Estimated Water Use and General Hydrologic Conditions for Oregon, 1985 and 1990

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CONVERSION FACTORS AND VERTICAL DATUM

[SI = International System of units, a modernized metric system of measurement]

Multiply	By	To obtain
	Length	
inch (in.)	25.4	millimeters
foot (ft)	0.3048	meters
	Area	
acre	4,047	square meters
	0.4047	hectares
square mile (mi^2)	259	hectares
	2.59	square kilometers
	Flow	
million gallons per day (Mgal/d)	1.121	thousand acre-feet per year
	0.001547	thousand cubic feet per second
	0.6944	thousand gallons per minute
	0.003785	million cubic meters per day
thousand acre-feet per year	0.8921	million gallons per day
	0.00138	thousand cubic feet per second
	0.6195	thousand gallons per minute
	0.003377	million cubic meter per day
	Energy	
gigawatt hour (GWh)	1,000	megawatt hour
	1,000,000	kilowatt hour
	Volume	
million gallons	3.07	acre-feet
1 acre-foot (acre-ft)	325,851	gallons
	43,560	cubic feet
1 inch of rain	17,400,000	gallons per square mile
	27,200	gallons per acre

Temperature: Air and water temperatures are given in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation: $F = 1.8\ (°C) + 32$

Estimated Water Use and General Hydrologic Conditions for Oregon, 1985 and 1990

By Tyson M. Broad *and* Charles A. Collins

Abstract

Water-use information is vital to planners, engineers, and hydrologists in water resources. This report is a compilation of water-use information for Oregon for calendar years 1985 and 1990. The report presents water-use data by geographic region for several categories of use, including public supply, domestic, commercial, industrial, mining, thermoelectric power, hydroelectric power, livestock, irrigation, reservoir evaporation, and wastewater treatment. Hydroelectric power is the only instream use discussed; all other uses are considered offstream. The Appendix presents 1985 and 1990 data by region and by drainage basin for the previously mentioned categories of use.

The Cascade Range divides Oregon into two distinct climatic zones. The area west of the Cascade Range has an average annual precipitation that ranges from 40 to 200 inches, and precipitation in the area east of the Cascade Range ranges from 10 to 20 inches. The differences in precipitation and geology have an effect on the sources, uses, and amounts of water withdrawn. Most of the large public-supply systems west of the Cascade Range rely on surface water, whereas many of the large public-supply systems east of the Cascade Range use on wells or springs. Irrigators west of the Cascade Range rely primarily on nearby surface-water sources; however, irrigators east of the Cascade Range use primarily surface water that commonly is delivered from distant sources through irrigation ditches.

A variety of methods was used to estimate water-use information. Most withdrawals for public-water suppliers were metered; however, irrigation withdrawals usually were estimated by using information on crops, climate, application efficiencies, and conveyance losses. The accuracy of the estimated total withdrawal values for public supply was estimated to be within 4 percent of the values that would be obtained if all public-supply withdrawals were metered. Total withdrawals for irrigation were estimated to be within 40 percent of metered irrigation withdrawals. The estimates-of-error are presented to show the relative, rather than absolute, accuracy of the data for each water-use category.

A total of 8,400 million gallons of water per day was withdrawn in Oregon during 1990, about 1,900 million gallons per day more than the 6,500 million gallons per day withdrawn in 1985. Whereas actual water use increased in 1990, the major differences between 1985 and 1990 were attributed to the inclusion of offstream fish hatcheries, the use of different crop coefficients to estimate irrigation, and the availability of more detailed information in the 1990 estimates. Surface-water withdrawals accounted for 92 percent of the total withdrawals in 1990; irrigation was the largest category of water use, accounting for 82 percent of the total withdrawals.

INTRODUCTION

Water-resource issues in Oregon are multifaceted. Water shortages during the late 1980's forced water users to develop conservation plans. Water-quality problems forced municipalities to rely on other sources of water supply, and declines in anadromous fish populations (fish that hatch in freshwater, mature in saltwater, and return to spawn in freshwater) required that water be released from reservoirs to benefit fish. These examples were just a few of the issues. Water-use information is vital to planners, engineers, hydrologists, and biologists who attempt to resolve these issues. By depicting the current and historical effects on water resources, water-use information can assist in the creation of conservation plans, the design of water-supply systems, or the calibration of hydrological and ecological models.

In Oregon, water-use information generally is difficult to obtain. Water-use data are available for only certain types of uses or for certain areas. In most cases, however, water use must be estimated by using water-use coefficients and related data such as population or irrigated acreage. The use of coefficients makes accurate tracking of increases and decreases in water use difficult. However, comparison and careful interpretation of changes in annual water-use data obtained from measurements and estimates can provide a benchmark for tracking changes until more accurate methods of monitoring are developed and implemented.

Purpose and Scope

During calendar years 1985 and 1990, the Oregon District of the U.S. Geological Survey (USGS) compiled water-use information to derive estimates of use for areas where data were not available and stored the accumulated data in digital form. This report presents these data by geographic region for the following categories of use: public supply, domestic, commercial, industrial, mining, thermoelectric power, hydroelectric power, livestock, irrigation, reservoir evaporation, and wastewater treatment. The geographic regions discussed in this report consist of drainage basins that have relatively similar hydrologic conditions and water use (fig. 1). The data presented by geographic region have been aggregated from water-use data collected by hydrologic unit (drainage basin). Water-use data by hydrologic unit are presented in the Appendix of this report. The discussion for each category of water use focuses on 1990; 1985 data are used as a reference for discussing changes in water use and (or) changes in data-collection methods. Unless noted otherwise, water-use data presented in the text are for 1990.

Previous Investigations

The USGS has compiled nationwide water-use data at 5-year intervals since 1950. These USGS Circulars—MacKichan (1951, 1957); MacKichan and Kammerer (1961); Murray (1968); Murray and Reeves (1972, 1977); and Solley and others (1983, 1988, 1993)—show aggregated water-use data by State and by major drainage basins for public supply, rural (domestic), irrigation, industrial, and hydroelectric power. Solley and others (1988, 1993) water-use reports further subdivided or added categories to create 11 categories of use: public supply, domestic, commercial, industrial, agricultural (irrigation and non-irrigation), hydroelectric power, thermoelectric power (fossil fuel, nuclear, and geothermal) and wastewater treatment. Oregon data presented in the 1988 and 1993 water-use reports (Solley and others, 1988, 1993) were aggregated from data presented herein. In a few instances (domestic and irrigation), updates to the Oregon data are not reflected in the national reports.

The USGS 1987 National Water Summary (Carr and others, 1990) contains information on water use for all States and Territories. The State chapters focus on water supply and use and feature subheadings on the history of water development, water use, public supply, domestic and commercial use, industrial and mining use, thermoelectric-power use, agricultural use, and water management. Oregon water-use data presented in the 1987 National Water Summary are for calendar year 1985.

Other Federal agencies also collect water-use information. As part of the Census of Mineral Industries and Census of Manufactures, the U.S. Department of Commerce (1985, 1986, 1990) publishes State water-use totals for industry and mining. The U.S. Bureau of Mines (Quan, 1988) publishes State water-use totals for types of mining. Irrigation water delivered to farms by Federal irrigation projects are reported by the Bureau of Reclamation (undated).

The Oregon State Water Resources Board (now the Oregon Water Resources Department) published reports for each of the major river basins in Oregon during the late 1950's and early 1960's.

Figure 1. Locations of counties and regions.

These reports examine water use on the basis of water-rights information. More recently, the Oregon Water Resources Department (1986, 1988, 1989) has revised several of the earlier basin reports.

The now defunct Pacific Northwest River Basins Commission made extensive studies of the water resources of the Columbia River Basin in the early 1970's. The Commission published a report (Pacific Northwest River Basins Commission, 1971) that examined current and future water needs for various categories, including irrigation, municipal (public supply), and industrial supply. Information for these categories has been published as separate appendixes to the main volume.

Acknowledgments

The authors would like to acknowledge the numerous water-users, government agencies, and individuals who contributed to this report. These contributors include: municipal water departments and large industrial users who supplied and verified information; Oregon State University Extension Service personnel who supplied data on the types of crops, acreage, irrigation techniques, and crop-water needs; Oregon Water Resources Department, which provided information on water rights and on municipal water use; and the Drinking Water Section of the Oregon State Health Division, which provided information on municipal and commercial water users. Appreciation also is extended to the Oregon Department of Environmental Quality, the Natural Resources Conservation Service (formerly the U.S. Soil Conservation Service), and the U.S. Bureau of Reclamation for furnishing data necessary.

U.S. GEOLOGICAL SURVEY WATER-USE PROGRAM

Water-use data collected prior to 1977 have been accumulated from numerous sources and differ in their accuracy. In an effort to develop a more standardized, timely, accurate, and accessible source of water-use information, Congress in 1977 directed the USGS to develop the National Water-Use Information Program. This program, part of the USGS Federal-State Cooperative Program, has brought about new programs at the National and the State level (Mann and others, 1982).

National Water-Use Program

The objective of the National Water-Use Information Program is to determine the quantities of withdrawals and consumptive use of the Nation's fresh and saline, surface and ground water. Instream uses are not addressed, except for hydroelectric power. As a part of the development of the National Water-Use Information Program, a computerized data storage and retrieval system for water-use information was implemented in 1979. The database, known as the Aggregated Water-Use Data System, is designed to store data on withdrawals and consumptive use for 11 categories of use, aggregated by county or hydrologic unit.

A schematic diagram, indicating how the Aggregated Water-Use Data System stores water-use data, is shown in figure 2. Three industries (X, Y, Z) in county 001 withdraw 100 Mgal/d (million gallons per day) from a river (surface water) and 20 Mgal/d from a well (ground water). Conveyance losses associated with the surface-water withdrawal are 1 Mgal/d. Thus, a total of 119 Mgal/d are delivered to the industries. After use by the industries, 117 Mgal/d are released as a result of a consumptive use of 2 Mgal/d. The conveyance of this water back to the river results in a loss of another 1 Mgal/d. Water-use information for county 001 would show that a total of 120 Mgal/d was withdrawn for industrial purposes, of which 2 Mgal/d was used consumptively, 2 Mgal/d was lost in conveyance, and 116 Mgal/d was returned.

State Water-Use Program

The National Water-Use Information Program also recognized the need for a State water-use database capable of storing site-specific data. The State Water-Use Data System was developed to store water-use data for individual water users and facilities. The State Water-Use Data System is similar to the Aggregated Water-Use Data System except that the information is for a single user (fig. 3) rather than an aggregate of users.

In Oregon, the Water-Use Information Program relies on cooperative agreements with the Oregon Water Resources Department and the Oregon State Health Division to collect, interpret, and disseminate water-use data for use in water-resources planning by public and private agencies. In addition to collecting water-use data for categories of use addressed in the National Water-Use Information Program, the Oregon

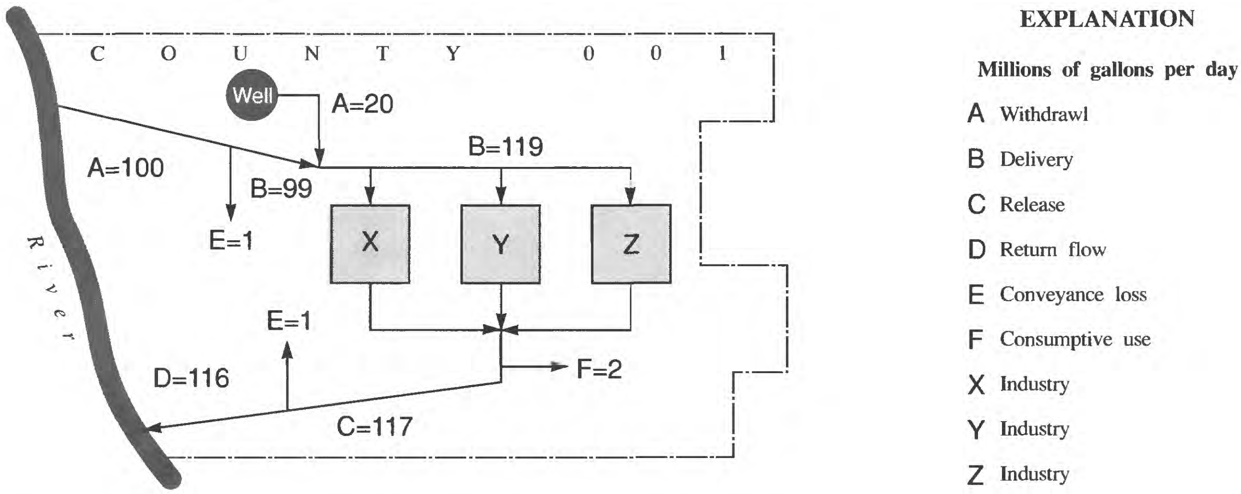

Figure 2. Aggregated water-use information for industries X, Y, and Z.

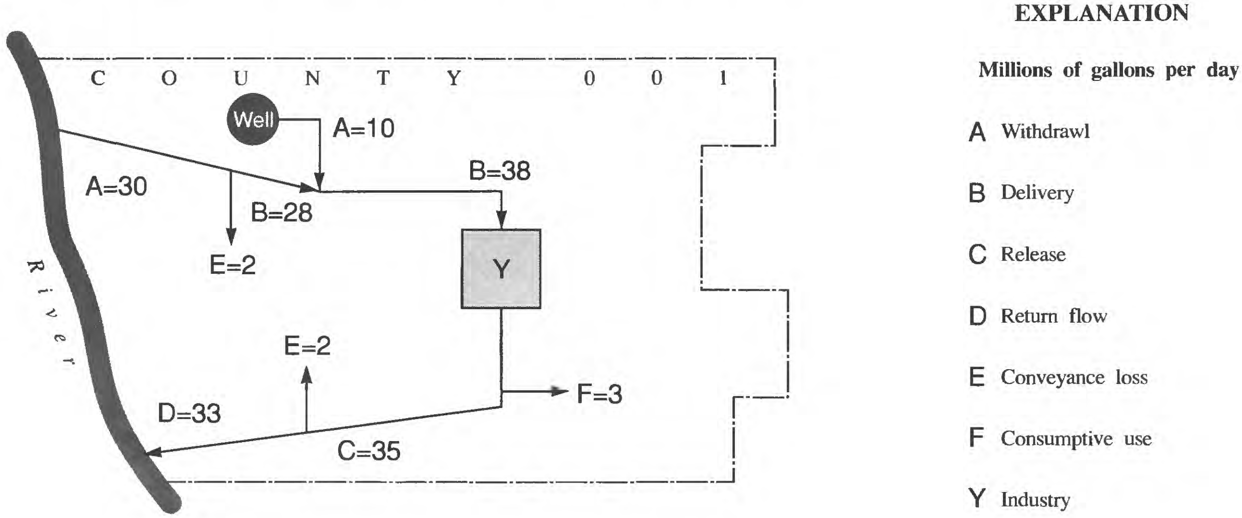

Figure 3. Site-specific water-use information for industry Y.

program also includes site-specific information on monthly withdrawals and returns, the source of water, and the geographic location of the withdrawal and return. For public-supply systems, information on the number of connections to the facility and the number of persons served by the facility has been included in the Oregon database.

METHODOLOGIES AND ESTIMATION OF ERROR

Water-use information has been collected in Oregon by the USGS since 1950. However, 1985 marked the beginning of more detailed data-collection efforts. As a result, some of the estimation techniques used in 1985 and in 1990 to collect water-use data may differ from those used in the previous years. For example, in the 1980 report, the total amount of water withdrawn for public supply was 230 Mgal/d, in 1985, 420 Mgal/d, and in 1990, 470 Mgal/d (Solley and others, 1983, table 4). The differences in these annual totals can be attributed to a population increase and related water-demand increases, and an increase in the accuracy of the data available. In 1983, a query of the largest 500 public suppliers was conducted to compute public-supply use. Beginning in 1988, Oregon State Law required public entities to report their water use. Because of the differences in data-collection techniques and data availability, comparing 1985 and 1990 data with previous water-use data needs to be done with caution. Those categories of water use in which large differences exist between annual data may be due to changes in collection methodologies.

Estimates-of-error are provided to show the relative, rather than absolute, accuracy of the data for each water-use category. An estimate-of-error is the total margin-of-error as a percentage of an estimated water-use value, compared to a water-use value obtained by using a flowmeter. The total margin-of-error is the sum of the errors introduced at each step of the estimation process. Some error values were determined by statistical sampling, other error values were only estimated. Therefore, estimates-of-error are not exact margins-of-error. These estimates-of-error are only for total withdrawals by a particular category of water use; withdrawal data for a selected region or hydrologic unit may contain errors that exceed the estimate-of-error.

Public Supply

Most of the 1985 data for the public-supply category were obtained from a 1983 USGS study of Oregon public-supply systems. In the study, a U.S. Environmental Protection Agency (EPA) list of more than 900 public-supply systems was used to obtain a list of the 500 largest public-supply systems in Oregon. That list included all public-supply systems that served more than 100 people. The managers of these systems were then queried to obtain information about the source and amount of withdrawals and the number and type of domestic, commercial, and industrial connections for 1980.

To update the public-supply data for 1985, withdrawal information for the 40 largest public-supply systems in Oregon was obtained from the Oregon State Health Division. Most of the population growth between 1980 and 1985 occurred in metropolitan areas (Portland State University, 1986); therefore, updating information for the larger public-supply systems was assumed to account for most of the significant changes in public-supply withdrawals. The population served by these systems also was updated in this manner. Changes in the number of domestic connections to each system were estimated on the basis of the number of persons served and the average number of persons per household. The number of commercial and industrial connections was not updated and was assumed to be constant between 1980 and 1985.

For 1990, a list of 963 public-supply systems was obtained from the Oregon State Health Division database. This database contains information on the number of connections and the population served by each public-supply system. Withdrawal information for 1990 was obtained from the water-use reporting program of the Oregon Water Resources Department. Withdrawals for public-supply systems that were not required to report water use (generally trailer parks and small private water companies) were estimated by multiplying the population served by the system by 75 gallons per day per person for trailer parks or 100 gallons per day for private water companies. These coefficients were estimated by using information provided by public-supply systems about average daily deliveries to domestic users. The number and type (domestic, commercial, industrial, and public) of connections, as well as the percentage of system losses, were obtained through telephone queries of 61 of the larger users of water in Oregon. For those users that were not queried, estimates of the number of connections and of system losses were established on the basis of information from queried systems of similar size.

To calculate the amount of water that was distributed to domestic, commercial, and industrial users by public suppliers, an algorithm was developed from a query of managers of three public-supply systems in Oregon: Portland, Eugene, and La Grande (D.D. Nebert, U.S. Geological Survey, written commun., 1985). That algorithm was used to estimate the amount of water delivered to users on the basis of the number and size of the connections to a system and on a coefficient of use. The coefficients were the average used for the different types of users in the three cities and were as follows:

- single-family dwelling 220 gallons per connection
- multiple-family dwelling 800 gallons per connection
- commercial establishment 780 gallons per connection
- industrial establishment 12,800 gallons per connection

Before the calculation was made, the amount of water transferred between systems was added to the amount of water withdrawn for public uses and to conveyance losses and the total was subtracted from the total withdrawals. The amount of water transferred between users was obtained in the query about the public-supply systems. The amount of water distributed for public uses, such as firefighting, public fountains, swimming pools, irrigation of city parks, and the amounts lost in conveyance, were obtained through queries about larger systems. The total amount of water for public uses and conveyance losses was calculated as a percentage of the total withdrawals. That percentage was applied to nonqueried users, on the basis of similarity of size and the source of water of the system.

Distinguishing between the amount of water delivered for public uses and the amount lost in conveyance was not feasible in most cases, and the two were combined. That combined amount generally varied from 5 to 20 percent of the total withdrawals.

Once a total for water delivered was calculated, that total was adjusted upward or downward to equal the total water available for delivery. That is:

$$(SFD + MFD + COM + IND) \times PA = WITH - TRANS - (PU + CONVEY) \quad (1)$$

where

- *SFD* = number of single family dwellings times 220 gallons per connection,
- *MFD* = number of multiple family dwellings times 800 gallons per connection,
- *COM* = number of commercial establishments times 780 gallons per connection,
- *IND* = number of industrial establishments times 12,800 gallons per connection,
- *PA* = percent adjustment,
- *WITH* = total withdrawals,
- *TRANS* = transfers,
- *PU* = public uses, and
- *CONVEY* = conveyance losses.

Public-supply withdrawal data, the most complete and accurate water-use data in this study, were within about 4 percent of total withdrawals measured with flowmeters. The estimated margin-of-error associated with the estimation of water distribution compared to distributions measured with flowmeters was about 25 percent. The manner in which these estimations of accuracy were determined is discussed in the remainder of this section.

Flow rates obtained from selected flowmeters generally were within 5 percent of flow rates obtained from an acoustic velocity meter (Collins, 1987); the acoustic velocity meter had an accuracy of about 1 percent. Measurements made with flowmeters were the standard against which all other determinations of accuracies were made in this report; thus, no margin-of-error was associated with measurements made with flowmeters.

Withdrawals by most of the larger public-supply systems in Oregon were measured with flowmeters. Other public-supply systems used weirs or estimated withdrawals on the basis of the pumping capacity multiplied by the number of hours of operation.

The accuracy of measurements made with weirs—right-angled, V-notched weirs were usually used—is generally between 1 and 12 percent (Brater and King, 1976); a value of 10 percent was used for this report. The accuracy of withdrawal estimates determined by pumping capacity and hours of operation can have a high variance; pumping-capacity values can vary greatly, depending on the efficiency of the pump. However, public-supply systems pumps generally are well maintained and pump efficiencies tend to remain high. Withdrawal estimates that used pumping capacity, therefore, were estimated to be within 15 percent of measurements made with flowmeters. Estimates of withdrawals based only on population and a coefficient of use were estimated to differ from flowmeter measurements by as much as 60 percent. Nationwide per-capita use coefficients generally range from 50 to 120 gallons (Solley and others, 1993); the coefficients used in Oregon were within 60 percent of the lowest or highest national value. Withdrawals that were estimated on the basis of population accounted for about 1 percent of the total withdrawals from public-supply systems.

An estimated 75 percent of the withdrawals from public supply were made by systems that used flowmeters, an estimated 5 percent of the withdrawals were made from systems that used weirs, an estimated 19 percent of the withdrawals were made from systems that estimated withdrawals on the basis of pumping capacity and hours of operation, and an estimated 1 percent of the withdrawals were made by systems that estimated withdrawals by using population and a coefficient of use. Therefore, the margin-of-error was calculated as the sum of the products of the accuracies for an estimation technique and the percentage of the total withdrawals for public supply withdrawn by facilities using that estimation technique, or:

$$(A \times B) + (C \times D) + (E \times F) + (G \times H) = I \quad (2)$$

where

A is the portion of withdrawals for public supply by systems that measured withdrawals with flowmeters (0.75),

B is the estimate-of-error for withdrawals measured with flowmeters (zero),

C is the portion of withdrawals for public supply by systems that measured withdrawals with weirs (0.05),

D is the estimate-of-error for withdrawals measured with weirs (0.10),

E is the portion of withdrawals for public supply by systems that estimated withdrawals by using pump capacity and hours of operation (0.19),

F is the estimate-of-error for withdrawals estimated by using pump capacity and hours of operation (0.15),

G is the portion of withdrawals for public supply by systems that estimated withdrawals by using population and a coefficient of use (0.01 percent),

H is the estimate-of-error for withdrawals estimated by using population and a coefficient of use (0.06, or 6 percent), and

I is the estimated margin-of-error for total withdrawals for public supply (0.03).

The 3 percent margin-of-error is for total withdrawals made from public-supply systems in Oregon. Estimates of withdrawals in specific regions may differ, depending on the estimation techniques of the public-supply systems in that region.

The accuracy of the distribution of water by public-supply systems to domestic, commercial, and industrial users was dependent on the accuracy of withdrawal estimates, estimates on the number and type of connections to the system, the amount of water that went to public uses and conveyance losses, and the distribution algorithm. The accuracy of withdrawal estimates was estimated to be within 4 percent. Information on the total number of connections to public-supply systems was obtained from billing records and was considered accurate unless a public-supply system made an error. The number and type of public-supply connections was obtained only for 61 of the largest users, who deliver 82 percent of the total withdrawals. Another 5 percent of the total withdrawals was assumed to have been distributed to domestic users. The number and type of connections were estimated for the remaining users, who withdrew 13 percent of the total withdrawals for public supply. Estimates of the number and types of connections were considered accurate to within 15 percent. The amount of water delivered to public users and to conveyance losses usually was estimated by individual public-supply systems and was within about 15 percent of the metered value. Estimates of the amount of water distributed to different types of users, made by using the algorithm, were within 1 percent of the metered deliveries for the three public-supply systems surveyed (D.D. Nebert, U.S. Geological Survey, written commun., 1985). That algorithm was applied to other public-supply systems; the resulting margin-of-error was estimated to be within 5 percent of the metered value. The estimated margin-of-error was calculated by using the following equation:

$$I + (J \times K) + (L \times M) + (N \times O) + P + Q = R \quad (3)$$

where

I is the estimated margin-of-error for total withdrawals for public supply (0.04),

J is the portion of withdrawals for public supply by systems that responded to the query on the number and type of connections (0.82),

K is the estimate-of-error for connection information from systems that responded to the query (zero),

L is the portion of withdrawals for public supply by systems with no commercial or industrial connections (0.05),

M is the estimate-of-error for connection information from systems with no commercial or industrial connections (zero),

N is the portion of withdrawals for public supply by systems whose connections were estimated on the basis of information from the queried public systems (0.13),

O is the estimate-of-error for connection information from systems where the number of connections was estimated on the basis of information from queried public systems (0.15),

P is the estimate-of-error for public use and conveyance loss information (0.15),

Q is the estimate-of-error for the accuracy of the distribution algorithm (0.05), and

R is the estimated margin-of-error for total deliveries from public-supply systems (0.026, or 26 percent). Because of uncertainties in the estimates, the estimated margin-of-error was rounded to 25 percent.

Domestic

For 1985, the withdrawals for self-supplied domestic users who were not on a public-supply system were calculated by (1) subtracting the population served by public-supply systems from the total county population in 1990 (U.S. Department of Commerce, 1992) and then (2) multiplying the remainder (self-supplied domestic users) by a water-use coefficient of 100 gallons per day per person for areas west of the

Cascade Range and 150 gallons per day per person for areas east of the Cascade Range. These coefficients of average daily delivery were derived by dividing the amount of water delivered by public-supply systems to domestic users by the number of persons served by the system. Domestic water usage by persons on public-supply systems was assumed to be about the same as by persons who supplied their own water.

Although the same water-use coefficients were used in 1990, a different method of estimating the number of self-supplied domestic users was employed. National Water Well Association data by county, which indicated the number of persons served by public-supply systems, the number of persons served by drilled and dug wells, and the number of persons served by other systems, were used to calculate the percentage of the population served by each source of water for each county (National Water Well Association, written commun., 1982). These percentages were then multiplied by 1990 county population data and verified against 1990 information on the number of persons served by public-supply systems.

Consumption by domestic users was estimated to be 25 percent of withdrawals. This estimate was based on information obtained from public-supply systems and represents an average annual use.

The accuracy of the domestic self-supplied water-use estimates was dependent on (1) the accuracy of the total county population, (2) the accuracy of the estimates of the population served by public-supply systems, and (3) the accuracy of the water-use coefficients. Total county population data was obtained from the 1990 Census (U.S. Department of Commerce, 1992). By using data obtained from the public-supply systems, the number of persons served by public supply was determined by multiplying the number of domestic connections by the average number of persons per household. The number of persons per household was derived from the 1990 Census data, which was assumed to be without error for purposes of this report. The water-use coefficients were determined in the same manner as public-supply deliveries to domestic users; for domestic users, the margin-of-error was about 25 percent. Therefore, estimates for water withdrawn for self-supplied domestic purposes were estimated to be within 25 percent of metered withdrawals for self-supplied domestic purposes.

Consumptive use was estimated to be within 30 percent of consumptive-use values that had been determined by using flowmeters. Combined with the margin-of-error associated with withdrawal values (25 percent), the total margin-of-error for consumptive use could have been as much as 55 percent.

Commercial

Data-collected in 1985 and in 1990 regarding the number and size of self-supplied commercial facilities was obtained from the Oregon State Health Division. The 1990 data were available in a digital format and provided more detail than the 1985 data. The following coefficients were used for some of the common commercial facilities and obtained from water-use data collected for ground-water studies (Collins and Broad, 1993) or from Wolff and others (1966):

Grade Schools ------------	5	gallons per day per student
High Schools -----------	10	gallons per day per student
Colleges (nonresident)	15	gallons per day per student
Colleges (resident)-----	75	gallons per day per student
Hospitals ---------------	300	gallons per day per bed
Nursing Homes -------	125	gallons per day per bed
Hotels--------------------	75	gallons per day per guest (assuming a 60 percent occupancy).

Consumptive use for all commercial facilities was estimated to be 20 percent of total commercial withdrawals. This estimate was obtained from information provided by public-supply systems. The method used to estimate public-supply deliveries to commercial users is described (see "Methodologies and Estimation of Error, Public Supply" section).

The largest difference between 1985 and 1990 commercial water-use estimates was the inclusion in 1990 of offstream fish hatcheries. These hatcheries generally are located near a stream; diversions of water from the stream to the hatchery are used only once to reduce the possibility of diseases to fish. Consumptive use, therefore, was estimated to be zero. Estimates of water diversions to the hatcheries were obtained from the Oregon Department of Environmental Quality (ODEQ) discharge-permit files.

The accuracy of self-supplied commercial water-use estimates depends on (1) the accuracy of the number of customers served, (2) the accuracy of the water-use coefficients, and (3) the accuracy of the fish-hatchery information. The number of customers served was provided by the commercial facility;

oftentimes, this value was the maximum number of customers that could be served. Because commercial facilities are rarely at capacity, that number was reduced on the basis of information obtained from commercial users. The estimated number of customers was not statistically analyzed but was considered to have a margin-of-error within 25 percent of the actual number of customers served. The water-use coefficients were based on water withdrawals made by facilities in the Portland area. It is unknown how well these estimates accurately predict withdrawal at other commercial facilities statewide, but applying the coefficients to 10 commercial water users in the Willamette Region (but outside of the Portland area) showed total withdrawals to be within about 25 percent of metered withdrawals. Self-supplied commercial water use for nonhatchery facilities, therefore, was estimated to have a margin-of-error of 50 percent of metered use. The total withdrawals for these nonhatchery facilities were small when compared to hatchery withdrawals. The accuracy of the hatchery withdrawals was about 10 percent of withdrawals measured with flowmeters, as most of the measurements were made with a right-angle, V-notched weir (see "Methodologies and Estimation of Error, Public Supply" section). Deliveries to commercial users from public-supply systems were estimated in a previous section to be 25 percent.

Industrial

A list of the largest industrial water users in the State was prepared by using the EPA Industrial Facilities Discharge file (a computer database of industries permitted to release wastewater), the Oregon Directory of Manufacturers (1987) and the 1982 Census of Manufactures (U.S. Department of Commerce, 1986). Selected facilities on the State list were then queried to determine the source and amount of water withdrawals and the amount returned. For those facilities that were not queried, an estimate of water withdrawals was made either by relying on previous reports by the State or the Pacific Northwest River Basins Commission or by relying on water rights and permitted or actual return-flow information obtained, respectively, from the Oregon Water Resources Department and the ODEQ. When actual return-flow values were available, an estimate of consumptive use was added to the return-flow value to estimate the withdrawal. Billing records from public-supply systems were used in conjunction with the public-supply distribution algorithm (see "Methodologies and Estimation of Error, Public Supply" section) to estimate deliveries from public-supply systems to industrial users.

Estimates of consumptive water use, obtained by querying those industries that were the large users of water, indicated that average consumptive use was about 5 percent of withdrawals. Consumptive water use for industries that were not queried usually was estimated on the basis of Standard Industrial Classification (SIC) codes (U.S. Office of Management and Budget, 1987) and SIC consumptive-use values prepared by the U.S. Department of Commerce, (1986). Average consumptive use of water by industry, estimated from SIC codes, was 8 percent.

Estimates of industrial water use had a range of accuracies. The largest industrial users of water accounted for about 60 percent of the total withdrawals made for industrial purposes and relied on flowmeters to measure withdrawals. Other facilities used flowmeters to measure the amount of water they discharged; the sum of discharge (return flow) and consumptive use is commonly equal to withdrawals. Consumptive use of water by Oregon industries generally was less than 10 percent of withdrawals; therefore, when the sum of return flow and consumptive use was used to estimate withdrawals, that estimate was considered to be within 20 percent of measured value. About 15 percent of total industrial withdrawals were estimated on the basis of return flows. Deliveries from public-supply systems represented 22 percent of the water withdrawn for industrial purposes and had a 25 percent margin-of-error when compared to deliveries measured with flowmeters. Additional estimates of water withdrawals for industrial uses were made from previous reports, water rights, or permitted discharge and represented 3 percent of the withdrawals. These withdrawals had an estimated 50 percent margin-of-error. By using the following equation, the margin-of-error for estimated total industrial water withdrawals was estimated to be about 10 percent when compared to total withdrawals measured with flowmeters, or:

$$(A \times B) + (C \times D) + (E \times F) + (G \times H) = I \quad (4)$$

where

A is the portion of withdrawals for industrial use by facilities that measured withdrawals with flowmeters (0.60),

B is the estimate-of-error for withdrawals measured with flowmeters (zero),

C is the portion of withdrawals for industrial use by facilities that estimated withdrawals on the basis of return flow (0.15),

D is the estimate-of-error for withdrawals estimated on the basis of return flow (0.20),

E is the portion of withdrawals for industrial use by facilities served by public-supply systems (0.22),

F is the estimate-of-error for the number of industries served by public-supply systems (0.25),

G is the portion of withdrawals for industrial use by facilities that estimated withdrawals by using previous reports (0.03),

H is the estimate-of-error for withdrawals estimated from previous reports (0.50), and

I is the estimated margin-of-error for total withdrawals and deliveries for industrial use (0.10, or 10 percent).

Mining

The location and status of most major mining operations in Oregon were determined by using the EPA Industrial Facilities Discharge file and information from Oregon Department of Geology and Mineral Industries, the U.S. Bureau of Mines, ODEQ, and Wiley (1991). Little water-use information for mining operations was available; consequently, indirect methods for estimating water use were developed.

Several of the larger placer-mine operations in Oregon were contacted to obtain information regarding their operations. Most of these operations were unsure of their actual water use but were able to supply information on the amount of material removed and the dimensions and angle of their sluice box. Using that information, an algorithm prepared for the Alaska Department of Natural Resources (Nebert, 1981) was employed to estimate water used for mining. These estimates were verified with the local watermaster. However, although algorithms and water-rights information were used, arriving at a precise figure for withdrawals was difficult as a result of the large percentage of recycling of water that occurs in placer-mine operations. Because much of the water was recycled, consumptive use for placer mines was estimated to be 100 percent. Water-use data for the few non-placer-mine operations were obtained from user queries, discharge permits, or water rights. Estimates of consumptive use were obtained from discussions with mining agencies and watermasters.

Little water-use information was available, but there are potentially large amounts of water recycled at placer mines; therefore, withdrawal information for mining was potentially in error by more than 100 percent of the metered withdrawal amounts. However, a comparison of 1985 withdrawal estimates with 1984 withdrawal estimates from the U.S. Bureau of Mines (Quan, 1988) showed a difference in estimates of 13 percent. The margin-of-error associated with the U.S. Bureau of Mines study is not known, but 80 percent of the mining operations in Oregon responded to the questionnaire (Quan, 1988).

Thermoelectric and Hydroelectric Power

Water-use information for thermoelectric- and hydroelectric-power generation was estimated by using a patented methodology developed by the Westinghouse Hanford Energy Development Laboratory (HEDL). The amount of water used was estimated on the basis of generating capacity, amount of power produced, and plant efficiency; hydroelectric facilities also reported head (Helen Carlson, Westinghouse Hanford Energy Development Laboratory, written commun., 1985). The power-generation data necessary to estimate water use by power plants were provided by the U.S. Department of Energy (1990). The consumptive-use data for the thermoelectric plants were determined by contacting the plants. No consumptive use was attributed to the hydroelectric plants.

When water-use estimates generated from the HEDL algorithm were compared with water-use measured at selected hydroelectric facilities, the HEDL algorithm underestimated use. A correction factor was added to the HEDL estimates that brought them to within 5 percent of the reported values.

Livestock

Water-use coefficients for various types of livestock were obtained from a U.S. Soil Conservation Service publication "Livestock Water Use" (U.S. Department of Agriculture, 1975). In addition, coefficients for evaporative losses from stockwater ponds, dairy sanitation, cleaning and waste disposal, cooling, water losses (overflow and refill watering) and processing also were obtained from this publication.

These coefficients were multiplied by the number of livestock to obtain an estimate of use. Livestock-population data were obtained from Commodity Data Sheets of the Extension Information Office at Oregon State University (Oregon State University Extension Service, 1985h–l, 1990f–k). Consumptive use for livestock was estimated to be 100 percent, as much of the wastewater went to holding ponds where it was evaporated or used for irrigation. The amount of wastewater consumed in irrigation is accounted for in the irrigation category.

Information on fur-production commodities, specifically mink farms, was not available from the Natural Resources Conservation Service (formerly the U.S. Soil Conservation Service) or from Oregon State University. Estimates for use were obtained by multiplying the number of mink farms (obtained from the U.S. Census of Agriculture [U.S. Department of Commerce, 1984]) by a coefficient of use determined from visits to mink farms.

Livestock-population data for this category is only collected at the county level; therefore, in order to estimate water use at the hydrologic-unit level, the livestock-population data had to be subdivided. For this subdivision, it was assumed that the distribution of livestock in Oregon roughly coincided with the distribution of agricultural lands. Land-use maps prepared by Oregon Water Resources Department (1978a–d, 1979a–i, 1980a–c) show the distribution of agricultural lands by basin; these distributions were used to determine the proportion of agricultural lands in a county within a particular basin. For 1990, water-rights information also was used to subdivide the livestock-population data.

To estimate data error for livestock is difficult, as no estimation of accuracy was provided with the water-use coefficients or the livestock-population data. Livestock-population data were obtained from county agricultural extension agents. Because agents were familiar with the agricultural characteristics of their county, the margin-of-error associated with the livestock-population data was assumed to be less than 5 percent of the actual value. The water-use coefficients ranged from 1 to 10 gallons per day per animal. Because the range is fairly small, the likelihood that a particular coefficient is in error by more than 20 percent of the actual value is doubtful. Therefore, the estimated margin-of-error for total withdrawals was estimated to be within 25 percent of metered withdrawals.

Irrigation

Water-use estimates for irrigation in Oregon were derived from a variety of sources. The Bureau of Reclamation (BOR) has projects that supply approximately 23 percent of irrigated lands in Oregon and maintains records of water use for each project. However, this type of information was not available for privately irrigated lands and had to be obtained from previous studies for which water-use data were collected or from indirect methods.

The BOR collects data on the amount of irrigated acreage, withdrawals, and conveyance losses in its project areas (Bureau of Reclamation, undated). These data are obtained from measurements and estimates made either by the BOR or by the local irrigation district. In 1987, the Oregon Water Resources Department conducted a survey of irrigation districts (many of which are in BOR projects) and requested information on withdrawals and conveyance losses. Some of the results of this survey, specifically the amount of canal (conveyance) loss, were used in this report.

Additional irrigation water-use information was available from hydrologic studies done in parts of Oregon. Some of these studies included Leonard and Harris (1973), Frank and Laenen (1976), Grady (1983), Leonard and Collins (1983), Collins (1987), Goodell (1988), Morgan (1988), Gannett (1990), McFarland and Ryals (1991), and Collins and Broad (1993). The data from these reports were used to make irrigation water-use estimates.

For those areas where information regarding irrigation water use was not available, water-use estimates were derived from crop-water need, crop acreage, and irrigation-application efficiencies. Crop-water need for 1985 was derived by using the U.S. Soil Conservation Service Blaney-Criddle Method; for 1990, the United Nations Food and Agriculture Organization modification of the Blaney-Criddle Method was used. These formulas determine crop-water need on the basis of such factors as the mean monthly air temperature, the monthly percentage of daylight hours for a given latitude, the length of the growing season, and the growth stage of the crop (U.S. Department of Agriculture, 1964; Cuenca, 1992). In addition, the United Nations Food and Agriculture Organization formula uses additional parameters of minimum relative humidity, ratio of actual to maximum possible sunshine hours, and daytime wind speed (Cuenca, 1992). To calculate crop-water need for 1985, climatic data was input into a

BOR Blaney-Criddle formula; for 1990, the 60 or 70 percent probability tables from Cuenca (1992) were used for most of the State. It should be noted that several assumptions were made when using the Blaney-Criddle formula to estimate use, including (1) that irrigators made the most efficient use of their water, so that the crop was not overwatered or underwatered and (2) that the crop was not limited in any other way, such as by pests or poor soils.

Irrigated acreage by crop type for 1985 was determined for each county by using a combination of the 1982 Census of Agriculture (U.S. Department of Commerce, 1984) and 1984 and 1985 Commodity Data Sheets obtained from Oregon State University Extension Service (1985a–g, 1986a–g). For 1990, this information was obtained from the 1987 Census of Agriculture (U.S. Department of Commerce, 1989), Oregon State University Extension Service (1990a–e, 1991a–l), and U.S. Department of Agriculture (undated) data.

Information on the methods of irrigation application were examined to determine application efficiencies. The Extension Information Office of Oregon State University (Stan Miles, written commun., 1984 and 1988) provided data on the number of acres in each county irrigated by sprinkler or by gravity (flood) for 1984 and 1988. The percentage of irrigated acreage that was irrigated by sprinkler or by gravity in 1984 and 1988 was applied to 1985 and 1990 irrigated-acreage values to estimate irrigated acreage by application type. Application efficiencies for the different methods of application were obtained from a U.S. Department of Energy publication (King and others, 1978). These efficiencies were added to the irrigation crop algorithm, and are as follows:

	Application Efficiency	
Application Type	West of the Cascade Range	East of the Cascade Range
Center Pivot	87 percent	82 percent
Big Gun	74 percent	67 percent
Drip	90 percent	85 percent
Other sprinkler	75 percent	65 percent
Gravity (flood)	45 percent	45 percent

As an example, irrigation-water use for corn in a humid county would be calculated as follows, assuming all corn is irrigated with big gun sprinklers:

$$\text{water withdrawals} = [(\text{number of irrigated acres of corn}) \times (\text{crop-water need for given year})] / \text{application efficiency of a big gun sprinkler.} \quad (5)$$

Consumptive use was calculated as the irrigated crop acreage multiplied by the crop-water need (from Blaney-Criddle); thus, it was assumed that water lost through application was not consumed, and returned to surface or ground water. Conveyance losses were estimated on the basis of ditch efficiencies, obtained from the watermaster or irrigation district, and the acreage irrigated by gravity (flood) from ditches. Information on the use of reclaimed-sewage for irrigation was obtained from the ODEQ permit-compliance files (see "Methodologies and Estimation of Error, Wastewater Treatment" section).

Irrigated-acreage data and application-type data were collected at the county level. In order to subdivide this data so that it could be used to estimate irrigation water use by hydrologic unit, Oregon Water Resources Department land-use maps (1978a–d, 1979a–i, 1980a–c) were used in 1985. These maps show the distribution of irrigated lands by basin and were used to apportion county irrigation data into hydrologic units on the basis of the amount of irrigated land in a county within a particular basin. For 1990, water-rights information was used to distribute irrigated lands in a county to a basin as a percentage. This method derived these percentages on the assumption that all rights in a county were active. Thus, if water rights for a county showed 400 irrigated acres of land in one basin and 600 acres of irrigated lands in a second basin, when crop statistics showed only 500 acres (50 percent) of land irrigated in that county for that year, 200 acres would nevertheless be assigned to one basin (400 × 50 percent) and 300 acres to the other basin.

The distribution of ground water and surface water used for irrigation in 1990 was estimated in a manner similar to that for the distribution of irrigated lands to a basin—by using water-rights information. The percentages of surface- and ground-water rights for a county, or derived for a basin, were applied to the estimated total irrigation withdrawals. Thus, if 70 percent of the irrigation water rights for a county or basin was for surface water, the total irrigation withdrawals were multiplied by 70 percent. Water-rights data were not as readily available for 1985, so the percentage of ground water and of surface water used for irrigation was estimated on the basis of conversations with local watermasters.

After the 1990 irrigation data for this report were collected, some coding problems in the water-rights database were discovered that caused a few surface-water rights in some basins to be coded twice. Thus, surface-water withdrawals may be overestimated and ground-water withdrawals may be underestimated, for certain regions.

Irrigation-water-use data had varying degrees of accuracy, depending on the information source. About 55 percent of the withdrawal information from the BOR was obtained by using in-line flowmeters, weirs, or flumes; it was estimated, for this report, that this information was accurate to within 10 percent of withdrawals measured entirely with flowmeters. The remaining withdrawals for the BOR projects were estimated by project managers; no statistical sampling was done on these estimates, but it was assumed that the estimates were within 35 percent of measured withdrawals. Many irrigation districts also measured their withdrawals, usually with weirs; the accuracy of these measurements varied, but was assumed to be within 25 percent of withdrawals measured with flowmeters, because the weirs were not always calibrated. BOR projects accounted for about 30 percent of the irrigation withdrawals in Oregon; irrigation districts accounted for about 8 percent. Information on about 5 percent of the irrigation withdrawals was obtained from the hydrologic studies previously mentioned in this section; the average reported margin-of-error of the withdrawal information in these studies was about 35 percent of withdrawals measured entirely with flowmeters.

Irrigation withdrawal estimates derived from Blaney-Criddle formula had a margin-of-error of 55 percent compared with metered withdrawals and accounted for 57 percent of the total irrigation withdrawals. Irrigated-crop-acreage data was obtained from county agricultural extension agents and the U.S. Census Bureau; the accuracy of this information is not known, but it was estimated for this report to be within 15 percent of the actual values. The accuracy of the crop-water-need coefficients was difficult to determine. Numerous parameters were used to calculate crop-water need, and no estimation of error was given by Cuenca (1992). It was estimated, therefore, that the margin-of-error for crop-water need was 25 percent of the actual value—recognizing that simultaneous errors may be introduced in the development of the crop coefficient and in the selection of the proper coefficient used to depict the climatic conditions and the irrigation practices of the farmer. Application efficiencies or losses had a margin-of-error within about 15 percent of the actual application efficiency, depending on whether the sprinkler system had a low or high efficiency (Cuenca, 1992).

The following equation combines the margins-of-error for irrigation estimates derived from the Blaney-Criddle Method with estimates of margins-of-error for data from the BOR, irrigation districts, and other reports and results in a 40 percent margin-of-error for estimates of irrigation withdrawals, compared to metered withdrawals:

$$[A \times ((B \times C) + (D \times E))] + (F \times G) + (H \times I) + (J \times (K + L + M) = N \qquad (6)$$

where

A is the portion of total withdrawals for irrigation by BOR projects (0.30);

B is the portion of total withdrawals for irrigation in BOR projects measured with flowmeters, weirs, or flumes (0.55);

C is the estimate-of-error for measurements made with flowmeters, weirs, or flumes in BOR projects (0.10);

D is the portion of total withdrawals for irrigation in BOR projects estimated by project managers (0.45);

E is the estimate-of-error for withdrawal estimates made by BOR project managers (0.35);

F is the portion of total withdrawals for irrigation in irrigation districts (0.08);

G is the estimate-of-error for withdrawals made in irrigation districts (0.25);

H is the portion of total withdrawals for irrigation obtained from other hydrologic studies (0.05);

I is the average estimate-of-error reported in the other hydrologic studies (0.35);

J is the portion of total withdrawals for irrigation calculated by using the Blaney-Criddle Method (0.57);

K is the estimate-of-error for the irrigated crop-acreage data (0.15);

L is the estimate-of-error for the crop-water need values (0.25);

M is the estimate-of-error for the application efficiencies (0.10); and

N is the estimated margin-of-error for total irrigation withdrawals (0.40).

