 11988 **EASTMORELAND** *Golf Course (North)* 1468X1000 1000	POD-ID 11988 **EASTMORELAND** *Golf Course (South)* 1728X10000 1000
POD-ID 11005 **HERON LAKES** *Well #2 East* Green Well 0.0 1000	POD-ID 11005 **HERON LAKES** *Well #2 South* Green Well 1607X10000 1000	POD-ID 11005 **HERON LAKES** *Well #2 West* Green Well 770 1000	POD-ID ????? **HERON LAKES** *Vanport Well #4* Black Well 455X100000 1000	POD-ID 61682 **KELLY POINT** 1865802 1502	POD-ID 61922 **LAURELHURST** 4657060 1500
POD-ID 51824 **LENTS** 4676391 1500	POD-ID 61919 **PARKLANE** 	POD-ID 61686 **PIR** 7131907 1500	POD-ID 11989 **REDTAIL** *North* 1550958 1500	POD-ID 11990 **REDTAIL** *South* 26582250 1500	POD-ID **REDTAIL** *Pump Station* 022178960 220B
POD-ID 11984 **ROSE CITY** *Well #3 East* 21597500 1500	POD-ID 11986 **ROSE CITY** *Well #2 North* 0.7 1000	POD-ID 11986 **ROSE CITY** *Well #2 South* 385X100 1000	POD-ID **ROSE CITY** *Pump Station* 019523527 220B	POD-ID 11986 **ROSE CITY PARK** 	POD-ID 47120 **SELLWOOD** 1668027 1500
POD-ID 47117 **WATERFRONT** 3293839 1500	POD-ID ????? **WESTMORELAND** Surface Water 13858430				

Figure 2-6. Water Year 2007-2008, Monthly Water Use for Portland Parks and Recreation Wells

2007-8 MONTHLY WATER USAGE LOG

SEPTEMBER, 2008

POD-ID 12520 **ARGAY PARK** 1876485 1500	POD-ID 47119 **CATHEDRAL PARK** 2859631 1500	POD-ID 11985 **EAST DELTA PARK** 13758210 1502	POD-ID 11987 **EASTMORELAND** *Rhody Gardens* 1579438 1500	POD-ID 11988 **EASTMORELAND** *Golf Course (North)* 1770X1000 1000	POD-ID 11988 **EASTMORELAND** *Golf Course (South)* 209X100000 1000
POD-ID 11005 **HERON LAKES** *Well #2 East* Green Well 0.0 1000	POD-ID 11005 **HERON LAKES** *Well #2 South* Green Well 1981X10000 1000	POD-ID 11005 **HERON LAKES** *Well #2 West* Green Well 1048 1000	POD-ID ????? **HERON LAKES** *Vanport Well #4* Black Well 528X100000 1000	POD-ID 61682 **KELLY POINT** 1899546 1502	POD-ID 61922 **LAURELHURST** 4951543 1500
POD-ID 51824 **LENTS** 5319197 1500	POD-ID 61919 **PARKLANE** 	POD-ID 61686 **PIR** 8342723 1500	POD-ID 11989 **REDTAIL** *North* 2479332 1500	POD-ID 11990 **REDTAIL** *South* 25396740 1500	POD-ID **REDTAIL** *Pump Station* 27194477 220B
POD-ID 11984 **ROSE CITY** *Well #3 East* 24003460 1500	POD-ID 11986 **ROSE CITY** *Well #2 North* 0-7 1000	POD-ID 11986 **ROSE CITY** *Well #2 South* 1520X1000 1000	POD-ID **ROSE CITY** *Pump Station* 23494797 220B	POD-ID 11986 **ROSE CITY PARK** 	POD-ID 47120 **SELLWOOD** 1848200 1500
POD-ID 47117 **WATERFRONT** 3899976 1500	POD-ID ????? **WESTMORELAND** Surface Water 15776130				

Figure 2-6. Water Year 2007-2008, Monthly Water Use for Portland Parks and Recreation Wells

2.3.1 Bull Run Watershed

The City has statutory rights to the water in the Bull Run watershed for municipal drinking water uses. In 1909, the state legislature enacted ORS 538.420 granting the City of Portland "the exclusive rights to the use of waters of the Bull Run and Little Sandy Rivers." The City also has filed claims to "pre-1909" water rights, with a priority date of 1886 on the Bull Run and a priority date of 1892 on the Little Sandy River.

In addition to its right to use Bull Run surface water for municipal drinking water, the City also holds rights to use of the Bull Run River for generating electricity. Prior to diversion for drinking water use, the City diverts the Bull Run River water through penstocks to hydroelectric turbines at Dam 1 and Dam 2. These Portland Hydroelectric Project power-houses operate under Federal Energy Regulatory Commission (FERC) license number 2821.

The City has not made use of its statutory water right on the Little Sandy River although a registered claim was submitted as noted above. The City and Portland General Electric (PGE) are the only entities with water claims or rights on the Little Sandy River.

2.3.2 Columbia South Shore Well Field

The City of Portland holds five groundwater permits for the CSSWF totaling 342 MGD. Rights for approximately 136 MGD have been developed, leaving 207 MGD of unexercised rights. See Figure 2-3 on page 2-10 for the location of each well in the well fields.

2.3.3 Former Powell Valley Road Water District Wells

Note: The City has obtained written approvals from the Oregon Water Resources Department (OWRD) to merge the requirement for a WMCP under the Powell Valley water right G-14007 to be contemporaneous with the City of Portland's WMCP submission.

With the absorption of the former Powell Valley Road Water District (PVRWD) wells, the Water Bureau acquired two water rights; one certificated right with a priority date of 1963, and one newer right with a priority date in 2000. See subsection 2.1.3 for a description of the wells, the Wellhead Protection Program, and a map.

2.4 Adequacy and Reliability of Existing Supply

This subsection addresses the requirements of OAR 690-086-0140 [3]: An assessment of the adequacy and reliability of the existing water supply considering potential limitations on continued or expanded use under existing water rights resulting from existing and potential future restrictions on the community's water supply

The City has three sources for its water supply: reservoir storage in the Bull Run watershed, the streamflow of the Bull Run River, and the groundwater from wells in the CSSWF. These resources are managed on a conjunctive-use basis.

Over the last 20 years, the City has examined a number of options for increasing water storage in the Bull Run system. In the future, the City will continue to explore these and other options to meet long-term water supply needs.

2.4.1 Bull Run Watershed

The Bull Run watershed is Portland's primary water source. The approximate median annual water yield from the Bull Run watershed (measured at Headworks, RM 6.5) is 180 billion gallons. The median annual diversion for water supply over the same period was about 36 billion gallons, or approximately 20 percent of the total median yield.

The reservoirs in the Bull Run are recharged during the wet fall, winter, and spring when rainfall is abundant. During the dry summer months (starting in June or July), the reservoirs are drawn down. This drawdown period typically lasts until early October but can sometimes last until November or December. During this period, the water flowing out of the reservoirs exceeds the infill from rainfall and tributary flow.

Hydrologic Limitations on Using Water from the Bull Run Watershed

Water demand varies annually, driven primarily by weather. In warm, dry summers when demand is high, the yield from the Bull Run watershed is at its lowest. In cool wet summers, water demand is often lower and yield from the Bull Run tends to be higher. Figure 2-7 shows a simplified view of demand and availability throughout the spring, summer, and fall.

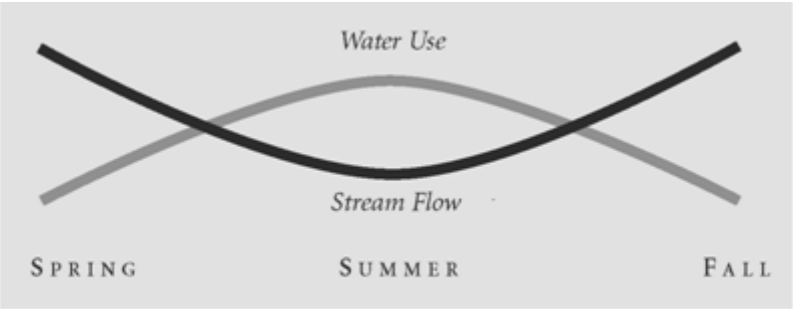


Figure 2-7. Simplified Diagram of Water Availability and Demand by Season for Three Seasons

The duration of the dry season is also important because it determines the time period during which the City will rely on the limited storage in the watershed's reservoirs. Long dry seasons increase the proportion of groundwater that the City uses to meet demand before fall rains return.

The two Bull Run reservoirs are relatively small in comparison to the amount of precipitation and stream discharge in the basin. The reservoirs are not large enough to provide a multi-year water supply. Refill each winter is necessary to ensure supply for the following summer.

The City's Actions to Study Climate Change

The City has kept detailed climate records for the past 66 years and continues to research and model climate patterns and their effect in the Bull Run watershed. The City also monitors current global and regional climate change information. The Water Bureau hired the University of Washington staff to develop a climate change study for the Bull Run watershed. This study was completed in 2002 and showed that winter precipitation would increase on average, but that snowmelt would provide less flow in spring. Although the

length of the longest drawdown period was not predicted to increase, the average length of drawdown for all years was expected to increase. The study also showed that the storage in the Bull Run system would still be filled each year, because overall winter flows in the watershed are still much greater than the amount stored.

Although global climate change models vary in predictions of precipitation amounts and patterns particularly in the summer, predictions of increased temperatures in the future show a more consistent trend. The University of Washington Climate Impacts Group's (CIG) review of newer global climate models for the 2007 Intergovernmental Panel on Climate Change reports show that, for the Pacific Northwest, the precipitation changes in the summer are still fairly unpredictable, and temperature increases are 10-20 years further in the future than predicted in studies conducted in 2002.

The City is preparing for climate change through research and monitoring, revising long-term planning models, working with other west coast cities on adaptation and mitigation strategies, developing its rights in the CSSWF to provide summer supply and emergency backup capacity, and supporting water conservation and sustainable water use practices.

Reliability of the Bull Run Supply

An analysis of seasonal (June-October) reservoir supply data from 1946-2004 shows a declining trend for total reservoir inflow for these months (City of Portland 2007). The City is monitoring inflow data to determine whether the trend will continue.

Regulatory Limitations on Using Water from the Bull Run Watershed

The City's Actions Regarding ESA Regulations

As described in Section 2.1.1 under "Regulations Affecting the Use of Bull Run Water," the City has drafted the *Bull Run Water Supply Habitat Conservation Plan* in preparation for seeking an Incidental Take Permit. The HCP covers anadromous fish species listed under the ESA that use the Bull Run and Sandy rivers. The HCP will, to the maximum extent practicable, minimize and mitigate the impacts of take on the listed species. As part of that HCP, the City is proposing to maintain instream flows in the lower Bull Run River, below City dams.[19] The City is already voluntarily implementing the proposed instream flows. The increased demands for fish coupled with municipal demands will require a greater proportion of the Bull Run supply than has been required in the past. The City plans to augment the Bull Run supply with groundwater from the Columbia South Shore Well Field (CSSWF) (Portland Water Bureau 2007c).

If approved, the City's HCP will be a 50-year contract with NMFS. The issue of an Incidental Take Permit will fulfill the City's regulatory obligation toward the species covered in the HCP.

The City's Actions Regarding CWA Regulations

As described in Section 2.1.1, the City is preparing a *Temperature Management Plan* (TMP) that outlines three strategies and the related management activities the City will undertake to

[19]Details on the proposed flows are available in Chapter 7 of the Draft HCP.

meet the criteria of the Clean Water Act. The City is proposing to implement riparian forest protections, and will manage the temperature of the water and control the amount of flow released to the lower Bull Run River especially during the summer peak season. The City plans to submit its TMP to the Oregon Department of Environmental Quality (ODEQ) in 2008.

2.4.2 Columbia South Shore Well Field

Groundwater provides the capacity to augment the Bull Run supplies in dry years. Since 1985, the City has used groundwater from CSSWF 12 times to augment the Bull Run supply during the summer season.[20] The duration of use varied from 12 days in 2001 to 88 days in 1987. Table 2-14 shows the Water Bureau's use of CSSWF wells as supply augmentation to the Bull Run water source by date, number of days used, average daily production, range of daily use, amount of water and aquifers used.

Groundwater also provides a year-round emergency backup for the Bull Run supply. When the U.S. Environmental Protection Agency (EPA) standards for turbidity in drinking water are exceeded in the Bull Run or when supply is limited due to other events such as landslides, the City shuts down the Bull Run supply and uses groundwater. This has happened 7 times since the well field became operational in the mid-1980s. Groundwater pumping for emergency backup has varied in duration from 4 to 27 days. Table 2-15 shows the Water Bureau's use of CSSWF wells during Bull Run shutdowns from 1984 to 2006.

[20] Drawdown periods for the Bull Run reservoirs can start as early as June and last as late as early October.

Table 2-14. Use of CSSWF Wells as Supply Augmentation to Bull Run Water Source, by Date

Start date	Days used	Average daily production	Range of daily use (MGD)	Approximate amount of water used (BG)	Aquifers used
June 25, 2007	73	23.5	8.05–80.1	1.73	BLA, SGA, TSA
August 14, 2006	79	46.0	4.5 – 72.0	3.58	TSA, SGA, BLA
July 27, 2004	28	36.5	36.0 – 37.0	1.01	TSA, SGA, BLA
July 22, 2003	63	58.8	20.8 – 72.6	3.70	TSA, SGA, BLA
October 8, 2001	12	38.7	6.9 – 45.8	0.44	TSA, SGA, BLA
August 9, 2000	41	29.6	10.0 – 36.0	1.70	TSA, SGA, BLA
September 4, 1996	27	27.7	13.0 – 31.0	0.70	BLA
August 2, 1994	73	26.0	2.0 – 36.0	2.50	TSA, BLA
August 17, 1992	45	23.0	17.0 – 30.0	1.50	TSA, 55 days; BLA, 45 days
August 7, 1990	23	9.6	4.7 – 14.0	0.22	BLA
September 4, 1987	88	60.0	28.0 – 86.0	5.30	—[a]
July 20, 1985	19	21.0	21.0	0.38	—[a]
Average number of days per use	48	*Approximate total amount of water used 1985–2007*		22.76	

[a]Data are not available.

Table 2-15. Use of CSSWF Wells During Shutdown of the Bull Run Supply, by Date

Start date	Days used	Average daily production	Range of daily use (MGD)	Approximate amount of water used (BG)	Aquifers used	Reason
November 7, 2006	14	78.6	27.8 – 92.2	1.1	TSA, SGA, BLA	Turbidity
January 29, 2004	4	18.4	18.4	0.04	SGA	Turbidity
November 25, 1999	19	78.9	19.0 – 89.0	1.5	TSA, SGA, BLA	Flood in the Bull Run River and turbidity in Bull Run supply
December 28, 1998	5	86.4	29.0 – 93.6	0.35	TSA, SGA, BLA, TGA, CRSA	Turbidity (rain on snow event)
February 7, 1996	8	61.5	4.9 – 86.6	0.5	TSA, SGA, BLA, TGA, CRSA	Flood in the Bull Run River and turbidity in Bull Run supply
November 28, 1995	27	25.4	5.1 – 29.8	0.7	BLA	Landslide in Bull Run watershed
February 25, 1986	22	49.0	21.0 – 84.0	1.2	—[a]	Turbidity
Average number of days per use	9	*Approximate total amount of water used 1985–2006*		5.39		

[a]Aquifer data are not available.

Operational Limitations and Reliability of the Current Groundwater System

There are three operational limitations on the reliability of the current groundwater operations at the Columbia South Shore Well Field: the aquifer yields over extended periods of time, the mechanical reliability of the system, and the presence of manganese in some of the CSSWF wells.

Although current well field capacity is sufficient to meet short-term (less than 30 days) emergency needs during the non-peak-season, there is no additional reliable capacity. The current capacity of the well field system is not sufficient to meet demand during a full shutdown of the Bull Run system due to emergencies or catastrophic events, for events longer than 30 to 90 days (depending on demand pattern at the time of need). The ability of the groundwater system to meet the full system demand for both short- and long-term emergencies assumes 100 percent reliability of all well and booster pumps and other infrastructure in the groundwater system.

The bureau has made assumptions about the ability to pump the well field over various periods based on drawdown data within the different aquifers utilized by the wells (Table 2-16). Pumping of the SGA may be limited in the future by the amounts of withdrawal from this aquifer by full-time and by growing municipal use in Clark County, Washington, and by users in Oregon withdrawing water east of the CSSWF from the same aquifers.

Table 2-16. Potential Rate of Use and Peak-season Volume for CSSWF Wells[a]

Number of days of pumping	Potential rate of use (MGD)	Potential peak-season volume (BG)
<30	102	3.1
30-90	92	8.6
More than 90	82 or less	More than 8.6

[a]SGA, BLA, and TSA wells

See Section 4, Water Curtailment, for an assessment of supply deficiencies and vulnerabilities and a discussion of the water curtailment plan. See Section 5, Element 4, Water Supply, for a full discussion of forecasted and projected demand and the necessity for extending existing permits.

If wells are out of service for routine maintenance or become unavailable due to unexpected equipment failures, the total volume of groundwater available will be incrementally reduced by the lost capacity of the unavailable wells.

High-manganese concentrations in two of the BLA wells have limited the ability of the Water Bureau to utilize these wells. The manganese can cause discoloration in the water which can affect the laundry businesses served by the Water Bureau. One of the two BLA wells affected by naturally high manganese concentrations has been taken out of service. The Water Bureau avoids using the high-manganese wells unless no Bull Run supplies are available and the full capacity of the well field is needed.

Regulatory Limitations on Using Groundwater

The City uses groundwater from the Columbia South Shore Well Field, in conjunction with the Bull Run River flows, to provide the total amount of water needed to meet water supply demands and the HCP flow commitments. The Columbia River is located adjacent to the well field; therefore the City analyzed the effects of the use of groundwater on flows in the Columbia River.

Effects of the Use of Groundwater on the Columbia River

Only one instream flow commitment has been established for the lower Columbia River to maintain the persistence of ESA-listed species. This flow is maintained by the federal Columbia River Power System with minimum flows of roughly 125,000 cfs below Bonneville Dam, unless competing priorities preclude it (USACE et al. 2006). These minimum flows are increased by contributions from the Sandy and Washougal rivers west of the dam and east of the Glenn Jackson Bridge (I-205 bridge).

The CSSWF has an estimated long-term 151-day sustainable capacity of approximately 82 million gallons per day (MGD), which is equivalent to approximately 127 cfs.[21] The actual amount and duration of pumping varies according to the weather and supply conditions, but the amount pumped per day for summer supply augmentation is typically between 20 and 70 MGD (approximately 30-110 cfs), significantly less than the full capacity of the well field.

If the City's groundwater pumping were to result in a direct and full 127 cfs reduction in Columbia River flows, that reduction would be at most 0.1 percent of the total minimum river flow (based on the 125,000 cfs minimum flows mentioned above). To put this reduction in perspective, the typical margin of error on measured flows for the Columbia River is +/- 10 percent.[22] This measurement error is significantly larger than the estimated flow reduction due to groundwater use. In addition, the City is confident, based on computer modeling, that there is not a one-to-one relationship between groundwater usage and river flow reductions. Assuming so, therefore, presents a worst-case analysis of groundwater pumping on Columbia River flows. The use of CSSWF is not expected to have an effect on Columbia River habitat for salmon and steelhead.

2.4.3 Conclusions Regarding the Adequacy and Reliability of the Existing Supply

The City has evaluated several options for maintaining and improving the adequacy and reliability of supplies the Bull Run watershed, CSSWF, and other sources. The results of these studies indicate that developing supplies in the CSSWF is the most cost-effective option. See subsections 5.5.2 and 5.5.3 for more information.

[21] Based on 151 days of use at a potential peak season volume of 13.6 BG (see Table 2-6).
[22] The accuracy of the gauges is indicated in the Remarks paragraph. "Good" means that 95 percent of the daily discharges are within 10 percent of true. See for example Remarks for Columbia River gage 14105700 at The Dalles (USGS 2005).

2.5 System Service Area

This subsection addresses the requirements of OAR 690-086-0140 [2] .A delineation of the current service areas and an estimate of the population served and a description of the methodology(ies) used to make the estimate.

Portland, Oregon, is the largest city in Oregon. Located in Multnomah County, Portland is a well-established mature city with a defined urban growth boundary (UGB). The UGB and the City's zoning laws encourage redevelopment and infill in the urban grid and density in newly developing areas.

Approximately 860,000 people living within a 225-square-mile service area around Portland are served by the Water Bureau's retail and wholesale water sales.[23] The Portland Water Bureau has supplied domestic water to residents of the Portland area for more than 100 years. The bureau is the largest supplier of domestic water in Oregon. The Water Bureau delivered 36 billion gallons (BG) to customers during fiscal year (FY) 2006-2007.

The 19 wholesale water customers are contiguous to the Water Bureau's retail service area, in Multnomah County and serve parts of neighboring Clackamas and Washington counties.

Figure 2-8 is a map of the Water Bureau's retail and wholesale service area for 2005-2006.

[23]This number reflects the average daily population served regularly; the total population number has been adjusted to reflect use of alternative water sources by wholesale customers. For more information, see the Demand Forecast Methodology subsection of Section 5.4 in Water Supply.

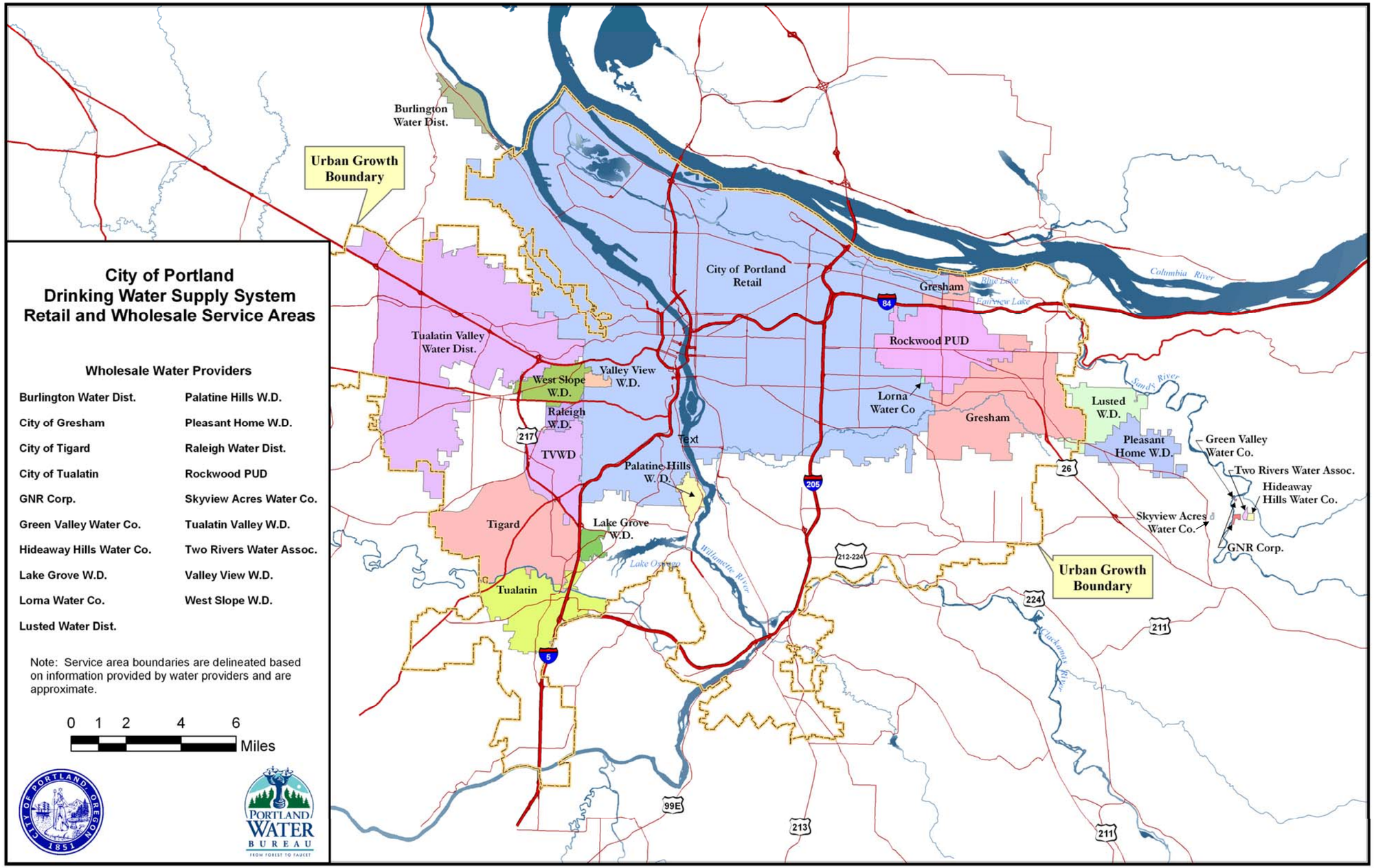


Figure 2-8. City of Portland Retail and Wholesale Service Areas

2.6 Service to Customers and Water Use Summary

This subsection addresses the requirements of OAR 690-086-0140 [6]: A description of customers served including other water suppliers and the estimated numbers; general water use characteristics of residences, commercial and industrial facilities, and any other uses; and a comparison of the quantities of water used in each sector with the quantities reported in the water supplier's previously submitted water management and conservation plan and progress reports.

In FY 2006-2007, the Water Bureau supplied approximately 60 percent of its water to retail accounts and approximately 40 percent to wholesale customers. These proportions vary each year depending on the weather and wholesale water districts' use of alternative sources of water supply. Figure 2-9 shows the proportion of average annual water demand among Portland's retail customers and 13 of the largest wholesale customers.

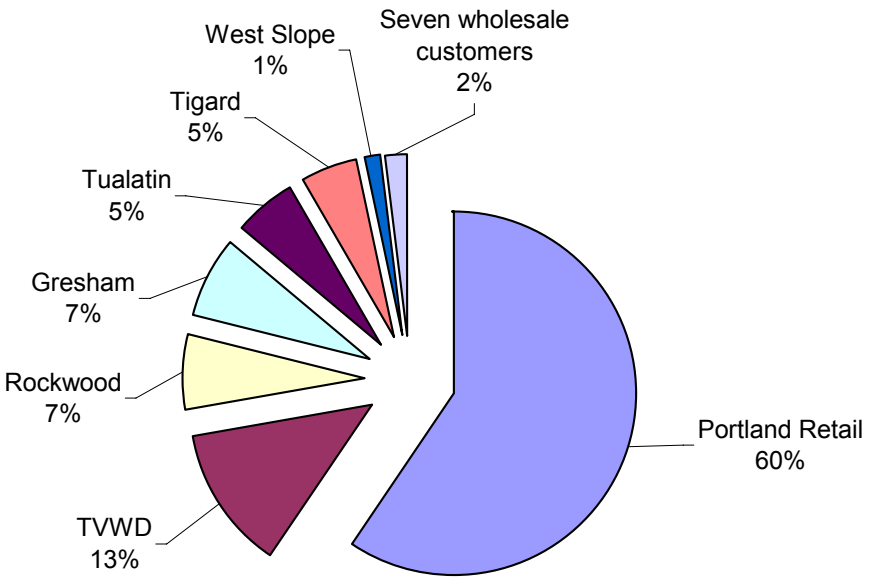


Figure 2-9. Percentage of Annual Average Water Demand for Retail and Wholesale Customers in Fiscal Year 2006-2007[a, b, c]

Source: Water Bureau billing data

[a]Total annual average demand for 2006-2007 was approximately 106 MGD

[b]The seven small wholesale customers are Burlington Water District, Lake Grove Water District, Lusted Water District, Palatine Hill Water District, Pleasant Home Water District, Raleigh Water District, and Valley View Water District.

[c]This figure does not include the following six smallest wholesale water providers: GNR Water Company, Green Valley Water Company, Hideaway Hills Water Company, Lorna Water Company, Skyview Acres Water Company, Two Rivers Water Association.

2.6.1 Retail Water Service

The Portland Water Bureau serves a mix of single- and multi-family residential retail and industrial, commercial, and institutional (ICI) customers. Portland's retail service area covers approximately 143 square miles and includes most of the city limits of Portland (except for a 12-square mile area served by Rockwood PUD).

Billing information for FY 2006-07 indicate that approximately half a million retail customers (545,300) purchased 21.4 billion gallons (BG) of water within the service area.[24] Table 2-17 shows average demand and peaking factors for the retail system for the past four fiscal years.

Table 2-17. Portland Summer Retail Demand Characteristics, Fiscal Years 2003-2004 to 2006-2007[a]

	Fiscal Year			
Consumption in MGD	**2003-2004**	**2004-2005**	**2005-2006**	**2006-2007**
Average annual sales	61.0	50.0	58.0	62.0
Average day during peak season	80.0	70.0	73.0	75.0
3-day peak	104.0	92.0	93.0	95.0
	Summer Season[c]			
Peaking factors[b]	**2003**	**2004**	**2005**	**2006**
Seasonal factor	1.3	1.2	1.3	1.2
3-day factor	1.7	1.5	1.6	1.5

[a]MGD=million gallons a day
[b]The peaking factor is the ratio of flow during a specified period to the average daily flow in a water system
[c]For the purposes of this table, the summer season is defined as the months of July, August, and September.

Table 2-17 indicates that the average summer seasonal peaking factor for the retail service area has been between 1.2 and 1.3 for the past four fiscal years.[25] The peak 3-day peaking factor is between 1.5 and 1.7 during the same time period.

[24] Population figures are based on Portland State University (PSU) Population and Research Center estimates and Metro's population forecasts as produced through the Metroscope modeling process, and capped by the Metro overall forecast as adopted by the Metro Council (Yee, 2002).

[25] The summer seasonal peaking factor is defined as the ratio between the summer average use and the annual average day water use.

These overall retail peaking factors are fairly low compared with national averages, and for the system as a whole because Portland

- has a low residential to ICI mix (about 55/45) and the ICI sector does not peak to the degree that residential typically does
- is an older city with smaller lot sizes and higher mix of multi-family to single family residences
- residents have developed an ethic or behavioral style of limiting outdoor water use (Campbell DeLong Resources, Inc., 1998)

The average per capita consumption for retail single-family residential customers was approximately 66 gallons a day for FY 2006-2007; the average per capita consumption for all retail customers this same year was 115 gallons a day.

More than half of the retail consumption in Portland is from residential users living in single- or multi-family homes. Table 2-18 shows the number of units of one hundred cubic feet (CCF) of water consumed and the percentage of the total by each retail customer class for calendar years 2003–2005.[26]

Table 2-18. Total Retail Consumption in CCFs by Customer Class, Calendar Years 2003–2005

	Calendar Year					
	2003		2004		2005	
Customer Class[a]	**# CCFs**	**%**	**# CCFs**	**%**	**# CCFs**	**%**
SFR	11,840,470	41	11,338,076	41	11,214,004	41
MFR	3,965,656	14	3,814,686	14	3,943,959	14
ICI	10,916,390	38	11,000,528	40	10,614,583	39
Other[b]	1,817,350	6	1,686,837	6	1,539,586	6
Total	28,539,866	100	27,840,127	100	27,312,132	100

Source: Portland Water Bureau systems billing data

[a]SFR is single-family residential; MFR is multi-family residential; ICI is industrial, commercial, and institutional

[b]Other includes water provided for fire flows, Water Bureau operations and maintenance needs, a small number of customers outside the city limits, and a small number of commercial customers (including one that uses groundwater only for ultraviolet testing)

[26] One CCF is a unit of one hundred cubic feet, which is 748 gallons.

Residential Retail Water Market

In 1999, the American Water Works Association Research Foundation conducted a study of indoor water use among residential customers of 12 water providers. The study indicated that nearly three quarters of all indoor water consumption was from using the shower, the clothes washer, or the toilet (see Figure 2-10). The Portland Water Bureau assumes that this breakdown of indoor water use is representative of water use among its residential retail customers.

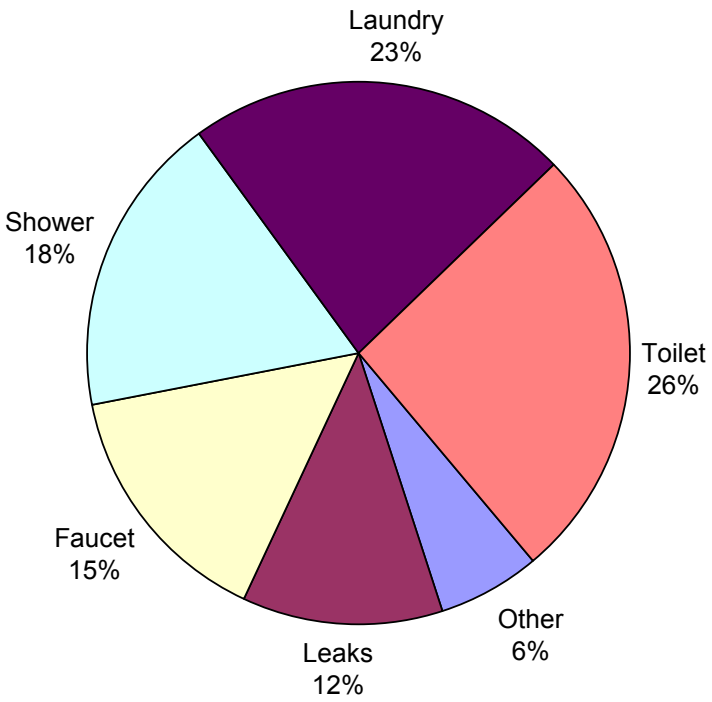


Figure 2-10. Assumed Residential Indoor Water Uses

Source: Mayer, 1999 Residential End User Survey

Variation in Summer Use

Summer irrigation, however, adds demand to the baseline of indoor water use. For example, during the winter of FY 2005-2006, 96 percent of all retail residential customers used less than 36 CCFs per customer. In the summer of that fiscal year, however, only 79 percent of retail residential customers used less than 36 CCFs, indicating that, in the summer, residential customers use more water.[27,28] Higher summer water use varies by the type of residential property. In 2005, single-family summer water use was 51 percent higher than winter use; multi-family residential summer water use was 24 percent higher than winter use.

[27]Based on 90 percent of all sampled bills

[28]36 CCFs is the equivalent of approximately 27,000 gallons of water

Top Residential Users

Billing information from 2005 indicates that the top 10 percent of the single-family residential accounts used approximately 28 percent of all the water consumed by the entire single-family residential sector (Figure 2-11), indicating a dramatic disparity in the amount of water used by a small percentage of users.

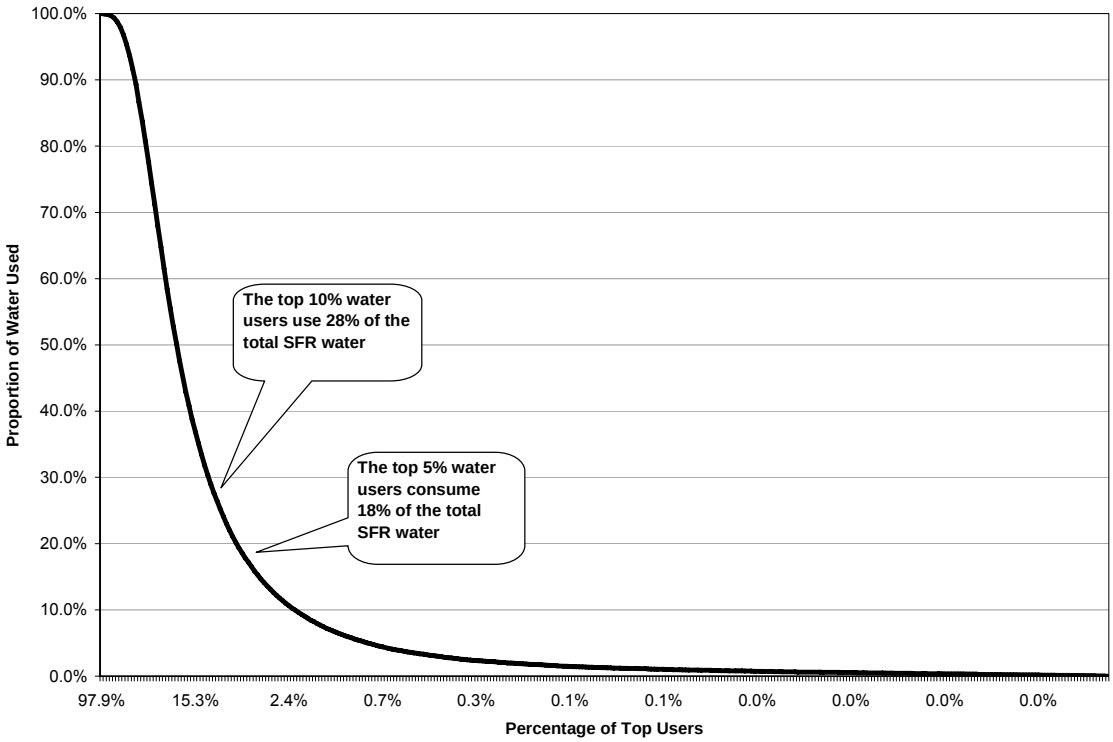


Figure 2-11. Water Use among Single-family Residential Users

Residential Water Use, Density, and Lot Sizes

Recent analyses on residential water use have shown correlations between residential lot size and water use (Bishop and Garg 2007, Tinker et al. 2005). According to the Utah Water Research Laboratory at Utah State University, lot size, along with persons per household and assessed value, are considered to be one of the best indicators of residential water use.

Since 1999, Portland has seen a rise in the density of development on the west side of the Willamette River, with redevelopment in the northwest Pearl District and the south waterfront district in the southwest quadrant. Density is also increasing in residential areas on the east side of the city, as infill and redevelopment occurs in existing neighborhoods.

With the increasing density in Portland, residential lot sizes are small and becoming smaller. Table 2-19 shows the average lot size for single and multi-family units for vacant and refill land (also known as infill land) between 1997 and 2001 (the latest year for which data are available).

Table 2-19. Average and Median Lot Size, Single- and Multi-family Units, Vacant and Refill Land, 1997–2001

	Lot size in square feet	
Land type	**Average**	**Median**
Vacant	6,495	4,660
Refill	3,957	2,997

Source: Regional Land Information System (RLIS) sample data, Metro Regional Government

Lot sizes for new construction are also trending toward smaller lots. The percentage of new single-family residences on lot sizes smaller than 5000 square feet grew from 14 percent in 1996 to 51 percent in 2002 (the latest year for which data are available). The percentages of new single-family residence construction on lot sizes between 5000 and 10,000 square feet declined by almost a third during that same period. (Metro Regional Government RLIS Lite, August 2003).

This trend toward diminishing lot sizes in Portland may be one factor contributing to the relatively flat demand for water in recent years.

Industrial, Commercial, and Institutional (ICI) Retail Water Market

The Water Bureau served approximately 19.5 thousand retail industrial, commercial, and institutional (ICI) users in the Portland area in FY 2006-2007. Portland's retail ICI water customers include health-care and building facilities, light and heavy manufacturing, and food service companies. ICI users consume nearly two-fifths (39 percent) of all retail water (see Table 2-18, above).

Among the top ICI customers are three manufacturing firms, six institutional users, and a hospital. The top 20 ICI customers for FY 2005-2006 are listed in Table 2-20.

The top water user among the nonresidential users, a semiconductor manufacturer, consumes nearly three times the water of the next-highest user, Portland Parks & Recreation (PP&R).[29] Semiconductor manufacturing is a water-intensive industry, requiring many thousands of gallons of water for cleaning and cooling the wafers. (Mendicino, et al. 1998)

[29] PP&R uses some water from its groundwater wells (which are noted in Table 2-3) and purchases the rest of its water from the Water Bureau.

