Section 5

Present and Future Water Demands

SECTION 5
PRESENT AND FUTURE WATER DEMANDS

5.1. General

The required capacity of a municipal water system is dictated by the total amount of water that it must furnish. This is a sum of the water required for domestic, commercial and industrial uses, plus water required for fire protection. For purposes of determining the required system capacity, the water required for domestic, commercial and industrial uses is usually taken as the maximum daily demand. In smaller towns, the requirements for fire protection typically meet or exceed this maximum daily demand.

The City currently obtains virtually all of its municipal drinking water from a surface water treatment plant, with water drawn from the Marys River. The City's maximum day demand in recent years is approximately 700 gpm. The total withdrawal rate permitted under the City's current Marys River water rights is approximately 2,550 gpm (See **Table 4-1**). Therefore, the City's current maximum day demand is approximately 27% of the total water rights controlled by the City. It is also interesting to note what proportion of the total water water rights issued on the Marys River Basin are controlled by the City. As previously stated, the City controls surface water rights in the amount of approximately 2,550 gpm or 5.68 CFS (See **Table 4-1**). Based on a review of the Oregon Water Resources Department Records, the sum of all surface water rights in the Marys River Basin equates to a withdrawal rate of approximately 180 CFS. Therefore, the City controls approximately 3% of the total water rights issued in the basin.

In order to select and size both pumping and distribution facilities for the planning period, projected water demands must be determined. The projected demands were determined based on a number of variables including the following.

- Rate of projected population increases
- Land use zoning within the study area
- Projected per capita flowrates.
- Projected fire flows.

This section develops water demand projections that are used for sizing the pump stations and distribution and storage system components, as well as the treatment plant components. The projected design flowrates were determined based on a number of variables including zoning of land within the service area, anticipated development density at buildout and within the planning period, projected per capita domestic flows, and fire flows.

5.2. Terms and Definitions

For purposes of the following discussions, some useful water system terms include the following.

- **Consumption** - Consumption is the water actually delivered to the system's users through service connections. Consumption is always somewhat less than demand, the difference being system loss. Demand is usually measured by system master meters and consumption is measured at the customer's meter. This report considers residential, public, commercial, industrial and rural consumption, as well as unmetered but quantifiable demands such as recommended fire flows.

- **Demand** - Demand refers to the total amount of water entering the distribution system from water sources and storage facilities to meet various user needs. Demand equals consumption plus system losses and is expressed in gallons per minute (gpm), gallons per day (gpd), or million gallons per day (MGD).

- **System Loss** - System loss is water which cannot be accounted for. It is the difference between the total system demand and the total consumption. System loss is not necessarily the same as leakage. Although the majority of system losses are typically the result of leaks, losses can also be attributed to meter error, as well as unmetered uses such as street flushing, hydrant testing and similar activities.

- **Average Day Demand (ADD)** - The average day demand is the total volume of water that enters the system over a period of one year, divided by 365 days. It is usually expressed in gpm or MGD.

- **Maximum Month Demand** - The maximum monthly demand is the largest total volume of water which enters the system in a one month period, divided by 30 days, expressed in gpm or MGD.

- **Maximum Day Demand (MDD)** - The maximum daily demand is the largest total volume of water that enters the system in a 24-hour period, expressed in gpm or MGD.

- **Peak Hour Demand (PHD)** - The peak hour demand is the greatest flow occurring in any one hour period, expressed in gpm or MGD. Unless the system has accurate records of both the production and the reservoir levels over time, this number may be hard to quantify.

- **Fire Flows** - The recommended fire flow is the flowrate required to fight a fire at a particular location. These fire flows are considered to be met if the system can deliver the required flowrate while maintaining a minimum residual pressure in the distribution system of 20 psi.

5.3. Current Water Demand and Consumption

For the purposes of this study, water consumption was determined by reviewing the system billings for water use. With the exception of tanker filling by the fire department, all service connections in the City are metered, with meters read on a monthly basis. As of January

2003 there were about 1,465 active water service connections in the City. **Table 5-1** shows a summary of the service connections within the City as of January 2003.

TABLE 5-1
WATER USER SUMMARY
(January 2003)

User Classification	No. of Services
Residential/Multi-Residential	1,276
Commercial/Schools	179
Industrial	10
Totals	1,465

Water demand is determined from the finish water flow meter at the WTP. This meter measures the water delivered to the distribution system and does not include water used for filter backwash.

Table 5-2 shows water demand and consumption characteristics for Philomath during the period from 2000 through 2002. It should be noted that neither the user's water meters nor the demand meter at the WTP are necessarily read at exactly the same time each month. Therefore the numbers in **Table 5-2** are most useful for annual averages, and may not accurately reflect month to month variations.