The estimated margin-of-error for consumptive use was about 40 percent. This estimate was calculated as the sum of the margins-of-error for irrigated-crop acreage (*K* in the preceding equation) and crop-water need (*L*). Conveyance losses were rarely measured, and there was no statistical sampling of the estimates. For this report, estimated conveyance losses were considered to be within 50 percent of measured conveyance losses.

Reservoir Evaporation

Estimates of reservoir evaporation were obtained by merging a Geographic Information System (GIS) coverage containing the location and surface area of reservoirs with another coverage containing free-water-surface lines of equal evaporation. The location and surface area of reservoirs in Oregon were obtained from a report on reservoirs in the United States and Puerto Rico that have a normal capacity of at least 5,000 acre-feet or a maximum capacity of at least 25,000 acre-feet (Ruddy and Hitt, 1990). Sixty-eight reservoirs in Oregon, ranging in size from 5,600 to 1,350,000 acre-feet of normal capacity, met these criteria. Most of the surface areas listed in the Ruddy and Hitt report generally are for normal capacity, but some are for a maximum capacity or for an unknown stage. Consequently, average surface-area values for 1990 were obtained from reservoir operators for the larger reservoirs. The coverage of free-water-surface lines of equal evaporation was digitized from a map in a National Oceanic Atmospheric Administration (NOAA) technical report (Farnsworth and others, 1982). To calculate the evaporation for a given reservoir, the reservoir was assigned the value of the closest line of equal evaporation and multiplied by the surface area.

Only evaporation from manmade reservoirs was calculated for the Reservoir Evaporation category. Thus, in instances where natural water bodies have been altered to improve the amount of storage, adjustments were made to surface-area values on the basis of the shoal area of the lake (Johnson and others, 1985).

Surface-area data obtained from reservoir operators were assumed to have no margin-of-error. For natural water bodies that had adjusted surface-area values, a factor of about one-third of the total surface area was used. These adjusted surface areas were assumed to be within 25 percent of the actual value. A specific value for data accuracy is not presented in the NOAA report (Farnsworth and others, 1982); however, much of the data presented in the report is estimated from correlations between pan evaporation and elevation. Depending on the terrain, correlation coefficients ranged from 1 to 27 percent, with the flatter terrain having smaller coefficients. Because much of Oregon is mountainous, it was estimated that the accuracy of the NOAA data for Oregon has a margin-of-error that is within 25 percent of the actual evaporation value. It was estimated, therefore, that the overall accuracy of reservoir evaporation data was within 35 percent from:

$$A + (B \times C) + D = E \qquad (7)$$

where

- A is the estimate-of-error for reported reservoir areas (zero),
- B is the portion of total surface area for reservoirs with adjusted surface areas (0.33),
- C is the estimate-of-error for surface areas calculated for reservoirs with adjusted surface areas (0.25),
- D is the estimate-of-error for the coefficient of evaporation (0.25), and
- E is the estimated margin-of-error for total evaporation from manmade reservoirs (0.33, rounded to 0.35).

An evaporation study of Warm Springs Reservoir, on the Malheur and Harney County line, used a mass-transfer water budget method and found that reservoir evaporation was two to four times greater than estimates based on pan evaporation (Harris, 1968); however, possible inaccuracies in the calculation of the water budget made the results of the study uncertain, illustrating the difficulty associated with estimating reservoir evaporation.

Wastewater Treatment

The amount of water discharged from public wastewater-treatment facilities was obtained from the permit compliance files of ODEQ. These files contained daily discharges for the major public wastewater-treatment facilities in Oregon. Those discharges not on file with ODEQ were estimated on the basis of water withdrawals by facilities served by the treatment plant and by wastewater-plant capacities obtained from the EPA Industrial Facilities Discharge file.

The number of public wastewater-treatment facilities in Oregon was obtained from ODEQ; the number of industrial and other wastewater facilities was estimated on the basis of ODEQ information. The amount of reclaimed sewage for industrial and irrigation purposes also was obtained from ODEQ.

The accuracy of the wastewater-discharge information was estimated to be within 15 percent of discharge measured entirely with flowmeters. Almost all of the wastewater discharge was measured with a flowmeter, weir, or flume as it was released to, or returned from, the wastewater-treatment facility. The margin-of-error estimated was based on (1) the average accuracy for weirs and flumes used in this report (10 percent) and (2) any losses at the wastewater-treatment facility, where the measurement was made as the wastewater arrived.

HYDROLOGIC AND CLIMATIC CONDITIONS IN REGIONS OF OREGON

Most of Oregon's water supply comes from precipitation, primarily as rain or snow. On a statewide basis, approximately 27 inches of precipitation falls on Oregon annually (Phillips and others, 1965); however, the influences of atmospheric circulation and topography cause the distribution of the annual precipitation to range from less than 10 inches to more than 200 inches (George H. Taylor, Oregon State Climatologist, written commun., 1992).

During the winter, storm centers develop in the Pacific Ocean where warm tropical air meets cold polar air. Prevailing westerly winds bring these storms onshore at about the same latitude as Oregon. Where these storms meet the north-south trending Coast and Cascade Ranges (fig. 1), the air is forced upslope, where it cools and condenses. As a result, the western slopes of the mountains receive large amounts of precipitation. After passing over the Coast and Cascade Ranges, these air masses have lost a large part of their moisture. As a result, central and eastern Oregon have a continental climate with greater temperature extremes and less precipitation.

During the summer, the storm centers in the Pacific Ocean are forced northward, resulting in dryer conditions in the western part of Oregon. About 80 percent of the precipitation west of the Cascade Range (often referred to as western Oregon) falls during the winter. Such a large discrepancy between winter and summer precipitation does not exist east of the Cascade Range because of the smaller amounts of winter precipitation and frequent convectional storms during the summer.

Coast

Owing to maritime influences, the climate in the Coast Region (fig. 4) is wet and mild. Monthly mean temperatures range from 43 to 61 degrees Fahrenheit (°F). Frost-free days along the Oregon Coast Range from about 180 days in the north to 275 days in the south; this period of time decreases inland in the mountains of the Coast Range, from 140 to 188 days. Precipitation ranges from 50 inches along the Oregon coast to more than 200 inches at the crest of the Coast Range, and 80 percent of this precipitation falls between October and March. Snowfall occurs only in the higher elevations and melts within a short period.

The small, forested basins of the Coast Region are underlain by marine sediments and volcanic rocks of low porosity and permeability. This fact, coupled with the lack of snowpack, results in little natural storage of winter precipitation. As a result, peak stream discharges occur between December and February, the rainiest months. The virtual lack of natural storage results in low flows during the summer months.

In some areas of the Oregon coast, windblown sand accumulates into large dunes. The dunes have blocked several small coastal streams, causing natural lakes to form. Additionally, the permeable sands are a source of ground water (Phillips and others, 1965).

Willamette

Even though the Coast Range blocks some of the moisture moving onshore, the Willamette Region (fig. 5) is still influenced by a maritime climate. Monthly mean temperatures range from 40 to 67°F on the valley floor and from 33 to 63°F in the foothills and mountains. Frost-free days average from 170 to 280 days. Precipitation ranges from 37 inches on the valley floor, to 73 inches in the foothills, to more than 160 inches near the crest of the Cascade Range. Only 2 percent of the Willamette Region's annual precipitation falls during July and August.

Streams in the Willamette Region have differing flow characteristics, depending upon their origin.

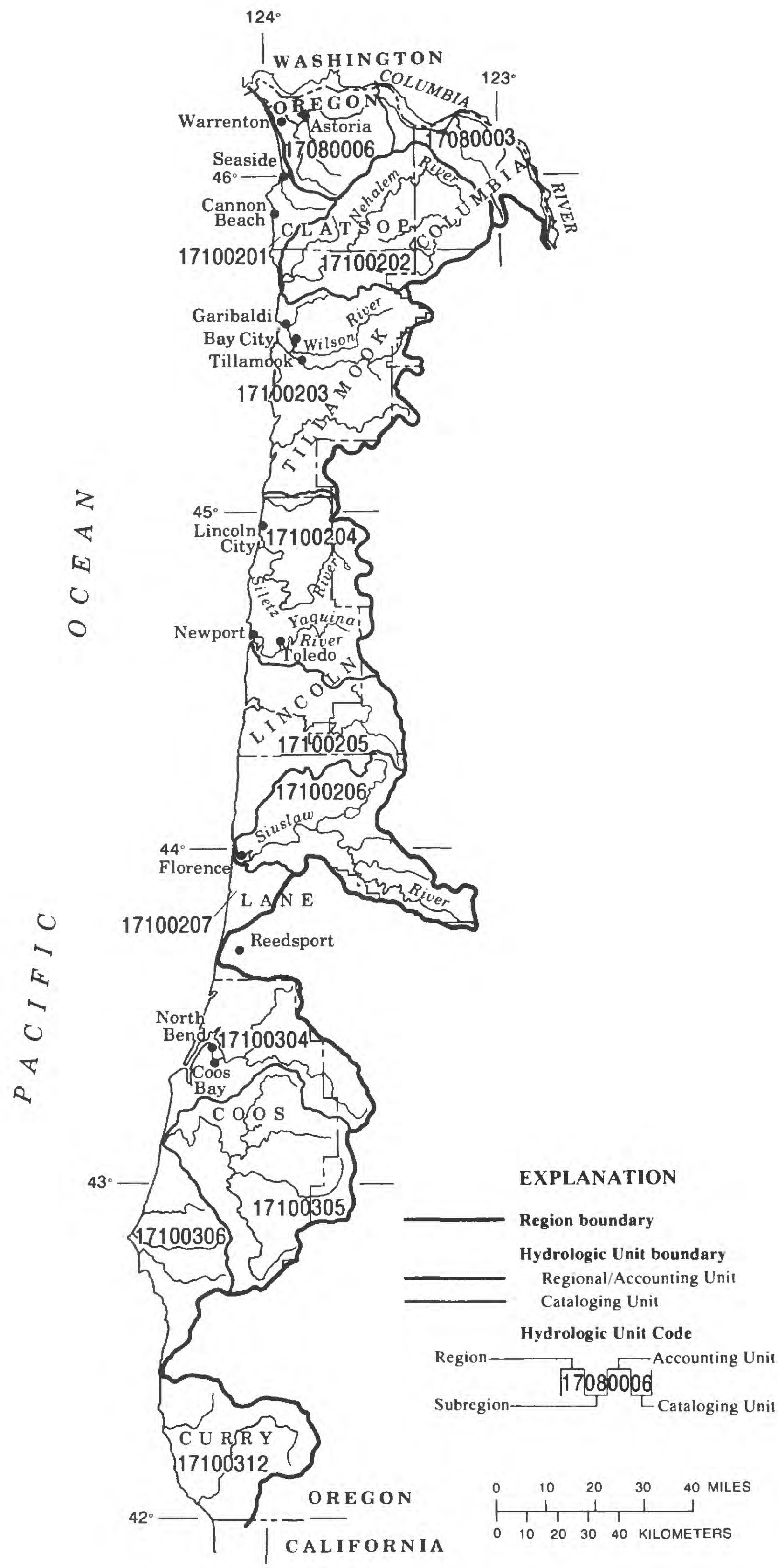

Figure 4. Coast Region and location of hydrologic units within the region.

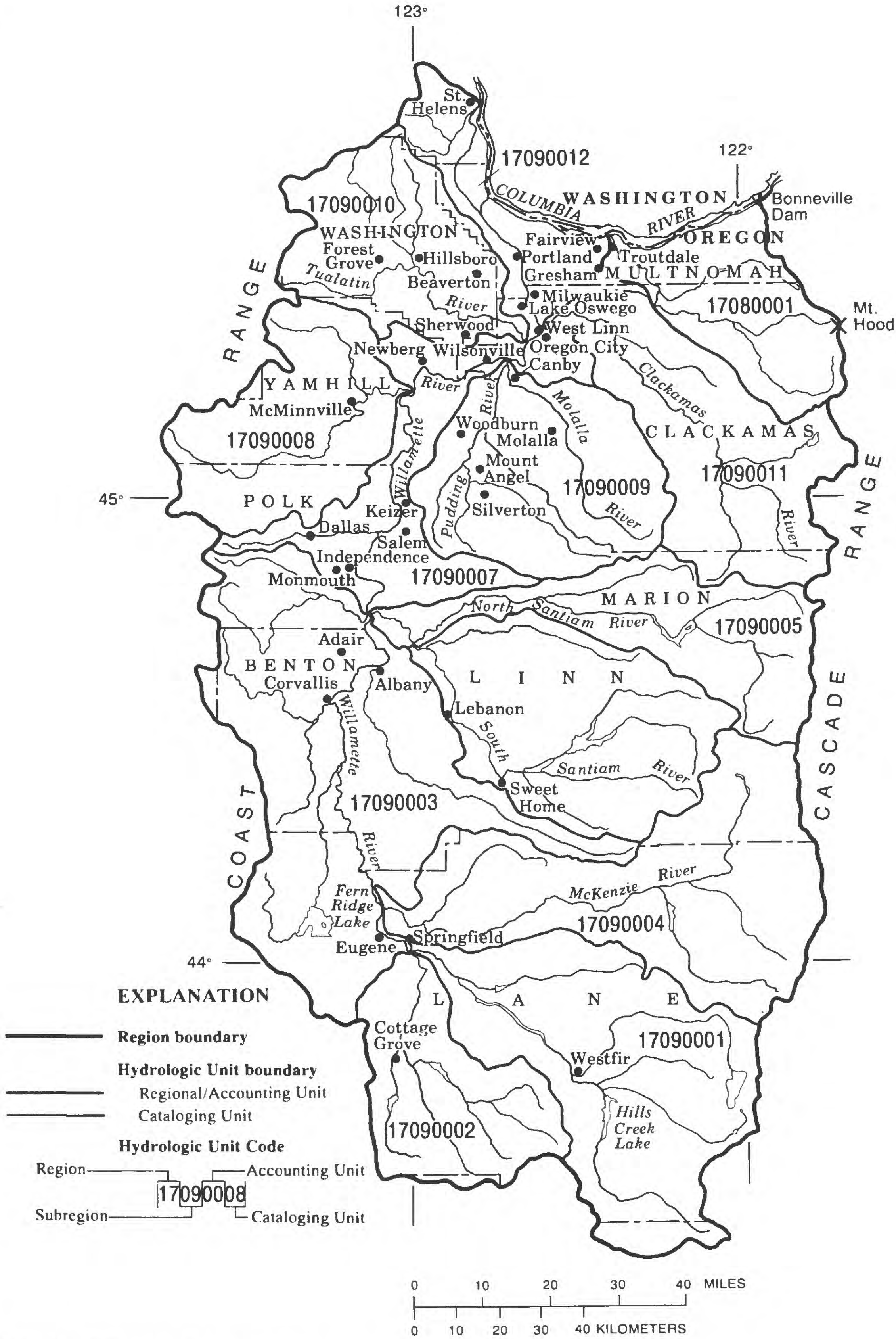

Figure 5. Willamette Region and location of hydrologic units within the region.

Streams that originate in the Coast Range are similar to coastal streams flowing to the Pacific Ocean; peak flows occur during the winter and little of the flow is from ground water. The flows from the Cascade Range, however, are considerably different. The average elevation of the Cascade Range is about 5,000 feet; consequently, much of the precipitation falls as snow. In addition, these mountains consist primarily of permeable, fragmented volcanic rock; thus, much of the flow in these streams is from snowmelt and ground water.

Ground-water supplies in the Willamette Region are available from the permeable sands and gravels beneath the terraces and bottomlands along the Willamette River. In some instances, problems have arisen from the pumpage of ground water when saline water within marine sediments infiltrated the overlying sediments (Phillips and others, 1965; McFarland, 1983).

Southwest

The Southwest Region, composed of the Rogue and Umpqua River Basins (fig. 6), also is influenced by a maritime climate. Because the Southwest Region is farther south, however, the maritime influences are slightly moderated; mean monthly temperature ranges are higher (from 38 to 70°F), and as little as 20 inches of precipitation falls in parts of the region. Despite the drier climate, the crest of the Cascade Range in this region still receives greater than 100 inches of precipitation. Frost-free days range from 102 to 220 days.

The upper parts of the Rogue and Umpqua River Basins in the Southwest Region consist of permeable volcanic rocks similar to those on the eastern side of the Willamette Region, whereas lower parts of these basins and the South Umpqua River Basin consist of materials of low permeability and limited ground-water storage, similar to the Coast Region. Minor amounts of ground water are available in areas along the Rogue and Umpqua Rivers. The marine bedrock that underlies parts of the Rogue and Umpqua River Valleys contains small amounts of saline ground water (Phillips and others, 1965; McFarland, 1983).

South-Central

The South-Central Region is composed of the Klamath River Basin (hydrologic unit code [HUC] 1801000) and the Oregon Closed Basins (HUC 17120000) (fig. 7). The region has an average elevation of between 4,000 and 5,000 feet. Most of the water of the Klamath River Basin drains into Upper Klamath Lake, which in turn discharges to the Klamath River. Waters of the Oregon Closed Basins do not drain to the ocean, but rather drain to landlocked lakes. South-central Oregon is east of the Cascade Range and has a continental-type climate with warm summers and cool, dry winters. The mean monthly temperatures range from 25 to 70°F, and frost-free days range from 75 to 130 days. Average annual precipitation ranges from about 10 to 20 inches on the valley floors to more than 60 inches near the crest of the Cascade Range. Most precipitation falls as snow in the mountains, but about 25 percent falls during the summer months as rain from convectional storms.

The major source of streamflow is snowmelt; thus, most of the runoff in the South-Central Region occurs from April to June. Runoff in the Klamath River Basin is supplemented by numerous seeps and springs fed by the snowfall percolating into the permeable uplands in the Cascade Range. Owing to the less permeable materials and smaller amounts of precipitation in the uplands, the amount of runoff supplemented by ground water in the Oregon Closed Basins is less than in the Klamath River Basin. However, most areas of the Oregon Closed Basins contain large amounts of ground water, which is commonly the sole source of water supply (Phillips and others, 1965).

Much of the surface-water flow in both basins is dissipated by evaporation and transpiration. Because of its flat valley floors, many of the streams in the Klamath River Basin grade into lakes and marshes, increasing the potential for evaporation. The landlocked lakes of the Oregon Closed Basins also are subject to high levels of evaporation, which increases the alkalinity of these lakes to a point that they are no longer a source of potable water.

North-Central

The North-Central Region consists of the Umatilla, John Day, Deschutes, and Hood River Basins, all of which flow into the Columbia River (fig. 8). Most of this region, like the rest of the regions east of the Cascade Range, is influenced by a continental climate. The one exception to this is the Hood River Basin; there, the Columbia River Gorge provides a passageway for maritime air to infiltrate eastward without being blocked by the Cascade Range.

Figure 6. Southwest Region and location of hydrologic units within the region.

Average monthly low temperatures range from about 25°F in the eastern part of the North-Central Region to 30°F in the western part. Maximum average monthly temperature for the region is about 70°F. Frost-free days range from 60 to 85 days in the west and from 110 to 185 days elsewhere.

Precipitation in the North-Central Region is generally from 10 to more than 100 inches along the crest of the Cascade Range. Most precipitation falls as snow; however, cloudbursts from summer convectional storms also bring large amounts of rain in short periods of time. July through September tend to be the driest months.

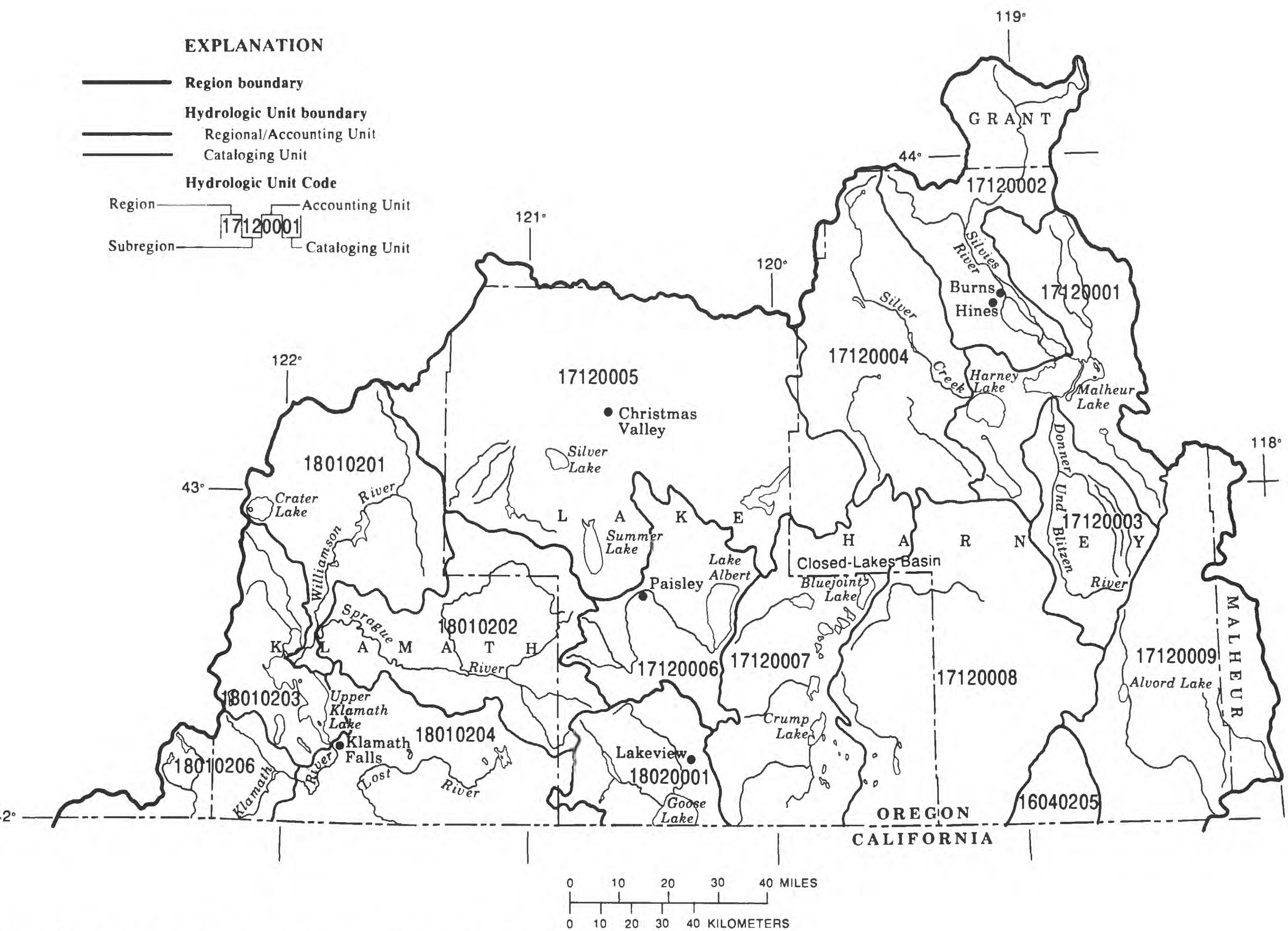

Figure 7. South-Central Region and location of hydrologic units within the region.

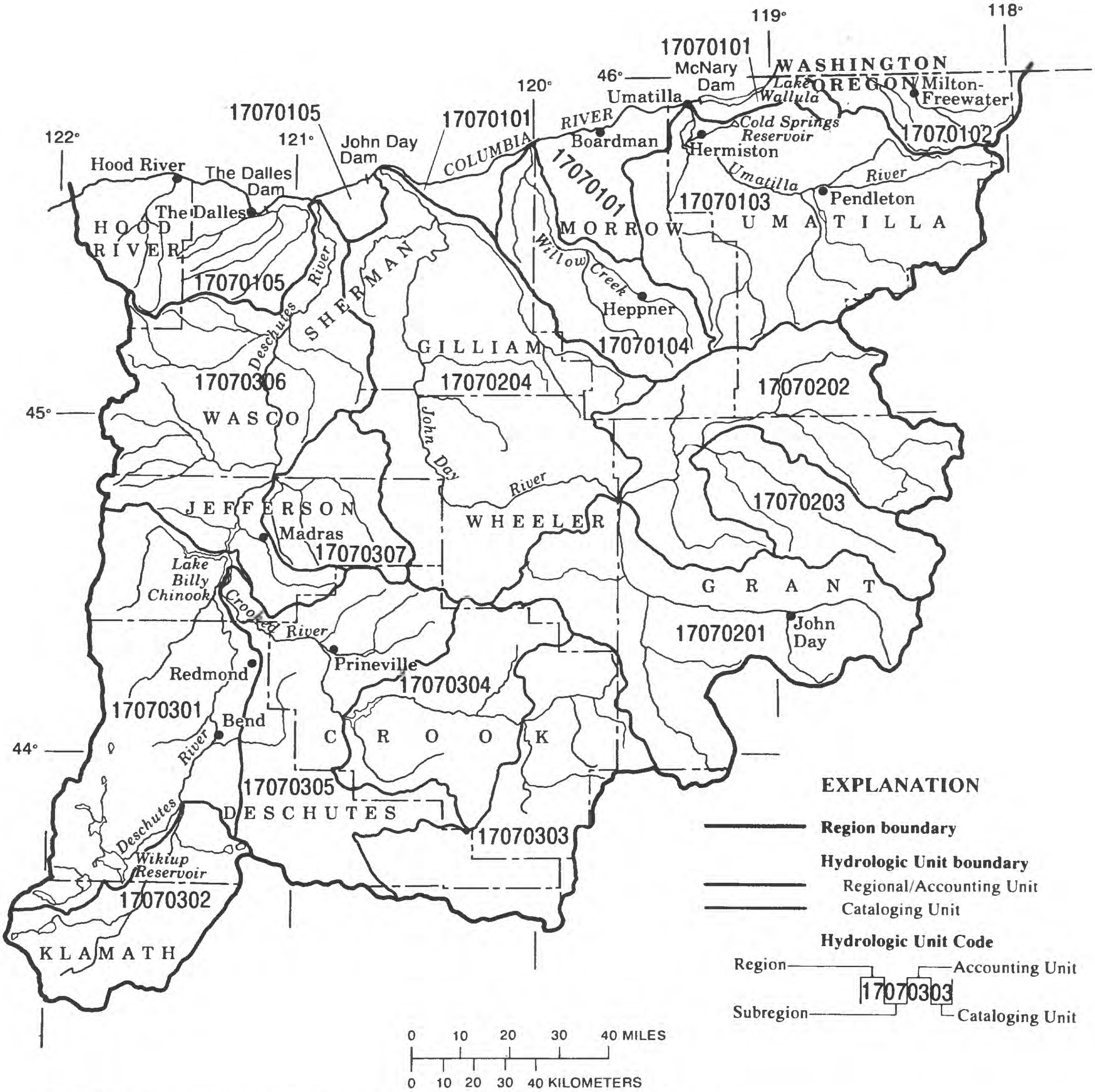

Figure 8. North-Central Region and location of hydrologic units within the region.

The major source of streamflow in the North-Central Region is snowmelt from the Cascade Range and the Blue Mountains, so runoff is generally greatest during April and May. Springs also provide base flow to streams in parts of the region. The largest input to streams from seepage occurs in the Deschutes River Basin and, to a lesser extent, in the Hood River Basin, where porous volcanic soils and rocks absorb a large amount of snowmelt flowing from the Cascade Range. Seepage from these materials makes the seasonal flow of the Deschutes River uniform. Low flow in the Deschutes River is approximately 20 times that of the John Day River, even though the drainage area for the Deschutes River is only 38 percent larger (Phillips and others, 1965).

Moderate to large amounts of ground water are available in the eastern part of the North-Central Region from basalts and alluvium and in the western part from volcanic rocks recharged in headwater regions along the Cascade Range. Only small amounts of ground water are available in the John Day River Basin. Overdrafts of water from the basalts west of Hermiston and near The Dalles have brought about State-imposed restrictions on ground-water withdrawals in those areas.

Southeast

The Southeast Region, composed of the Owyhee and Malheur River Basins (fig. 9), is the most arid part of the State; average annual precipitation ranges from 6 to 10 inches. The continental climate that influences this region brings cold winters and warm, dry summers. Monthly mean temperatures are about 25 to 30°F for lows, and about 70°F for highs. Frost-free days average around 120 to 140 days.

Snowmelt is the primary source of runoff in the Southeast Region; however, the amount of snowfall is small, resulting in a small amount of runoff that peaks in April. Deep ground-water levels and the lack of springs cause many streams in the area to be ephemeral (Phillips and others, 1965).

Much of the area where ground water is used consists of permeable volcanic rocks overlain in the valley floors by alluvium. Wells drilled into these alluvial materials yield adequate amounts of water for domestic use and, in some cases, yield adequate amounts for municipal and irrigation use (Gonthier, 1985). Over-pumping of ground water in a small area northwest of Ontario has brought about restrictions on withdrawals from the aquifer. Also, concerns recently have been raised regarding pesticides and nitrates in the shallow ground water in the lower Malheur and Owyhee River Basins.

Northeast

This diverse Northeast Region contains the Burnt, Powder, and Grande Ronde River Basins, which, like the Owyhee and Malheur River Basins, drain into the Snake River (fig. 10). This region is influenced by a continental climate; however, the presence of mountains in the northern part of the region results in differing hydrologic regimes between the northern and southern parts of the region. These mountains, with peaks above 9,500 feet, intercept moisture-laden air as do the Coast and Cascade Ranges.

Monthly mean low temperatures in the Northeast Region are about the same as in the Southeast Region (25 to 30°F), but the monthly mean high temperatures are about 5°F cooler (65°F). Frost-free days average around 120 to 140 days, but may be as few as 36 days in mountainous areas. Average annual precipitation ranges from 10 to 20 inches along the Grande Ronde River to more than 80 inches in the northeastern mountains.

Precipitation in the mountains falls mostly as snow; consequently, peak flows occur between April and June. Flows of rivers also are supplemented by springs. Runoff in the Grande Ronde River Basin in the Northeast Region is about 10 times greater than runoff in the Owyhee River Basin in the Southeast Region, even though the Owyhee River Basin is almost 3 times larger (Phillips and others, 1965).

Hydrologic Conditions in 1985 and 1990

Climatic conditions have an effect on water use. Therefore, it is useful to define climatic conditions that existed during the periods of study and compare them to normal conditions. The normal climatic conditions were determined on the basis of a 30-year period of record from 1951 to 1980. The information contained in this section was obtained from the Climatological Data for Oregon prepared by the U.S. National Oceanic and Atmospheric Administration (1985, 1990), and special weather summaries (Kelly Redmond, Oregon State Climatologist, written commun., 1985; George H. Taylor, Oregon State Climatologist, written commun., 1990).

Water availability during 1985 and 1990 was below normal (Alexander and others, 1987; Hubbard, Herrett, and others, 1991). For 1985, early precipitation was followed by dry, hot weather throughout the spring and summer. During 1990, significant amounts of precipitation did not fall across Oregon until the middle of spring, then lasted through the beginning of summer. A more detailed analysis of the hydrologic conditions is presented in the remainder of this section.

1985

Cool and wet weather in the fall of 1984 resulted in a heavy snowpack in the mountains of Oregon at the beginning of 1985. October and November temperatures were as much as 11 percent below normal, and precipitation amounts for the period were as much as 150 percent greater than normal. Beginning in December, and continuing through April, little additional precipitation fell. Most of the snowpack was maintained, however, by the presence of cooler-than-normal air temperatures. With the arrival of warm temperatures in April, the snowpack melted rapidly at all but the highest elevations. The storage reservoirs for irrigation and flood control averaged 96 percent and 84 percent of usable storage, respectively.

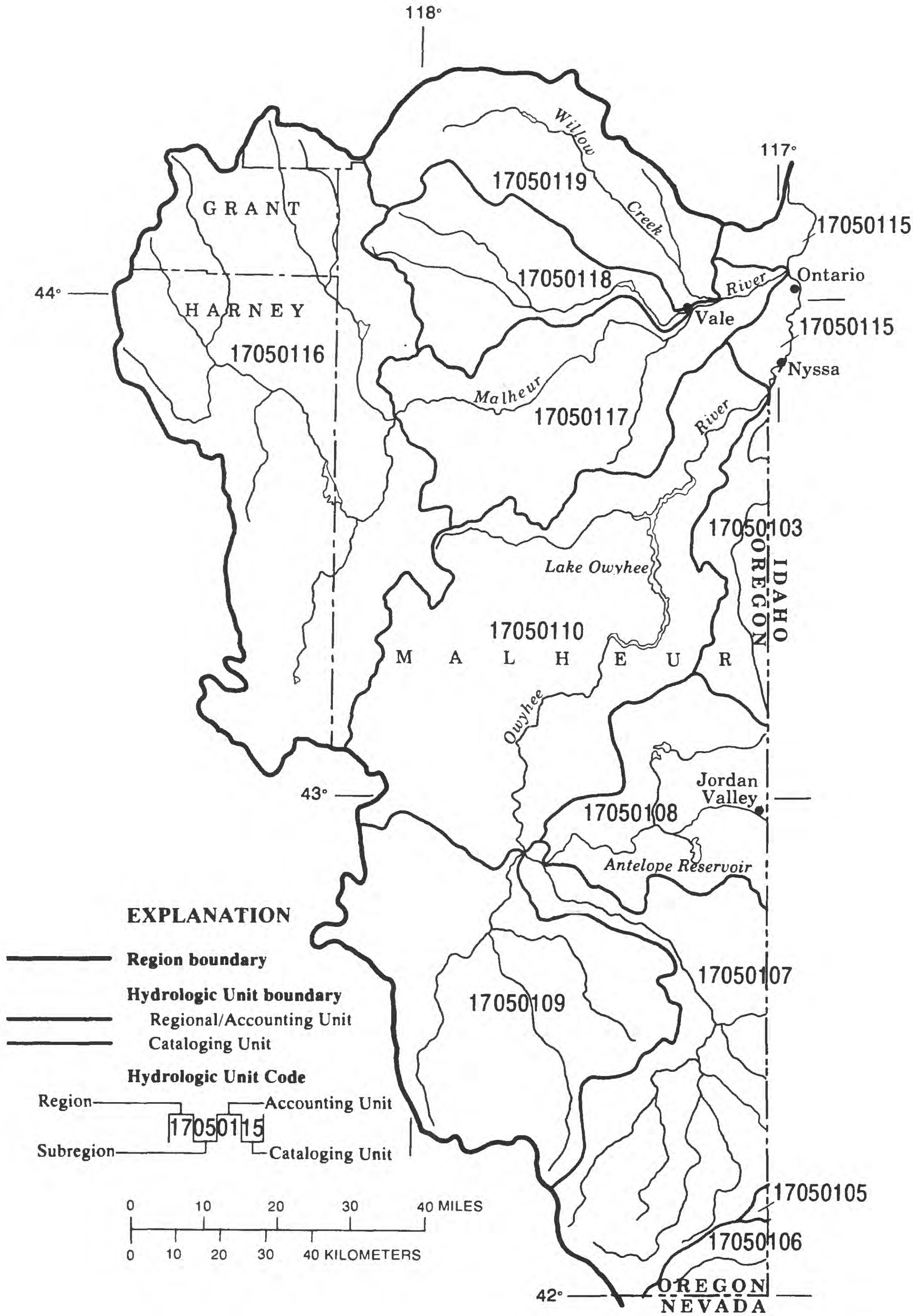

Figure 9. Southeast Region and location of hydrologic units within the region.

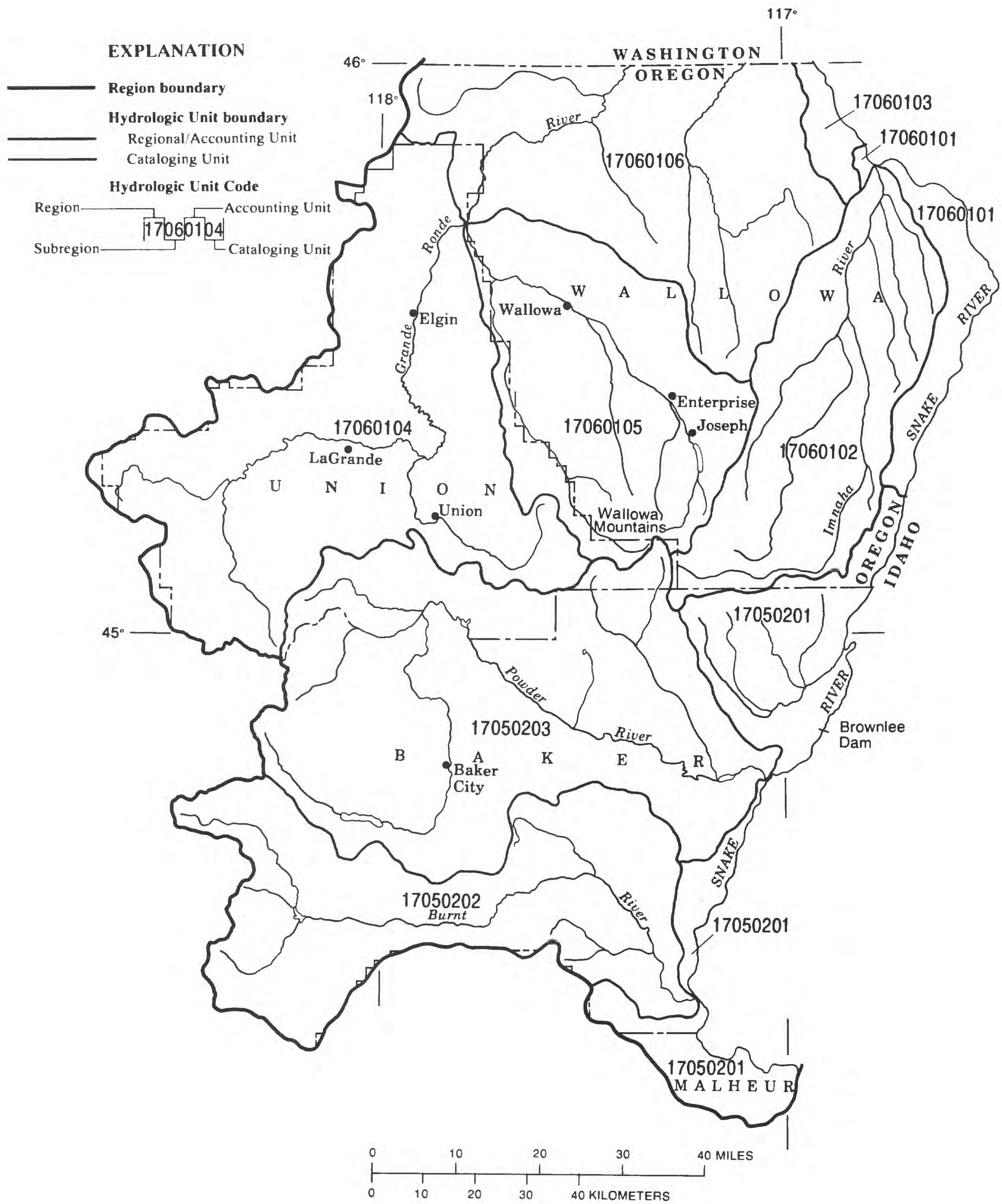

Figure 10. Northeast Region and location of hydrologic units within the region.

Owing to brief, heavy showers during the first part of the month, June was the first month in 1985 in which the regional precipitation averages were above normal. Afterwards, however, hot, dry weather set in for the rest of June and almost all of July. Temperatures were above normal throughout Oregon, except for a few locations along the coast. July was one of the hottest months on record at several locations. For more than 50 consecutive days no rain fell at Pendleton, Klamath Falls, Medford, Eugene, Corvallis, and Portland. The warm temperatures and low humidities resulted in some of the highest pan evaporation readings for July on record.

Scattered, heavy showers fell at the end of July and at the first part of August, but dry conditions continued throughout most of Oregon. For most areas, the first 8 months of 1985 were at or near the minimum precipitation for the period of record.

September brought cooler and wetter weather to Oregon, when average regional temperatures were 3 to 11 percent below normal and precipitation was 33 to 173 percent above normal. Even with an extremely wet September and a wet November, 1984, the water year (October 1, 1984 to September 30, 1985) was one of the driest on record. Only 10 to 30 percent of the water years (depending on location) were drier than 1985 in the Coast Region, and only 25 percent of the water years were drier in the northern part of the Willamette Region. In the southern part of the Willamette Region and in the Southwest Region, the 1985 water year was within the driest 30 to 50 percent on record. The 1985 water year in the Cascade Range was within the driest 20 to 30 percent on record and for most of southeastern and northeastern Oregon was within the driest 20 to 50 percent on record.

The remainder of calendar year 1985 generally was characterized by very cold and dry weather, with most of the stations statewide recording the coldest autumn on record. Average minimum daily temperatures in November were as much as 30°F below normal in parts of central and eastern Oregon; below normal seasonal precipitation statewide resulted in December streamflows that were 40 to 80 percent of normal for much of Oregon.

1990

The 1990 water year began with snowfall in the mountains in late October. However, by the end of December, less than 10 inches of snow were on the ground at Crater Lake in the southern part of the Cascade Range. Low snowfall amounts were indicative of fall weather that had precipitation amounts 20 to 50 percent below normal throughout Oregon.

Calendar year 1990 began with above normal precipitation for almost all of Oregon. Heavy rains in northwestern Oregon produced record floods for the Nehalem River. A trend of above normal precipitation continued through February in Oregon west of the Cascade Range, whereas precipitation amounts east of the Cascade Range were about 20 to 55 percent below normal. Snowfall amounts increased throughout the State but remained below normal.

Below normal precipitation and resulting low snowpacks continued throughout much of the spring. Irrigation began in early April in some areas. In April and May precipitation was heavy and helped alleviate the low soil-moisture levels, as monthly precipitation amounts were greater than normal by 10 to 90 percent throughout Oregon. However, these spring showers did little to increase snowpack depths, which as of April 1 were normal for only Mount Hood and the western side of the Cascade Range; east of the Cascade Range, snowpack conditions were 46 percent of normal (Hubbard, Herrett, and others, 1991).

Low snowpack conditions translated into low streamflow throughout most of Oregon. Streamflows were 54 percent of normal for the snowmelt runoff months of March to June for the Donner und Blitzen River in southeastern Oregon and 57 percent for the year. Annual flow was 58 percent of normal for the Williamson River in south-central Oregon, and 59 percent of normal for the Umpqua River in southwestern Oregon. The Wilson River in the Coast Region had an annual flow of 98 percent of normal (Hubbard, Herrett, and others, 1991).

Precipitation during the summer was above average for all of western Oregon, but only in late July and August was precipitation above average east of the Cascade Range. In terms of total rainfall, these comparisons are not representative, because the August average for most of Oregon west of the Cascade Range is between 1.0 and 1.5 inches and between 0.5 and 1.0 inches for areas east of the Cascade Range.

Average temperatures during the summer were above normal. Temperatures west of the Cascade Range were 2 to 3°F above normal; east of the Cascade Range, average temperatures were from slightly below normal (less than 1°F) to almost 5°F above normal. Statewide, temperatures were average for the year.

Only in certain areas in south-central and north-central Oregon were temperatures more than 1 to 2°F above normal. April had the highest above normal average temperatures—from 3 to 8°F above normal. December had the lowest below normal temperatures—from 7 to 11°F below normal.

The calendar year ended much dryer than normal. Except for October, when precipitation amounts were above normal for western Oregon and the North-Central and Southeast Regions, all months had precipitation amounts that were considerably below normal. September precipitation amounts around the State were only 7 to 42 percent of normal, and December's precipitation was 26 to 55 percent of normal.

For all of 1990, precipitation in western Oregon ranged from 90 to 100 percent of normal, whereas precipitation in all area east of the Cascade Range was below normal, ranging from 67 to 90 percent of average.

WATER USE

A total of 8,400 Mgal/d of freshwater was withdrawn in 1990 for public supply, domestic, commercial, industrial, mining, thermoelectric power, livestock, and irrigation purposes (fig. 11; table 1). Of this amount, nearly 92 percent (7,700 Mgal/d) was withdrawn from surface-water sources, and 770 Mgal/d was withdrawn from ground-water sources. Of the total ground water used in 1990, nearly 50 percent was withdrawn from unconsolidated sedimentary rock aquifers. Undifferentiated volcanic and sedimentary rock aquifers and older basalt rock aquifers each contributed an estimated 25 percent to the ground-water withdrawals. McFarland (1983) and Gonthier (1985) provide detailed descriptions of these aquifers. Approximately 38 percent of the withdrawals were consumed, primarily as a result of evapotranspiration. Another 15 percent (1,300 Mgal/d) was lost in conveying water from the point of withdrawal to the place of use.

Irrigation withdrawals accounted for 82 percent (6,900 Mgal/d) of the total withdrawals (table 2). Owing to the inclusion of offstream fish hatcheries in the commercial water-use category, self-supplied withdrawals accounted for the next largest percentage of total withdrawals (8 percent). Public-supply systems withdrew about 6 percent of the total amount of water, and self-supplied withdrawals for industrial purposes were 3 percent.

An average of about 27 inches of precipitation falls across Oregon annually (Phillips and others, 1965), which equates to about 125,000 Mgal/d. The 8,400 Mgal/d withdrawal rate is about 7 percent of that total. Much of the precipitation falls during the winter, when water use is at its lowest, and falls in areas where natural and (or) artificial storage methods are not available. In addition, about 35 percent of the precipitation amount returns to the atmosphere as a result of evapo-

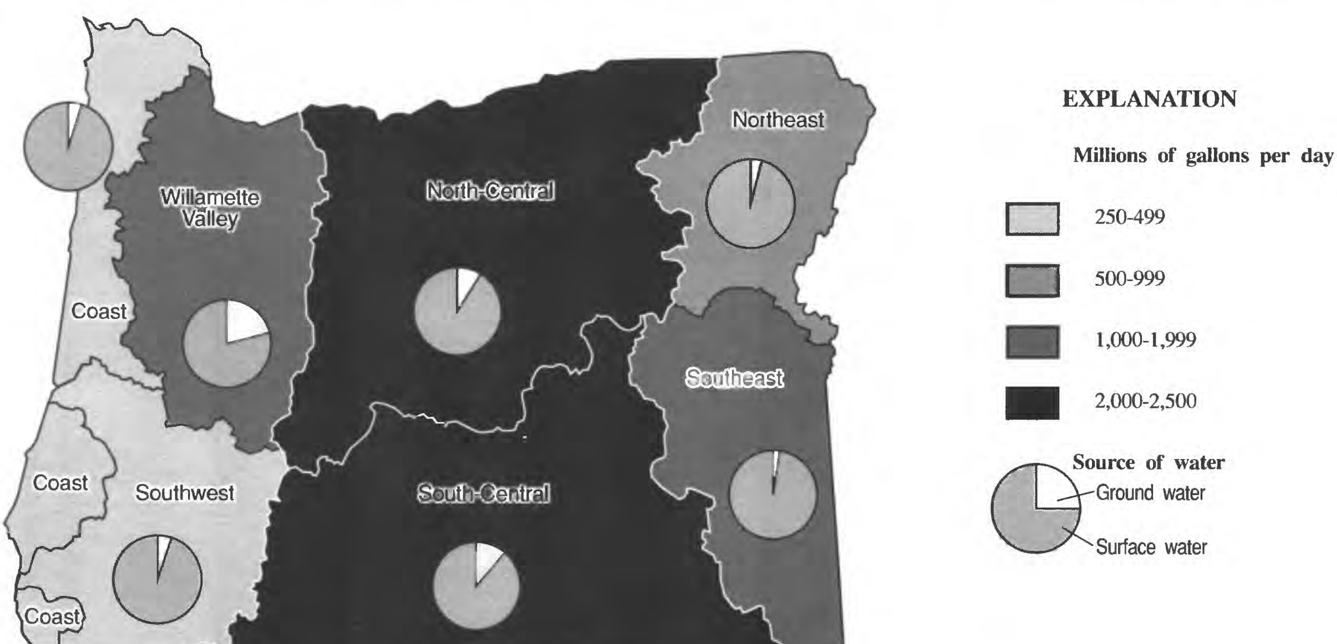

Figure 11. Total water use, by region, 1990.

transpiration and is not available for use (Broad and Nebert, 1990). Finally, the 8,400 Mgal/d of water that was withdrawn in 1990 was for offstream uses only. Instream uses such as aquatic-habitat maintenance, navigation, recreation, and waste dilution were not considered in this report.