Table 2-20. Top 20 ICI Water Users by Number of CCFs Used, Fiscal Year 2005–2006

Company name	# CCFs used	NAICS code[a]	NAICS or non-NAICS description
Siltronic Corporation	792,045	334413	Semiconductor and related device manufacturing
Portland Parks & Recreation	277,067[b]	n/a	Municipal park maintenance and administration
Oregon Health Sciences University	259,758	61131, 62211	Colleges, universities, and professional schools; general medical and surgical hospitals
City of Portland, Bureau of Maintenance	252,376	n/a	Maintenance and repair of all transportation- and sewer-related City infrastructure
Portland Public Schools	231,309	n/a	Maintain and operate more than 85 public school buildings and campuses
Precision Castparts	210,751	331511, 331528	Steel investment foundries, other nonferrous foundries (except die-casting)
Housing Authority of Portland	174,540	n/a	Oversees 6,300 public housing units and administers approximately 8,000 HUD-funded Section 8 rent-assistance vouchers
Port of Portland	157,490	n/a	Oversees Portland International Airport, general aviation, and marine activities in Portland
Cascade General Inc.	149,861	336611	Ship building and repairing
Multnomah County Facilities & Property Management	145,455	n/a	Supports the operation and maintenance of county-owned and -leased facilities including more than two million square feet of owned and leased space in 120+ properties
Portland State University	127,159	61131	Colleges, universities or professional schools
American Property Management	116,314	561110	Office administrative services
Westfarm Foods	116,304	311511	Fluid milk manufacturing

Table continued on next page.

Table 2-20. Top 20 ICI Water Users by Number of CCFs Used, Fiscal Year 2005–2006

Company name	# CCFs used	NAICS code[a]	NAICS or non-NAICS description
Providence Medical Center	105,560	622100	General medical and surgical hospitals
Oregon Zoo	106,852	712130	Zoos and botanical gardens
Emanuel Hospital	99,617	622100	General medical and surgical hospitals
Sapa Inc.	88,817	331316	Aluminum extruded product manufacturing
Good Samaritan Hospital	79,337	622100	General medical and surgical hospitals
Oregon Steel Mills	77,380	331111	Iron and steel mills

[a]The North American Industrial Classification System (NAICS) groups establishments into industries according to similarity in the processes they use to produce goods or services.

[b]PP&R also uses water from its own wells, listed in Table 2-3 in this section.

Data sources: Portland Water Bureau billing system data, total water usage and dollars billed, NAICS codes, and web sites for the Portland Parks & Recreation, Bureau of Maintenance, Housing Authority of Portland, Port of Portland, and the Multnomah County Facilities & Property Management

Through its Business, Industry, and Government (BIG) program, the Water Bureau works with ICI customers on water conservation measures. See Section 3, Water Conservation, subsections 3.1.7 and 3.1.10, for a description of water re-use and recycling programs used at some customers' commercial and industrial facilities.

Although current rates of growth in the ICI sector are flat, the Metro population forecasts used to prepare the *2000 Regional Transportation Plan* (Metro, 2004) are based on estimates that growth in industrial and commercial sector will bring approximately 10,000 new jobs to the Portland Harbor Area by the year 2020—a 36 percent increase over the number of jobs in the region in 2007. The Water Bureau is collaborating with the Bureau of Planning to identify the infrastructure needs for economic development predicted to occur in the industrial centers of northwest Portland, Swan Island, and the Rivergate subdistrict (Portland Water Bureau, 2007d).

2.6.2 Wholesale Water Service

In addition to supplying the citizens of Portland, the Water Bureau has wholesale contracts with 19 water purveyors in the Portland metropolitan area, including cities, water districts, and private water companies. Portland can potentially sell water to a wholesale population of approximately 418,000 and routinely provides wholesale service to more than 314,700 people. Annual wholesale water sales account for approximately 19 percent of the bureau's annual water sales and approximately 40 percent of annual water demand.

Figure 2-8 on page 2-57 shows the locations of all wholesale water customers served by the Portland Water Bureau.

Wholesale Sales Agreements

In 2006, new agreement terms were negotiated between the City and its public wholesale customers. Five of the 13 cities and public water districts have signed 10-year agreements, eight have signed 20-year agreements, and six small water companies have 5-year agreements with terms similar to the 10- and 20-year contracts. Appendix D is a sample 20-year wholesale water sales agreement. Table 2-21 shows the wholesale water customers by contract duration and whether the provider is a rural or urban provider.[30]

[30] "Rural" water providers are those that are outside the city's urban growth boundary. Although the current city policy is not to provide rural water service outside of the urban growth boundary, the Water Bureau's purchasing agreements were made with the seven rural water districts or companies that were served before land use planning guidelines had been adopted.

Table 2-21. Wholesale Water Customers by Contract Duration and Provider Type

Customer Name	Contract Duration			Provider Type	
	5-year	10-year	20-year	Rural	Urban
Burlington Water District			✓	✓	
City of Gresham			✓		✓
Lake Grove Water District		✓			✓
Lusted Water District			✓	✓	
Palatine Hill Water District			✓		✓
Pleasant Home Water District		✓		✓	
Raleigh Water District			✓		✓
Rockwood Water PUD			✓		✓
City of Tigard		✓			✓
City of Tualatin		✓			✓
Tualatin Valley Water District		✓			✓
Valley View Water District			✓		✓
West Slope Water District			✓		✓
GNR Water Company	✓			✓	
Green Valley Water Company	✓			✓	
Hideaway Hills Water Company	✓			✓	
Lorna Water Company	✓				✓
Skyview Acres Water Company	✓			✓	
Two Rivers Water Association	✓			✓	

The new water agreements are virtually identical except that the customers with 10-year agreements pay a higher rate to the City than those with 20-year agreements. Figure 2-12 shows the proportion of water use among 12 of the wholesale customers for FY 2005-2006.

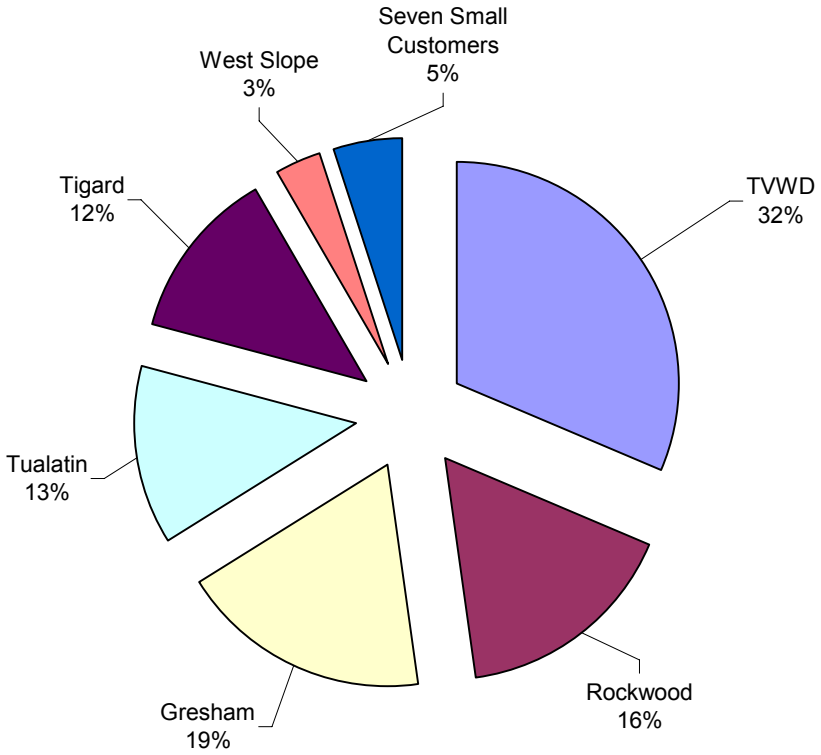


Figure 2-12. Percentage of Wholesale Water Use by Wholesale Water Provider, Fiscal Year 2006-2007[a,b]

Source: Portland Water Bureau billing data, 2006-2007

[a]The seven small wholesale customers are Burlington Water District, Lake Grove Water District, Lusted Water District, Palatine Hill Water District, Pleasant Home Water District, Raleigh Water District, and Valley View Water District.

[b]This figure does not include the following six smallest wholesale water providers: GNR Water Company, Green Valley Water Company, Hideaway Hills Water Company, Lorna Water Company, Skyview Acres Water Company, Two Rivers Water Association.

2.7 Present and Historical Use

This subsection addresses the requirements of OAR 690-086-0140 [4]: A quantification of the water delivered by the water supplier that identifies current and available historic average annual water use, peak seasonal use, and average and peak day use.

Since 1990, the population of Portland has increased every year due to immigration, population growth, and annexation. Data from the Center for Population Research at Portland State University indicate that the number of people in the City of Portland increased 28 percent between 1990 and 2006 (Proehl, 2007).[31]

Despite overall increases in population in both the retail and wholesale service areas, total water usage has declined since the 1990s, due to decreases in per capita consumption patterns as well as a decrease in the amount of wholesale water provided.

2.7.1 Water Use System-wide

Consumption per Capita

Each year for the past five years, the Water Bureau has provided approximately 33–37 billion gallons of water to its customers. Table 2-22 shows the total annual consumption system-wide, the total number of people served, the per capita annual consumption, and the per capita daily consumption for fiscal years (FYs) 2002–2003 through 2006–2007.

Table 2-22. System Consumption by Fiscal Year, FY 2002-2003 through FY 2006-2007

Consumption	Fiscal Year				
	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
Total annual system consumption[a]	35.9 BG	37.0 BG	32.9 BG	33.9 BG	36.0 BG
Total people served[b]	786,700	782,300	770,250	801,900	860,000
Per capita annual consumption	45,600 G	47,300 G	42,700 G	42,200 G	41,800 G
Per capita daily consumption	125 G	130 G	117 G	116 G	115 G

[a]Retail demand for FY 2003-2004 to FY 2005-2006 is based on data from billing system reports. Other years are based on historical trends.

[b]Population figures are based on Portland State University Population Research Center estimates and Metro's population forecasts updated from current U.S. Census data and regional growth patterns. Metro refined its population estimates in 2005.

The population numbers shown in Table 2-22 are estimates of the total system area population served by the Portland water system. These population estimates are derived in a different manner from the population estimates in Table 2-23. The estimates of population served by the Portland water system is based on figures provided by Metro and the Portland State University (PSU) population center (for some of the wholesale service areas).

The shifts in population totals in Table 2-22 from FY 2002-2003 to FY 2004-2005 are because of reduced wholesaling terms under older wholesale contracts. The population increases shown in FY 2005-2006 are due to a re-estimation of the region's population by Metro. The

[31] A small part of east Portland is served by the Rockwood PUD; these population numbers are included in the wholesale information.

increase in population observed in FY 2006-2007 is due to implementation of new wholesale contracts that resulted in a proportional increase in the population served by Portland water.

Although the population numbers in Table 2-22 may not agree in every instance with the population numbers in Table 2-13 (due to decennial census data, service area geography, and estimations of census data by different sources), the numbers are accurate enough for long-range planning purposes.

Table 2-23 shows the average daily demand (ADD), maximum daily demand (MDD), and gallons per capita per day (GPCPD) for the total population served by the Portland water system every year from 1960–2006. The population served number is utilized for the water demand forecasting methodology described in Element 4.

Table 2-23. Retail and Wholesale Annual Demand and Population Served, Calendar Years 1960–2006[a]

CY	ADD	MDD	GPCPD	Population	CY	ADD	MDD	GPCPD	Population
1960	83.9	217.9	148.7	564,500	1984	115.3	197.0	170.9	674,797
1961	85.9	205.9	150.7	570,147	1985	116.2	228.0	172.5	673,428
1962	84.3	179.5	147.7	570,835	1986	121.9	224.7	180.0	677,153
1963	85.3	156.9	147.3	579,418	1987	125.0	218.9	183.9	679,611
1964	86.3	178.5	145.7	592,206	1988	117.1	227.2	169.9	689,347
1965	95.5	209.7	156.4	610,772	1989	118.1	201.1	168.4	701,315
1966	95.3	189.0	154.9	615,444	1990	122.0	226.0	170.8	714,575
1967	102.3	217.1	166.4	614,967	1991	121.6	220.3	168.7	720,882
1968	94.4	212.6	153.2	616,360	1992	110.4	203.2	150.6	733,202
1969	101.7	207.8	163.9	620,317	1993	110.3	182.5	147.2	749,687
1970	109.0	227.8	174.9	623,122	1994	118.5	223.9	154.7	765,810
1971	105.8	222.4	166.9	634,267	1995	115.9	205.7	150.4	770,349
1972	115.2	225.3	184.1	625,560	1996	113.1	212.3	143.7	787,037
1973	113.9	202.9	180.8	629,851	1997	115.6	208.2	142.9	808,676
1974	110.1	188.0	172.2	639,416	1998	117.3	204.0	143.5	817,285
1975	105.0	191.0	161.4	650,463	1999	113.8	182.8	139.6	815,445
1976	107.7	237.8	164.6	654,380	2000	113.2	196.7	141.7	798,598
1977	107.4	217.7	162.7	659,908	2001	109.7	183.5	134.0	819,180
1978	108.4	219.2	163.3	663,377	2002	104.7	179.0	134.3	779,790
1979	120.6	225.5	180.5	668,096	2003	103.4	197.3	135.1	765,103
1980	117.1	230.7	175.4	667,811	2004	102.3	185.3	132.6	771,725
1981	116.1	225.9	172.9	671,340	2005	96.4	169.2	124.0	773,504
1982	119.5	220.5	177.1	674,538	2006	104.0	180.9	128.6	809,002
1983	108.9	172.9	162.3	670,821					

[a]Demand includes unbilled water which includes system leakage, reservoir and system flushing, and other municipal uses such as fire fighting that are not billed.

CY - calendar year

ADD - average daily demand in MGD

MDD- maximum daily demand in MGD

GPCPD - gallons per capita per day

Per capita consumption of water generally been decreasing since the late 1980s despite an increase in the population served. Although the average daily demand has hovered around

100 million gallons a day (MGD) since calendar year 2002, the average per capita use has declined since FY 2001-2002.

Figure 2-13 shows the 7-day moving average of demand for 2006 compared with the mean for the previous decade (1997–2006). The 7-day moving average for demand in 2006 is at or below the previous decade's mean for approximately 9 out of 12 months.

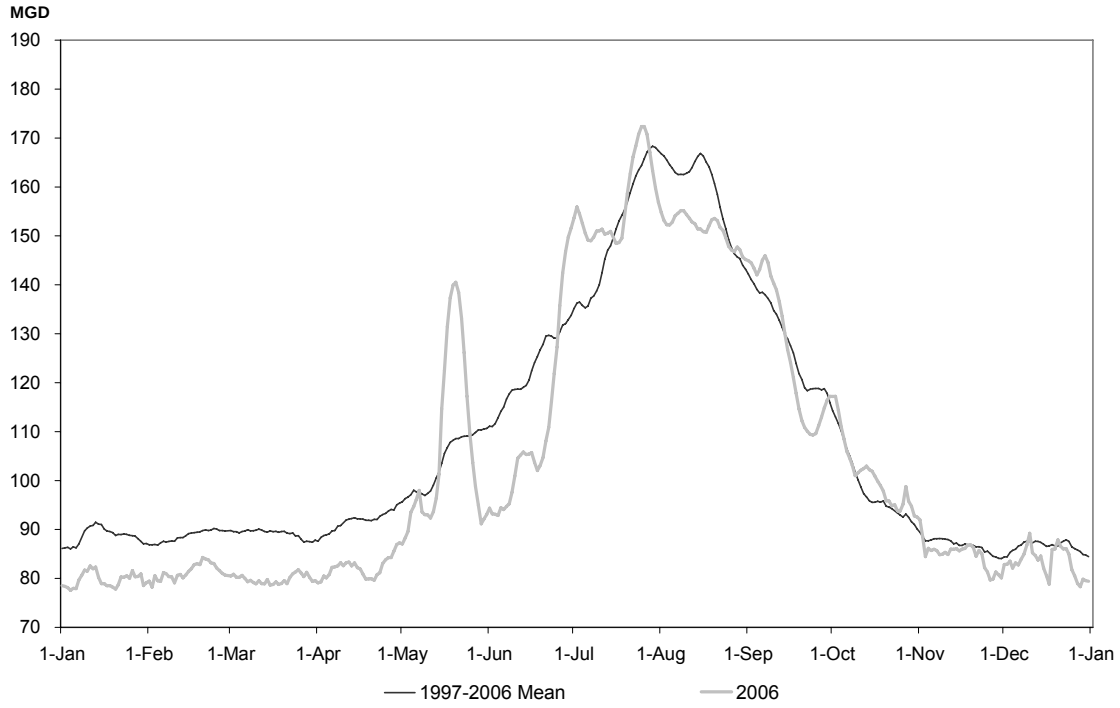


Figure 2-13. 7-day Moving Average of Total 2006 Water Demand Compared with Previous Decade Demand (1997–2006)

Source: Portland Water Bureau billing data

The decrease in per capita daily consumption for the past few years does not necessarily forecast a decreasing trend but could be attributed to the following factors:

- Summer weather in both 2004 and 2005 was wetter and cooler than normal.
- During FY 2005-2006, the billing system was changed and consumption reports were based on different data fields.
- Powell Valley Road Water District customers became Portland Water Bureau customers on July 1, 2005; customers' demand from this district is not part of the historical basis for retail consumption.
- Conservation programs have promoted low-flow plumbing
- Regulations for fixtures that have resulted in lower per-person consumption
- An increase in conservation behaviors among consumers

Peak Demand System-wide

The peak demand (or maximum daily demand) on the water system has been almost twice as high as the average daily demand in some years (Table 2-23). The difference between the peak demand and the average daily demand has decreased slightly in recent decades.

In the past five fiscal years, peak demand has varied from 177 MG in August of 2002 to 198 MG in July of 2003. Figure 2-14 shows the annual average demand as well as the peak demand by fiscal year for the past five fiscal years.

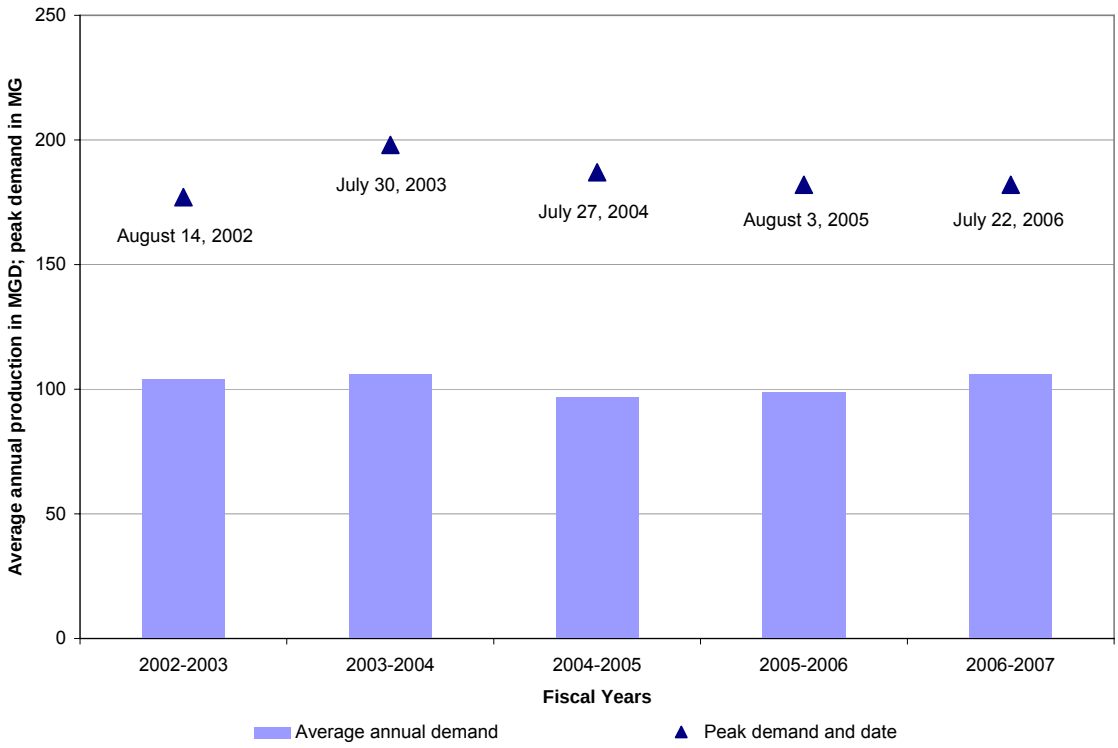


Figure 2-14. Peak Demand (in MG) by Date and Average Annual Demand (in MGD), FY 2002-2003 to FY 2006-2007

Source: Portland Water Bureau billing data

Seasonal Demand System-wide

In Figure 2-13, the peak demand period from the beginning of May through the end of October is clearly visible. This period roughly coincides with the onset of hot, dry weather in the Portland metropolitan area, indicating that water use increases when the rain decreases or stops.

Average winter and summer demand figures are respectively lower than, and higher than, the average annual demand. Figure 2-15 shows the average winter and summer demand compared with the average annual demand. The winter averages have been approximately 80 percent of the average annual demand for the past five years. In FY 2004-2005, the average winter demand was 85 percent of annual demand. Summer average demand varies from one-quarter to one-third more than the annual average demand.

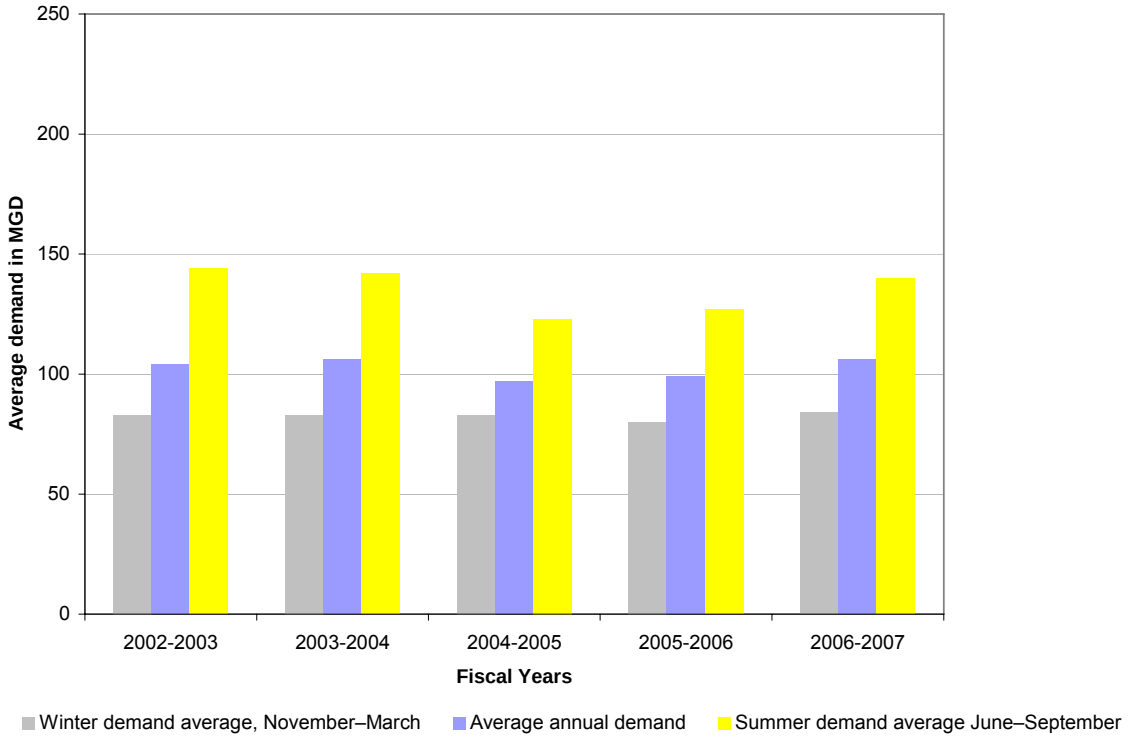


Figure 2-15. Average Winter Demand (November–March) and Summer Demand (June–September) Compared with Average Annual Demand

2.7.2 Detailed Water Use by All Retail Customers

In FY 2006-2007, Portland served an estimated 545,300 people and businesses through 180,100 services in the retail sector. The average daily consumption per service was 325 gallons. Table 2-24 gives a summary of retail consumption, number of people served, number of services, and the average daily consumption for the past five fiscal years.

Table 2-24. Retail Consumption and Number of Services by Fiscal Year, FY 2002-2003 through FY 2006-2007

Consumption	Fiscal Year				
	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
Total annual retail consumption[a]	20.9 BG	21.6 BG	20.1 BG	21.1 BG	21.4 BG
Total people served[b]	482,500	488,800	494,200	539,200	545,300
Number of services	163,900	165,350	166,250	178,500	180,100
Average daily consumption per service	349 G	358 G	331 G	323 G	325 G

[a]Retail demand for FY 03-04 to FY 05-06 is based on data from billing system reports. Other years are based on historical trends.

[b]Population figures are based on Portland State University (PSU) Population and Research Center estimates and Metro's population forecasts updated from the current census and growth patterns. Metro refined its population estimates in 2005. Most of the increase in retail population between 2004-2005 and 2005-2006 is because Powell Valley Road Water District was annexed by the Portland Water Bureau on July 1, 2005.

Small-meter Retail Residential Customers

The Water Bureau provided approximately 8.9 billion gallons of water to small-meter retail residential customers in FY 2006-2007 (Table 2-25). The number of services grew by approximately 8 percent from FY 2004-2005 to FY 2005-2006, reflecting both the increase in the population served and the annexation of the former Powell Valley Road Water District on the first day of the 2005-2006 fiscal year.

Table 2-25. Small-meter Residential Customer Consumption and Number of Services by Fiscal Year, FY 2002-2003 through FY 2006-2007[a]

Consumption	Fiscal Year				
	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
Total consumption[b]	8.7 BG	9.0 BG	8.2 BG	8.3 BG	8.9 BG
Number of services	135,000	137,000	137,700	149,000	150,400
Average daily consumption per service	177 G	180 G	163 G	153 G	162 G
Per capita daily consumption[c]	72 G	73 G	66 G	62 G	66 G

[a]Small meters are 5/8" and 3/4" nominal inlet diameter.

[b]Retail demand for FY 03-04 to FY 05-06 is based on data from billing system reports. Other years are based on historical trends.

[c]Recent Metro data identified 2.47 people per household. Prior year "per capita daily consumption" was updated from 2.6 people per household. The residential water consumption prior to the 1992 water shortage was 90 gallons per day per capita based on 2.47 people per household.

Large Meter Residential Customers

During FY 2006-2007, the Water Bureau provided 3.6 billion gallons of water to retail residential customers served by large meters—primarily those in multi-family residences (Table 2-26). The increase in the number of services between FY 2004-2005 and 2005-2006 is due in part to the annexation of the former Powell Valley Road Water District on July 1, 2005—the first day of the 2005-2006 fiscal year.

Table 2-26. Large-meter Residential Customer Consumption and Number of Services by Fiscal Year, FY 2002-2003 through 2006-2007[a]

	Fiscal Year				
Consumption	**2002-2003**	**2003-2004**	**2004-2005**	**2005-2006**	**2006-2007**
Total consumption[b]	3.2 BG	3.2 BG	3.1 BG	3.6 BG	3.6 BG
Number of services	9,900	8,600	8,650	10,300	10,400

[a]Large meters are meters 1" and larger.

[b]Retail demand for FY 0304 to FY 0506 is based on data from billing system reports. Other years are based on historical trends.

Industrial, Commercial, and Institutional Customers

Retail services to industrial, commercial, and institutional customers accounted for approximately 8.9 billion gallons of water in 2006-2007 (Table 2-27). Since FY 2002-2003, the net growth in this customer sector has been relatively flat.

Table 2-27. ICI Customer Consumption and Number of Services by Fiscal Year, FY 2002–2003 through FY 2006–2007

	Fiscal Year				
Consumption	**2002-2003**	**2003-2004**	**2004-2005**	**2005-2006**	**2006-2007**
Total consumption[a]	9.0 BG	9.4 BG	8.8 BG	9.2 BG	8.9 BG
Number of services	19,000	19,750	19,850	19,150	19,400
Average daily consumption per service[b]	1,720 G	1,740 G	1,630 G	1,780 G	1,690 G

[a]Retail demand for FY 0304 to FY 0506 is based on data from billing system reports. Other years are based on historical trends.

[b]Excludes services with minimal usage

2.7.3 Detailed Water Use by Wholesale Customers

Currently, the Water Bureau provides water to an estimated population of nearly 314,700 people in the Portland metropolitan area through wholesale contracts.[32] The combined area served through wholesale contracts is approximately 82 square miles. Table 2-28 shows the total wholesale consumption, wholesale consumption as a percentage of total consumption, population served, and the per capita daily consumption.

Table 2-28. Wholesale Customer Consumption and Number of Services, Fiscal Years 2002-2003 through 2006-2007

	Fiscal Year				
Consumption	**2002-2003**	**2003-2004**	**2004-2005**	**2005-2006**	**2006-2007**
Total consumption[a]	15.0 BG	15.4 BG	12.8 BG	12.8 BG	14.6 BG
Wholesale consumption as a percentage of total consumption	42%	42%	39%	38%	41%
Population served	304,100	293,500	276,050	262,700	314,700
Average per capita daily consumption	135 G	144 G	127 G	133 G	127 G

[a]Population figures are based on PSU Population and Research Center estimates and Metro's population forecasts updated from the current census and growth patterns. Metro refined its population estimates in 2005. The wholesale population estimate is adjusted to reflect the percentage of total water purchased by wholesale customers from alternative sources. The decrease in wholesale population between 2004-2005 and 2005-2006 is partly because Powell Valley Road Water District was annexed by the Portland Water Bureau on July 1, 2005.

During FY 2006-2007, the average per capita consumption for wholesale customers was approximately 127 gallons a day, compared with approximately 115 gallons a day per capita for the entire water system and 108 gallons a day for Portland's retail accounts. Overall, the 11 urban wholesale water users comprise areas with less urban density and a greater percentage of single-family dwellings than in the Portland city limits.

Table 2-29 shows wholesale water districts by number of CCFs used, revenue, active services and service population. Tualatin Valley Water District, with more than 6.1 million CCFs used, is the largest wholesale contract holder.

[32] The wholesale population estimate is based on the percentage of total water purchased from Portland compared with water served from other sources.

Table 2-29. City of Portland Wholesale Customer Statistics for Fiscal Year 2006-2007

Distributor	Consumption in CCFs[a]	Revenue in dollars[a]	Active Services[b]	Service Population[c]		
				Regular	Intermittent	Contract Expires
Burlington Water District	22,860	22,401	116	520		2026
City of Gresham	3,572,198	2,188,786	16,668	63,429	628	2026
Lake Grove Water District	167,995	106,057	1,225	1,693	1,402	2016
Lusted Water District	88,853	57,482	407	1,139		2026
Palatine Hill Water District	217,311	255,705	587	2,577		2027
Pleasant Home Water District	97,795	75,762	515	2,083		2016
Raleigh Water District	293,999	214,700	976	5,391		2026
Rockwood Water PUD	3,207,052	1,934,115	13,113	48,308	2,737	2026
City of Tigard	2,429,683	1,915,431	17,665	42,957	10,731	2016
City of Tualatin	2,580,123	1,647,914	6,614	24,082		2016
Tualatin Valley Water District	6,112,693	5,162,568	57,152	105,931	87,469	2016
Valley View Water District	74,889	68,433	404	1,415		2026
West Slope Water District	666,219	712,925	3,351	14,827		2026
Subtotal large users	**19,531,670**	**14,362,279**	**118,793**	**314,352**	**102,967**	
GNR Water Company	2,914	1,888	25	9		2011
Green Valley Water Company	345	322	3	10		2011
Hideaway Hills Water Company	2,043	1,280	14	6		2011
Lorna Water Company	9,747	5,618	90	240		2011
Skyview Acres Water Company	13,876	8,187	75	43		2011
Two Rivers Water Association	1,499	1,139	4	6		2011
Subtotal small users	**30,424**	**18,434**	**211**	**314**		
Total wholesale customers[a]	**19,562,094**	**14,380,713**	**119,004**	**314,666**	**102,967**	

[a]Consumption and revenue figures are adjusted for water sales to city customers.

[b]Source of active services: Distributors' reports of active services as of June 30, 2007.

[c]Population estimates are based on Metro's population forecasts. Wholesale customers with “intermittent” population numbers use water sources in addition to the water supplied by the City of Portland.

2.8 Transmission and Distribution Systems

This subsection addresses the requirements of OAR 690-086-0140 [8].

Portland's water system is the largest in Oregon. Approximately 2,300 miles of transmission and distribution lines serve the Water Bureau's retail and wholesale customers. The water mains range from 1 inch to 90 inches in diameter.

2.8.1 Transmission System

Three 22-mile long conduits carry the water from Dam 2 in the Bull Run watershed to the Water Bureau's in-town storage and distribution system. Conduits 2, 3, and 4 have a combined maximum capacity of approximately 210 MGD and have interconnections in three places to ensure reliability, should one or two conduits fail.

The water flows downhill from an elevation of 735 feet above mean sea level (MSL) then through the Lusted Treatment facility to Portland's easternmost storage reservoir on Powell Butte, at 530 feet above MSL. When the municipal water supply is from both Bull Run and the Columbia South Shore Well Field, the water is blended at Powell Butte.

2.8.2 Distribution System

The retail distribution system comprises 2,100 miles of mains connected to 67 active storage reservoirs and 39 pump stations, located in 42 service areas. Table 2-30 lists the retail distribution service areas and the number of service connections (according to Water Bureau maps as of August 2006).

Table 2-30. Distribution System Service Areas

Service Area	Number of Service Connections	Service Area	Number of Service Connections
Arlington Heights	825	Powell Butte Pump	50
Arnold	1,548	Powell Valley Road 415	3,782
Bertha	1,730	Powell Valley Road Pump	15
Broadway	604	Powell Valley Road Raymond	2,000
Burlingame	7,816	Rocky Butte	892
Calvary	643	Rocky Butte Pump	46
Clatsop	438	Rose Parkway	766
Clatsop Pump	277	Saltzman	8
Council Crest	1,334	Sherwood	679
Denver	225	Stephenson	1,383
Greenleaf	2,414	Stephenson Pump	379
Lexington	526	Tabor 302	32,362
Linwit	192	Tabor 411[a]	59,070

Table continued on next page.

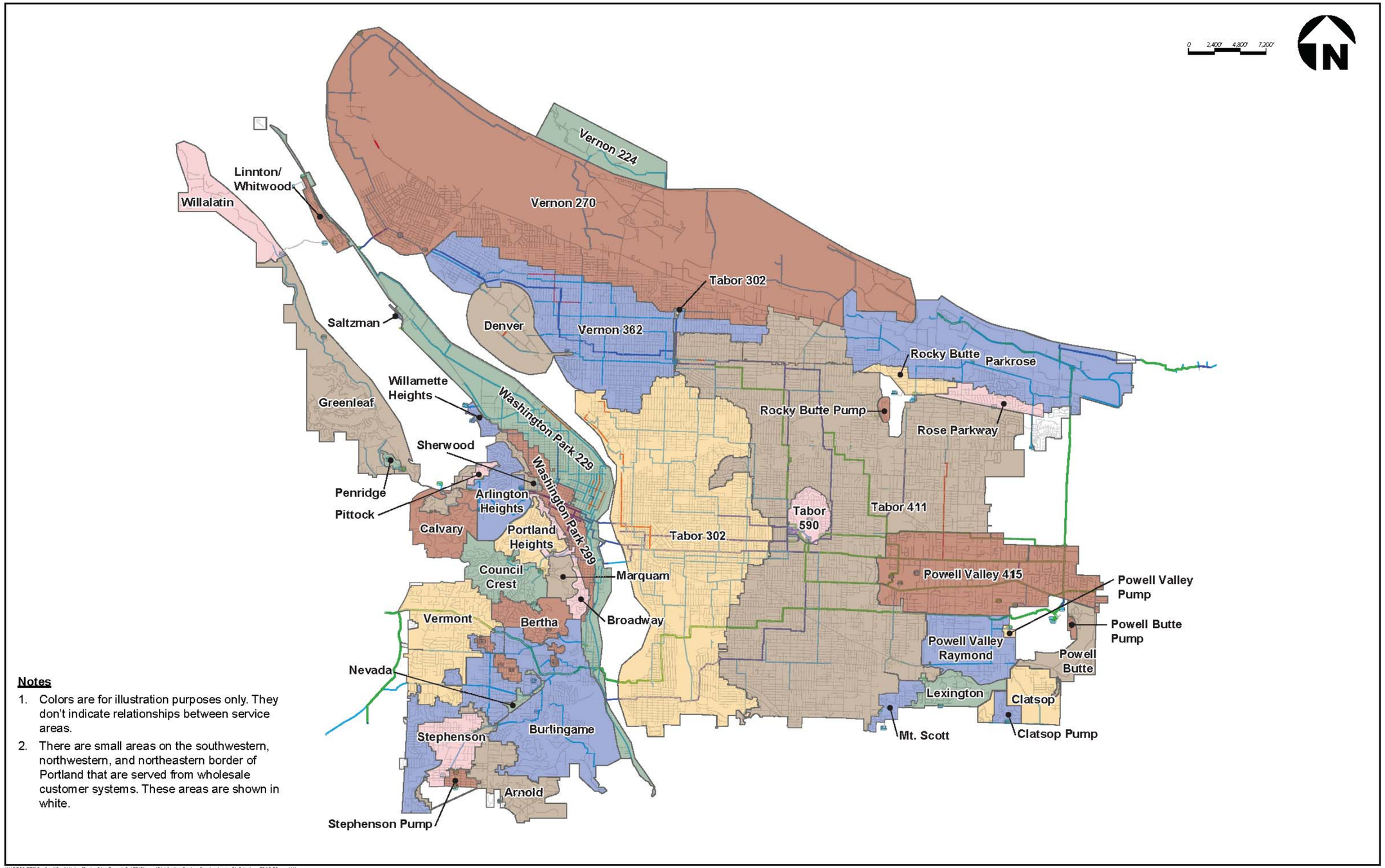
Table 2-30. Distribution System Service Areas

Service Area	Number of Service Connections	Service Area	Number of Service Connections
Marquam	170	Tabor 590	888
Mt. Scott	699	Vermont	3,650
Nevada	144	Vernon 224 & 270	15,932
Parkrose	4,167	Vernon 362	18,545
Penridge	37	Washington Park 229	5,223
Pittock	78	Washington Park 299	4,297
Portland Heights	1,323	Willalatin	213
Powell Butte	431	Willamette Heights	292
Total Service Connections			176,093

[a]The estimate for Tabor 411 includes Tabor 338

Figure 2-16, on the following page, is a map showing the location of the 42 retail service areas. For a schematic diagram of the entire Water Bureau system, including surface water supply in the Bull Run watershed, groundwater supply at the Columbia South Shore Well Field, and the transmission, storage, and distribution system, see Section 2.2, System Schematic on page 2-18.

The distribution system configuration has evolved over the past 100+ years, in response to changing requirements and regulations. Many parts of the system originated as small, independent water districts that have been incorporated into the Portland city system as the city grew.



Notes

1. Colors are for illustration purposes only. They don't indicate relationships between service areas.
2. There are small areas on the southwestern, northwestern, and northeastern border of Portland that are served from wholesale customer systems. These areas are shown in white.

Figure 2-16. Retail Service Areas

Mains

Portland's retail distribution system comprises more than 2,100 miles of pipeline. Figure 2-17 summarizes pipeline diameters in the distribution system. Distribution piping includes a number of materials, including galvanized steel, unlined and lined cast iron, ductile iron, and a small percentage of other materials.