TABLE 5-2
RECORDED WATER DEMAND AND CONSUMPTION
2000 THROUGH 2002

Month	2000 Demand (MG)	2000 Cons. (MG)	2001 Demand (MG)	2001 Cons. (MG)	2002 Demand (MG)	2002 Cons. (MG)	Average Demand (MG)	Average Cons. (MG)
January	13.187	11.154	10.301	10.425	11.655	10.498	11.714	10.692
February	11.601	9.829	9.150	8.268	11.008	9.581	10.586	9.226
March	13.784	11.130	9.922	8.511	11.643	9.594	11.783	9.745
April	13.107	9.471	9.999	8.894	11.074	9.003	11.393	9.123
May	13.755	11.850	14.733	12.865	12.625	12.048	13.704	12.254
June	18.988	17.692	16.815	15.706	17.597	13.648	17.800	15.682
July	22.640	19.630	20.583	16.612	24.307	23.185	22.510	19.809
August	24.144	22.371	20.276	19.524	23.49	20.468	22.637	20.788
September	16.255	14.139	16.878	14.729	18.502	16.558	17.212	15.142
October	13.372	11.007	13.569	13.047	11.621	12.211	12.854	12.088
November	10.643	9.994	11.720	9.277	10.327	8.885	10.897	9.385
December	10.304	8.648	11.309	9.231	10.540	9.348	10.718	9.076
Totals	181.780	156.915	165.255	147.089	174.389	155.027	173.808	153.010
Average	15.148	13.076	13.771	12.257	14.532	12.919	14.484	12.751

Based on the data in **Table 5-2**, several calculated parameters that describe Philomath's water consumption patterns are presented in **Table 5-3.**

TABLE 5-3
WATER CONSUMPTION 2000 THROUGH 2002

Year	Annual Water Consumption (MG)	Est. Pop.	Average Annual Per Capita Consumption (gpcd)	Average Day Consumption (MGD) (gpm)	Max. Month Per Capita Consumption (gpcd)	Max. Month Consumption (MGD) (gpm)
2000	157	3838	112	0.430 299	188	0.722 500
2001	147	4010	100	0.403 280	157	0.630 437
2002	155	4100	103	0.425 295	182	0.748 519

The average per capita consumption for the three years shown is 105 gallons per capita per day, for all uses. For comparison purposes, the statewide average for domestic consumption is in the range of 110-120 gpcd.

Total system demand is shown in **Table 5-4**. The demand is assumed to be equal to the finished water produced at both the WTP and the 11th Street well. The production values do not include filter backwash water.

TABLE 5-4
WATER DEMAND 2000 THROUGH 2002

Year	Annual Water Production (MG)	Est. Pop.	Average Annual Per Capita Demands (gpcd)	Average Day Demand (MGD) (gpm)	Maximum Month Per Capita Demands (gpcd)	Maximum Month Demand (MGD) (gpm)	Maximum Day Per Capita Demands (gpcd)	Maximum Day Demand (MGD) (gpm)
2000	182	3838	130	0.499 346	202	0.779 540	261	1.004 697
2001	165	4010	112	0.452 313	165	0.652 452	215	0.864 600
2002	174	4100	116	0.476 331	191	0.784 544	261	1.074 746

The average annual per capita demand for the three years shown is 119 gallons per capita per day, for all uses. The average maximum month per capita demand is 186 gallons per capita per day. The average maximum day demand per capita is 245 gallons per capita per day. These numbers include both the water sold to users and the water lost in the distribution system.

5.4. Current Water System Losses

By comparing demand versus consumption, the unaccounted for water can readily be determined. The average percent unaccounted for water for Philomath for the years 2000 through 2002 are listed by month in **Table 5-5**. It should be noted that the production values do not include backwash water. It should also be noted, that the water meters at the services as well as at the production facilities are not necessarily read at the same time each month. Therefore, of the values presented in **Table 5-5**, the annual averages are the most useful.

TABLE 5-5
SYSTEM LOSSES

Month	Average Production (MG)	Average Consumption (MG)	Average System Loss (MG)	Average System Loss (gpm)	Average System Loss % Production
January	11.714	10.692	1.022	22.9	8.72%
February	10.586	9.226	1.360	33.7	12.85%
March	11.783	9.745	2.038	45.7	17.30%
April	11.393	9.123	2.271	52.6	19.93%
May	13.704	12.254	1.450	32.5	10.58%
June	17.800	15.682	2.118	49.0	11.90%
July	22.510	19.809	2.701	60.5	12.00%
August	22.637	20.788	1.849	41.4	8.17%
September	17.212	15.142	2.070	47.9	12.02%
October	12.854	12.088	0.766	17.1	5.96%
November	10.897	9.385	1.511	35.0	13.87%
December	10.718	9.076	1.642	36.8	15.32%
Average	14.484	12.751	1.733	39.593	12.38%

From **Table 5-2**, an average of 12.4% of the water produced is unaccounted for. This includes water lost through leaks, water unaccounted for due to unmetered uses such as fire fighting, or it may be the result of inaccurate meters. Given the age of the piping in the distribution system, approximately 12% loss is not surprising nor is it excessive when compared to other communities.