The need for exercising caution when comparing water-use data presented in this report with water-availability data becomes obvious when examining water supply and use for the Columbia River. The average flow of the Columbia River is 124,000 Mgal/d (Hubbard, Kroll, and others, 1991), nearly equal to the amount of precipitation that falls annually in Oregon. About 300 Mgal/d was withdrawn from the river for irrigation, industrial, and municipal purposes in 1990. Instream uses were large but difficult to measure. Water used for hydroelectric power was the only instream use considered and was estimated to be 480,000 Mgal/d (about 3.5 times the average flow of the Columbia River). Most of the flow of the Columbia River goes through turbines; the rest is used for fish ladders and navigation locks. The four hydroelectric facilities that use the Columbia River produced about 80 percent of the hydroelectric power generated in

Table 1. Total offstream water use by region in Oregon, 1990
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses): Ground water	Surface water	Total	Water use, in Mgal/d: Reclaimed wastewater	Consumptive use	Conveyance losses
			West of the Cascade Range				
Coast	213	16	330	350	1.2	50	0.1
Willamette	1,959	230	870	1,100	5.4	330	13
Southwest	305	19	370	390	.1	130	35
Total	2,476	260	1,600	1,800	6.7	510	48
			East of the Cascade Range				
South-Central	71	250	2,100	2,400	.2	850	370
North-Central	223	190	1,900	2,100	5.4	900	430
Southeast	26	30	1,200	1,200	.1	500	290
Northeast	47	38	860	890	.1	390	140
Total	366	510	6,100	6,600	5.8	2,600	1,200
State totals	2,842	770	7,700	8,400	12	3,200	1,300

Table 2. Total water withdrawals by water-use category by region in Oregon, 1990
{Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day}

Region name	Withdrawals, in Mgal/d: Public supply	Domestic self-supplied	Commercial self-supplied	Industrial self-supplied	Mining	Thermoelectric power	Livestock	Irrigation	Total
				West of the Cascade Range					
Coast	43	6.0	170	87	0.1	15	1.5	32	350
Willamette	290	33	240	160	.8	0	3.8	360	1,100
Southwest	49	12	140	3.1	.1	0	.9	190	390
Total	380	51	550	250	1.0	15	6.1	580	1,800
				East of the Cascade Range					
South-Central	12	3.2	37	2.5	0	0	4.8	2,300	2,400
North-Central	58	9.5	100	25	.2	.4	5.2	1,900	2,100
Southeast	5.6	1.7	.1	2.8	0	0	2.4	1,200	1,200
Northeast	9.1	2.1	22	.7	.4	0	2.8	860	890
Total	85	16	160	31	.6	.4	15	6,300	6,600
State totals	470	68	710	280	1.6	15	21	6,900	8,400

Oregon. In addition, navigational locks at these facilities, as well as at facilities in Washington, make the Columbia and Snake Rivers navigable to barges as far inland as Lewiston, Idaho, near the Washington-Idaho border. These barges carry grain from the Nation's northern interior to international terminals at Portland, Oregon. Unfortunately, the dams at these hydroelectric facilities have created problems for migrating fish. (Fish habitat is another category of use that was not considered in this report, and one that is difficult to quantify.) Owing to declines in the anadromous fish populations, additional amounts of water have begun to be used to maintain habitat. Water that once was stored for power generation, navigation, and irrigation is now being released from the reservoirs to assist fish passage up and down the Columbia River and its tributaries and to maintain adequate stream temperatures—a recent development.

A total of 6,500 Mgal/d was withdrawn in 1985 (table 3). Of this total, nearly 91 percent (5,900 Mgal/d) was withdrawn from surface water, and the remaining 660 Mgal/d was withdrawn from ground water. Irrigation withdrawals accounted for 5,700 Mgal/d (88 percent) of the water withdrawn in 1985 (table 4).

Table 3. Total offstream water use by region in Oregon, 1985
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses): Ground water	Surface water	Total	Water use, in Mgal/d: Reclaimed wastewater	Consumptive use	Conveyance losses
West of the Cascade Range							
Coast	207	16	140	150	0.4	30	2.5
Willamette	1,817	220	570	790	2.2	290	3.0
Southwest	293	23	350	370	.1	170	40
Total	2,317	260	1,100	1,300	2.7	480	45
East of the Cascade Range							
South-Central	71	140	1,400	1,600	.4	690	88
North-Central	212	180	1,600	1,800	1.8	750	290
Southeast	28	43	1,100	1,100	.1	390	210
Northeast	48	41	690	730	.2	280	140
Total	359	400	4,800	5,200	2.6	2,100	730
State totals	2,675	660	5,900	6,500	5.2	2,600	770

Table 4. Total water withdrawals by water-use category by region in Oregon, 1985
{Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day}

Region name	Withdrawals, in Mgal/d: Public supply	Domestic self-supplied	Commercial self-supplied	Industrial self-supplied	Mining	Thermoelectric power	Livestock	Irrigation	Total
West of the Cascade Range									
Coast	38	6.4	0.1	67	0	11	1.5	27	150
Willamette	280	41	.4	170	.2	0	4.8	290	790
Southwest	37	13	.2	22	2.5	0	1.1	290	370
Total	350	61	.8	260	2.6	11	7.4	610	1,300
East of the Cascade Range									
South-Central	11	3.1	.1	2.4	0	0	5.2	1,500	1,600
North-Central	38	12	.7	23	2.1	.5	6.2	1,700	1,800
Southeast	5.3	1.9	0	2.5	.1	0	3.1	1,100	1,100
Northeast	7.6	2.3	.1	1.8	2.6	0	3.2	710	730
Total	62	19	.9	29	4.7	.5	18	5,100	5,200
State totals	420	80	1.6	290	7.5	12	25	5,700	6,500

Estimated water withdrawals in Oregon increased nearly 30 percent between 1985 and 1990. The 1990 increase can be attributed to the inclusion of off-stream fish hatcheries in the estimates, the use of different crop coefficients to estimate irrigation, the availability of more detailed information, and an increase in water withdrawals caused by population growth.

Withdrawals from surface water accounted for about 89 percent (1,600 Mgal/d) of the total withdrawals west of the Cascade Range in 1990 (table 1). Ground-water withdrawals totaled 260 Mgal/d. More than 88 percent (230 Mgal/d) of the ground water withdrawn was from unconsolidated sedimentary rock aquifers; the rest was withdrawn from basalt aquifers (20 Mgal/d) and from undifferentiated pre-Miocene rock aquifers (10 Mgal/d). Most of the ground-water withdrawals occurred in the Willamette Region.

Because of the larger population and the smaller acreage of irrigated lands on the western side of the Cascade Range, water-use withdrawals by category were fairly evenly distributed (table 2). Water withdrawn in 1990 west of the Cascade Range totaled 1,800 Mgal/d (21 percent of the total withdrawals in Oregon). Irrigation withdrawals accounted for 32 percent of the water withdrawn in this area, followed by self-supplied commercial water use (31 percent), public-supply water use (21 percent), self-supplied industrial water use (14 percent), and self-supplied domestic water use (3 percent).

East of the Cascade Range, irrigation withdrawals during 1990 accounted for more than 95 percent (6,300 Mgal/d) of the total withdrawals in the area and 75 percent of the total withdrawals in Oregon (table 2). Self-supplied commercial water use was the next largest category of use (2 percent), followed by public supply (1 percent), and self-supplied industrial (less than 1 percent). Surface-water withdrawals were about 6,100 Mgal/d (92 percent of the total withdrawals east of the Cascade Range). The 510 Mgal/d withdrawn from ground water was obtained from undifferentiated volcanic and sedimentary rock aquifers, older basalt aquifers, and unconsolidated sedimentary rock aquifers. Contributions from these aquifers ranged from 31 to 36 percent of the total ground water withdrawn.

Public Supply

Public supply, as defined by the National Water-Use Information Program, is the water withdrawn by public and private water-supply systems and delivered to users that do not supply their own water (Solley and others, 1993). Examples of public-system suppliers in Oregon range from the City of Portland Water Bureau to a mobile home park or resort that has its own water supply. The types of users served by public-supply systems are domestic, commercial, industrial, and public. In addition to the uses of water defined in the Glossary as public uses, water that is transferred from one public-supply system to another, water lost in conveyance, and other unaccounted-for water is included in the public-use and losses category. Consequently, the amount of water withdrawn by a public-supply system is equal to the amount of water delivered to domestic, commercial, and industrial users plus the amount of water lost in conveyance, the amount transferred to other public-supply systems, and the amount used for actual public uses.

In 1990, public-supply systems in Oregon served 2,200,000 people (fig. 12; table 5), 77 percent of the State's population. Public-supply water use for 1990 was an estimated 470 Mgal/d, or nearly 6 percent of the total water use in the State. Surface-water withdrawals accounted for nearly 79 percent (370 Mgal/d) of the public-supply withdrawals.

In 1985, public-supply systems served 1,900,000 people (table 6), 71 percent of Oregon's population. Public-supply water use during 1985 was 420 Mgal/d, more than 6 percent of the total water use in the State (table 4). Surface-water withdrawals accounted for 79 percent (330 Mgal/d) of the public-supply withdrawals. The increase in total withdrawals and population served from 1985 to 1990 can be attributed to increases in Oregon's population and a better inventory of public-supply systems for 1990.

The three largest public-supply systems in Oregon during 1990 were the Portland Water Bureau (120 Mgal/d), Eugene Water and Electric (30 Mgal/d), and Salem Public Works (28 Mgal/d). These three systems accounted for approximately 38 percent of all public-supply withdrawals in Oregon for 1990. All three of these systems relied solely on surface water during 1990.

Even though surface water accounted for 79 percent of the total withdrawals, more public-supply systems used ground-water sources than surface-water sources. Of the 963 public-supply systems surveyed in 1990, more than 72 percent (698) relied solely on ground water, 22 percent (209) on surface water, and 6 percent (56) on both surface and ground water.

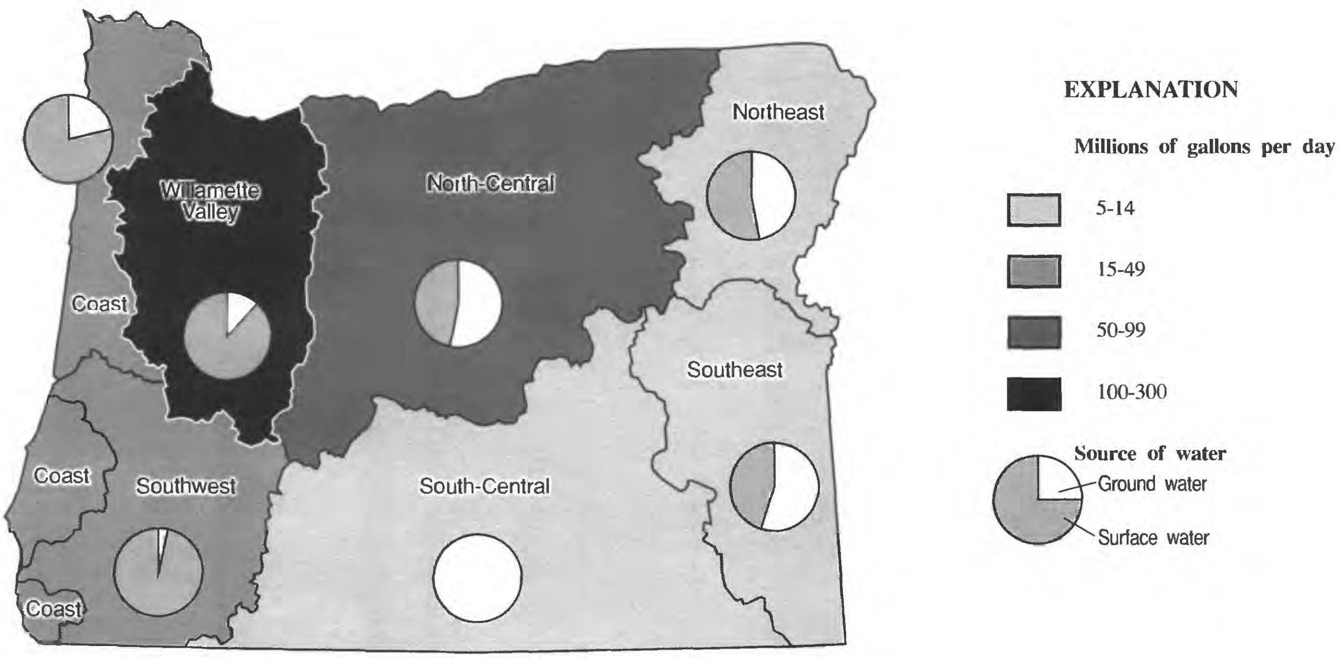

Figure 12. Total water withdrawals for public supply, by region, 1990.

The three largest public-supply systems in Oregon that use ground water are the Springfield Utility Board (9 Mgal/d), the Klamath Falls Water Department (7 Mgal/d), and the Hood River Water System (4 Mgal/d). These three systems accounted for approximately 21 percent of the ground-water withdrawals by public-supply systems in 1990.

Of the water withdrawn for public supply in 1990, more than 53 percent (250 Mgal/d) was delivered for domestic uses, 17 percent (79 Mgal/d) for industrial uses, 17 percent (79 Mgal/d) for public uses (including transfer water or conveyance losses), and 14 percent (66 Mgal/d) for commercial uses (table 5). Overall, the 1990 per-capita use in Oregon (total public-supply water withdrawn divided by total population served) was about 210 gallons per day.

The climatic and hydrologic differences west and east of the Cascade Range also accounted for differences in water sources for Oregon's public-supply systems. West of the Cascade Range, where streamflows generally are adequate, 89 percent (340 Mgal/d) of the total withdrawals were from surface water. On the dryer, eastern side of the Cascade Range, 59 percent (50 Mgal/d) of the withdrawals were from ground water (table 5). Per-capita use also differed west and east of the Cascade Range. West of the Cascade Range, per-capita use was 200 gallons per day, whereas in areas east of the Cascade Range, per-capita use was 330 gallons per day.

West of the Cascade Range

The sources of water for public-supply systems differ among the Coast, Willamette, and Southwest Regions; these differences reflect the hydrologic conditions and population distributions in each region. Most of the withdrawals come from surface-water sources; however, areas where ground water is available have a relatively large number of public-supply systems that rely on ground water. In the Willamette Region, for example, surface water supplied almost 90 percent of the total withdrawals, yet ground water was the source for more than seven times as many public-supply systems as surface-water sources. The Willamette Region, which contains most of the State's population, has many small public-supply systems serving rural areas adjacent to cities. An important financial consideration is the ability of these small systems to tap a reliable supply of potable ground water and thereby save water-treatment costs. The ratio of surface-water to ground-water sources for systems outside the Willamette Region is about 1.5:1, primarily due to the lack of readily available ground water and the smaller number of small public-supply systems.

Table 5. Public-supply water use by region in Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

Region name	Population served, in thousands			Withdrawals, total in Mgal/d			Water deliveries, by type of use, in Mgal/d					Per capita use, in gal/d
	Ground water	Surface water	Total	Ground water	Surface water	Total	Commer-cial	Domestic	Indus-trial	Public use and losses	Total deliveries	
West of the Cascade Range												
Coast	40	110	150	10	32	43	5.9	21	6.2	9.8	33	280
Willamette	240	1,400	1,600	36	260	290	39	160	59	39	250	180
Southwest	11	170	180	1.6	47	49	8.0	26	5.5	9.2	39	260
Total	290	1,700	2,000	48	340	380	53	200	71	58	330	200
East of the Cascade Range												
South-Central	49	.1	49	12	0	12	1.1	6.1	2.9	1.6	10	240
North-Central	110	49	160	31	28	58	9.2	28	2.6	18	40	370
Southeast	9.7	5.0	15	3.1	2.5	5.6	1.8	1.7	1.7	.5	5.1	380
Northeast	14	19	32	4.3	4.8	9.1	1.6	5.4	.8	1.3	7.8	280
Total	180	73	250	50	35	85	14	42	8.0	21	63	330
State totals	470	1,800	2,200	97	370	470	66	250	79	79	390	210

Table 6. Public-supply water use by region in Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

Region name	Population served, in thousands			Withdrawals, total in Mgal/d			Water deliveries, by type of use, in Mgal/d					Per capita use, in gal/d
	Ground water	Surface water	Total	Ground water	Surface water	Total	Commer-cial	Domestic	Indus-trial	Public use and losses	Total deliveries	
West of the Cascade Range												
Coast	34	110	140	7.7	30	38	4.8	20	4.9	8.2	38	270
Willamette	230	1,200	1,400	38	240	280	27	160	35	53	280	200
Southwest	4.4	160	160	.6	37	37	5.0	25	3.5	3.4	37	230
Total	270	1,400	1,700	46	310	350	37	210	43	65	350	210
East of the Cascade Range												
South-Central	51	0	51	11	0	11	.9	3.9	4.7	1.1	11	210
North-Central	85	46	130	23	15	38	5.7	27	1.7	3.9	38	290
Southeast	7.4	7.7	15	2.2	3.0	5.3	.8	1.6	2.1	.8	5.3	350
Northeast	6.7	26	33	1.7	6.0	7.6	.9	4.5	.8	1.5	7.6	230
Total	150	80	230	38	24	62	8.2	37	9.4	7.2	62	270
State totals	420	1,500	1,900	83	330	420	45	250	53	72	420	210

Coast

The Coast Range receives large amounts of rainfall, and the amount of runoff in streams from the mountains tends to be fairly high. As a result, most public-supply systems in the Coast Region obtain water from these streams. Of the 124 public-supply systems in this region with withdrawal points, 61 withdraw solely from surface-water sites, 57 withdraw solely from ground-water sites, and 6 withdraw from both. Twenty-seven systems purchase water from another system. In 1990, surface-water withdrawals accounted for 74 percent (32 Mgal/d) of all public-supply withdrawals in the region. Seventy percent of the region's 213,000 people are served by these 151 public-supply systems. Many of these systems serve small communities and resorts consisting of second-family homes.

Although annual precipitation in the Coast Range is high, natural storage is low. Consequently, storage reservoirs are constructed to maintain supplies for public-water systems during the summer. Many of the intakes for surface-water sources, therefore, are on tributary streams rather than main-stem streams. These smaller streams offer more feasible storage sites compared to the larger main stems, which harbor important fisheries and provide transportation corridors through the rugged Coast Range. Owing to the smaller size of the tributary streams, many of the larger systems require multiple intakes; these systems include Warrenton Water System (2 Mgal/d), Lincoln City Water District (2 Mgal/d), and Toledo Water Utilities (1 Mgal/d). Large systems that rely on only one surface-water source include the cities of Astoria (4 Mgal/d), Seaside (3 Mgal/d), Newport (2 Mgal/d), and Reedsport (2 Mgal/d). During the drought of 1987, Astoria had only a 2-month supply remaining in its reservoirs. The Seal Rock Water District, serving an area of recent growth south of Newport, has faced restrictions on its use of Siletz River water, because the District's water rights were issued after instream-flow rights in the river were issued; in other words, the instream-flow use rights have priority.

There are few areas along the Oregon coast where ground water is available in sufficient quantities for public supply. However, ground water does serve as the primary or secondary source for several of the larger public-supply systems in the coastal area. The Garibaldi Water System (0.5 Mgal/d) and the Kilchis Regional Water District (0.7 Mgal/d), which serve the Bay City area, rely strictly on ground water from alluvial deposits; the Tillamook Water Commission (2 Mgal/d) relies on ground water from alluvial deposits as a backup to its surface-water source. Farther south, the city of Florence (0.5 Mgal/d) relies on ground water from dune-sand aquifers to supplement surface water purchased from another system. Dune-sand aquifers provided about 60 percent (9.0 Mgal/d) of the supply for the Coos Bay-North Bend Water District in 1990. The Coos Bay-North Bend Water District has experienced problems with high iron content in the water (Bortleson and others, 1992).

Willamette

The Willamette Region covers only 12.5 percent (12,045 square miles) of the total land area in Oregon yet contained 69 percent (1,960,000) of the State's population in 1990 (table 3). Nearly 82 percent of the residents in this region were served by public-supply systems. These systems accounted for 62 percent (290 Mgal/d) of all the water withdrawn by public-supply systems in Oregon (table 5). Of the 290 Mgal/d withdrawn, 90 percent (260 Mgal/d) was withdrawn from surface-water sources.

When pioneers began arriving in Oregon during the 1840's, most settled in the Willamette Valley. Many of the settlements that sprang up in the valley relied on the Willamette River as a source of drinking water. However, these communities also used the Willamette River as a means of waste disposal for municipal and industrial waste. As a result, many of the communities began looking for sources of water other than the Willamette River. The most notable example is the city of Portland. In 1892, entered into an agreement with what is now the U.S. Forest Service to administer the mostly federally owned lands in the Bull Run Watershed (30 miles east of the city) for the maintenance of a public-supply system for the city. Public entry, grazing, and timber harvesting originally were prohibited. Since the time of the original agreement, timber harvesting has been allowed, but with the stipulation that it does not affect water quality. Because the intakes for the public-supply system do not have filters, there has been much concern regarding the effect of logging on the turbidity of the water system (City of Portland, 1983).

The interbasin transfer of water—from the Bull Run drainage in the Sandy River Basin to Portland in the lower Willamette River Basin—supplied about 26 percent (120 Mgal/d) of all water withdrawn by public-supply systems in Oregon and served about 25 percent of the State's population in 1990.

In addition to supplying Portland, the Portland Water Bureau sold approximately 38 Mgal/d of water to more than 30 public-supply systems that serve residents in the surrounding communities. Some of the larger systems are Tualatin Valley (formerly Wolf Creek) Water District in eastern Washington County (14 Mgal/d), Rockwood Water District east of Portland (5 Mgal/d), and the city of Gresham (4 Mgal/d). In addition, the Portland Water Bureau supplied water to industrial and commercial users in the region; some of whom used more than 1 Mgal/d.

Many of the surface-water withdrawals for public-supply systems in the Willamette Region come from the streams flowing off of the crest of the Cascade Range—the Clackamas, North and South Santiam, and McKenzie Rivers. Besides being supplied by aquifers with dependable ground-water storage, these streams also are regulated by reservoirs whose primary purpose is power generation and (or) flood control. Public-supply systems relying on these sources include the Clackamas Water District southeast of Portland (10 Mgal/d), which withdraws water from the Clackamas River; Salem Public Works, which withdraws water from the North Santiam River; the city of Albany (8 Mgal/d), the city of Lebanon (2 Mgal/d), and the Sweet Home Water Department (1 Mgal/d), which withdraw water from the South Santiam River; and the Eugene Water and Electric Board (30 Mgal/d), which uses the McKenzie River for its supply. The Salem, Albany, and Lebanon systems obtain their water through the use of canals.

Some systems in the Willamette Region rely on streams that do not originate at the crest of the Cascade Range. The Molalla, Pudding, and Row Rivers do not receive as much input from snowmelt as do streams that reach the crest. Because of a flood control reservoir on the Row River, the city of Cottage Grove (2 Mgal/d) is able to obtain an adequate supply. Systems that rely on the rivers in the Molalla and Pudding Basin—Canby Utility Board (1 Mgal/d) and city of Silverton (1 Mgal/d)—also rely on other streams, infiltration galleries near the Molalla River, or springs. The city of Molalla (0.7 Mgal/d), however, is able to obtain an adequate supply solely from the Molalla River.

There are several systems in the Willamette Region that rely on streams that have headwaters on the eastern slope of the Coast Range. These systems include the Hillsboro-Forest Grove-Beaverton Joint Water Treatment Plant (10 Mgal/d), the city of Corvallis (7 Mgal/d), McMinnville Water System (4 Mgal/d), and the city of Dallas (2 Mgal/d); the Hillsboro-Forest Grove-Beaverton and McMinnville systems withdraw some of their supply from the western slope of the Coast Range.

Although restrictions on discharges and low-flow augmentation from upstream reservoirs have considerably improved the water quality of the Willamette River, only three public-supply systems continue to use the river as either a primary or secondary source. Adair Water System (0.2 Mgal/d) uses Willamette River water as a primary supply source, while the city of Westfir (0.1 Mgal/d) withdraws its supply from the North Fork of the Middle Fork of the Willamette River. The city of Corvallis uses the Willamette River as a supply source when its Coast Range source becomes depleted during the summer.

Only 36 Mgal/d was withdrawn from ground water by public-supply systems in the Willamette Region during 1990. However, of the 436 public-supply systems surveyed in the region, 325 rely exclusively on ground water. Most of these small systems withdraw less than 0.1 Mgal/d and supply a small town, subdivision, or trailer park.

The larger public-supply systems that use ground water in the Willamette Region generally are located in areas along eastern tributaries of the Willamette River. These tributaries are lined with flood plain alluviums overlying older alluvium on the valley floor. During 1990, the Springfield Utility Board withdrew 8 Mgal/d and the Rainbow Water District (near Springfield) withdrew 2 Mgal/d from the alluvium along the McKenzie River. A productive ground-water region between Salem and Wilsonville, known as the French Prairie-Mission Bottom area, supplies users such as the city of Newberg (3 Mgal/d), the Keizer Water Department (3 Mgal/d), and the city of Woodburn (2 Mgal/d).

The Columbia River Basalts Group aquifer is a source of water for the cities of Wilsonville (1 Mgal/d), Sherwood (0.6 Mgal/d), and Mount Angel (0.4 Mgal/d). The cities of Beaverton, West Linn, and Lake Oswego once used this aquifer for a water supply, but declining water levels in the aquifer (and in the case of Lake Oswego, water-quality problems) encouraged these systems to develop surface-water sources.

Few ground-water systems are located along the tributaries that drain the eastern slope of the Coast Range. These streams flow over fine-grained sediments of low porosity and permeability. The two largest suppliers that use ground water west of the Willamette River are Independence (1 Mgal/d) and Monmouth (1 Mgal/d), both of which obtain water from alluvium near the Willamette River. In addition to low porosity, aquifers that consist of source material from the Coast Range also have a problem with infiltration of saline water from underlying marine sediments. In some cases, rural public-supply systems, such as the Luckiamute Water Cooperative (0.2 Mgal/d) and Rickreall Water Association (0.1 Mgal/d), pump water from the alluvium along the Willamette River to service areas in the foothills south of the city of Dallas. In the case of the Luckiamute Water Cooperative, water is pumped approximately 16 miles from the source to service area (Gonthier, 1983).

In the Portland area, the best sources of available ground water are alluvial and sedimentary aquifers along the Willamette and Columbia Rivers. The city of Troutdale (1 Mgal/d) relies totally, and the Fairview Water Department (0.3 Mgal/d) relies in part, on withdrawals from these aquifers. The Parkrose Water District (east of Portland) and the city of Milwaukie withdrew their water supplies from these aquifers in the past, but because of contamination, these users now obtain water wholly, or in part, from the city of Portland.

The city of Portland has developed a backup supply that uses the aquifers along the Columbia River. This system, completed in 1984, is used during periods of low water or when the turbidity in the reservoirs is high (the intakes of the Bull Run surface-water system do not have filters). During the drought of 1987, the backup system supplied an average of 77 Mgal/d between September and December. Contamination problems in the aquifer upgradient from the wells have forced close monitoring of wells to determine if pumping of these wells draws contaminated waters into the aquifer.

Several other public-supply systems in the Willamette Region supplement their surface-water source with ground water. In addition to the ones previously mentioned, the city of St. Helens (3 Mgal/d) also supplements its supply with ground water.

Southwest

In Oregon's Southwest Region, almost all of the large public-supply systems rely on surface water. Eighty-three of the 121 systems surveyed rely solely on ground water, but only 3 of these 83 withdrew more than 0.05 Mgal/d in 1990. Consequently, surface-water withdrawals accounted for 96 percent (47 Mgal/d) of all public-supply withdrawals.

Unlike many of the surface-water intakes for public supply in the Coast Region, surface-water intakes in southwest Oregon are located on main stem streams. Flows along the North Umpqua main stem are generally adequate, owing to the large amounts of base flow from ground water; flows along the Rogue River are adequate because of base flows, upstream U.S. Army Corps of Engineers dams, and BOR projects that bring water from the eastern side of the Cascade Range. Large base flows and upstream storage projects are not present on the South Umpqua River; consequently, extended periods of low flow occur during the summer months. A few, small, upstream-storage projects in the South Umpqua River have helped alleviate some of the low-flow problems.

In the Umpqua River Basin, almost all of the 13 Mgal/d withdrawn for public supply was from surface water. Because of low flows in the South Umpqua River, however, the Umpqua River Basin's largest public-supply system, the city of Roseburg (5 Mgal/d), withdraws its water from the North Umpqua River—even though Roseburg is located on the South Umpqua River. Flows along the South Umpqua River are large enough to supply two smaller systems south of Roseburg: Roberts Creek Water System (1 Mgal/d) and the Winston-Dillard Water Department (0.7 Mgal/d).

Public-supply systems that relied on surface-water withdrawals accounted for 95 percent (34 Mgal/d) of all public-supply withdrawals in the Rogue River Basin in 1990. The largest water supplier in the basin, Medford Water Commission, withdrew more than 90 percent of its 25 Mgal/d from springs issuing from porous lava 30 miles northeast of the city of Medford. The remaining amount was withdrawn from the rogue river, which is located just north of Medford. The Medford Water Commission also supplied several of the surrounding communities. Grants Pass, the second largest public water supplier in the Rogue River Basin (4 Mgal/d), obtained its supply from the Rogue River. The Ashland Water District (4 Mgal/d) uses a tributary stream of the Rogue River; consequently, the Ashland District uses headwater storage and water from an irrigation district to meet demand.

The largest ground-water user for public supply in southwest Oregon is the city of Rogue River. This system withdrew 0.3 Mgal/d from alluvial material during 1990. The city of Cave Junction (0.3 Mgal/d) uses ground water to supplement surface water from the Illinois River.

East of the Cascade Range

The lack of available surface water East of the Cascade Range dictates that most of the public-supply systems in the area rely on ground water. Of the 254 systems surveyed, 239 rely solely, or in part, on ground water. In 1990, ground water supplied about 59 percent (50 Mgal/d) of the water withdrawn for public supply (table 5). However, some of the larger systems in the area rely on surface water from main stem rivers or mountain streams.

South-Central

Whereas southwestern Oregon consists of public-supply systems that rely almost entirely on surface water, south-central Oregon consists of 38 systems that rely solely on ground water. The region's largest system, the Klamath Falls Water Department, withdrew 7 Mgal/d, or about 58 percent of the areas total public-supply withdrawals (12 Mgal/d) in 1990. The source of this supply is an undifferentiated volcanic and sedimentary rock aquifer. The Burns Water Department (1.3 Mgal/d), the city of Hines (0.8 Mgal/d), and the city of Lakeview (0.8 Mgal/d) obtain ground-water supplies from volcanic materials as well. Basalts are the source of ground water in the city of Christmas Valley (0.3 Mgal/d), while alluvial material is the source of ground water for the city of Paisley (0.1 Mgal/d).

North-Central

Public-supply systems in the North-Central Region of Oregon rely on a combination of surface and ground water for sources of supply. Of the 189 systems surveyed, ground-water systems greatly outnumber surface-water systems; 169 systems rely solely on ground water, 8 on surface water, 8 on surface and ground water, and 4 obtain their supply from another system. In terms of total withdrawals, ground water accounted for 53 percent (31 Mgal/d) of the 58 Mgal/d withdrawn for public supply in 1990 (table 5). The large number of ground-water users reflects the fact that the region consists of many small towns and small retirement areas.

In the eastern part of the region, the large surface-water users are the Pendleton Water System (2 Mgal/d) and the Boardman City Water System (1 Mgal/d). Pendleton relies on infiltration galleries in the gravels along the Umatilla River. As a backup supply, the system also relies on wells tapping the basalt aquifer underlying the city. Boardman and St. Helens, which use infiltration galleries along the Columbia River, are the only public-supply systems in Oregon that use Columbia River water. The city of Walla Walla, Washington (11 Mgal/d), north of Milton-Freewater, withdraws the largest volume of water for public supply in the region; the intake for the city is physically located in Oregon.

Most of the other large public-supply systems in the eastern part of north-central Oregon rely on ground water from basalts and sedimentary deposits. These include Hermiston Water Department (3 Mgal/d), Milton-Freewater Water District (3 Mgal/d), Umatilla Water System (0.9 Mgal/d), and the Heppner Water Department (0.6 Mgal/d).

The porous volcanic deposits along the eastern slope of the Cascade Range are a water source for public-supply systems in the western part of north-central Oregon. These deposits hold large amounts of snowmelt and release it gradually to springs. As a result, the yearly flow of streams in this area is fairly constant and ground water is plentiful. The Bend Water Department, the largest public-supply system in the area, withdrew 5 Mgal/d from surface water. The Redmond Water Department (3 Mgal/d) pumps ground water from volcanic material that underlies the city. In the Madras area, a large part of the population, including the city of Madras, is served by the Deschutes Valley Water District (2 Mgal/d), which obtains its water from Opal Springs in the lower part of the Crooked River. Other systems that rely exclusively on ground water include the Hood River Water System (4 Mgal/d), Crystal Springs Water District in Hood River County (2 Mgal/d), and the city of Prineville (1 Mgal/d). The Prineville system taps alluvial material, while the other two systems tap volcanic sediments.

The Dalles Water System (5 Mgal/d) relies on a combination of surface and ground water. The surface water comes from two watersheds in National Forest land west of The Dalles. Ground water is withdrawn from wells drilled in basalt deposits.

Southeast

Only seven public-supply systems are located in the sparsely populated Southeast Region. All of these systems rely on ground water for at least part of their supply. Ground-water pumpage by these systems was 55 percent (3.1 Mgal/d) of total public-supply withdrawals in 1990 (table 5).

The largest user in the Southeast Region, the city of Ontario (5 Mgal/d), uses the Snake River as a surface-water source and alluvial material along the Snake River as a ground-water source. Most smaller systems use ground-water sources; such systems include the cities of Vale and Nyssa (0.3 Mgal/d) and the city of Jordan Valley (0.1 Mgal/d).

Northeast

Public-supply withdrawals in the Northeast Region are from a mix of surface- and ground-water sources. Of the 23 suppliers surveyed, 18 rely solely on ground water, and 3 rely solely on surface water; the 2 largest users rely on a combination of surface and ground water. Surface water (4.8 Mgal/d) accounted for more than 50 percent of the 9.1 Mgal/d withdrawn (table 5).

The two largest public-supply system in the Northeast Region, the La Grande Water Department (3 Mgal/d) and Baker City (2 Mgal/d), rely on multiple intakes in headwater regions of the mountains to the west and on supplemental ground-water supplies, mostly from basalt aquifers. Smaller systems in this region use basalt aquifers and mountain streams and lakes for supply sources. The Union Water System (0.8 Mgal/d), Elgin Water Department (0.6 Mgal/d), and Wallowa Water Supply (0.3 Mgal/d) rely on basalt aquifers; the city of Enterprise relies on surface water, and the city of Joseph (0.6 Mgal/d) relies on Wallowa Lake.

Domestic

The Water-Use Information Program defines domestic water use as the water used "for household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens" (Solley and others, 1993). The source of domestic water is either a public-supply system or self-supplied from a well, stream, or spring. Water from a spring for domestic use is considered surface water in this report.

Domestic water use in Oregon for 1990 totaled 310 Mgal/d, of which almost 81 percent (250 Mgal/d) was delivered by public-supply systems (fig. 13 and table 7). Domestic water use for 1985 totaled 330 Mgal/d, of which almost 76 percent was delivered by public-supply systems (table 8). The differences in the values for the 2 years can be attributed to (1) an increase in the number of persons on public-supply systems, (2) an increase in the number of systems surveyed for information on withdrawals and deliveries, and (3) a change in the methodology for estimating domestic self-supplied water use.

Domestic water use accounted for 5 percent of total water use in 1985, and 4 percent of total water use in 1990. The smaller percentage of total water use for 1990 was due to the increase in total water use.

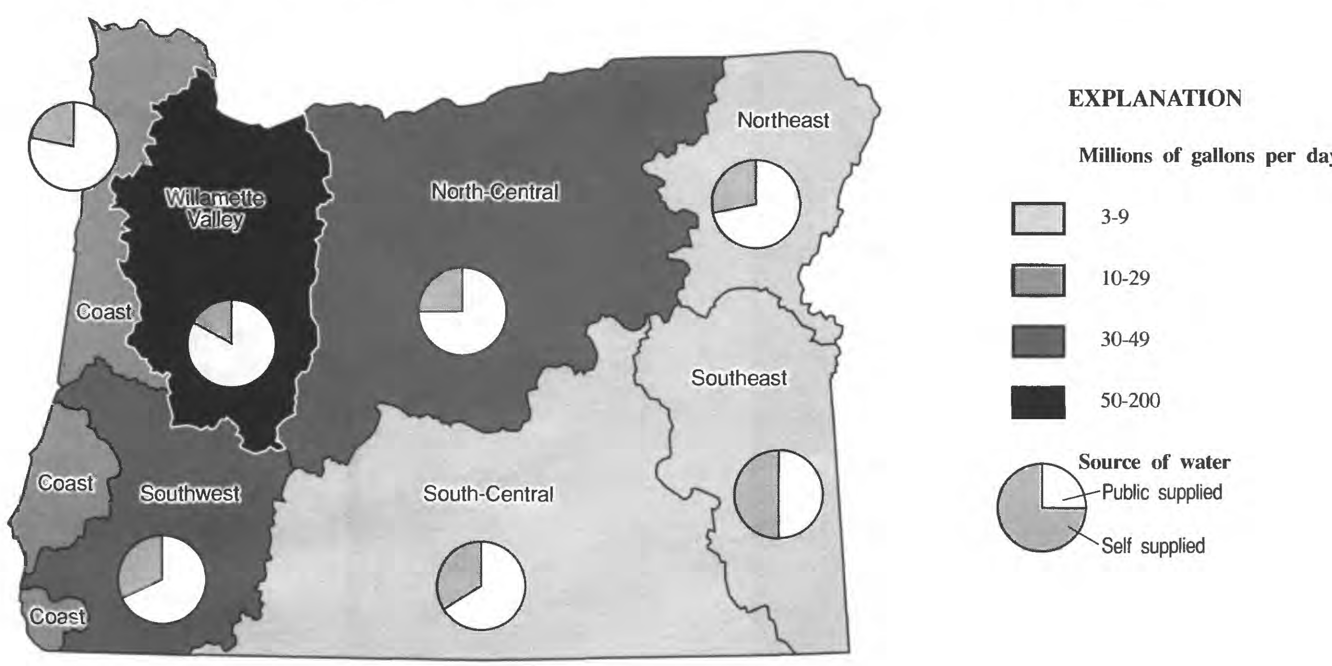

Figure 13. Total self-supplied and public-supplied water withdrawals for domestic uses, by region, 1990.

Table 7. Domestic water use by region in Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

Region name	Self supplied: Population, in thousands	Self supplied: Water withdrawals, in Mgal/d: Ground water	Self supplied: Water withdrawals, in Mgal/d: Surface water	Self supplied: Water withdrawals, in Mgal/d: Total	Self supplied: Per capita use, in gal/d	Public supplied: Population served, in thousands	Public supplied: Deliveries from public supply, in Mgal/d	Public supplied: Per capita use, in gal/d	Total: Withdrawals and deliveries, in Mgal/d	Total: Consumptive use, in Mgal/d
West of the Cascade Range										
Coast	60	4.0	2.0	6.0	100	150	21	140	27	7.2
Willamette	330	30	3.0	33	100	1,600	160	96	190	48
Southwest	120	11	1.1	12	100	180	26	140	38	11
Total	510	45	6.1	51	100	2,000	200	100	250	66
East of the Cascade Range										
South-Central	22	3.1	.1	3.2	150	49	6.1	130	9.5	2.9
North-Central	64	8.1	1.4	9.5	150	160	28	180	38	10
Southeast	11	1.7	0	1.7	150	15	1.7	120	3.4	1.2
Northeast	14	1.7	.4	2.1	150	32	5.4	170	7.5	2.1
Total	110	15	1.8	16	150	250	42	160	59	17
State totals	600	60	7.9	68	110	2,200	250	110	310	83

Table 8. Domestic water use by region in Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

Region name	Self supplied: Population, in thousands	Self supplied: Water withdrawals, in Mgal/d: Ground water	Self supplied: Water withdrawals, in Mgal/d: Surface water	Self supplied: Water withdrawals, in Mgal/d: Total	Self supplied: Per capita use, in gal/d	Public supplied: Population served, in thousands	Public supplied: Deliveries from public supply, in Mgal/d	Public supplied: Per capita use, in gal/d	Total: Withdrawals and deliveries, in Mgal/d	Total: Consumptive use, in Mgal/d
West of the Cascade Range										
Coast	64	5.7	0.7	6.4	100	140	20	140	27	7.3
Willamette	410	37	4.8	41	100	1,400	160	120	210	53
Southwest	130	10	2.8	13	100	160	25	150	38	12
Total	610	52	8.3	61	100	1,700	210	120	270	72
East of the Cascade Range										
South-Central	20	3.0	0	3.1	150	51	3.9	77	7.0	2.3
North-Central	80	11	1.0	12	150	130	27	200	39	11
Southeast	13	1.9	0	1.9	150	15	1.6	110	3.5	1.3
Northeast	15	2.0	.3	2.3	150	33	4.5	140	6.7	2.0
Total	130	18	1.3	19	150	230	37	160	56	17
State totals	700	70	9.6	80	110	1,900	250	130	330	89

West of the Cascade Range

More than 85 percent of the Oregon population lives west of the Cascade Range, and this population density accounts for greater domestic water use and a larger percentage of the domestic population being served by public supply than east of the Cascade Range. Total domestic water use in 1990 was 250 Mgal/d, with 80 percent (200 Mgal/d) of the water used coming from public-supply systems (table 7) in 1990. About 88 percent (45 Mgal/d) of the self-supplied domestic withdrawals came from wells. Consumptive use west of the Cascade Range was about 26 percent (66 Mgal/d) of total domestic use.

Coast

Deliveries from public-supply systems made up 78 percent (21 Mgal/d) of the total domestic water use in the Coast Region during 1990. In this humid area, where many self-supplied residents obtain water from streams and springs, ground water accounted for only 67 percent of the self-supplied withdrawals. Domestic water use accounted for about 8 percent of the total water use in this region.

In the northern part of the Coast Region (north of the mouth of the Umpqua River), about 81 percent of the water used for domestic purposes came from public-supply systems. In the southern part of the region, public-supply systems provided 70 percent of the water used.

Willamette

The densely populated Willamette Region accounted for more than 61 percent (190 Mgal/d) of the water used for domestic purposes statewide in 1990. Eighty-four percent (160 Mgal/d) of the domestic water use came from public-supply systems. Ground water constituted 91 percent of the 33 Mgal/d of self-supplied withdrawals. Domestic water use accounted for 17 percent of total water use in the region.

The percentage of domestic water consumed by users in the Willamette Region who supply their own water ranged, by county, from 5 to 38 percent. In the more populated counties (Multnomah, Washington, and Lane), domestic self-supplied withdrawals were less than 20 percent of domestic use. In the less populated counties (Benton, Columbia, Linn, and Yamhill), domestic self-supplied withdrawals were more than 30 percent of domestic use. Ground water provided between 78 and 96 percent of the water withdrawn for self-supplied domestic use for the counties in the Willamette Region.

Southwest

The Southwest Region is characterized by rugged terrain, and as a consequence, the major communities in the region are located along the main stems of the Umpqua and Rogue Rivers. However, many of the tributary basins of these rivers also are inhabited, and many of these residents supply their own sources of water. As a result, only 59 percent of the population in the Southwest Region was served by public-supply systems in 1990. Ground water constituted 92 percent of the 12 Mgal/d withdrawn by self-supplied domestic users (table 7). Domestic water use constituted almost 10 percent of the total water use in the region.

In the Umpqua River Basin, self-supplied withdrawals made up 27 percent (3 Mgal/d) of the domestic water use (11 Mgal/d). Ground-water withdrawals by self-supplied users accounted for 79 percent of the 3 Mgal/d.

Wells for self-supplied domestic users in the Rogue River Basin accounted for 95 percent of the 9 Mgal/d withdrawn, an amount that was 33 percent of the total domestic water use in the basin (27 Mgal/d). In the basins that are distant from the major population centers of Medford, Ashland, and Grants Pass, self-supplied withdrawals were 87 percent (7 Mgal/d) of the domestic water use.

East of the Cascade Range

On the more sparsely populated eastern side of the Cascade Range, 27 percent of the population supplied its own water, compared to 21 percent west of the mountains. Total domestic water use was 59 Mgal/d, and 71 percent (42 Mgal/d) was delivered by public-supply systems (table 7). About 94 percent of the 16 Mgal/d withdrawn by self-supplied users came from ground water.

South-Central

The arid South-Central Region is characterized by sparsely populated areas that average about three persons per square mile. Domestic water use was only 9.5 Mgal/d, or less than 1 percent of the total water use in the region. Self-supplied uses were about 34 percent (3.2 Mgal/d) of the domestic water use. Little surface water is available, and 97 percent of the withdrawals for domestic use in 1990 came from ground water.

North-Central

Sources of domestic water in the North-Central Region are more varied than for South-Central Region. Of the 38 Mgal/d used for domestic purposes (about 2 percent of the total water use in the region), approximately 74 percent was from public-supply systems. The 8.1 Mgal/d withdrawn from ground water by self-supplied domestic users was 85 percent of the 9.5 Mgal/d withdrawn by self-supplied users.

Many water users in the Deschutes River Basin are served by a system of canals tapping headwater storage reservoirs east of the Cascade Range. Most canal-transported water is used for irrigation, and some water is delivered to domestic users who store the water in cisterns. In the rest of the North-Central Region, self-supplied users rely primarily on ground water.

Southeast

In the sparsely populated Southeast Region, 26,000 people live in a 10,500 square-mile area (2.5 persons per square mile). The 3.4 Mgal/d withdrawn for domestic water use was less than 1 percent of the total water use in the region (table 7). The area is arid, and, as a result, almost 100 percent of the self-supplied domestic supplies were from ground water. Public-supply systems provided 50 percent of the domestic water use.

Northeast

Self-supplied domestic users in the more mountainous Northeast Region used surface water for 19 percent of their needs. The 2.1 Mgal/d withdrawn by these users, however, represented only 28 percent of the total domestic water use (7.5 Mgal/d). Domestic water use by the 47,000 residents was less than 1 percent of the total water use in the region.

Commercial

Commercial water use includes water for motels, hotels, schools, restaurants, office buildings, other commercial facilities, and civilian and military institutions. In Oregon, commercial water users include 39 offstream fish hatcheries.

Total commercial water use in Oregon for 1990 was 770 Mgal/d (fig. 14; table 9), or more than 9 percent of the total water use in Oregon. With the inclusion of offstream fish hatcheries in 1990, surface water accounted for almost 99 percent of the self-supplied withdrawals. In order to prevent diseases, the water that is withdrawn for fish hatcheries usually is not recycled. Therefore, water withdrawn for fish hatcheries generally passes through the fish ponds once and is immediately returned to the stream. As a result, fish hatcheries do not add to consumptive use, which accounted for only 2 percent of all commercial use statewide.