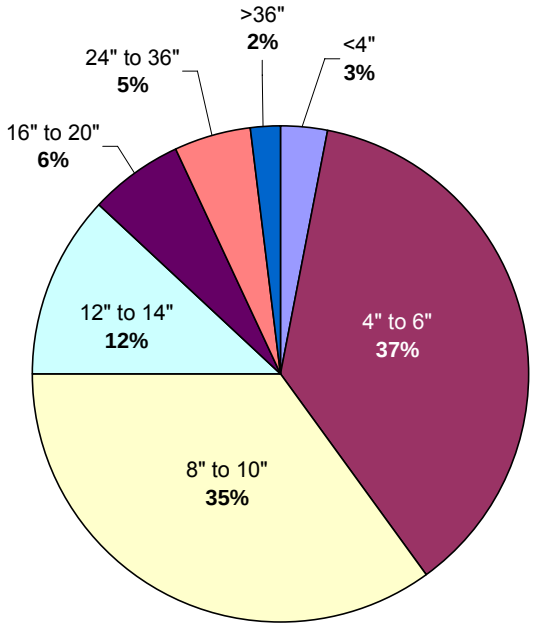


Figure 2-17. Pipeline Diameters in the Distribution System

Source: Water Bureau field data

Storage Reservoirs

The retail water system is served by 67 active storage reservoirs with a total storage capacity of approximately 270 million gallons. Table 2-31 lists the reservoir, its service area, capacity information, and whether the condition of the reservoir was assessed in 2006 as a part of the Distribution System Master Plan.

Table 2-31. Distribution Storage Reservoirs

Storage Tank	Service Area	Storage Capacity (MG)	Diameter[a] (feet)	Bottom Elevation (feet above MSL)	Depth to Overflow (feet)	Overflow Elevation (feet above MSL)	Condition Assessed[b,c]
101st Avenue	PV 415	0.5	54	382.6	29.0	411.6	✓
104th/Klickitat	Parkrose	4.0	151	230.0	30.0	260.0	✓
109th Avenue 1	PV 415	3.0	100	364.3	50.7	415.0	✓
109th Avenue 2	PV 415	0.7	64	382.5	28.5	411.0	—
148th/Halsey	Parkrose	2.0	130	240.0	20.0	260.0	✓
160th Avenue 1	PV 415	7.0	187	381.0	34.0	415.0	✓
160th Avenue 2	PV 415	3.0	135	386.9	28.1	415.0	✓
Alma	Vernon 270	1.0	70	211.0	35.0	246.0	✓
Alto Park	Arnold	0.2	48	654.0	15.0	669.0	✓
Arlington 1	Arlington	0.5	69	847.0	18.0	865.0	✓
Arlington 2	Arlington	1.0	92	845.0	20.0	865.0	✓
Arlington 3	Arlington	3.0	160	845.0	20.0	865.0	✓
Arnold 1	Arnold	0.5	65	665.0	20.0	685.0	✓
Arnold 2	Arnold	0.5	64	665.0	20.0	685.0	✓
Arnold 3	Arnold	0.6	65	663.0	22.0	685.0	✓
Bertha 1	Bertha	0.2	40	1,027.5	21.1	1,048.6	✓
Bertha 2	Bertha	0.9	80	1,026.1	22.5	1,048.6	✓
Broadway Drive	Broadway	0.4	45	464.0	32.0	496.0	✓
Buddington	Burlingame	0.3	46	609.0	21.0	630.0	✓
Burlingame 2	Burlingame	1.6	30	571.5	72.0	643.5	×
Burlingame 3	Burlingame	0.4	30	571.5	72.0	643.5	×
Burlingame 4	Burlingame	0.9	46	574.5	69.0	643.5	×
Calvary	Calvary	1.0	64	1,003.0	41.0	1,044.0	✓
Clatsop	Clatsop	3.0	130	784.0	30.0	814.0	✓
Council Crest	Council Crest	0.5	35	1,074.0	70.0	1,144.0	✓
Denver	Denver	3.0	37	288.0	40.0	328.0	✓
Forest Park	Greenleaf	0.5	NC	1,219.5	30.5	1,250.0	—
Greenleaf 1	Greenleaf	0.03	13	1,224.7	30.3	1,255.0	✓
Greenleaf 2	Greenleaf	0.3	43	1,220.7	29.3	1,250.0	✓
Kelly Butte	Tabor 411	10.0	268	415.3	23.7	439.0	✓
Kings Heights	Arlington	0.2	39	843.0	22.0	865.0	✓
Lexington	Lexington	1.0	92	638.0	20.0	658.0	✓
Marigold	Burlingame	1.0	18	588.5	45.3	633.8	✓
Marquam Hill 1	Marquam	0.3	35	697.0	40.0	737.0	✓

Table continued on next page.

Table 2-31. Distribution Storage Reservoirs

Storage Tank	Service Area	Storage Capacity (MG)	Diameter[a] (feet)	Bottom Elevation (feet above MSL)	Depth to Overflow (feet)	Overflow Elevation (feet above MSL)	Condition Assessed[b,c]
Marquam Hill 2	Marquam	2.3	92	691.0	46.0	737.0	✓
Mayfair	Washington Park 299	5.6	180	270.0	29.5	299.5	✓
Mt. Scott	Mt. Scott	0.4	46	490.0	32.0	522.0	✓
Mt. Tabor 1	Tabor 411	12.0	NC	378.6	36.5	415.1	—
Mt. Tabor 5	Tabor 411	49.0	NC	380.0	36.1	416.1	—
Mt. Tabor 6	Tabor 302	37.8	NC	283.0	22.1	305.1	—
Mt. Tabor 7	Tabor 590	0.2	39	568.0	22.0	590.0	✓
Nevada Ct	Nevada	0.6	76	566.0	18.0	584.0	✓
North Linnton	Washington Park 229	1.0	75	150.0	30.0	180.0	✓
Penridge	Penridge	0.1	13	1,270.0	45.0	1315.0	✓
Pittock	Pittock	1.0	92	970.0	20.0	990.0	✓
Portland Heights 1	Portland Heights	0.6	75	848.0	18.0	866.0	✓
Portland Heights 2	Portland Heights	0.5	70	848.0	18.0	866.0	✓
Portland Heights 3	Portland Heights	1.9	120	844.0	22.0	866.0	✓
Powell Butte N/S	Powell Butte	50.0	NC	495.7	34.8	530.5	—
PV 138th/Center (Gilbert)	PV Raymond	0.0	22	232.0	11.0	243.0	✓
PV 144th/Center (Vivian)	PV 415	0.2	36	226.0	20.5	246.5	✓
PV 160th Avenue 1	PV 415	7.0	187	381.0	34.0	405.0	✓
PV 160th Avenue 2	PV 415	3.0	135	386.9	28.0	404.9	✓
Raymond	PV Raymond	2.0	117	410.0	25.0	435.0	✓
Rivergate	Emergency	1.5	89	31.0	32.0	63.0	✓
Rocky Butte	Rocky Butte	0.5	53	360.0	29.0	389.0	✓
Rose Parkway	Rose Parkway	0.5	1	290.5	35.0	325.5	✓
Sam Jackson 2	Washington Park 299	2.8	97	250.0	49.5	299.5	✓
Sherwood	Sherwood	0.4	52	510.0	24.0	534.0	✓
St Johns 1	Out of Service	0.4	25	150.0	96.0	246.0	✓
St Johns 2	Vernon 270	1.5	28	211.0	35.0	246.0	✓
Stephenson 1	Stephenson	1.3	85	739.2	23.8	763.0	✓
Stephenson 3	Stephenson	0.3	49	745.4	17.6	763.0	✓

Table continued on next page.

Table 2-31. Distribution Storage Reservoirs

Storage Tank	Service Area	Storage Capacity (MG)	Diameter[a] (feet)	Bottom Elevation (feet above MSL)	Depth to Overflow (feet)	Overflow Elevation (feet above MSL)	Condition Assessed[b,c]
Texas	Burlingame	0.7	70	607.5	23.5	631.0	✓
Vermont Hills 2	Vermont	0.6	76	569.6	17.0	586.6	✓
Vermont Hills 3	Vermont	0.9	87	567.1	19.5	586.6	✓
Vermont Hills 4	Vermont	0.5	67	565.0	20.0	585.0	✓
Vermont Hills 5	Vermont	2.8	160	566.4	18.6	585.0	✓
Vernon 2	Tabor 302	2.5	90	310.9	52.0	362.9	✓
Vernon 3	Vernon 362	3.2	94	243.3	61.7	305.0	✓
Washington Park 3	Washington Park 299	16.0	NC	250.5	51.0	301.5	—
Washington Park 4	Washington Park 229	17.6	NC	189.0	41.0	230.0	—
Westwood	Burlingame	1.0	92	633.0	20.0	653.0	✗
Whitwood	Linwit	0.1	30	552.0	25.0	577.0	✗
Willalatin	Willalatin	0.2	3	1,171.0	29.0	1200.0	✓
Willamette Heights	Willamette Heights	0.1	25	428.0	17.0	445.0	✗
	Total	283.6					

[a]NC = Non-cylindrical

[b]✗ indicates condition assessed in other studies. Results and improvements incorporated into Distribution System Master Plan.

[c]—indicates condition has not been assessed recently

Pump Stations

The distribution system includes 39 pump stations. Table 2-32 lists the capacity and other essential features of each pump station, and whether a condition assessment was performed in 2006 as a part of the Distribution System Master Plan.

Table 2-32. Distribution System Pump Stations

Pump Station	Service Area Supplied	No of Units	Firm Capacity[a] (gpm)	Condition Assessed[b, c]
105th & Fremont	Out of Service	2	510	✓
112th Avenue	Lexington	3	1100	✓
162nd Avenue	Clatsop	3	880	✓
1st & Kane	Powell Butte	2	Unavailable	✓
Arlington Heights	Arlington Heights	2	Unavailable	✓
Arnold	Stephenson	2	1000	✓
Barbur Gibbs	Marquam	3	1300	✓
Burnside	Calvary	2	470	✓
Calvary	Greenleaf	4	1900	✓
Capitol Hwy	Arnold	3	2500	✓
Carolina	Burlingame	6	10800	✗[b]
Clatsop	Clatsop Pump	3	775	✓
Fulton	Burlingame	6	6400	✓
Greenleaf	Penridge	2	130	✓
Hoyt Park	Calvary	3	2800	✓
Linnton	Linwit	3	130	✓
Marquam Hill 1 & 2	Bertha	4	2410	✗[b]
Mt. Tabor	Tabor590	3	1200	✓
Portland Heights	Council Crest	4	4300	✓
Powell Butte Heights	Powell Butte Pump	4	1480	✓
PV 138TH / Center	PV Raymond	3	1100	✓
PV 144th / Center (Vivian)	Inactive	3	Unavailable	✓
PV Raymond Street	PV Pump	5	440	✓
Rivergate	Emergency	3	Unavailable	✓
Rocky Butte	Rocky Butte Pump	2	200	✓

Table continued on next page.

Table 2-32. Distribution System Pump Stations

Pump Station	Service Area Supplied	No of Units	Firm Capacity[a] (gpm)	Condition Assessed[b, c]
Saltzman	Saltzman	2	75	—
Sam Jackson (Broadway)	Broadway	2	800	✓
Sam Jackson (Marquam)	Marquam	2	2100	
Sam Jackson (Portland Hts)	Arlington Heights/ Portland Heights	2	1700	
Springville	Willalatin	3	630	✓
Stephenson	Stephenson Pump	3	500	•[c]
Taylors Ferry	Arnold	2	2000	✓
Tenino Ct.	Mt. Scott	2	320	✓
Verde Vista	Pittock	2	1000	✓
Washington Park 1	Arlington Heights/ Portland Heights	4	3200	✓
Washington Park 2	Arlington Heights/ Portland Heights	6	7500	✓
Washington Park 2 (Sherwood)	Sherwood	2	1400	
Washington Park 3	Arlington Heights/ Portland Heights	2	1300	✓
Whitwood	Linwit	3	640	✓

[a]Pump station firm capacity is the pump station capacity with the largest unit in the pump station out of service. Firm capacities were estimated by Water Bureau, using the hydraulic model.

[b]✕ indicates pump station assessed in other studies. Results and improvements included in Distribution System Master Plan.

[c]• indicates pump station recently constructed, so pump station was not included in the condition assessment.

[d]—indicates pump station condition has not been assessed recently.

2.9 Interconnections

This subsection addresses the requirements of OAR 690-086-0140 [7]: Identification and description of interconnections with other municipal supply systems.

The Water Bureau maintains 46 interconnections with other water suppliers. Figure 2-18 shows the locations of the interconnections and Table 2-33 lists the interconnections and the location, size, and maximum capacity of the pipes.

Most of these interconnections are from the Water Bureau's transmission conduits or distribution system to wholesale customers on the east and west sides of the Portland retail service area. These interconnections vary in size from quite small (e.g. Lorna Water Company, Valley View Water District, and small water companies from a back feed line from the Lusted treatment facility) to large connections off the primary transmission conduits (Gresham and Rockwood PUD) or from the Washington County Supply Line from Powell Butte (Tualatin Valley Water District (TVWD), Raleigh Water District, the City of Tualatin). All of the wholesale customer connections have master meters to quantify the amounts of water sold. Very few of these interconnections with wholesale providers are capable of passing supply to Portland, either due to infrastructure issues or because those wholesale customers do not have other supplies available.

There are a few interconnections with other water providers with whom Portland does not have wholesale contracts: Clackamas River Water, Lake Oswego, Beaverton, and the City of Milwaukie. These interconnections have been used in the past for emergency provision of water supplies either from or to Portland. The total amount of water that can be passed between these non-contract customers and Portland is fairly limited at this time (around 6.5 MGD).

The City has been discussing other interconnections with wholesale customers (e.g. TVWD) to move water from the Joint Water Commission system to Portland for emergency purposes, as well as other discussions with entities on the east side of the Portland service area. No projects are proposed at this time.

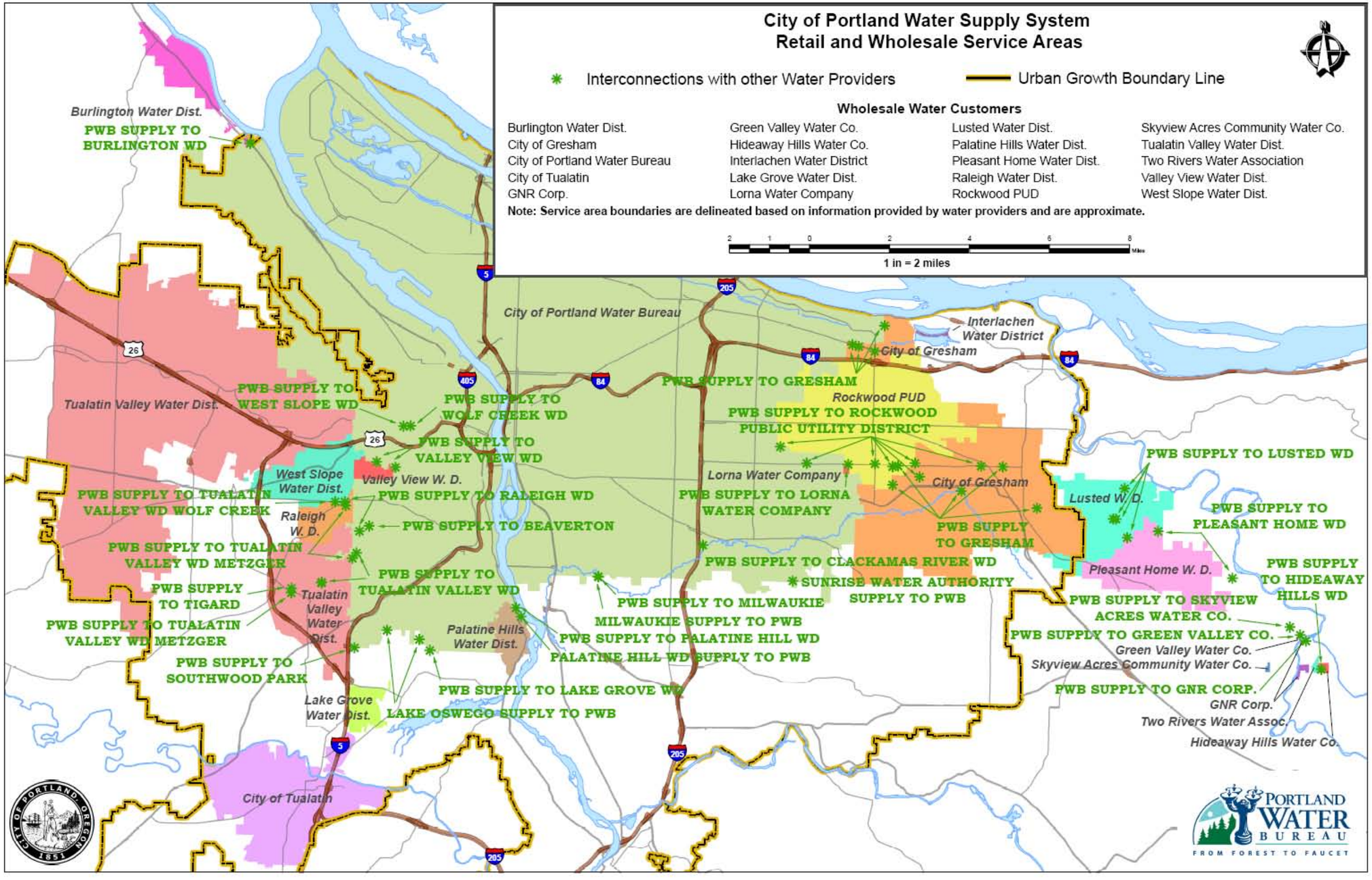


Figure 2-18. Interconnections with Other Water Suppliers

Table 2-33. Interconnections with Other Water Suppliers, Portland Water Bureau

Connection	General Location	Supply	QSEC	Pipe Size	Max. Flow Capacity
60th & Vermont (Raleigh / Beaverton)	Beaverton Meter: North Side Vermont-East Chimney-House # 5945-East MH. Raleigh meter: North Side Street-West MH.	PWB SUPPLY TO BEAVERTON PWB SUPPLY TO RALEIGH WATER DISTRICT	3723 3723	16" to 12" pipe for Beaverton (10" meter), 8" pipe for Raleigh (6" meter)	Total of 500 gpm to the Raleigh and Beaverton connections (May 2001 review).
80th & Florence Lane (Tualatin / TVWD)	NE Corner SW 80th Ave & Florence Ln. Tigard, OR 97223	PWB SUPPLY TO TUALATIN PWB SUPPLY TO TVWD METZGER	3921 3921	48" pipe	6.3 MGD for TVWD (10.5%), 10.8 MGD for Tualatin (18%)
Alto Park	12215 SW 29th Ave Portland, OR 97219	LAKE OSWEGO SUPPLY TO PWB (ALTO PARK)		LO 8"? 6" pipe on our side of meter	Lake Oswego indicates 1,000 gpm @ 21 psi (Joel Komarek email)
Arlington Heights	3900 SW Fairview Blvd Portland, OR 97221	PWB SUPPLY TO TVWD WOLF CREEK PWB SUPPLY TO WEST SLOPE WATER DISTRICT	3125 3125	Connections are supplied by a variety of pipe sizes ranging from 12" - 36".	DSMP analysis indicates additional 9.6 MGD could be delivered to these connections in excess of the current demands (hydraulic CAPACITY only).
Burlington St Helens Road	NW St. Helens Rd , OR	PWB SUPPLY TO BURLINGTON WATER DISTRICT	1717	12" pipe to 4" meter	

Table continued on next page.

Table 2-33. Interconnections with Other Water Suppliers, Portland Water Bureau

Connection	General Location	Supply	QSEC	Pipe Size	Max. Flow Capacity
Clackamas 97th & Glenwood		PWB SUPPLY TO CLACKAMAS RIVER WATER DISTRICT	3740	18" pipe	Review indicates 1 MGD available currently, 5 MGD could be available with system modifications.
Clatsop	14221 SE Clatsop St Portland, OR 97236	SUNRISE WATER AUTHORITY SUPPLY TO PWB (CLATSOP)	3845	???	Indications are that supply is very small and limited to very controlled or emergency situations.
Gresham 170th & Sandy	TCH - 170TH PL & SANDY BLVD IN S/W Gresham, OR	PWB SUPPLY TO GRESHAM (170TH & SANDY)		24" main	
Gresham 172nd & Sandy	NE 172nd Ave & Sandy Blvd/25' South of Sewer Manhole Portland, OR	PWB SUPPLY TO GRESHAM (172ND & SANDY)	2748	24" main, 10" meter	
Gresham 181st & Sandy	SE Corner of 181st & Sandy	PWB SUPPLY TO GRESHAM (181ST & SANDY)	2748	24" main, 10" meter	
Gresham 185th & Riverside	60" WWL Building 18550 NE Riverside Pkwy,	PWB SUPPLY TO GRESHAM (185TH & RIVERSIDE)	2649	16" main, 8" meter	

Table continued on next page.

Table 2-33. Interconnections with Other Water Suppliers, Portland Water Bureau

Connection	General Location	Supply	QSEC	Pipe Size	Max. Flow Capacity
Gresham 242nd & Division	Near NE Division Street & SE 242nd Avenue (Hogan Dr) / Parking Lot at Golf Course Gresham, OR 97030	PWB SUPPLY TO GRESHAM (242ND & DIVISION)	3255	Conduit 4 (56"), 10" meter	
Gresham 262nd & Powell	S of SE Powell Valley Road, E of SE Barnes Road Gresham, OR 97080	PWB SUPPLY TO GRESHAM (262ND & POWELL)	3557	Conduit 3 (50"), 8" meter	
Gresham Grant Butte	3375 NW 1st St Gresham, OR 97030	PWB SUPPLY TO GRESHAM (GRANT BUTTE)	3349	Conduit 3 (50"), 16" meter	
Gresham North 3148 Division	3148 NW Division St Gresham, OR	PWB SUPPLY TO GRESHAM NORTH (195TH & DIVISION)	3350	Conduit 4 (56"), 10" meter	
Gresham Public Works	219 S Main Ave Gresham, OR 97030	PWB SUPPLY TO GRESHAM (PUBLIC WORKS)	3453	Conduit 3 (50"), 10" meter	
Hideaway Hills Water Co	40605 SE Latigo Ln Sandy, OR 97055	PWB SUPPLY TO HIDEAWAY HILLS WATER CO	4271	8" main, 3" meter	
Lake Grove Boones Ferry	12761 SW Boones Ferry Rd Lake Oswego, OR 97035	PWB SUPPLY TO LAKE GROVE WATER DISTRICT (BOONES FERRY RD)	4227	8" main, 6" meter	Historical SCADA indicates max flow is about 1,000 gpm
Lorna Water Co	SE 168th Avenue & Division,	PWB SUPPLY TO LORNA WATER CO (168TH & DIVISION)	3347	Conduit 2 (44"), 4" meter	

Table continued on next page.

Table 2-33. Interconnections with Other Water Suppliers, Portland Water Bureau

Connection	General Location	Supply	QSEC	Pipe Size	Max. Flow Capacity
Lusted & Hudson	SE Lusted & Hudson Sandy, OR 97055	PWB SUPPLY TO SKYVIEW ACRES WATER CO		12" main, 3" meter	
Lusted Water District Supply to District 302nd & Pipeline	302ND & PIPELINE RD, 50' N LUSTED - CONDUIT 2	PWB SUPPLY TO LUSTED WATER DISTRICT (302ND & PIPELINE)		Conduit 2 (44"), 6" meter	
Lusted Water District Supply to District Division & Oxbow	DIVISION & OXBOW, CONDUIT 4	PWB SUPPLY TO LUSTED WATER DISTRICT (DIVISION & OXBOW)		Conduit 4 (56"), 4" meter	
Lusted Water District Supply to District Lusted Rd	LUSTED RD, 50' RT 2 BOX 660, CONDUIT 3	PWB SUPPLY TO LUSTED WATER DISTRICT (LUSTED RD)		Conduit 3 (50"), 6" meter	
Lusted Water District Supply to District Pipeline Rd	TCH-350' E 302ND & PIPELINE, CONDUIT 2	PWB SUPPLY TO LUSTED WATER DISTRICT (PIPELINE RD)		Conduit 2 (44"), 6" meter	
Milwaukie	SE Johnson Creek Blvd @ SE 45th Ave Milwaukie, OR	MILWAUKIE SUPPLY TO PWB (JOHNSON CREEK BLVD)	3935		2001 review filed under qsec 3338 indicates 2 MGD capacity to Milwaukie.
		PWB SUPPLY TO MILWAUKIE (JOHNSON CREEK BLVD)	3935	20" main	

Table continued on next page.

Table 2-33. Interconnections with Other Water Suppliers, Portland Water Bureau

Connection	General Location	Supply	QSEC	Pipe Size	Max. Flow Capacity
Oleson & Hall (Tigard / TVWD @ Bradley Corners)	About 9195 SW Oleson Road / NE Corner Hall & Oleson Portland, OR 97223	PWB SUPPLY TO TIGARD (BRADLEY CORNERS) PWB SUPPLY TO TVWD METZGER (BRADLEY CORNERS)	4020 4020	24" main	Normal supply is 8.6 MGD; previous agreement was for 11.6 MGD for limited duration.
Palatine Hill Riverside Drive	10509 SW Riverside Dr Portland, OR	PWB SUPPLY TO PALATINE HILL WATER DISTRICT (RIVERSIDE @ CAREY)	4031	24" main, 8" meter	October 2006 flow test indicates 2.8 MGD with all Palatine pumps on.
Palatine Hill Supply to PWB		PALATINE HILL SUPPLY TO PWB (RIVERWOOD)	4131	4" main?	
Pleasant Home Pipeline Rd	32421 SE Pipeline Rd Gresham, OR 97080 36200 SE Lusted Rd Gresham, OR	PWB SUPPLY TO PLEASANT HOME WATER DISTRICT	3663	16" main, 4" meter to be upsized to 6"	2006 letter indicates capacity of 1,000 gpm ok.
Raleigh WCSL Beaverton Hillsdale & Oleson	About 6970 SW Beaverton/Hillsdale Hwy (West side Oleson, North Line Little Caesars) , OR 97225	PWB SUPPLY TO RALEIGH WATER DISTRICT (WCSL OLESON)	3522	48" to 16" main, 6" meter	0.9 MGD (1.5% of Capacity)
Rockwood 135th & Mill	1773 SE 135th St Portland, OR 97233	PWB SUPPLY TO ROCKWOOD (135TH & MILL)	3244	Conduit 4 (56"), 8" meter	

Table continued on next page.

Table 2-33. Interconnections with Other Water Suppliers, Portland Water Bureau

Connection	General Location	Supply	QSEC	Pipe Size	Max. Flow Capacity
Rockwood 148th & Division	14800 SE Division St Portland, OR 97236	PWB SUPPLY TO ROCKWOOD (148TH & DIVISION)	3245	Conduit 3 (50"), 8" meter	
Rockwood 182nd & Division	18200 SE Division St Portland, OR 97236	PWB SUPPLY TO ROCKWOOD (182ND & DIVISION)	3249	Conduit 4 (56"), 8" meter	
Rockwood 192nd & Division	19200 SE Division St Portland, OR 97236	PWB SUPPLY TO ROCKWOOD (192ND & DIVISION)	3250	Conduit 2 (44"), 10" meter	
Rockwood 202nd & Division	20200 SE Division St Portland, OR 97236	PWB SUPPLY TO ROCKWOOD (202ND (BIRDSDALE) & DIVISION))	3351	Conduit 2 (44"), 6" meter	
Rockwood 235th & Division	1100 NE Cleveland St Portland, OR 97233	PWB SUPPLY TO ROCKWOOD (235TH & DIVISION)	3254	Conduit 4 (56"), 10" meter	
Rockwood Pump Station	Meter Location: Conduit 2, NW 5th & Riverview, (RTU is in Rockwood's Pump Station @ NW 1st & Riverview)) Gresham, OR 97030	PWB SUPPLY TO ROCKWOOD PUMP STATION (1ST & RIVERVIEW)	3351	Conduit 2 (44"), 10" meter	

Table continued on next page.

Table 2-33. Interconnections with Other Water Suppliers, Portland Water Bureau

Connection	General Location	Supply	QSEC	Pipe Size	Max. Flow Capacity
Sandy River Station	10991 SE Lusted Rd Sandy, OR 97055	PWB SUPPLY TO GNR WATER CORPORATION	4170		
		PWB SUPPLY TO GREEN VALLEY WATER CO.	4170	8" main, 2" meter	
Southwood Park	62nd 21' North Driveway 12810 in Street,	PWB SUPPLY TO SOUTHWOOD PARK (62ND & DOUGLAS)	4223	8" main, 2" meter	emergency connection
Stephenson	4680 SW Stephenson St Portland, OR 97206	LAKE OSWEGO SUPPLY TO PWB (STEPHENSON PUMP)	4224	6" main	Lake Oswego estimates capacity to connection is 1,500 gpm at 50 psi (Joel Komarek email)
TVWD 62nd & Multnomah	Multnomah--10' west line driveway 6241, North side street,	PWB SUPPLY TO TVWD METZGER (MULTNOMAH)	3823	8" main, 6" meter	
TVWD 65th & Garden Home Road	West Line House 6421 Garden Home Rd,	PWB SUPPLY TO TVWD METZGER (GARDEN HOME ROAD)	3823	10" main, 6" meter	To be replaced with new 6" meter at 65th and Taylors Ferry supplied by 6" main. Capacity at new meter limited to 1,100 gpm at 55 psi.

Table continued on next page.

Table 2-33. Interconnections with Other Water Suppliers, Portland Water Bureau

Connection	General Location	Supply	QSEC	Pipe Size	Max. Flow Capacity
TVWD Oleson & Beaverton-Hillsdale Highway (Redundant)	570' SSL Beaverton-Hillsdale Hwy	PWB SUPPLY TO TVWD METZGER (WCSL OLESON)	3522	48" main? 24" meter?	Not in service?
TVWD Washco Beaverton-Hillsdale Highway	7412 SW Beaverton-Hillsdale Hwy Portland, OR 97225	PWB SUPPLY TO TVWD WOLF CREEK (WCSL)	3522	54" main, 30" meter	36 MGD = 60% of Total
VVWD 54th Avenue	54th centerline street at 5328	PWB SUPPLY TO VALLEY VIEW WATER DISTRICT (54TH AVENUE)	3324	6" main, 6" meter	Review indicates 200 gpm available normally, 1,500 gpm available in emergency.
VVWD Patton Rd & Hillside Drive	4400 SW Patton Rd Portland, OR 97221	PWB SUPPLY TO VALLEY VIEW WATER DISTRICT (PATTON RD)	3325	4" main, 3" meter	

2.10 Agreements to Supply Water to Other Entities

This subsection addresses the requirements of OAR 690-086-0140 [6].

Subsection 2.6.2 described the wholesale contracts in terms of the areas served and their consumption characteristics. This section will describe the general nature of the wholesale contracts as they currently exist. A copy of a wholesale contract is included as Appendix D of this plan.

The wholesale contracts signed in July 2006 are 10- and 20-year terms, each with a different rate-of-return cost factor. Each contract contains the following summarized sections:

1. A description of the nature of the service such as the City of Portland will provide service from the same supplies as those used to serve the retail customers. Each customer retains control of its own distribution system while Portland retains control and ownership of its supply, transmission, and distribution system. The City of Portland is required to maintain the supply and transmission system to meet guaranteed supply quantities for each wholesale customer, but the City is not responsible for certain acts or events that may reduce available supplies, such as human-made or natural events.
2. A list of the terms of the contract, including the wholesaler's right to renewal for 10 further years at each increment of renewal; the City of Portland's notice of contract non-renewal required five years ahead of time within a certain time identified in the contract.
3. A description of the Water Managers Advisory Board established to facilitate coordination between the City of Portland and wholesale customers, including the operations and conservation committees. Also, a description of the wholesale providers' obligations for providing data and setting up operating standards, establishing opportunities for budget coordination and rate review.
4. Section 5 sets up guaranteed purchase obligations for quantities of water and for seasonal and daily peaking factors. This section outlines how changes or transfers of guaranteed amounts can be accomplished and describes the purchaser's relief from guaranteed purchase amounts for the year if there are curtailments of supplies due to shortages of more than five days. There is also a section on the release of the purchaser from guaranteed purchase amounts over the longer term if the City of Portland fails to supply the required amount for more than 30 days. This section also addresses circumstances in which the wholesale customer exceeds the purchase amounts specified under the contract processes, for increases when a notice is provided and when it is not.
5. The contract also contains language that allows a wholesale customer to request interruptible water in winter or summer conditions, and the terms under which that water is provided and reduced or terminated.
6. Section 7 of the contract addresses the rates and charges for the guaranteed water quantity. It sets out the cost methodology for pricing water supplies including operations and maintenance (O&M) and capital costs. Subsections address cost caps for O&M, rate of return calculations, depreciation costs, and the allocation of assets. Section 8 addresses how interruptible water is charged. Section 15 outlines billing and payment procedures.

7. Water system planning and cooperation is outlined, including the need for each purchaser to project their water usage for the next five years. The City of Portland is required to provide information about the capacity of the Portland water system if new quantities are requested. A contract purchaser can request reserved capacity on the Portland system if it is available, based on the rate of return for the specific capital assets needed.
8. Responsibilities for metering and connections ownership and costs are outlined. There is also specific language addressing the circumstances in which a purchaser provides water supply through their system to Portland customers.
9. Section 13 specifically addresses the need for each contract customer and the City to prepare water conservation plans (which can be OAR Division 86 WMCPs that have been approved) with a review by the Water Managers Advisory Board. This section outlines what a conservation plan should include. Periodic conservation reporting is also required. Section 14 enacts similar requirements for curtailment planning and coordination.
10. Joint ownership and/or funding of capital improvements is expressly allowed under separate agreements, if there is agreement among the respective parties, but joint ownership and/or funding are not required.
11. There is a specific dispute resolution section that outlines how disputes are to be raised and resolved.

As noted in the interconnections subsection, the City also has connections with Beaverton, Lake Oswego, Milwaukie, and Clackamas River Water. There are no specific agreements at this time for the provision of emergency water supplies, either from or to these entities.

2.11 Accounted-for and Unaccounted-for Water in the System

This subsection addresses the requirements of OAR 690-086-0140 [9].A quantification and description of system leakage that includes any available information regarding the locations of significant losses.

Within all larger municipal water systems, water is classified into two types: accounted-for and unaccounted-for water. Accounted-for water usually applies to that water that is metered at its point of use, which can included both billed and unbilled water (or non-revenue water). The information presented in subsection 2.6.1 is generated from the billing system and represents water that is metered.

Unaccounted-for water is water diverted from supply sources that enters the system but is not metered. Unaccounted-for water includes water used for fire flows, and water used for system maintenance such as line flushing, tank cleaning, or testing of facilities such as groundwater systems, and water line breaks, evaporation from open storage reservoirs, and leakage. In many water supply systems, including Portland's, it is not possible to determine exact amounts for each category of unaccounted-for water because the uses are not metered. However, it is possible to estimate this amount, particularly the amount estimated to be lost from the system due to leakage. See Section 3.4.1 in Water Conservation.

3. Water Conservation Program

Per capita water use for retail single-family residential customers has gone down significantly since 1992. The average consumption for retail single-family customers between 1987 and 1992 was 87 gallons per person per day (GPC), is now down to about 66 GPC, and has been as low as 62 GPC. Variables such as the water shortage of 1992, updated state and national plumbing codes, the change from flat rates to consumption-based rates for wastewater (in 1994), and behavioral changes from conservation education have helped to reduce each household's overall consumption. Figure 3-1 shows the average annual GPC from 1988–2007.

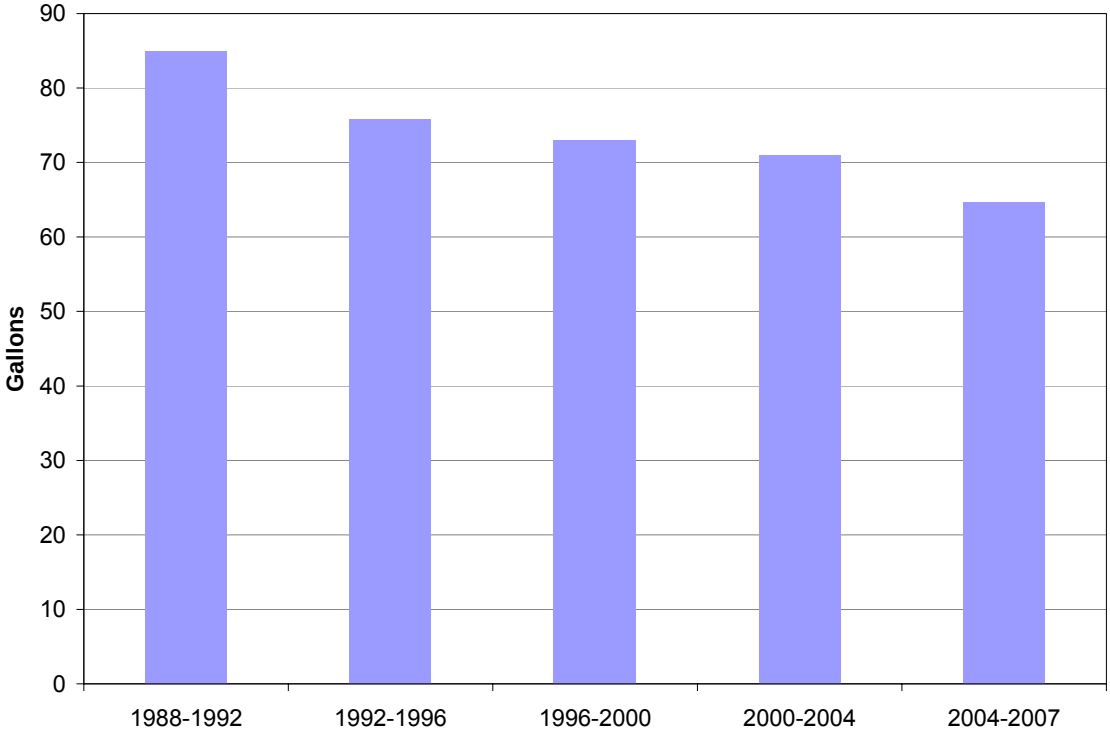


Figure 3-1. Average Residential Per Capita Daily Water Use[a]

[a]Each bar is an average of the gallons-per-capita for the three- or four-year period.

Source: Water Bureau system billing data

The water shortage in the summer of 1992 had an influence on customers' continued outdoor water use, according to feedback from customers on the bureau's customer service telephone lines and at outreach events. Many customers realized that if they didn't water their lawn, they didn't have to spend time mowing it, and the grass grew back green as soon as the fall rains began.

In addition, plumbing codes changed in Oregon in November of 1992, and nationally (through the Energy Policy Act) in 1993. Per the 1992 code changes, toilet flush volumes decreased from 3.5 to 1.6 gallons per flush; urinal flush volumes were down to 1 gallon per

flush; and aerators and showerheads were down to no more than 2.5 gallons per minutes (for faucets, down from 5 gallons per minute before the code changes).

The introduction of high-efficiency washing machines has also contributed to the reduction in per capita water use. The high-efficiency machines use about half of the water of a conventional, top-loading machine.

In 1994 in Portland, sewer rates changed from a flat fee to a consumption-based rate. Yearly sewer consumption charges are based on winter use—or the water consumption on a household's first quarterly bill after February 1st each year. Customers quickly became aware that they needed to control those costs, as Portland's sanitary sewer costs are some of the highest in the nation.

Credit is also due to the Water Bureau's conservation program. Since the early 1990s, Water Bureau staff have made presentations to classrooms, teaching children to turn the water off when brushing their teeth and washing their hands. These children took those conservation messages home. As young adults, potentially paying their own water bills now, these former students may be practicing water conservation in their own homes.

Although the effects of outreach and education are difficult to measure in the short term, the conservation program has been varied and has addressed the needs of our customers with information and technical assistance as well as a few incentive programs. We will continue to meet the needs of our customers with the programs we develop.