5.5. Projected Future Water Demands

Projected water demands were based on population projections, and typical water demand statistics. As discussed in **Section 2**, the population projection for Philomath is 7,365 residents in 2029.

The projected future industrial demands are based on the assumption that future industrial development will track the population growth. No provision has been made for new industries with heavy water demands such as food processing or beverage production. For purposes of this master plan it is assumed that new commercial and industrial developments will not be large water users (i.e., dry industries).

To project future flows, it is assumed that the long term per capita water demands will reflect the historical City averages. Since hourly data is not readily available, peaking factors were used to estimate peak hour demands. A peaking factor of 5 times ADD was used to estimate the PHD (peak hourly demand). This peaking factor is a commonly found value in the engineering literature and is often used for water system analysis and master planning.

Maximum daily demands have special significance because they can put stress on the water supply capabilities of the system. The water sources should be able to supply the entire water demand during the maximum day of the year in addition to any required fire flows. **Table 5-6** shows the projected water demands based on the peaking factors and population projections.

TABLE 5-6
SUMMARY OF PROJECTED WATER DEMANDS

Category / Year	2005	2010	2015	2020	2025	2029	Buildout[5]
Population	4,220	4,739	5,322	5,977	6,712	7,365	15,170
Avg. Day Demand (ADD)[1]							
mgd	0.502	0.564	0.633	0.711	0.799	0.876	1.805
(gpm)	(350)	(390)	(440)	(490)	(550)	(510)	(1,250)
Max. Month Demand (MMD)[2]							
mgd	0.785	0.881	0.990	1.110	1.250	1.370	2.820
(gpm)	(550)	(610)	(690)	(770)	(870)	(950)	(1,960)
Max. Day Demand (MDD)[3]							
mgd	1.034	1.161	1.304	1.464	1.644	1.804	3.720
(gpm)	(720)	(810)	(910)	(1,020)	(1,140)	(1,250)	(2,580)
Peak Hour Demand (PHD)[4]							
mgd	2.510	2.820	3.165	3.555	3.995	4.380	8.025
(gpm)	(1,740)	(1,960)	(2,200)	(2,470)	(2,770)	(3,040)	(6,270)

[1] - Based on 119 gpcd (historical demands)
[2] - Based on 186 gpcd (historical demands)
[3] - Based on 245 gpcd (historical demands)
[4] - Based on peaking factor of 5 x ADD
[5] – Flows at buildout are used to size future transmission mains (see **Section 6**).

5.6. Fire Flows

In general, the water system is a community's primary resource for fighting fires. To assure adequate fire protection, the water system must be capable of supplying required fire flows in addition to maximum daily demands to the system. The Insurance Services Office (ISO) provides guidelines for determining the recommended fire flows for various structures. Large combustible buildings require larger fire flows than smaller or less combustible buildings. Buildings with fire protection systems (automatic sprinklers) generally require smaller fire flows than buildings without these systems. These guidelines are then used for the purpose of establishing insurance rates.

The minimum recommended fire flows from hydrants located in the City are based on two sets of criteria. The first is City or Fire Department standards, if present. The other is the ISO report prepared by the ISO Commercial Risk Services. The typical requirements are that the system in residential areas shall be designed to provide a minimum of 1,000 gpm per hydrant at a residual pressure of 20 psi at the highest water meter. Although flows of 1,000 gpm are normally adequate to provide fire protection in residential areas, much higher flows are required in commercial, industrial and multi-family developments.

To limit the size of the water mains and storage facilities necessary to supply fire flows to large combustible structures, some cities have a policy stating that all buildings requiring fire flows of 2,500 gpm or greater must install an automatic sprinkler system unless otherwise approved by the local fire marshall. If not already in place, it is recommended that the City institute a similar policy. The effect of such a policy would be to limit the City's obligation for providing fire flows to a maximum of 2,500 to 4,000 gpm to any single hydrant, thereby reducing the size and cost of future water system improvements.

As part of the Public Works Design Standards, the City adopted a policy of requiring adequate fire flow capacity as a prerequisite for future development. In addition to the ability of the water system to deliver the required fire flows at a particular location, fire protection rating also requires the capability of the system to deliver the required flowrate for a specified period of time. Section 5.10 of the City's Public Works Design Standards contains recommended fire flow standards. These are listed in **Table 5-7**.

TABLE 5-7
RECOMMENDED FIRE FLOWS

Location		Recommended Fire Flow (gpm)	Duration (hours)	Required Volume (gallons)
All others		1,000	2	120,000
Residential	Single Family	1,000	2	120,000
	Multi-familiy	2,500	2	300,000
Commercial		3,500	3	630,000
Industrial		4,000	4	960,000