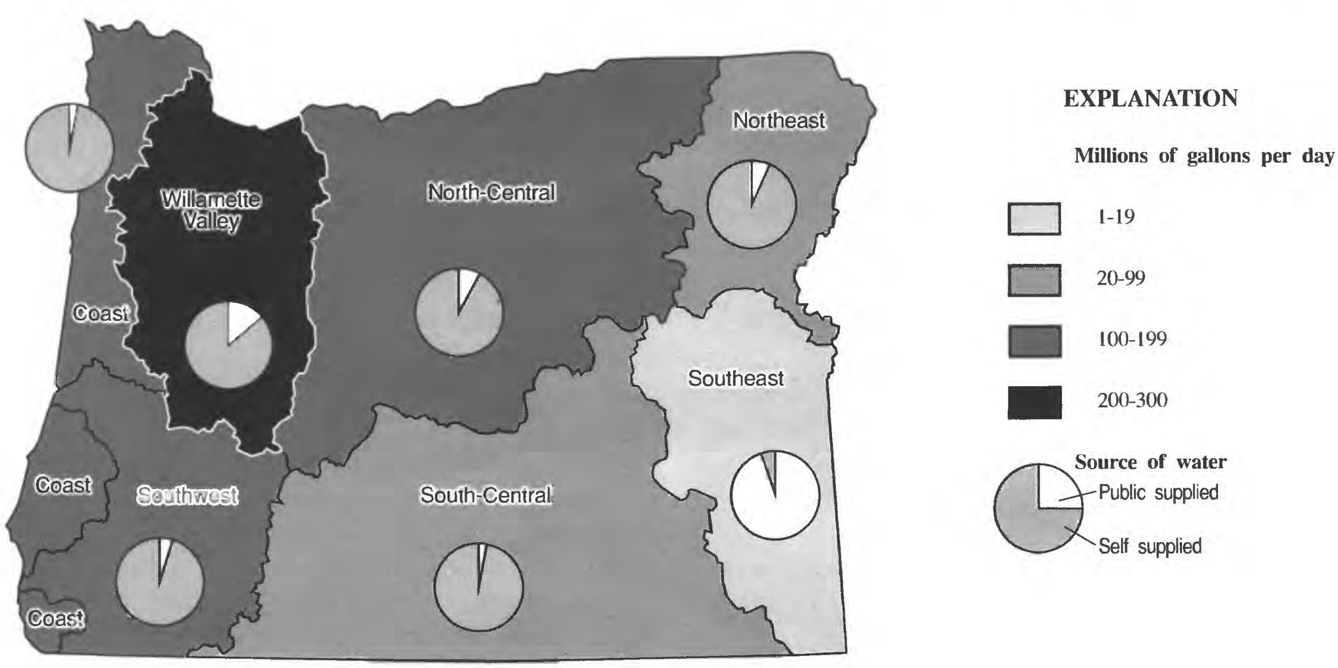

Figure 14. Total self-supplied and public-supplied water withdrawals for commercial uses, by region, 1990.

Excluding fish hatcheries, commercial use for 1990 was 82 Mgal/d, and 80 percent of that amount was supplied by public-supply systems.

Commercial water use in Oregon for 1985 was 46 Mgal/d (table 10). This amount did not include water withdrawn for fish hatcheries. The apparent increase in commercial water use (even without including fish hatcheries) between 1985 and 1990 was a result of more information being available in 1990.

Table 9. Commercial water use by region in Oregon, 1990
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Self-supplied withdrawals in Mgal/d: Ground water	Surface water	Total	Deliveries from public supply, in Mgal/d	Total: Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
			West of the Cascade Range			
Coast	0.3	170	170	5.9	170	1.4
Willamette	4.3	240	240	39	280	9.9
Southwest	.4	140	140	8.0	150	1.8
Total	5.1	540	550	53	600	13
			East of the Cascade Range			
South-Central	1.5	36	37	1.1	38	.8
North-Central	.4	100	100	9.2	110	2.1
Southeast	.1	0	.1	1.8	1.9	.4
Northeast	.2	21	22	1.6	23	.8
Total	2.3	160	160	14	170	4.2
State totals	7.3	700	710	66	770	17

Table 10. Commercial water use by region in Oregon, 1985
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Self-supplied withdrawals in Mgal/d: Ground water	Surface water	Total	Deliveries from public supply, in Mgal/d	Total: Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
			West of the Cascade Range			
Coast	0.1	0	0.1	4.8	4.9	1.0
Willamette	.4	0	.4	27	27	5.4
Southwest	.2	.1	.2	5.0	5.3	1.1
Total	.7	.1	.8	37	37	7.5
			East of the Cascade Range			
South-Central	.1	0	.1	.9	1.0	.2
North-Central	.7	0	.7	5.7	6.4	1.3
Southeast	0	0	0	.8	.9	.2
Northeast	.1	0	.1	.9	.9	.2
Total	.8	0	.9	8.2	9.1	1.8
State totals	1.5	.1	1.6	45	46	9.3

West of the Cascade Range

Most fish hatcheries in Oregon are located west of the Cascade Range; this area accounted for 600 Mgal/d (78 percent) of the 1990 commercial water use in Oregon. The fish hatcheries used 540 Mgal/d (90 percent), and public-supply systems used 53 Mgal/d (9 percent) of the water used for commercial purposes (table 9). The 600 Mgal/d used for commercial purposes is 33 percent of the total water use west of the Cascade Range.

Coast

Commercial water use in the Coast Region totaled 170 Mgal/d, and more than 160 Mgal/d was withdrawn for 13 fish hatcheries. Public-supply systems delivered 5.9 Mgal/d to commercial users, and 215 self-supplied commercial users withdrew 0.4 Mgal/d (table 9). Commercial water use accounted for 49 percent of the total withdrawals in the region.

Willamette

Twelve fish hatcheries in the Willamette Region withdrew nearly 96 percent (230 Mgal/d) of the self-supplied surface water used commercially within the region in 1990. About 7 Mgal/d of self-supplied, non-fish-hatchery withdrawals were made by 690 commercial users, and 39 Mgal/d was delivered from public-supply systems (table 9). Overall, commercial water use was 25 percent of the total water use in the region.

Southwest

Commercial water use was estimated to be 150 Mgal/d, or 38 percent of the total water use in the Southwest Region. Almost 140 Mgal/d was withdrawn by three fish hatcheries. An estimated 8.0 Mgal/d was delivered to commercial users by public-supply systems. More than 375 commercial users supplied their own water.

East of the Cascade Range

Oregon has 11 fish hatcheries east of the Cascade Range, most of which serve the Columbia River anadromous fish populations and most of which are located near the Columbia River and its tributaries. No fish hatcheries are located in the Oregon Closed Basins area (fig. 7). The 11 fish hatcheries withdrew most of the 160 Mgal/d of self-supplied surface water. An estimated 14 Mgal/d was delivered by public-supply systems (table 9). Commercial water use represents less than 3 percent of the total water use east of the Cascade Range.

South-Central

Only two fish hatcheries exist in the South-Central Region; however, these hatcheries accounted for 95 percent (36 Mgal/d) of the commercial water use in the region. The 139 self-supplied users withdrew 1.5 Mgal/d, more than 99 percent of which came from ground water (table 9). The 38 Mgal/d withdrawn and delivered for commercial water use represented less than 2 percent of the total water use in the region in 1990.

North-Central

Commercial water use in the North-Central Region totaled 110 Mgal/d in 1990, the most for any region east of the Cascade Range (table 9). The 100 Mgal/d withdrawn by seven fish hatcheries constituted most of the use. Deliveries from public-supply systems were 9.2 Mgal/d, and withdrawals from the 264 self-supplied commercial users were about 1 Mgal/d (table 9). The 110 Mgal/d of commercial use was 5 percent of the total water use in the region.

Southeast

Commercial water use in the sparsely populated Southeast Region was about 1.9 Mgal/d, of which about 95 percent (1.8 Mgal/d) was delivered by public-supply systems. The 31 commercial self-supplied users withdrew about 0.15 Mgal/d (table 9). Commercial water use was less than 1 percent of the total water use in the region.

Northeast

Two fish hatcheries in Union and Wallowa Counties withdrew 19 Mgal/d of surface water, which accounted for 83 percent of the commercial water use in the Northeast Region (23 Mgal/d). About 2 Mgal/d was withdrawn for 69 self-supplied commercial users, and 1.6 Mgal/d was delivered from public-supply systems (table 9). Commercial water use was less than 3 percent of the total water use in the region.

Industrial

The industrial water-use category includes water used for such purposes as processing, washing, refining, and cooling in facilities that manufacture products such as steel, chemical and allied products, paper and allied products, and petroleum products. The categories of industries were obtained from the Standard Industrial Classification Manual from the U.S. Office of Management and Budget (1987). Water used for industrial purposes may either be delivered by a public-supply system or be self-supplied.

Industrial water use in Oregon for 1990 totaled 360 Mgal/d (fig. 15; table 11), which included 78 percent (280 Mgal/d) that was self-supplied and 22 percent (79 Mgal/d) that was delivered by public-supply systems. An additional 1.6 Mgal/d of reclaimed wastewater was used for industrial purposes during 1990. Industrial water use was 4 percent of the total water use in Oregon. Industrial withdrawals in certain areas of Oregon were larger than irrigation withdrawals. In the Portland Basin, which includes parts of Multnomah, Clackamas, and Columbia Counties and parts of Washington State, self-supplied industrial groundwater pumpage accounted for 50 percent, public supply for 40 percent, and irrigation for 10 percent of the total withdrawals (Collins and Broad, 1993).

Industrial water use in Oregon for 1985 was 350 Mgal/d (table 12), nearly the same as in 1990. The methods used to obtain data for industrial self-supplied users during 1985 and 1990 were similar, but a more thorough investigation was conducted of industrial users supplied by public-supply systems during 1990. Nationwide, freshwater industrial water use declined 11 percent during the period 1985 to 1990 (Solley and others, 1993). Industrial water use in Oregon in 1990 did not decline when compared with 1985, principally because slightly more surface water was withdrawn by pulp-and-paper mills and more data were available in 1990.

The wood-products industry, including the paper- and allied-products-industry group, accounted for 76 percent of industrial withdrawals in Oregon during 1990, and the 15 pulp-and-paper mills accounted for 71 percent (200 Mgal/d) of all withdrawals by self-supplied industrial users. The chemical- and allied-products industry accounted for 13 percent (35 Mgal/d) of the self-supplied withdrawals; the food-products industry and the primary-metals industry each accounted for 5 percent (15 Mgal/d) of the withdrawals.

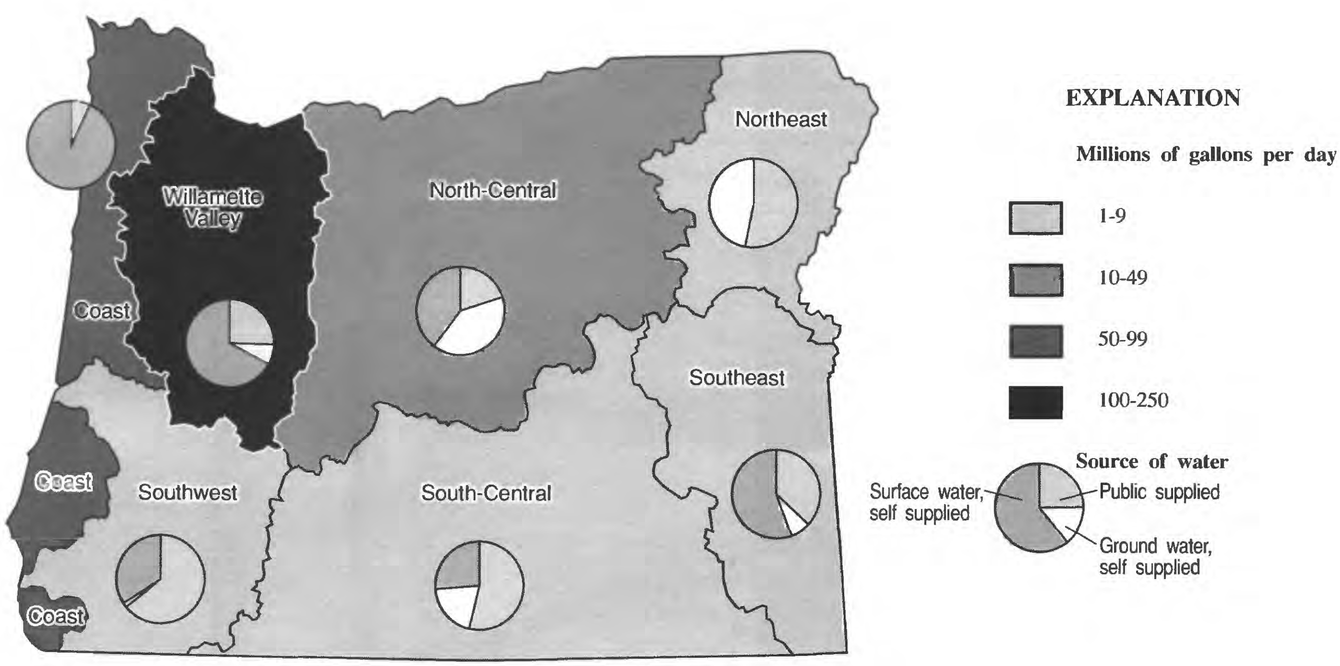

Figure 15. Total self-supplied and public-supplied water withdrawals for industrial uses, by region, 1990.

West of the Cascade Range

Most (about 89 percent) of the industrial water use in Oregon during 1990 was west of the Cascade Range, where all of the paper- and allied-products mills in Oregon are located. Self-supplied withdrawals totaled 250 Mgal/d, and 96 percent (240 Mgal/d) of these withdrawals were from surface water. Industrial water use was almost 18 percent of the total water use in the area.

Coast

Industrial water use in the Coast Region was 93 Mgal/d in 1990 (table 11), about 27 percent of the total water use in the region. Self-supplied surface water withdrawals for industrial purposes in the region totaled 87 Mgal/d; self-supplied ground-water withdrawals were insignificant. Deliveries from public-supply systems were about 6.2 Mgal/d.

The paper- and allied-products industries and the chemical- and allied-products industries accounted for 99 percent (86 Mgal/d) of the self-supplied withdrawals. Almost all of this amount came from surface-water sources; consequently, these intensive water-using industries are located near ample sources of surface water. However, a paper mill in the Coos Bay-North Bend area obtains its water from wells operated by the local public-supply system.

Table 11. Industrial water use by region in Oregon, 1990
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Self-supplied withdrawals, in Mgal/d: Ground water	Surface water	Total	Reclaimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
West of the Cascade Range							
Coast	0	87	87	1.0	6.2	93	6.7
Willamette	14	150	160	.6	59	220	19
Southwest	.2	2.9	3.1	0	5.5	8.6	5.6
Total	14	240	250	1.6	71	320	31
East of the Cascade Range							
South-Central	1.1	1.4	2.5	0	2.9	5.5	1.0
North-Central	14	11	25	0	2.6	28	6.6
Southeast	.3	2.5	2.8	0	1.7	4.5	.4
Northeast	.7	0	.7	0	.8	1.5	.2
Total	16	15	31	0	8.0	39	8.1
State totals	30	250	280	1.6	79	360	39

Table 12. Industrial water use by region in Oregon, 1985
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Self-supplied withdrawals, in Mgal/d: Ground water	Surface water	Total	Reclaimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
West of the Cascade Range							
Coast	0	67	67	0	4.9	72	1.0
Willamette	10	160	170	.6	35	210	16
Southwest	0	22	22	0	3.5	25	1.5
Total	10	250	260	.6	43	310	18
East of the Cascade Range							
South-Central	2.4	0	2.4	0	4.7	7.2	.5
North-Central	16	6.7	23	0	1.7	24	1.1
Southeast	.7	1.8	2.5	0	2.1	4.6	1.8
Northeast	.1	1.7	1.8	0	.8	2.6	.2
Total	19	10	29	0	9.4	39	3.5
State totals	29	260	290	.6	53	350	22

Willamette

Total water use for industrial purposes in the Willamette Region in 1990 was about 220 Mgal/d, of which self-supplied surface-water withdrawals accounted for 68 percent (150 M gal/d), deliveries from public-supply systems accounted for almost 27 percent (59 Mgal/d), and self-supplied ground-water withdrawals accounted for 6 percent (14 Mgal/d) (table 11). The Willamette River provided about 84 Mgal/d, and the Columbia River, between Bonneville Dam and St. Helens, provided about 42 Mgal/d. The city of Portland delivered an estimated 22 Mgal/d to industrial users in its service area; the city of Eugene delivered 12 Mgal/d to its users. Basin-fill alluvium, usually in areas along the Willamette and Columbia Rivers, is the major source of ground water for industrial use. Industrial users in the Willamette Region also tapped basalt aquifers as a source of supply. Industrial water use represented 20 percent of the total water use in the Willamette Region.

All five of the pulp-and-paper mills in the Willamette Region are located on the Willamette or Columbia Rivers, because of the large amount of water required for production. These mills withdrew 120 Mgal/d of surface water and 2 Mgal/d of ground water during 1990.

An estimated 4 Mgal/d of water was used by plywood and other wood-products mills; 75 percent (3 Mgal/d) of the amount came from surface water. Water use at these mills has decreased over the last 20 years. Because of concerns about water quality and changes in production methods, the mills have begun to rely less on log ponds for log sorting and prevention of log drying (which can cause wood splitting and contribute to fire hazards). Today, machines sort logs and deliver them to the saw deck, and log deck (stack) sprinklers are used to inhibit drying.

The chemical- and allied-products group, the second largest water-using group in the Willamette Region, used 22 Mgal/d during 1990 of which most (89 percent) came from surface water. The food and kindred products group, the third largest water-using industry in the Willamette Region, used 9 Mgal/d that was derived mostly from deliveries from public supply and from withdrawals of ground water. The heavy reliance on public supply and ground water indicates the importance of water quality to this industry for which the primary use is washing the product. The primary-metals industry, located in the Portland and Albany areas, was the fourth largest water-using group. The estimated total combined withdrawals from surface and ground water was 7 Mgal/d, and an additional 1 Mgal/d was from public-supply systems.

Southwest

No pulp-and-paper mills are located in the Southwest Region; therefore, total industrial water use (8.6 Mgal/d) was much less than in other parts of Oregon west of the Cascade Range and only 2 percent of the total water use in the region. The largest water-using industrial group was the wood-products industry, which accounted for 5 Mgal/d of withdrawals. About 65 percent of the industrial withdrawals were consumed; however, this number is misleading because of interbasin transfers from the Coast Region. Cosumptive use and withdrawal values are assigned to the basins in which they occur. In the case of an interbasin transfer, the percentage of consumptive use is calculated only for water withdrawn in the basin, which includes water transferred into the basin.

East of the Cascade Range

Industrial water use east of the Cascade Range was 39 Mgal/d, less than 1 percent of the total water use east of the mountains (table 11). About 41 percent (16 Mgal/d) of the industrial water use came from ground water, 38 percent (15 Mgal/d) from surface water, and 21 percent (8 Mgal/d) from public-supply systems. Consumptive use east of the Cascade Range was 21 percent of industrial withdrawals and was higher than the State average, because effluent is used for irrigation by several users. In this report, industrial water used in this manner is consumed 100 percent. Food processors and wood-products industries each withdrew an estimated 13 Mgal/d in 1990. There are no pulp-and-paper mills east of the Cascade Range.

South-Central

Industrial water use in South-Central Region was 5.5 Mgal/d, less than 1 percent of the total water use in the region in 1990 (table 11). Most of the water used for industrial purposes was delivered from public-supply systems (53 percent). Self-supplied industries in the Klamath River and Goose Lake Basins relied primarily on surface and ground water. Self-supplied industries in the Oregon Closed Basins used primarily ground water.

North-Central

The North-Central Region had the largest amount of industrial use (28 Mgal/d) east of the Cascade Range; however, this amount was only about 1 percent of the total water use in this region during 1990 (table 11). Self-supplied ground-water and surface-water withdrawals provided 50 percent (14 Mgal/d) and 39 percent (11 Mgal/d), respectively, of the water supplies for industrial use.

Wood-products industries in the North-Central Region relied on self-supplied surface-water sources for most of the 9 Mgal/d they withdrew. Food-products industries are common in the Hood and Umatilla River Basins; total withdrawals were estimated to be 8 Mgal/d. Canneries in the Hood River Basin process fruit, and canneries in the Umatilla River Basin process vegetables. Although surface water is not usually a supply source for canneries in Oregon, the fruit canneries in the Hood River area rely on surface water, primarily from springs in the porous volcanic material northeast of Mount Hood. Most of the food processors in the Umatilla Basin rely on ground water.

Southeast

The food-products industry in the Ontario area used most of the industrial water withdrawn in the Southeast Region. Total industrial water use in this region was 4.5 Mgal/d, less than 1 percent of the region's total water. Surface water, specifically from the Snake River, and public-supply systems provide water for the canneries and sugar-producing plants in the area. Ground water supplies a mushroom-growing operation located in the region.

Northeast

The wood-products industry in the Northeast Region used most of the 1.5 Mgal/d withdrawn for industrial purposes during 1990. Public-supply deliveries and self-supplied ground-water withdrawals provided most of the water used. Industrial water use as a whole accounted for less than 1 percent of the region's total water use.

Mining

Water withdrawals in this category are used for the extraction of naturally occurring materials (excluding petroleum), milling, and other preparations. Whereas dewatering is included as a use in the National Water-Use Information Program, the lack of information precludes dewatering from being included in these estimates. The USGS water-use program considers mine processing water to be industrial water use. All mining uses in this category are self-supplied.

In 1990, 1.6 Mgal/d of water was withdrawn for mining in Oregon. Approximately 1.0 Mgal/d was from ground water and 0.6 Mgal/d from surface water (table 13 and fig. 16), most of which (99 percent ground water and 74 percent surface water) was used in sand-and-gravel operations. The remainder of the water is used primarily for placer mines, which usually operate between early spring and midsummer, when surface flows are sufficient.

Table 13. Mining water use by region in Oregon, 1990
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total	
West of the Cascade Range				
Coast	0.1	0	0.1	0
Willamette	.4	.4	.8	0
Southwest	.1	0	.1	0
Total	.6	.4	1.0	0
East of the Cascade Range				
South-Central	0	0	0	0
North-Central	.2	0	.2	0
Southeast	0	0	0	0
Northeast	.2	.2	.4	.1
Total	.4	.2	.6	.1
State totals	1.0	.6	1.6	.2

A study conducted by the U.S. Bureau of Mines (Quan, 1988) estimated that 7 Mgal/d of water was withdrawn by mining operations in Oregon in 1984. This total resulted from a query of 40 users: 2 operations used more than 1 Mgal per year, 14 used less, 19 used none, and 5 were closed. The estimated amount from Quan (1988) is consistent with the USGS estimate for 1985 of 7.5 Mgal/d (table 14). Much of the decline in water use between 1985 and 1990 has resulted from a decrease in the number of active placer mines and from reduced activity at the largest mining operation in Oregon.

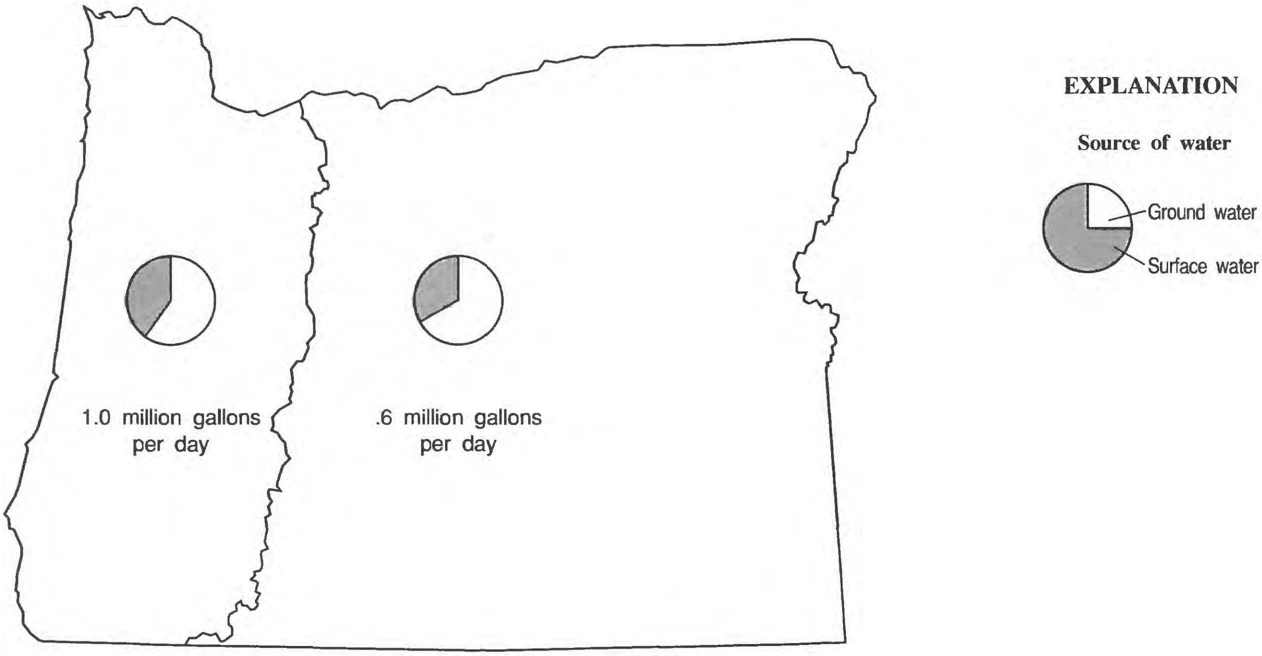

Figure 16. Total water withdrawals for mining use, west and east of the Cascade Range, 1990.

Table 14. Mining water use by region in Oregon, 1985
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Withdrawals, in Mgal/d: Ground water	Surface water	Total	Consumptive use, in Mgal/d
West of the Cascade Range				
Coast	0	0	0	0
Willamette	.1	.1	.2	0
Southwest	0	2.5	2.5	.4
Total	.1	2.6	2.8	.4
East of the Cascade Range				
South-Central	0	0	0	0
North-Central	0	2.1	2.1	.5
Southeast	0	.1	.1	0
Northeast	.1	2.5	2.6	.7
Total	.1	4.6	4.7	1.2
State totals	.3	7.2	7.5	1.6

West of the Cascade Range

Sixty percent (0.6 Mgal/d) of the water withdrawn in 1990 for mining purposes west of the Cascade Range was ground water (table 13). Sand-and-gravel operations accounted for almost all (greater than 99 percent) of the ground-water withdrawals and for more than 90 percent of the surface-water withdrawals (0.4 Mgal/d) for mining. These operations are distributed throughout the area. Mineral mines in areas west of the Cascade Range consist of placer gold mines in Josephine and Jackson Counties, and soapstone and silica mines in Douglas and Jackson Counties.

The largest mining operation in the State, Glenbrook Nickel at Riddle (Douglas County), processed material but did no mining in 1990.

East of the Cascade Range

Only 0.6 Mgal/d was withdrawn for mining purposes east of the Cascade Range in 1990. Sand-and-gravel operations located in this area used more than 95 percent of the ground-water withdrawals and 33 percent of the surface-water withdrawals for mining. Mineral mines (primarily placer gold mines in Baker and Grant Counties), and crushed limestone, perlite, pumice, and diatomite mines in Baker, Deschutes, and Lake Counties (Wiley, 1991), accounted for most of the surface-water withdrawals for mining.

Thermoelectric Power

Only three thermoelectric-power facilities in Oregon generate electric power by using fossil-fuel, nuclear, or geothermal energy. Total water withdrawals for 1990 by these three facilities was 15 Mgal/d, all from surface-water sources (table 15). A total of 8,000 GWh (Gigawatt hours) of energy was produced by these plants. The amount of water withdrawn was less than 1 percent of the total water use in Oregon for 1990; however, the power generated was 16 percent of the power generated in Oregon.

Table 15. Thermoelectric power water use by region in Oregon, 1990
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt-hours
		West of the Cascade Range		
Coast	0	15	10	6,900
Willamette	0	0	0	0
Southwest	0	0	0	0
Total	0	15	10	6,900
		East of the Cascade Range		
South-Central	0	0	0	0
North-Central	0	.4	.4	1,100
Southeast	0	0	0	0
Northeast	0	0	0	0
Total	0	.4	.4	1,100
State totals	0	15	10	8,000

In 1985, thermoelectric-power water use was 12 Mgal/d; 7,500 GWh of power was generated (table 16). Although geothermal energy is used for heating in the Klamath Falls area, significant amounts of electrical power are not generated in Oregon by this source of energy, and no water was used for geothermal-power production in Oregon in 1985 or 1990.

Only thermoelectric plants that use fossil-fuel or nuclear energy are considered in this report to be water users. Consequently, other power-generating facilities, such as the refuse-burning facility in Marion County (which uses ground water) and several cogeneration facilities around the State, are not included.

Table 16. Thermoelectric power water use by region in Oregon, 1985
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt-hours
		West of the Cascade Range		
Coast	0	11	2.3	6,900
Willamette	0	0	0	0
Southwest	0	0	0	0
Total	0	11	2.3	6,900
		East of the Cascade Range		
South-Central	0	0	0	0
North-Central	0	.5	.5	590
Southeast	0	0	0	0
Northeast	0	0	0	0
Total	0	.5	.5	590
State totals	0	12	2.8	7,500

Nuclear

The Trojan Nuclear Power Plant in Columbia County had an installed capacity of 1.22 GWh and supplemented hydroelectric facilities during periods of high demand, usually from October through April. In 1990, this plant operated during all but the summer months and produced 6,100 GWh. Withdrawals from the Columbia River for the plant were estimated to be 14 Mgal/d; consumptive use was estimated to be 10 Mgal/d.

Fossil-Fuel

Two fossil-fuel plants, the Boardman Plant in Morrow County and the Beaver Plant in Columbia County, withdraw less than 1 Mgal/d from surface water. Total power generated from these two plants in 1990 was 1,900 GWh, and consumptive use was estimated to be 100 percent.

The Boardman Plant uses a combination of light-weight oil and bituminous coal as its heat source, although coal is used almost 100 percent of the time. Water delivery to this facility is a multistage process, as noted in the Appendix. Although the plant is located in Morrow County, the withdrawal point is in Gilliam County; the point of diversion and the site of use are also located in two different hydrologic units. The pumps that supply water to the plant are located along Willow Creek in the backwater behind the John Day Dam on the Columbia River. These pumps, owned by a corporate farm, provide irrigation water for lands on the plateau above the Columbia River. An undetermined amount of these withdrawals goes to the cooling reservoir at the power plant. The withdrawal amounts estimated in this report are for those amounts withdrawn from the cooling reservoir rather than from the Columbia River.

The Beaver Plant uses light oil and natural gas as its fuel source; natural gas provides 97 percent of the fuel. This facility withdraws water from the Columbia River and generated 800 GWh in 1990. The plant did not operate in 1985.

Hydroelectric Power

Oregon ranked second in the nation in hydroelectric-power generation in 1990 (Solley and others, 1993). Facilities in Oregon that generate electricity from water-driven turbine generators fall within the hydroelectric-power category; generally, hydroelectric-power generation is considered to be an instream water use.

It is common in Oregon, however, for power companies located in areas of high stream gradients to divert water from a stream into a canal. The canal has nearly constant elevation, whereas the river channel continues to drop in elevation. The water from the canal returns to the river several miles downstream, where it then falls as much as 1,000 feet or more through penstocks and turbines. The water used by the hydroelectric plants in these instances generally is not consumed and is effectively an instream use; however, locally the plants can greatly influence the hydrologic system.

More than 480,000 Mgal/d was used by 57 hydroelectric facilities in 1990 to generate 41,000 GWh of electricity (fig. 17; table 17). The power generated at these facilities was 84 percent of the power generated in Oregon. The 1985 estimates (table 18), produced by a slightly different methodology, showed withdrawals for hydroelectric power to be 440,000 Mgal/d. The facilities that used the most water and produced the most power were the four facilities located on the Columbia River. Although the dams at these hydroelectric facilities are located in both Oregon and Washington, the power plants are located in Oregon; therefore, the water use is assigned to Oregon. Bonneville Dam has power plants in both Washington and Oregon, so water use is assigned on the basis of the power generated at each station. In 1990, the four facilities on the Columbia River used 440,000 Mgal/d (92 percent of the total use for hydropower) to produce 33,000 GWh or 80 percent of the total hydroelectric production.

West of the Cascade Range

The 33 non-Columbia River hydroelectric facilities west of the Cascade Range withdrew 52 percent of the water used for hydroelectric-power generation to produce 54 percent of the power. Many of the 17 facilities in the Willamette Region are constructed and managed by the U.S. Army Corps of Engineers to produce hydroelectricity and to provide navigation, flood-crest reduction, and low-flow augmentation. By using the storage area behind a dam, runoff from winter and spring storms can be captured in the reservoir and then released during the summer. This practice reduces the potential for flooding and provides increased summer flows for irrigation and the dilution of wastewater. All of the U.S. Army Corps of Engineers hydroelectric facilities are located on major streams that drain the western slope of the Cascade Range. These facilities usually consist of an upper dam, where most of the power is produced, and a lower dam (called a reregulation dam) that is used to mitigate the fluctuations in downstream flow caused by power production. In 1990, the 17 facilities in the Willamette Region generated 2,800 GWh using 19,000 Mgal/d and the facility at Bonneville Dam generated 8,500 GWh using 120,000 Mgal/d (table 17).

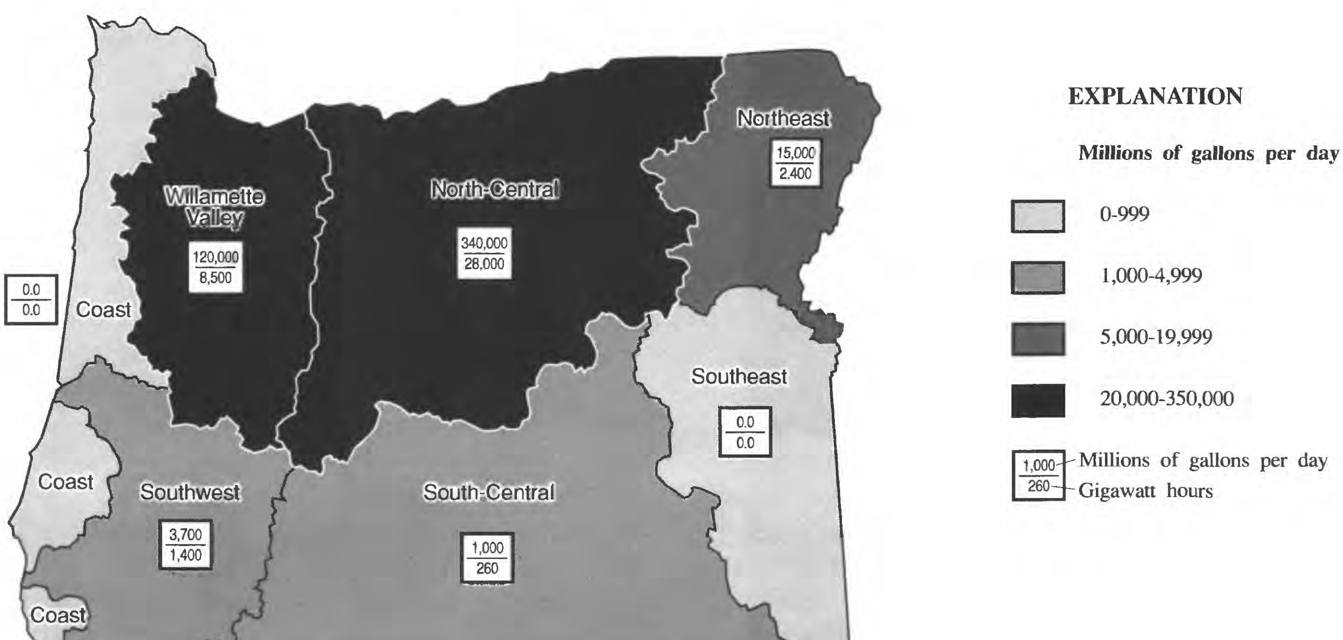

Figure 17. Total water withdrawals and power production for hydroelectric facilities, by region, 1990.

Table 17. Hydroelectric power water use by region, in Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Region name	Water use, in Mgal/d	Power generated, in GWh
	West of the Cascade Range	
Coast	0	0
Willamette	120,000	8,500
Southwest	3,700	1,400
Total	130,000	9,900
	East of the Cascade Range	
South-Central	1,000	260
North-Central	340,000	28,000
Southeast	0	0
Northeast	15,000	2,400
Total	350,000	31,000
State totals	480,000	41,000

Table 18. Hydroelectric power water use by region, in Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours)

Region name	Water use, in Mgal/d	Power generated, in GWh
	West of the Cascade Range	
Coast	0	0
Willamette	120,000	13,000
Southwest	4,300	1,600
Total	120,000	15,000
	East of the Cascade Range	
South-Central	680	160
North-Central	290,000	27,000
Southeast	0	0
Northeast	23,000	3,600
Total	310,000	31,000
State totals	440,000	46,000

Hydroelectric-power generation also occurs in the Umpqua and Rogue River Basins; all of the 15 hydroelectric facilities in this area are located along the North Umpqua River or in the upper reaches of the Rogue River. The 15 facilities used a total of 3,700 Mgal/d to generate 1,400 GWh. The Umpqua River facilities are primarily the canal-and-penstock variety located within steep, narrow canyons of the basin and have small storage areas. Most facilities in the Rogue River Basin also use canals and penstocks. One such facility, managed by the BOR, generates power from canals that bring water, primarily for irrigation, from the eastern side of the Cascade Range.

The one large reservoir in the Rogue River Basin that has a hydroelectric facility is a U.S. Army Corps of Engineers project that provides flood control, supplies water, and generates electricity. Controversy surrounding the completion of the Elk Creek Dam, another large project in the Rogue River Basin, demonstrates the increasing constraints on dam construction in streams that have anadromous fish populations.

East of the Cascade Range

Twelve hydroelectric facilities, excluding those on the Columbia River, used an estimated 22,000 Mgal/d and generated 3,900 GWh of power in 1990. These facilities are located primarily on the Klamath, Deschutes, and Snake Rivers. Most hydroelectric facilities on the eastern side of the Cascade Range are located on the lower reaches of the main stem rivers, rather than on the upper reaches of main stem rivers or tributaries, as on the western side of the Cascade Range.

The three hydroelectric facilities on the Klamath River used a combined total of 1,000 Mgal/d to generate 260 GWh of power during 1990. One facility generates power from water flowing from Klamath Lake into the Klamath River. Klamath Lake is a natural lake, but it is regulated by a small dam at the outlet to increase storage, primarily for irrigation use. One dam and reservoir exist on the main stem of the Klamath River below Klamath Lake, whereas the development of a second, similar dam, Salt Caves, has been stalled since the mid-1980's because of conflicts regarding their effect on fisheries.

There are four hydroelectric facilities on the Deschutes River and one hydroelectric facility in the Hood River drainage. The five facilities used 5,700 Mgal/d to generate 1,300 GWh of electricity during 1990. Two of the facilities on the Deschutes River use storage from a reservoir for production; the other two facilities rely on the natural flow of the river. Of the four facilities on the Deschutes River, the two facilities that rely on storage used more than 90 percent of the water and generated more than 90 percent of the electricity. The fifth plant uses a canal and penstock for production.

During 1990, two facilities on the Snake River generated almost 2,400 GWh and used almost 15,000 Mgal/d of water. Brownlee, a third facility on the Snake River, has its generators on the Idaho side of the Snake River and is not included in the data. All of the Snake River dams are owned by power companies and also are used for flood control.

Livestock

Water used for the production of red meat, poultry, eggs, milk, and wool is categorized as stock water use, whereas water used for the production of fur-bearing animals, horses, and animal aquaculture (fish farms) is categorized as animal-specialty water use. In previous years, the water-use program grouped the animal-specialty category with the stock category. When fish-farming operations in other parts of the country (Idaho, Arkansas, Mississippi) began, the two categories were created. Although some trout rearing does exist in Oregon, scant information is available regarding instream and offstream use. Consequently, water use for trout-rearing operations is not estimated. Other aquaculture activities, such as oyster rearing, also exist in Oregon but are categorized as instream uses. Horse production and mink production are the only classified animal specialties in Oregon. Stock water use and animal-specialty water use are grouped in this report as livestock water use.

According to the U.S. Department of Commerce (1989), of the nearly 20,000 farms involved in the rearing of livestock and animal specialties in Oregon in 1987, 65 percent raised beef cattle. On more than 2,000 farms, sheep, goats, and horses were reared. Oregon ranked fifth in the nation in the raising and production of fur-bearing animals, primarily mink, with approximately 150 farms. Oregon ranked 10th in sheep and lamb production. For the most valuable commodity in Oregon, cattle and calf production, Oregon ranked 26th nationally in 1987 (U.S. Department of Agriculture, undated).

Total water withdrawals during 1990 for livestock were estimated to be 21 Mgal/d, of which about 86 percent was from surface water (fig. 18 and table 19). Consumptive use for this category was assumed to be 100 percent. Stock water use accounted for all but 0.6 Mgal/d of the withdrawals for this category. Water use for all types of cattle rearing, excluding dairy cattle, was an estimated 16 Mgal/d for 1990; dairy production used an estimated 3 Mgal/d; poultry used 0.6 Mgal/d; sheep and horse rearing used an estimated 0.5 Mgal/d; and swine rearing used an estimated 0.3 Mgal/d. These total amounts include uses such as washing and dairy sanitation but do not include the growing of forage crops. Water use was estimated on the basis of the following populations: cattle (excluding dairy cows), 1,300,000; dairy cows, 95,000; poultry, 7,500,000; sheep, 475,000; swine, 100,000; and horses, 60,000. Livestock water use accounted for less than 1 percent of the total 1990 water use in Oregon.

Livestock water use in 1985 was estimated to be 25 Mgal/d (table 20). The reduction in water use for this category from 1985 to 1990 can be attributed primarily to a decrease in the populations of livestock in Oregon from 1985 to 1990, except for poultry.

Figure 18. Total water withdrawals for livestock use, west and east of the Cascade Range, 1990.

Table 19. Livestock water use by region in Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Stock: Withdrawals, in Mgal/d: Ground water	Stock: Withdrawals, in Mgal/d: Surface water	Stock: Withdrawals, in Mgal/d: Total	Stock: Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Animal specialties: Withdrawals, in Mgal/d: Surface water	Animal specialties: Withdrawals, in Mgal/d: Total	Animal specialties: Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Total livestock: Withdrawals, in Mgal/d: Surface water	Total livestock: Withdrawals, in Mgal/d: Total	Total livestock: Consumptive use, in Mgal/d
West of the Cascade Range												
Coast	0.1	1.3	1.4	1.4	0	0	0	0	0.1	1.3	1.5	1.5
Willamette	.4	3.2	3.6	3.6	0	.2	.2	.2	.4	3.4	3.8	3.8
Southwest	.1	.7	.8	.8	0	.1	.1	.1	.1	.8	.9	.9
Total	.5	5.3	5.8	5.8	0	.3	.4	.4	.6	5.6	6.1	6.1
South-Central	.7	4.0	4.7	4.7	0	.1	.1	.1	.7	4.1	4.8	4.8
North-Central	1.2	3.9	5.0	5.0	0	.1	.1	.1	1.2	4.0	5.2	5.2
Southeast	.5	1.9	2.4	2.4	0	0	0	0	.5	2.0	2.4	2.4
Northeast	.3	2.5	2.8	2.8	0	.1	.1	.1	.3	2.5	2.8	2.8
East of the Cascade Range												
Total	2.7	12	15	15	0	.3	.3	.3	2.7	13	15	15
State totals	3.2	18	21	21	.1	.6	.6	.6	3.2	18	21	21

Table 20. Livestock water use by region in Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Stock: Withdrawals, in Mgal/d: Ground water	Stock: Withdrawals, in Mgal/d: Surface water	Stock: Withdrawals, in Mgal/d: Total	Stock: Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Animal specialties: Withdrawals, in Mgal/d: Surface water	Animal specialties: Withdrawals, in Mgal/d: Total	Animal specialties: Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Total livestock: Withdrawals, in Mgal/d: Surface water	Total livestock: Withdrawals, in Mgal/d: Total	Total livestock: Consumptive use, in Mgal/d
West of the Cascade Range												
Coast	0.1	1.3	1.5	1.5	-	-	-	-	0.1	1.3	1.5	1.5
Willamette	.5	4.4	4.8	4.8	-	-	-	-	.5	4.4	4.8	4.8
Southwest	.1	1.0	1.1	1.1	-	-	-	-	.1	1.0	1.1	1.1
Total	.7	6.7	7.4	7.4	-	-	-	-	.7	6.7	7.4	7.4
East of the Cascade Range												
South-Central	.8	4.4	5.2	5.2	-	-	-	-	.8	4.4	5.2	5.2
North-Central	1.4	4.8	6.2	6.2	-	-	-	-	1.4	4.8	6.2	6.2
Southeast	.6	2.5	3.1	3.1	-	-	-	-	.6	2.5	3.1	3.1
Northeast	.3	2.9	3.2	3.2	-	-	-	-	.3	2.9	3.2	3.2
Total	3.2	14	18	18	-	-	-	-	3.2	14	18	18
State totals	3.8	21	25	25	-	-	-	-	3.8	21	25	25

West of the Cascade Range

The largest use of water for livestock west of the Cascade Range was by the dairy industry, which used nearly 41 percent (2.5 Mgal/d) of the total withdrawals. This amount is slightly more than the 38 percent (2.3 Mgal/d) used by the cattle industry. Animal-specialty water use was 0.4 Mgal/d. Surface-water withdrawals accounted for 92 percent (5.6 Mgal/d) of the water used for livestock west of the Cascade Range.

The largest concentration of dairy activity in western Oregon is in the Coast Region of Tillamook and Coos Counties, where creamery and cheese plants are located, and in the heavily populated Willamette Region. In 1990, the population of beef cattle was distributed throughout Lane, Linn, Marion, and Clackamas Counties in the Willamette Region, Coos County in the Coast Region, and Jackson and Douglas Counties in the Southwest Region. Douglas County had the largest population of beef cattle (approximately 43,000) and the largest number of sheep (93,000). The swine population varied between 10,000 and 15,000 animals in Marion, Washington, Yamhill, and Clackamas Counties. Clackamas County had the largest number of horses, and the rest of the horse population was distributed throughout western Oregon. Mink farms were most numerous in Marion and Linn Counties.

East of the Cascade Range

Water use for beef cattle accounted for 94 percent (14 Mgal/d) of the livestock withdrawals east of the Cascade Range during 1990. Water use for dairy cattle, sheep, and swine totaled 1 Mgal/d. Water used for animal specialties (horses) was 0.3 Mgal/d.

The population of beef cattle was large in the remote counties of the South-Central and Southeast Regions. Malheur County, with 155,000 head of cattle, was the most populous, followed by Harney County (110,000) and Lake County (100,000). Surface water was the primary source of water for beef stock, but ground water contributed more than 20 percent of the total in the area east of the Cascade Range. The dairy-cattle population totaled 15,000, About 70 percent of which was located in Malheur and Klamath Counties. The sheep population was concentrated in Umatilla, Morrow, and Klamath Counties, where the 64,000 head accounted for 47 percent of the sheep population east of the Cascade Range. Forty-three percent (14,500) of the swine population east of the Cascade Range was concentrated in Umatilla County. The horse population was fairly evenly distributed east of the Cascade Range.

Irrigation

In the National Water-Use Information Program, the "irrigation" category is water artificially applied to farms and horticultural crops and water used to irrigate public and private golf courses (Solley and others, 1993). Water used for irrigation may be self-supplied or supplied by irrigation companies or districts. Oregon ranked seventh nationally in irrigation withdrawals and ninth in acres irrigated; the amount of water withdrawn for irrigation in Oregon was about 5 percent of the total nationwide irrigation withdrawals (Solley and others, 1993). Application rates statewide were about 3.8 feet per year. These rates are defined as the total annual withdrawals for irrigation divided by the number of acres irrigated.