3.1 Progress Report from Prior Water Management Plan

This subsection addresses the requirements of OAR 690-086-0150 [1]: A progress report on the conservation measures scheduled for implementation in a water management and conservation plan previously approved by the Department

The Portland Water Bureau's previous WMCP was submitted to the Water Resources Department in 2000, and was approved on February 22, 2001. The WMCP noted that a "pause and assess" study was conducted in 1999 by consultants, who made recommendations for future activities. A more sophisticated plan was to be developed by December 2000. Issues unrelated to water conservation caused the bureau to shift resources, and Water Bureau staff completed an interim plan in 2003, comprising several program areas including the following:

- Retail Customer Education and Awareness
    - Development and distribution of educational materials for all retail customers, with special emphasis on providing services to youth
    - Media messages targeted to all retail customers
    - Development of web-based education messages and tools
    - Distribution of information and conservation devices at community events
- Retail Residential In-home Efficiency
    - Low-income self-help workshops
    - Targeted toilet replacements for low-income customers

  - Distribution of devices to residential users
- Retail Single-family Residential Seasonal Efficiency
  - Pilot projects related to single-family outdoor water use
- Retail Multi-family and Business, Industry and Government (BIG) Water Efficiency Assistance
  - Technical assistance to multi-family, industrial, commercial, and institutional customers, including site evaluations and water management plan development for specific customers
  - Pilot projects of new technologies for multi-family and BIG customers
- Targeted Seasonal Efficiency Projects (Non-single-family Residential)
  - Pilot landscaping or irrigation projects
- City Water Loss Reduction and Improved Accountability
- Regional Water Providers Consortium Partnerships for Projects

Several of the conservation programs at the Water Bureau have been implemented in collaboration with other agencies, water providers, and bureaus within the City of Portland. The bureau has worked with the City's Bureau of Environmental Services (BES) and with the Regional Water Providers Consortium (RWPC) to conduct outreach to schools and the community.[33] The bureau shares resources and coordinates with RWPC for media outreach and events. Several of the bureau's programs for low-income customers have been conducted in collaboration with other housing and low-income advocacy agencies such as the Hacienda Community Development Corporation and the Salvation Army, Rose Community Development Corporation, Housing Our Families, and Friendly House.

The progress report provided in subsections 3.1.1–3.1.10 is based on the areas described in the 2000 WMCP. Each subsection provides a summary of the activities described in the 2000 WMCP; most also provide an update on activities since the 2000 WMCP. Note that some of the projects from the 2000 WMCP have been accomplished, modified, or replaced with other activities. All of the bureau's replacement conservation activities were drawn from the interim plan.

3.1.1 Media Outreach

The Water Bureau has used print and electronic media to educate customers and promote water-efficient behaviors, devices, and technologies. Through inserts in the quarterly residential and monthly commercial and industrial bills, and strategic use of radio and web messages, the Water Bureau has promoted conservation awareness and provided education to its retail customers.

Bill Stuffers

2000 WMCP: For the past 24 years, the Water Bureau has used printed inserts called bill stuffers to communicate information on conservation and other water-related topics to both residential and non-residential customers.

[33] The Regional Water Providers Consortium is a collaborative and coordinating organization to improve the planning and management of municipal water supplies in the Portland metropolitan region.

Update: The theme of the summer 2006 bill stuffer was "water to the weather." This bill insert educated customers about the importance of watering to the weather, introducing the term, evapotranspiration.[34] The Water Bureau sends about 195,000 bill stuffers each summer, with additional bill stuffers distributed at community events. See Appendix F for examples from recent years.

Radio Campaign

2000 WMCP: Each summer since 1993, the Water Bureau has participated in a large-scale radio campaign in partnership with the Portland Area Radio Council (PARC). The campaign consists of more than 1,000 60-second radio spot advertisements aired each summer, usually during the month of August. The radio spots offer tips for maintaining a healthy lawn and other ways to use water wisely outdoors.

Update: For the past few years, the Water Bureau has shared the by-line and cost of the radio spots with the Regional Water Providers Consortium (RWPC).[35] This media messaging is still used.

The *Oregonian* Inside Line

2000 WMCP: The Water Bureau coordinates information on over 20 conservation-related topics on the *Oregonian* Inside Line. In 1997, there were 2,609 calls made to the line; in 1998, 3,806 calls; and in 1999, 5,344 calls.

Update: Due to the increased use of the Internet, the Water Bureau has discontinued the *Oregonian* Inside Line and focused on sharing information on the Water Bureau's web site, www.portlandonline.com/water.

Water Bureau Web Site

2000 WMCP: The Water Bureau's web site has been online since 1996. It comprises information about the water system, water quality and conservation, as well as customer services updates. It is available at www.portlandonline.com/water.

Update: Many updates to the conservation information have occurred since the bureau migrated to the City's Portland online web site in 2003. The conservation section is one of the most popular pages on the bureau's web site. During FY 2006-2007, the conservation section averaged approximately 6,600 hits each month. In addition to finding information about conservation, customers can request conservation devices and information directly through the web page.

RWPC, of which the Portland Water Bureau is a member, has a web site with information about indoor and outdoor conservation practices and devices as well as youth education activities. The RWPC web site is www.conserveh2o.org.

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[34] Evapotranspiration is a measurement of the water a plant needs after water has evaporated and been transpired by the plant.

[35] The Regional Water Providers Consortium is a collaborative and coordinating organization to improve the planning and management of municipal water supplies in the Portland metropolitan region.

3.1.2 Community Events, Presentations, and Activities

The Water Bureau has collaborated with more than 10 public and private organizations, businesses, and government agencies to bring its conservation messages, technology, and devices to people in all sectors of the community.

Salmon Festival

2000 WMCP: Since 1991, the Water Bureau has distributed water conservation information and has staffed a conservation exhibit at the Salmon Festival. For the past 10 years, the bureau has also been a sponsoring partner of this region-wide event; an estimated 7,000 to 10,000 people visit the festival each year.

Update: Since 2005, the Water Bureau has partnered with RWPC in staffing its water conservation booth at the Salmon Festival. The focus of the Water Bureau's exhibit is healthy fish and their environments. The funding for the sponsorship of the Salmon Festival has been transferred to the bureau's Endangered Species Act (ESA) program. The bureau continues to be an active sponsor of the Salmon Festival.

WashWise Demonstration Program

2000 WMCP: This partnership with Northwest Natural Gas promoted high-efficiency washers in 1997-98 through a mobile public display that included a video presentation and a live "laundry expert."

Update: The bureau has not had any active programs for marketing high-efficiency washing machines since the late 1990s. Oregon has the highest market penetration of these machines in the country. The Energy Trust of Oregon's financial incentives and assistance with the residential energy tax credit have made these machines more affordable through purchasing assistance and by creating market competition for the rising demand.

Low-Income Program

2000 WMCP: Conservation staff at the Water Bureau developed a conservation workshop in 1995 to address the concerns of the Portland City Council and citizens about the cost of water and sewer bills. The bureau contracted with an outside nonprofit organization to conduct the workshops. The workshops teach participants how to read water bills, do "still" meter readings to check for leaks, fix leaks, and make inexpensive technological and behavioral changes to reduce water use. In FY 1997-1998, 63 workshops were held for 705 people; in 1998-99, 69 workshops were held for 825 people.

Update: In 1999-2000 an evaluation of this project was conducted by PSU Center for Community Research. The PSU consultants found the workshops to be educational and recommended that the Water Bureau continue and offer the workshops to the larger residential retail customer base. The Water Bureau decided to offer the workshops for another five years, and make them available for other purposes, such as, Fix-It Fairs and other community events. The bureau has information on leak detection and repair on its web site and in brochures that staff distribute at community events (for examples, see Appendix F).

In fall 2005, the Water Bureau requested proposals to pilot a two-year low-income demand management program, in partnership with the Office of Sustainable Development's (OSD) Solid Waste and Recycling workgroup. The firm of Barney & Worth won the bid to create a

new low-income program, partnering with existing service agencies to provide education and assistance about water conservation, recycling, and solid waste.

2000 WMCP: The Water Bureau also distributes water conservation information through existing low-income assistance agencies and organizations, such as the Salvation Army, Rose Community Development Corporation, Housing Our Families, and Friendly House. The bureau has also provided plumbing-repair toolboxes to ten social service agencies in Portland since 1995. Under this partnership, clients can borrow a toolbox to fix a leak in their home.

Update: Water conservation information and devices are still being distributed through the Salvation Army and the Rose Community Development Corporation and other social service agencies.

Bureau conservation staff participated in a pilot assistance project with Hacienda Community Development Corporation at a multi-family residence during the summer of 2005.[36] Hacienda had sub-metered some of its multi-family units which housed some of the lowest-income residents in Portland.

To provide water and financial savings to Hacienda's residents, the Water Bureau, using information gained from participation in a national sub-metering study in 2004, provided plumbing fixtures that met or exceeded code. The plumbing fixtures included new 1.6-gallon-per-flush toilets, showerheads and faucet aerators that flowed at rates lower than code requirements, and technical assistance identifying other water-use reductions in the entire complex. The pilot project was completed in October 2007 and the bureau will analyze the water savings at the Hacienda properties by the end of 2008.

Multi-Family Mailing

2000 WMCP: In 1999, the Water Bureau developed a water-use worksheet to help property managers and landlords estimate how much water their tenants use and to calculate potential savings from technological changes. The worksheet was mailed to 1,700 multi-family property managers and landlords in partnership with Northwest Natural Gas. Northwest Natural provides "pass through" cash payments from the Oregon Business Energy Tax Credit for energy-efficiency improvements.

Update: From this project, a guidebook for multi-family property managers was developed and is currently posted on the bureau's conservation web site. In 2004, the bureau partnered with OSD and offered toilet rebates for multi-family property owners/managers who offered housing to low-income residents. A $45 rebate was offered on the $90-fixture, and 964 toilets were replaced. A six-month review of water use in the complexes in which toilets were replaced showed almost a 25 percentage-point reduction in water use.

Other Community Events and Presentations

2000 WMCP: Bureau staff have been educating customers in the community about conservation since the 1980s. Staff participated in large events such as ArtQuake and the Yard, Garden, and Patio Show, and in many smaller events such as neighborhood fairs. Staff

[36] Hacienda CDC develops affordable housing and builds resident communities for working Latino families and others in Oregon.

distribute informational materials and conservation devices, and interact with the public. Bureau staff also make presentations to groups such as the Metro Multi-Family Housing Association, the Kiwanis, and the Eco-Audit Team (sponsored by the Recycling Advocates and the Northwest Earth Institute). Staff have appeared on local cable access television through the Mayor's Forum.

Update: Over the years, the bureau has actively participated in numerous community events. As a member of the RWPC, the bureau offers water conservation information and activities at the Yard, Garden, and Patio Show and at the Salmon Festival. Since the 1990s, the bureau has participated in OSD's Fix-It Fairs. Three or more of these fairs are conducted yearly, primarily in lower-income neighborhoods. Conservation staff also make presentations to civic and professional organizations, as well as garden clubs and school groups.

2000 WMCP: Since 1995, bureau staff have interacted with more than 165,000 community members.

Update: This number has greatly increased since 2000, as conservation staff interact each year with thousands of people at the above-mentioned events. Since 2000, conservation staff have interacted with, or been seen by, an estimated 315,000 people.

3.1.3 Water Conservation Education Projects

Service Learning Project

2000 WMCP: Service learning involves concentrated educational efforts with small groups of students who—with the assistance of bureau staff—learn about the water system in detail, then create avenues to educate others – particularly their peers. The bureau's first project was a video created by nine Hosford Middle School students in 1997-98. The video "Conserving Portland's Water Supply" was presented to seven schools; 100 videos were distributed to middle schools with a "Conservation Activity Guide." Bureau staff planned and coordinated the project and facilitated the services of professional videographers to help the students develop and edit the video.

The second project, completed in 1998-99, resulted in a book about conservation and Portland's water system, written and illustrated by 55 third- and fourth-grade students from Buckman Elementary School, the City's art magnet school. The bureau's conservation staff helped plan the project, facilitated field trips, and engaged bureau experts in educating the students. Staff also arranged for a professional artist to aid the students. 2,500 copies of the book *Portland Water Works* (see Appendix F) have been printed and distributed in the Portland metro region and the country. The book is being revised and will be distributed during the 2000-2001 school year along with a teacher's guide.

This year's service learning project was with Madison High School. The students developed a game show for their peers called "Water You Know." This game show will be played at select venues in the coming school year.

Update: In 2006, the bureau partnered with the CityCorps program of Open Meadow, an alternative school. The City Corps program was created to engage youth in local government. Conservation and education staff worked with City Corps staff to examine strategies for engaging youth in water conservation. This project resulted in several exciting suggestions for how to reach young people and engage them in resource conservation.

Also in 2006, the bureau hosted an AmeriCorps member who worked with students from Marshall High School to develop the bureau's first annual Field Day. Citizens who participated in Field Day were invited to Water Bureau work sites to learn about water quality testing, maintenance and operations of the transmission and distribution system, and protecting both the groundwater and surface water supplies. The AmeriCorps member worked with the high school students, taking them on field trips to view bureau operations. The students gave their feedback as to what citizens might enjoy seeing. They created the Field Day T-shirt, and provided displays the day of the event. The 2006 Field Day was so successful that the bureau decided to continue the event in 2007.

Cascade Streamwatch

2000 WMCP: Cascade Streamwatch is a hands-on science and math-oriented outdoor experience for urban middle and high school students, run by the non-profit organization Wolftree, Inc. The bureau worked with Wolftree in 1995-96 to develop a joint curriculum and now sponsors the program. Staff have, in past years, provided participating classes with conservation information following their visit to the Salmon River watershed, educating approximately 1,000 students each year at 10-12 events.

Update: Water Bureau staff have continued sponsorship and participation in this program. This program has been especially augmented by addition of professional education staff in the bureau and a focus on project collaboration with specific schools. In 2006-2007, three schools participated with bureau staff at Cascade Streamwatch and toured the Bull Run watershed as part of a project-based learning experience.

School Presentations

2000 WMCP: Conservation staff have made school presentations since 1992. The bureau has a slide show about the Bull Run and the importance of conservation. Students receive conservation information and devices to take home. Over the years, staff have made a number of presentations to a variety of age groups, from Head Start pre-kindergarten groups to college classes. In FY 1997-1998, 47 presentations were made to 1,100 students.

Update: In 2001, the bureau hired an natural resource educator to augment the youth education activities of the conservation group. Since that time, the youth education focus for the bureau has shifted from conservation to water source and system education. In 2006, a water conservation staff position was filled to begin to expand the bureau's conservation education again. This staff person is working with the natural resource educator to develop classroom presentations and has partnered with an alternative high school class this past year to get input and creative ideas on educating teens about resource conservation. In addition, staff have developed an on-going relationship with the Sustainability Program at PSU and have made presentations on residential conservation to college students for the past three terms. This program is growing.

The bureau has also participated in a large youth educational effort – the Children's Clean Water Festival. The bureau provides classroom activities and participates with the RWPC on classroom activities and exhibits. The Water Bureau is a primary financial sponsor of the Children's Clean Water Festival, providing staff time to plan the event and coordinate volunteer recruitment, training, and placement. This event is attended by over 1,000 students each spring.

Since the 2000 WMCP, the Water Bureau has offered tours to the Bull Run for educational purposes for students of all ages. In the past six years staff have averaged 24 student tours a year, working with an average of 554 students each year.

"Where's Rosie?" Puppet Show

2000 WMCP: In 1996, with the assistance of World of Wonders Puppet Theater, the bureau worked with the Columbia-Willamette Water Conservation Coalition to design an educational puppet show on conservation for kindergarten through second-grade children. Since then, the "Where's Rosie?" show has played for numerous schools around the region, including schools in the Hillsboro, Tualatin Valley Water District, Portland, Gresham, Lake Oswego, Powell Valley, City of Tualatin, Newberg, Beaverton, and Rockwood water districts. Altogether, in 1996-97, 3,000 students attended 17 shows; in 1997-98, 2,357 students attended 21 shows; and in 1998-99, 1,575 students attended 20 shows. The puppet show was videotaped and teachers can now request a video of the show and activity books for K-12. The video has also been broadcast on local cable channels.

Update: The conservation program has offered this program (now performed by Ladybug Theater) to elementary schools for the past four years—an average of 22 shows per year, with an average of 109 children attending each show (87 shows total, presented to 9,502 students). Due to the continued demand for this program, the Water Bureau will continue to provide it to elementary schools in Portland at least through June 2008. The activity book is included in Appendix F.

Additional Educational Activities

In 2000, the RWPC also began offering an upper elementary school assembly program using a game show format, "As the Faucet Turns." This show has been presented 82 times in three years to 8,715 students.

Another program for upper elementary students was developed by RWPC in 2004. The "Rockin' Water Road Show," performed by Recycleman and the Garbage Gurus, has delivered 36 shows for 3,600 students in the past two years in Portland schools, with rave reviews. Through music, youth are educated about the water cycle, how much water it takes to produce manufactured goods and food, and ways to conserve. The Portland conservation program also distributes a conservation activity guide developed by RWPC to all students who attend the Recycleman performances. This activity book is included in Appendix F.

3.1.4 Curriculum Materials

Water Conservation Education Kits

2000 WMCP: Bureau staff have developed three different water conservation education kits (including instructions, curriculum materials, and supplies) on topics such as home water use reviews, low-water-use plants, and conservation testing devices. Additionally, staff has coordinated with the Bureau of Environmental Services (BES) CleanRivers educators to include conservation topics in two other kits. All kits are available for loan to teachers. Eight kits were loaned to teachers to serve 206 children in 1998-99.

Update: The water conservation education kits are no longer used due to a change in the focus of the bureau's education program.

Project WET Teacher Workshops

2000 WMCP: Water Bureau staff have sponsored Project WET (Water Education for Teachers) workshops with BES and the RWPC since 1996. Project WET is a nationally distributed activity guide available only through workshops provided to educators in each state under an agreement with a state coordinating agency. Several Water Bureau and RWPC staff are certified to lead workshops. Since 1997, the bureau has conducted six workshops for 111 teachers. The workshops include a tour of BES and water facilities during which participating teachers test water and learn about activities to teach water conservation principles to their students.

Update: No further workshops have been offered due to a shift in focus for the bureau on water resource education.

3.1.5 Water-Efficient Landscape Demonstration Gardens

"Planter Hollywood"

2000 WMCP: In 1998, the Water Bureau partnered with the Hollywood Boosters in replanting cement planters in the Hollywood District with low-water-use, low-maintenance, primarily native, perennials. Prior to this partnership, the Hollywood Boosters had planted annuals. The planters were adopted by various businesses in the neighborhood. The project provided cost savings to the Hollywood Boosters and contributed to the goals of the Green Neighborhood Network for enhancing neighborhood livability and sustainability in the Hollywood District.

Street of Dreams

2000 WMCP: In 1995, as part of the Street of Dreams, the bureau partnered with the City of Lake Oswego to install a water-wise landscape at the "Harmony House." The display attracted 75 people.

Neighborhood Demonstration Gardens

2000 WMCP: In 1996, the bureau partnered with the Rose City Development Commission and the Neighborhood Pride Team to fund ten water-wise landscapes at low-to-moderate-income homes. Water conservation information was provided at open houses held at two of the homes the year the gardens were established.

Update: In 2004, conservation staff, in partnership with Portland Parks & Recreation, established a small water-efficient demonstration garden at a local community garden in north Portland. This garden was dismantled in 2007 due to its remote location. The plants from the garden were moved to Tubman Middle School—a school that is close to the bureau's main operations and maintenance facility.

Another, larger garden at a bureau facility—now referred to as the Hazelwood Hydro Park in northeast Portland—has been developed. This garden features low-water-use plants, permeable hardscapes, and an efficient irrigation system.

Conservation program staff recently completed an automatic irrigation system for Metro's Garden of Natural Techniques – a demonstration garden in southeast Portland. The garden irrigation now operates via battery-operated controllers; in-line emitters in a drip system;

and MP Rotators®, sprinkler heads designed for a grassy area. The system also contains a rain sensor that switches off the system when it rains more than ¼ inch.

3.1.6 Residential Technical Assistance Programs

Residential Outdoor Water Use Reviews

2000 WMCP: This program targets customers with high outdoor water use. It began in 1997 as a pilot effort and involved the cities of Portland, Tigard, Gresham, Hillsboro, and the Tualatin Valley Water District. The program will become permanent in the summer of 2000, with 1,500 audits being conducted. Preliminary draft evaluation results of the 1998 survey data indicate that the 272 Portland pilot participants saved an average of 19 percent, compared with usage in previous years.

Update: The original finding of an average of 19 percent reduction in water use was done by the consultant with no use of a control group. A methodology was established to look at water-use reductions by the test group compared with a control group. The resulting data indicated that the water use reductions were closer to 3 percent, with the test group actually using more water the following year. The average savings per household was less than $10 per season, with a cost to the bureau of over $60 per evaluation. It was decided not to continue to expend resources on this project.

Residential Retrofit and Impact Programs

Pilot Multifamily Sub-metering Project

2000 WMCP: Water Bureau staff are working with a Portland developer, Prendergast and Associates, on a pilot multi-family sub-metering project at Buckman Terrace, a new 122-unit development. In the late spring of 2000, individual units will be retrofitted with sub-meters, making it possible to bill tenants individually rather than combine water costs with the rent. The project will assess whether individual bills reduce tenant water consumption.

Update: This project was completed and an average 20 percent reduction in use was seen on the units that were sub-metered compared with those that were not. In 2004, the conservation program also partnered with conservation staff at other utilities around the country to study the affects of sub-metering in multi-family housing compared with in-rent and RUBS (ratio utility billings). The study found that the greatest savings can be realized through the installation of high-efficiency plumbing fixtures (about 25 percent) followed by sub-metering (15 percent). See information about Hacienda Community Development Corporation in Section 3.1.2.

Low-Income Housing Retrofit and Impact Assessment

2000 WMCP: Johnson Creek Commons, a 15-unit predominantly low-income, multi-family complex is being renovated and retrofitted with efficient fixtures, low-water-use landscaping features, and an irrigation system. Quantitative impacts have been assessed. This effort included Sustainable Communities Northwest, Rose Community Development Corporation, and several City bureaus.

Update: This project was completed.

Portland State University Student Housing Retrofit

2000 WMCP: Conservation staff worked with Portland State University's non-profit housing organization and the Portland Energy Office (now renamed as the Office of Sustainable Development) to retrofit plumbing fixtures and develop methods to educate students about water and energy conservation. This project was coordinated by a graduate student as part of her Master's Degree program. As a result of this project, a purchase-and-replace policy was adopted for low-flow toilets and washing machines.

Update: This project was completed.

Conservation Kit Distribution and Installation

2000 WMCP: Between 1993 and 1997, the bureau engaged in partnerships with Portland General Electric (PGE), the Portland Public Schools, Pacific Power, and Northwest Natural Gas to distribute and install residential conservation kits. In cooperation with PGE, the bureau funded bathroom faucet aerators and toilet displacement devices as part of a larger kit purchased and installed by PGE. The bureau helped coordinate installation of 100,000 kits in the Portland region.

Update: The kit distribution program available at this time is primarily through events, the Water Bureau's conservation web site, customer service requests, or conservation telephone line requests.

The indoor conservation devices that are distributed include

- bathroom faucet aerators, with a flow rate of 1.0 gallons per minute
- toilet displacement bags, that save up to 0.5 gallon per flush
- a fill-cycle diverter which can save 0.5 gallon of water per flush or more
- toilet leak-detection tablets
- 1.5 gallon-per-minute (gpm) kitchen faucet aerator
- 1.5 gpm showerheads
- self water-audit kits
- rain gauges that can be used to measure irrigation output

During the past five years, conservation staff have mailed an average of 700 devices to customers and distributed another 1,200 kits through community events.

In 2006, the Water Bureau collaborated with the Portland Department of Transportation to distribute water conservation kits via bicycle to targeted neighborhoods in the city. Over 9500 kits – indoor and outdoor – were distributed by bicycle in the spring and summer of 2006 and 2007.

Evaluation of Customer Savings

A study was conducted in 2007 to evaluate customer savings from the distribution of kits between 2002 and 2005. The analysis used only the savings from a toilet displacement bag (0.5 gallon-per-flush savings), a fill-cycle diverter (0.5 gallon-per-flush savings) and a 1.5 gallon-per-minute bathroom faucet aerator (assumption of 1 gallon-per-minute savings). In areas where the kits had been installed, the study found an average annual savings of 13.4 ccf per household (about 10,000 gallons). This is a cost of $.28 per ccf—a significant savings.

The Water Bureau plans to continue to distribute devices. For more information on the analysis, see Appendix G, *Evaluation of the Bathroom Kit Distribution Program*.

3.1.7 Educational and Technical Assistance for Industrial, Commercial, and Institutional Customers — the BIG Program

The Business, Industry, and Government (BIG) program has been ongoing since 1993. Originally, the program targeted the top 15 percent of the bureau's retail customers that account for 85 percent of the water consumed by these classes. As the program services became better known in the business community and requests for technical services increased, the BIG program no longer marketed services to retail customers. After the rate reform of 2001 that shifted from fixed to consumption-based rates, BIG program assistance became even more popular, because some customers saw as much as a 44 percent increase in their water/sewer bills.

The program continues to offer extensive one-on-one customer technical assistance and a number of educational programs. The program has resulted in dramatic savings of up to 85 percent for individual customers and overall savings for BIG customers as a whole of about 10-15 percent, despite increases in the quantity of goods and services produced. The BIG Program components include a cooling tower guidebook, cooling tower training, food service training, the Businesses for an Environmentally Sustainable Tomorrow (BEST) program, and special projects. These components are described below.

Cooling Tower Guidebook

2000 WMCP: In 1999, the BIG program staff developed and produced a cooling tower guidebook and 3,000 copies have been printed. The guidebook encourages customers to switch from single-pass to closed-loop or air-cooled systems and to operate cooling towers efficiently.

Update: The guidebook is still used.

Cooling Tower Training

2000 WMCP: In 1995, the bureau partnered with the Regional Energy Management Program (REMPRO) to train facility managers and engineers on efficient operation and maintenance of cooling towers, single-pass cooling, and air distribution systems. The training was co-sponsored by PGE, Pacific Power, Bonneville Power Administration, and the City of Vancouver. One workshop was conducted in 1995, two in 1996, and two in 2000.

Update: Another workshop was offered to businesses throughout the Portland metro area in May 2003.

Food Service Training

Update: In 2004, the bureau provided a water efficiency workshop for restaurants and the food service industry. A subject matter expert provided information and the bureau distributed high-efficiency pre-rinse sprayers to 20 attendees.

Businesses for an Environmentally Sustainable Tomorrow (BEST)

2000 WMCP: Since 1993, the bureau has been involved in the BEST program as a key financial sponsor and a partner in the implementation of the program. Some examples of past BEST winners that received technical assistance from BIG include the following:

- DoubleTree Inns - In 1993, DoubleTree Inns saved 12 million gallons of water a year (36 percent) by retrofitting with water-efficient fixtures
- Hercules Inc. - In 1994, Hercules, Inc. won a BEST award for reusing cooling water for boiler make-up and boiler condensate to wash tank trucks. This, and other water efficiency improvements, have helped Hercules save approximately 136 million gallons between 1992 and 1998.
- Crown Cork and Seal, Inc. - In 1999, Crown Cork and Seal, Inc. made a $12,000 investment in measures to save $46,000 per year in water and sewer costs by reducing water use by 80 percent.

Update: The Water Bureau's participation in the BEST program continues with recognition for new and ongoing BIG clients:

- Bullseye Glass Company – In 2004, Bullseye Glass installed a cooling water recirculating system, resulting in a 60 percent drop in water consumption.
- Port of Portland– In 2004, the Port installed weather-based irrigation controllers at two of their north Portland sites as part of the BIG program's Weather Reach Pilot Project. Average annual savings for the first two years of the project exceeded 900,000 gallons—nearly 30 percent of total use.
- DoubleTree Lloyd Center – In 2007, some of the water efficiency opportunities identified and implemented include low-flow showerheads (2.0 gpm – code is 2.5 gallons per minute); toilet replacements (from 3.5 to 1.6 gallons per flush); retrofitting other toilets with fill-cycle diverters, saving .5 gallon per flush; bathroom faucet flow reductions (replacing 2.5 gpm aerators with .5 gpm aerators in the public restrooms and reducing flows in 30 guest rooms); cooling system monitoring; and pre-rinse sprayer replacements in the restaurants (flow rates up to 5 gpm replaced with 1.6 gpm). The total potential water savings for the hotel is approximately 2.9 million gallons a year.

Special Projects

2000 WMCP: The bureau has several on-going special projects. One is participation in The Natural Step Network, working with businesses to encourage doing business based on environmentally sustainable principles. Another special project has been to work with the Portland Public Schools in custodial training, a rain sensor program, and school irrigation water use reviews.

Update: Irrigation audits at schools were done in 1996 and again in 2000-01. In 2000-01, some rain sensors were also installed. BIG staff conducted one class for custodians, mainly educating them about our source and how the water system works.

In 2001, the bureau dedicated staff time to work on sustainability issues with customers, the City, and within the bureau. That program is now staffed by one full-time person and a part-time person.

3.1.8 Low-Water-Use Landscaping Programs

In addition to the Large Landscape Audits and Trade Ally Workshops described below, the City is engaged in water-efficient landscaping through efforts of Columbia-Willamette Water Conservation Coalition (now the Regional Water Providers Consortium) and the City's BIG program. The following are examples of efforts the City has taken to reduce water use for landscaping.

Portland Parks & Recreation

2000 WMCP: The Water Bureau provided funding for irrigation wells in three parks. The funding would be paid back through savings in water costs. The City is working on an assistance plan for PP&R to identify approximately $50,000 in water cost- reduction opportunities to offset increased costs from recent water rate reforms. The aim is to achieve a 50,000 CCF reduction in water use at parks facilities, which would be a 16 percent decrease in overall water use by the Parks bureau. The plan will include irrigation system audit assistance, training, investigating additional opportunities for irrigation wells, and other technical assistance to improve water use efficiency at PP&R properties.

Update: See next update.

Portland Public Schools, Port of Portland, and Portland Parks & Recreation Outdoor Efficiency Assistance

2000 WMCP: Efforts were initiated last summer to begin providing irrigation system audits for landscaped areas under the jurisdiction of Portland Public Schools, PP&R, and the Port of Portland. This activity will continue. Some audits will be done through the RWPC partnership for these customers; additional audits will be completed over the next 3–5 years by BIG staff or through contracted auditing services. Currently, the bureau is working on reducing water use for four public K–12 school districts that receive Portland water directly.

Update: The Portland City Council asked BIG to help offset cost increases associated with the 2001 rate reform for PP&R and Portland Public Schools. Water efficiency improvements, billing corrections, as well as sub-metering credits were implemented. These efforts have resulted in savings of over $500,000 for PP&R. In 2005, BIG staff reviewed PP&R accounts again to verify the results.

In 2001, BIG program staff collected data from nine Portland Public Schools on volumetric consumption of the automatically flushing urinals. The schools chosen for evaluation were within the top 20 schools with the highest metered water use per student. The purpose of this evaluation was to provide a more accurate assessment of the amount of water used by the automatically flushing urinals or due to mechanical malfunctions, improper settings, leaks or other problems that were causing higher-than-average water use at these schools.

2000 WMCP: Plans are underway to meter landscape irrigation at all bureau facilities and to install water-efficient plantings and evapotranspiration sprinkler controllers at bureau-owned facilities.

Update: Although metering landscape irrigation at all bureau facilities did not occur, water-efficient plantings are installed and discussions about how to irrigate occur as green spaces are developed.

3.1.9 Outdoor Water Efficiency Projects

Landscape Trade Ally Workshops

2000 WMCP: Beginning July 1, 2000, the bureau will be working with the Columbia-Willamette Water Conservation Coalition [now the RWPC] to conduct training and education for landscape trades people including landscape designers, installers, and maintenance professionals. The primary objective of these workshops is to increase awareness and use of water-efficiency practices among those responsible for irrigation system and large landscape design and maintenance. One goal is to have water efficiency become a performance criterion in contracts between customers and landscape maintenance firms.

Update: In July 2000, the Columbia-Willamette Water Conservation Coalition merged with the Regional Water Providers Consortium. Workshops with landscape professionals were conducted in March and November 2001, and again in November 2005. Discussions with landscape professionals continue primarily with members of the Oregon Landscape Contractors Association.

Workshops for property managers were conducted in 2007 through the RWPC Conservation Committee. Information about what to expect from a good landscape/irrigation contractor as well as the latest new practices and technologies will be shared with these end users.

Large Landscape Audits

2000 WMCP: A pre-pilot project for multi-family landscape audits was completed last spring. This spring, a pilot project of 8-10 landscape water audits for BIG customers with large landscapes will be completed. If successful, additional landscape audits will be conducted each year until an audit has been performed for all identified sites that could benefit from one. This project is a regional partnership being conducted through the Columbia-Willamette Water Conservation Coalition [now RWPC].

Update: Audits of large landscapes continued with five area utilities through 2000. After an analysis of the work required for these audits and the actual savings realized by participants, the five partners decided not to pursue the audits as a formal program. The analysis revealed that many end users decided not to fix their systems once they received the audit results. If those who were being audited would not commit to make some investments in their irrigation systems, the information provided by the audit would not be useful. When requested by Portland retail customers, BIG staff will conduct landscape audits.

3.1.10 Water Reuse Programs

The City is engaged in numerous water reuse projects, administered primarily through the BIG program. The following describes the Water Bureau's efforts.

Zoo Tunnel Water Project

2000 WMCP: Several alternatives have been evaluated to assess the feasibility of using clean groundwater encountered during the construction of the Westside Light Rail Tunnel for various uses at the Oregon Zoo. The scope of the project was recently scaled back because the volume of water available was less than originally anticipated. Work is underway to complete planning approvals and obtain water rights to use the tunnel water at the zoo for animal exhibit make-up.

Update: Due to the complexity and cost of the project, no further work has been done. It is still cheaper for the zoo to use municipal water and dechlorinate it.

Port of Portland

2000 WMCP: The bureau is working with the Port on non-potable systems at Rivergate and at the Portland International Center. A system at Swan Island has already been installed.

Update: The Port has gone further on this project without Water Bureau assistance. The Port has installed the first phase of a non-potable water supply system in the Rivergate Industrial District, near the Wapato Corrections Facility. A well was drilled in 2003 near this facility and is currently being used to irrigate landscape.

As discussed in the Port's updated WMCP (2008), the Port is planning the expansion of this system to serve a non-potable water system service area encompassing Rivergate and Marine Terminals 5 and 6. The Port's updated WMCP also identifies two other areas that currently have non-potable water supplies: the Portland Shipyard in the Swan Island Industrial District, and the Portland International Airport / Portland International Center (PDX/PIC) complex. Current non-potable water use at PDX/PIC is for irrigation and some construction water; the Portland shipyard at Swan Island uses non-potable water for process water uses.

Microelectronics Water Use Analysis Project

2000 WMCP: Ibera Efficiency Services was retained to provide assistance in performing detailed water use analyses for electronics and microelectronics firms served by the City's system and by our wholesale providers. The analyses will include potential water-efficiency measures, water and sewer savings, and a cost/benefit analyses. A study has been completed for Wacker Siltronic that identified over 110 million gallons per year in cost-effective water savings projects. Wacker Siltronic has implemented or is in the process of implementing at least two of the recommended projects, with potential savings of 32.5 million gallons per year:

- recycling of ultra pure water with the elimination of leaks at a cooling tower
- recycling reverse-osmosis reject for wet scrubbing applications

Site visits at other companies by the BIG staff are underway.

Update: Siltronic (formerly Wacher Siltronic) continues to be the bureau's top water user. After publication of the 2000 WMCP, Siltronic completed projects that included recycling ultra pure water (UPW), eliminating leaks in cooling towers, and recycling reverse osmosis water (RO) for wet-scrubbing applications. The estimated savings from these projects is 80 million gallons per year.

Cooling Tower Guidebook and Customer Workshops

2000 WMCP: As mentioned in Section 3.1.7, the BIG program published a cooling tower guidebook in 1999. The guidebook recently won an Excellence in Communications Award from the Pacific Northwest Section of the American Water Works Association (AWWA). Two workshops were held in May 2000 to provide customer education on increasing cooling system efficiency. The workshops are being sponsored jointly by the City of Portland BIG program and the Columbia-Willamette Water Conservation Coalition.

Update: The bureau also offered cooling tower workshops in Portland in May of 2003.

HVAC System Performance Evaluations

2000 WMCP: The bureau is currently seeking proposals from consultants to perform site visits to evaluate the efficiency of operations for heating, ventilating, and cooling (HVAC) systems at BIG customer facilities. The project will include a cost-benefit evaluation for making improvements to increase operational efficiency and provide recommendations to customers for implementation. HVAC systems often use large quantities of water, particularly during the summer. Many companies can achieve substantial water savings by improving the efficiency of HVAC systems. This is a joint project with the City's Energy Office (now known as the Office of Sustainable Development).

Update: Six evaluations were completed and reports have been issued with recommended changes as to which efficiency improvements could be achieved.

3.2 Water Use Reporting Description and Compliance

This subsection addresses the requirements of OAR 690-086-0150 [2]: A description of the water supplier's water use measurement and reporting program and a statement that the program complies with the measurement standards in OAR Chapter 690, Division 85, that a time extension or waiver has been granted, or that the standards are not applicable

Portland Water Bureau submits its annual Municipal Water Report per the requirements of OAR 690 Division 85 and meets the standard requirements. Measuring methods are per Section 15(5)(a), flow meter method for pipe flow measurements at the well head. The equipment meets the 15 percent accuracy requirement. All well discharge information is transmitted via a SCADA system to a central monitoring point for viewing, storing, and evaluating well output by individual well, or by all wells combined.[37]

In October of each year, the output data for the previous water year is taken by individual well and imported into a spreadsheet for monthly discharge computations. The spreadsheet is the source for the input into OWRD's online Water Use Reporting Database.

3.3 Conservation Measures Currently Implemented

This subsection addresses the requirements of OAR 690-086-0150 [3]: A description of other conservation measures, if any, currently implemented by the water supplier, including any measures required under water supply contracts

3.3.1 Pilot Projects Testing New Technologies

Since 2000, the bureau has also participated in a pilot project to study the cost effectiveness of using water-efficient washing machines, and two studies to examine the effectiveness of irrigation tools.

[37] SCADA stands for Supervisory Control and Data Acquisition. The Water Bureau's SCADA system collects data from various points in the water system and sends the data to a central computer for display, management, and control.

Washing Machines

In 2003, the Portland Water Bureau, in collaboration with OSD, Northwest Energy Efficiency Alliance, Oregon Department of Energy, and Coin Meter Company, began a study to determine the energy and water efficiency of commercial washing machines typically used in the common room laundry of a multi-family residence. Results of this study showed the differences in water consumption by typical washers. This information can be used by the decision makers in multi-family housing to better judge the cost effectiveness of continuing to use less efficient models.

Sprinkler Timer Pilot Project

In 2004, a two-year pilot project was initiated to explore the water-saving capability of digital sprinkler timers at residential sites. Digital sprinkler timers allow for automatic watering in locations where in-ground irrigation systems and alternating current-powered controllers are not feasible. The study included 108 Water Bureau customers. The study results showed that sprinkler timers do not directly conserve water, but do encourage users to become educated in water-wise gardening and irrigating practices.

Weather-Based Irrigation Pilot Project

In the spring of 2004, the bureau initiated a pilot project to measure the effectiveness of weather-based irrigation controllers. These devices use hourly data sent from local weather stations (including rainfall, air temperature, wind speed, and other factors) to calculate how much water plants would use and how much would be lost to evaporation. The controllers adjust irrigation schedules to exactly match the water needs of a landscape, eliminating over-watering.

Currently, 12 controllers are operating at 8 sites in Portland. Project participants include the Port of Portland, the State of Oregon, and Kaiser Permanente. During the first two summers of the pilot project, participants decreased their irrigation use by an average of 22 percentage points, and saved over 3 million gallons of water. The controllers have also eliminated the labor costs associated with constantly monitoring and adjusting irrigation schedules in attempt to keep up with Portland's changing weather.

3.3.2 Wholesale Water Contracts and Conservation

In July 2006, new 10- and 20-year wholesale contracts were signed by the Portland City Council and the primary wholesale customers of the City of Portland. Unlike the prior wholesale contracts, the new contracts contain a section on conservation requirements (Section 13). This section requires the following:

- The purchaser must operate a system that is fully metered.
- The purchaser must submit a water conservation and management plan to the Water Managers Advisory Board (WMAB) every five years, unless the water provider already has a valid WMCP as approved by OWRD or the provider serves fewer than 1,000 people.
- The WMAB will review the WMCPs under the same rules for mandatory and discretionary programs as specified in Division 86.

- The WMAB will accept a OWRD-approved plan, however, for water providers not required to submit them by OWRD, the WMAB may provide comments and then approve or disapprove the WMCP.
- Purchasers are required to report to the WMAB on an annual basis regarding the implementation of WMCPs, and to report every five years on the estimated water savings from their WMCP.

See the following subsection for more information on conservation programs and projects currently underway and those that will be in the work plan in the next 5 years. Section 2 of this plan, the Water System Description, contains more information about the wholesale contracts and customers; Appendix D is a copy of the 20-year contract.

3.4 Mandatory Conservation Measures

This subsection addresses the requirements of OAR 690-086-0150 [4]: A description of the specific activities, along with a schedule that establishes five-year benchmarks, for implementation of each of the conservation measures that are required of all municipal water suppliers

This subsection describes the specific conservation activities related to the annual water audit, metering, meter testing and maintenance, the Water Bureau's rate structure, and the bureau's public education program. This subsection also includes a schedule that establishes five-year benchmarks for each of these activities.

The Water Bureau's asset management program has been evolving during FYs 2006-2007 and 2007-2008. Through the asset management program, bureau staff analyze the bureau's physical assets, examine the likelihood and consequences of failure, and provide recommendations to the management team for strategic management. Therefore, although this plan establishes benchmarks, the asset management plan may recommend alternative benchmarks as the asset management planning effort matures.

3.4.1 Annual Water Audit

This subsection addresses the requirements of OAR 690-086-0150 [4](a): An annual water audit that includes a systematic and documented methodology for estimating any un-metered authorized and unauthorized uses

The Portland Water Bureau provides annual data on water use to the City Auditor's Office for an annual report of City services to residents of the City of Portland. Table 3-1 shows a five-year history of water metered at the sources from the Bull Run reservoirs and groundwater, minus billed water to retail and wholesale customers to show the amount of unbilled water.

Table 3-1. Water Produced, Water Sold, and Unbilled Water, Fiscal Years 2002-2003 through 2006-2007

Fiscal Year	Amount of Water (in million gallons)		
	Produced	Sold – Billed	Unbilled[a]
2002–03	37,788.0	35,900.0	1,888.0
2003–04	38,632.0	36,700.0	1,932.0
2004–05	35,492.0	32,900.0	2,592.0
2005–06	35,968.0	33,800.0	2,158.0
2006–07	38,574.6	35,874.4	2700.2
Total	**186,454.6**	**175,174.4**	**11,280.2**

[a]Unbilled water is the difference between water produced and billed and includes water used for fire flows, distribution system maintenance, facility testing, and cleaning reservoirs.

The average unbilled water for the past five years is approximately 6 percent of the total water produced. This amount includes fire flows, distribution system maintenance, facility testing, and cleaning reservoirs. The bureau does not have an exact estimate of the water used for each of these activities, therefore does not have a firm estimate of the leakage. However, the amount of unbilled water is relatively low at 6 percent, and the amount of leakage, or unaccounted-for water, is less than the amount of unbilled water.

The AWWA industry benchmark for the average range for unaccounted-for water in the U.S. west is between 4–11.5 percent; the bureau's average is at the low end of this range.[38] The Water Bureau's total percentage of unbilled water is both lower than industry benchmark averages and lower than the amount identified for needing an active leak detection program by the Division 86 rules.

Benchmark: To keep unaccounted-for water at less than 10 percent. Further benchmarks will be determined once the bureau's asset management program is completed.

3.4.2 Metering

This subsection addresses the requirements of OAR 690-086-0150 [4](b): If the system is not fully metered, a program to install meters on all un-metered water service connections

Portland Water Bureau customers, both retail and wholesale, are fully metered. Portland City Code Chapter 21.12 Water Services, Section 270 requires that all new customers be metered at the time of water service connection.

Benchmark: All new customers will be metered at 100 percent.

[38] Lafferty, Angela K. and William C. Lauer (2005) Benchmarking Performance Indicators for Water and Wastewater Utilities: Survey Data and Analysis Report. AWWA.

3.4.3 Meter Testing and Maintenance

This subsection addresses the requirements of OAR 690-086-0150 [4](c):— A meter testing and maintenance program

Small Meters

The Portland Water Bureau has 176,000 small meters. The Portland Water Bureau replaces all small meters, 1″ or smaller, every 20 years. The annual rate of replacement for small meters is five percent. The industry benchmark for replacement of small meters is between 15 and 25 years.

Benchmark: Replace all small meters (1″ or smaller) every 20 years. The bureau meets this benchmark now and will continue to do so into the future.

The performance measures in the bureau's budget for FY 2007-2008 are as follows:

- Small meters read within 3 percent of actual value at all times (20-year replacement cycle)
- Bureau workforces will replace 5 percent of all small meters annually
- Replace all DNR small meters within 10 days of request

Changes in asset management may change the time line and/or criteria for replacing small meters, but the final asset management plan won't be adopted until late in FY 2007-2008.

Large Meters

The bureau began a large meter replacement program in 2002, primarily to reduce lead in customer systems. Under this program, large meters were tested every five years. As of the first quarter of 2007, 90 percent of the large meters installed prior to 1986 have been replaced. By late fiscal year 2008-2009, all of the large meters will have been replaced.

A new large meter asset management plan will be implemented in FY 2007-2008. The asset management plan will prioritize meters to be tested based on the meter condition and criticality.

Benchmark: Test high consumption and wholesale meters every year. Test other meters 3″ and greater per newly implemented Asset Management Plan.

The performance measure contained in the Bureau's budget for FY 2007-2008 are as follows:

- Large meters read within 3 percent of actual value at all times (annual test program)
- Field-test and clean all water district and high-consumption (12,000 CCF/year) 159 meters annually.
- 24-hour response to all emergency maintenance requests
- Complete 560 large-meter tests (343 meters were tested in FY 2006-2007)

Other Types of Metering

Automatic meter reading includes 300 meters that are on radio reads due to their hazardous locations; another 3500 meters are on touchpad readers—these are primarily large meters that require confined-space entries.

The master meters that measure overall production from the Bull Run and from the groundwater pump station at the Columbia South Shore Well Field have electronic and mechanical components. The electronic elements of the master meters, and any that are utilized within large portions of the retail system, are calibrated each year and have a 25-year life expectancy. The mechanical portions of the Bull Run meters are located in the conduits and date back to the 1920s and 1950s; replacement for the meters is scheduled for FY 2007-2008.

The bureau issues temporary-use permits (45 site-specific hydrant permits in 2006), complete with a meter and backflow device. There are a few unconditional use permits also—45 annual permits were granted in 2006. According to code, these permits are limited to 60,000 cubic feet annually (but since the hydrants are not metered, there is no way to verify the actual use amounts).

Fiscal Commitment

The Water Bureau budget allocation for the meter program for FY 2007-2008 is 24.6 FTE and $3,772,531.

3.4.4 Rate Structure

This subsection addresses the requirements of OAR 690-086-0150 [4](d): A rate structure under which customers' bills are based, at least in part, on the quantity of water metered at the service connections

The bureau bills users based on water used, as measured by meters. There is also a fixed base charge, which covers the cost of reading and inspecting meters, servicing customer accounts, and billing. It is based on a cost per day, reflecting the number of days in the service period.

In 2000, water rates were restructured so that virtually all costs other than meter reading, servicing accounts, and billing were recovered from the volumetric portion of the rate.[39] The primary motive for the 2000 rate structure change was to give customers increased incentives to conserve water. The change gave customers an increased ability to control their bills and, therefore, motivation to conserve.

The Water Bureau had an inclining block rate structure until early in 2006 when a new billing system was installed. The new billing system is a temporary uniform rate adopted to ease into the new system. Once the system has been deemed stable, a new conservation rate structure will be adopted. A group of staff and outside stakeholders are reviewing potential conservation rate structures, with the goal of implementing the new rate structure as one of the 5-year benchmarks in this WMCP.

Submetering

The Water Bureau's conservation program participated in a national submetering study in 2004, sponsored by the Environmental Protection Agency and managed by the East Bay

[39] Under the old rate structure, other costs were recovered from the fixed base charge.

Municipal Utility District.[40] The study found a 15.3 percent savings (7.96 kgal per household per year) in water in multi-family complexes that used submetering over multi-family complexes that included utility bills in the rent. The study also found that more savings (11 kgal per household per year)[41] were achievable with older units (those built prior to the Energy Policy Act of 1992, which required more efficient plumbing fixtures in 1994) by retrofitting the plumbing fixtures and appliances.

The study also found that, from 2000 to 2004, the subset of multi-family units covered by separate billing systems grew by 25 percent, despite the lack of public-sector incentives for converting to separate billing. The payback for landlords, especially if they do not reduce rents—which was mostly the case in this study—is about one year. Therefore it makes financial sense for a property owner to make such an investment without incentives or requirements from a utility/legal jurisdiction. PWB is not authorized to implement regulatory options to require submetering in new construction.

Portland Water Bureau conservation staff inform multi-family customers about the potential benefits of submetering, from both a financial and resource savings perspective. PWB will continue to inform property manager groups and new building developers and will work with other City bureaus to encourage the use of submetering.

PWB does not believe that a benchmark at this point is justified because of the water savings that are gained from other programs and the payback is short and therefore it is in the interests of the property owner to implement submetering voluntarily. PWB, in concert with other bureaus in the City of Portland, will continue to inform property owners and encourage submetering. Further developments on this issue will be reported in next update of the WMCP.

3.4.5 Leak Detection Program

This subsection addresses the requirements of OAR 690-086-0150 [4](e): If the annual water audit indicates that system leakage exceeds 10 percent, a regularly scheduled and systematic program to detect leaks in the transmission and distribution system using methods and technology appropriate to the size and capabilities of the municipal water supplier

The Water Bureau's system leakage rate does not exceed 10 percent (see information presented in Section 2 and in subsection 3.4.1). The Bureau has a strong resource

[40] Mayer, PW, et al. 2004. National Multiple Family Submetering and Allocation Billing Program Study. Available at www.aquacraft.com/Projects/submeter.html. Accessed January 14, 2010.

41 Kgal is one thousand gallons (Mayer 2004).

commitment to emergency repair response and a leak location program in the annual budget. Specific performance measures for the distribution system in the FY 2007-2008 budget are as follows:

- Less than 5 percent of customers shall experience a cumulative outage of water for more than 8 hours in a year
- Planned outages, causing disruption of service, shall be limited to 8 hours
- Emergency outages are limited to 24 hours, except for mains exceeding 16 inches in diameter, for which emergency outages are limited to 48 hours

A specific workload measure for the leak detection program is to maintain the ability to respond to leak survey requests within 24 hours and continue to do the scheduled leak survey in specified areas. The fiscal commitment to the distribution program for FY 2007-2008 is 283 FTE and $41,843,741. (This total includes the meter program listed above.)

3.4.6 Public Education Program

This subsection addresses the requirements of OAR 690-086-0150 [4](f): A public education program to encourage efficient water use and the use of low water use landscaping that includes regular communication of the supplier's water conservation activities and schedule to customers

Water Efficiency Public Education Programs

The Water Bureau is committed to providing programs and services that educate our customers about the importance of water efficiency. Portland maintains year-round programs, with an emphasis on reducing the summer water peak. The public education program comprises the bureau's conservation pages on the City's Portland Online web site, public presentations, yearly bill inserts, a summer media campaign, a community outreach program (that targets low-income and other customers), and tours of Portland's water sources and the transmission and distribution system. These components are discussed in detail in Table 3-2.

Table 3-2. Public Education Program Components

Public Education Program Component	5-Year Benchmark
Web Site	
The Water Bureau's web site has a section devoted to water conservation. Information is provided for both residential and commercial customers. Case studies portray businesses that have successfully incorporated water reduction practices. The Water Bureau's conservation web pages received an average of 6,800 hits per month during FY 2006-2007. The conservation page is atwww.portlandonline.com/water under the conservation tab. The home page provides a link to the RWPC web site, www.conserveh2o.org, which complements the information provided by Portland.	Continue to maintain and update City of Portland web site with current conservation information for both residential and commercial customers. Support ongoing development of RWPC newsletter and other web communications.
Public Presentations	
Water conservation staff are frequently asked to talk about water conservation at community meetings, college classes, and other events. Public presentations are an excellent way to reach a small audience with detailed information. Past presentations have covered methods for reducing water consumption for residential and commercial customers and new technologies for reducing water use. Other water professionals request information about our programs. Conservation staff have provided program information at professional association meetings and conferences.	Make 10 public presentations about water conservation in Portland each year.
Bill Insert	
Each year, the conservation program develops information to send with the water and sewer bills about ways to reduce peak-season water.	Develop annual bill insert to be included in bills from June through August. The insert will include information on reducing outdoor water use by changing behaviors and providing education on new technologies.
Summer Media Campaign	
The Water Bureau partners with the RWPC and others to develop summer media campaigns through radio, print, and television. The Water Bureau and RWPC have a partnership with the Portland Area Radio Council (PARC) to play informative radio ads in the metro area more than 1,200 times, primarily during the month of August.	Continue to provide input into the RWPC's media campaign each spring to be broadcast during the summer with an outdoor watering focus. Continue to use PARC and partner with RWPC when appropriate.

Table 3-2. Public Education Program Components

Public Education Program Component	5-Year Benchmark
Community Outreach	
The Water Conservation program of the Portland Water Bureau is a highly visible community program that provides outreach to low-income and other customers. As was noted in Section 3.1.5, the Water Bureau has been doing outreach to low-income customers since 1996. Self-help workshops were offered for a number of years to an average of 700 people per year. A chance to partner with OSD's Solid Waste and Recycling Program gave the bureau a chance to take a look at new ways to offer information and devices. A two-year pilot program will be completed in 2008. The bureau participates with the Regional Water Providers Consortium at large events such as the Yard, Garden, and Patio Show and the Salmon Festival where staff can engage with thousands of customers. Other examples of the outreach specific to the Portland Water Bureau can be found in Sections 3.1.2, 3.1.3, 3.1.5, and 3.1.6. Some of the more visible events include the annual Fix-It Fair (a partnership with OSD) which reaches hundreds of customers each year; and local street fairs including the Mississippi Street Fair and the Clinton/Division Street Fairs. We have branched out to participate in more culturally diverse events including a celebration of the Chinese New Year, Asia Fest. Last summer, Water Bureau participated in a Native American home-buying fair.	Develop partnerships to reach 1,000 low-income customers each year on water conservation. Staff booths at four summer community events each summer – to reach 1,000 customers with conservation messages.
Water Source and System Tours	
The Portland Water Bureau offers a limited number of tours annually in the Bull Run watershed. All tours are planned and guided by professional Natural Resources Educators. Tour participants learn about Portland's primary drinking water supply and the importance of using it wisely.	Deliver approximately 24 water source tours to more than 550 students and 26 tours to other groups. The bureau will continue to integrate water conservation information on each tour.
School Assembly Programs	
Develop and contract with professional performers to offer free youth education assembly programming focused on water conservation. Examples of past performances include a rock n' roll show, a puppet show, and a play. See Section 3.1.3 for descriptions of past performances.	Deliver 20 water conservation assembly programs per year to schools within the Water Bureau's service area, both public and private.

3.5 Discretionary Conservation Program Activities

This subsection addresses the requirements of OAR 690-086-0150 [6]: If the supplier serves a population greater than 1,000 and proposes to expand or initiate diversion of water under an extended permit for which resource issues have been identified under OAR 690-086-0140(5)(i), or if the supplier serves a population greater than 7,500, a description of the specific activities, along with a schedule that establishes five-year benchmarks, for implementation of each of the following measures; or documentation showing that implementation of the measures is neither feasible nor appropriate for ensuring the efficient use of water and the prevention of waste

3.5.1 Leak Repair Program

This subsection addresses the requirements of OAR 690-086-0150 [6](a): A system-wide leak repair program or line replacement to reduce system leakage to 15 percent, and if the reduction of system leakage to 15 percent is found to be feasible and appropriate, to reduce system leakage to 10 percent

The Water Bureau has leak detection equipment and a leak detection crew that can survey small distribution mains completely every 2.5 years. They use underground microphones and a correlator to detect leaks. When leaks are detected, they are submitted for repair. System leakage at this time is less than 10 percent. See Section 3.4.5, Leak Detection Program.

3.5.2 Assistance Programs

This subsection addresses the requirements of OAR 690-086-0150 [6](b): Technical and financial assistance programs to encourage and aid residential, commercial and industrial customers in implementation of conservation measures

As noted in subsection 3.1, the Water Bureau's conservation program has staff that provide technical services to industrial, commercial, and institutional customers. The Business, Industry, and Government (BIG) program offers assistance to any customers who communicate a desire to reduce water use. Sometimes this assistance is as simple as identifying leaks; other times entire industrial processes are re-worked. The savings attributed to the technical assistance vary because the customer type can be complex. Water Bureau staff can assist customers in making decisions about industrial processes, but if the facility's production increases, overall water savings may not be apparent by looking at billing histories. Often, staff can make estimates that closely relate to the savings that can or do occur. This type of customer technical assistance will continue, and expand as needed to meet the needs of these customer classes (see subsection 3.1 for details on the technical assistance programs).

Incentives have been offered to low-income housing owners to replace older, less efficient toilets with current low-flush models (1.6 gallons per flush). These incentives will continue to be offered – either as rebates or by actually providing toilets to agencies and owners that provide affordable housing in our city. Evaluations of past programs that encourage replacement of older toilets to toilets to conform to the current code indicate a savings of 25 percent or more in individual water bills. Since the payback for most single-family households can be 1-2 years for a fixture that has a life expectancy of 20+ years, it is most beneficial to offer incentives to lower-income households that might not be able to afford the new fixture.

3.5.3 Retrofit/Replacement Fixtures Programs

This subsection addresses the requirements of OAR 690-086-0150 [6](c): Supplier-financed retrofitting or replacement of existing inefficient water using fixtures, including distribution of residential conservation kits and rebates for customer investments in water conservation

The residential conservation program is growing and provides distribution of devices and education about behavioral changes to help customers reduce their water use. The bureau is currently pilot-testing home water surveys in partnership with the Energy Trust of Oregon. Our targeted customers are low-income customers who receive bill assistance. Once the pilot has been completed, the bureau will evaluate the water use of participants. If the benefits to customers exceed the cost, the bureau will probably move ahead with a more formal program.

The City of Portland helped retrofit some of the Portland State University student dormitories with low-flow aerators in showers and sinks. The City has also been working with University of Portland (UP). In 2009, PWB submitted a written report to UP with recommendations for saving water.

3.5.4 Rate Structures

This subsection addresses the requirements of OAR 690-086-0150 [6](d): Adoption of rate structures, billing schedules, and other associated programs that support and encourage water conservation

PWB's Rate Structure

The Portland Water Bureau used inclining block rates from 1995 until April, 2006. With the implementation of a new billing system, the bureau converted to a consumption-based rate in order to provide stability to the billing system while it was being implemented. Currently the bureau uses a fixed-base charge and a single consumption-based rate that is higher ($2.44/ccf) than the highest block rate in 2005-2006 ($2.34 over 20 ccf/month).

PWB adopted this rate so that the billing system issues would be stabilized prior to a period of increasing rates. Beginning in fiscal year 2009-10, PWB is increasing its rates on average by 12 percent per year over the following five years. These rate increases are largely due to major capital efforts to implement the requirements of the Long Term 2 Enhanced Surface Water Treatment Rule of the Safe Drinking Water Act (i.e., rules changes affecting water treatment and open reservoirs). PWB started increasing the single rate during a time of declining per capita water use and an economic recession. In addition PWB's quarterly billing for residential customers masks the effectiveness of inclining block rates.

Table 3-3 shows the history of Portland Water Bureau rates from fiscal year 2004-2005 to 2009-2010.

Table 3-3. PWB Rates Since Fiscal Year 2004-2005

Fiscal Year Ending June 30	2004-05	2005-06[a]	2006-07	2007-08	2008-09	2009-10
WATER USAGE RATES						
Block 1 (0-12 ccf per month)	$1.72	$1.73	N/A	N/A	N/A	N/A
Block 2 (13-20 ccf per month)	1.97	1.98	N/A	N/A	N/A	N/A
Block 3 (over 20 ccf per month)	2.33	2.34	N/A	N/A	N/A	N/A
Volume Rate (per ccf)	N/A	N/A	$1.77	$1.86	$2.07	$2.44
BASE CHARGE[b]						
Water Quarterly Billed Customer per Month[c]	$2.95	$2.99	$3.32	$6.55	$6.17	7.38
Water Monthly Billed Customer[c]	$8.85	$8.96	$9.96	$19.66	$18.51	$22.13
Retail Average Overall Rate Change	5.00%	0.60%	2.50%	5.10%	8.60%	17.90%

[a] On April 10, 2006, PWB converted to a single rate structure of $1.73 with the implementation of the Cayenta billing system. The negative financial impact of this change was about $140,000 for FY 2005-06.
[b] Reflects rate structure with the base charge only paying for direct billing and customer service costs (including Cayenta operations and development).
[c] Beginning in FY 2007-08, PWB began collecting the full base charge for both the water and sewer bills which is the reason for the increase going forward from that year.

Figure 3-2 shows the actual and inflation-adjusted changes for a typical customer's water bill from fiscal year 1999-2000 to fiscal year 2007-2008.

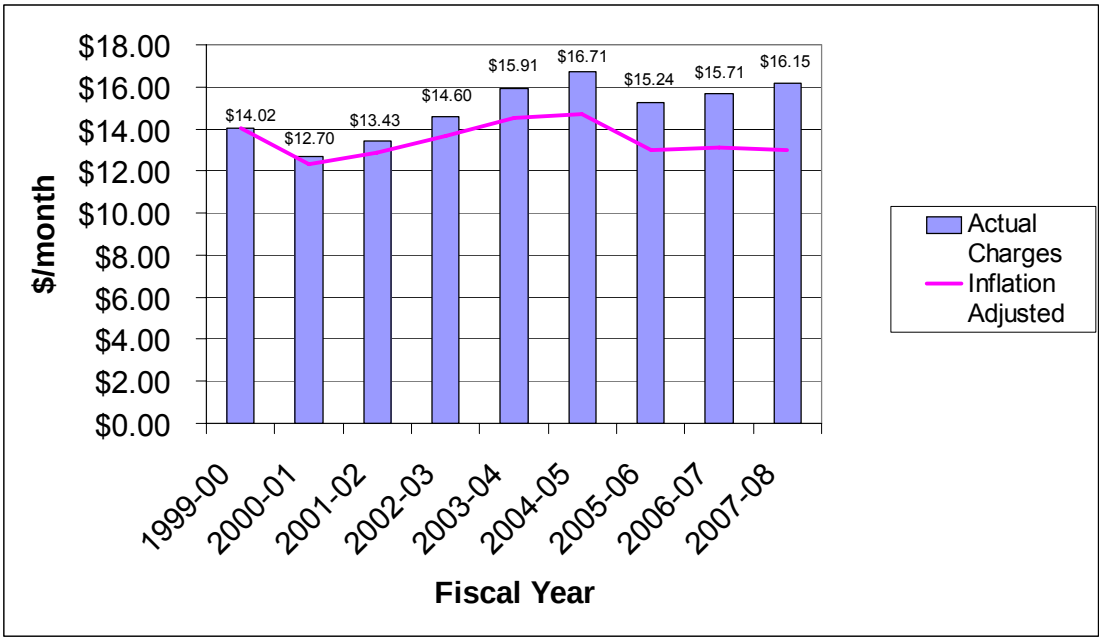

Figure 3-2. Actual Charges and Inflation-adjusted Charges for Typical Residential Water Customer in Portland, Fiscal Years 1999-2000–2007-2008[a,b]

[a]Based on 7 CCFs since FY 2005-2006 and 8 CCFs prior to FY 2005-2006

[b]Average annual change = 1.8%; average inflation adjusted change = -0.9%

Source: Portland Water Bureau Water Rates presentation, May 23, 2007

The water service to Portland retail customers is one of the lowest bills they have. Figure 3-3 shows what a typical Portland customer paid per month for water, telephone, sewer, and energy in 2007.

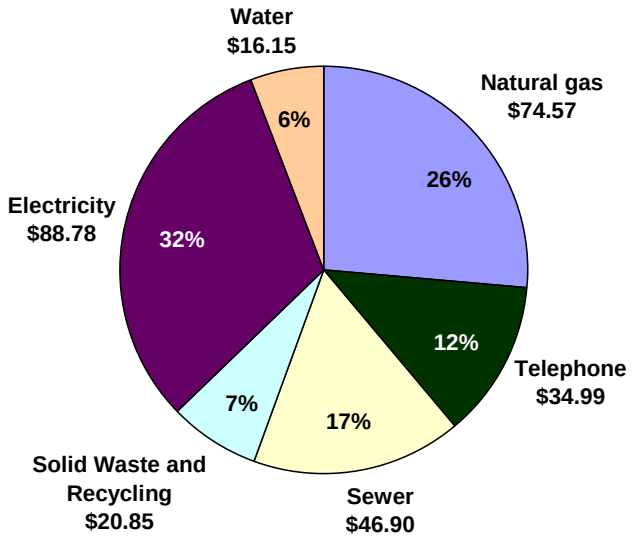

Figure 3-3. Basic Utility Rates, Typical Monthly Charges[a]

[a]Typical water use is 7 CCF per month.

Source: Basic Utility Services file, updated January 11, 2008

Comparisons to Other Water Providers' Rate Structures

An American Water Works Association study conducted in 2008 indicates that, nationally, 32 percent of all utilities have uniform block rates (a single rate like Portland's) and 28 percent have decreasing block rates (the more you use, the less you pay). The remaining 40 percent of utilities have increasing block rates.[42] An informal survey of western cities, however, indicates a predominance of tiered block rate structures in cities such as Seattle, Denver, San Francisco, San Diego, Salt Lake City, Las Vegas, Eugene, and Honolulu.

PWB's rates are among the lowest in the area and are close to the median compared with similar cities around the country. Table 3-4 compares Portland's 2006 water and sewer rates with the rates of other water providers in the region.

Table 3-4. Cost of Portland City Water and Sewer Compared with Costs for Other Regional Water and Sewer Providers

	Cost in 2007 Dollars		
	Water (7 CCFs)	Sewer[a,b]	Combined
Clackamas River Water	15.10	31.76	46.86
City of Portland	**16.15**	**45.25**	**61.40**
Rockwood Water District	18.04	45.25	63.29
City of Tigard	18.23	33.62	51.85
City of Lake Oswego	19.04	35.09	54.13
Tualatin Valley Water District	19.18	33.62	52.80
City of Beaverton	21.15	37.62	58.77
City of Tualatin	21.45	33.62	55.07
City of Gresham (current)	28.62	31.33	59.95

[a]Sewer bills include stormwater charges and base charge.
[b]In this example, the Portland sewer bill is for a customer receiving a 16 percent Clean River Rewards Program discount.

In 2009, the Regional Water Providers Consortium conducted a survey of 23 water providers in the Portland metropolitan area to determine the use of block rates. The survey shows that 9 of those surveyed use inclining block rates for residential water pricing, see Table 3-5. Of the water providers that use inclining block rates, only three have upper rates higher than Portland's single consumption-based rate for fiscal year 2009-10. Evaluating regional rates is complex, however, because of the base, or service, charge for the fixed costs associated with producing and operating the billing system and the frequency of billing. The base or service charge makes up a major part of the monthly bill and can be quite different for each jurisdiction. Less-frequent billing cycles, like Portland's quarterly billing cycle, can reduce the efficacy of rates to influence demand patterns.

For these reasons, and because of the need to stabilize the billing system, PWB believes that the use of a single consumption-based rate does foster conservation and that it is both justified and necessary to continue with this structure for the next five years.

[42] American Water Works Association. 2008. Water and Wastewater Rate Survey. Denver, CO.

Table 3-5. Residential Water Rates of Regional Water Providers Consortium Members

Water Provider	Monthly Rate Per CCF	Other Monthly Charges		Meter Size	Notes
Beaverton, City of	$2.07/CCF	Base Rate	$8.00		
Clackamas River Water	$1.60 (up to 4 CCF) $1.78 (4-8 CCF) $2.12 (9-24CCF)	Base Rate	$11.70		
Fairview, City of	$1.72/CCF				
Forest Grove, City of	$0.94 CCF ($1.25 per1000 for 0- 5k gallons) $1.53 CCF ($2.05 per 1000 for 5-10k gallons) $2.25 CCF ($3.01per 1000 for over 10,000)				
Gladstone, City of	.20 per 1200 CCF	Base Rate	$24.10		
Gresham, City of	$.995 (0 – 34 CCF) $1.205 (35 – 54 CCF) $1.505 (more than 54 CCF)	Base Rate	$14.03	5/8 inch	Fire flow $4.20 per month
Hillsboro, City of	$1.10 (0-8 CCF) $1.70 (9-18 CCF) $2.30 (19+ CCF)	Base Rate	$8.96		
Lake Oswego, City of	$0.45 (0-16 CCF) $.675 (17-32 CCF) $1.37 (over 32 CCF)	Service/Fixed Charge	$13.48		
Milwaukie, City of	$1.73 (per 100 CCF)	Base Rate	$3.81		
Newberg, City of	$3.18/CCF	Base Rate	$4.14		
Oak Lodge Water District	$1.08 (0-10 CCF) $1.45 (11-50 CCF) $1.71 (51 and up CCF)	Base Rate	$5.05	5/8 inch	
Portland, City of	$2.44/CCF	Base Rate	$7.38		
Raleigh Water District	$2.00/CCF	Base Rate	$9.61	3/4 inch	
Rockwood Water PUD	$1.63/CCF	Base Rate	$5.78	5/8 inch	
Sandy, City of	$1.99/CCF	Base Rate	$5.26		
Sherwood, City of	$0.46/100 gallons = $3.44 to 28 CCF $0.71/100 gallons = $5.31 over 28 CCF	Base Rate	$16.76	5/8 inch	
Sunrise Water Authority	$1.55 (up to 7 CCF) $2.35 (8-24 CCF) $2.75 (24 or more CCF)	Base Rate	$4.25		
Tigard, City of	$2.68/CCF				
Troutdale, City of	$1.83/CCF ($2.45/1000 gallons)				
Tualatin, City of	$2.29	Service/Fixed Charge	$3.40	5/8 inch	Facility charge $3.50/monthly.
Tualatin Valley Water District	$2.45 up to 28 CCF $3.50 over 28 CCF	Service/Fixed Charge	$6.49	5/8 inch	
West Slope Water District	$3.48 per 100 CCF	Base Rate	$6.87	5/8 inch	.
Wilsonville, City of	$3.49/CCF				All rates include a 4% franchise fee.

For all of the reasons noted above, it is PWB's intent to retain the single rate for the next five years (which is estimated to steadily increase over that period). During that same period, PWB will conduct a study of the feasibility in the Portland retail area of different rate structures based on the specific circumstances of customer class mix, trends in per capita water use and seasonal water use patterns, potential shifts in land use and climate patterns that impact water use, and the investment that must be made regarding capital facility construction to meet regulatory requirements.

PWB's overall goal for studying conservation rates relates primarily to peak-season water use, which is what puts the most pressure on the water system and PWB's commitments to instream flows. This study will be conducted by PWB and will involve stakeholders (the public, businesses, industrial and institutional users, and other agencies and interest groups) within the retail service area and will include any commenter on the WMCP on this issue. The City will evaluate different types of graduated rate structures including summer peak pricing. PWB is not able, at this time, to state which price blocks it will evaluate, primarily because the continuing increase in the single rate can only be determined by City Council on an annual basis, and it will be those increases that will dictate the exact nature of the type of rate structure blocks or methods that will be evaluated and recommended. The study will recommend any needed changes if the results indicate that a different rate structure will in fact produce equal or greater water efficiencies than are currently obtained by the existing single rate. PWB has proposed revisions to its benchmarks in Table 3-7 to reflect this proposed course of action, as well as a new benchmark recognizing the requirements of the City's wholesale contract language on conservation planning for wholesale customers.

The bureau also participates in the Water/Sewer Low Income Financial Assistance Program (LINC) rate assistance program, along with the Bureau of Environmental Services. Customers qualify based on income level to receive discounts on both water and sewer bills. Both bureaus also offer $150 in crisis assistance to each qualifying customer once every 12 months. Leak and fixture repair services are also available from a partnership the bureau has with Multnomah County. The program brochure is included in Appendix F.

3.5.5 Water Reuse and Recycling and Opportunities for Non-Potable Water

This subsection addresses the requirements of OAR 690-086-0150 [6](e): Water reuse, recycling, and non-potable water opportunities

Recycling, Reuse, and Use of Non-Potable Water

Section 5.5 provides more detail about the current and future use of non-potable water supplies, particularly by PP&R, which has increased the amount of non-potable water provided for parks irrigation over the last two decades.[43] The Water Bureau has provided technical information for a variety of projects related to the reuse, recycling, and use of non-potable water. Projects have been implemented with other City bureaus, other nongovernmental agencies, and local businesses to recycle and reuse water or use non-potable sources of water.

Portland Parks & Recreation

PP&R has constructed the Willamette River well project, which supplies river water to irrigate four different parks (August 2000). In addition, PP&R is researching new water conservation technologies such as waterless urinals, rainwater harvesting systems, and the use of gray water.

Port of Portland

The Port of Portland has developed three non-potable water system service areas for irrigation, some construction, and process water use (see Section 3.1.10). The Port has also identified two other future non-potable water supply system service areas: Marine Terminal 4 and West Hayden Island. The service area for Marine Terminal 4 consists of 289 acres located along the Willamette River. Development of Port-owned surface water rights in this service area could allow non-potable water to be used for landscape irrigation, toilet flushing, industrial processes, facility and vehicle washdown, ship washdown, ship ballast, and construction activities.

West Hayden Island is owned by the Port and is currently undeveloped and is identified as a strategic marine reserve property by the Port of Portland. Future development will consist of marine cargo, industrial facilities and/or managed and enhanced natural habitat in a 685-acre area. Future water uses that could be met by non-potable sources (Port-owned Columbia River surface water rights) include landscape irrigation, toilet flushing, fire suppression, industrial process, facility and vehicle washdown, ship washdown, ship ballast, and

[43] Section 2.3 lists the water rights for the PP&R non-potable sources.

construction activities. As planning and development of West Hayden Island progresses, the Port intends to incorporate non-potable water use as a key component.

Columbia Boulevard Wastewater Treatment Plant

The Bureau of Environmental Services's (BES) Columbia Boulevard Wastewater Treatment Plant (WTP) has a reuse water facility that produces water for facilities washdown and irrigation on-site only. The washdown water can be used to supplement flow to an English water garden, also on the site, when needed. This garden uses roof drain water from the large WTP Headquarters Facility as well. Washdown water comes from the Treatment Plant's effluent. Tryon Creek has this practice as well.

This product water from the water reuse facility currently does not meet state standards for off-site use. BES has no plans at this time to upgrade the facility to enable off-site uses, but it would take the opportunity to take advantage of any favorable opportunities once they arise.

Aramark Laundry

Aramark Laundry installed a "last rinse to first wash" recycling system in which the last-rinse water is piped to a tank and used again in the first steps of the washing process. (October 2002).

Green Investment Fund Projects

The Green Investment Fund Project is a partnership involving both funding and technical expertise with OSD, the Bureau of Environmental Services, the Water Bureau, and the Energy Trust of Oregon. Since 2004, these organizations have been working together to provide grants to companies and individuals who are making efforts to invest in green building technologies, including the reuse/recycling/use of non-potable water. Some of the projects have been completed and data are available on the Kerby Avenue homes and the Oregon Clinic.

Kerby Avenue Homes — Includes four homes that share one 1,500-gallon storage tank which collected 17,400 gallons or rainwater over the course of one year. This is the only project (from 2005) that has a full year of results from monitoring.

Oregon Clinic — Uses a 20,000-gallon tank to provide irrigation and toilet flushing water. Savings, reported by the building owners, include a 42 percent reduction in utility-provided water for potable uses and a 100 percent reduction for irrigation.

Recycling Cooling Water

Artistic Glass Manufacturer

An artistic glass manufacturer reduced its water consumption by 65 percent, or 5.4 million gallons, by installing a unique recycling system for cooling water used to cool glass rollers and table surfaces. A similar system was installed by local competitors.

Ink Manufacturer

An ink manufacturer saved 3 million gallons per year by adding an evaporative cooler that recycles, cools, and reuses the water to maintain proper ink temperature. The manufacturer purchased a used cooler, and recovered costs within 6 months.

Office Building

An office building connected water source heat pumps to a cooling tower to save 8 million gallons per year.

Community Pool, Portland Parks & Recreation

A community pool was discharging 5,000 gallons per day in backwashing to maintain pool safety standards. The Water Bureau made recommendations regarding sand filters, airflow and ozonation equipment. The water savings were approximately 1 million gallons annually.

Other Recycling and Reuse Opportunities

Bureau staff plan to implement a pilot project related to water recycling/reuse in the next five years. The results will be shared with customer classes that can benefit from the use of those technologies. Staff will continue to provide technical expertise to customers who are looking at ways to reduce water use by changing technologies to reuse water. We will continue our partnership with the Office of Sustainable Development and the Green Investment Fund for the next few years, when an evaluation will occur to determine benefits to the bureau, its customers, and the City. Some projects receiving funding could provide the bureau with an opportunity to study new technologies as well.

3.5.6 Other Conservation Measures to Improve Water Use Efficiency

This subsection addresses the requirements of OAR 690-086-0150 [6](f): Any other conservation measures identified by the water supplier that would improve water-use efficiency

Conservation staff have created a project to pilot-test new technologies every few years, especially the new weather-based irrigation products. Staff works closely with RWPC and member utilities to partner when possible on projects. Water Bureau conservation staff are open to new ideas and projects that to meet the goals of reducing peak-season water use and providing excellent customer service.

Retrofitting or Replacement of Existing Water Fixtures

The Water Bureau has worked to maximize efficiency on the free-flowing Benson Bubblers, which have been retrofitted with flow restrictors and put on timers to ensure they provide water when needed during the day and to be turned off at night. Also, many of the decorative fountains have been retrofitted or built to re-circulate water.

System Efficiency

When a dead-end main is replaced or when a new development main is constructed, the new main is typically looped through to help eliminate flushing requirements—unless future development is anticipated that would otherwise extend the main. Also, when mains are replaced the bureau looks at the surrounding distribution system to see if the system can be reconfigured as part of the replacement to improve pressure, fire flow, water quality, etc. Improving the efficiency of the system is an important part of the project planning process.

The bureau has worked closely with PP&R in the past to enable PP&R to dig and use non-potable wells for irrigation. The most notable example is Portland's Waterfront Park which has a lot of pedestrian traffic and events in the warm months. During this time each year, PP&R replants and irrigates grass several times for that park.

The Water Bureau also supports the efforts of PP&R to more efficiently irrigate many of the parks in Portland. Of the 735 irrigated acres of parks, 400 are now on the Maxicom Central Control, which waters according to the weather. This system also provides many tools for managing water use. Conservation staff will continue to work closely with PP&R to ensure continued efficiencies in water use. See the details of PPR water conservation practices in Appendix F.