Irrigation water use in Oregon during 1990 totaled 6,900 Mgal/d (table 21) and accounted for 82 percent of the total water use in the State. More than 91 percent (6,300 Mgal/d) of the irrigation withdrawals were from surface water, whereas the remaining withdrawals came from ground water (570 Mgal/d) and from reclaimed wastewater (11 Mgal/d). Approximately 43 percent (3,000 Mgal/d) of water withdrawn for irrigation was used for crops. Conveyance losses from canals and pipes that deliver irrigation water to fields was about 19 percent (1,300 Mgal/d) of the water withdrawn for irrigation.

Most of the irrigation in Oregon occurs in the rural areas east of the Cascade Range (fig. 19). Consequently, most irrigation water is used to grow forage for livestock. Alfalfa, corn silage, pasture, and hay were grown on about two-thirds of the irrigated lands in Oregon. Grains such as wheat, barley and oats were irrigated on about 15 percent of the lands in Oregon. Vegetable and field crops, such as corn, potatoes, beans, onions and peas, were grown on about 10 percent of the irrigated lands in the State. Other irrigated crops were grown on less than 5 percent of the irrigated lands statewide and included berries and orchards, seed crops such as grass and sugar beets, and other crops such as mint, hops, cranberries, and nursery stock.

Table 21. Irrigation water use by region in Oregon, 1990
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Withdrawals, in Mgal/d				Irrigated land by irrigation type, in thousand acres			Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d
	Fresh water		Reclaimed wastewater	Total	Spray	Flood	Total		
	Ground	Surface							
West of the Cascade Range									
Coast	1.4	31	0.2	32	29	0.7	29	0.1	23
Willamette	140	220	4.8	360	290	1.1	290	13	250
Southwest	5.4	180	.1	190	43	36	79	35	110
Total	150	430	5.1	580	360	38	400	48	390
East of the Cascade Range									
South-Central	230	2,100	.2	2,300	180	420	600	370	840
North-Central	140	1,800	5.4	1,900	420	120	540	430	880
Southeast	25	1,200	.1	1,200	23	230	250	290	500
Northeast	31	830	.1	860	88	160	250	140	380
Total	420	5,900	5.8	6,300	710	930	1,600	1,200	2,600
State totals	570	6,300	11	6,900	1,100	970	2,000	1,300	3,000

Figure 19. Total water withdrawals for irrigation, by region, 1990.

More than 38 percent (2,000,000 acres) of the 5,200,000 acres of Oregon cropland were irrigated in 1990. Various types of sprinkler systems (center pivot, hand move, side roll, solid set, big gun, and drip) were used on 55 percent (1,100,000 acres) of the State's irrigated acreage in 1990. Irrigation with these types of sprinklers is referred to as spray irrigation. Flood (gravity-flow) irrigation refers to systems that use gravity to deliver water to crops by way of canals; with this technique, the rows of crops are flooded. Flood irrigation was used on 45 percent (910,000 acres) of the irrigated lands in Oregon during 1990. Sprinklers generally have an application efficiency of 65 to 87 percent, whereas flood irrigation has an application efficiency of about 45 percent (King and others, 1978).

Water withdrawn for irrigation in Oregon during 1985 totaled 5,700 Mgal/d and irrigated the same amount of land (2,000,000 acres) as in 1990 (table 22).

Table 22. Irrigation water use by region in Oregon, 1985
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region name	Withdrawals, in Mgal/d: Fresh water: Ground	Fresh water: Surface	Reclaimed wastewater	Total	Irrigated land by irrigation type, in thousand acres: Spray	Flood	Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d
				West of the Cascade Range					
Coast	2.7	25	0.4	27	26	0.6	27	2.5	17
Willamette	140	160	1.6	290	270	1.2	280	3.0	210
Southwest	12	280	.1	290	43	40	84	40	150
Total	150	460	2.1	610	340	42	390	44	370
				East of the Cascade Range					
South-Central	120	1,400	.4	1,500	200	400	600	88	680
North-Central	120	1,600	1.8	1,700	400	130	530	290	730
Southeast	37	1,100	.1	1,100	24	220	250	210	380
Northeast	37	670	.2	710	150	120	270	140	280
Total	320	4,800	2.6	5,100	780	870	1,600	730	2,100
State totals	470	5,200	4.6	5,700	1,100	910	2,000	770	2,500

The reported increase in the amount of water withdrawn between 1985 and 1990 was attributable to increases in the amount of data available, the use of a different formula for calculating crop coefficients, and a longer irrigation period in 1990 resulting from the dry spring season. The differences attributable to the use of different crop coefficients constituted more than 40 percent of the reported increase in water use, as indicated by the increases in consumptive use. Consumptive use and crop-water need are considered to be the same for this report.

Irrigation-application rates for different crops are presented in the regional discussions of this report to show the differences in irrigation requirements among crops within a region and between crops in different regions. The application rates are the sum of the average crop-water need for the crops in the region, conveyance loss for the region, and application inefficiency in the region. Average crop-water need is the sum of the weighted crop-water needs for each crop in the region. The crop-water need is weighted on the basis of the percentage of irrigated acreage in the region that each crop represents. Average conveyance losses are the total conveyance losses in a region divided by the total irrigation withdrawals in a region. Application inefficiencies refer to water lost through the use of sprinkler or flood application techniques. Water losses from sprinkler-application include evaporation and misdirected spray; water losses from flood application result from the percolation of water into the ground below the root zone before it reaches the crop. A gross estimate of the water loss ascribable to application inefficiencies can be obtained by subtracting consumptive use and conveyance losses from total withdrawals.

West of the Cascade Range

Approximately 27 percent (400,000 acres) of the 1,500,000 acres of cropland west of the Cascade Range were irrigated during 1990, of which 90 percent were spray irrigated. Irrigation water use west of the Cascade Range during 1990 was 580 Mgal/d (table 21), which was 32 percent of the total water use in this area. Irrigation water use west of the Cascade Range was low (8 percent of the total irrigation water use statewide), because this area is (1) relatively humid, (2) has only 30 percent of the cropland in the State, (3) has only 20 percent of the irrigation, and (4) has relatively high application efficiencies. Irrigation application rates were estimated to be 1.6 feet per year.

Statewide, forage crops were grown on about 67 percent of the irrigated lands, but in western Oregon, forage crops were grown on about 45 percent of the irrigated lands during 1990. Vegetable crops were grown on 27 percent of the irrigated lands in this area, compared to about 10 percent statewide. Berries and orchards were grown on about 7 percent of western Oregon's irrigated lands. Nursery stock was grown on more than 16,000 acres (about 4 percent) of land and had the highest market value of any agricultural commodity in Oregon except cattle (U.S. Department of Agriculture, undated).

Most of the irrigated lands west of the Cascade Range are located close to population centers. The average farm size is about 85 acres, and the average size of an irrigated farm is about 50 acres (U.S. Department of Commerce, 1987). These small farm sizes result, in part, from limited land availability—a reflection of higher population densities and increased land values. Consequently, a greater percentage of the crops grown west of the Cascade Range have a higher cash value per acre than those grown east of the Cascade Range. These higher value crops require more careful management, which includes the use of expensive sprinkler systems rather than less efficient, but deeper, flood-irrigation systems. Also, the growing season in western Oregon tends to be longer than in central and eastern Oregon. Investments in costlier irrigation systems, therefore, are more justifiable as the probability of crop success is higher.

In addition to economic factors, water availability can influence the selection of sprinkler technique. Most of the irrigation in western Oregon occurs in the Willamette Valley, where water supplies generally are available from nearby on-farm streams or shallow wells, a situation that makes sprinkler irrigation feasible. In the Southwest Region of Oregon, however, where ground and surface water are not as plentiful but where topographic relief is greater, flood irrigation by way of canals is more common than sprinklers. The canals, which bring water from headwater sources, follow the contours of valley walls above croplands, making application with flood-irrigation techniques more practicable. In 1982, only 30 percent of the lands in western Oregon (compared with 47 percent statewide) obtained irrigation water from off-farm supplies (U.S. Department of Commerce, 1984).

Because sprinkler-irrigation methods are more efficient and more water goes directly to the crop, consumptive use was 67 percent (390 Mgal/d) of the water withdrawn for irrigation, and conveyance losses were only 8 percent of the irrigation withdrawals west of the Cascade Range in 1990. Seventy-four percent of the water withdrawn for irrigation was from surface water (430 Mgal/d), and 26 percent (150 Mgal/d) was from ground water. Slightly more than 5 Mgal/d of reclaimed sewage was used in this region in 1990 to irrigate crops (mostly pasture).

The highest water-use crop west of the Cascade Range is nursery stock, with an application rate of about 2.3 feet per year. Stock is grown in containers and that is the primary reason this rate is high. The root zone and water availability are restricted by these containers; consequently, frequent watering is required. The irrigation requirements for grass seed are the lowest in the area. Grass-seed crops generally are irrigated infrequently west of the Cascade Range and have an estimated application rate of about 0.3 feet per year. Other crops and their estimated application rates are forage, 1.5 feet per year; vegetables, 1.3 feet per year; and mint 1.3 feet per year.

Coast

Because of the rugged topography that characterizes the Coast Region, the 130,000 acres of cropland in the region (U.S. Department of Commerce, 1989) are on small farms (average size in 1982 was less than 70 acres) located primarily along the coastal margins and in the valley bottoms. Most of the cropland is pasture used to support the region's dairy herds. Although moisture generally is adequate to grow pasture grasses, approximately 27,000 acres of pasture were irrigated in 1990; that acreage accounted for more than 90 percent of the irrigated lands in the Coast Region. On the average, approximately 1.1 feet per year of water was applied to irrigate the pasture grasses.

Because of the low water requirements and the small number of acres irrigated in the Coast Region, only about 32 Mgal/d was withdrawn for irrigation in 1990 (table 21). This amount was less than 6 percent of the irrigation water use west of the Cascade Range and 9 percent of the total water use in the region. About 31 Mgal/d (97 percent) of the irrigation withdrawals in the region were from surface water, about 1.4 Mgal/d was estimated withdrawn from ground water, and about 0.2 Mgal/d was supplied from reclaimed wastewater. Sprinkler (spray) irrigation was used to irrigate all but 700 acres, so there was a fairly high application efficiency; consumptive use accounted for 72 percent of the irrigation withdrawals. Conveyance losses were negligible, because there are no irrigation projects in the Coast Region. Here, farms with irrigated lands are small (averaging 38 acres in size) and likely to have on-farm water sources (U.S. Department of Commerce, 1989).

A variation of flood irrigation has been used in the 1,200 acres of cranberry bogs in Coos and Curry Counties. Although generally irrigated with sprinklers during the growing season, the diked bogs are flooded at harvest time so that the cranberries will float to the surface to be harvested.

Willamette

The Willamette Region is the most agriculturally diverse region in Oregon. Of the 1,200,000 acres of cropland, 290,000 acres were irrigated in 1990. The average size of an irrigated farm in the Willamette Region is about 50 acres, whereas the average size of a non-irrigated farm is about 95 acres (U.S. Department of Commerce, 1989). A wide variety of irrigated vegetable crops such as beans, corn, broccoli, cabbage, garlic, onions, and squash were grown on more than 90,000 acres in the Willamette Region in 1990. Other irrigated crops included mint (20,000 acres), nursery stock (16,000 acres), berries (13,000 acres), hops (6,000 acres) and sugar beets for seed (4,500 acres).

The acreage in forage crops in the Willamette Region in 1990 was about 25 percent of the total irrigated lands in the region. Previous water-use studies in the area (Collins and Broad, 1993) have suggested that the amount of water applied to pasture is highly variable; some areas may be irrigated once or twice a season but are still included in the totals for irrigated acreage. Because of this variability in irrigation frequency, the suggested coefficient for the crop-water need of 1.5 feet per year for pasture (Cuenca, 1992) was reduced to 1.0 foot per year.

Average application rates for crops in the Willamette Region were about 1.3 feet per year. Forage crops had an application rate of about 1.4 feet per year; the rate for vegetable crops was about 1.3 feet per year, the rate for corn was about 1.7 feet per year, the rate for mint was about 1.2 feet per year, and the rate for hops was about 1.1 feet per year. Nursery stock had an average application rate of about 2.3 feet per year. As mentioned, the application rates for nursery stock are higher than for other crops because much of the stock is grown in containers.

Irrigation water use in the Willamette Region was about 360 Mgal/d, which was 33 percent of the total water use in the region and 62 percent of the irrigation water use west of the Cascade Range (table 21). Surface water accounted for about 61 percent (220 Mgal/d) and ground water for about 39 percent (140 Mgal/d) of the irrigation withdrawals. Much of the ground water was withdrawn from shallow wells in alluvium along the Willamette River. Consumptive use in this region was almost 70 percent of the irrigation withdrawals.

Water for about 22 percent of the irrigated acreage in the Willamette Region comes from off-farm sources (U.S. Department of Commerce, 1984). The county with the highest percentage of acreage irrigated with water from off-farm sources is Washington County, where a BOR project irrigates more than 13,000 acres with water that has been stored on the eastern side of the Coast Range. Lined canals and pipes in 60 percent of the 150-mile distribution system keep conveyance losses at about 5 percent of the withdrawals for this project. Conveyance losses in the other large irrigation project in the Willamette Region, Santiam Water Control District (Marion County), are about 20 percent of withdrawals. This non-Federal project irrigates about 17,000 acres of land with water from the North Santiam River. Conveyance losses from these two projects and a few smaller irrigation and water control districts total about 13 Mgal/d.

Irrigation withdrawals in the Willamette Region in 1990 increased almost 25 percent (70 Mgal/d) when compared with 1985. Much of the reported increase was attributable to an increase in the amount of information available, the use of a different formula for calculating crop coefficients, and a longer irrigation season caused by dry conditions during the spring. Although not readily evident from the data, irrigation water use in the French Prairie area west of Woodburn has decreased. As the value of grass seed continued to increase, many fields were converted from crops which require irrigation to grass-seed fields that require little or no irrigation.

Southwest

An estimated 190 Mgal/d, of which 95 percent was from surface water, was withdrawn for irrigation use in the Southwest Region; this amount represents 49 percent of the total water use in the region. An additional 20 Mgal/d was withdrawn from the eastern side of the Cascade Range and transferred into the region by a BOR project.

BOR projects in the Southwest Region withdrew more than 55 percent of the water withdrawn for irrigation purposes and irrigated 40 percent of the 79,000 acres irrigated.

The discrepancy between BOR-project withdrawals and amounts delivered to users resulted from several factors. In addition to the conveyances involved with the interbasin transfers, these projects also use canals to deliver water to users. Conveyance losses associated with these projects were 69 percent (24 Mgal/d) of the total conveyance losses in the region. Also, much of the flood-irrigated 36,000 acres were associated with these projects. Thus, application efficiencies tended to be lower. The Grants Pass Irrigation District provides water to more than 10,000 customers who individually irrigate less than 5 acres. Most of the water for these plots is used for residential lawn watering and is, therefore, not included in the irrigated-acreage data but is included in the irrigation withdrawals. Consumptive use in the Southwest Region was 58 percent (110 Mgal/d) of withdrawals. This percentage is artificially high, because interbasin transfers occur in the region. (Consumptive-use and withdrawal values are assigned to the basins in which they occur.) In the case of an interbasin transfer, therefore, the percentage of consumptive use is calculated only with respect to water withdrawn in the basin—although it includes water transferred into the basin.) Off-farm sources distributed water to an average of 66 percent of the irrigated acreage in the region (U.S. Department of Commerce, 1984).

In the Umpqua River Basin, the percentage of off-farm sources of irrigation water was only about 29 percent, because most irrigators supplied their own water, generally from surface sources. Only 12 percent of the 120,000 acres of cropland in the Umpqua River Basin were irrigated. This was due primarily to limited surface and ground-water supplies and to the fact that most of the cropland was in pasture, of which only about 6 percent was irrigated. Irrigation withdrawals in the Umpqua River Basin, therefore, accounted for only 14 percent (27 Mgal/d) of the region's irrigation withdrawals. Less than 2 percent of that was from ground water. Irrigation withdrawals were 40 percent of the total withdrawals for all purposes in the Umpqua River Basin.

The 90,000 acres of cropland in the Rogue River Basin were farms that average about 50 acres in size (U.S. Department of Commerce, 1989). About 71 percent of the cropland in the basin was irrigated in 1990. Although only 6 percent of the pasture in the Umpqua River Basin was irrigated, more than 60 percent of the pasture in the Rogue River Basin was irrigated. The high percentage of irrigated lands in the Rogue River Basin contrasts with the climatically similar Umpqua River Basin, and illustrates the effect that available water supply from natural and artificial sources (irrigation districts) has on a basin.

Forage crops were grown on 83 percent of the irrigated lands in the Southwest Region. Compared to the other regions in Oregon west of the Cascade Range, southwestern Oregon has a dry climate; average crop-water need for the forage crops was about 1.5 feet per year in contrast with the 1.0 feet per year estimated for the Willamette Region. Application rates for forage crops in the Southwest Region were about 2.9 feet per year for pasture land and about 4.0 feet per year for alfalfa.

Economically valuable vegetables and orchard fruits constitute most of the remaining crops. The irrigated apple, peach, and pear orchards, grown on more than 10,000 acres, had a crop-water need of about 2.7 feet per year in 1990; application rates exceeded 5.0 feet per year. Some of the water needed for these orchards was used to water grass planted between the rows of trees. The presence of grass instead of bare ground between tree rows facilitates the movement of machinery in the orchards, especially during wet periods.

East of the Cascade Range

Irrigation water use for lands east of the Cascade Range was 6,300 Mgal/d, which was 75 percent of the total water use in Oregon during 1990 (table 21). These irrigation withdrawals are applied to more than 1,600,000 acres of cropland, for an average application rate of 4.4 feet per year. The lands irrigated east of the Cascade Range constitute 80 percent of all the irrigated lands in Oregon. About 94 percent (5,900 Mgal/d) of the irrigation withdrawals are from surface-water sources, and about 6 percent (420 Mgal/d) are from ground-water sources. About 5.8 Mgal/d of reclaimed wastewater was used for irrigation in 1990.

East of the Cascade Range, most of the irrigated lands are located in areas that receive less than 20 inches of precipitation per year; therefore, in most areas, 90 to 95 percent of the crops require irrigation. Nonetheless, in the North-Central Region, more than 900,000 acres of grain were grown without irrigation. Forage crops constituted 72 percent of the irrigated acreage east of the Cascade Range. The high percentage of cropland in forage is the result of the arid climate and short growing season in much of the area. Annual crops, in many areas, would not be sufficiently frost tolerant and would not receive enough moisture to reach maturity. Perennial forage crops such as grass or alfalfa, however, are more tolerant of the relatively harsh conditions east of the Cascade Range.

In areas east of the Cascade Range where the growing season is adequate and water is available, crops such as potatoes (50,000 acres), mint (22,000 acres), sugar beets (12,000 acres), onions (11,000 acres), and a variety of fruit trees (29,000 acres) are grown. Grains, primarily wheat and barley, were irrigated on about 230,000 acres of land, but about 75 percent of the total acreage planted with grain was not irrigated.

Consumptive use by irrigation in areas east of the Cascade Range was about 41 percent (2,600 Mgal/d) of irrigation withdrawals (table 21). This percentage of total irrigation withdrawals was much smaller than the 67 percent lost to consumptive uses west of the Cascade Range. Application efficiencies were usually higher in western Oregon, because sprinkler (spray) irrigation was more common (90 percent of the lands irrigated). In contrast, sprinkler (spray) irrigation east of the Cascade Range was used on only 44 percent of the irrigated lands.

In the arid western United States, large land areas historically have been necessary for farming and ranching to be economical. The average size of a farm with cropland in Oregon east of the Cascade Range is 408 acres (U.S. Department of Commerce, 1989). The scarcity of water and the large parcels of land require that conveyance systems be designed to deliver water to areas not adjacent to water sources.

Irrigation in Oregon began in the southwestern and eastern parts of the State in the 1850's and 1860's, when traditional dryland-farming methods could not keep pace with the demands for provisions from gold miners. Employing the same techniques used by miners to deliver water to the mining areas, farmers began to divert water from streams into ditches to deliver to fields. When government land claims and the development of railroads encouraged settlement in the arid regions of Oregon, irrigation districts and ditch companies were formed. Subsequently, in 1902, the Federal government passed the National Reclamation Act, which provided for construction of large irrigation projects across the western United States, including Oregon. Six such projects were constructed in central and eastern Oregon between 1908 and 1921 by the BOR, the agency founded to administer the Reclamation Act. In 1990, BOR projects covered almost 400,000 irrigated acres (25 percent) of all irrigated land east of the Cascade Range and withdrew 30 percent (1,900 Mgal/d) of all irrigation water in this area. Most of these projects use local topographic relief to deliver water to fields by using ditches and conduits. Because of the local relief, many fields have a natural grade that facilitates the use of flood-irrigation techniques. Other irrigation districts that were not involved with BOR projects irrigated about 150,000 acres (9 percent) of irrigated lands and accounted for an estimated 7 percent (450 Mgal/d) of the irrigation withdrawals east of the Cascade Range during 1990.

East of the Cascade Range, consumptive use in 1990 was 2,600 Mgal/d. Crop-water need (from which consumptive use was calculated) for various crops included the following: orchards, 2.8 feet per year; potatoes, 2.1 feet per year; onions, 2.0 feet per year; forage 1.8 feet per year; and grain and mint, 1.6 feet per year.

A large amount of water was transferred from source to field by means of irrigation ditches or conduits; therefore, conveyance losses were large—about 19 percent (1,200 Mgal/d) of the surface-water withdrawals east of the Cascade Range. Conveyance losses for BOR projects averaged about 30 percent of withdrawals, whereas private irrigation companies that were not involved in these projects averaged about 22 percent of withdrawals. Conveyance losses for BOR projects were usually larger than for other projects, because of the long distance over which water was transported.

Conveyance losses and a lower application efficiency, resulting from the predominance of flood-irrigation techniques, caused application rates to be much higher than crop-water need east of the Cascade Range. The estimated values included the following: orchards, 4.4 feet per year; potatoes, 3.3 feet per year; onions, 3.2 feet per year; forage, 2.8 feet per year; grain, 2.6 feet per year; and mint, 2.5 feet per year.

South-Central

Irrigation water use in the South-Central Region totaled 2,300 Mgal/d (table 21), which was 96 percent of total water use in the region and 27 percent of total water use statewide. Consumptive use was estimated to be 37 percent (840 Mgal/d) of the total irrigation withdrawals. Only 37 percent of the water withdrawn for irrigation was consumed by crops, because 70 percent of the irrigated acres were supplied using flood-irrigation techniques. Much of the water withdrawn for flood irrigation does not reach the crops and eventually returns to the local hydrologic system. Conveyance losses were about 16 percent of irrigation withdrawals in the region.

Surface water provided 91 percent of the irrigation withdrawals in the South-Central Region; most of this surface water comes from snowmelt runoff from the Cascade Range and other smaller mountain ranges. In localized areas, ground water provides an important source of water in this arid region.

Most of the irrigated lands in the South-Central Region are at elevations of greater than 4,000 feet. Consequently, the growing season is usually short. In 1990, forage crops made up about 86 percent of the irrigated crops, grains (mostly barley) made up about 11 percent of the irrigated crops, and potatoes made up about 2 percent of the irrigated crops. About 89 percent of the approximately 670,000 acres of cropland were irrigated; cropland generally is found only where irrigation water is available. Average farm size was about 370 acres, but most lands in South-Central Region are used for rangeland.

The application rate for most crops in the South-Central Region was about 3.6 feet per year, except for potatoes, which had an estimated rate of 4.1 feet per year. The type of application system used largely determined how much water was required to grow a crop. The efficiency with which water is applied to the crops varies from an estimated 25 to 45 percent for certain types of flood irrigation to more than 80 percent for center-pivot irrigation.

Water availability determines differences between irrigation practices in the Klamath River Basin and the Oregon Closed Basins of the South-Central Region. In the Klamath River Basin, much of the land that is now irrigated was originally too marshy to be arable. The valley floor is too flat to provide adequate natural drainage for the large amounts of water that flow to the valley from the eastern slope of the Cascade Range. Upward ground-water movement and springs along the base of slopes at the edge of the valley floor added to the marshiness of the area. Some of the original reclamation efforts in the Klamath River Basin involved draining the valley floor with canals. Although shortages can occur in the basin, water is usually more readily available there than in areas farther east. In the eastern part of the State, the snowfall in the mountains surrounding the basins is not as great as in the Cascade Range. Thus, surface-water runoff is usually less in quantity and in duration. In addition, although Upper Klamath Lake is used as a reservoir to store runoff, the water from lakes in many of the Oregon Closed Basins valleys is too saline for irrigation use.

In the Klamath River Basin, 60 percent of the irrigated lands are supplied with water from off-farm sources. Most of these lands are in the 200,000-acre BOR Klamath Project, which irrigates about 125,000 acres in Oregon and about 75,000 acres in California under conditions of the 1957 Klamath River Compact. Water for this project is obtained primarily from surface water flowing from the eastern slopes of the Cascade Range and into Upper Klamath Lake, as well as from rivers flowing into Upper Klamath Lake from the east. In addition, water from the Lost River supplies land within the Lost River Basin (including land in California) and land in the Klamath River Basin. The low divide between these two basins allows water to be pumped back and forth between the Lost River and the Klamath River Basins. Conveyance losses in this project are equivalent to about 24 percent of the irrigation withdrawals. In addition to forage crops, most of the grains and potatoes in the region are grown on irrigated project lands.

Off-farm sources accounted for about 10 percent of the irrigation-water supplies in the Oregon Closed Basins (U.S. Department of Commerce, 1984) of South-Central Region. There are no BOR projects in this area; the four irrigation districts in the area serve about 18,000 acres. Approximately 74 percent (220,000 acres) of the irrigated lands use flood-irrigation techniques. On some of these flood-irrigated lands, a technique known as "wild flooding" is employed. This technique is designed to take advantage of the limited snowmelt runoff that is available for a short period during the late spring. By using temporary dams that usually consist of boulders, streams that carry snowmelt are blocked and allowed to flood surrounding meadows.

Ground-water withdrawals in the South-Central Region accounted for 10 percent of the irrigation withdrawals in 1990 and were concentrated in four areas. The area of heaviest ground-water pumpage is in the Fort Rock Valley of northern Lake County, where little surface water is available. Miller (1986) estimates that 63 Mgal/d was withdrawn in 1986 from volcanic-material aquifers underlying the area. Because of declines in water levels, legal restrictions on the construction of new wells have been implemented in the Fort Rock area (Miller, 1986). Other areas of significant ground-water pumpage for irrigation include lands east of Klamath Falls, the Goose Lake area near Lakeview, and areas around Malheur Lake near Burns. The areas near Klamath Falls and Lakeview obtain most ground-water supplies from undifferentiated volcanic and sedimentary aquifers, whereas the area near Burns obtains its ground-water supplies primarily from unconsolidated sedimentary rock aquifers (Gonthier, 1985). In areas near Klamath Falls, Lakeview, and Burns, surface water is the primary water source for irrigation withdrawals.

North-Central

Irrigation water use in the North-Central Region totaled about 1,900 Mgal/d during 1990 (table 21), which was about 90 percent of the total water use in the region and 23 percent of the total water use in Oregon. Surface-water withdrawals accounted for 95 percent (1,800 Mgal/d) of these irrigation withdrawals; ground water provided 140 Mgal/d, and reclaimed sewage accounted for 5.4 Mgal/d. Consumptive use was 46 percent of irrigation withdrawals, and conveyance losses were 23 percent. Unlike most of the other irrigated areas east of the Cascade Range, spray irrigation was the primary irrigation application method and was used 78 percent of the time. The approximately 1,900 Mgal/d of water withdrawn in 1990 irrigated 540,000 acres at an application rate of about 4.0 feet per year.

Cropland in the North-Central Region totaled about 2,400,000 acres, of which 23 percent was irrigated in 1990. The relatively small percentage of land irrigated in this arid climate is a consequence of the fact that 1,100,000 acres were in summer fallow and 720,000 acres were planted in grains, neither of which requires significant irrigation. Much of the grain crop was winter wheat, which uses moisture available during the period of maximum precipitation. Land on which grain is harvested is allowed to lie fallow every other summer, so that soil moisture may be accumulated during the fallow year and used by grain crops the following year.

Of the North-Central Region crops that were irrigated in 1990, forage crops accounted for about 60 percent (330,000 acres); vegetables and potatoes, about 10 percent (55,000 acres); fruit trees, about 5 percent (28,000); and mint, about 4 percent (20,000 acres). Some grain also was irrigated, accounting for 17 percent (93,000 acres) of the irrigated crops. The estimated application rates for these crops were as follows: orchards, 5.8 feet per year; potatoes, 3.5 feet per year, forage, 3.4 feet per year (with alfalfa requiring about 4.0 feet per year); and mint, 3.3 feet per year.

Like the South-Central Region, large parcels of land are necessary to make farming economical in the North-Central Region. The average size of a farm in the North-Central Region is about 500 acres, and the average size of an irrigated farm is 115 acres. There is a large discrepancy between irrigated and nonirrigated farm size, because dryland-wheat farms typically are large. Outside of the dryland-wheat area, water availability determines the location of cropland. About 58 percent of the irrigated lands in the region receive water from off-farm sources (U.S. Department of Commerce, 1984). The BOR projects deliver water to many of the farms (185,000 acres were in these projects in 1990), but these Federal projects are not distributed evenly throughout the region. The manner in which irrigators obtain water varies among individual basins according to the presence of BOR projects and the availability of ground water or Columbia River water. The economic means and physical methods used to obtain water from these sources and to apply water to crops also influence the development of sources and of irrigated areas. In some locations, the overall lack of available water limits the extent of irrigation.

Irrigation water in the Deschutes River Basin is supplied primarily by the BOR Deschutes Project. In 1990, this project irrigated about 120,000 acres of land across Deschutes, Crook, and Jefferson Counties. Most of the nearly 650 Mgal/d withdrawn for this project came from the Deschutes River above Bend and was distributed by canals to land as far north as Madras. Because much of the basin overlies porous volcanic materials, conveyance losses for this project averaged 32 percent. Crops grown in the project area included pasture and alfalfa, wheat, grass seed, and mint. For the three-county area in which the Deschutes Project is located, sprinkler-application techniques (mostly side roll or hand set) are used on 65 percent of the irrigated lands. Ground-water withdrawals for irrigation accounted for less than 5 percent of the total irrigation withdrawals in these three counties.

Apple, cherry, and pear orchards covered more than 23,000 acres in the areas surrounding Hood River and The Dalles in 1990. Most of these orchards were irrigated with surface water. In the Hood River area, 95 percent of the water supply were obtained from runoff from the Mount Hood area and were delivered to users by canals operated by irrigation districts. Conveyance losses within these irrigation districts ranged from 5 to 45 percent, and average losses were about 15 percent. Most water was applied to crops by the use of sprinklers. Irrigation of orchards (mostly cherry) in the vicinity of The Dalles was from a 5,000 acre BOR project that withdraws water from the Columbia River. This project, which delivers water through pipes to sprinklers in fields located above the city, has little or no conveyance loss.

In southern Wasco County, sprinkler irrigation of forage crops and wheat is augmented by the 2,000 acre BOR Wapinitia Project; several other private irrigation districts, improvement districts, and ditch companies irrigate an additional 13,000 acres of land. These projects use unlined ditches to deliver water flowing from the eastern side of the Cascade Range. Conveyance losses for the BOR Wapinitia Project were estimated at 35 to 40 percent.

Most cropland in the John Day River Basin is used for dryland wheat farming, and only 8 percent (45,000 acres) of the cropland was irrigated in 1990. The 160 Mgal/d withdrawn for irrigation was equal to an application rate of about 4 feet per year. Most (90 percent) of the irrigated land was in forage, and the remaining 10 percent was in grain.

There are no large irrigation projects in the John Day River Basin. Most of the irrigation is, therefore, in the upper reaches of the basin where riparian areas are wide and easily irrigated by main-stem channel diversions. These diversions are generally small, and the water is diverted a short distance upstream from the place of application. The water is conveyed along a ditch and is subsequently applied to the field by using flood-irrigation techniques. It was estimated that flood irrigation is used for about 65 percent of the irrigated lands in the upper areas of the basin. In the lower John Day River Basin, where the streams are more incised, water typically is applied with pumps and sprinklers. Ground water accounted for 12 percent of the withdrawals in the lower basin, but for less than 1 percent of the withdrawals in the upper basin.

Irrigation methods in the Umatilla River Basin are the most diverse in the North-Central Region. About 21 percent of the estimated 1,200,000 acres of cropland in the basin is irrigated. Most cropland is planted in dryland wheat or is in summer fallow. Of the 248,000 acres irrigated in 1990, 45 percent was in forage; 27 percent was in grains; 11 percent was in potatoes; and 8 percent was in vegetables. A variety of crops was grown on the remaining irrigated lands (9 percent). The sources of water for these crops were off-farm sources (about 51 percent), wells (about 33 percent), and on-farm surface-water sources (about 16 percent) (U.S. Department of Commerce, 1984). Food-processing plants in the Umatilla River Basin process much of the produce grown.

Total irrigation withdrawals for the Umatilla River Basin were 640 Mgal/d, which is equal to an application rate of about 2.9 feet per year. Surface-water withdrawals were 84 percent (540 Mgal/d) of the total irrigation withdrawals. Although wells provide about 33 percent of the water for irrigation, the total amount of ground water withdrawn was estimated to be only 16 percent (100 Mgal/d) of the total withdrawals (Collins, 1987). Ground-water withdrawals usually do not have associated conveyance losses and ground water is not typically used for flood irrigation. As a result, less water is withdrawn to irrigate a crop with ground water than with surface water.

BOR projects in the Umatilla River Basin supplied irrigation water for about 25,000 acres of land in 1990 and withdrew water at a rate of about 8 feet per year. An estimated 40 percent of the water withdrawn was lost during conveyance through 25- to 40-mile canals that cross alluvium and loess deposits. Depending on the area, sprinklers were used 50 to 80 percent of the time when applying water obtained from these canals to irrigate the fields. Most of the withdrawals in the BOR project areas were from the Umatilla River. The Columbia River, however, provided about 6 percent (12 Mgal/d) of the project withdrawals. A future BOR project will withdraw water from the Columbia River above the mouth of the Umatilla River and pump the water into the Umatilla River Basin to supplement flows.

About 10 irrigation districts and ditch companies in the Umatilla River Basin that are not associated with BOR projects use the Umatilla River and the Walla Walla River to irrigate about 13,000 acres. Conveyance losses associated with these irrigation districts were about 35 percent.

The development of the center-pivot sprinkler system during the 1960's encouraged the irrigation of other areas that are not adjacent to the Umatilla and Walla Walla Rivers. The center-pivot sprinkler allows water to be applied to lands that historically have been too sandy and undulating to be irrigated by gravity techniques or that would have required prohibitive expenditure of labor if they had been irrigated using traditional sprinkler techniques (Muckleston and Highsmith, 1978). As a result, beginning in the 1970's, much of the area in western Umatilla and northern Morrow Counties was irrigated with either ground water or Columbia River water. Farms within these newly irrigated lands generally are large; the average size of an irrigated farm in Morrow County is about 390 acres (U.S. Department of Commerce, 1984). The cost of pumping water from wells or from the Columbia River onto the overlying plateaus and of installing distribution systems for these large farms requires that many farms be privately financed through corporations.

Withdrawals from the Columbia River totaled 120 Mgal/d, or about 19 percent of the total irrigation withdrawals in the Umatilla River Basin. Interbasin transfers from the John Day River Basin into the Umatilla River Basin, which totaled about 1.5 Mgal/d, have been used since before the turn of the century.

Southeast

Of about 1,200 Mgal/d withdrawn for irrigation in the Southeast Region, all but 25 Mgal/d was surface water; the balance was ground water. More than 99 percent of the total water use in Southeast Region was for irrigation. Oregon's Southeast Region ranked behind South-Central and North-Central Regions in irrigation withdrawals; however, more than 800 Mgal/d was withdrawn from the Owyhee, Malheur, and Snake Rivers and applied to about 175,000 acres of mostly contiguous land in the northeastern part of the Southeast Region. This area is the most intensely irrigated in Oregon.

Of the approximately 175,000 acres of irrigated land in the northeastern part of the Southeast Region, BOR projects irrigated almost 110,000 acres in 1990. Withdrawals from these projects totaled about 500 Mgal/d. The Owyhee River, with storage from Lake Owyhee, supplied about 70 percent of the withdrawals; and the Malheur River and its tributaries, with three storage reservoirs, supplied about 24 percent of the withdrawals. The remaining amount, about 24 Mgal/d, was withdrawn from the Snake River. Withdrawals along the Snake River in Idaho supplied about 6 Mgal/d to about 1,300 acres of land in Oregon. Canals and conduits distribute water either directly from the storage reservoir, as is the case for the Owyhee River, or from the rivers. Conveyances losses in these projects averaged about 35 percent. Some of these canals are more than 70 miles long and transfer water from one basin into another. About 90 percent of the lands in BOR projects were flood irrigated. An additional 29,000 acres of land were irrigated by irrigation districts not associated with BOR projects. Most of these irrigation districts are located in the Vale and Ontario area, with the exception of the Jordan Valley Irrigation District, which supplies water to lands in southeast-central Malheur County.

About 92 percent of the 250,000 acres of irrigated lands in the Southeast Region used flood-irrigation techniques in 1990. Most of the irrigated lands in the valley bottoms were irrigated in this manner. Because these lie above the irrigation canals, benchlands above the valley floor generally were irrigated with sprinklers. Benchlands commonly are irrigated with ground water (Gannett, 1990). Wells located on the benchlands tap lake sediment aquifers, whereas wells in the valley bottoms tap shallow gravel aquifers that are recharged primarily by canal leakage (Gannett, 1990).

With the exception of about 10 percent of the cropland that is either idle or in summer fallow, almost all cropland in the Southeast Region is irrigated. The average farm size is about 225 acres (U.S. Department of Commerce, 1989). Although forage crops accounted for 170,000 acres (68 percent) of the irrigated crops in 1990, crops in the region are diverse. Grains accounted for about 34,000 acres of irrigated land, and most of the irrigated acreage remaining was planted in corn (14,000 acres), onions (10,000 acres), grass seed (8,000 acres), potatoes (7,000, acres), beans (3,000 acres), and mint (1,000 acres). About 13,000 acres of sugar beets supplied beet-sugar processing plants in the region and in Idaho. Potatoes, corn, and beans supply local food-processing plants.

Conveyance losses associated with irrigation in the Southeast Region were 24 percent (290 Mgal/d) of the irrigation withdrawals (table 21). Consumptive-use losses were 42 percent (500 Mgal/d) of the withdrawals. Because much of the land is flood irrigated, application efficiencies were estimated to be only about 47 percent. Application rates for the various crops were as follows: alfalfa, 7.4 feet per year; potatoes, 6.2 feet per year; beets 6.1 feet per year; pasture, 5.6 feet per year; onions, 5.2 feet per year; and grain, 5.0 feet per year.

Northeast

About 440,000 acres of cropland exist in the Northeast Region, and the average farm size is about

275 acres (U.S. Department of Commerce, 1989). The major nonirrigated crop is wheat that is grown in the uplands; nonirrigated hay and pasture are grown in the valley bottoms. About 250,000 acres were irrigated in 1990, most of that in the valley bottoms around Baker City, La Grande, and Enterprise. The primary irrigated crops were forage on about 80 percent of the lands and wheat on about 17 percent of the lands. The remaining irrigated crops were grass seed, dry beans and peas, potatoes, and orchards.

Approximately 860 Mgal/d was withdrawn to irrigate the 250,000 acres irrigated in the Northeast Region (table 21). This volume is equivalent to an application rate of about 3.9 feet per year. Most of the land (64 percent) was flood irrigated. About 44 percent of the withdrawals were consumed by the crops, and about 16 percent of the withdrawals were lost in conveyance. Estimated application rates for crops irrigated in this region were as follows: alfalfa, 4.2 feet per year; pasture, 3.6 feet per year; and grains 3.2 feet per year. Irrigation water use accounted for 97 percent of the total water use in the region.

More than 96 percent of the irrigation withdrawals came from surface water in 1990. Irrigation withdrawals in this region began in the 1860's, when gold miners began arriving in the western part of Baker County. The amount of irrigated land peaked in the 1920's (Oregon State Water Resources Board, 1967). After the construction of storage reservoirs, the amount of acreage remained the same, but the length of the irrigation season was increased.

The southern part of the Northeast Region (Baker County and the extreme southern part of Union County) has several storage reservoirs, three of which are associated with BOR projects. These Federal-project lands covered about 40,000 acres in 1990, or 25 percent of the lands in the southern part of the Northeast Region. Conveyance losses associated with these projects were about 21 percent. An additional 120,000 acres of land were irrigated on lands outside of BOR project areas; about one-half of this land was supplied by water-control districts and ditch companies. Because of the availability of water and the methods of delivery to farms, the southern part of the region accounted for 74 percent of irrigation withdrawals and 64 percent of the irrigated lands in northeastern Oregon. More than 81 percent of the irrigated lands in the southern part of the Northeast Region used flood-irrigation techniques.

Irrigated acreage in the northern part of the Northeast Region (Union and Wallowa Counties) was about 90,000 acres in 1990. With the exception of Wallowa Lake, a natural lake with a control dam, there are no major storage reservoirs in this area. Water supplies are obtained from snowmelt originating in the Wallowa Mountains and, to a lesser extent, the Blue Mountains. Supplies, therefore, usually decline late in the irrigation season. Total withdrawals were about 225 Mgal/d, which equates to an application rate of 2.8 feet per year. This lower application rate was due, in part, to the fact that sprinkler-irrigation techniques were used 66 percent of the time. In the northern part of the region, only about 13,000 acres of the irrigated land is in areas served by irrigation districts, improvement districts, and ditch companies.

The estimated 31 Mgal/d of ground water withdrawn for irrigation was about 3.6 percent of the total irrigation withdrawals in the Northeast Region. More than one-half of the ground water withdrawn in the region came from wells located on the valley floor near Baker City, and another one-fourth was withdrawn from wells located on the valley floor near La Grande. Most of the ground water is pumped from shallow wells completed in unconsolidated sedimentary rock aquifers.

Reservoir Evaporation

The USGS Water-Use Program has calculated water loss by evaporation from reservoirs that have a normal capacity equal to or greater than 5,000 acre-feet (Ruddy and Hitt, 1990). The definition of normal capacity is the total volume in a reservoir below the normal retention level, including dead storage, but excluding flood-control and surcharge storage.

The total amount of water evaporated from reservoirs in Oregon for 1990 was about 410,000 acre-feet, or about 370 Mgal/d (fig. 20 and table 23). This amount was about 4 percent of the total surface-water withdrawals in Oregon, but it was not included in the summation of total surface-water withdrawals for 1990. The total surface area covered by reservoirs in Oregon was estimated to be 140,000 acres. Adjustments to the total surface area were made for natural water bodies that have been altered to increase storage capacity. For example, Upper Klamath Lake is a natural lake that was diked and dammed to increase storage.

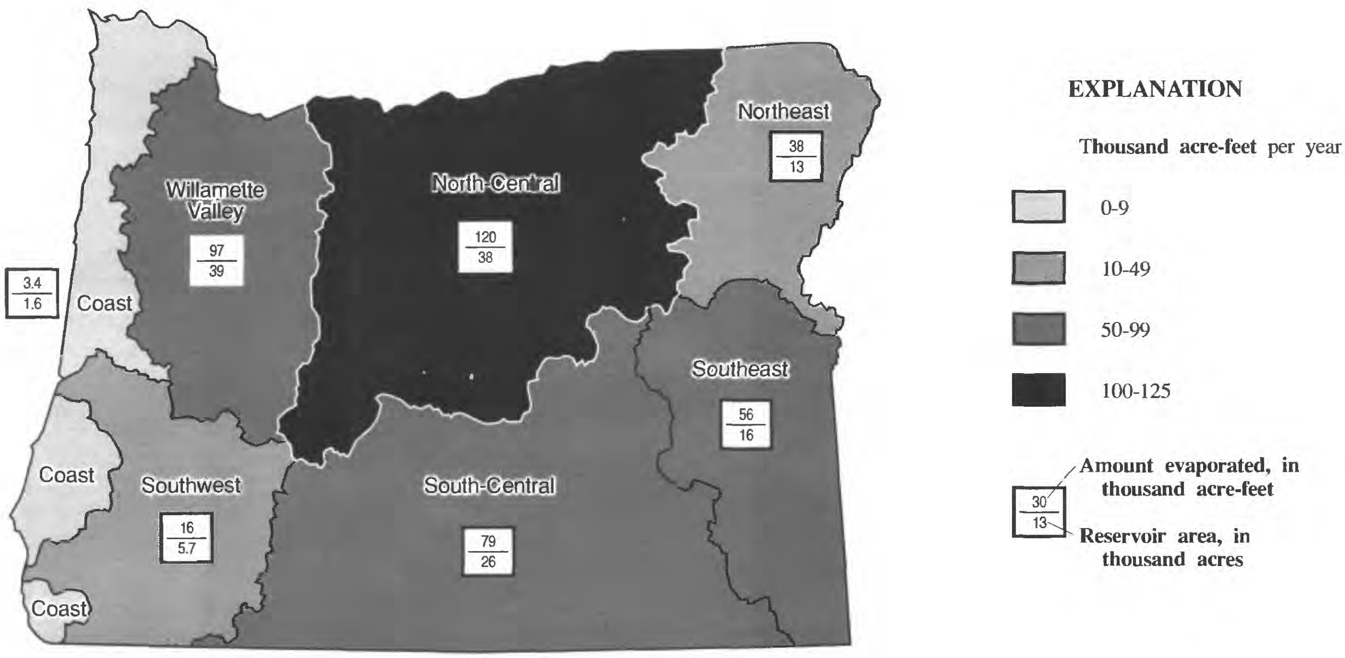

Figure 20. Total evaporation from manmade reservoirs, by region, 1990.

Table 23. Reservoir evaporation by region in Oregon, 1990
[Source: Ruddy and Hitt, 1990; individual values may not add to totals because of independent rounding)

Region name	Amount evaporated, in thousand acre-feet	Reservoir area, in thousand acres
	West of the Cascade Range	
Coast	3.4	1.6
Willamette	97	39
Southwest	16	5.7
Total	120	46
	East of the Cascade Range	
South-Central	79	26
North-Central	120	38
Southeast	56	16
Northeast	38	13
Total	300	93
State totals	410	140

The surface area of the lake is about 77,500 acres and about 12,600 surface acres were added as a result of the alterations. Reservoirs that form State boundaries generally were divided in half between the States for statistical purposes.

Phillips and others (1965) estimated that, statewide, 2,000,000 acre-feet (or about 1,800 Mgal/d) evaporated from streams, ponds, lakes, and reservoirs. A comparison of that value with the reservoir evaporation estimate (Ruddy and Hitt, 1990) indicates that roughly one-fifth of the statewide evaporation from water bodies comes from reservoirs.

West of the Cascade Range

Reservoir evaporation estimates were made for 30 reservoirs west of the Cascade Range. The 30 reservoirs accounted for 29 percent (120,000 acre-feet) of the total reservoir evaporation in Oregon and 33 percent of the reservoir surface area in the State. The amount evaporated from reservoirs represents nearly 6 percent of total water use west of the Cascade Range.

Thirty-five reservoirs west of the Cascade Range are used to generate hydroelectricity, but only 16 have sufficient storage capacity to be discussed in the reservoir-evaporation section of this report. Only two of the reservoirs used to generate hydroelectric power have large storage capacities. The remaining 14 reservoirs used in the reservoir evaporation calculations do not generate power but are used for flood control, irrigation, or water supply. The annual evaporation in this area, defined as annual reservoir evaporation divided by surface area, is 2.6 acre-feet per year (or 2.6 feet).

Coast

Only two reservoirs, Siltcoos Lake and Tahkenitch Lake (north of the mouth of the Umpqua River), were included in reservoir calculations for the Coast Region. These two natural sand-dune-dammed lakes have been raised by dams constructed across their outlets and are used for industrial-water supplies in the Reedsport area. The lakes have an average depth of

11 feet (Johnson and others, 1985) and a volume-to-area ratio of 14. (This ratio, derived by dividing the storage capacity of a reservoir by its surface area, is largest for reservoirs located in deep canyons and smallest for large, shallow reservoirs). Total evaporation for these lakes was estimated at 3,400 acre-feet per year, when adjusted to represent only the human-caused effects on evaporation, which is equivalent to about 3.0 Mgal/d or about 1 percent of the total water use in the region. The rate of evaporation was 2.1 feet per year in 1990.

Willamette

In the Willamette and Sandy River Basins, an estimated 97,000 acre-feet of water (about 87 Mgal/d) evaporated from the 39,000 acres of surface area of 24 reservoirs in 1990; the evaporation rate was 2.5 feet per year. Reservoir evaporation was equivalent to about 1 percent of the total water use in the Willamette Region. Fourteen reservoirs are used for hydroelectric power, 8 reservoirs are used for flood control, 1 reservoir is used for public supply, and 1 reservoir is used for irrigation and public supply.

The largest reservoir, in terms of surface area, is Lake Bonneville, the part of the Columbia River between Bonneville Dam and The Dalles Dam. Most of the surface area of the reservoir is east of the Cascade Range; however, evaporation from the reservoir was calculated in the area west of the Cascade Range, because the dam is located in that area. The reservoir with the second largest surface area is Fern Ridge Lake, located in the southern Willamette Valley.

The five reservoirs with the largest volume-to-area ratios (greater than 100) are located along the western slope of the Cascade Range and are used to store storm runoff for flood control. The two reservoirs with the lowest ratios are the largest in size—Lake Bonneville and Fern Ridge Lake. The average volume-to-area ratio is 47 for the Willamette Region.

Southwest

Six reservoirs in Southwest Region met the minimum storage criterion for consideration in this section of the report. Only two of these reservoirs are used for hydroelectric purposes, one each in the Rogue and Umpqua River Basins. Three of the remaining four reservoirs are located in the Rogue River Basin, all of which are used primarily for irrigation; two reservoirs have secondary uses for flood control. The fourth reservoir, in the Umpqua River Basin, is used for water supply and irrigation.

The total area of the six reservoirs in 1990 was 5,700 acres; evaporation was about 16,000 acre-feet (about 14 Mgal/d), equivalent to about 4 percent of the total water use in the Southwest Region. The largest of these reservoirs (55 percent of the surface area) is Lost Creek Lake, a flood-control reservoir on the Rogue River. This reservoir has a volume-to-area ratio of more than 90, the largest in the region. The average ratio for the six reservoirs is 69. The average evaporation rate for all reservoirs was 2.8 feet per year during 1990.

East of the Cascade Range

Forty-one reservoirs located east of the Cascade Range were evaluated. The estimated 300,000 acre-feet (about 270 Mgal/d) evaporated from 93,000 acres of reservoir surface was equal to 4 percent of the total water use for the area. The rate of reservoir evaporation was 3.2 feet per year. The average volume-to-area ratio for reservoirs in this area was 24. Of the 16 reservoirs discussed in the Hydroelectric Power section of this report, 10 are east of the Cascade Range. Almost all of the remaining 31 reservoirs east of the Cascade Range are used for irrigation purposes and, in some instances, flood control. The BOR manages 21 of the 41 reservoirs. Three of these reservoirs are used for interbasin water transfers from the eastern side to the western side of the Cascade Range.

South-Central

Upper Klamath Lake, in the South-Central Region, has a surface area of about 77,500 acres and is the largest lake in Oregon. About 86 percent of Upper Klamath Lake's area was present before the installation of control structures; therefore, only 14 percent of the total acreage was considered in the reservoir evaporation calculations. In addition to Upper Klamath Lake, 11 other reservoirs in the South-Central Region are used primarily for irrigation. Total evaporation from the 26,000 acres of reservoir surface area was 79,000 acre-feet (about 70 Mgal/d), which is equal to 3 percent of the total water use in the South-Central Region. The rate of evaporation in 1990 was 3.0 feet per year. The average volume-to-area ratio in the region is 11. Keno Reservoir on the Klamath River has the highest ratio (more than 460); however, most of the reservoirs in the area are shallow and have ratios of less than 10.

North-Central

The North-Central Region has the largest amount of water evaporated from reservoirs. More than

120,000 acre-feet (about 110 Mgal/d) were evaporated from 38,000 surface acres of reservoir in 1990 (3.2 feet per year), almost 6 percent of the total water use in the region. Lake Umatilla, located on the Columbia River between the John Day and McNary Dams, had the most reservoir evaporation in the region.

Nine of the 15 reservoirs in the North-Central Region are managed by the BOR primarily for irrigation and, to a lesser degree, for flood control. Four reservoirs are operated by the U.S. Army Corps of Engineers, of which three are used for hydroelectric-power production on the Columbia River. The one exception, Willow Creek Lake, was constructed as a flood-control reservoir above the town of Heppner, where, in 1903, 225 people were killed in the most catastrophic flood in Oregon history (Hubbard, 1991). The other reservoirs are used primarily for hydroelectric-power production (two reservoirs) or for cooling water supplied to a thermoelectric plant (one reservoir).

The volume-to-area ratios of the reservoirs in North-Central Region ranges from 11 for reservoirs in the flooded meadows that make up the upper Deschutes project to more than 210 for Lake Billy Chinook in the gorge at the confluence of the Deschutes and Crooked Rivers. The average volume-to-area ratio is 28.

Southeast

In 1990, six reservoirs in the Southeast Region had an average evaporation rate of 3.5 feet per year distributed over 16,000 acres of surface area for a total 56,000 acre-feet (50 Mgal/d) of evaporation—4 percent of the total water use in the region. The largest reservoir in the Southeast Region is the 13,900 acre Lake Owyhee; however, during 1990 the reservoir had an average surface area of only 9,500 acres. Evaporation from this reservoir was estimated to be 36,000 acre-feet, or 64 percent of the total reservoir evaporation in the region. Volume-to-area ratios for reservoirs in the area average 58. The range of the ratios for these reservoirs is between 19 and 81; Antelope Reservoir in southern Malheur County has the lowest ratio, and Lake Owyhee has the highest ratio. All six reservoirs in the region are used primarily for irrigation.

Northeast

There are eight major reservoirs in the Northeast Region. In 1990, these reservoirs had a total surface area of 13,000 acres and an evaporation rate of 2.9 feet per year for 13,000 acres, yielding an evaporation amount of 38,000 acre-feet (34 Mgal/d)—about 4 percent of the region's total water use. Brownlee Reservoir, located in Oregon and Idaho, is the largest reservoir in the region. The average volume-to-area ratio for these eight reservoirs is 75. The ratios range from 24 (Thief Valley Reservoir in Baker County) to almost 95 (Brownlee Reservoir). Five of the reservoirs are used for irrigation and three are used to generate hydroelectricity.

Wastewater Treatment

Return flow is an important component of water use but is difficult to measure; however, wastewater-treatment facilities are often required by law to measure and report the flows from treated discharge. Wastewater-treatment facilities collect, treat, and dispose of wastewater collected through a sewer system (Solley and others, 1993). The amount of return flow discussed in this section refers to water that is returned to surface water by public wastewater-treatment facilities. Seepage from wastewater-holding lagoons is not included in these amounts. Public facilities are defined as facilities that receive and treat wastewater from various water users and that generally are publicly owned or receive public funding. Reclaimed wastewater, or reclaimed sewage, is water that is reused, usually for irrigation of grass after processing by a wastewater-treatment facility. Information was collected on the number of industrial and other wastewater facilities and on the amount of reclaimed wastewater from these facilities used for irrigation; however, return-flow information from these facilities was not collected.

In 1990, approximately 370 Mgal/d of wastewater was released from 202 public wastewater-treatment facilities in Oregon (table 24 and fig. 21). Nearly 18 percent (36) of these facilities have holding lagoons and do not discharge to surface water. The remaining 166 facilities discharge between 0.002 and 70 Mgal/d. The additional 126 industrial and other wastewater facilities in Oregon range in size from small facilities serving ski areas to large facilities serving pulp-and-paper mills. A total of 11 Mgal/d of wastewater from public and industrial and other facilities was reused for irrigation in 1990.

In 1985, 252 public wastewater-treatment facilities were inventoried (table 25). Discharge from these facilities was 340 Mgal/d. The difference between the total number of public and industrial and other facilities for 1985 and 1990 resulted from a change in the manner in which the facilities were classified.

Table 24. Wastewater-treatment facility releases by region in Oregon, 1990
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region Name	Number of facilities: Public	Number of facilities: Industrial and Other	Number of facilities: Total	Total public releases, in Mgal/d	Reclaimed waste water from all waste-water facilities
West of the Cascade Range					
Coast	39	25	64	60	0.2
Willamette	67	57	124	260	4.8
Southwest	24	18	42	30	.1
Total	130	100	230	350	5.1
East of the Cascade Range					
South-Central	13	6	19	5.7	.2
North-Central	40	13	53	11	5.4
Southeast	5	3	8	1.9	.1
Northeast	14	4	18	3.4	.1
Total	72	26	98	22	5.8
State totals	202	126	328	370	11

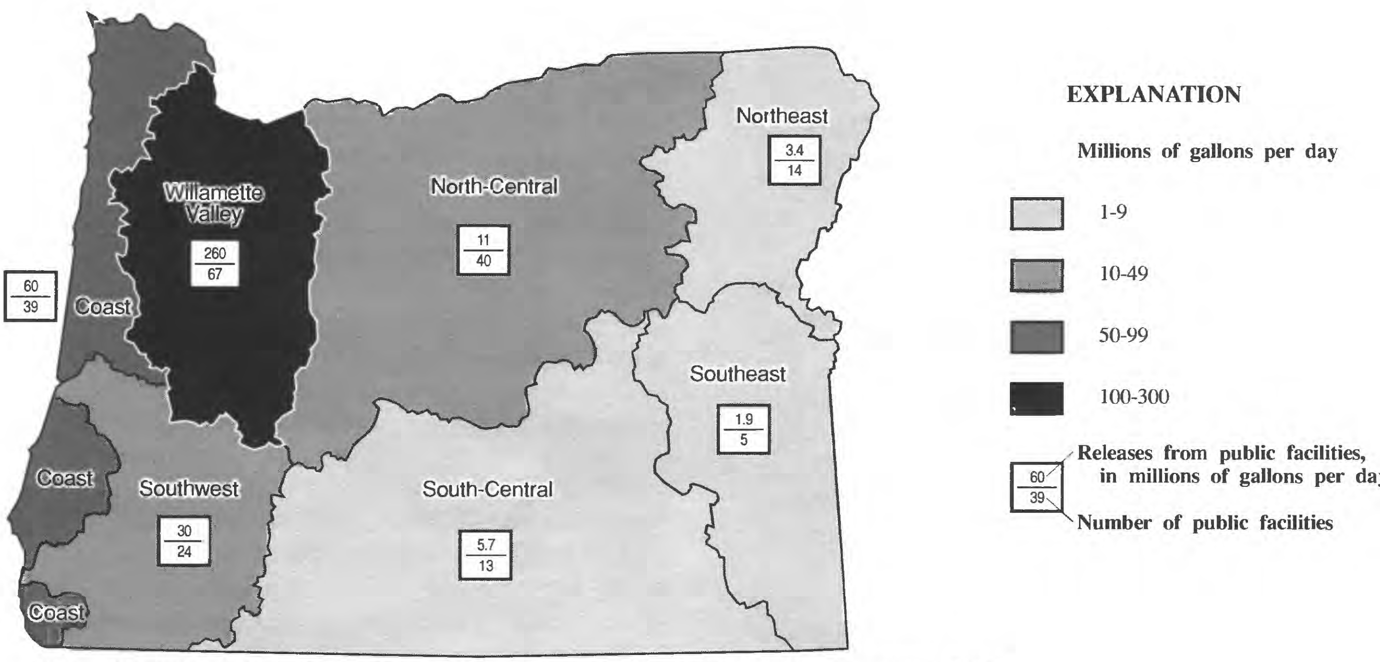

Figure 21. Total water releases from public wastewater-treatment facilities, by region, 1990.

West of the Cascade Range

The distribution of public-wastewater facilities in Oregon is similar to the distribution of public-water suppliers. Communities on the western side of the Cascade Range generally have large treatment facilities serving several communities, whereas communities on the eastern side of the Cascade Range with smaller population densities generally have their own waste-treatment facility. As a result, the 130 public waste-water-treatment facilities in western Oregon are only 64 percent of the total in Oregon, yet the amount of water discharged by theses facilities is 95 percent (350 Mgal/d) of the total returns (table 24). Treated wastewater from facilities west of the Cascade Range usually is returned to streams, whereas the treated wastewater at facilities east of the Cascade Range usually is routed to seepage lagoons, because stream-flow is insufficient to dilute discharges. The 100 indus-trial and other wastewater facilities west of the Cascade Range constitute 79 percent of the total number in the State (126).

Table 25. Wastewater treatment facility releases by region in Oregon, 1985
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Region Name	Number of facilities: Public	Number of facilities: Industrial and Other	Number of facilities: Total	Total public releases, in Mgal/d	Reclaimed waste water from all waste-water facilities
		West of the Cascade Range			
Coast	41	17	58	57	.4
Willamette	98	36	134	230	1.6
Southwest	34	16	50	29	.1
Total	173	69	242	310	2.1
		East of the Cascade Range			
South-Central	13	5	18	6.8	.4
North-Central	45	11	56	13	1.8
Southeast	5	1	6	1.9	.1
Northeast	16	0	16	3.6	.2
Total	79	17	96	25	2.6
State totals	252	86	338	340	4.6

Coast

In the Coast Region, 39 public wastewater-treatment facilities discharged a total of 60 Mgal/d to surface waters in 1990 (table 24). That amount is unusually high, because discharges from the pulp mill in St. Helens were treated by the municipal facility. Most of the other large industrial water users have their own industrial wastewater-treatment facilities. In addition to St. Helens, other cities that discharged more than 2 Mgal/d included Astoria, Newport, and Coos Bay. The city of Cannon Beach uses a wetlands area during the summer months to assist the settling and dilution of effluent. About 4 Mgal/d of treated effluent was discharged directly to the Pacific Ocean by five public facilities. Four facilities, including St. Helens, had a combined discharge of about 40 Mgal/d to the Columbia River.

The Coast Region has 25 industrial and other wastewater-treatment facilities. The users of these facilities range from schools and State parks to pulp-and-paper mills. Four of the facilities discharge to the Columbia River, and five of the facilities discharge into the Pacific Ocean.

Willamette

In 1990, about 70 percent (260 Mgal/d) of the return flows from public wastewater-treatment facilities in Oregon came from the Willamette Region (table 24), and all but 2 of 67 facilities in the Willamette Region discharged wastewater into streams. Nine facilities used treated effluent for irrigation during some part of the year. There are also 57 industrial and other facilities in the region, for a total of 124 wastewater-treatment facilities—the largest number for any region in Oregon.

In the Willamette Region, several public-wastewater-treatment facilities released more than 10 Mgal/d per day in 1990: two facilities in Portland (77 Mgal/d total), Eugene/Springfield (33 Mgal/d), Salem (32 Mgal/d), and two facilities in Washington County that are operated by the Unified Sewerage Agency and returned a total of 38 Mgal/d to the Tualatin River. The Unified Sewerage Agency, which operates a total of 6 facilities in Washington County, was created in 1970 to replace more than 20 secondary-treatment plants with tertiary-treatment facilities or with facilities that release no discharge during the summer. All of these facilities discharge into the Tualatin River. To help augment summer low flows, the Unified Sewerage Agency purchases water from the BOR storage project in the upper reaches of the Tualatin Valley.

Summer flows in the Willamette River are augmented by upstream reservoir storage from U.S. Army Corps of Engineers projects. About 16 public wastewater-treatment facilities discharged more than 110 Mgal/d of treated water directly into the Willamette River during 1990; additionally, 12 industrial and other facilities discharge directly into the Willamette River. Only one public facility (Gresham, 8 Mgal/d) and two industrial facilities discharge wastewater directly into the Columbia River. The major discharge point of the wastewater-treament facility for the city of Portland is located on a slough near the confluence of the Willamette and Columbia Rivers.

Southwest

In 1990, 42 public wastewater-treatment facilities discharged a total of 30 Mgal/d into streams in the Southwest Region of Oregon, whereas 2 public facilities had no discharge and applied less than 0.1 Mgal/d to land. The Medford, Roseburg, and Grants Pass public wastewater-treatment facilities released 75 percent of the return flows. Seven of the 12 facilities in the Rogue River Basin discharged more than 19 Mgal/d directly into the Rogue River, and 5 of the 12 facilities in the Umpqua River Basin discharged 6 Mgal/d directly to the South Umpqua or Umpqua Rivers. Only one system discharged to the North Umpqua River. In 1990, 18 industrial and other wastewater-treatment facilities in the Southwest Region treated waste from schools, ranger stations, and industries.

East of the Cascade Range

In 1990, 73 percent (72) of the wastewater-treatment facilities located east of the Cascade Range were public facilities. Thirty of these public facilities used wastewater-holding lagoons and did not discharge to surface water. The other 42 public facilities discharged 22 Mgal/d into streams; only 9 of these facilities discharged more than 1 Mgal/d.

In 1990, there were 26 industrial and other wastewater-treatment facilities east of the Cascade Range. Several of these facilities treated waste from food-processing plants and used the effluent for irrigation. About 69 percent (4.0 Mgal/d) of the treated effluent used for irrigation came from industrial and other wastewater-treatment facilities; the rest came from public facilities.

South-Central

As of 1990, there were 13 public wastewater-treatment facilities located in the South-Central Region (table 24). Many of the facilities, including the one in Burns and three facilities in the Oregon Closed Basins, do not discharge to streams. Of the seven facilities that do discharge to streams, the largest is the Klamath Falls facility that discharged more than 3 Mgal/d into the Klamath River or about 53 percent of the total water discharged (5.7 Mgal/d) by all public facilities in the region. One other facility uses the Klamath River as a receiving stream, and one facility uses a canal connected to the nearby irrigation project. Of the six facilities that do not discharge to streams, four use the effluent for irrigation. There are six industrial and other wastewater-treatment facilities in the South-Central Region; three of these facilities discharge to surface water.

North-Central

There were 53 wastewater-treatment facilities in North-Central Region in 1990: 40 public facilities and 13 industrial and other facilities (table 24). Twenty-three of the public facilities discharged a total of 11 Mgal/d to surface water during 1990. About 91 percent (10 Mgal/d) of this amount came from 18 public facilities located in the Umatilla and the Hood River Basins. Six of the facilities discharged to the Columbia River (4 Mgal/d) and three discharged to the Umatilla River (4 Mgal/d). Fourteen facilities in the North-Central Region do not discharge to surface water; most of the larger cities in the John Day and Deschutes River Basins, including John Day, Bend, Redmond, and Madras, use holding lagoons. Redmond and Madras use the effluent for irrigation, as do nine other facilities in the John Day and Deschutes River Basins. Three of the 13 industrial and other wastewater-treatment facilities discharge to the Columbia River.

Southeast

Only eight wastewater-treatment facilities were located in the Southeast Region in 1990, the smallest number of facilities for any region in Oregon (table 24). Ontario, the largest of the five public wastewater-treatment facilities in the region, contributed about 80 percent of the region's total discharges (1.9 Mgal/d) to the Malheur River at a point less than 2 miles from its confluence with the Snake River. The three major food-processing plants in the Southeast Region have industrial wastewater-treatment facilities. Two of the facilities discharge to the Snake River, whereas the other uses the effluent for irrigation.

Northeast

A total of 14 public wastewater-treatment facilities discharged 3.4 Mgal/d to surface waters in the Northeast Region in 1990 (table 24). Baker City and La Grande facilities, each of which discharged slightly more than 1 Mgal/d, are the largest facilities. Only four industrial and other wastewater-treatment facilities are located in Northeast Region.

SUMMARY

This report summarizes water use in Oregon during 1985 and 1990 for 11 categories of use: public supply, domestic, commercial, industrial, mining, thermoelectric power, hydroelectric power, livestock, irrigation, reservoir evaporation, and wastewater treatment. Hydroelectric power is the only instream use discussed; all other uses are considered offstream.

The methods used to collect the data differed according to the category of water-use. Data for water users such as public-supply systems and self-supplied commercial and industrial users usually were estimated by obtaining actual withdrawal information or by applying a water-use coefficient to each individual user. Data for water-use categories such as livestock and irrigation were derived primarily from information on livestock population or crop acreage obtained at the county level and distributed areally on the basis of water-rights and land-use information. Water-use estimates, based on information for each individual user, were as much as 10 times more accurate than water-use estimates based on county information.

Differences in climate and in geological characteristics west and east of the Cascade Range determine, in large part, the sources, uses, and amounts of water withdrawn in Oregon. West of the Cascade Range, annual average precipitation ranges from 40 to 200 inches, whereas annual average precipitation east of the Cascade Range ranges from 10 to 20 inches in most areas. Most of the large public-supply systems west of the Cascade Range rely on surface water, whereas many of the large public-supply systems east of the Cascade Range use wells or springs. Irrigators west of the Cascade Range mainly use local surface-water sources, whereas irrigators east of the Cascade Range rely primarily on surface water that is often delivered from distant sources through irrigation ditches.

Water was withdrawn at an estimated rate of 8,400 Mgal/d (million gallons per day) in Oregon during 1990. This rate was 1,900 Mgal/d greater than the 6,500 Mgal/d withdrawn in 1985. Although actual water use did increase, the major differences between 1985 and 1990 are attributable to the inclusion of offstream fish hatcheries in the estimates, the use of different crop coefficients to estimate irrigation, and the availability of more detailed information in 1990.

Surface-water withdrawals accounted for 92 percent (7,700 Mgal/d) of the total withdrawals in 1990. Withdrawals from the Columbia River were estimated to be only 300 Mgal/d. Instream use on the Columbia River for hydroelectric-power generation, navigation, and maintenance of aquatic habitat were all significant, but only water use for power generation was estimated. An estimated 440,000 Mgal/d was used by the four Oregon hydroelectric facilities on the Columbia River to produce 80 percent of the hydroelectric power generated in Oregon.

Ground-water withdrawals accounted for 8 percent (770 Mgal/d) of the total water withdrawals in Oregon in 1990. About 50 percent of the ground-water withdrawals were from unconsolidated sedimentary rock aquifers; undifferentiated volcanic and sedimentary rock aquifers and older basalt rock aquifers each contributed an estimated 25 percent.

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GLOSSARY

acre-foot (acre-feet)—the volume of water required to cover 1 acre of land (43,560 square feet) to a depth of 1 foot, equivalent to 325,851 gallons.

alluvium—general term for deposits of clay, silt, sand, gravel, or other particulate material deposited by a stream or other body of running water in a streambed, on a flood plain, in a delta, or at the base of a mountain.

anadromous fish—migratory fish, such as salmon, that are born in freshwater, spend most of their lives in estuary and ocean waters, and return to freshwater to spawn.

animal specialty water use—water use associated with the production of fish in captivity (except fish hatcheries), fur-bearing animals in captivity, horses, rabbits, and bees. See also livestock water use.

application rate—rate at which irrigation water is applied per unit area.

aquaculture—farming of organisms that live in water, such as fish, shellfish, and algae.

aquifer—a geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

base flow—sustained low flow of a stream. In most places, base flow is ground-water inflow to the stream channel.

commercial water use—water for motels, hotels, restaurants, office buildings, other commercial facilities, and institutions (both civilian and military). The water may be obtained from public supply or may be self-supplied.

consumptive use—that part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment. Referred to also as "water consumed" or "water depletion."

conveyance loss—water that is lost in transit from a pipe, canal, conduit, or ditch by leakage or evaporation. Typically, the water is not available for further use; however, leakage from an irrigation ditch, for example, may percolate to a ground-water source and be available for further use.

cooling water—water used for cooling purposes, such as for condensers and nuclear reactors.

crop-water need—the amount of water that must be applied by irrigation to a crop to account for evapotranspiration is equivalent to consumptive use.

delivery/release—the amount of water delivered to the point of use and the amount released after use—the difference between these amounts is usually the same as the consumptive use. See also "consumptive use."

diversion—a turning aside or alteration of the natural course of a flow of water; the diverted water is normally considered to physically leave the natural channel.

domestic water use—water used for household purposes, such as drinking, preparing food, bathing, washing clothes and dishes, flushing toilets, and irrigating lawns and gardens. Referred to also as "residential water use." The water may be obtained from a public supply or may be self-supplied.

drainage basin—land area drained by a river.

evaporation—process by which water is changed from the liquid to the vapor state. See also "evapotranspiration" and "transpiration."

evapotranspiration—a collective term that includes water discharged to the atmosphere as a result of evaporation from the soil and surface water bodies, and by plant transpiration. See also "evaporation" and "transpiration."

fallow—cropland, tilled or untilled, allowed to lie idle during the whole or the greater part of the growing season.

fish hatchery—facility primarily engaged in the rearing of fish under controlled feeding procedures. The fish are generally released to rivers, lakes, and streams, and are not harvested on-site.

gigawatt hour (GWh)—1 billion watthours.

ground water—generally, all subsurface water as distinct from surface water; specifically, that part of the subsurface water in the saturated zone (a zone in which all voids are filled with water).

head—the difference in elevation in feet between the water surface in the reservoir and the plant tailrace.

hydroelectric-power water use—the use of water in the generation of electricity at plants where the turbine generators are driven by falling water; an instream use.

hydrologic unit—a region that includes an area drained by a river system, the reach of a river and the tributaries in that reach, a closed basin(s), or a group of streams that form a coastal drainage system.

industrial water use—water used for industrial purposes such as fabrication, processing, washing, and cooling in such industries as steel, chemical and allied products, paper and allied products, mining, and petroleum refining. The water may be obtained from a public supply or may be self-supplied.

instream use—water use within the stream channel for such purposes as hydroelectric-power generation, navigation, water-quality improvement, fish propagation, and recreation. Sometimes called in-channel use.

interbasin transfer—artificial transfer (pipes or canals) of freshwater from one hydrologic unit to another hydrologic unit.

irrigation—generally, the controlled application of water to arable lands in order to supply the water requirements of crops that are not satisfied by rainfall. Irrigation systems used include the following:

center pivot—automated sprinkler irrigation achieved by rotating a sprinkler pipe or boom while supplying water to sprinkler heads or nozzles. The pipe is supported above the crop by towers at fixed spacings and propelled by pneumatic, mechanical, hydraulic, or electric power on wheels or skids in fixed circular paths at uniform angular speeds. Water, which is delivered to the center or pivot point of the system, is applied at a uniform rate by progressive increase of nozzle size from the pivot to the end of the line. The depth of water applied is determined by the rate of travel of the system. Single units are ordinarily about 1,250 to 1,300 feet long and irrigate about a 130-acre circular area.

drip—an irrigation system in which water is applied directly to the root zone of plants by means of applicators (orifices, emitters, porous tubing, perforated pipe) operated under low pressure. The applicators can be placed on or below the surface of the ground, or can be suspended from supports.

flood—the application of irrigation water, whereby the entire surface of the soil is covered by ponded water.

gravity—irrigation in which the water is not pumped, but flows in ditches or pipes and is distributed by gravity.

sprinkler—an irrigation system in which water is applied by means of perforated pipes or nozzles, operated under pressure, to form a spray pattern.

subirrigation—a system in which water is applied below the ground surface either by raising the water table within or near the root zone, or by using a buried perforated or porous pipe system that discharges directly into the root zone.

traveling gun—sprinkler-irrigation system consisting of a single large nozzle that rotates and is self-propelled. The name also refers to the fact that the base is on wheels and can be moved by the irrigator or affixed to a guide wire. Also referred to as "big gun."

wild flooding—flood irrigation resulting from a temporary dam (usually rocks and gravel) being placed in a stream that carries snowmelt runoff. The stream overflows, and the resulting flood irrigates surrounding lands.

irrigation district—in the United States, a cooperative, self-governing, public corporation set up as a subdivision of the State government, with definite geographic boundaries, organized and having taxing power to obtain and distribute water for irrigation of lands within the district that has been created under the authority of a State legislature with the consent of a designated fraction of the landowners or citizens.

irrigation return flow—part of irrigation water that is not consumed by evapotranspiration and that migrates to an aquifer or surface water body.

irrigation water use—artificial application of water on lands to assist in the growing of crops and pastures or to maintain vegetative growth in recreational lands, such as parks and golf courses.

livestock water use—water used for stock watering, feed lots, dairy operations, fish farming, and other on-farm needs. Livestock, as used here, includes cattle, sheep, goats, hogs, and poultry. See also "animal specialty water use."

million gallons per day (Mgal/d)—a rate of flow of water.

mining water use—water use for the extraction of naturally occurring minerals, including solids such as coal and ores; liquids, such as crude petroleum; gases, such as natural gas. Also, uses associated with quarrying, well operations (dewatering), milling (crushing, screening, washing, flotation), and other preparations customarily done at a mine site or as part of a mining activity.

normal storage—the total storage space in a reservoir below the normal retention level, including dead and inactive storage but excluding any flood-control or surcharge storage.

offstream use—water withdrawn or diverted from a ground- or surface-water source for public-water supply, industry, irrigation, livestock, thermoelectric-power generation, and other uses.

per-capita use—the average amount of water used per person during a standard time period (generally a day).

placer mining—extraction of heavy metals or minerals from surface gravel or other similar deposit by washing the deposits with water.

public supply—water withdrawn by public and private water suppliers and delivered to groups of users. Public suppliers provide water for a variety of uses, such as domestic (residential), commercial, industrial, and public water use.

public-supply deliveries—water provided for multiple users through a public-supply distribution system.

public water use—use of water supplied from a public-water supply and used for such purposes as firefighting, street washing, system maintenance, and municipal parks and swimming pools.

recharge (ground water)—the addition of water to the ground-water system by natural or artificial processes.

reclaimed sewage—wastewater-treatment-plant effluent that has been diverted or intercepted for use before it reaches a natural waterway or aquifer.

recycled water—water that is used more than one time before it returns to the natural hydrologic system.

return flow—water that reaches a ground- or surface-water source, after release from the point of use, and becomes available for further use.

self-supplied water—water withdrawn from a surface- or ground-water source by the water user, rather than being obtained from a public supply.

sewage—waste matter and water that passes through sewers and drains.

sewage treatment—the processing of wastewater for the removal or reduction of solids or other undesirable constituents.

sewage-treatment return flow—water returned to the hydrologic system by sewage treatment facilities.

Standard Industrial Classification (SIC) codes — four-digit codes established by the U.S. Office of Management and Budget and used in the classification of establishments by the type of activity in which they are engaged.

surface water—an open body of water, such as a stream or a lake.

thermoelectric power—electrical power generated using fossil fuel (coal, oil, or natural gas), geothermal, or nuclear energy.

thermoelectric-power water use—water used in the process of the generation of thermoelectric power. The water may be obtained from a public supply or may be self-supplied.

transpiration—process by which water that is absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface. See also "evaporation" and "evapotranspiration."

wastewater—water that carries wastes from homes, businesses, and industries.

watermaster—State employee who regulates the distribution of water among users of water from any natural surface- or ground-water supply in accordance with the user's existing water rights of record.

water consumed—see "consumptive use."

water rights—legal rights to use a specific quantity of water, on a specific time schedule, at a specific place, and for a specific purpose.

water transfer—artificial conveyance of water from one area to another.

water use—see "offstream use" and "instream use."

watthour (Wh)—an electrical energy unit of measure equal to 1 watt of power continuously supplied to, or taken from, an electrical circuit for 1 hour.

withdrawal—water removed from the ground or diverted from a surface-water source for use. See also "offstream use" and "self-supplied water."

APPENDIX

TABLES OF WATER USE BY HYDROLOGIC UNIT AND REGION FOR OREGON, 1990

AND

TABLES OF WATER USE BY HYDROLOGIC UNIT AND REGION FOR OREGON, 1985

Total offstream water use by hydrologic unit, in Coast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses) Ground water	Surface water	Total	Water use, in Mgal/d Reclaimed wastewater	Consumptive use	Conveyance losses
17080003	21.4	1.8	91	92	0	16	0
17080006	22.7	0.2	52	52	0	1.4	0
17100201	11.1	0.2	4.0	4.2	0	0.7	0
17100202	5.3	0.2	4.8	5.0	0	1.1	0
17100203	19.1	2.8	28	31	0	4.1	0
17100204	30.1	0.3	58	58	1.2	3.8	0
17100205	12.5	0.4	26	27	0	1.5	0
17100206	11.2	0.8	1.7	2.5	0	0.9	0
17100207	2.4	0.2	13	13	0	0.2	0
17100304	38.8	5.8	6.4	12	0	3.3	0
17100305	19.9	0.9	14	15	0	9.9	0
17100306	7.7	0.7	27	27	0	5.0	0.1
17100312	10.7	2.0	8.3	10	0	2.2	0
Total	212.8	16	330	350	1.2	50	0.1

Total offstream water use by hydrologic unit, in Coast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses) Ground water	Surface water	Total	Water use, in Mgal/d Reclaimed wastewater	Consumptive use	Conveyance losses
17080003	20.6	1.8	48	49	0	4.0	0
17080006	20.4	0.3	10	10	0	2.0	0
17100201	12.9	0.4	1.4	1.8	0	0.5	0
17100202	5.1	0.5	3.S3	3.8	0.4	2.2	0
17100203	19.0	3.7	10	14	0	4.7	0
17100204	28.8	1.0	20	21	0	1.6	0.9
17100205	12.0	0.9	1.2	2.1	0	0.9	0
17100206	10.7	0.7	0.9	1.6	0	0.5	0
17100207	2.3	0.2	0	0.2	0	0.1	0
17100304	38.7	4.6	19	24	0	1.6	1.5
17100305	19.9	1.3	18	19	0	9.3	0
17100306	6.9	0.4	2.8	3.2	0	2.3	0
17100312	9.4	0.5	1.4	1.9	0	0.8	0
Total	206.7	16	140	150	0.4	30	2.5

Public-supply water use by hydrologic unit, in Coast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Population served, in thousands			Withdrawals, total in Mgal/d			Water deliveries, by type of use, in Mgal/d					Per capita use, in gal/d
	Ground water	Surface water	Total	Ground water	Surface water	Total	Commercial	Domestic	Industrial	Public use and losses	Total deliveries	
17080003	1.6	5.5	7.1	0.6	1.5	2.1	0.2	1.1	0.1	0.7	1.4	300
17080006	0.8	21	22	0.1	7.1	7.2	0.9	4.0	1.0	1.4	5.9	330
17100201	0.8	9.8	11	0.1	3.5	3.6	0.3	1.1	0	2.2	1.4	340
17100202	0.1	3.7	3.8	0	0.6	0.6	0.1	0.4	0	0.1	0.5	160
17100203	5.3	9.3	15	2.1	6.3	8.4	1.1	3.3	0.3	3.7	4.7	580
17100204	0.6	24	25	0.1	5.8	5.9	1.1	3.1	0.8	0.9	5.0	230
17100205	0.4	7.8	8.2	0.1	1.1	1.2	0.1	0.9	0	0.1	1.0	140
17100206	4.6	3.8	8.4	0.5	1.0	1.5	0.1	1.0	0.2	0.2	1.3	170
17100207	0	0.3	0.3	0	0	0	0	0	0	0	0	80
17100304	17	13	29	5.2	3.7	8.9	1.5	3.7	3.3	0.5	8.5	310
17100305	0.2	10	10	0	1.4	1.4	0.2	0.7	0.3	0.2	1.2	130
17100306	1.3	1.8	3.0	0.1	0.2	0.3	0.1	0.2	0	0	0.3	110
17100312	8.1	2.1	10	1.5	0	1.5	0.3	1.1	0.2	-0.1	1.6	150
Total	40	110	150	10	32	43	5.9	21	6.2	9.8	33	280

Public-supply water use by hydrologic unit, in Coast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Population served, in thousands			Withdrawals, total in Mgal/d			Water deliveries, by type of use, in Mgal/d					Per capita use, in gal/d
	Ground water	Surface water	Total	Ground water	Surface water	Total	Commercial	Domestic	Industrial	Public use and losses	Total deliveries	
17080003	0.7	4.9	5.7	0.1	0.3	0.4	0	0.3	0.1	0	0.4	62
17080006	0.4	17	17	0	8.5	8.6	0.9	5.4	0.9	1.4	8.6	490
17100201	0.8	8.0	8.8	0.1	1.1	1.2	0.2	1.0	0	0	1.2	130
17100202	0.1	2.9	3.0	0	0.9	0.9	0.1	0.6	0	0.1	0.9	310
17100203	6.8	7.8	15	2.7	5.9	8.5	0.8	2.8	0.5	4.5	8.5	590
17100204	0.6	19	19	0	5.7	5.8	1.1	3.3	0.4	1.0	5.8	300
17100205	0	5.1	5.1	0	0.8	0.8	0.1	0.7	0	0	0.8	150
17100206	5.1	4.1	9.2	0.4	0.6	1.0	0	0.9	0.1	0	1.0	110
17100207	0	0.1	0.1	0	0	0	0	0	0	0	0	140
17100304	19	19	39	4.4	3.7	8.1	1.1	3.4	2.8	0.7	8.1	210
17100305	0	11	11	0	1.5	1.5	0.2	1.0	0.1	0.2	1.5	140
17100306	0	1.9	1.9	0	0.4	0.4	0.1	0.2	0	0.1	0.4	200
17100312	0	8.1	8.1	0	0.9	0.9	0.2	0.5	0.1	0.1	0.9	120
Total	34	110	140	7.7	30	38	4.8	20	4.9	8.2	38	270

Domestic water use by hydrologic unit, in Coast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

	Self supplied					Public supplied			Total	
		Water withdrawals, in Mgal/d								
Hydrologic unit	Population, in thousands	Ground water	Surface water	Total	Per capita use, in gal/d	Population served, in thousands	Deliveries from public supply, in Mgal/d	Per capita use, in gal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17080003	14	1.1	0.3	1.4	100	7.1	1.1	160	2.6	0.9
17080006	0.5	0	0	0.1	100	22	4.0	180	4.0	0.8
17100201	0.5	0	0	0.1	100	11	1.1	100	1.1	0.2
17100202	1.5	0.1	0	0.2	100	3.8	0.4	110	0.6	0.2
17100203	4.5	0.2	0.3	0.5	100	15	3.3	230	3.8	0.9
17100204	5.1	0.3	0.3	0.5	100	25	3.1	120	3.6	0.9
17100205	4.4	0.3	0.2	0.4	100	8.2	0.9	110	1.4	0.4
17100206	2.7	0.2	0	0.3	100	8.4	1.0	120	1.3	0.3
17100207	2.2	0.2	0	0.2	100	0.3	0	80	0.2	0.1
17100304	9.7	0.6	0.3	1.0	100	29	3.7	130	4.6	1.2
17100305	9.5	0.6	0.3	1.0	100	10	0.7	69	1.7	0.6
17100306	4.6	0.3	0.2	0.5	100	3.0	0.2	69	0.7	0.3
17100312	0.6	0	0	0.1	100	10	1.1	110	1.2	0.3
Total	60	4.0	2.0	6.0	100	150	21	140	27	7.2

Domestic water use by hydrologic unit, in Coast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

	Self supplied					Public supplied			Total	
		Water withdrawals, in Mgal/d								
Hydrologic unit	Population, in thousands	Ground water	Surface water	Total	Per capita use, in gal/d	Population served, in thousands	Deliveries from public supply, in Mgal/d	Per capita use, in gal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17080003	15	1.4	0.1	1.5	100	5.7	0.3	53	1.8	0.8
17080006	3.0	0.3	0	0.3	100	17.0	5.4	310	5.7	1.3
17100201	4.1	0.4	0	0.4	100	8.8	1.0	110	1.4	0.3
17100202	2.2	0.2	0	0.2	100	3.0	0.6	220	0.9	0.2
17100203	4.4	0.4	0	0.4	100	15	2.8	190	3.3	0.9
17100204	9.4	0.9	0.1	0.9	100	19	3.3	170	4.3	1.3
17100205	7.0	0.6	0.1	0.7	100	5.1	0.7	140	1.4	0.4
17100206	1.5	0.1	0	0.2	100	9.2	0.9	95	1.0	0.3
17100207	2.2	0.2	0	0.2	100	0.1	0	71	0.2	0.1
17100304	0.2	0	0	0	100	39	3.4	89	3.4	0.7
17100305	8.9	0.7	0.2	0.9	100	11	1.0	94	1.9	0.4
17100306	5.0	0.4	0.2	0.5	100	1.9	0.2	120	0.7	0.4
17100312	1.3	0.1	0	0.1	100	8.1	0.5	59	0.6	0.2
Total	64	5.7	0.7	6.4	100	140	20	140	27	7.3

Commercial water use by hydrologic unit, in Coast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d			Deliveries from public supply, in Mgal/d	Total	
	Ground water	Surface water	Total		Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17080003	0	13	13	0.2	13	0.1
17080006	0	44	44	0.9	45	0.2
17100201	0	0	0	0.3	0.4	0.1
17100202	0	2.9	2.9	0.1	3.0	0
17100203	0.1	18	18	1.1	19	0.3
17100204	0	38	38	1.1	39	0.2
17100205	0	23	23	0.1	24	0
17100206	0.1	0	0.1	0.1	0.2	0.1
17100207	0	0	0.1	0	0.1	0
17100304	0	0	0	1.5	1.5	0.3
17100305	0.1	0	0.1	0.2	0.3	0.1
17100306	0	20	20	0.1	20	0
17100312	0	6.2	6.2	0.3	6.5	0.1
Total	0.3	170	170	5.9	170	1.4

Commercial water use by hydrologic unit, in Coast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d			Deliveries from public supply, in Mgal/d	Total	
	Ground water	Surface water	Total		Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17080006	0	0	0	0.9	0.9	0.2
17100201	0	0	0	0.2	0.2	0
17100202	0	0	0	0.1	0.1	0
17100203	0	0	0	0.8	0.8	0.2
17100204	0	0	0	1.1	1.1	0.2
17100205	0	0	0	0.1	0.1	0
17100304	0	0	0	1.1	1.2	0.2
17100305	0	0	0	0.2	0.2	0
17100306	0	0	0	0.1	0.1	0
17100312	0	0	0	0.2	0.2	0.1
Total	0.1	0	0.1	4.8	4.9	1.0

Industrial water use by hydrologic unit, in Coast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d			Reclaimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
	Ground water	Surface water	Total				
17080003	0	60	60	0	0.1	60	4.1
17080006	0	0.2	0.2	0	1.0	1.2	0.1
17100202	0	0	0	0	0	0.1	0
17100203	0	0	0	0	0.3	0.3	0
17100204	0	14	14	1.0	0.8	14	2.2
17100206	0	0	0	0	0.2	0.2	0
17100207	0	13	13	0	0	13	0
17100304	0	0.1	0.1	0	3.3	3.4	0.2
17100305	0	0.1	0.1	0	0.3	0.3	0
17100306	0	0	0	0	0	0.1	0
17100312	0	0.1	0.1	0	0.2	0.3	0
Total	0	87	88	1.0	6.2	93	6.7

Industrial water use by hydrologic unit, in Coast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d			Reclaimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
	Ground water	Surface water	Total				
17080003	0	35	35	0	0.1	35	0
17080006	0	0.9	0.9	0	0.9	1.7	0.1
17100203	0	0.1	0.1	0	0.5	0.5	0
17100204	0	13	13	0	0.4	13	0.1
17100206	0	0.2	0.2	0	0.1	0.2	0
17100304	0	13	13	0	2.8	16	0.6
17100305	0	4.9	4.9	0	0.1	5.0	0.2
17100306	0	0.1	0.1	0	0	0.1	0
17100312	0	0	0	0	0.1	0.1	0
Total	0	67	67	0	4.9	72	1.0

Mining water use by hydrologic unit, in Coast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total	
Total	0.1	0	0.1	0

Mining water use by hydrologic unit, in Coast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total	
Total	0	0	0	0

Thermoelectric power water use by hydrologic unit, in Coast Region, Oregon, 1990
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
17080003	0	15	10	6,900
Total	0	15	10	6,900

Thermoelectric power water use by hydrologic unit, in Coast Region, Oregon, 1985
[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
17080003	0	11	2.3	6,900
Total	0	11	2.3	6,900

Hydroelectric power water use by hydrologic unit, in Coast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
Total	0	0

Hydroelectric power water use by hydrologic unit, in Coast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
Total	0	0

Livestock water use by hydrologic unit, in Coast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock				Animal specialties				Total livestock			
	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total		Ground water	Surface water	Total		Ground water	Surface water	Total	
17100202	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17100203	0.1	0.7	0.7	0.7	0	0	0	0	0.1	0.7	0.8	0.8
17100304	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17100305	0	0.3	0.3	0.3	0	0	0	0	0	0.3	0.3	0.3
17100306	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
Total	0.1	1.3	1.4	1.4	0	0	0	0	0.1	1.3	1.5	1.5

Livestock water use by hydrologic unit, in Coast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock				Animal specialties				Total livestock			
	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total		Ground water	Surface water	Total		Ground water	Surface water	Total	
17080003	0	0.1	0.1	0.1	--	--	--	--	0	0.1	0.1	0.1
17100201	0	0	0.1	0.1	--	--	--	--	0	0	0.1	0.1
17100202	0	0.2	0.2	0.2	--	--	--	--	0	0.2	0.2	0.2
17100203	0.1	0.5	0.6	0.6	--	--	--	--	0.1	0.5	0.6	0.6
17100304	0	0.1	0.1	0.1	--	--	--	--	0	0.1	0.1	0.1
17100305	0	0.3	0.3	0.3	--	--	--	--	0	0.3	0.3	0.3
17100306	0	0.1	0.1	0.1	--	--	--	--	0	0.1	0.1	0.1
Total	0.1	1.3	1.5	1.5	--	--	--	--	0.1	1.3	1.5	1.5

Irrigation water use by hydrologic unit, in Coast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Withdrawals, in Mgal/d: Fresh water: Surface	Withdrawals, in Mgal/d: Reclaimed wastewater	Withdrawals, in Mgal/d: Total	Irrigated land by irrigation type, in thousand acres: Spray	Irrigated land by irrigation type, in thousand acres: Flood	Irrigated land by irrigation type, in thousand acres: Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
17080003	0	1.2	0	1.3	1.1	0	1.1	0	0.7
17080006	0	0.3	0	0.3	0.4	0	0.5	0	0.2
17100201	0	0.4	0	0.5	0.5	0.1	0.6	0	0.3
17100202	0	1.1	0	1.1	1.3	0.1	1.3	0	0.8
17100203	0.4	2.5	0	2.9	4.2	0	4.2	0	2.2
17100204	0	0.5	0.2	0.5	0.5	0	0.5	0	0.4
17100205	0	1.7	0	1.7	1.7	0	1.7	0	1.0
17100206	0	0.6	0	0.6	0.9	0	0.9	0	0.5
17100207	0	0.1	0	0.1	0.1	0	0.1	0	0.1
17100304	0	2.2	0	2.2	1.8	0	1.8	0	1.6
17100305	0.2	12	0	12	11	0	11	0	8.8
17100306	0.2	6.1	0	6.3	3.9	0.6	4.4	0.1	4.6
17100312	0.4	2.0	0	2.4	1.6	0	1.6	0	1.8
Total	1.4	31	0.2	32	29	0.7	29	0.1	23