The bureau has become a sponsoring partner of the Environmental Protection Agency's (EPA's) new WaterSense program, a voluntary certification program. To achieve WaterSense certification, services and products must meet certain specifications for water efficiency that are reviewed by water conservation professionals.[44]

Staff will also support the efforts of the new clearinghouse for water conservation information, the Alliance for Water Efficiency (AWE). AWE is a stakeholder-based, 501(c)(3) nonprofit organization dedicated to the efficient and sustainable use of water. Participation in AWE is a way for the bureau to share information about our program and project results with other water utilities, manufacturers, and other interested parties around the country. The bureau has recently become a charter sponsor of this organization.

Wholesale Customer Water Management and Conservation Measures

Section 13 of the current 10- and 20-year wholesale water contracts between PWB and other water provider entities (cities, special districts, and a People's Utility District) requires that any entity with a population of more than 1,000 must submit a conservation plan based on the requirements of OAR Division 390-86. This requirement includes approval by the Water Managers Advisory Board (WMAB).[45] This requirement was met in 2009 and is documented in Table 3-6.

In addition to conservation planning, Section 14 of PWB's wholesale contract also requires curtailment planning coordination that recognizes the different supply sources that wholesale customers have access to as well as conditions within PWB's water system that might require curtailment.

[44] More information on WaterSense is available at www.epa.gov/WaterSense/basic/index.htm.

[45] The Water Managers Advisory Board advises PWB's Administrator on implementation of the wholesale contracts.

Table 3-6. Status of Conservation Plans under PWB Wholesale Contract Submitted to WMAB

Water Providers	Submitted Plan		Notes	Consortium Member	Submitted WMCP to WRD	Mandatory Programs					Discretionary Programs					Operation Measures to Reduce Peak Events on PDX	WMAB Approval	Annual Report on Conservation to WMAB	WMAB Notes
	Yes	No				Leak Detection Program	Education Programs	Consumption-Based Rates	Meter Testing & Maintenance	Annual Water Audit	Technical Assistance Programs	Retrofit Programs	Water Conservation Rates	Reuse, Recycling, Non-potable Opportunities	Other Measures				
Large Entities																			
Rockwood PUD	X		WMCP not yet approved by WRD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Not feasible or appropriate	No	Yes - GW system to reduce peak use	**Yes**	July 2010	
Gresham	X			Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes for Pleasant Valley area	Yes	Yes - GW system to reduce peak use	**Yes**	July 2010	
TVWD	X		WMCP approved by WRD May 2009	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Demo garden	Yes	**Yes**	July 2010	
Tualatin	X			Yes	No	Yes - below 5%	Yes	Yes	Yes	Monitored	Consortium Program only	Consortium Program only	No	Not feasible or appropriate	No	Yes	**Yes**	July 2010	
West Slope	X			Yes	No	Yes - below 10%	Yes	Yes	Yes	Yes	No	Consortium Program only	No	Not feasible or appropriate	No	Yes	**Yes**	July 2010	
Tigard	X			Yes	No	Yes - below 10%	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	**Yes**	July 2010	
Portland	X		WMCP submitted to WRD - March 2008 - Plan on hold	Yes	Yes	Yes - below 10%	Yes	Yes	Yes	Yes	Yes - BIG program	Yes	No	Yes	Multifamily metering pilot	N/A	**Yes**	July 2010	
Small Entities																			
Pleasant Home	X			No	No	**Yes (11.5%)**	**Yes - start in 2009**	**Graduated Rates - Yes**	**Yes**	**Yes**	**These programs do not apply to entities below 7,500 population unless WMAB determines that they should be**					**Yes**	**Yes**	July 2010	Check on Education implementation in 2010
Lusted	X			No	No	**Yes (2.9%)**	**Yes**	**Yes-will proposed graduated rates in 2009**	**Yes**	**Yes**						**Did not address**	**Yes**	July 2010	Need to address peak operational measures per Sec 13 - 2(b)vi.
Raleigh	X			Yes	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**						**Sort of**	**Yes**	July 2010	Studying Graduated rates
Lake Grove	X			No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**						**Yes**	**Yes**	July 2010	No PDX water July-Sept
Palatine Hill WD	X			No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**						**Yes**	**Pending**	July 2011	

3.5.7 Work Plan and Benchmarks

Table 3-7 shows the ten-year work plan with five-year benchmarks for the BIG and residential conservation programs.

Table 3-7. BIG and Residential Conservation Programs

10-Year Work Plan	5-Year Benchmarks	Comments
Technical Assistance		
Partnerships to leverage technical assistance		
• One-stop Shop –partnership with the City's Office of Sustainable Development (OSD)	Receive 12 referrals each year	The One-stop Shop is a three-year pilot project beginning in FY 07-08. The program will be evaluated at end of 08-09.
• Energy Trust Home Assessment	100 assessments each year by end of program	The Energy Trust Home Assessments are in a pilot-testing mode for the next year. We are targeting low-income customers who receive our bill assistance. We will assess success and move forward or discontinue based on evaluation of home water-use reductions.
• RWPC provision of evapotranspiration data for customers	Data to be provided weekly during summer watering season	
• Bureau-provided technical assistance to industrial, commercial, institutional accounts	40 site visits each year; provide written reports to customers when needed	Professional staff from the bureau are available to assist industrial, commercial and institutional customer classes, e.g., schools, restaurants, hotel/motels, etc.
Technical Assistance		
• Pilot projects to test new technologies to share with customers	1 pilot project each year	Pilot project findings will be shared with customers and other interested parties
• Educational workshops	2 workshops per year	These could include plumbing for conservation, drip irrigation for gardeners, cooling/HVAC workshops for businesses
• Web education	Annual updates to web information by staff	
Rates		
• Portland will retain a single consumption-based rate for five years during which a study of different conservation rate structures will be conducted. Any changes will be enacted and reported upon at the 5-year benchmark.	The rate structure study will be completed and recom-mendations for the future rate structure for the Portland retail service area will be made within 5 years of the Final Orders approving the WMCP.	The rate study will include stakeholder participation for the Portland retail service area.

Table continued on next page.

Table 3-7. BIG and Residential Conservation Programs, continued

10-Year Work Plan	5-Year Benchmarks	Comments
Wholesale Contracts		
• The conservation planning requirements of the wholesale contracts have been implemented as of 2009 and updates as required will be conducted.	Update of the wholesale customer's Conservation Plans and estimated water savings will be done by 2014 under the specifications in Section 13 of the wholesale contracts. Reports on implementation of Conservation Plans are required annually.	City does not have control over the rates of wholesale customers, but does require joint approval of Conservation Plans by the Water Managers Advisory Board under the Portland wholesale contracts.
Financial Assistance		
• Rebates for weather-based irrigation controllers/equipment	Targeted commercial and residential large water users.	To begin in FY 09-10, once information about soil moisture sensors is available. Soil moisture sensors will be pilot-tested in the spring/summer of 2008. The bureau will offer rebates for devices approved by Smart Water Applications Technologies (SWAT), a partnership between water providers, manufacturers and the Irrigation Association.
Supplier-Financed Retrofit/Replacement		
• Distribution of conservation devices o toilet displacement bags that save about 0.5 gallon per flush o fill-cycle diverter that saves another 0.5 gallon per flush o 1.0 gpm bathroom and 1.5 gpm kitchen faucet aerators (0.5 gpm bathroom aerators for multi-family and others who request) o 1.5 gpm showerheads o 5-minute shower timers o Other devices that become available	20,000 devices distributed per year	Through web and customer service events
• Low-income toilet replacements	100 per year	Through partnerships with Housing Authority of Portland and other low-income housing providers
Water Reuse		
• Fund and review Green Investment Fund projects, in partnership with OSD for both commercial and residential projects that incorporate water reuse	Track water use reductions projects, which include water reuse	

Table continued on next page.

Table 3-7. BIG and Residential Conservation Programs, continued

Water Reuse		
• Work with city-wide team to develop educational materials about water reuse for distribution and web posting	By 2007–2008	Staff is working with other City staff to develop educational materials about rainwater harvesting.
• Pilot projects to test potential new technologies that can reuse water in various customer settings to reduce peak-season water use	1 pilot test of reuse technology in 5 years	This project is contingent upon the development of new technologies that can help various customer classes reuse water in primarily industrial settings, but also for customers with irrigation, cooling, and HVAC needs, which have large peak-season impacts

4. Water Curtailment

This section addresses the requirements of OAR 690-086-0160 [1]: A description of the frequency and magnitude of supply deficiencies within the past 10 years and current capacity limitation. The description shall include an assessment of the ability of the water supplier to maintain delivery during long-term drought or other source shortages.

4.1 Frequency and Magnitude of Supply Deficiencies in the Last Ten Years

The Portland Water Bureau has not experienced any major supply deficiencies in the last 10 years. Portland is fortunate in that it has a high-quality secondary source of drinking water in the Columbia South Shore Well Field (CSSWF) to use should there be a supply shortage in the Bull Run watershed.

According to the *Seasonal Water Supply Augmentation and Contingency Plan*—also referred to as the *Summer Supply Plan* (SSP), the CSSWF is used for as seasonal supply augmentation and emergency supply under the following conditions:

Supply Augmentation: During seasonal warm dry periods, groundwater may be used

- to augment the Bull Run supply to meet demand when the Bull Run water supply is not sufficient to meet the needs of the bureau's retail and wholesale customers
- to maintain instream flows for fish habitat
- if water demand exceeds the conduit capacity long enough to deplete in-town storage below safe levels[46]

Turbidity Event Augmentation: Groundwater may be needed to augment or replace the Bull Run surface supply to avoid violating state and federal drinking water standards for turbidity. Turbidity in the surface water supply is typically caused by storm events in the Bull Run watershed.

Emergency Use: Groundwater may be needed during catastrophic events (in addition to turbidity events) that would cause a loss of part or all of the Bull Run surface water supply. Catastrophic events include, but are not limited to, severe or extended drought, fire in the watershed, flood, landslides, volcanic activity, earthquakes, and acts of vandalism or terrorism. Any of these events could cause significant water quality problems or result in damage to, or shutdown of, the conduits or other critical infrastructure used to transfer Bull Run water to the Bureau's in-town reservoirs. An example of a catastrophic event in the watershed was a landslide in 1995 that damaged two conduits. Groundwater was used for 27 days and provided an average of 25.4 MGD to the distribution system.[47]

Table 4-1 shows a summary of groundwater use since 1997, including the duration of supply augmentation and quantity of water supplied. The two reasons for supply augmentation

[46] Conduit capacity may be exceeded if demand is exceptionally high or if one or more of the conduits is out of service.

[47] Although the average is 25.4 MGD, the actual amounts per day varied widely.

were turbidity in Bull Run (4 times in last 10 years) and summer supply augmentation (5 times in last 10 years).

Table 4-1. Groundwater Use, January 1997–January 2007

Start date	Days used	Average daily production (MGD)	Range of daily use (MGD)	Reason for groundwater use
November 7, 2006	14	78.6	27.8–92.2	Turbidity
August 14, 2006	79	46.0	4.5–72.0	Seasonal supply augmentation
July 27, 2004	29	36-37	36–37	Seasonal supply augmentation
January 29, 2004	4	18.4	18.4	Turbidity
July 22, 2003	63	58.8	20.8–72.6	Seasonal supply augmentation
October 8, 2001	12	38.7	6.9–45.8	Seasonal supply augmentation
August 9, 2000	41	29.6	10.0–36.0	Seasonal supply augmentation
November 25, 1999	19	78.9	19.0–89.0	Turbidity
December 28, 1998	5	86.4	29.0–93.6	Turbidity

Since the groundwater system was installed in the mid-1980s, it has been used a total of 19 times—6 times for turbidity events in Bull Run, once for a landslide that took the conduits out of service, and 12 times for summer supply augmentation.

4.2 Ability of Water Sources to Maintain Delivery During Long-term Drought or Other Shortage

Portland has two reliable and high quality sources of water, which means there should be no difficulty supplying water during most long-term droughts or other shortages. Each water source is, however, susceptible to different vulnerabilities. Vulnerabilities for Bull Run watershed include the following:

- Turbidity or other water-quality events
- Earthquake
- Volcanic eruption
- Landslides
- Floods
- Drought
- Wind and/or ice storm
- Forest fire
- Intentional acts/terrorism including contamination

Vulnerabilities for the groundwater supply include the following:

Earthquake	Contamination
Floods (Columbia River levee break)	Wildfires
Power outage	Intentional acts/terrorism including contamination

The Portland Water Bureau's *Vulnerability Assessment* and *Hazard Vulnerability Statement* describe individual vulnerabilities and potential impacts to the system. If one source were to go off-line due to an emergency event, the backup source would have some limitations, described below.

4.2.1 Bull Run

The Bull Run system has a finite amount of storage and is an unfiltered system. If the well field were unavailable and Portland experienced a sustained drought or other emergency event, Bull Run water supplies may not be adequate to meet demand. Since 1992 the Portland Water Bureau has prepared a *Seasonal Water Supply Augmentation and Contingency Plan* (available as Appendix H). Also called the Summer Supply Plan (SSP), this document provides a comprehensive strategy for augmenting the Portland Water Bureau's water resources at any time of the year. The SSP identifies baseline and contingency resources to help meet demand. Table 4-2 shows the baseline primary resources and baseline augmentation resources outlined in the 2007 SSP.

If the well field were unavailable or could not supply enough water during a Bull Run shutdown, other supply strategies could be implemented, including wholesale demand offloads for wholesale customers who have access to other supplies; getting water through the interconnections with other sources; using the Powell Valley Wells; and water-use curtailment measures.

Table 4-2. Portland Water System Baseline, Augmentation, and Seasonal Contingency Resource Availability for Peak Season 2007

Seasonal Water Supply Resources	Potential Rate of Use (MGD)	Potential Peak-season Volume (BG)	Potential Use Period (Duration = 151 days, 6/1–10/29)
Baseline Primary Resources			
Conservation Measures	Incorporated into demand forecast	Incorporated into demand forecast	Duration
Bull Run Watershed			
Streamflow	Incorporated into drawdown forecast	Incorporated into drawdown forecast	Duration
Reservoirs 1 and 2	Variable	9.9 BG (useable storage)	Duration

Table continued on next page.

Table 4-2. Portland Water System Baseline, Augmentation, and Seasonal Contingency Resource Availability for Peak Season 2007

Seasonal Water Supply Resources	Potential Rate of Use (MGD)	Potential Peak-season Volume (BG)	Potential Use Period (Duration = 151 days, 6/1–10/29)
Baseline Augmentation Resources			
Columbia South Shore Wells			
SGA, BLA and TSA Wells*	100 / 90 / 80 MGD (30 / 90 / 151 days)	3.0 / 8.4 / 13.3 BG (30 / 90 / 151 days)	Duration
Bull Run Lake Increment #1 above elevation 3,165 feet	30 MGD	Up to 0.7 BG depending on starting lake surface elevation	10-23 days (not permitted to release prior to July 15)
Contingency – Tier 1			
Bull Run Lake Increment #2 (elevation 3,165 to 3,152 feet)	30 MGD	Up to 1.8 BG depending on starting lake surface elevation	60 days
Voluntary Curtailment	10 MGD	0.3 BG	30 days (before September 1)
Clackamas River Water Intertie	4.5 MGD	0.7 BG	Duration
Contingency – Tier 2			
Former PVRWD Wells (in the former PVRWD service area)	2.5 MGD[a]	0.1 / 0.2 / 0.3 BG (30 / 90 / 151 days)	Duration
Bull Run Lake Increment #3 (elevation 3,152 to 3,143 feet)	30 MGD	Up to 1.1 BG depending on starting lake surface elevation	37 days
Milwaukie Intertie (with portable pump)	2 MGD	0.3 BG	Duration (less the 20 hottest days)
Emergency Wholesale Demand Offloads	7.5 MGD	1.1 BG	Duration
Mandatory Curtailment	30 MGD 15 MGD	0.9 BG 0.45 BG	30 days (before September 1) 30 days (after September 1)
Additional draft of Bull Run Reservoirs 1 and 2 below 9.9 BG usable storage	Unspecified	Unspecified	Unspecified

[a]The installed capacity of the former Powell Valley Road Water District wells is approximately 2.5 MGD, based on the need to perform significant electrical and/or mechanical upgrades to three of the six wells before they can be put into service.

4.2.2 Columbia South Shore Well Field

The average winter demand for the retail and wholesale system for the past five years is 83 MGD; the average annual demand for the past five years is about 135 MGD for the retail and wholesale system. Groundwater can supply a peak capacity of around 100 MGD from 26 wells in three different aquifers. There are some limitations with the groundwater system to sustain peak capacity over long periods of time, especially during the summer when demand is higher than what the well field alone can provide. The SSP for 2007 lists the capacity of the well field as 102 MGD for up to 30 days, 92 MGD for up to 90 days, and 82 MGD for up to 151 days.

If Portland had to rely solely on groundwater for a sustained period of time, it is likely that the Water Bureau would have to consider other supply options such as using the interconnections, demand offloads, or activation of the curtailment plan.

Portland has been improving the well field capacity since its initial development in the early 1980s. The purpose in developing the well field capacity is to improve sustained pumping rates for longer than in the past, with the eventual goal of meeting annual average demands of more than 30 days to address shoulder season needs when use is higher than the winter average.

This WMCP addresses the need to

- consider curtailment if the Bull Run is not available at full capacity
- request a "green light" for additional development of more wells under existing permits to improve capacity and meet annual average demands

At this time, the role of the assumed assets of the former Powell Valley Road Water District (PVRWD) wells has not been determined because the former PVRWD system needs redevelopment and further pipeline development to be operational in the Portland water system.

4.2.3 Loss of Both Sources

The most likely scenario that would affect distribution of water from both sources for a sustained period of time is a major earthquake. A significant earthquake could damage water mains and tanks, including river pipeline crossings. Landslides caused by earthquakes could damage conduits and/or cause turbidity in the Bull Run reservoirs.

In addition, it is likely that landslides could damage groundwater pump stations, in-town reservoirs, and pipelines. An earthquake might also damage the Columbia River levees which could cause flooding in the well field. Since all of the regional water providers would be affected by an earthquake, Portland would have to rely more heavily on curtailment or alternate sources of water (e.g. bottled water or portable water distribution systems) to meet basic needs while both systems were restored.

Two seismic stability analyses of Bull Run Dam 1 and 2 have concluded that safety factors for the dams exceed FERC's requirements for safe dams (Dames & Moore 1995, Cornforth Associates 1994). The dams will most likely fare well in a major earthquake.

The Water Bureau identified the area where the two Bull Run conduits cross the Sandy River as most vulnerable to damage from an earthquake or landslide. The bureau is in the

planning phase for a tunnel under the Sandy River to protect the conduits and the interconnections between the conduits. The anticipated completion date for the project is January 2010.

4.2.4 Emergency Operations Plan

In the event of an emergency with either or both sources, the Portland Water Bureau has an updated *Emergency Operations Plan* (2002) that addresses all foreseeable hazards and provides a framework, organizational structure, and direction for the bureau's response to a significant emergency. The bureau also has a full-time Emergency Manager and staff to plan for and coordinate the bureau's actions during an emergency.

The bureau is also a member of the Regional Water Providers Consortium (RWPC's) Emergency Planning Committee which has been working together since 2001 to improve communication and coordination among water providers and other regional emergency managers. The RWPC's Emergency Planning Committee has organized and executed several tabletop exercises to test real water emergency scenarios.

The Emergency Planning Committee has also secured grant funding for three emergency portable water distribution systems that can be used when water from the distribution system is unavailable. A regional emergency water distribution plan is being prepared to support the storage, maintenance, deployment, and use of the portable water distribution systems. The bureau also helped develop and participates in the Oregon Water/Wastewater Agency Response Network (ORWARN) which supports and promotes statewide emergency preparedness, disaster response, and mutual assistance for public and private water and wastewater utilities. Participants in ORWARN sign a mutual assistance agreement and are able to share equipment with members state-wide.

4.2.5 Wholesale Contracts

Portland's wholesale contracts were completed in July 2006. Section 14 of the Regional Water Sales Agreement (Appendix D) between the Portland Water Bureau and its wholesalers has a provision for WMAB to develop and recommend a curtailment plan to the Portland Water Bureau Administrator or for individual wholesale water providers to submit individual plans. Under the water sales agreement, the curtailment plan must be designed to accomplish levels of reductions in demand necessary, in the event of a water shortage, to protect the system's capacity to supply water for fire, life, safety, and other high-priority needs.

The curtailment plans are due by the end of the second contract year (2008). Water Bureau staff will closely coordinate with WMAB on the development of this plan and any plans developed by individual wholesale water providers to ensure consistency. A curtailment plan under this agreement will have many contingencies to reflect an individual provider's access to alternative supplies, the nature of the event causing the shortage, and fulfillment other contract requirements. The Water Bureau will work diligently with wholesalers to ensure that no shortages occur.

4.2.6 Stages of Alert, Triggers, and Curtailment Actions

This subsection addresses the requirements of

OAR 690-086-0160 [2]: A list of three or more stages of alert for potential shortage or water service difficulties. The stages shall range from a potential or mild alert, increasing through a serious situation to a critical emergency.

OAR 690-086-0160 [3]: A description of pre-determined levels of severity of shortage or water service difficulties which will trigger the curtailment actions under each stage of alert to provide the greatest assurance of maintaining potable supplies for human consumption.

OAR 690-086-0160 [4]: A list of specific stand-by water use curtailment actions for each stage of alert ranging from notice to the public of a potential alert, increasing through limiting non-essential water use, to rationing and/or loss of service at the critical alert stage.

Portland Water Bureau has had very few water shortages requiring curtailment during its history. The 1992 drought is the best example of a time when Portland had to call on customers to curtail water use because the back-up groundwater supply was unavailable.

Because of the bureau's groundwater source and its ability to work with wholesalers to seek alternative supplies or to provide Portland with water, the bureau does not anticipate triggering advanced levels of the curtailment plan unless there is a catastrophic event, such as an earthquake. Below are the four stages of alert identified for this plan.

Level 1 – Mild Alert

Level 2 – Voluntary Curtailment Measures

Level 3 – Emergency Mandatory Curtailment Measures

Level 4 – Critical Water Shortage

Triggers for the different levels of curtailment are determined by the Water Bureau's ability to meet anticipated demand for the time of year and our terminal storage volume. Table 4-3 shows the levels of alert, triggers, and curtailment actions. Table 4-4 is a list of PP&R sites that are excepted from the implementation measures listed in Table 4-3 under Level 3 – Emergency Mandatory Curtailment Measures.

Table 4-3. Curtailment Plan Matrix

Stage of Alert	Trigger	Goal	Implementation Measures
Level 1–Mild Alert	• Available supply is less than 95% of anticipated demand for time of year AND it is predicted that the bureau will be below 75% target terminal storage volume within 5 days.	Reduce demand 5%	Summer Only: • Implementation of Portland Water Bureau and Regional Water Providers Consortium annual summer water conservation campaign, Portland Area Radio Council ads, summer bill stuffer inserted into all water and sewer bills mailed June 1 to August 31 • Press releases to the media reminding public about the need to conserve due to hot, dry weather. Advisories on the beginning of drawdown in the Bull Run reservoirs and groundwater operations • Conservation-focused community events • Information on Water Bureau blog Do not anticipate mild alert for non-summer event.
Level 2–Voluntary Curtailment Measures	• Available supply is less than 90% of anticipated demand for time of year AND it is predicted that the bureau will be below 75% target terminal storage volume within 5 days. • In summer, use of Tier 1 Contingency Resources as listed in SSP	Reduce demand 10%	In summer, include Level 1 measures; in seasons other than summer, implement the following: • Coordinate with WMAB and other regional water providers about what we are doing and to learn what conditions they are projecting for their systems • Coordinate with WMAB Curtailment Plan • Evaluate ability, resources, and plans to move to Level 3 alert status and as appropriate, begin preparatory measures • Coordinate with other bureaus such as Parks about potential water shortages and actions • Update elected officials • Issue voluntary reduction message to public with actions they can take to reduce water use (SSP projected savings 0.3 BG)

Table continued on next page.

Table 4-3. Curtailment Plan Matrix

Stage of Alert	Trigger	Goal	Implementation Measures

Level 2 –Voluntary Curtailment Measures, continued			• Use media outlets to disseminate information about water-saving measures
			• Promote use of evapotranspiration data for more efficient outdoor watering – RWPC web site
			• City of Portland will limit water use for street sweeping and hydrant and water-line flushing
			• Free-flowing fountains and Benson Bubblers will be turned off in most areas
			• Portland Fire Bureau will limit training exercises to those that do not use water
			• Utilize paid advertising with conservation message using multi-lingual media
			• Use Customer Service phone line hold message to promote conservation
			• Portland Online Web site messaging
			• PP&R will
			  o Shut off all non-recirculating water features
			  o Shut off or retrofit all continually running drinking fountains
			  o Increase frequency of using blowers to clean hard surfaces; washing walks and tennis courts for sanitation purposes only
			  o Water only highly used park turf such as
			  ▪ Athletic fields
			  ▪ Picnic areas with more than one table
			  ▪ Play equipment areas
			  ▪ Summer recreation program areas
			  ▪ Parks with wells
			  ▪ Renovated turf areas
			  ▪ Areas that will become unsightly to the City if not irrigated (e.g. Plaza blocks)

Table continued on next page.

Table 4-3. Curtailment Plan Matrix

Stage of Alert	Trigger	Goal	Implementation Measures
Level 3 – Emergency **Mandatory Curtailment Measures**	• Available supply is less than 80% of anticipated demand for time of year AND it is predicted that the bureau will be below 75% target terminal storage volume within 5 days. • In summer, use of Tier 2 Contingency Resources as listed in summer supply plan	Reduce demand 20%	• Same measures as Level 1 and Level 2 • Potentially activate Emergency Operations Center • Require curtailment under authority of City Code Chapter 21.32 in which the Commissioner may authorize the Administrator to adopt rules, procedures, and forms to restrict water use (e.g. mandatory curtailment measures) as appropriate. • Paid advertising and media outreach Examples of curtailment could include the following: • Limit outdoor water use to the hours between 8:00 p.m. and 8:00 a.m. • Limit or prohibit non-essential watering such as o watering or irrigating lawns, grass or turf except for new installations after March 1 of the current calendar year o use of City-supplied water to wash sidewalks, streets, driveways, walkways, parking lots, or other impervious surfaces except where necessary for public health or safety. o use of City-supplied water to wash vehicles (including boats and watercraft) except at facilities equipped with water re-circulation equipment or where necessary for public health or safety

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Table 4-3. Curtailment Plan Matrix

Stage of Alert	Trigger	Goal	Implementation Measures
Level 3 – Emergency **Mandatory Curtailment Measures, continued**			○ cleaning, filling, or maintaining decorative water features, natural or man-made, including, but not limited to, fountains, lakes, ponds and streams, unless the water is recirculated through the decorative water feature. Water features that do not include continuous or constant in-flowing water are not included ○ wasting water by leaving unattended hoses running • Contemplate rate surcharge to reinforce voluntary actions and/or recover revenue losses • Highlight actions of BIG users and what they are doing to conserve water and use these messages for public outreach[a] PP&R will • operate spray pools only when ambient air temperature is over 80° F • reduce swimming pool temperatures and consider covering pools • reduce/eliminate watering of annual beds • limit pressure-washing to uses for sanitation purposes only Exceptions include • dust mitigation – watering down dirt infields • watering of some shrubs, perennial beds, and young trees • irrigation of sports fields and playground areas for safety and liability reasons • additional exceptions are listed in Table 4-4

Table continued on next page.

Table 4-3. Curtailment Plan Matrix

Stage of Alert	Trigger	Goal	Implementation Measures
Level 4 – Critical Water Shortage	• Available supply is less than 70% of anticipated demand for time of year AND it is predicted that the bureau will be below 75% target terminal storage volume within 5 days. • State of Emergency is Declared	Meet basic human health and safety needs	Administrator will update or adopt rules requiring mandatory curtailment measures pursuant to City Code 21.32. • Activate Emergency Operations Center and use emergency plans for notifications and alerts to broad audience with tools including paid advertising, media outreach and coordination of messaging • All outdoor non-essential water use prohibited except where necessary for public health or safety • Large industrial and institutional accounts shall restrict water use to fire protection and other critical functions only • Restrict water flow as needed • Activate portable water distribution systems (pending grant funding or availability from other providers) • Isolate damaged parts of system and other operational needs to maintain maximum performance of system.

[a]BIG is the Business Industry, and Government conservation program aimed at industrial, commercial, and institutional users

Table 4-4. List of PPR Sites Excepted from Drought Response[a,b]

Site	Purpose
Argay	Well
Buckman Field	High School Use
Cathedral Park	Well
Crystal Springs	Spring water, garden & weddings
East Delta	Well & tournaments
Erv Lind	Stadium
Historical Features (e.g. Laurelhurst)	Gardens
Grant Bowl	High School Use
Golf courses under the jurisdiction of PP&R	Wells
Japanese Garden	Garden
Ladd's Rose Garden	Garden
Laurelhurst Park	Well
Leach	Garden
Lents	Well
Memory Garden	Garden
Normandale 1 & 2	Tournament
Oaks Pioneer Church	Wedding
Overlook House	Wedding
Peninsula	Garden
Pittock	Wedding
Portland International Raceway	Well
Sellwood	Well
Sckavone	Stadium
Walker Stadium	Stadium
Washington Park Rose Garden	Garden
Waterfront, south garden	Garden
Waterfront	Permit, Well
Westmoreland	Well
Westmoreland lighted ball fields	Tournament

[a]Exceptions from Level 3 – Emergency Mandatory Curtailment Measures
[b]Other sites may be added by the PP&R Director

5. Water Supply

5.1 Current and Future Service Areas

This subsection addresses the requirements of OAR 690-086-0170 [1]: A delineation of the current and future service areas consistent with state land use law that includes available data on population projections and anticipated development consistent with relevant acknowledged comprehensive land use plans and urban service agreements or other relevant growth projections

The City of Portland is responsible for providing water supplies to the retail and wholesale service areas as indicated on Figure 2-7 in the Water Supplier Description. The retail service area is within the City of Portland city limits, and includes most of the City of Portland with the exception of a portion in the northeast section that is served by the Rockwood People's Utility District (PUD). The wholesale service customers are entities that have signed 10- and 20-year contracts and include

- The cities of Gresham, Tigard, and Tualatin
- Tualatin Valley Water District in Washington County
- a number of smaller entities that are along the conduit routes from the Bull Run watershed to the City of Gresham
- two large rural water districts east of Gresham (Pleasant Valley and Lusted)
- the Lorna Water Company on the east side of the urban area
- the Burlington water district in the rural parts of northwest Portland
- Palatine Hill water district in the urban part of southwest unincorporated Multnomah County
- Lake Grove Water District in the urban part of Washington County near Lake Oswego

The City of Portland water supplies are primarily utilized to serve customers inside the urban growth boundary (UGB). All land use plans are managed by the City of Portland, Gresham, Beaverton, and unincorporated Clackamas and Multnomah counties. Connections within the wholesale service areas are managed by the individual water provider entities; connections in the City of Portland are managed by the Bureau of Development Services and the Bureau of Planning. For more information on the wholesale service providers, see Section 2, Municipal Water Supplier Description.

The potential retail service area of the City of Portland is not likely to be expanded beyond the lands already included in the UGB, with the exception of some small additions along the northwest boundary of the City of Portland west of Forest Park. No areas of significant additional retail service territory were identified as a part of preparing this plan. However, the City of Portland has identified significant infill/redevelopment and vacant-land development as a part of the most recent Metro *Regional Transportation Plan* (RTP) update process. The major new growth within the retail service area is due to additional population to be accommodated inside the existing limits of Portland.

The Water Bureau's wholesale customers also identified additional growth within existing service areas, as well as some small additions that were made to the UGB by Metro in 2004.

However, no significant additions to geographic service areas over the next 20 years have been identified.

Currently, Metro is conducting a regional planning process called "Making the Greatest Place" to identify additional potential urban growth boundary extensions and lands that may be off-limits to future urban development. However, as of the preparation of this WMCP, Metro has not identified specific urban or rural reserves to which additional urban growth was assigned unless the lands were already included inside the existing service territory of the water providers with wholesale contracts. When Metro takes action in the next year as a part of the "Great Communities" planning process to add urban reserves, some of PWB's wholesale customers will have additional potential service areas. However, actual commitments to serve these new areas will have to be reflected in adopted comprehensive plans and then service agreements or annexations will have to occur. This process can take a number of years.

The City of Portland has been exploring the possibility of entering into new wholesale service agreements with new customers on the east side of the current service territory, but as of this writing, no specific commitments have been made. The bureau has identified the specific capacities of the current water system, and the upgrades needed to the backup/summer supply groundwater system in order to meet annual average demands. As a part of ongoing studies on the west side of the region the bureau is exploring how any current or future surplus in supplies can be made available to areas in north Clackamas County. Any further additions to the wholesale service territory would be addressed in the next update of the WMCP, or at the time of benchmark reporting, if needed.

The nature of PWB's wholesale contracts do not obligate Portland to supply additional growth beyond the minimum purchase amounts contained in the original specific contracts. For these two reasons, PWB did not identify significant additions to geographic service areas. PWB is not obligated to serve new additions until action is taken to add new areas to the UGB around wholesale contract service areas, and Portland City Council is asked and approves additional amounts of water to be committed through the contract process. At this time the growth projections contained in the WMCP address infill and redevelopment within the existing UGB. PWB will report on any changes in future services areas as requested by the OWRD if sooner than the next 10-year revision and update of the WMCP.

Additional water services within the rural water districts or companies served under wholesale contracts are limited in nature by the land-use approval processes within the counties and by the fact that each water provider must nominate their service amounts over time. The Water Bureau determines whether any proposed increases are within the system capacity before approving them (see the Water System Description subsection 1.5.2 on Wholesale Contracts).

Six wholesale customers are non-governmental water companies that have five-year rolling contracts for water sales. The six contracts are strictly limited in terms of service expansions. These contracts contain provisions that require bureau approval for any service connection expansions (see the wholesale water contract in Appendix D and a summary in Section 5).

5.1.1 Population Projections

Metro regional government provided the population projections to Portland for the future population allocations to specific geographic areas. Metro provides population forecasts based on Transportation Analysis Zones (TAZs) which are fairly small in the denser urban areas, and can be aggregated fairly closely to the different water provider boundaries. Metro conducted an allocation process by TAZ for the 2007 RTP update and the City utilized these files to conduct the most recent set of water demand forecasts. The population forecasts in Table 5-1 in subsection 5.1.1 are derived from Metro population allocations completed for the RTP update, which are generated through the MetroScope modeling program, and then adjusted based on detailed review by all of the land-use planning agencies within the Metro District.

Table 5-1. Population Projections for the Portland Retail and Wholesale Service Areas, Calendar Years 2007–2030

	Population Forecast[a]		
CY[b]	Portland Retail[b]	Wholesale[c]	Total Population (Retail & Wholesale)
2007	537,854	279,732	817,586
2008	541,968	284,332	826,300
2009	546,067	289,028	835,095
2010	550,137	293,588	843,725
2011	554,183	298,082	852,265
2012	558,201	302,429	860,630
2013	562,202	306,878	869,080
2014	566,174	311,182	877,356
2015	570,121	315,418	885,539
2016	574,039	319,497	893,536
2017	577,940	323,686	901,626
2018	581,811	327,715	909,526
2019	585,657	331,667	917,324
2020	589,473	335,447	924,920
2021	593,271	339,331	932,602
2022	597,038	343,038	940,076
2023	600,781	346,659	947,440
2024	604,492	350,093	954,585
2025	608,184	353,643	961,827
2026	611,846	357,025	968,871
2027	615,480	360,297	975,777
2028	619,083	363,359	982,442
2029	622,667	366,530	989,197
2030	626,223	369,505	995,728

[a]Population forecasts are based on the Metro TAZ population forecasts matched to the service areas.
[b]CY= calendar year
[b]Retail Portland population is reduced by the population served by Rockwood PUD
[c]Wholesale population forecasts reflect adjustments for portions of their service population served by other sources.

5.2 Schedule of Full Exercise of Water Rights Currently Held by Supplier

This subsection addresses the requirements of OAR 690-086-0170 [2]: An estimated schedule that identifies when the water supplier expects to fully exercise each of the water rights and water use permits currently held by the supplier

5.2.1 Municipal Groundwater Rights[48]

At this time the Bureau anticipates that all of the groundwater permits currently held by the Portland Water Bureau will be fully developed within 75 years. The Bureau is not seeking an extension for Permit G-2093 since the two former Parkrose wells have been officially abandoned. The City is in the process of seeking extensions for Permits G-8755, G-10124, G-10455, and G-10479. The City has not submitted an extension request for G-15095 because the City is still evaluating the developed facilities under this permit that were obtained from the former Powell Valley Road Water District.

5.2.2 Parks & Recreation Groundwater Rights

The following PP&R sites are under certificate, thus they are fully exercising their water rights and permits: Argay Park, Cathedral Park, East Delta Park, Eastmoreland Golf Course (one surface water right - no well right), Heron Lakes Golf Course (well #2 only), Kelly Point Park, Laurelhurst Park, Lents Park, Oaks Bottom Wildlife Refuge (two reservoir rights and one surface water right - no well right), Red Tail Golf Course (two wells, five reservoirs, and five surface water rights), Rose City Golf Course (two wells, one reservoir, and one surface water right), Sellwood Park, and Waterfront Park.

Park sites with non-certificated water rights include the following:

- Eastmoreland: PP&R has an approved transfer T-10102, will submit Claim of Beneficial Use (COBU) in 2008.
- Heron Lakes Golf Course: PP&R has an approved transfer T-10355 and will submit Claim of Beneficial Use (COBU) in 2008. Also the Parks Department will need to file COBU for permit G-16140 in 2008.
- Parklane Park: PP&R cannot submit COBU for approximately 10 years in order to fully develop the 20-acre parcel with an irrigation system.
- Portland International Raceway (P.I.R): PP&R cannot submit a COBU for approximately 10 years or more in order to fully develop the site.
- Rose City Park: PP&R will need to file COBU for permit G-16812 in 2008.

[48] The City's right for the use of the Bull Run River is a statutory right to the full flow of the Bull Run and Little Sandy Rivers, only constrained by any rights prior to February 24, 1909 (ORS 538.420) and not stating any ending date or time certain for exercise of this statute. Since the City's statutory right is not subject to the requirement of full exercise of the water by any date certain, this right is not required to be listed in this subsection. Table 2-3 mentions this right and Section 2.1.1 discusses the Bull Run source as part of PWB's overall water supplies.

In summary, all PP&R sites should be under certificate by the end of 2008 with the exception of Parkland Park and P.I.R., both of which will not be completed until 10 to 15 years from now.

5.3 Demand Projections

This subsection addresses the requirements of OAR 690-086-0170 [3]: Based on the information in (1), an estimate of the water supplier's water demand projections for 10 and 20 years, and at the option of the municipal water supplier, longer periods

5.3.1 Demand Analysis

According to bureau population estimates, the Portland Water Bureau served a population of approximately 545,300 retail customers in FY 2006-2007. Additionally, the bureau served an estimated population of 314,700 wholesale customers in 19 regional water providers' service areas for a total of 860,000.

Wholesale Contracts

Although the City of Portland wholesale contracts have end dates, other sections of the contracts allow continued service beyond those dates. In Section 3, Duration of Agreement and Renewal, subsections C & D allow that contracts may continue indefinitely, upon agreement by both parties (see Appendix D of the WMCP for the contract language). The City of Portland has wholesaled water since the early 1900s and has stated in several venues (including in its bond statements) that it intends to continue wholesaling water as long as there is a demand for the water and as long as the customer, PWB, and Portland City Council agree on the terms. As an example, Portland City Council approved a new wholesale contract with the City of Sandy in 2009. In addition, the City is justified in including the wholesale demands of the current wholesale customers because at this point in time no other water sources are in the development stage for the west side customers, and there is still uncertainty as to when such new sources will be developed, whether under existing extensions of new water right applications by those entities. Additional development of the Columbia South Shore Well Field is projected to be necessary to meet backup needs as already discussed in other sections of the WMCP, and any development can be tailored to changes in future conditions due to the nature of the development of groundwater supplies in an incremental fashion.