Irrigation water use by hydrologic unit, in Coast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Withdrawals, in Mgal/d: Fresh water: Surface	Withdrawals, in Mgal/d: Reclaimed wastewater	Withdrawals, in Mgal/d: Total	Irrigated land by irrigation type, in thousand acres: Spray	Irrigated land by irrigation type, in thousand acres: Flood	Irrigated land by irrigation type, in thousand acres: Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
17080003	0.3	0.8	0	1.1	1.3	0	1.3	0	0.8
17080006	0	0.6	0	0.6	0.6	0	0.6	0	0.4
17100201	0	0.2	0	0.2	0.2	0	0.2	0	0.1
17100202	0.3	2.2	0.4	2.5	2.5	0	2.5	0	1.8
17100203	0.5	3.7	0	4.2	4.0	0	4.0	0	3.1
17100204	0.1	1.2	0	1.3	1.2	0	1.2	0.9	0
17100205	0.3	0.3	0	0.6	0.6	0	0.6	0	0.5
17100206	0.2	0.1	0	0.3	0.3	0	0.3	0	0.2
17100304	0.1	2.1	0	2.2	2.0	0.1	2.1	1.5	0
17100305	0.5	11	0	12	11	0.5	11	0	8.2
17100306	0.1	2.1	0	2.2	2.4	0	2.4	0	1.7
17100312	0.3	0.4	0	0.7	0.7	0	0.7	0	0.5
Total	2.7	25	0.4	27	26	0.6	27	2.5	17

Reservoir evaporation water use by hydrologic unit, in Coast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding]

Hydrologic unit	Amount evaporated, in thousand acre-feet	Reservoir area, in thousand acres
17100207	3.4	1.6
Total	3.4	1.6

Wastewater-treatment water releases by hydrologic unit, in Coast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities			Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
	Public	Industrial and other	Total		
17080003	3	4	7	36	0
17080006	3	3	6	4.7	0
17100201	4	1	5	2.0	0
17100202	2	1	3	1.1	0
17100203	7	4	11	2.7	0
17100204	7	3	10	5.8	0.2
17100205	2	2	4	0.4	0
17100206	1	3	4	0.6	0
17100304	4	2	6	4.1	0
17100305	4	1	5	2.2	0
17100306	1	1	2	0.1	0
17100312	1	0	1	0.7	0
Total	39	25	64	60	0.2

Wastewater-treatment water releases by hydrologic unit, in Coast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities			Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
	Public	Industrial and other	Total		
17080003	3	3	6	34	0
17080006	2	0	2	4.5	0
17100201	4	2	6	2.7	0
17100202	1	0	1	0.1	0.4
17100203	8	3	11	3.3	0
17100204	7	2	9	4.7	0
17100205	2	2	4	0.3	0
17100206	2	1	3	0.6	0
17100304	5	3	8	4.5	0
17100305	4	0	4	2.1	0
17100306	1	1	2	0.1	0
17100312	2	0	2	1.0	0
Total	41	17	58	57	0.4

Total offstream water use by hydrologic unit, in Willamette Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses): Ground water	Surface water	Total	Water use, in Mgal/d: Reclaimed wastewater	Consumptive use	Conveyance losses
17080001	31.0	4.5	170	170	0	1.7	0
17090001	13.3	5.0	52	57	0	2.9	0
17090002	24.7	3.6	8.0	12	0.3	6.3	0
17090003	279.5	38	78	120	0.6	61	0
17090004	79.2	11	160	170	0	15	0
17090005	15.3	10	100	110	1.2	23	2.3
17090006	28.8	6.2	56	62	0	14	0.5
17090007	266.9	55	61	120	0	64	9.1
17090008	49.9	7.2	22	30	0.2	19	0
17090009	79.1	46	22	69	1.1	48	0
17090010	379.2	16	42	57	1.3	38	0.8
17090011	39.5	4.7	32	37	0	6.8	0
17090012	672.2	21	71	92	0.6	32	0
Total	1,958.6	230	870	1,100	5.4	330	13

Total offstream water use by hydrologic unit, in Willamette Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses): Ground water	Surface water	Total	Water use, in Mgal/d: Reclaimed wastewater	Consumptive use	Conveyance losses
17080001	27.1	7.5	110	110	0	3.8	0.1
17090001	12.7	6.6	4.1	11	0	4.8	0
17090002	23.5	5.7	5.9	12	0	6.7	0
17090003	268.8	37	69	110	0	53	0.3
17090004	75.4	15	52	67	0	10	0
17090005	14.5	19	47	66	0	23	2.4
17090006	28.1	9.1	16	25	0	12	0
17090007	245.1	37	81	120	0.1	46	0
17090008	43.9	8.6	24	32	0.1	16	0
17090009	72.8	36	21	56	0	36	0
17090010	331.0	15	42	57	1.4	34	0
17090011	35.2	6.5	33	39	0	6.1	0
17090012	638.9	19	72	91	0.6	35	0.2
Total	1,817.1	220	570	790	2.2	290	3.0

Public-supply water use by hydrologic unit, in Willamette Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Population served, in thousands: Ground water	Surface water	Total	Withdrawals, total in Mgal/d: Ground water	Surface water	Total	Water deliveries, by type of use, in Mgal/d: Commercial	Domestic	Industrial	Public use and losses	Total deliveries	Per capita use, in gal/d
17080001	8.7	20	29	1.3	120	120	0.2	2.1	0.4	120	2.7	4,300
17090001	7.6	2.2	9.8	3.7	2.2	6.0	0.4	1.7	0.5	3.5	2.5	610
17090002	3.4	17	20	1.5	2.1	3.6	0.7	2.5	1.5	-1.0	4.6	180
17090003	21	200	220	2.1	8.5	11	7.3	20	16	-33	43	47
17090004	51	6.8	58	6.6	30	36	1.0	5.0	1.9	28	8.0	630
17090005	0.5	11	11	0	31	31	0.3	1.3	1.6	28	3.2	2,700
17090006	1.3	17	18	0.1	11	11	0.6	1.6	0.2	8.9	2.4	610
17090007	57	160	210	10	2.5	13	5.8	27	4.6	-25	37	59
17090008	5.5	25	31	0.5	4.5	5.0	0.8	3.8	0.5	-0.2	5.2	160
17090009	23	18	41	3.1	3.4	6.5	0.9	3.7	0.8	1.1	5.4	160
17090010	13	280	290	1.5	11	13	4.8	27	4.8	-24	37	43
17090011	11	24	35	1.2	27	29	0.7	3.8	1.0	23	5.4	810
17090012	34	610	640	3.8	1.6	5.4	15	57	26	-93	98	8.4
Total	240	1,400	1,600	36	260	290	39	160	59	39	250	180

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Public-supply water use by hydrologic unit, in Willamette Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Population served, in thousands: Ground water	Surface water	Total	Withdrawals, total in Mgal/d: Ground water	Surface water	Total	Water deliveries, by type of use, in Mgal/d: Commercial	Domestic	Industrial	Public use and losses	Total deliveries	Per capita use, in gal/d
17080001	3.5	5.6	9.1	0.5	100	100	0.1	1.0	0.1	100	100	12,000
17090001	4.6	0.8	5.4	3.1	0.5	3.7	0	0.9	0	2.7	3.7	680
17090002	4.6	5.7	10	0.8	1.0	1.8	0.3	1.3	0.2	0	1.8	180
17090003	12	170	190	2.3	10	13	4.6	22	10	-24	13	69
17090004	42	0	42	7.6	25	33	1.2	7.3	0.9	23	33	780
17090005	4.1	6.3	10	1.5	30	31	0.4	2.1	1.5	27	31	3,000
17090006	1.1	18	19	0.1	9.3	9.4	0.4	1.7	0.2	7.1	9.4	490
17090007	50	160	210	6.9	3.1	10	3.8	29	2.6	-26	10	47
17090008	3.5	22	25	0.4	2.1	2.6	0.9	4.4	0.1	-3.0	2.6	100
17090009	19	15	34	2.3	2.2	4.5	0.4	3.2	0.3	0.6	4.5	130
17090010	25	200	230	1.6	15	17	2.6	22	2.9	-10	17	73
17090011	17	4.7	22	2.1	30	32	0.3	2.2	0	30	32	1,500
17090012	43	560	600	8.4	9.3	18	2.0	68	16	-78	18	30
Total	230	1,200	1,400	38	240	280	27	160	35	53	280	200

Domestic water use by hydrologic unit, in Willamette Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

	Self Supplied					Public supplied			Total	
		Water withdrawals, in Mgal/d								
Hydrologic unit	Population, in thousands	Ground water	Surface water	Total	Per capita use, in gal/d	Population served, in thousands	Deliveries from public supply, in Mgal/d	Per capita use, in gal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17080001	2.2	0.2	0	0.2	100	29	2.1	72	2.3	0.5
17090001	3.6	0.3	0	0.4	100	9.8	1.7	170	2.0	0.5
17090002	4.3	0.4	0	0.4	100	20	2.5	120	2.9	0.7
17090003	55	5.1	0.4	5.5	100	220	20	90	26	6.8
17090004	21	1.9	0.2	2.1	100	58	5.0	87	7.2	2.1
17090005	3.8	0.4	0	0.4	100	11	1.3	110	1.7	0.5
17090006	10	1.0	0	1.0	100	18	1.6	86	2.6	0.8
17090007	54	5.0	0.4	5.4	100	210	27	130	32	8.0
17090008	19	1.6	0.3	1.9	100	31	3.8	120	5.7	1.7
17090009	38	3.6	0.2	3.9	100	41	3.7	90	7.5	2.7
17090010	86	7.7	0.9	8.6	100	290	27	93	36	9.8
17090011	4.2	0.4	0	0.4	100	35	3.8	110	4.2	1.0
17090012	28	2.4	0.4	2.8	100	640	57	89	60	13
Total	330	30	3.0	33	100	1,600	160	96	190	48

Domestic water use by hydrologic unit, in Willamette Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

	Self Supplied					Public supplied			Total	
		Water withdrawals, in Mgal/d								
Hydrologic unit	Population, in thousands	Ground water	Surface water	Total	Per capita use, in gal/d	Population served, in thousands	Deliveries from public supply, in Mgal/d	Per capita use, in gal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17080001	18	1.6	0.2	1.8	100	9.1	1.0	110	2.8	0.9
17090001	7.3	0.6	0.1	0.7	100	5.4	0.9	170	1.7	0.6
17090002	13	1.1	0.2	1.3	100	10	1.3	130	2.7	0.9
17090003	84	7.0	1.4	8.4	100	190	22	120	30	8.6
17090004	33	2.8	0.5	3.3	100	42	7.3	170	11	3.1
17090005	4.1	0.4	0	0.4	100	10	2.1	200	2.5	0.6
17090006	9.0	0.8	0.1	0.9	100	19	1.7	90	2.6	0.8
17090007	31	2.8	0.3	3.1	100	210	29	140	32	7.1
17090008	19	1.7	0.2	1.9	100	25	4.4	170	6.2	1.8
17090009	39	3.8	0.1	3.9	100	34	3.2	94	7.1	2.6
17090010	100	9.2	1.1	10	100	230	22	95	32	9.4
17090011	13	1.2	0.1	1.3	100	22	2.2	98	3.5	1.1
17090012	40	3.6	0.4	4.0	100	600	68	110	72	16
Total	410	37	4.8	41	100	1,400	160	120	210	53

Commercial water use by hydrologic unit, in Willamette Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d			Deliveries from public supply, in Mgal/d	Total	
	Ground water	Surface water	Total		Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17080001	2.0	42	44	0.2	45	0.1
17090001	0	47	47	0.4	47	0.1
17090002	0.5	0	0.5	0.7	1.1	0.4
17090003	0.2	4.4	4.6	7.3	12	2.5
17090004	0.1	99	99	1.0	100	0.3
17090005	0.1	14	14	0.3	15	0.1
17090006	0.1	32	32	0.6	33	0.2
17090007	0.7	0.1	0.8	5.8	6.7	1.6
17090008	0	0	0	0.8	0.9	0.2
17090009	0.2	0	0.2	0.9	1.2	0.2
17090010	0.1	0	0.1	4.8	4.9	1.0
17090011	0.1	0.2	0.3	0.7	0.9	0.2
17090012	0.2	0.	0.2	15	15	3.2
Total	4.3	240	240	39	280	9.9

Commercial water use by hydrologic unit, in Willamette Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d			Deliveries from public supply, in Mgal/d	Total	
	Ground water	Surface water	Total		Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17080001	0	0	0	0.1	0.1	0
17090001	0	0	0	0	0.1	0
17090002	0	0	0	0.3	0.3	0.1
17090003	0.1	0	0.1	4.6	4.7	0.9
17090004	0	0	0	1.2	1.2	0.2
17090005	0	0	0	0.4	0.4	0.1
17090006	0	0	0	0.4	0.5	0.1
17090007	0	0	0	3.8	3.9	0.8
17090008	0	0	0	0.9	0.9	0.2
17090009	0	0	0	0.4	0.5	0.1
17090010	0.1	0	0.1	2.6	2.6	0.5
17090011	0	0	0	0.3	0.3	0.1
17090012	0.1	0	0.1	12	12	2.4
Total	0.4	0	0.4	27	27	5.4

Industrial water use by hydrologic unit, in Willamette Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d: Ground water	Surface water	Total	Re-claimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17080001	0	0	0	0	0.4	0.4	0
17090001	0.3	0.4	0.8	0	0.5	1.2	0.2
17090002	0	0.1	0.1	0	1.5	1.6	0.1
17090003	0.8	29	30	0	16	45	2.4
17090004	0	22	22	0	1.9	24	4.0
17090005	0.1	0.1	0.2	0	1.6	1.8	1.3
17090006	0	0.6	0.6	0	0.2	0.9	0.2
17090007	0.1	35	35	0	4.6	40	1.5
17090008	0.2	0	0.2	0	0.5	0.7	0.3
17090009	2.3	0.3	2.6	0	0.8	3.4	0.9
17090010	0.3	0.3	0.6	0	4.8	5.4	0.9
17090011	0.1	0	0.1	0	1.0	1.0	0.1
17090012	9.6	62	71	0.6	26	98	6.7
Total	14	150	160	0.6	59	220	19

Industrial water use by hydrologic unit, in Willamette Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d: Ground water	Surface water	Total	Re-claimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17080001	2.3	0.5	2.8	0	0.1	3.0	0.1
17090001	0	0.8	0.8	0	0	0.8	0.1
17090002	0	1.2	1.2	0	0.2	1.4	0.1
17090003	1.2	29	30	0	10	40	2.3
17090004	0	22	22	0	0.9	23	0.1
17090005	0	4.7	4.7	0	1.5	6.2	0.1
17090006	0	0.3	0.3	0	0.2	0.5	0
17090007	0.1	48	48	0	2.6	51	1.6
17090008	0.1	1.5	1.6	0	0.1	1.7	0.1
17090009	2.3	0	2.3	0	0.3	2.5	0.
17090010	0	0.2	0.3	0	2.9	3.2	0.8
17090012	4.3	56	60	0.6	16	76	10
Total	10	160	170	0.6	35	210	16

Mining water use by hydrologic unit, in Willamette Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Ground water	Withdrawals, in Mgal/d: Surface water	Withdrawals, in Mgal/d: Total	Consumptive use, in Mgal/d
17090003	0.1	0	0.1	0
17090007	0.1	0	0.1	0
17090010	0.1	0	0.1	0
17090012	0.1	0.4	0.5	0
Total	0.4	0.4	0.8	0

Mining water use by hydrologic unit, in Willamette Region, Oregon, 1985

[Individual value may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Ground water	Withdrawals, in Mgal/d: Surface water	Withdrawals, in Mgal/d: Total	Consumptive use, in Mgal/d
17090003	0	0	0.1	0
17090004	0	0.1	0.1	0
Total	0.1	0.1	0.2	0

Thermoelectric power water use by hydrologic unit, in Willamette Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
Total	0	0	0	0

Thermoelectric power water use by hydrologic unit, in Willamette Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
Total	0	0	0	0

Hydroelectric power water use by hydrologic unit, in Willamette Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
17080001	100,000	5,700
17090001	3,200	510
17090004	3,400	560
17090005	2,600	500
17090006	2,000	380
17090007	2,800	100
17090011	4,900	720
Total	120,000	8,500

Hydroelectric power water use by hydrologic unit, in Willamette Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
17080001	100,000	5,600
17090001	3,200	510
17090004	3,000	400
17090005	2,400	5,800
17090006	1,700	310
17090007	2,700	100
17090011	4,500	690
Total	120,000	13,000

Livestock water use by hydrologic unit, in Willamette Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock: Withdrawals, in Mgal/d: Ground water	Surface water	Total	Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Surface water	Total	Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Surface water	Total	Consumptive use, in Mgal/d
17090002	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17090003	0.1	0.5	0.5	0.5	0	0.1	0.1	0.1	0.1	0.5	0.6	0.6
17090004	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17090005	0	0.2	0.3	0.3	0	0	0	0	0	0.2	0.3	0.3
17090006	0	0.2	0.2	0.2	0	0	0	0	0	0.2	0.2	0.2
17090007	0.1	0.7	0.8	0.8	0	0	0	0	0.1	0.7	0.8	0.8
17090008	0.1	0.5	0.5	0.5	0	0	0	0	0.1	0.5	0.5	0.5
17090009	0.1	0.5	0.5	0.5	0	0	0.1	0.1	0.1	0.5	0.6	0.6
17090010	0	0.3	0.3	0.3	0	0	0	0	0	0.3	0.4	0.4
17090011	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17090012	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.2	0.2
Total	0.4	3.2	3.6	3.6	0	0.2	0.2	0.2	0.4	3.4	3.8	3.8

Livestock water use by hydrologic unit, in Willamette Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock: Withdrawals, in Mgal/d: Ground water	Surface water	Total	Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Surface water	Total	Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Surface water	Total	Consumptive use, in Mgal/d
17090001	0	0.2	0.3	0.3	--	--	--	--	0	0.2	0.3	0.3
17090002	0	0.3	0.4	0.4	--	--	--	--	0	0.3	0.4	0.4
17090003	0.1	1.0	1.1	1.1	--	--	--	--	0.1	1.0	1.1	1.1
17090004	0.1	0.4	0.5	0.5	--	--	--	--	0.1	0.4	0.5	0.5
17090005	0	0.3	0.3	0.3	--	--	--	--	0	0.3	0.3	0.3
17090006	0	0.2	0.2	0.2	--	--	--	--	0	0.2	0.2	0.2
17090007	0.1	0.5	0.6	0.6	--	--	--	--	0.1	0.5	0.6	0.6
17090008	0	0.3	0.3	0.3	--	--	--	--	0	0.3	0.3	0.3
17090009	0.1	0.5	0.5	0.5	--	--	--	--	0.1	0.5	0.5	0.5
17090010	0	0.3	0.4	0.4	--	--	--	--	0	0.3	0.4	0.4
17090011	0	0.2	0.2	0.2	--	--	--	--	0	0.2	0.2	0.2
17090012	0	0.2	0.2	0.2	--	--	--	--	0	0.2	0.2	0.2
Total	0.5	4.4	4.8	4.8	--	--	--	--	0.5	4.4	4.8	4.8

Irrigation water use by hydrologic unit, in Willamette Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Withdrawals, in Mgal/d: Fresh water: Surface	Withdrawals, in Mgal/d: Reclaimed wastewater	Withdrawals, in Mgal/d: Total	Irrigated land by irrigation type, in thousand acres: Spray	Irrigated land by irrigation type, in thousand acres: Flood	Irrigated land by irrigation type, in thousand acres: Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
17080001	1.0	0.6	0	1.6	1.2	0	1.2	0	1.1
17090001	0.6	2.3	0	2.9	2.5	0	2.5	0	2.2
17090002	1.2	5.8	0.3	6.9	6.0	0	6.0	0	5.1
17090003	30	35	0.6	65	58	0	58	0	49
17090004	2.3	9.6	0	12	10	0	10	0	8.8
17090005	9.6	54	1.2	64	24	0	24	2.3	21
17090006	5.0	12	0	17	13	1.0	14	0.5	12
17090007	39	22	0	61	60	0	60	9.1	52
17090008	4.7	17	0.2	22	19	0	19	0	16
17090009	37	18	1.1	55	49	0.1	49	0	43
17090010	5.8	29	1.3	35	28	0	28	0.8	26
17090011	2.9	4.1	0	7.0	5.9	0	5.9	0	5.4
17090012	5.0	6.2	0	11	8.6	0	8.6	0	8.8
Total	140	220	4.8	360	290	1.1	290	13	250

Irrigation water use by hydrologic unit, in Willamette Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Withdrawals, in Mgal/d: Fresh water: Surface	Withdrawals, in Mgal/d: Reclaimed wastewater	Withdrawals, in Mgal/d: Total	Irrigated land by irrigation type, in thousand acres: Spray	Irrigated land by irrigation type, in thousand acres: Flood	Irrigated land by irrigation type, in thousand acres: Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
17080001	3.1	0.8	0	3.9	3.7	0	3.7	0.1	2.7
17090001	2.8	2.4	0	5.2	5.1	0	5.1	0	3.9
17090002	3.7	3.2	0	6.9	6.8	0	6.8	0	5.2
17090003	27	28	0	54	52	0.6	53	0.3	40
17090004	4.7	4.0	0	8.7	8.4	0	8.4	0	6.5
17090005	17	12	0	29	28	0.4	29	2.4	21
17090006	8.1	6.1	0	14	13	0	13	0	11
17090007	27	29	0.1	55	52	0	52	0	35
17090008	6.3	19	0.1	26	17	0	17	0	13
17090009	27	18	0	45	48	0	48	0	33
17090010	3.7	25	1.4	29	27	0	27	0	23
17090011	3.1	2.2	0	5.3	6.1	0.2	6.2	0	4.7
17090012	2.9	6.0	0	9.0	8.2	0	8.2	0.2	5.9
Total	140	160	1.6	290	270	1.2	280	3.0	210

Reservoir evaporation water use by hydrologic unit, in Willamette Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding]

Hydrologic unit	Amount evaporated, in thousand acre-feet	Reservoir area, in thousand acres
17080001	15	5.9
17090001	24	9.6
17090002	6.5	2.6
17090003	19	7.7
17090004	5.5	2.2
17090005	8.6	3.4
17090006	12	4.7
17090010	2.2	1.1
17090011	4.3	1.7
17090012	0.5	0.2
Total	97	39

Wastewater-treatment water releases by hydrologic unit, in Willamette Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities: Public	Number of facilities: Industrial and other	Number of facilities: Total	Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
17080001	3	5	8	1.2	0
17090001	2	1	3	0.8	0
17090002	2	2	4	2.5	0.3
17090003	13	16	29	51	0.6
17090004	0	1	1	0	0
17090005	2	1	3	1.4	1.2
17090006	3	0	3	5.6	0
17090007	11	7	18	47	0
17090008	8	1	9	5.5	0.2
17090009	8	4	12	6.0	1.1
17090010	6	4	10	43	1.3
17090011	3	3	6	1.2	0
17090012	6	12	18	96	0
Total	67	57	124	260	4.8

Wastewater-treatment water releases by hydrologic unit, in Willamette Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities: Public	Number of facilities: Industrial and other	Number of facilities: Total	Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
17080001	7	3	10	1.4	0
17090001	3	1	4	0.6	0
17090002	2	4	6	2.4	0
17090003	21	13	34	41	0
17090004	0	1	1	0	0
17090005	2	1	3	1.3	0
17090006	3	1	4	5.2	0
17090007	19	4	23	37	0.1
17090008	9	1	10	5.2	0.1
17090009	6	2	8	3.9	0
17090010	8	1	9	30	1.4
17090011	3	1	4	0.8	0
17090012	15	3	18	97	0
Total	98	36	134	230	1.6

Total offstream water use by hydrologic unit, in Southwest Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses) Ground water	Surface water	Total	Water use, in Mgal/d Reclaimed wastewater	Consumptive use	Conveyance losses
17100301	6.2	0.2	31	31	0	2.9	0
17100302	63.9	1.7	20	21	0	13	0.1
17100303	24.5	1.1	13	14	0	12	0
17100307	21.6	2.2	200	200	0	24	5.5
17100308	145.6	6.6	92	98.	0	68.	28
17100309	18.5	3.0	10	13	0	7.3	0.8
17100310	17.1	2.5	1.9	4.5	0	2.5	0.3
17100311	7.8	1.6	3.2	4.7	0.1	3.1	0.7
Total	305.3	19	370	390	0.1	130	35

Total offstream water use by hydrologic unit, in Southwest Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses) Ground water	Surface water	Total	Water use, in Mgal/d Reclaimed wastewater	Consumptive use	Conveyance losses
17100301	6.1	0.2	4.4	4.7	0	2.5	0.2
17100302	62.2	1.6	33	34	0	16	1.2
17100303	23.9	1.4	25	27	0	8.8	0.6
17100307	20.4	2.8	50	53	0	20	9.9
17100308	138.3	10	180	190	0.1	84	24
17100309	18.0	3.2	23	26	0	20	3.0
17100310	16.4	1.4	9.9	11	0	4.1	1.2
17100311	7.6	1.8	21	23	0	9.4	0
Total	292.9	23	350	370	0.1	170	40

Public-supply water use by hydrologic unit, in Southwest Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Population served, in thousands			Withdrawals, total in Mgal/d			Water deliveries, by type of use, in Mgal/d					Per capita use, in gal/d
	Ground water	Surface water	Total	Ground water	Surface water	Total	Commer-cial	Domestic	Indus-trial	Public use and losses	Total deliveries	
17100301	0	4.6	4.6	0	6.5	6.5	0.3	1.1	0	5.2	1.3	1,400
17100302	0.3	49	49	0	3.2	3.3	1.3	5.4	0.2	-3.7	6.9	67
17100303	0.1	13	13	0	3.1	3.1	0.4	1.7	0.5	0.6	2.6	230
17100307	1.3	3.1	4.4	0.2	23	24	0.1	0.5	0	23	0.6	5,400
17100308	7.2	100	110	0.6	10	11	5.7	17	4.8	-16	27	100
17100309	0.3	0	0.3	0	0	0	0	0	0	0	0	74
17100310	1.4	0.1	1.5	0.6	0	0.6	0	0.2	0	0.4	0.2	430
17100311	0.6	0.7	1.3	0.1	0.2	0.3	0.1	0.2	0	0	0.3	240
Total	11	170	180	1.6	47	49	8.0	26	5.5	9.2	39	260

Public-supply water use by hydrologic unit, in Southwest Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Population served, in thousands			Withdrawals, total in Mgal/d			Water deliveries, by type of use, in Mgal/d					Per capita use, in gal/d
	Ground water	Surface water	Total	Ground water	Surface water	Total	Commer-cial	Domestic	Indus-trial	Public use and losses	Total deliveries	
17100301	0	5.4	5.4	0	1.0	1.0	0.2	0.7	0	0.2	1.0	180
17100302	0	54	54	0	8.3	8.3	1.1	5.5	0.2	1.5	8.3	150
17100303	0	10	10	0	1.5	1.5	0.3	1.3	0	-0.1	1.5	150
17100307	0.3	3.2	3.5	0	0.2	0.2	0.1	0.4	0	-0.3	0.2	49
17100308	3.9	84	88	0.5	25	25	3.3	17	3.3	2.1	25	290
17100309	0.1	0	0.1	0	0	0	0	0	0	0	0	99
17100310	0	3.3	3.3	0	0.5	0.5	0.1	0.4	0	0.1	0.5	160
17100311	0.2	0.5	0.7	0.1	0.2	0.3	0.1	0.2	0	0	0.3	440
Total	4.4	160	160	0.6	37	37	5.0	25	3.5	3.4	37	230

Domestic water use by hydrologic unit, in Southwest Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

	Self Supplied					Public supplied			Total	
		Water withdrawals, in Mgal/d								
Hydrologic unit	Population, in thousands	Ground water	Surface water	Total	Per capita use, in gal/d	Population served, in thousands	Deliveries from public supply, in Mgal/d	Per capita use, in gal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17100301	1.7	0.1	0	0.2	100	4.6	1.1	230	1.2	0.3
17100302	15	1.2	0.3	1.5	100	49	5.4	110	6.9	1.8
17100303	11	0.9	0.2	1.1	100	13	1.7	130	2.8	0.9
17100307	17	1.6	0.1	1.7	100	4.4	0.5	110	2.2	1.0
17100308	36	3.5	0.2	3.6	100	110	17	150	20	5.2
17100309	18	1.8	0.1	1.8	100	0.3	0	74	1.9	0.9
17100310	16	1.4	0.1	1.6	100	1.5	0.2	130	1.8	0.8
17100311	6.5	0.6	0	0.7	100	1.3	0.2	130	0.8	0.4
Total	120	11	1.1	12	100	180	26	140	38	11

Domestic water use by hydrologic unit, in Southwest Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

	Self Supplied					Public supplied			Total	
		Water withdrawals, in Mgal/d								
Hydrologic unit	Population, in thousands	Ground water	Surface water	Total	Per capita use, in gal/d	Population served, in thousands	Deliveries from public supply, in Mgal/d	Per capita use, in gal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17100301	0.7	0.1	0	0.1	100	5.4	0.7	130	0.7	0.2
17100302	8.6	0.6	0.3	0.9	100	54	5.5	100	6.3	1.5
17100303	14	0.9	0.5	1.4	100	10	1.3	120	2.6	0.9
17100307	17	1.5	0.2	1.7	100	3.5	0.4	120	2.1	0.9
17100308	51	4.2	0.8	5.1	100	88	17	190	22	5.9
17100309	18	1.3	0.5	1.8	100	0.1	0	99	1.8	0.9
17100310	13	1.0	0.3	1.3	100	3.3	0.4	120	1.7	0.8
17100311	6.9	0.5	0.2	0.7	100	0.7	0.2	260	0.9	0.4
Total	130	10	2.8	13	100	160	25	150	38	11

Commercial water use by hydrologic unit, in Southwest Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d			Deliveries from public supply, in Mgal/d	Total	
	Ground water	Surface water	Total		Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17100301	0	21	21	0.3	21	0.1
17100302	0	0	0	1.3	1.4	0.3
17100303	0	0.1	0.1	0.4	0.6	0.1
17100307	0	120	120	0.1	120	0
17100308	0.2	0	0.2	5.7	6.0	1.2
17100310	0	0	0.1	0	0.1	0
17100311	0	0	0	0.1	0.1	0
Total	0.4	140	140	8.0	150	1.8

Commercial water use by hydrologic unit, in Southwest Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d			Deliveries from public supply, in Mgal/d	Total	
	Ground water	Surface water	Total		Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17100301	0	0	0	0.2	0.2	0
17100302	0	0	0	1.1	1.1	0.2
17100303	0	0	0	0.3	0.3	0.1
17100307	0	0	0	0.1	0.1	0
17100308	0.1	0	0.1	3.3	3.4	0.7
17100310	0	0	0	0.1	0.1	0
17100311	0	0	0	0.1	0.1	0
Total	0.2	0.1	0.2	5.0	5.3	1.1

Industrial water use by hydrologic unit, in Southwest Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d: Ground water	Surface water	Total	Reclaimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17100301	0	0	0	0	0	0.1	0
17100302	0.1	2.5	2.6	0	0.2	2.8	1.0
17100303	0	0.3	0.3	0	0.5	0.7	3.5
17100308	0	0.1	0.1	0	4.8	4.9	1.1
17100311	0	0.1	0.1	0	0	0.1	0
Total	0.2	2.9	3.1	0	5.5	8.6	5.6

Industrial water use by hydrologic unit, in Southwest Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d: Ground water	Surface water	Total	Reclaimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17100301	0	0.2	0.2	0	0	0.2	0
17100302	0	4.3	4.3	0	0.2	4.5	0.3
17100303	0	14	14	0	0	14	0.9
17100308	0	2.0	2.0	0	3.3	5.2	0.3
17100310	0	1.6	1.6	0	0	1.6	0.1
Total	0	22	22	0	3.5	25	1.5

Mining water use by hydrologic unit, in Southwest Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total	
17100308	0.1	0	0.1	0
Total	0.1	0	0.1	0

Mining water use by hydrologic unit, in Southwest Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total	
17100302	0	0.1	0.1	0
17100308	0	1.0	1.0	0.2
17100309	0	0.9	0.9	0.1
17100310	0	0.3	0.3	0
17100311	0	0.3	0.3	0
Total	0	2.5	2.5	0.4

Thermoelectric power water use by hydrologic unit, in Southwest Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
Total	0	0	0	0

Thermoelectric power water use by hydrologic unit, in Southwest Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
Total	0	0	0	0

Hydroelectric power water use by hydrologic unit, in Southwest Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
17100301	2,200	780
17100307	1,400	550
17100308	32	54
Total	3,700	1,400

Hydroelectric power water use by hydrologic unit, in Southwest Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
17100301	2,800	990
17100307	1,500	610
Total	4,300	1,600

Livestock water use by hydrologic unit, in Southwest Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock: Withdrawals, in Mgal/d: Ground water	Stock: Withdrawals, in Mgal/d: Surface water	Stock: Withdrawals, in Mgal/d: Total	Stock: Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Animal specialties: Withdrawals, in Mgal/d: Surface water	Animal specialties: Withdrawals, in Mgal/d: Total	Animal specialties: Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Total livestock: Withdrawals, in Mgal/d: Surface water	Total livestock: Withdrawals, in Mgal/d: Total	Total livestock: Consumptive use, in Mgal/d
17100301	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17100302	0	0.2	0.2	0.2	0	0	0	0	0	0.2	0.2	0.2
17100303	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17100307	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17100308	0	0.2	0.2	0.2	0	0	0	0	0	0.2	0.3	0.3
17100309	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
Total	0.1	0.7	0.8	0.8	0	0.1	0.1	0.1	0.1	0.8	0.9	0.9

Livestock water use by hydrologic unit, in Southwest Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock: Withdrawals, in Mgal/d: Ground water	Stock: Withdrawals, in Mgal/d: Surface water	Stock: Withdrawals, in Mgal/d: Total	Stock: Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Animal specialties: Withdrawals, in Mgal/d: Surface water	Animal specialties: Withdrawals, in Mgal/d: Total	Animal specialties: Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Total livestock: Withdrawals, in Mgal/d: Surface water	Total livestock: Withdrawals, in Mgal/d: Total	Total livestock: Consumptive use, in Mgal/d
17100302	0	0.3	0.3	0.3	--	--	--	--	0	0.3	0.3	0.3
17100303	0	0.1	0.2	0.2	--	--	--	--	0	0.1	0.2	0.2
17100307	0	0.1	0.1	0.1	--	--	--	--	0	0.1	0.1	0.1
17100308	0	0.3	0.4	0.4	--	--	--	--	0	0.3	0.4	0.4
17100309	0	0.1	0.1	0.1	--	--	--	--	0	0.1	0.1	0.1
17100311	0	0.1	0.1	0.1	--	--	--	--	0	0.1	0.1	0.1
Total	0.1	1.0	1.1	1.1	--	--	--	--	0.1	1.0	1.1	1.1

Irrigation water use by hydrologic unit, in Southwest Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Withdrawals, in Mgal/d: Fresh water: Surface	Withdrawals, in Mgal/d: Reclaimed wastewater	Withdrawals, in Mgal/d: Total	Irrigated land by irrigation type, in thousand acres: Spray	Irrigated land by irrigation type, in thousand acres: Flood	Irrigated land by irrigation type, in thousand acres: Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
17100301	0	3.5	0	3.5	2.0	0.1	2.1	0	2.5
17100302	0.3	14	0	14	7.8	0.5	8.3	0.1	10
17100303	0.1	9.5	0	9.6	5.4	0.4	5.8	0	6.9
17100307	0.3	62	0	62	7.3	7.8	15	5.5	22
17100308	2.2	81	0	83	16	24	41	28	60
17100309	1.2	10	0	11	2.4	1.9	4.3	0.8	6.4
17100310	0.5	1.8	0	2.2	0.9	0.3	1.2	0.3	1.6
17100311	0.8	2.8	0.1	3.6	1.2	0.7	1.9	0.7	2.7
Total	5.4	180	0.1	190	43	36	79	35	110

Irrigation water use by hydrologic unit, in Southwest Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Withdrawals, in Mgal/d: Fresh water: Surface	Withdrawals, in Mgal/d: Reclaimed wastewater	Withdrawals, in Mgal/d: Total	Irrigated land by irrigation type, in thousand acres: Spray	Irrigated land by irrigation type, in thousand acres: Flood	Irrigated land by irrigation type, in thousand acres: Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
17100301	0.2	3.2	0	3.4	1.6	0.1	1.7	0.2	2.3
17100302	1.0	19	0	20	9.6	0.4	10	1.2	14
17100303	0.5	9.7	0	10	4.8	0.2	5.0	0.6	6.8
17100307	1.3	50	0	51	4.5	5.8	10	9.9	19
17100308	5.5	150	0.1	160	16	24	40	24	77
17100309	1.9	22	0	24	4.7	5.2	9.9	3.0	19
17100310	0.4	7.1	0	7.5	0.7	1.1	1.8	1.2	3.2
17100311	1.2	20	0	21	1.4	3.3	4.7	0	8.9
Total	12	280	0.1	290	43	40	84	40	150

Reservoir evaporation water use by hydrologic unit, in Southwest Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding]

Hydrologic unit	Amount evaporated, in thousand acre-feet	Reservoir area, in thousand acres
17100301	1.2	0.5
17100302	0.5	0.2
17100307	11	3.7
17100308	1.6	0.5
17100309	2.1	0.9
Total	16	5.7

Wastewater-treatment water releases by hydrologic unit, in Southwest Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities			Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
	Public	Industrial and other	Total		
17100301	2	4	6	0.9	0
17100302	5	4	9	5.3	0
17100303	5	3	8	1.5	0
17100307	3	1	4	0.5	0
17100308	6	5	11	21	0
17100310	2	1	3	0.9	0
17100311	1	0	1	0	0.1
Total	24	18	42	30	0.1

Wastewater-treatment water releases by hydrologic unit, in Southwest Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities			Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
	Public	Industrial and other	Total		
17100301	2	2	4	0.1	0
17100302	8	5	13	7.2	0
17100303	6	2	8	3.1	0
17100307	4	3	7	0.5	0
17100308	10	4	14	18	0.1
17100310	3	0	3	0.3	0
17100311	1	0	1	0.2	0
Total	34	16	50	29	0.1

Total offstream water use by hydrologic unit, in South-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses) Ground water	Surface water	Total	Water use, in Mgal/d Reclaimed wastewater	Consumptive use	Conveyance losses
16040201	0	0.6	4.7	5.3	0	2.5	0.7
16040204	0	0	0	0	0	0	0
16040205	0	0	0.5	0.5	0	0.2	0.1
17120001	1.5	30	60	90	0	35	10
17120002	5.2	12	200	210	0.2	69	23
17120003	0.1	0.8	110	110	0	37	11
17120004	0.1	3.4	120	120	0	39	12
17120005	1.3	83	78	160	0	100	36
17120006	0.5	2.6	170	170	0	53	19
17120007	0.3	0.7	200	200	0	59	21
17120008	0	5.7	53	58	0	20	6.0
17120009	0.2	4.5	29	34	0	12	3.5
18010101	0	0	0	0	0	0	0
18010201	1.1	7.7	76	84	0	37	17
18010202	2.7	0.4	78	79	0	34	17
18010203	11.7	4.1	200	200	0	80	40
18010204	38.0	74	490	560	0	180	120
18010205	0	0	0	0	0	0	0
18010206	3.1	0.5	39	39	0	9.4	0.8
18010209	0	0	0	0	0	0	0
18020001	5.1	17	240	250	0	89	32
Total	70.8	250	2,100	2,400	0.2	850	370

Total offstream water use by hydrologic unit, in South-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses) Ground water	Surface water	Total	Water use, in Mgal/d Reclaimed wastewater	Consumptive use	Conveyance losses
16040201	0	0	19	19	0	8.8	2.8
16040204	0	0	0	0	0	0	0
16040205	0.1	0.2	0.2	0.3	0	0.1	0
17120001	1.5	3.2	59	62	0	27	1.9
17120002	5.4	7.8	110	120	0.3	57	4.5
17120003	0.1	3.0	60	63	0	27	1.9
17120004	0.2	1.6	32	33	0	15	1.0
17120005	1.4	82	98	180	0	110	5.7
17120006	0.5	2.3	78	80	0	37	0
17120007	0.3	0.1	100	100	0	46	0.5
17120008	0	1.5	33	34	0	14	0.9
17120009	0.2	1.9	35	37	0	17	1.1
18010101	0	0	0	0	0	0	0
18010201	0.1	0	44	44	0	21	0.9
18010202	3.7	5.9	110	110	0.1	45	0.9
18010203	4.8	5.9	96	100	0	45	2.7
18010204	44.8	11	470	480	0	180	58
18010205	0	0	0	0	0	0	0
18010206	3.0	0.5	10	11	0	3.4	2.2
18010209	0	0	0	0	0	0	0
18020001	5.3	12	83	95	0	44	3.6
Total	71.2	140	1,400	1,600	0.4	690	88

Public-supply water use by hydrologic unit, in South-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Population served, in thousands: Ground water	Surface water	Total	Withdrawals, total in Mgal/d: Ground water	Surface water	Total	Water deliveries, by type of use, in Mgal/d: Commercial	Domestic	Industrial	Public use and losses	Total deliveries	Per capita use, in gal/d
17120002	4.7	0	4.7	2.2	0	2.2	0.6	1.4	0	0.2	2.0	470
17120005	0.4	0	0.4	0.3	0	0.3	0	0.2	0	0.2	0.2	850
17120006	0.3	0	0.3	0.1	0	0.1	0	0	0	0	0.1	250
18010201	0.8	0	0.8	0.2	0	0.2	0	0.1	0	0.1	0.2	240
18010202	0.9	0	0.9	0.1	0	0.1	0	0.1	0	0	0.1	130
18010203	2.0	0	2.0	0	0	0	0	0.2	0	-0.2	0.2	5.1
18010204	37	0	37	8.1	0	8.1	0.4	3.5	2.9	1.3	6.8	220
18020001	2.7	0.1	2.8	0.7	0	0.8	0.1	0.6	0	0	0.8	270
Total	49	0.1	49	12	0	12	1.1	6.1	2.9	1.6	10	240

Public-supply water use by hydrologic unit, in South-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Population served, in thousands: Ground water	Surface water	Total	Withdrawals, total in Mgal/d: Ground water	Surface water	Total	Water deliveries, by type of use, in Mgal/d: Commercial	Domestic	Industrial	Public use and losses	Total deliveries	Per capita use, in gal/d
17120002	5.0	0	5.0	1.5	0	1.5	0.2	1.0	0.1	0.2	1.5	300
17120005	0.5	0	0.5	0.2	0	0.2	0	0.1	0	0	0.2	360
17120006	0.4	0	0.4	0.1	0	0.1	0	0	0	0	0.1	170
18010202	1.7	0	1.7	0.3	0	0.3	0	0.2	0	0	0.3	160
18010203	0.1	0	0.1	0	0	0	0	0	0	0	0	99
18010204	41	0	41	7.9	0	7.9	0.5	2.0	4.6	0.8	7.9	190
18020001	2.7	0	2.7	0.8	0	0.8	0.2	0.5	0.1	0.1	0.8	290
Total	51	0	51	11	0	11	0.9	3.9	4.7	1.1	11	210

Domestic water use by hydrologic unit, in South-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Self Supplied: Population, in thousands	Self Supplied: Water withdrawals, in Mgal/d: Ground water	Self Supplied: Water withdrawals, in Mgal/d: Surface water	Self Supplied: Water withdrawals, in Mgal/d: Total	Self Supplied: Per capita use, in gal/d	Public supplied: Population served, in thousands	Public supplied: Deliveries from public supply, in Mgal/d	Public supplied: Per capita use, in gal/d	Total: Withdrawals and deliveries, in Mgal/d	Total: Consumptive use, in Mgal/d
16040201	0	0	0	0	150	0	0	0	0	0
17120001	1.5	0.2	0	0.2	150	0	0	0	0.2	0.1
17120002	0.5	0.1	0	0.1	150	4.7	1.4	290	1.4	0.3
17120003	0.1	0	0	0	150	0	0	0	0	0
17120004	0.1	0	0	0	150	0	0	0	0	0
17120005	0.9	0.1	0	0.1	150	0.4	0.2	380	0.3	0.1
17120006	0.2	0	0	0	150	0.3	0	130	0.1	0
17120007	0.3	0	0	0	150	0	0	0	0	0
17120009	0.2	0	0	0	150	0	0	0	0	0
18010201	0.3	0.1	0	0.1	150	0.8	0.1	150	0.2	0.1
18010202	1.8	0.3	0	0.3	150	0.9	0.1	150	0.4	0.2
18010203	9.8	1.4	0.1	1.5	150	2.0	0.2	87	1.6	0.8
18010204	0.9	0.1	0	0.1	150	37	3.5	95	3.7	0.8
18010206	3.1	0.4	0	0.5	150	0	0	0	0.5	0.2
18020001	2.3	0.3	0	0.3	150	2.8	0.6	230	1.0	0.3
Total	22	3.1	0.1	3.2	150	49	6.1	125	9.4	2.9

Domestic water use by hydrologic unit, in South-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Self Supplied: Population, in thousands	Self Supplied: Water withdrawals, in Mgal/d: Ground water	Self Supplied: Water withdrawals, in Mgal/d: Surface water	Self Supplied: Water withdrawals, in Mgal/d: Total	Self Supplied: Per capita use, in gal/d	Public supplied: Population served, in thousands	Public supplied: Deliveries from public supply, in Mgal/d	Public supplied: Per capita use, in gal/d	Total: Withdrawals and deliveries, in Mgal/d	Total: Consumptive use, in Mgal/d
16040205	0.1	0	0	0	150	0	0	0	0	0
17120001	1.5	0.2	0	0.2	150	0	0	0	0.2	0.1
17120002	0.4	0.1	0	0.1	150	5.0	1.0	200	1.0	0.2
17120003	0.1	0	0	0	150	0	0	0	0	0
17120004	0.2	0	0	0	150	0	0	0	0	0
17120005	0.9	0.1	0	0.1	150	0.5	0.1	290	0.3	0.1
17120006	0.2	0	0	0	150	0.4	0	110	0.1	0
17120007	0.3	0	0	0	150	0	0	0	0	0
17120008	0	0	0	0	150	0	0	0	0	0
17120009	0.2	0	0	0	150	0	0	0	0	0
18010201	0.1	0	0	0	150	0	0	0	0	0
18010202	2.0	0.3	0	0.3	150	1.7	0.2	140	0.5	0.2
18010203	4.7	0.7	0	0.7	150	0.1	0	99	0.7	0.4
18010204	4.1	0.6	0	0.6	150	41	2.0	50	2.7	0.7
18010206	3.0	0.5	0	0.5	150	0	0	0	0.5	0.2
18020001	2.6	0.4	0	0.4	150	2.7	0.5	180	0.9	0.3
Total	20	3.0	0	3.1	150	51	3.9	77	7.0	2.3

Commercial water use by hydrologic unit, in South-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d			Deliveries from public supply, in Mgal/d	Total	
	Ground water	Surface water	Total		Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17120002	0	0	0	0.6	0.6	0.1
17120005	0.2	0	0.2	0	0.2	0.1
18010201	0	0	0	0	0.1	0
18010203	0	18	18	0	18	0
18010204	1.1	18	19	0.4	20	0.5
18010206	0.1	0	0.1	0	0.1	0
18020001	0	0	0	0.1	0.1	0
Total	1.5	36	37	1.1	38	0.8

Commercial water use by hydrologic unit, in South-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d			Deliveries from public supply, in Mgal/d	Total	
	Ground water	Surface water	Total		Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17120002	0	0	0	0.2	0.2	0.1
18010204	0	0	0	0.5	0.5	0.1
18020001	0	0	0	0.2	0.2	0
Total	0.1	0	0.1	0.9	1.0	0.2

Industrial water use by hydrologic unit, in South-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d			Reclaimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
	Ground water	Surface water	Total				
17120002	1.0	0	1.0	0	0	1.0	0.1
18010202	0	0.1	0.1	0	0	0.1	0
18010204	0.1	1.3	1.3	0	2.8	4.2	0.8
18020001	0	0	0.1	0	0	0.1	0
Total	1.1	1.4	2.5	0	2.9	5.5	1.0