Changes in Demand

The historical demand data since 1960 show that demand has gone through some changes. During the 1960-1980 period, the region experienced a sharp rise in water demand. Population growth, economic expansion, large residential lots with water-intensive landscaping, inefficient fixtures, and low rates were major drivers behind the growth in demand. During the 80s, the demand leveled off as a result of economic slowdown that also led to lower population growth. Residential lots became smaller and the number of multi-family residential dwellings increased.

From 1990 to present, despite population growth and economic expansion, water demands have been on a downward trend. The primary factors behind the fall in demand have been

- a 1992 code change that mandates the installation of water-efficient fixtures in residential new construction or remodeling
- the implementation of regional water conservation programs
- the introduction of inclining block rates in 1994 and substantially increased sewer rates
- a trend toward smaller single family lot sizes
- an increase in the ratio of multifamily to single family dwellings

The economic slowdown of the early 2000s and lower demand by wholesale customers (which also reduced the population served) have also contributed to the fall in demand.

Table 5-2 shows the average annual, maximum annual and per capita demand by all retail and wholesale customer classes between 1960 and 2006. Figures 5-1 and 5-2 depict the historical trend in demand and service area population.

The bureau also has been collecting data on meters that serve the wholesale customers using its SCADA system since 1993. The retail demand can be imputed by subtracting the wholesale demand from the total demand.

The imputed demand data show an average annual drop of 3.4 percent in retail demand since 1993 (Table 5-3).

Table 5-2. Retail and Wholesale Annual Demand and Population Served, Calendar Years 1960-2006

CY	ADD	MDD	GPCPD	Population	CY	ADD	MDD	GPCPD	Population
1960	83.9	217.9	148.7	564,500	1984	115.3	197.0	170.9	674,797
1961	85.9	205.9	150.7	570,147	1985	116.2	228.0	172.5	673,428
1962	84.3	179.5	147.7	570,835	1986	121.9	224.7	180.0	677,153
1963	85.3	156.9	147.3	579,418	1987	125.0	218.9	183.9	679,611
1964	86.3	178.5	145.7	592,206	1988	117.1	227.2	169.9	689,347
1965	95.5	209.7	156.4	610,772	1989	118.1	201.1	168.4	701,315
1966	95.3	189.0	154.9	615,444	1990	122.0	226.0	170.8	714,575
1967	102.3	217.1	166.4	614,967	1991	121.6	220.3	168.7	720,882
1968	94.4	212.6	153.2	616,360	1992	110.4	203.2	150.6	733,202
1969	101.7	207.8	163.9	620,317	1993	110.3	182.5	147.2	749,687
1970	109.0	227.8	174.9	623,122	1994	118.5	223.9	154.7	765,810
1971	105.8	222.4	166.9	634,267	1995	115.9	205.7	150.4	770,349
1972	115.2	225.3	184.1	625,560	1996	113.1	212.3	143.7	787,037
1973	113.9	202.9	180.8	629,851	1997	115.6	208.2	142.9	808,676
1974	110.1	188.0	172.2	639,416	1998	117.3	204.0	143.5	817,285
1975	105.0	191.0	161.4	650,463	1999	113.8	182.8	139.6	815,445
1976	107.7	237.8	164.6	654,380	2000	113.2	196.7	141.7	798,598
1977	107.4	217.7	162.7	659,908	2001	109.7	183.5	134.0	819,180
1978	108.4	219.2	163.3	663,377	2002	104.7	179.0	134.3	779,790
1979	120.6	225.5	180.5	668,096	2003	103.4	197.3	135.1	765,103
1980	117.1	230.7	175.4	667,811	2004	102.3	185.3	132.6	771,725
1981	116.1	225.9	172.9	671,340	2005	96.4	169.2	124.0	773,504
1982	119.5	220.5	177.1	674,538	2006	104.0	180.9	128.6	809,002
1983	108.9	172.9	162.3	670,821					

Demand includes unbilled water which includes system leakage, reservoir and system flushing, and other municipal uses such as fire fighting that are not billed.
CY - calendar year ADD - average daily demand in MGD MDD- maximum daily demand in MGD
GPCPD - gallons per capita per day

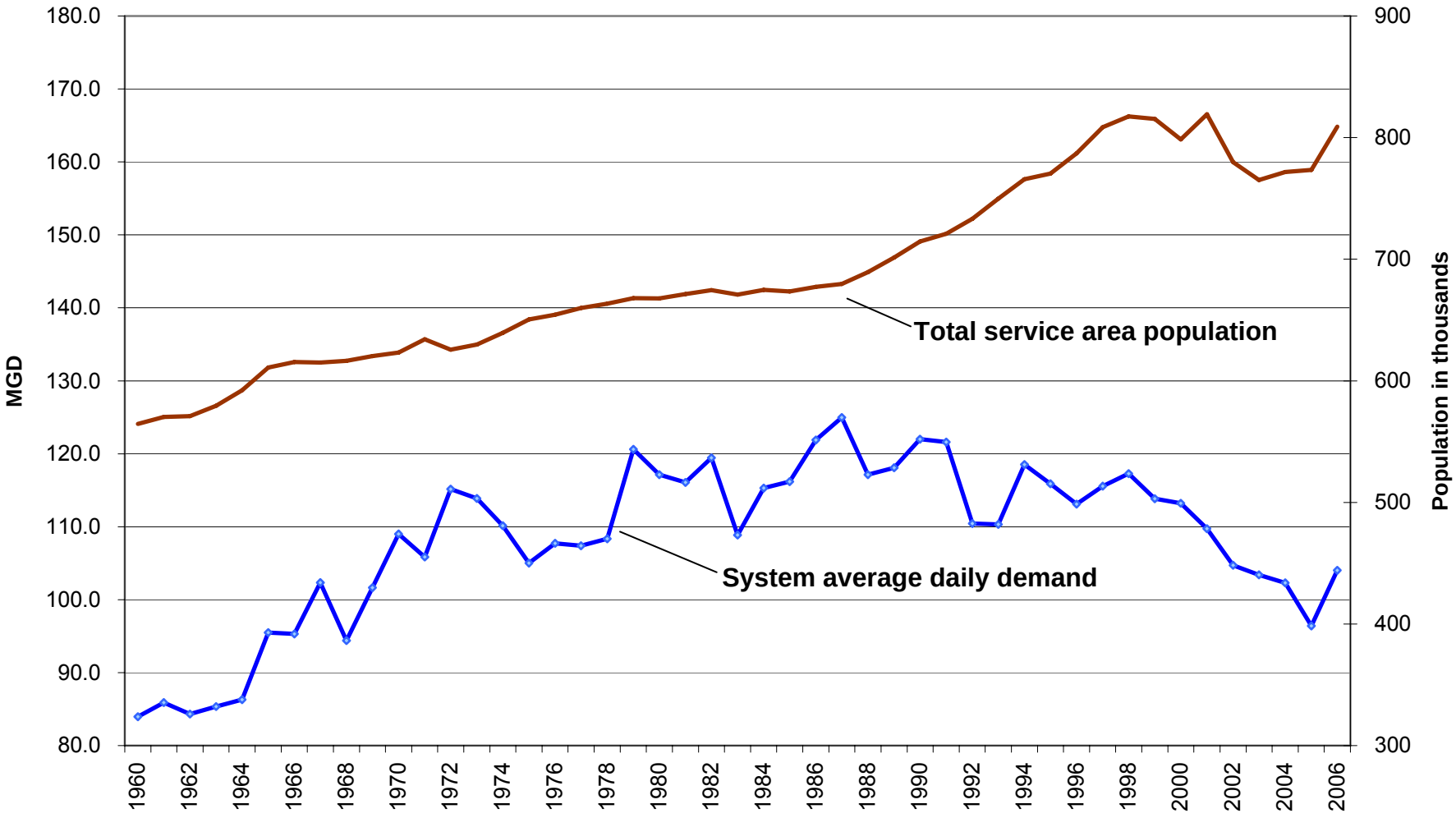
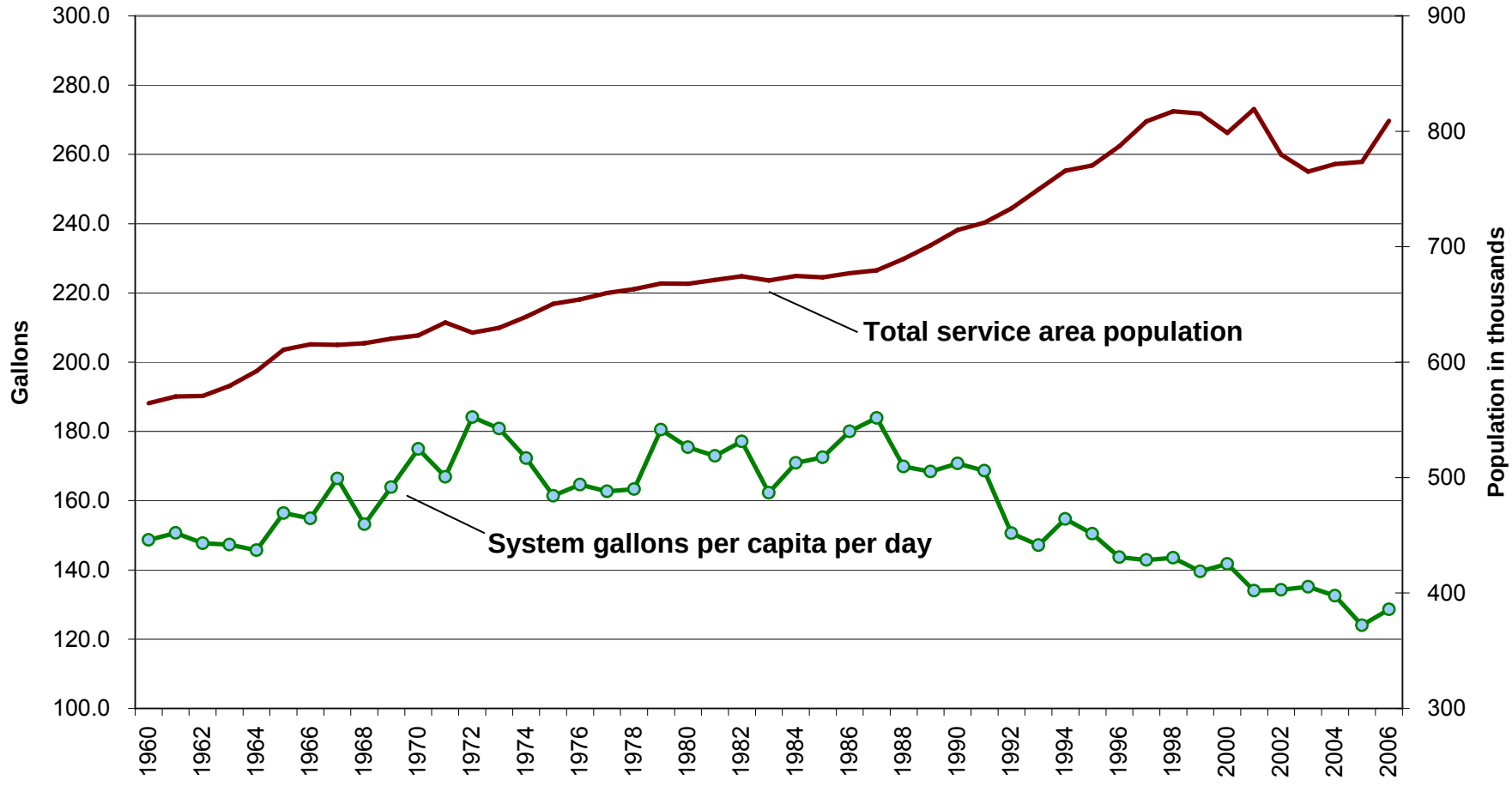


Figure 5-1. Historical Total System Average Daily Demand and Service Area Population, Calendar Years 1960-2006



5-2. Historical Total System Gallons per Capita per Day Demand and the Service Area Population, Calendar Years 1960-2006

Table 5-3. Retail Annual Demand and Population Served, Calendar Years 1993-2006[a]

	Demand[c,d]			
CY[b]	ADD	MDD	GPCPD	Population[e]
1993	81.6	133.8	181.0	450,545
1994	84.0	153.1	184.5	455,416
1995	82.0	142.8	179.0	458,344
1996	76.0	135.9	164.7	461,607
1997	75.8	134.0	162.6	466,376
1998	74.4	124.2	158.3	470,000
1999	69.8	110.2	147.9	472,009
2000	69.9	111.1	147.8	472,824
2001	66.3	103.9	139.5	475,235
2002	62.8	101.6	131.5	478,037
2003	71.4	145.1	148.4	480,893
2004	65.9	113.5	136.2	483,802
2005	59.5	95.1	112.4	529,783
2006	66.3	124.4	124.2	533,722

[a]Demand includes unbilled water.
[b]CY - calendar year
[c]ADD - average daily demand in MGD; MDD- maximum daily demand in MGD; GPCPD - gallons per capita per day
[d] The increase in demand in 2003 is a result of meter malfunction of one of the wholesale customers that led to higher imputed retail demand.
[e]The increase in retail area population in 2005 is due to the annexation of the Powell Valley Road Water District, formerly a wholesale customer.

PWB based its request for extensions of the CSSWF groundwater rights on peak-season demand over the four-month period from June 1 to September 30. Peak-season demand is the total volume used between June and September divided by 122 days in that four-month time frame. This is a realistic target for backup supply development over the longer term. The reduced per capita usage rate of recent years was used as the starting point for future forecasting. In addition, the declining trend in per capita use appears to have lessened slightly in the last two years. Table 1-3 in section 1.1.2, Significant Changes Since 2008, is 2008-2009 Demand and Consumption Information, Portland Water Bureau. This table shows production and demand figures from 2004-2005 to 2008-2009 which includes two fiscal years in addition to the materials submitted in the original WMCP in March 2008.

Figures 5-3 and 5-4 depict the historical trend in retail demand along with the retail area population.

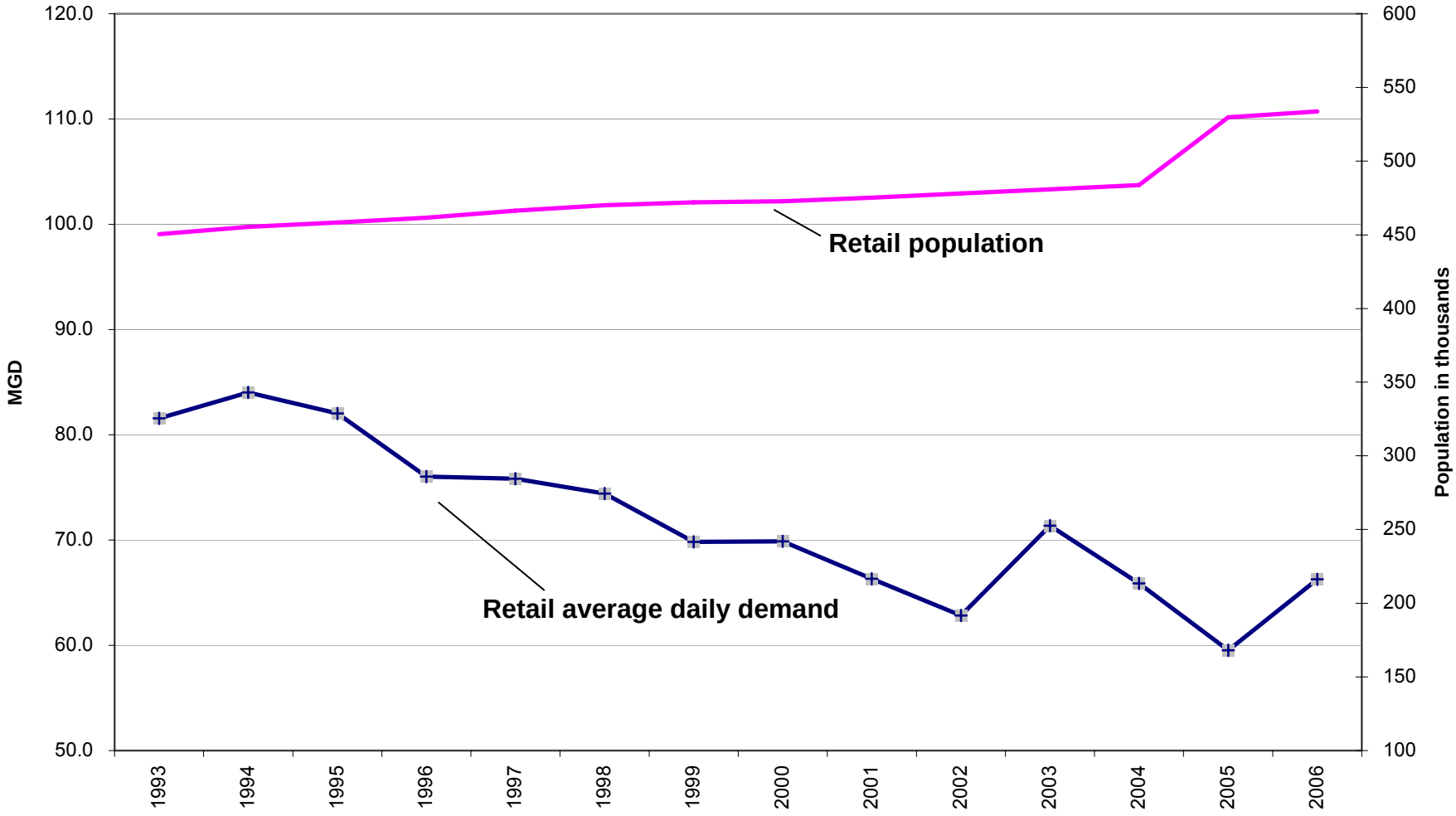


Figure 5-3. Historical Retail Average Daily Demand and Population, Calendar Years 1993-2006

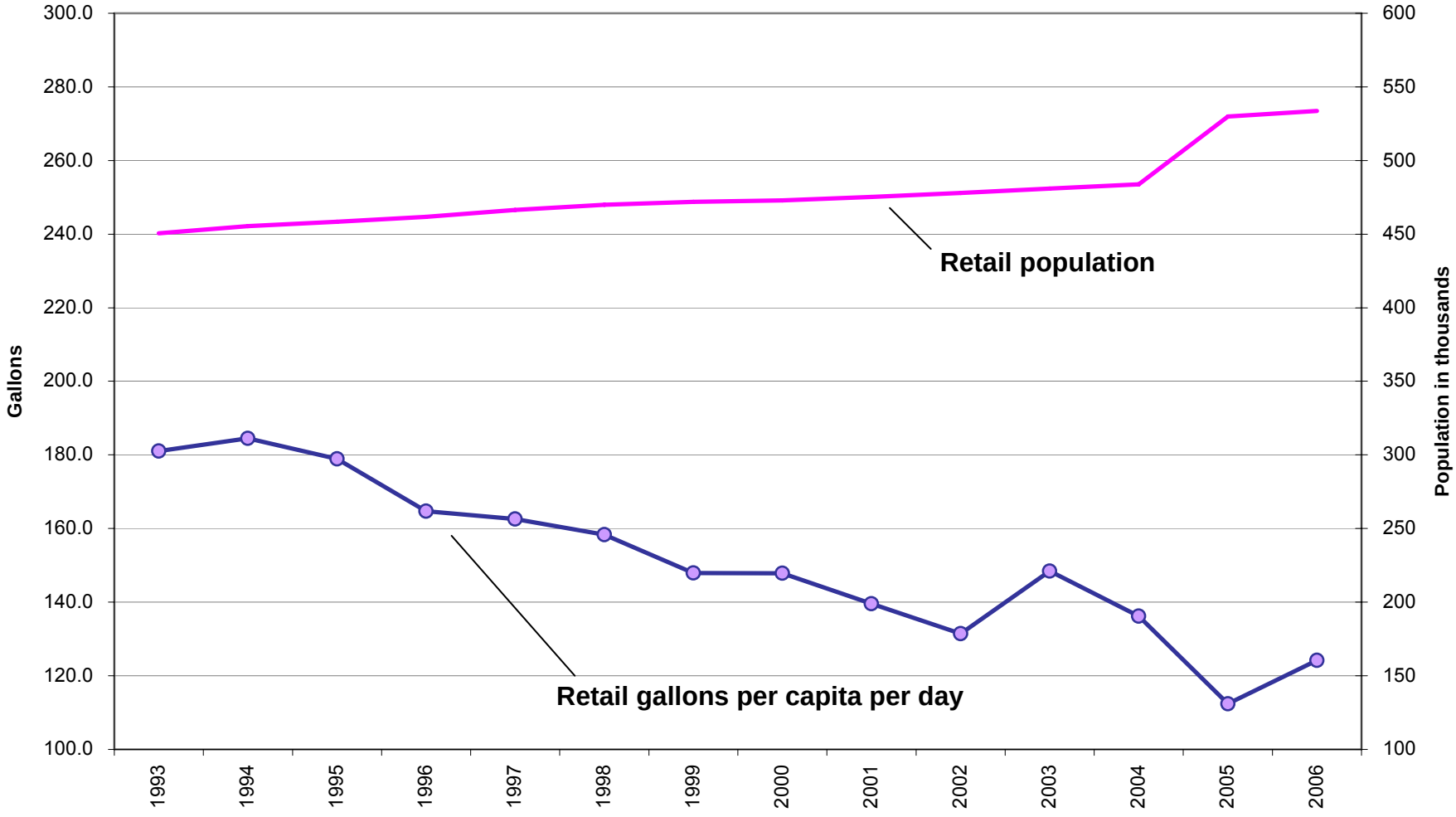


Figure 5-4. Historical Retail Gallons per Capita per Day Demand and Population, Calendar Years 1993-2006

5.3.2 Water Demand Forecast Methodology

Since 1997 the Water Bureau has been using a demand model to forecast demand. The model was developed internally for long-term and short-term demand forecasting and structural analysis.

The Water Bureau's Demand Model

The model is a single-equation econometric model that statistically estimates the mathematical relationship between the overall retail and wholesale demand for water and a series of explanatory variables. These variables explain daily variations in demand as a result of weather and seasonal variations, price changes, population growth, conservation, and long-term trends.

The total daily demand used in the model includes demand by all retail and wholesale customer classes, from January 1, 1960 onward. The model is updated with new data every year. On any given day, total demand is measured as the total production at the Headworks plus groundwater less water sold to Portland General Electric (PGE) for hydropower generation. To best reflect daily demand, the daily total is adjusted for changes in the in-town reservoir levels.

Daily precipitation and maximum daily temperature, measured at the Portland Airport weather station since 1940, are used to generate the weather variables.

Population is a major driver in the demand model. Historical population is estimated for the retail and wholesale service area based on Metro population estimates for regional jurisdictions. Some of the wholesale customers have access to other sources of water. The population of wholesale customers is adjusted according to the proportion of demand that is served by water supplied by the Portland Water Bureau.

Other variables in the model include the following:

- The average price of water to the customer
- An indicator variable for weekends
- An indicator variable for plumbing fixture code changes implemented in 1992
- A variable that explains long-term variations in demand that are not explained by other economic and demographic variables
- Weather factors of precipitation and temperature
- Population

The model allows for decomposition of demand into weather-normalized and weather-affected demand. It also allows for simulating demand under historical (1940-2006) weather scenarios.

Water Demand Estimation Issues

The water demand forecast developed by PWB uses methodology based on as good an estimate of future growth as is possible at the time. PWB's estimate is based on econometric forecasting that uses allocated population numbers from Metro. Metro does not provide small-scale geographically allocated population numbers (that is, point or range forecasts) beyond forecasts to the year 2035. The methodology for creating a forecast beyond 2035 is

based on the assumptions that infill and redevelopment will continue to add to population density, that additional land will be included in the urban growth boundary, and that Portland will continue to provide wholesale water supplies.

PWB consulted with Metro about the growth rates that could be utilized in developing its forecasts beyond the 2035 window. An annual growth rate of 0.6–1.2 percent was applied to create the forecast. Although per capita demand in the residential sector is very low in the Portland retail area, as a larger population occupies the existing service area, demand will increase overall.

Another key factor in demand forecasting is the nature of the nonresidential water demand, Nonresidential water use has shifted in the Portland retail area away from industrial/ commercial uses toward institutional demands that also peak but at higher volumes than the industrial/commercial customers due to more of that use being for outdoor purposes. Currently, several of PWB's top 10 water users are institutional customers, in contrast to 20 years ago, when more top water users were private-sector industrial/commercial accounts. PWB will continue to adjust the demand forecast for future updates of the WMCP.

In some demand studies, billing data are used to estimate separate demand models for different customer classes. The Water Bureau delivers water to retail customers in the city and to wholesale customers in the metropolitan area. Some of the wholesale customers rely exclusively on the Portland Water Bureau as the source of supply; others receive water from both the Water Bureau and other sources.

In the Water Bureau's customer mix and in the customer mix of the wholesale providers served by the Water Bureau, there are different classes of customers with different water-use profiles and different billing cycles. For instance, the Water Bureau's single-family residential customers are billed quarterly whereas multi-family, industrial, commercial and institutional (ICI), and wholesale customers are billed monthly. Moreover, all meters are not read on the same day of the billing cycle; readings are staggered over the cycle. As a result, the billing data do not accurately reflect the total demand by the customer class during the billing cycle.

Furthermore, demand models based on billing data do not reflect the effect of weather variations with daily resolution. Daily demand forecasting and peak load analysis are important issues for the bureau from both a short-term operations and a long-term planning point of view.

Another important issue is the effect of price on demand. The bureau has different rate structures for different customer classes. Approximately 40 percent of all of the water that the Water Bureau sells is sold to the wholesale customers. In FY 2006-2007, there were 19 different wholesale customers. Reflecting the rate structure on demand would not be possible.

In light of these complexities, demand analysis based on customer class and billing data is not useful for the bureau. The demand model, therefore, uses daily production data which includes demand by all customer classes along with overall revenue per million gallons as a proxy for price. The use of daily data makes it possible to strongly reflect the effect that weather variations have on water demands.

For a more detailed explanation of the demand forecast methodology, see Appendix I.

5.4 Supply and Demand Analysis

This subsection addresses the requirements of OAR 690-086-0170 [4]: A comparison of the projected water needs and the sources of water currently available to the municipal water supplier and to any other suppliers to be served considering the reliability of existing sources

5.4.1 Water Supplies

The amount of water available to serve the future projected water demands identified in subsection 5.3 includes the Bull Run and groundwater supplies identified in the Water Supplier Description (Section 2) of this plan. If both sources were available consistently at the same time, these supplies would likely be adequate for meeting the added need for the next 23 years (or to 2030).

System Reliability Planning

The City's experience is that the groundwater system has helped meet, and will continue to be needed to meet, summer water demands. The need for groundwater from the CSSWF is not solely based upon the need to meet summer peak-season demand, but also on the need to have a backup supply when the Bull Run supply is not available. When some or all of the Bull Run surface water source is not available, CSSWF must be available to provide annual average demands.

The seasonal supply augmentation from the groundwater system will likely be increasingly important to meet the instream needs for fish flows under the draft HCP, and the possible impacts from climate change in the Bull Run. The City is not basing the need for additional supplies of groundwater on fully meeting future summer peak-season demands. The system vulnerabilities with an unfiltered surface water supply, future demand projections, fish flow requirements in the Bull Run, and potential reductions in overall summer production from the Bull Run due to climate change are the primary drivers for additional supply development.

As a part of the Distribution System Master Plan. the Water Bureau reviewed approaches used by other water utilities with regard to vulnerabilities and reliability planning. Each utility took a slightly different approach to system reliability planning. A common theme among the utilities is defining reliability scenarios based on the most likely events to affect utility water service (e.g., earthquakes for utilities in the San Francisco Bay area; power outages for Austin, Texas; ice storms or earthquakes for Portland). Each utility establishes different levels of service for the events of varying likelihood of occurrence.

Among utilities that use similar approaches to defining levels of service for emergencies, Portland uses a reliability planning framework that has more conservative level-of-service requirements (especially for less frequent events) than the requirements for other utilities.

The analysis of system reliability for the Portland system in the *2007 Distribution System Master Plan* is summarized in Table 5-4.

Table 5-4. System Reliability Planning Scenarios

Planning Scenario	Service Area Size	Level of Service Goal	Evaluated In
Normal Operation			
All Components in Service	All Service Areas	Meet Peak-Hour Demand or Peak-Day Demand plus Fire Flow	Distribution System Master Plan Hydraulic Evaluation
Unplanned Events			
More Frequent: (e.g. main break, pump station or tank outage) (5- to 25-year Return Period ±)	Eastside, Westside, Entire City	Turbidity Event: Average Day Demand (ADD)	Distribution System Master Plan Hydraulic Evaluation; Service Area Master Plans
Less Frequent: (e.g. landslide, earthquake) (>50-year Return Period)	Eastside, Westside, Entire City	ORS Phase II Design Storm: Average Daily Demand + two Scenario-1 fires	Service Area Master Plans
Earthquake (100-year Return Period ±)	Eastside, Westside, Entire City	Average Summer Day Demand	System Vulnerability Study
Earthquake (500-year Return Period ±)	Eastside, Westside, Entire City	Average Daily Demand	

5.4.2 Demand Forecasts

Two econometric demand models are estimated for each service area: the entire system (retail and wholesale) and retail-only. The econometric demand models and the population forecasts are used to forecast water demand. The demand models allow for the impacts of weather effects on daily demand.

The results are a set of weather-normalized demand forecasts along with demand forecasts under historical weather conditions. The historical weather effects show that 1967 weather resulted in the highest average daily demand during the peak season. In addition, 1981 weather generated the highest single peak-day water demand. Tables 5-5 and 5-6 show several aspects of annual and peak-season demand as well as the populations for the total system—retail and wholesale customers (Table 5-5) and retail customers only (Table 5-6). The annual and peak-season demand forecasts are shown as the average daily demand (ADD) under weather-normalized and 1967 weather conditions. In addition, the peak-season demand is shown as the maximum daily demand (MDD) under 1981 weather conditions.

Table 5-5. Total System (Retail and Wholesale) Annual and Peak-season Demand Forecasts and Population, Calendar Years 2007-2030

	Annual (MGD)		Peak Season (MGD)			
CY	ADDWN	ADDW67	ADDWN	ADDW67	MDDW81	Population
2007	111.0	115.8	140.0	154.7	235.0	817,586
2008	112.4	117.3	141.9	156.8	235.7	826,300
2009	113.5	118.4	143.4	158.5	240.7	835,095
2010	114.7	119.6	144.9	160.1	243.2	843,725
2011	115.8	120.8	146.4	161.7	245.7	852,265
2012	117.0	122.0	147.8	163.3	247.7	860,630
2013	118.0	123.2	149.2	164.9	248.5	869,080
2014	119.1	124.3	150.7	166.5	250.9	877,356
2015	120.2	125.4	152.2	168.1	255.4	885,539
2016	121.3	126.6	153.6	169.7	257.3	893,536
2017	122.3	127.6	154.9	171.1	260.1	901,626
2018	123.4	128.7	156.2	172.6	262.4	909,526
2019	124.4	129.8	157.5	174.1	262.4	917,324
2020	125.4	130.9	159.0	175.7	266.3	924,920
2021	126.4	131.9	160.3	177.1	269.1	932,602
2022	127.4	132.9	161.5	178.5	271.2	940,076
2023	128.3	133.9	162.7	179.8	273.3	947,440
2024	129.3	135.0	164.0	181.2	272.6	954,585
2025	130.2	135.9	165.2	182.5	275.1	961,827
2026	131.1	136.8	166.4	183.9	279.5	968,871
2027	132.0	137.7	167.6	185.2	281.4	975,777
2028	132.9	138.7	168.7	186.4	282.8	982,442
2029	133.7	139.6	169.7	187.6	285.2	989,197
2030	134.6	140.4	170.8	188.8	284.6	995,728

ADDWN - average daily demand, weather-normalized

ADDW67 - average daily demand under 1967 weather conditions

MDDW81 - maximum daily demand under 1981 weather conditions

Peak Season – 122 days between June 1 and September 30

Table 5-6. Retail Annual and Peak-season Demand Forecasts and Population, Calendar Years 2007-2030

	Annual (MGD)		Peak Season (MGD)			
CY	ADDWN	ADDW67	ADDWN	ADDW67	MDDW81	Population
2007	64.4	66.4	78.4	84.5	113.9	537,854
2008	64.4	66.4	78.5	84.6	113.0	541,968
2009	64.4	66.4	78.5	84.6	113.9	546,067
2010	64.6	66.6	78.7	84.8	114.3	550,137
2011	64.8	66.7	78.9	85.1	114.6	554,183
2012	64.9	66.9	79.1	85.3	114.7	558,201
2013	65.1	67.1	79.3	85.4	114.3	562,202
2014	65.2	67.2	79.5	85.7	114.5	566,174
2015	65.4	67.4	79.7	85.9	115.7	570,121
2016	65.6	67.6	79.9	86.1	115.9	574,039
2017	65.7	67.7	80.1	86.3	116.2	577,940
2018	65.8	67.9	80.2	86.4	116.5	581,811
2019	66.0	68.0	80.4	86.6	115.9	585,657
2020	66.2	68.2	80.6	86.9	116.9	589,473
2021	66.3	68.3	80.8	87.1	117.2	593,271
2022	66.4	68.4	80.9	87.2	117.5	597,038
2023	66.5	68.6	81.1	87.4	117.7	600,781
2024	66.7	68.7	81.2	87.6	117.0	604,492
2025	66.8	68.9	81.4	87.7	117.2	608,184
2026	66.9	69.0	81.6	87.9	118.4	611,846
2027	67.0	69.1	81.7	88.1	118.6	615,480
2028	67.2	69.2	81.9	88.2	118.7	619,083
2029	67.3	69.4	82.0	88.3	119.0	622,667
2030	67.4	69.5	82.1	88.5	118.3	626,223

ADDWN - average daily demand, weather-normalized

ADDW67 - average daily demand under 1967 weather conditions

MDDW81 - maximum daily demand under 1981 weather conditions

Peak Season – 122 days from June 1 to September 30

Given the demographic and economic conditions of the forecasted years, the demand forecasts provide a range of potential changes in demand forecasts as a result of weather variations. For instance, for the total system (Table 5-5), the 2030 weather-normalized average daily demand (ADDWN) is 4 percent (6 MGD) lower than annual average daily demand based on 1967 weather conditions (ADDW67). During the peak season, weather-normalized ADD is 11 percent (18 MGD) lower than ADD based on 1967 weather conditions.

For the retail area only (Table 5-6), in 2030 the weather-normalized ADD is 3 percent lower (approximately 2 MGD than the annual ADD based on 1967 weather conditions. During the peak season, weather-normalized ADD is 8 percent (approximately 6 MGD) lower than ADD under 1967 weather conditions.

Tables 5-5 and 5-6 also show a 21 percent (24 MGD) and 5 percent (3 MGD) increase in weather-normalized demand over the 2007-2030 period in the total system and retail service areas respectively. Figures 5-5 through 5-8 show the demand forecasts under the weather-normalized and 1967 weather conditions for the total system and retail service areas respectively.

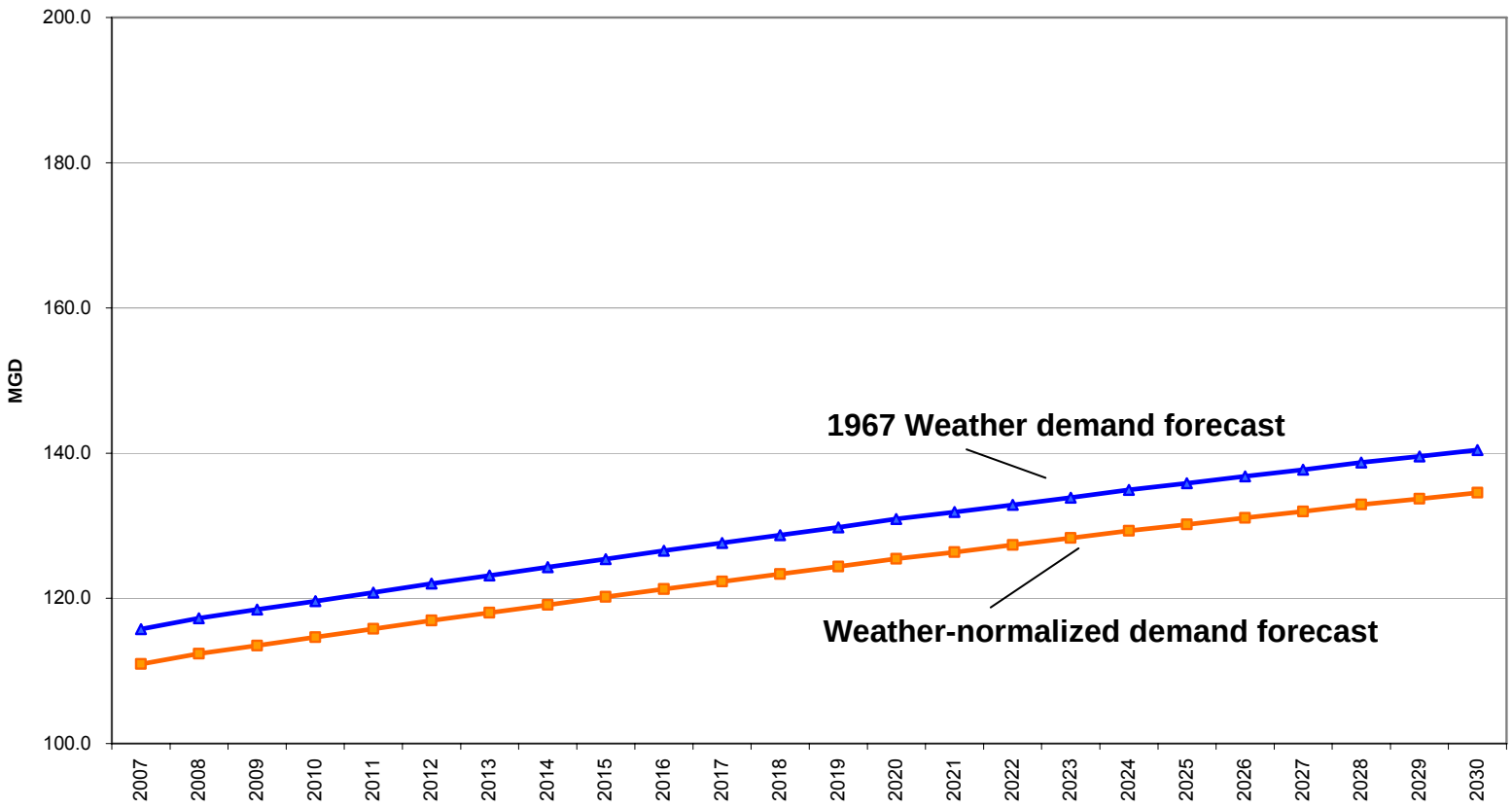


Figure 5-5. Total System Average Annual Daily Demand Forecasts Under 1967 Weather and Weather-normalized Conditions, Calendar Years 2007-2030

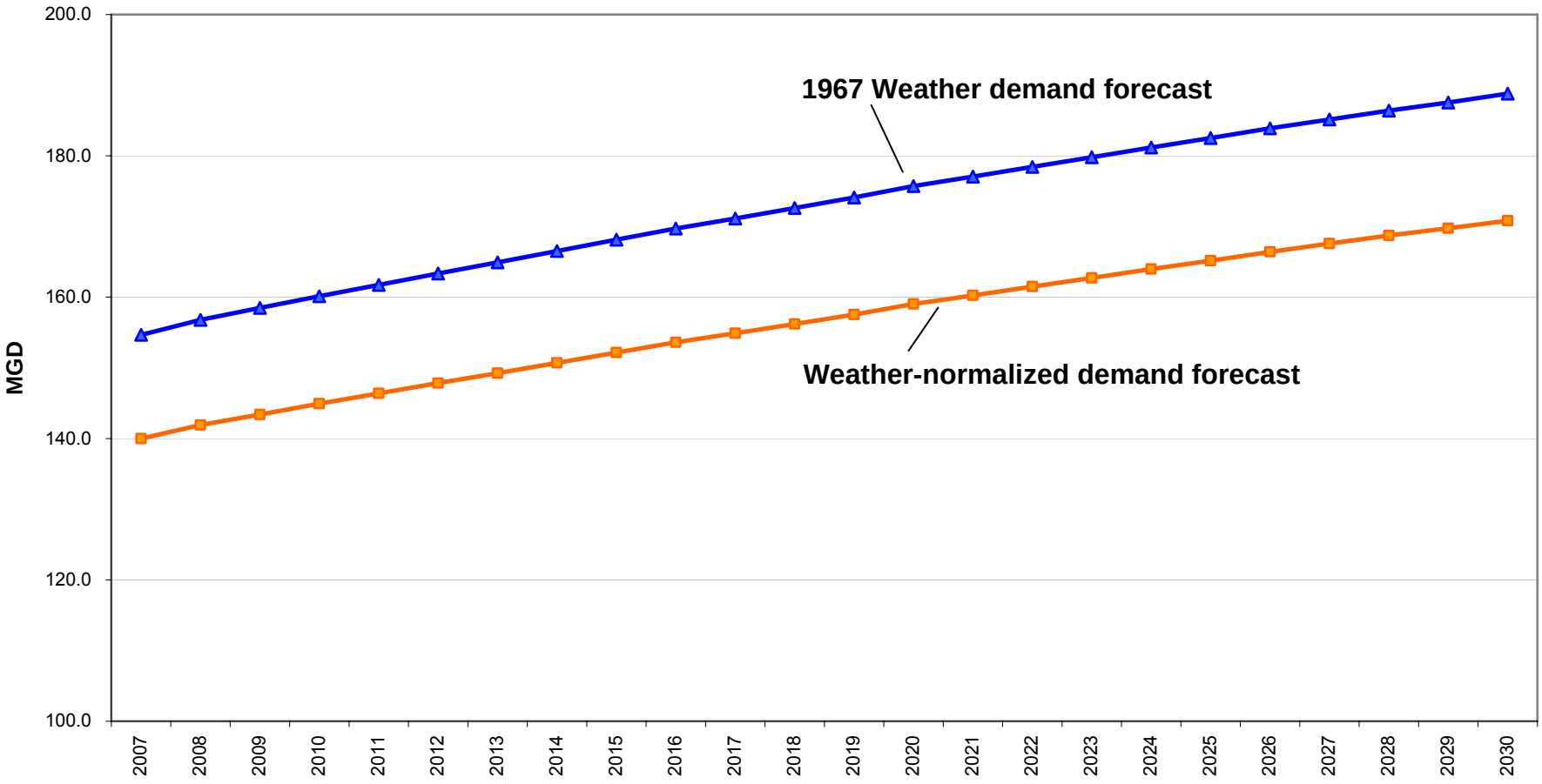


Figure 5-6. Total System Peak-season Demand Forecasts Under 1967 Weather and Weather-normalized Conditions, Calendar Years 2007-2030

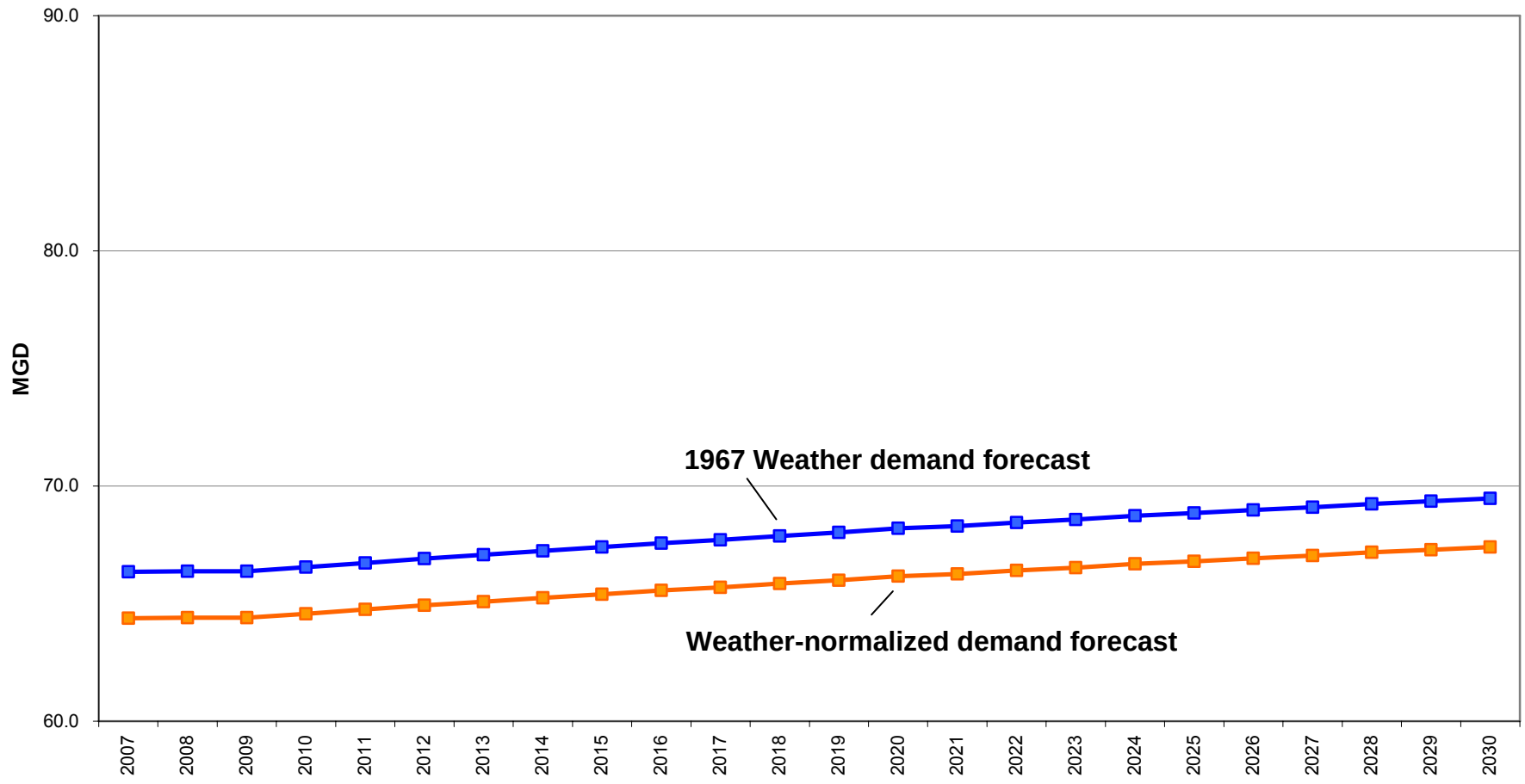


Figure 5-7. Retail Average Annual Daily Demand Forecasts Under 1967 Weather Weather-normalized Conditions, Calendar Years 2007-2030

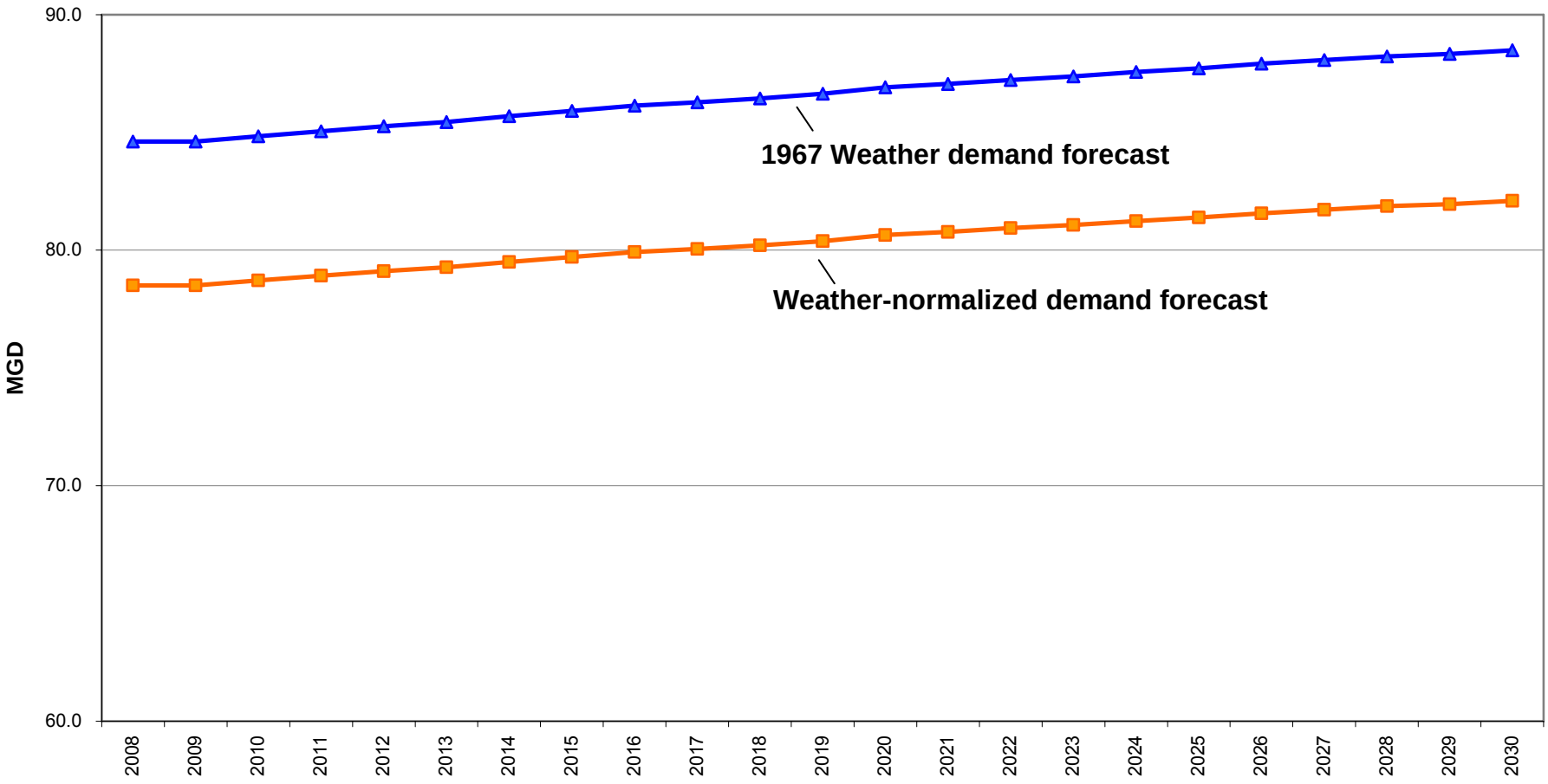


Figure 5-8. Retail Peak-season Demand Forecasts Under 1967 Weather Weather-normalized Conditions, Calendar Years 2007-2030

Table 5-7 shows the estimated demand and population for 2007 and forecasted demand and population for 2028 (from Table 5-5). The difference between the demand figures and the populations for 2028 and 2007 is the amount of the increase—labeled as 2028 Increase in the bottom row.

Table 5-7. Estimated Increase in Total Annual and Peak-season Demand and Population by 2028

	Annual (MGD)		Peak Season (MGD)			
Calendar Year	**ADDWN**	**ADDW67**	**ADDWN**	**ADDW67**	**MDDW81**	**Population**
2007	111.0	115.8	140.0	154.7	235.0	817,586
2028	132.9	138.7	168.7	186.4	282.8	982,442
2028 Increase	**21.9**	**22.9**	**28.7**	**31.7**	**47.7**	**164,856**

ADDWN - average daily demand, weather-normalized
ADDW67 - average daily demand under 1967 weather conditions
MDDW81 - maximum daily demand under 1981 weather conditions
Peak Season – 122 days, June 1 to September 30

The water demand projections in Table 5-7 indicate an added demand by 2028 of 21.9 MGD of annual average weather-normalized demand up to a possible added demand of 47.7 MGD during a maximum day demand under 1981 weather conditions. Depending on the weather conditions, meeting the Portland-area water demand during the peak season depends on both the available surface (Bull Run) and groundwater (Columbia South Shore Well Field and Powell Valley) supplies.

The Bureau has chosen to use the average daily demand under 1967 weather conditions (ADDW67) to account for the slight increase in ADD because of the longer peak-season extensions into the spring and fall months. In 2028, the ADDW67 is predicted to be 138.7, which is estimated to be 22.9 MGD more than the estimated ADDW67 for 2007.

5.4.3 Supply Management

As described in the Water System Description, the Portland system is not filtered and is subject to vulnerabilities that prompted Portland to build an extensive groundwater backup system beginning in the 1970s. As described in the Water Curtailment section of this plan, Portland has used the backup groundwater system several times for emergencies and for additional supplies to meet peak-season demands.

Management of these two systems during the peak season has required a bi-weekly decision making process based upon identified stream flows, storage capacity, fish flow needs, and water demands (see the Summer Supply Plan 2007 in Appendix H). The Summer Supply Plan (SSP) identifies the water sources that may be available to meet water needs. The SSP identifies resources based on tiers that include supplies owned and operated by Portland, conservation savings, curtailment, and limited supplies available from interconnections with other water provider supplies (see Table 1 in Appendix H). The current wholesale contracts require that Portland make the requested water amounts available to customers as a part of the processes outlined in the contracts. If these supplies are not available for reasons within

the control of the City, then reductions in revenue and wholesale obligations can result. Portland also has the option of selling higher amounts and interruptible water upon request, if the supply is available.

System Vulnerability and Reliability

The City prepared a vulnerability analysis of the water system in 2001 that identified human-made and natural events that can impact the reliability and availability of surface water supplies from the Bull Run and from the groundwater system. The events capable of reducing supplies from both sources are relatively few. The bureau's *Distribution System Master Plan* (Portland Water Bureau 2007a) used event return periods based on earlier analyses of events from turbidity to 500-year earthquakes from the vulnerability analysis. Because the surface water supply is unfiltered, it is particularly vulnerable to certain events. The groundwater system is important, to temporarily replace the surface water source if needed, to meet summer peak-season needs, and to allow for additional Bull Run stream flows to meet obligations under the Endangered Species Act.

As noted in the Water System Description, several factors influence the reliability of the groundwater system for short- and longer-term service. Not all of the infrastructure is likely to be available at the same time because of failures or planned maintenance. Reductions in available water for production purposes may be due to electrical, mechanical and other reliability and vulnerability issues relating to individual well pumps, well performance, pipelines, tanks, treatment facilities, and the well field booster pump station. Unexpected water quality problems in one or more wells could reduce capacity. The other major factor for the range of capacity numbers over time relates to the hydrogeology of the individual aquifers tapped by the wells in the Columbia South Shore Well Field (CSSWF).

The estimated reliability of groundwater production as contained in the *2007 Summer Supply Plan* is shown in Table 5-8. The reduction in flow does not account for mechanical equipment that is out-of-service, and is based on the aquifer yield of the CSSWF.

Table 5-8. Estimated Reliability of Supplies of CSSWF Groundwater from the 2007 Summer Supply Plan [a]

Number of Days of Pumping	Estimated Reliability in Millions of Gallons a Day	Estimated Volume in Billions of Gallons
Up to 30	102	3.1
30–90	92	8.6
More than 90	82 or less	More than 8.6

[a]Assumes 100% mechanical operation of all facilities

The City needs the well field to provide vulnerability protection and summer supply augmentation. We assume that during all events except a 500-year earthquake, the CSSWF will need to provide for annual average demand levels for 30-90 days. Although Table 5-8 indicates a reliable 30–90-day supply of 92 MGD from the CSSWF (provided the mechanical infrastructure is working), for the purposes of this analysis, this amount will be reduced by 10 percent to account for mechanical equipment that is out-of-service for any of the reasons discussed above.

Reducing 92 MGD by 10 percent results in a capacity figure for 30-90 days of 82.8 MGD. ***The reliable capacity amount of 82.8 MGD accounts for the reductions in aquifer yield after 30***

days of pumping and for a modest amount of out-of-service components of the groundwater system. All of this supply is assumed to be in the first baseline augmentation resources to be utilized within the city water supply system (see Table 1 in Appendix H).

Based on the projections for 2028 using annual ADD under 1967 weather conditions and accounting for the factors described in this water supply element, the City has identified an additional demand for 53.39 MGD maximum diversion rate in 2028. This 53.39 MGD maximum diversion rate is not met by the reliable capacity of the existing well field for more than 30 days of use. In evaluating how much water to request from the Columbia South Shore permits as "green light water" for the next 20 years, the City has taken into consideration the following information:

1. An evaluation of the cost-effective conservation savings from Section 3
2. Continuing reductions in per capita use as incorporated in the water demand forecast
3. The assumed obligations of the current wholesale contracts, and future wholesale contracting is assumed beyond the current contract expiration dates
4. Assumptions about the actual available capacities of the existing groundwater system. The actual capacities reflect an inability to produce the maximum capacities of each well during every day when the system is needed, based on past experience
5. The analysis of vulnerabilities represented by past bureau studies since 2000, particularly the *Distribution System Master Plan* of June 2007 and the focus on annual average demands to meet emergency scenarios with 5 to 25-year return intervals in addition to demands to meet emergency scenarios for a 100-year earthquake (Portland Water Bureau 2007a)
6. The need to plan for annual ADDs based upon climate patterns that represent higher-than-usual demand factors (the 1967 weather pattern specifically). This takes into consideration potential future climate change and the need to augment Bull Run streamflows to protect ESA-listed species under an approved HCP (Palmer and Hahn 2002 & City of Portland HCP draft).
7. Evidence from actual pumping experience and modeling of the Columbia South Shore Well Field using a Deep Aquifer Yield (DAY) model (based on MODFLOW) that evaluates the reduction in production over time within the primary production aquifers, particularly the Blue Lake and Sand and Gravel aquifers (BLA and SGA) (Leighton and Porcello, 2001).
8. That peak-day and average peak-season supplies will be met using both sources of supply and curtailment rather than sole reliance on the CSSWF
9. Groundwater well assets from the Powell Valley Road Water District (Gilbert and Vivian wells) are assumed at 7.36 MGD from the 30–90-day supply yield estimated in the Powell Valley Design Well Study (Portland Water Bureau 2007b) in this plan until a future update when studies of the ability to utilize these wells in the larger Portland distribution system are defined
10. The potential interference of the Portland groundwater system by increased use of the same aquifer by the City of Vancouver and the Clark County Public Utility District

The alternative sources for water are considered in the following section.

5.5 Alternative Sources Analysis

This subsection addresses the requirements of OAR 690-086-0170 [5]: If any expansion or initial diversion of water allocated under existing permits is necessary to meet the needs as shown in (3), an analysis of alternative sources of water that considers availability, reliability, feasibility and likely environmental impacts. The analysis shall consider the extent to which the projected water needs can be satisfied through:

a) Implementation of conservation measures identified under 690-086-0150,

b) Interconnection with other municipal water supply systems and cooperative regional water management, and

c) Any other conservation measures that would provide water at a cost that is equal to or lower than the cost of other identified sources.

For the purposes of this WMCP, the City is selecting the ADD based on 1967 weather as the basis for determining additional needed supplies from the CSSWF. The City also assumes that this need is based more on reliability requirements than on growth needs, and that a 90-day supply at the ADD is the target goal for the groundwater system.

The City has analyzed all of the possible sources that could help meet this need, including conservation and alternative water supplies. The analysis of conservation measures is included in subsection 5.5.1. The analysis of alternative water supplies (subsection 5.5.2) includes water available through interconnections with other providers, projects identified through regional water supply planning, and other water sources that could be developed within the city water system.

5.5.1 Implementation of Conservation Measures

As noted in the previous subsection, the City's analysis assumes that conservation programs for the Portland retail system will continue to be cost-effective. This is one of the primary reasons that the City's request for access to undeveloped water rights in subsection 5.6 does not identify peak-season demand as the basis for future development of the groundwater system, but rather annual average water demand.

Portland's retail system has already demonstrated significant reductions in per capita demand over the last two decades. The conservation programs selected for implementation and the benchmarks are those that reduce retail water demands during the peak season and those that focus on reducing demands in the industrial, commercial, and institutional (ICI) sector based on cost savings to the ICI customers. The City has also required wholesale customers to develop WMCPs for conservation program savings, however, the exact nature of these savings will not be known until the next benchmark reporting period.

The City does not expect that conservation will be able to meet all of the future demand for additional supplies, especially as the need is to meet annual average demands under higher demand weather years, projecting that the Bull Run system may be out-of-service for at least 90 days. The existing groundwater system is not capable of meeting annual average weather-normalized demands currently. Voluntary curtailment is considered a contingency in the bureau's annual summer supply plans. The voluntary and mandatory curtailment strategies are more fully described in Section 3, Water Curtailment.

5.5.2 Alternative Sources of Supply Other than Conservation

Other potential sources of supply include supplies from sources other than those managed and owned by the City of Portland and additional supply from the Bull Run or other groundwater sources (e.g. Powell Valley wells, Bull Run groundwater).

Interconnections and Supplies Not Owned by the City

Very few interconnections currently exist that could supply water to the City of Portland beyond those listed in Table 2-33 in the Water System Description (a total of 6.5 MGD is identified in the 2007 Summer Supply Plan as Tier 1 or Tier 2 resources). Other sources of supply could include expanded interconnections with the entities that obtain water from the Clackamas River; however this supply is fully ascribed to meeting demands in the Clackamas & Tualatin basins.

The Portland City Council has already determined that Portland will not use the Willamette River as a future supply source as a part of the ordinance endorsing the 1996 *Regional Water Supply Plan* (RWSP). Further action by the Council would be needed before any exploration of this source could begin. Another potential source of supply would be direct filtration of the Columbia River. However, the City owns no water rights to the Columbia River, and considers the use of the undeveloped groundwater rights—a source that is already indirectly connected to the river—to be a superior source.

Other City Sources

Bull Run Storage (Dam 3 and associated facilities)—The City has explored the development of a third dam in the Bull Run (Dam 3) as a part of the 1996 RWSP, the 2004 RWSP Update, and the Infrastructure Master Plan. The costs associated with further development of the Bull Run and the potential impacts on natural resources in this watershed appear prohibitive at this time. In addition, the proposal would result in more water capacity than is necessary or feasible to develop. The 2004 RWSP Update identified costs of $185 million for Dam 3 plus $181 million of additional cost for Conduit 5 to bring more of the available water to Portland plus an estimated $125 million for a water treatment plant—should one be necessary to enable construction in the watershed.

Adding Storage at Reservoirs 1 and 2 —Additional storage in Reservoirs 1 and 2 could only be achieved by raising the levels of the dams. Raises at the existing Dams 1 & 2 would not be sufficient to meet future demands as identified in subsection 5.4 and would trigger significant additional environmental impacts/costs and other costs associated with the potential need for filtration (Regional Water Providers Consortium 2004).

Former Powell Valley Road Water District (PVRWD) Groundwater Wells—The City has taken control of groundwater facilities owned by the former Powell Valley Road Water District, one certificated and one permitted set of wells. These wells have produced up to 12.27 cfs (7.36 MGD) of instantaneous supply, the water rights allow 1.6 MGD certificated rights for the Gilbert Wells, and 8.58 MGD from the Vivian wells for a total of 10.18 MGD of water rights). However, these wells are currently not connected to the primary terminal storage reservoir on Powell Butte and can only supply the former Powell Valley Road Water District service territory. Some of the equipment associated with these wells has failed, was removed, or is substandard. It is also possible that the two Gilbert Wells (#3 and #4) will need substantial rehabilitation or replacement before they can be put into service because

they are old wells (circa 1961) with perforated, rather than slotted, screens, and they currently produce unacceptable amounts of sand. The City is in the process of conducting a study on these wells to determine how they will be utilized within the larger Portland water supply system in the future (Portland Water Bureau 2007b).

In addition, the wellhead protection program for the Powell Valley wells is less protective than the one approved for the CSSWF. The City is beginning the process to upgrade this program.

The fiscal year 2007-2011 capital improvement plan (CIP) budget for the City of Portland includes several projects associated with the PVRWD infrastructure: booster pumps, water quality treatment facilities, electrical and information technology upgrades, and a 24" pipe to connect the facilities to the conduits and Powell Butte. If implemented, these projects would bring some or all of the capacity of these wells into the overall water distribution system by 2010.

For many of the reasons cited above, the 2007 Summer Supply Plan identified the Powell Valley wells in their current condition as Tier 2 contingency supplies for up to 2.5 MGD (or .38 billion gallons) over the peak season (151 days total). ***However, for the purposes of this WMCP the City assumes that, over the next 20 years, 7.36 MGD of supply can be made available from these wells.*** If this assumption proves incorrect based on further study, well testing, or construction of improvements, then the City will request either an increase or a reduction in the amount of "green light" water requested in subsection 5.6.

Bull Run Groundwater —Exploratory Bull Run groundwater wells close to Headworks at Dam 2 have been drilled and tested in the last 6 years. A water right application and well construction notices were filed with OWRD. The City stopped work on this and withdrew the water right application in 2005 because the groundwater quality and/or temperature was not good for either instream fish flow or for all potable water customers. Blending Bull Run groundwater with surface water could reduce these problems; however, the need to blend reduced the overall value of the Bull Run groundwater project. At some point in the future, the City may re-evaluate its ability to utilize this source, particularly since the yields were high, but at this time the CSSWF is more proximate to the area of need and the facilities are in place to utilize this already-developed source.

Aquifer Storage and Recovery — As described in subsection 2.1.2 of this plan, the bureau tested Aquifer Storage and Recovery (ASR) using four SGA wells under a Limited License pilot-testing permit issued by the Oregon Water Resources Department (OWRD). Injection of Bull Run water into the SGA aquifer occurred in 2002, 2003, and 2004, following completion of an initial Feasibility Study in 2000, receipt of the Limited License from OWRD in 2001, and completion of the necessary well field infrastructure in 2001. The final step in the pilot testing program would have been to install and test a stand-alone injection well at the Groundwater Pump Station site.

The Limited License was voluntarily cancelled by the bureau in August 2006 when the City decided that this project was not necessary because of the project costs, the added complexity of operation and monitoring, and because the project did not add sufficient new water above what was already available under the City's groundwater rights. The City informed WRD that it would not renew the limited license in 2005. The data collected as a part of this pilot test can be used in the future if the City determines that aquifer augmentation is a cost-effective and necessary project at some time in the future.

Non-potable supplies — The City has developed a significant number of groundwater wells for use by the Portland Parks & Recreation (PP&R). These rights and facilities are listed in Table 2-3 of the Water Supplier Description. These facilities have replaced the use of potable water in some circumstances; in other circumstances, these sources were specifically obtained or developed for the purpose of irrigating Portland Parks facilities or golf courses. These wells do not represent opportunities for further potable municipal drinking water supplies, and would not be affected by the reliability issues noted above. The Water Bureau has worked with the Parks Department to explore cost-effective water conservation measures.

Other sources of non-potable water have been developed by the Port of Portland in the Rivergate/Swan Island/Airport areas, primarily for outdoor irrigation but also for industrial processes such as ship washing. The Port and the Water Bureau have studied the development of a non-potable water system for the Rivergate area; however, the cost of developing this system has prevented implementation.

The City Bureau of Environmental Services Columbia Boulevard Wastewater Treatment Plant discharges a significant amount of water (plant capacity is 500 MGD). The level of wastewater treatment (Level 2) produces lower quality water from this facility on a year-round basis. The location and need for extensive transmission piping and the lack of nearby customers limits this alternative as a replacement for potable water supplies. The Bureau of Environmental Services does have a smaller ultra-violet (UV) treatment facility and utilizes this water for wetland rehabilitation at the Columbia Boulevard Wastewater Treatment Plant facility. The Office of Sustainable Development (OSD) has worked with specific developers on recycling and reusing water for individual projects and on providing information to customers about recycling water and using rainwater harvesting, but the impact of these programs has been limited.

At this time, non-potable supplies have limited ability to meet summer demands, and even less ability to significantly reduce the need for full backup supplies for annual average demands. Using non-potable supplies is considered promising for the future to reduce peak-season demands, but not at significant levels for the foreseeable future to reduce annual average demands.

5.5.3 Summary and Conclusions Regarding Alternative Sources

The Water Bureau concludes at this time that, although there may be alternatives to the development of additional groundwater rights in the CSSWF to meet annual average demand, most of the alternatives within the control of the City are not as cost-effective as developing CSSWF supplies. The average cost of CSSWF groundwater is approximately $1 million per MGD and the Water Bureau has the ability to make most of the needed improvements to the existing distribution system to move water from the CSSWF into the main system.

One exception is the Powell Valley wells, which are being evaluated and programmed for system improvements to determine how much water can be utilized. A revised estimate of the capacity of these facilities will be included at the next WMCP update or sooner. The availability of the Powell Valley supplies could reduce or increase the amount of water needed from the CSSWF undeveloped rights. Other sources within the control of the City, such as increasing the storage of Bull Run surface water with new or higher dams, are not considered cost-effective, and have impacts associated with both environmental resources

and with the continued status of the Bull Run as an unfiltered supply. The development of groundwater supplies is considered more cost-effective than these alternatives.

Additional conservation programs will be evaluated as a part of pilot programs (particularly non-potable sources either as a part of source-switching or at the individual user level).

Water sources not within the control of the City of Portland such as Columbia, Willamette, and Clackamas Rivers have also been evaluated. These sources are not considered viable sources to meet either reliability needs or growth needs for summer supplies for reasons of cost, water quality, or availability. The City anticipates continuing to supply wholesale customers in the future. The City is not assuming reduced consumption based on reduced future sales even if the current set of wholesale customers were to change in the future. In fact, reliance on Portland supplies in some basins (e.g. the Clackamas) could reduce the need to develop more environmentally sensitive sources of supply.

Because of the current need to focus on reinvestment in the City's older infrastructure system and the possibility of needing to address new Safe Drinking Water Act regulations, the Water Bureau has prioritized the limited public resources available to it to address these issues. The City needs to invest in sufficient groundwater resources to address annual average water demands while at the same time reinvesting in the system, and continuing its strong commitment to sustainable and efficient water use practices.

5.6 Undeveloped, Expanded, and New Water Rights

This subsection addresses the requirements of OAR 690-086-0170 [6]: If any expansion or initial diversion of water allocated under existing permits is necessary to meet the needs shown in (3), a quantification of the maximum rate and monthly volume of water to be diverted under each of the permits.

The City of Portland is requesting additional water in the amount under existing permits for the Columbia South Shore Well Field for the next 20 years, from the present to 2028. The request is to develop an additional 48.54 MGD/53.39 maximum MGD of supply from the CSSWF water rights shown in Table 5-9.

Table 5-9. Requested Groundwater Supplies by Permit, to 2028

Permit #	Monthly Volume[a] (in BG)	Millions of Gallons a Day	Maximum Diversion Rate[b] (in MGD)
G-10124 & G-10455	.54	17.84	19.62
G-8755 & G-10479	.92	30.7	33.77
Totals	1.46	48.54	53.39

[a]30–90-day supply based on 30 days of pumping

[b]The maximum diversion rate is a 10 percent increase of the monthly volume to represent the capacity yield for a less-than-30-day pumping event.

The basis for the 48.54 MGD of additional supply comes from the materials presented in the supply and demand analysis (subsection 5.4). This total is accounted for in Table 5-10 below.

Table 5-10. Accounting for Requested Groundwater Supplies

	Amounts in MGD	Maximum Diversion Rate
Total Annual ADD (1967 weather year) Demand Forecast for 2028	138.7[a]	
Minus CSSWF 30–90-day Reliable Supply	-82.8[b]	
Minus Powell Valley Wells Supply Assumption	-7.36	
Total Requested over 20 Years (to 2028)	48.54	53.39[c]

[a]From demand forecast for retail and wholesale service (Table 5-6) for the year 2028.
[b]This figure is based on a 10% reduction in yield capacity due to multiple well drawdown when all wells are in production, as well as a 10% out-of-service-calculation for mechanical or other operational considerations.
[c]The maximum diversion rate is a 10% increase over the total monthly volume requested to represent the capacity yield for a less-than-30-day pumping event.

The maximum diversion rate is 10 percent higher than the total volume requested to represent the less-than-30-day diversion amount. If the diversion amount is needed past 30 days, it will drop after the 30-day period to an average of the monthly production needed to meet 48.54 MGD of annual average supply. This is the same yield analysis that is applied to the reductions in overall CSSWF capacities in the summer supply planning process.

These amounts of supply will be developed over a 20-year period of time beginning in 2009 and progressing to 2028 at an estimated cost of $29.5 million (or approximately $750,000 per MGD). These estimates are in 2004 dollars. This $29.5 million does not include the added infrastructure cost associated with pumping, pipeline upgrades, storage, or other distribution system costs not directly associated with the specific well sites. These amounts will be evaluated in future WMCP plan updates and revised as needed based on the following three elements:

- The factors associated with defining the amount of supply from the Powell Valley well system
- The amount of actual demand increments based on weather effects and conservation savings
- The status of wholesale contracting beyond the expiration of the first set of 10-year contracts

In addition, increased costs will be defined for other infrastructure projects associated with pumping, transmission, and storage that may be necessary with an increased supply of groundwater from the CSSWF.

On October 6, 2009, OWRD provided Final Orders on the extensions of the four primary groundwater rights in the Columbia South Shore Well Field (G-8755, G-10479, G-10455, and G-10124). OWRD also provided a Final Order on December 7, 2009 approving Permit Amendment T-10489 for an additional point of diversion for Well #38 under G-8755. The Notice for Final Orders from OWRD is provided as Appendix B of this document.[49]

[49] Appendix B is provided in electronic format only, on CD with the printed version of this WMCP and on the PWB web site for this WMCP: www.portlandonline.com/water/WMCP.

5.7 Description of Mitigation Actions

This subsection addresses the requirements of OAR 690-086-0170 [7]: For any expansion or initial diversion of water under existing permits, a description of mitigation actions the water supplier is taking to comply with legal requirement including but not limited to the Endangered Species Act, Clean Water Act, Safe Drinking Water Act

Based on analysis of the gaging information in the Columbia River in the Portland metropolitan area, it would appear that there would be limited impacts from Portland's increased use of an average flow amount of 53.4 MGD in the CSSWF on flows in the mainstem Columbia River.

A flow of approximately 53.4 MGD (or 85 cfs) would be difficult to measure because the flows on the Columbia are so much greater. Also, the modeling done by the Portland Water Bureau for remediation of the CSSWF in the late 1990s indicates that although there is a connection between the aquifers tapped by the well field, it is not a one-to-one relationship, and that relationship changes over time (that is, there is more impact the longer the various wells are utilized). See subsection 2.4.2 under the Water Supplier Description for more information.

Furthermore, use of the CSSWF for greater amounts of water (such as those needed for emergency purposes such as turbidity events, flooding damage, or windstorms) have typically occurred during the winter season when flows in the Columbia are significantly above minimums.

As a part of the City's Habitat Conservation Plan, a significant commitment to utilization of the CSSWF is proposed to offset flows needed for listed fish species in the Bull Run and Sandy rivers. In order to meet future needs for retail and wholesale summer supplies and for emergency backup , the City plans to use water from the CSSWF which is a better environmental and regulatory alternative than full utilization of the current Bull Run system or to expanding storage within the Bull Run. As discussed in subsection 5.5, the ability to develop additional storage in the Bull Run is long, complex, and difficult at best particularly considering the unfiltered nature of this primary supply.

In response to the 1996 Safe Drinking Water Act Amendments, the cities of Portland, Gresham, and Fairview have developed a significant wellhead protection program for the CSSWF. Although this program does not directly mitigate for use of the groundwater itself, it is an important tool for environmental protection. The program regulates businesses using hazardous chemicals to prevent groundwater contamination. The best management practices implemented as a part of the wellhead protection program are also protective of runoff and recharge to surface water including the Columbia Slough and Columbia River. The former Powell Valley Road Water District, now under the Portland Water Bureau has a state-approved wellhead protection program. The City anticipates updating the Powell Valley program and integrating it into the overall wellhead protection program in 2008.

5.8 Analysis of Alternative Sources of Water, if Needed

This subsection addresses the requirements of OAR 690-086-0170 [8]: If acquisition of new water rights will be necessary within the next 20 years to meet the needs shown in (3), an analysis of alternative sources of the additional water that considers availability, reliability, feasibility and likely environmental impacts and a schedule for development of the new sources of water. The analysis shall consider the extent to which the need for new water rights can be eliminated through

(a) Implementation of conservation measures identified under OAR 690-086-0150;

(b) Interconnection with other municipal supply systems and cooperative regional water management; and

(c) Any other conservation measures that would provide water at a cost that is equal to or lower than the cost of other identified sources.

The City is not anticipating requesting additional water rights during the pendency of this WMCP, or for a period of 10 years. Some permit amendments and certification of existing rights are anticipated during this time period.

5.9 Additional Involvement Requirements

This subsection addresses the requirements of OAR 690-086-0125:

This section of the rules sets out logistical requirements for future updates, copies of any comments submitted by affected local governments, and any requests for more time related to past WMCP benchmarks.

[5]A list of the affected local governments to whom the draft plan was made available pursuant to 0120(6) and a copy of any comments on the plan provided by local governments.

The Portland Water Bureau provided notice via a letter to the following affected local governments and to agencies that either contain the retail service area or have facilities of the Portland Water Bureau located within them:

- City of Beaverton
- City of Hillsboro
- City of Gresham (Planning Department)
- City of Fairview
- City of Lake Oswego
- City of Maywood Park
- City of Portland (Bureau of Planning, Bureau of Environmental Services, Office of Sustainable Development, Parks & Recreation)
- City of Tualatin
- City of Tigard
- Clackamas County (Department of Environmental Services)
- METRO Regional Government
- Multnomah County
- Oregon Health & Science University
- Port of Portland
- Washington County (Land Use and Transportation Department)

Water Bureau staff also met with the Port of Portland to discuss each agency's WMCP and presented this WMCP to the wholesale Water Managers Advisory Board.

Other affected local government agencies that received the letter are agencies representing the Portland wholesale customers that utilize Portland water supplies but are not land use planning agencies. These agencies include the following:

Tualatin Valley Water District	Lusted Water District
Rockwood PUD	Pleasant Home Water District
West Slope Water District	Burlington Water District
Raleigh Water District	Palatine Hill Water District

An 16 additional stakeholders received a letter announcing the availability of the WMCP.

The letter offered a link to the draft WMCP on the Portland web site or a copy of the draft WMCP for review and comment (see Appendix G). The letter was mailed on January 2, 2008 and the comment period lasted until January 31, 2008. The comments received from local governments are listed in Appendix H.

[6] A proposed date for submittal of an updated plan within no more than 10 years based on the proposed schedule for implementation of conservation measures, and relevant schedules for other community planning activities, and the rate of growth or other changes expected by the water supplier; or an explanation of why submittal of an updated plan is unnecessary and should not be required by the Department.

The request will be for 10 years after the date of the Final Order approving the City's WMCP. The City will submit any required 5-year benchmark reports, including a report on incorporation of Powell Valley wells into the Portland water system, and on the adopted HCP if it includes any conditions relevant to the WMCP or as part of the 10-year update of the WMCP.

[7] If the municipal supplier is requesting additional time to implement metering as required under OAR 690-086-0150 (b)(b) or a benchmark established in a previously approved plan, documentation showing additional time is necessary to avoid unreasonable and excessive costs.

The City is not requesting additional time to implement metering or other benchmarks from the City's prior WMCP.