Industrial water use by hydrologic unit, in South-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d			Reclaimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
	Ground water	Surface water	Total				
17120002	0.4	0	0.4	0	0.1	0.5	0
18010202	0.1	0	0.1	0	0	0.1	0
18010204	1.9	0	1.9	0	4.6	6.4	0.4
18020001	0	0	0	0	0.1	0.1	0
Total	2.4	0	2.4	0	4.7	7.2	0.5

Mining water use by hydrologic unit, in South-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total	
Total	0	0	0	0

Mining water use by hydrologic unit, in South-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total	
Total	0	0	0	0

Thermoelectric power water use by hydrologic unit, in South-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
Total	0	0	0	0

Thermoelectric power water use by hydrologic unit, in South-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
Total	0	0	0	0

Hydroelectric power water use by hydrologic unit, in South-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
18010204	1,000	260
Total	1,000	260

Hydroelectric power water use by hydrologic unit, in South-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
18010204	640	94
18010206	39	70
Total	680	160

Livestock water use by hydrologic unit, in South-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock: Withdrawals, in Mgal/d: Ground water	Stock: Withdrawals: Surface water	Stock: Withdrawals: Total	Stock: Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Animal specialties: Withdrawals: Surface water	Animal specialties: Withdrawals: Total	Animal specialties: Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Total livestock: Withdrawals: Surface water	Total livestock: Withdrawals: Total	Total livestock: Consumptive use, in Mgal/d
17120001	0.1	0.2	0.3	0.3	0	0	0	0	0.1	0.2	0.3	0.3
17120002	0.2	0.5	0.6	0.6	0	0	0	0	0.2	0.5	0.6	0.6
17120003	0.1	0.2	0.3	0.3	0	0	0	0	0.1	0.2	0.3	0.3
17120004	0.1	0.2	0.3	0.3	0	0	0	0	0.1	0.2	0.3	0.3
17120005	0	0.4	0.5	0.5	0	0	0	0	0	0.4	0.5	0.5
17120006	0	0.2	0.3	0.3	0	0	0	0	0	0.2	0.3	0.3
17120007	0	0.3	0.3	0.3	0	0	0	0	0	0.3	0.3	0.3
17120008	0.1	0.1	0.2	0.2	0	0	0	0	0.1	0.1	0.2	0.2
17120009	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
18010201	0	0.2	0.3	0.3	0	0	0	0	0	0.2	0.3	0.3
18010202	0	0.2	0.2	0.2	0	0	0	0	0	0.2	0.2	0.2
18010203	0	0.5	0.5	0.5	0	0	0	0	0	0.5	0.5	0.5
18010204	0	0.5	0.5	0.5	0	0	0	0	0	0.5	0.5	0.5
18020001	0	0.4	0.4	0.4	0	0	0	0	0	0.4	0.4	0.4
Total	0.7	4.0	4.7	4.7	0	0.1	0.1	0.1	0.7	4.1	4.8	4.8

Livestock water use by hydrologic unit, in South-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock: Withdrawals, in Mgal/d: Ground water	Stock: Withdrawals: Surface water	Stock: Withdrawals: Total	Stock: Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Animal specialties: Withdrawals: Surface water	Animal specialties: Withdrawals: Total	Animal specialties: Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Total livestock: Withdrawals: Surface water	Total livestock: Withdrawals: Total	Total livestock: Consumptive use, in Mgal/d
17120001	0.1	0.2	0.3	0.3	--	--	--	--	0.1	0.2	0.3	0.3
17120002	0.2	0.5	0.7	0.7	--	--	--	--	0.2	0.5	0.7	0.7
17120003	0.1	0.2	0.3	0.3	--	--	--	--	0.1	0.2	0.3	0.3
17120004	0.1	0.1	0.2	0.2	--	--	--	--	0.1	0.1	0.2	0.2
17120005	0.1	0.6	0.7	0.7	--	--	--	--	0.1	0.6	0.7	0.7
17120006	0	0.2	0.2	0.2	--	--	--	--	0	0.2	0.2	0.2
17120007	0	0.3	0.3	0.3	--	--	--	--	0	0.3	0.3	0.3
17120008	0.1	0.1	0.2	0.2	--	--	--	--	0.1	0.1	0.2	0.2
17120009	0.1	0.1	0.1	0.1	--	--	--	--	0.1	0.1	0.1	0.1
18010201	0	0.2	0.2	0.2	--	--	--	--	0	0.2	0.2	0.2
18010202	0	0.3	0.4	0.4	--	--	--	--	0	0.3	0.4	0.4
18010203	0	0.3	0.3	0.3	--	--	--	--	0	0.3	0.3	0.3
18010204	0	1.0	1.0	1.0	--	--	--	--	0	1.0	1.0	1.0
18020001	0	0.3	0.3	0.3	--	--	--	--	0	0.3	0.3	0.3
Total	0.8	4.4	5.2	5.2	--	--	--	--	0.8	4.4	5.2	5.2

Irrigation water use by hydrologic unit, in South-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Fresh water: Surface	Reclaimed wastewater	Total	Irrigated land by irrigation type, in thousand acres: Spray	Flood	Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
16040201	0.6	4.7	0	5.3	0.2	1.0	1.3	0.7	2.5
16040205	0	0.5	0	0.5	0	0.1	0.2	0.1	0.2
17120001	30	60	0	90	5.0	21	26	10	35
17120002	8.2	200	0.2	210	11	39	50	23	68
17120003	0.6	110	0	110	5.2	22	27	11	37
17120004	3.3	120	0	120	5.5	23	29	12	39
17120005	82	77	0	160	22	45	68	36	99
17120006	2.5	170	0	170	12	24	36	19	53
17120007	0.7	200	0	200	13	27	40	21	59
17120008	5.6	53	0	58	2.9	12	15	6.0	20
17120009	4.5	29	0	34	1.7	7.0	8.7	3.5	12
18010201	7.4	76	0	83	1.9	25	27	17	36
18010202	0.1	78	0	78	2.0	23	25	17	33
18010203	2.6	180	0	180	4.1	55	59	40	79
18010204	65	470	0	530	72	56	130	120	170
18010206	0	39	0	39	2.5	3.7	6.2	0.8	9.1
18020001	15	240	0	250	20	40	60	32	88
Total	230	2,100	0.2	2,300	180	420	600	370	840

Irrigation water use by hydrologic unit, in South-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Fresh water: Surface	Reclaimed wastewater	Total	Irrigated land by irrigation type, in thousand acres: Spray	Flood	Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
16040201	0	19	0	19	0.5	5.6	6.2	2.8	8.8
16040205	0.2	0.2	0	0.3	0	0.1	0.1	0	0.1
17120001	2.8	59	0	62	6.4	16	23	1.9	27
17120002	5.7	110	0.3	120	12	32	44	4.5	56
17120003	2.8	59	0	62	6.5	18	24	1.9	27
17120004	1.5	31	0	33	3.5	9.4	13	1.0	15
17120005	82	97	0	180	57	34	91	5.7	110
17120006	2.2	77	0	79	4.5	25	30	0	37
17120007	0	100	0	100	5.7	31	37	0.5	46
17120008	1.4	33	0	34	3.4	10	14	0.9	14
17120009	1.9	35	0	37	2.7	8.7	11	1.1	17
18010201	0	44	0	44	7.8	16	24	0.9	21
18010202	5.2	100	0.1	110	7.4	40	47	0.9	44
18010203	5.2	96	0	100	16	33	49	2.7	44
18010204	0.7	470	0	470	47	95	140	58	170
18010206	0.1	10	0	11	0.9	1.7	2.5	2.2	3.2
18020001	11	83	0	94	16	24	40	3.6	44
Total	120	1,400	0.4	1,500	200	400	600	88	680

Reservoir evaporation water use by hydrologic unit, in South-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding]

Hydrologic unit	Amount evaporated, in thousand acre-feet	Reservoir area, in thousand acres
17120004	1.4	0.4
17120005	3.3	1.1
17120007	12	3.6
18010203	37	13
18010204	8.5	2.9
18010206	5.1	1.9
18020001	12	3.7
Total	79	26

Wastewater-treatment water releases by hydrologic unit, in South-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities: Public	Number of facilities: Industrial and other	Number of facilities: Total	Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
17120001	0	1	1	0	0
17120002	3	0	3	0	0.2
17120006	1	0	1	0	0
18010201	1	0	1	0.1	0
18010202	1	0	1	0	0
18010203	0	1	1	0	0
18010204	6	3	9	5.3	0
18010206	0	1	1	0	0
18020001	1	0	1	0.3	0
Total	13	6	19	5.7	0.2

Wastewater-treatment water releases by hydrologic unit, in South-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities: Public	Number of facilities: Industrial and other	Number of facilities: Total	Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
17120001	0	1	1	0	0
17120002	3	0	3	0.1	0.3
17120006	1	0	1	0	0
18010202	2	0	2	0	0.1
18010204	6	3	9	6.3	0
18010206	0	1	1	0	0
18020001	1	0	1	0.5	0
Total	13	5	18	6.8	0.4

Total offstream water use by hydrologic unit, in North-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses) Ground water	Surface water	Total	Water use, in Mgal/d Reclaimed wastewater	Consumptive use	Conveyance losses
17070101	9.5	25	160	190	0.2	190	9.2
17070102	12.2	18	69	87	1.2	47	17
17070103	42.7	74	210	290	3.0	190	80
17070104	3.1	10	140	150	0	23	2.6
17070105	36.9	21	110	130	0	55	12
17070201	6.3	1.3	120	120	0.1	36	22
17070202	0.5	0.3	30	31	0	10	6.0
17070203	0.6	0.3	11	11	0	3.5	2.0
17070204	3.1	5.5	32	37	0	15	5.3
17070301	65.5	12	680	690	0.7	53	130
17070302	4.3	0.6	8.9	9.5	0	3.1	1.3
17070303	0.3	5.5	28	34	0	24	12
17070304	0.2	0.9	14	15	0	12	5.7
17070305	23.1	7.3	160	170	0	120	76
17070306	13.9	2.3	130	130	0.1	94	33
17070307	0.4	11	24	35	0	30	16
Total	222.5	190	1,900	2,100	5.4	900	430

Total offstream water use by hydrologic unit, in North-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses) Ground water	Surface water	Total	Water use, in Mgal/d Reclaimed wastewater	Consumptive use	Conveyance losses
17070101	9.5	13	170	190	0.2	120	11
17070102	12.3	19	79	98	0	43	12
17070103	43.2	74	290	360	0.3	170	44
17070104	3.1	10	28	39	0	23	1.3
17070105	36.7	20	81	100	0	52	8.4
17070201	6.6	4.6	97	100	0	45	6.9
17070202	0.8	0.9	21	22	0.1	10	1.5
17070203	0.6	1.0	13	14	0	5.7	0.9
17070204	3.3	3.7	33	36	0	19	1.3
17070301	57.2	6.7	210	220	0.9	75	58
17070302	4.0	1.0	7.4	8.4	0.1	2.9	3.4
17070303	0.3	1.6	48	50	0	18	7.8
17070304	0.2	0.8	24	25	0	8.9	3.9
17070305	21.2	13	300	310	0	110	65
17070306	12.7	5.8	150	150	0.2	44	45
17070307	0.3	0.3	72	72	0	17	23
Total	212.0	180	1,600	1,800	1.8	750	290

Public-supply water use by hydrologic unit, in North-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Population served, in thousands: Ground water	Surface water	Total	Withdrawals, total in Mgal/d: Ground water	Surface water	Total	Water deliveries, by type of use, in Mgal/d: Commercial	Domestic	Industrial	Public use and losses	Total deliveries	Per capita use, in gal/d
17070101	4.5	1.5	6.0	1.3	1.0	2.2	0.4	1.6	0	0.2	2.0	370
17070102	7.0	0	7.0	2.9	11	14	0.8	1.4	0.4	12	2.6	2,100
17070103	25	6.6	31	6.8	2.1	8.9	1.9	5.8	0.1	1.2	7.8	280
17070104	2.1	0	2.1	1.0	0	1.0	0.2	0.7	0	0.1	0.9	450
17070105	21	11	32	8.4	4.4	13	2.1	8.2	0.5	2.0	11	410
17070201	3.5	1.1	4.6	0.7	0.2	0.9	0.2	0.4	0.1	0.1	0.7	190
17070202	0.4	0.1	0.5	0.1	0	0.1	0	0.1	0	0	0.1	300
17070203	0.3	0	0.3	0.1	0	0.1	0	0	0	0	0.1	240
17070204	1.9	0.2	2.1	1.0	0.1	1.2	0.1	0.3	0	0.8	0.4	540
17070301	32	18	50	6.2	5.6	12	2.9	6.9	1.1	1.0	11	240
17070302	1.7	0	1.7	0.2	0	0.2	0	0.2	0	0	0.2	110
17070305	8.9	2.0	11	1.6	2.0	3.6	0.4	1.3	0.1	1.9	1.8	330
17070306	1.7	8.7	10	0.4	0.7	1.1	0.2	1.6	0.4	-1.1	2.1	100
17070307	0.1	0	0.1	0	0	0	0	0	0	0	0	0
Total	110	49	160	31	28	58	9.2	28	2.6	18	40	370

Public-supply water use by hydrologic unit, in North-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Population served, in thousands: Ground water	Surface water	Total	Withdrawals, total in Mgal/d: Ground water	Surface water	Total	Water deliveries, by type of use, in Mgal/d: Commercial	Domestic	Industrial	Public use and losses	Total deliveries	Per capita use, in gal/d
17070101	1.4	1.5	2.8	0.4	1.0	1.3	0.2	1.0	0	0.1	1.3	480
17070102	6.6	0	6.6	2.9	0	2.9	0.6	1.8	0.2	0.3	2.9	440
17070103	23	9.6	33	5.7	2.7	8.3	1.2	6.3	0.1	0.8	8.3	250
17070104	2.1	0	2.1	0.6	0	0.6	0.1	0.5	0	0.1	0.6	310
17070105	20	9.3	29	7.1	3.3	10	1.3	7.3	0.5	1.2	10	360
17070201	2.9	1.2	4.1	0.7	0.2	0.8	0.1	0.5	0.1	0.1	0.8	200
17070202	0.4	0	0.4	0.1	0	0.1	0	0.1	0	0	0.1	320
17070203	0.2	0	0.2	0	0	0	0	0	0	0	0	150
17070204	1.8	0.4	2.2	0.2	0.1	0.3	0	0.2	0	0	0.3	130
17070301	13	22	34	2.6	7.0	9.6	1.9	6.0	0.7	0.9	9.6	280
17070302	1.3	0	1.3	0.2	0	0.2	0	0.2	0	0	0.2	140
17070305	6.8	0	6.8	1.1	0	1.1	0.2	0.7	0	0.1	1.1	150
17070306	6.5	2.7	9.2	1.6	0.9	2.4	0.1	2.2	0	0.2	2.4	260
17070307	0.1	0	0.1	0	0	0	0	0	0	0	0	160
Total	85	46	130	23	15	38	5.7	27	1.7	3.9	38	290

Domestic water use by hydrologic unit, in North-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

	Self Supplied					Public supplied			Total	
		Water withdrawals, in Mgal/d								
Hydrologic unit	Population, in thousands	Ground water	Surface water	Total	Per capita use, in gal/d	Population served, in thousands	Deliveries from public supply, in Mgal/d	Per capita use, in gal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17070101	3.4	0.5	0.1	0.5	150	6.0	1.6	260	2.1	0.6
17070102	5.2	0.7	0.1	0.8	150	7.0	1.4	210	2.2	0.7
17070103	11	1.6	0.1	1.7	150	31	5.8	190	7.5	2.0
17070104	1.0	0.1	0	0.1	150	2.1	0.7	320	0.8	0.2
17070105	5.2	0.6	0.2	0.8	150	32	8.2	260	8.9	2.0
17070201	1.7	0.1	0.1	0.3	150	4.6	0.4	95	0.7	0.2
17070202	0.1	0	0	0	150	0.5	0.1	210	0.1	0
17070203	0.4	0	0	0.1	150	0.3	0	160	0.1	0
17070204	1.0	0.1	0	0.2	150	2.1	0.3	140	0.4	0.1
17070301	15	1.9	0.4	2.3	150	50	6.9	140	9.2	2.5
17070302	2.6	0.3	0	0.4	150	1.7	0.2	100	0.6	0.2
17070303	0.3	0.1	0	0.1	150	0	0	0	0.1	0
17070304	0.2	0	0	0	150	0	0	0	0	0
17070305	12	1.6	0.3	1.8	150	11	1.3	120	3.1	1.2
17070306	3.5	0.4	0.1	0.5	150	10	1.6	150	2.1	0.6
17070307	0.3	0	0	0.1	150	0	0	0	0.1	0
Total	64	8.1	1.4	9.5	150	160	28	180	38	10

Domestic water use by hydrologic unit, in North-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

	Self Supplied					Public supplied			Total	
		Water withdrawals, in Mgal/d								
Hydrologic unit	Population, in thousands	Ground water	Surface water	Total	Per capita use, in gal/d	Population served, in thousands	Deliveries from public supply, in Mgal/d	Per capita use, in gal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17070101	6.7	1.0	0	1.0	150	2.8	1.0	350	2.0	0.7
17070102	5.7	0.8	0	0.9	150	6.6	1.8	270	2.6	0.8
17070103	10	1.4	0.1	1.5	150	33	6.3	190	7.8	2.0
17070104	1.0	0.1	0	0.2	150	2.1	0.5	230	0.6	0.2
17070105	7.8	1.0	0.1	1.2	150	29	7.3	250	8.5	2.0
17070201	2.5	0.3	0.1	0.4	150	4.1	0.5	130	0.9	0.3
17070202	0.4	0.1	0	0.1	150	0.4	0.1	240	0.2	0.1
17070203	0.4	0.1	0	0.1	150	0.2	0	100	0.1	0
17070204	1.1	0.1	0	0.2	150	2.2	0.2	98	0.4	0.1
17070301	23	3.0	0.4	3.4	150	34	6.0	180	9.5	2.9
17070302	2.8	0.4	0	0.4	150	1.3	0.2	120	0.6	0.2
17070303	0.3	0.1	0	0.1	150	0	0	0	0.1	0
17070304	0.2	0	0	0	150	0	0	0	0	0
17070305	14	2.0	0.2	2.2	150	6.8	0.7	100	2.8	1.2
17070306	3.6	0.5	0	0.5	150	9.2	2.2	240	2.7	0.7
17070307	0.3	0	0	0	150	0.1	0	160	0	0
Total	80	11	1.0	12	150	130	27	200	39	11

Commercial water use by hydrologic unit, in North-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d: Ground water	Surface water	Total	Deliveries from public supply, in Mgal/d	Total: Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17070101	0	36	36	0.4	36	0.1
17070102	0	0	0	0.8	0.8	0.2
17070103	0.1	0.1	0.2	1.9	2.1	0.4
17070104	0	0	0	0.2	0.2	0
17070105	0.1	15	15	2.1	17	0.5
17070201	0	0	0	0.2	0.2	0
17070204	0	0	0	0.1	0.1	0
17070301	0.2	23	23	2.9	26	0.7
17070202	0	0	0	0	0.1	0
17070305	0	0	0.1	0.4	0.5	0.1
17070306	0	28	28	0.2	28	0
Total	0.4	100	100	9.2	110	2.1

Commercial water use by hydrologic unit, in North-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d: Ground water	Surface water	Total	Deliveries from public supply, in Mgal/d	Total: Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17070101	0.3	0	0.3	0.2	0.5	0.1
17070102	0	0	0	0.6	0.6	0.1
17070103	0.2	0	0.2	1.2	1.4	0.3
17070104	0	0	0	0.1	0.1	0
17070105	0	0	0	1.3	1.3	0.3
17070201	0	0	0	0.1	0.2	0
17070301	0	0	0	1.9	1.9	0.4
17070305	0	0	0	0.2	0.2	0.1
17070306	0	0	0	0.1	0.1	0
Total	0.7	0	0.7	5.7	6.4	1.3

Industrial water use by hydrologic unit, in North-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d: Ground water	Surface water	Total	Reclaimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17070101	2.6	0	2.6	0	0	2.6	0.3
17070102	1.3	0	1.3	0	0.4	1.7	1.2
17070103	5.3	0	5.3	0	0.1	5.4	3.3
17070104	0.2	0	0.2	0	0	0.2	0
17070105	4.5	3.8	8.3	0	0.5	8.8	0.7
17070201	0	0	0	0	0.1	0.1	0
17070301	0	3.0	3.0	0	1.1	4.1	0.5
17070302	0	3.6	3.6	0	0	3.6	0.5
17070305	0.2	0.7	0.8	0	0.1	0.9	0
17070306	0	0.1	0.1	0	0.4	0.5	0.1
Total	14	11	25	0	2.6	28	6.6

Industrial water use by hydrologic unit, in North-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d: Ground water	Surface water	Total	Reclaimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17070101	3.0	0	3.0	0	0	3.0	0
17070102	0	0	0	0	0.2	0.2	0
17070103	5.2	0.1	5.3	0	0.1	5.4	0.2
17070104	0.2	0	0.2	0	0	0.2	0
17070105	2.2	1.5	3.7	0	0.5	4.3	0.2
17070201	0.1	1.4	1.5	0	0.1	1.6	0.1
17070203	0.4	0	0.4	0	0	0.4	0
17070301	0	3.7	3.7	0	0.7	4.4	0.2
17070302	0.4	0	0.4	0	0	0.4	0
17070305	4.3	0	4.3	0	0	4.4	0.2
17070306	0	0.1	0.1	0	0	0.1	0
Total	16	6.7	23	0	1.7	24	1.1

Mining water use by hydrologic unit, in North-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total	
17070102	0.2	0	0.2	0
Total	0.2	0	0.2	0

Mining water use by hydrologic unit, in North-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total	
17070202	0	1.0	1.0	0.3
17070203	0	1.0	1.0	0.3
Total	0	2.1	2.1	0.5

Thermoelectric power water use by hydrologic unit, in North-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
17070101	0	0	0.4	1,100
17070104	0	0.4	0	0
Total	0	0.4	0.4	1,100

Thermoelectric power water use by hydrologic unit, in North-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
17070101	0	0	0.5	590
17070104	0	0.5	0	0
Total	0	0.5	0.5	590

Hydroelectric power water use by hydrologic unit, in North-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
17070101	110,000	7,200
17070105	230,000	20,000
17070301	270	5.10
17070306	5,300	1,300
Total	340,000	28,000

Hydroelectric power water use by hydrologic unit, in North-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
17070101	100,000	6,800
17070105	180,000	19,000
17070301	480	8.3
17070306	5,900	1,400
Total	290,000	27,000

Livestock water use by hydrologic unit, in North-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock: Withdrawals, in Mgal/d: Ground water	Stock: Withdrawals: Surface water	Stock: Withdrawals: Total	Stock: Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Animal specialties: Withdrawals: Surface water	Animal specialties: Withdrawals: Total	Animal specialties: Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Total livestock: Withdrawals: Surface water	Total livestock: Withdrawals: Total	Total livestock: Consumptive use, in Mgal/d
17070101	0.4	0.5	0.9	0.9	0	0	0	0	0.4	0.5	1.0	1.0
17070102	0.1	0.1	0.2	0.2	0	0	0	0	0.1	0.1	0.2	0.2
17070103	0.4	0.5	1.0	1.0	0	0	0	0	0.4	0.5	1.0	1.0
17070104	0.1	0.2	0.2	0.2	0	0	0	0	0.1	0.2	0.2	0.2
17070105	0	0.2	0.2	0.2	0	0	0	0	0	0.2	0.2	0.2
17070201	0	0.5	0.6	0.6	0	0	0	0	0	0.5	0.6	0.6
17070202	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17070203	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17070204	0	0.2	0.3	0.3	0	0	0	0	0	0.2	0.3	0.3
17070301	0	0.2	0.2	0.2	0	0	0	0	0	0.2	0.2	0.2
17070303	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17070304	0	0.2	0.3	0.3	0	0	0	0	0	0.2	0.3	0.3
17070305	0	0.4	0.4	0.4	0	0	0	0	0	0.4	0.4	0.4
17070306	0	0.4	0.4	0.4	0	0	0	0	0	0.4	0.5	0.5
17070307	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
Total	1.2	3.9	5.0	5.0	0	0.1	0.1	0.1	1.2	4.0	5.2	5.2

Livestock water use by hydrologic unit, in North-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock: Withdrawals, in Mgal/d: Ground water	Stock: Withdrawals: Surface water	Stock: Withdrawals: Total	Stock: Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Animal specialties: Withdrawals: Surface water	Animal specialties: Withdrawals: Total	Animal specialties: Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Total livestock: Withdrawals: Surface water	Total livestock: Withdrawals: Total	Total livestock: Consumptive use, in Mgal/d
17070101	0.4	0.1	0.5	0.5	--	--	--	--	0.4	0.1	0.5	0.5
17070102	0.2	0.2	0.3	0.3	--	--	--	--	0.2	0.2	0.3	0.3
17070103	0.6	0.8	1.4	1.4	--	--	--	--	0.6	0.8	1.4	1.4
17070104	0.1	0.5	0.6	0.6	--	--	--	--	0.1	0.5	0.6	0.6
17070105	0	0.3	0.3	0.3	--	--	--	--	0	0.3	0.3	0.3
17070201	0	0.7	0.7	0.7	--	--	--	--	0	0.7	0.7	0.7
17070202	0	0.1	0.1	0.1	--	--	--	--	0	0.1	0.1	0.1
17070203	0	0.1	0.1	0.1	--	--	--	--	0	0.1	0.1	0.1
17070204	0	0.4	0.4	0.4	--	--	--	--	0	0.4	0.4	0.4
17070301	0	0.3	0.3	0.3	--	--	--	--	0	0.3	0.3	0.3
17070303	0	0.2	0.2	0.2	--	--	--	--	0	0.2	0.2	0.2
17070304	0	0.1	0.1	0.1	--	--	--	--	0	0.1	0.1	0.1
17070305	0	0.7	0.7	0.7	--	--	--	--	0	0.7	0.7	0.7
17070306	0	0.4	0.4	0.4	--	--	--	--	0	0.4	0.4	0.4
17070307	0	0.1	0.1	0.1	--	--	--	--	0	0.1	0.1	0.1
Total	1.4	4.8	6.2	6.2	--	--	--	--	1.4	4.8	6.2	6.2

Irrigation water use by hydrologic unit, in North-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Withdrawals, in Mgal/d: Fresh water: Surface	Withdrawals, in Mgal/d: Reclaimed wastewater	Withdrawals, in Mgal/d: Total	Irrigated land by irrigation type, in thousand acres: Spray	Irrigated land: Flood	Irrigated land: Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
17070101	21	130	0.2	150	95	8.3	100	9.2	190
17070102	12	58	1.2	70	24	2.5	26	17	44
17070103	59	210	3.0	270	96	10	110	80	180
17070104	8.7	140	0	150	11	1.6	13	2.6	23
17070105	7.1	85	0	92	26	0.1	26	12	52
17070201	0.5	120	0.1	120	8.8	17	26	22	35
17070202	0.1	30	0	30	3.1	3.9	7.0	6.0	9.9
17070203	0.2	11	0	11	0.9	1.7	2.5	2.0	3.4
17070204	4.3	31	0	36	5.5	3.8	9.3	5.3	15
17070301	3.2	650	0.7	650	20	15	35	130	49
17070302	0	5.2	0	5.2	0	1.7	1.7	1.3	2.3
17070303	5.4	28	0	34	11	5.4	16	12	24
17070304	0.8	14	0	14	5.4	2.6	8.0	5.7	12
17070305	3.9	160	0	160	50	27	77	76	110
17070306	1.4	98	0.1	99	47	11	59	33	93
17070307	11	24	0	35	16	6.3	22	16	30
Total	140	1,800	5.4	1,900	420	120	540	430	880

Irrigation water use by hydrologic unit, in North-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Withdrawals, in Mgal/d: Fresh water: Surface	Withdrawals, in Mgal/d: Reclaimed wastewater	Withdrawals, in Mgal/d: Total	Irrigated land by irrigation type, in thousand acres: Spray	Irrigated land: Flood	Irrigated land: Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
17070101	7.9	170	0.2	180	74	8.2	82	11	110
17070102	15	79	0	94	25	2.4	28	12	42
17070103	61	290	0.3	350	100	9.8	110	44	170
17070104	9.3	28	0	37	16	1.9	18	1.3	22
17070105	9.5	76	0	85	36	0.9	36	8.4	49
17070201	3.5	95	0	99	8.1	22	30	6.9	43
17070202	0.7	20	0.1	21	1.5	4.2	5.6	1.5	10
17070203	0.5	12	0	12	1.0	2.7	3.6	0.9	5.3
17070204	3.3	32	0	35	5.7	6.4	12	1.3	19
17070301	1.1	200	0.9	200	15	17	32	58	71
17070302	0	7.3	0.1	7.3	0.8	0.3	1.1	3.4	2.6
17070303	1.5	48	0	50	11	5.2	16	7.8	18
17070304	0.8	24	0	25	5.4	2.6	8.0	3.9	8.8
17070305	6.0	300	0	300	51	29	80	65	100
17070306	3.7	150	0.2	150	37	11	48	45	43
17070307	0.3	71	0	72	15	6.3	21	23	17
Total	120	1,600	1.8	1,700	400	130	530	290	730

Reservoir evaporation water use by hydrologic unit, in North-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding]

Hydrologic unit	Amount evaporated, in thousand acre-feet	Reservoir area, in thousand acres
17070101	67	17
17070103	5.5	1.6
17070105	8.5	2.9
17070301	30	12
17070302	1.4	0.6
17070304	6.1	2.1
17070305	1.3	0.5
17070306	3.2	1.2
Total	120	38

Wastewater-treatment water releases by hydrologic unit, in North-Central Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities: Public	Number of facilities: Industrial and other	Number of facilities: Total	Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
17070101	3	2	5	0.6	0.2
17070102	2	0	2	0.6	1.2
17070103	6	2	8	4.5	3.0
17070104	1	0	1	0.3	0
17070105	9	4	13	3.8	0
17070201	3	0	3	0.1	0.1
17070202	1	0	1	0	0
17070203	1	0	1	0	0
17070204	3	0	3	0.2	0
17070301	4	2	6	0	0.7
17070302	1	0	1	0	0
17070305	3	1	4	0.5	0
17070306	3	2	5	0.1	0.1
Total	40	13	53	11	5.4

Wastewater-treatment water releases by hydrologic unit, in North-Central Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities: Public	Number of facilities: Industrial and other	Number of facilities: Total	Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
17070101	2	1	3	0.1	0.2
17070102	2	0	2	0.6	0.1
17070103	6	3	9	4.1	0.4
17070104	1	0	1	0.3	0
17070105	10	2	12	4.1	0
17070201	3	0	3	0.6	0
17070202	1	2	3	0	0
17070203	1	0	1	0.1	0
17070204	3	0	3	0.2	0
17070301	7	3	10	1.9	0.9
17070302	1	0	1	0	0.1
17070305	4	0	4	0.5	0
17070306	3	0	3	0.1	0.2
17070307	1	0	1	0	0
Total	45	11	56	13	1.8

Total offstream water use by hydrologic unit, in Southeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses)			Water use, in Mgal/d		
		Ground water	Surface water	Total	Reclaimed wastewater	Consumptive use	Conveyance losses
17050103	0.7	0.2	20	20	0	14	33
17050105	0	0	0	0	0	0	0
17050106	0	0	0	0	0	0	0
17050107	0	0.1	12	12	0	4.1	1.9
17050108	0.8	1.3	120	130	0	50	19
17050109	0	0	11	11	0	3.6	1.7
17050110	0.8	1.3	410	410	0	54	33
17050115	13.4	3.7	290	300	0.1	170	95
17050116	0.8	3.4	45	48	0	18	6.8
17050117	6.1	6.5	150	150	0	130	74
17050118	1.8	2.6	40	42	0	22	12
17050119	1.5	11	71	83	0	35	11
Total	26.0	30	1,200	1,200	0.1	500	290

Total offstream water use by hydrologic unit, in Southeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses)			Water use, in Mgal/d		
		Ground water	Surface water	Total	Reclaimed wastewater	Consumptive use	Conveyance losses
17050103	0.8	0.2	130	130	0	39	21
17050105	0	0	0	0	0	0	0
17050106	0	0	0	0	0	0	0
17050107	0	0	5.0	5.0	0	2.7	0.7
17050108	0.8	4.1	140	140	0	25	32
17050109	0.1	0	2.4	2.4	0	1.3	0.4
17050110	0.9	2.7	100	100	0	38	22
17050115	14.4	3.0	260	260	0	88	57
17050116	0.8	1.9	67	69	0	34	5.7
17050117	4.2	19	160	170	0	61	26
17050118	1.4	4.7	78	83	0	25	14
17050119	4.6	6.8	160	170	0	77	31
Total	27.9	43	1,100	1,100	0.1	390	210

Public-supply water use by hydrologic unit, in Southeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

	Population served, in thousands			Withdrawals, total in Mgal/d			Water deliveries, by type of use, in Mgal/d					
Hydrologic unit	Ground water	Surface water	Total	Ground water	Surface water	Total	Commercial	Domestic	Industrial	Public use and losses	Total deliveries	Per capita use, in gal/d
17050103	0.2	0	0.2	0.1	0	0.1	0	0.1	0	0	0.1	410
17050108	0.4	0	0.4	0.1	0	0.1	0	0	0	0	0.1	210
17050115	7.5	5.0	13.0	2.6	2.5	5.2	1.6	1.5	1.6	0.4	4.8	410
17050118	0.3	0	0.3	0	0	0	0	0	0	0	0	0
17050119	1.3	0	1.3	0.3	0	0.3	0.1	0.1	0	0.1	0.2	230
Total	9.7	5.0	15	3.1	2.5	5.6	1.8	1.7	1.7	0.5	5.1	380

Public-supply water use by hydrologic unit, in Southeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

	Population served, in thousands			Withdrawals, total in Mgal/d			Water deliveries, by type of use, in Mgal/d					
Hydrologic unit	Ground water	Surface water	Total	Ground water	Surface water	Total	Commercial	Domestic	Industrial	Public use and losses	Total deliveries	Per capita use, in gal/d
17050103	0.4	0	0.4	0	0	0	0	0	0	0	0	100
17050108	0.5	0	0.5	0.1	0	0.1	0	0.1	0	0	0.1	130
17050115	4.7	7.7	12	1.8	3.0	4.8	0.7	1.3	2.1	0.8	4.8	390
17050119	1.8	0	1.8	0.3	0	0.3	0.1	0.2	0	0	0.3	190
Total	7.4	7.7	15	2.2	3.0	5.3	0.8	1.6	2.1	0.8	5.3	350

Domestic water use by hydrologic unit, in Southeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Self supplied: Population, in thousands	Self supplied: Water withdrawals, in Mgal/d: Ground water	Self supplied: Water withdrawals, in Mgal/d: Surface water	Self supplied: Water withdrawals, in Mgal/d: Total	Self supplied: Per capita use, in gal/d	Public supplied: Population served, in thousands	Public supplied: Deliveries from public supply, in Mgal/d	Public supplied: Per capita use, in gal/d	Total: Withdrawals and deliveries, in Mgal/d	Total: Consumptive use, in Mgal/d
17050103	0.6	0.1	0	0.1	150	0.2	0.1	290	0.1	0.1
17050107	0	0	0	0	150	0	0	0	0	0
17050108	0.4	0.1	0	0.1	150	0.4	0	100	0.1	0
17050109	0	0	0	0	150	0	0	0	0	0
17050110	0.8	0.1	0	0.1	150	0	0	0	0.1	0.1
17050115	0.8	0.1	0	0.1	150	13	1.5	120	1.7	0.4
17050116	0.8	0.1	0	0.1	150	0	0	0	0.1	0.1
17050117	6.1	0.9	0	0.9	150	0	0	0	0.9	0.5
17050118	1.5	0.2	0	0.2	150	0.3	0	63	0.2	0.1
17050119	0.2	0	0	0	150	1.3	0.1	70	0.1	0
Total	11	1.7	0	1.7	150	15	1.7	120	3.4	1.2

Domestic water use by hydrologic unit, in Southeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

Hydrologic unit	Self supplied: Population, in thousands	Self supplied: Water withdrawals, in Mgal/d: Ground water	Self supplied: Water withdrawals, in Mgal/d: Surface water	Self supplied: Water withdrawals, in Mgal/d: Total	Self supplied: Per capita use, in gal/d	Public supplied: Population served, in thousands	Public supplied: Deliveries from public supply, in Mgal/d	Public supplied: Per capita use, in gal/d	Total: Withdrawals and deliveries, in Mgal/d	Total: Consumptive use, in Mgal/d
17050103	0.4	0.1	0	0.1	150	0.4	0	75	0.1	0
17050108	0.4	0.1	0	0.1	150	0.5	0.1	110	0.1	0
17050109	0.1	0	0	0	150	0	0	0	0	0
17050110	0.9	0.1	0	0.1	150	0	0	0	0.1	0.1
17050115	2.0	0.3	0	0.3	150	12	1.3	110	1.6	0.4
17050116	0.8	0.1	0	0.1	150	0	0	0	0.1	0.1
17050117	4.2	0.6	0	0.6	150	0	0	0	0.6	0.3
17050118	1.4	0.2	0	0.2	150	0	0	0	0.2	0.1
17050119	2.8	0.4	0	0.4	150	1.8	0.2	95	0.6	0.2
Total	13	1.9	0	1.9	150	15	1.6	110	3.5	1.3

Commercial water use by hydrologic unit, in Southeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d			Deliveries from public supply, in Mgal/d	Total	
	Ground water	Surface water	Total		Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17050115	0.1	0	0.1	1.6	1.7	0.4
17050119	0	0	0	0.1	0.2	0.1
Total	0.1	0	0.1	1.8	1.9	0.4

Commercial water use by hydrologic unit, in Southeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d			Deliveries from public supply, in Mgal/d	Total	
	Ground water	Surface water	Total		Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17050115	0	0	0	0.7	0.7	0.1
17050119	0	0	0	0.1	0.2	0
Total	0	0	0	0.8	0.9	0.2

Industrial water use by hydrologic unit, in Southeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d			Re-claimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
	Ground water	Surface water	Total				
17050115	0	2.5	2.5	0	1.6	4.2	0.3
17050117	0.3	0	0.3	0	0	0.3	0.1
Total	0.3	2.5	2.8	0	1.7	4.5	0.4

Industrial water use by hydrologic unit, in Southeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d			Re-claimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
	Ground water	Surface water	Total				
17050115	0.7	1.8	2.5	0	2.1	4.6	1.8
Total	0.7	1.8	2.5	0	2.1	4.6	1.8

Mining water use by hydrologic unit, in Southeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total	
Total	0	0	0	0

Mining water use by hydrologic unit, in Southeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total	
Total	0	0.1	0.1	0

Thermoelectric power water use by hydrologic unit, in Southeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
Total	0	0	0	0

Thermoelectric power water use by hydrologic unit, in Southeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
Total	0	0	0	0

Hydroelectric power water use by hydrologic unit, in Southeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
Total	0	0

Hydroelectric power water use by hydrologic unit, in Southeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
Total	0	0

Livestock water use by hydrologic unit, in Southeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock: Withdrawals, in Mgal/d: Ground water	Stock: Withdrawals, in Mgal/d: Surface water	Stock: Withdrawals, in Mgal/d: Total	Stock: Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Animal specialties: Withdrawals, in Mgal/d: Surface water	Animal specialties: Withdrawals, in Mgal/d: Total	Animal specialties: Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Total livestock: Withdrawals, in Mgal/d: Surface water	Total livestock: Withdrawals, in Mgal/d: Total	Total livestock: Consumptive use, in Mgal/d
17050108	0.1	0.2	0.3	0.3	0	0	0	0	0.1	0.2	0.3	0.3
17050110	0.1	0.2	0.3	0.3	0	0	0	0	0.1	0.2	0.3	0.3
17050115	0.2	0.8	1.0	1.0	0	0	0	0	0.2	0.8	1.0	1.0
17050116	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17050117	0.1	0.3	0.4	0.4	0	0	0	0	0.1	0.4	0.4	0.4
17050118	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17050119	0	0.2	0.2	0.2	0	0	0	0	0	0.2	0.2	0.2
Total	0.5	1.9	2.4	2.4	0	0	0	0	0.5	2.0	2.4	2.4

Livestock water use by hydrologic unit, in Southeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock: Withdrawals, in Mgal/d: Ground water	Stock: Withdrawals, in Mgal/d: Surface water	Stock: Withdrawals, in Mgal/d: Total	Stock: Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Animal specialties: Withdrawals, in Mgal/d: Surface water	Animal specialties: Withdrawals, in Mgal/d: Total	Animal specialties: Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Total livestock: Withdrawals, in Mgal/d: Surface water	Total livestock: Withdrawals, in Mgal/d: Total	Total livestock: Consumptive use, in Mgal/d
17050103	0	0.2	0.2	0.2	--	--	--	--	0	0.2	0.2	0.2
17050108	0.1	0.4	0.5	0.5	--	--	--	--	0.1	0.4	0.5	0.5
17050110	0.1	0.2	0.2	0.2	--	--	--	--	0.1	0.2	0.2	0.2
17050115	0.1	0.4	0.5	0.5	--	--	--	--	0.1	0.4	0.5	0.5
17050116	0.1	0.2	0.3	0.3	--	--	--	--	0.1	0.2	0.3	0.3
17050117	0.2	0.7	0.9	0.9	--	--	--	--	0.2	0.7	0.9	0.9
17050118	0	0.1	0.1	0.1	--	--	--	--	0	0.1	0.1	0.1
17050119	0.1	0.2	0.3	0.3	--	--	--	--	0.1	0.2	0.3	0.3
Total	0.6	2.5	3.1	3.1	--	--	--	--	0.6	2.5	3.1	3.1

Irrigation water use by hydrologic unit, in Southeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Withdrawals, in Mgal/d: Fresh water: Surface	Withdrawals, in Mgal/d: Reclaimed wastewater	Withdrawals, in Mgal/d: Total	Irrigated land by irrigation type, in thousand acres: Spray	Irrigated land by irrigation type, in thousand acres: Flood	Irrigated land by irrigation type, in thousand acres: Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
17050103	0	20	0	20	0.3	6.4	6.7	33	13
17050107	0.1	12	0	12	0.2	1.8	2.0	1.9	4.0
17050108	1.1	120	0	130	3.1	22	25	19	49
17050109	0	11	0	11	0.2	1.6	1.8	1.7	3.6
17050110	1.1	410	0	410	2.6	24	27	33	54
17050115	0.7	290	0.1	290	7.9	77	85	95	170
17050116	3.2	44	0	48	1.4	8.5	10	6.8	18
17050117	5.2	150	0	150	5.0	59	64	74	130
17050118	2.3	40	0	42	0.9	10	11	12	22
17050119	11	71	0	82	1.5	16	17	11	35
Total	25	1,200	0.1	1,200	23	230	250	290	500

Irrigation water use by hydrologic unit, in Southeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Withdrawals, in Mgal/d: Fresh water: Surface	Withdrawals, in Mgal/d: Reclaimed wastewater	Withdrawals, in Mgal/d: Total	Irrigated land by irrigation type, in thousand acres: Spray	Irrigated land by irrigation type, in thousand acres: Flood	Irrigated land by irrigation type, in thousand acres: Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
17050103	0	130	0	130	2.1	21	23	21	38
17050107	0	4.9	0	4.9	0.1	1.5	1.6	0.7	2.7
17050108	3.9	140	0	140	2.7	28	31	32	24
17050109	0	2.4	0	2.4	0.1	0.7	0.8	0.4	1.3
17050110	2.5	100	0	100	2.0	21	23	22	38
17050115	0	260	0	260	4.5	42	46	57	85
17050116	1.7	67	0	69	4.4	21	25	5.7	34
17050117	19	150	0	170	3.2	33	36	26	59
17050118	4.4	78	0	83	1.3	14	15	14	25
17050119	6.0	160	0	170	4.1	42	46	31	76
Total	37	1,100	0.1	1,100	24	220	250	210	380

Reservoir evaporation water use by hydrologic unit, in Southeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding]

Hydrologic unit	Amount evaporated, in thousand acre-feet	Reservoir area, in thousand acres
17050108	5.8	1.7
17050110	36	9.5
17050116	11	3.2
17050118	1.3	0.4
17050119	2.3	0.8
Total	56	16

Wastewater-treatment water releases by hydrologic unit, in Southeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities: Public	Number of facilities: Industrial and other	Number of facilities: Total	Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
17050103	1	0	1	0	0
17050108	1	0	1	0	0
17050115	2	3	5	1.9	0.1
17050119	1	0	1	0	0
Total	5	3	8	1.9	0.1

Wastewater-treatment water releases by hydrologic unit, in Southeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities: Public	Number of facilities: Industrial and other	Number of facilities: Total	Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
17050103	1	0	1	0	0
17050108	1	0	1	0	0
17050115	2	1	3	1.7	0
17050119	1	0	1	0.2	0
Total	5	1	6	1.9	0

Total offstream water use by hydrologic unit, in Northeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses) Ground water	Surface water	Total	Water use, in Mgal/d Reclaimed wastewater	Consumptive use	Conveyance losses
17050201	2.2	2.4	82	84	0	33	15
17050202	1.4	0.3	130	130	0	50	25
17050203	13.3	18	410	430	0	180	78
17060101	0	0	15	15	0	7.6	1.9
17060102	0.8	0.1	16	17	0	8.3	2.0
17060103	0	0	0	0	0	0	0
17060104	22.7	12	91	100	0	51	8.0
17060105	5.8	2.1	110	120	0	52	13
17060106	0.4	3.2	1.8	4.9	0	2.2	0.2
Total	46.5	38	860	890	0.1	390	140

Total offstream water use by hydrologic unit, in Northeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Total population, in thousands	Withdrawals, in Mgal/d (includes irrigation conveyance losses) Ground water	Surface water	Total	Water use, in Mgal/d Reclaimed wastewater	Consumptive use	Conveyance losses
17050201	2.3	0.4	73	74	0.1	29	15
17050202	1.5	0.3	85	85	0	23	24
17050203	13.6	9.3	330	340	0.1	130	51
17060101	0	0	0.1	0.1	0	0.1	0
17060102	0.8	0.1	18	18	0	1.4	3.1
17060103	0	0	0	0	0	0	0
17060104	23.4	25	77	100	0.1	59	3.5
17060105	6.2	5.8	99	110	0	40	40
17060106	0.4	0.1	1.0	1.0	0	0.5	0.3
Total	48.1	41	690	730	0.2	280	140

Public-supply water use by hydrologic unit, in Northeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

	Population served, in thousands			Withdrawals, total in Mgal/d			Water deliveries, by type of use, in Mgal/d					
Hydrologic unit	Ground water	Surface water	Total	Ground water	Surface water	Total	Commer-cial	Domestic	Indus-trial	Public use and losses	Total deliveries	Per capita use, in gal/d
17050201	0.4	0	0.4	0.1	0	0.1	0	0.1	0	0	0.1	370
17050202	0.5	0	0.5	0.1	0	0.1	0	0.1	0	0	0.1	230
17050203	2.0	8.6	11	0.8	1.9	2.7	0.4	1.5	0.4	0.4	2.3	250
17060104	9.7	7.0	17	2.9	1.8	4.7	1.0	2.5	0.4	0.8	3.9	280
17060105	1.1	3.1	4.2	0.4	1.1	1.5	0.2	1.1	0	0.2	1.3	350
Total	14	19	32	4.3	4.8	9.1	1.6	5.4	0.8	1.3	7.8	280

Public-supply water use by hydrologic unit, in Northeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; negative values for public use and losses result from interbasin transfers; Mgal/d, million gallons per day; gal/d, gallons per day]

	Population served, in thousands			Withdrawals, total in Mgal/d			Water deliveries, by type of use, in Mgal/d					
Hydrologic unit	Ground water	Surface water	Total	Ground water	Surface water	Total	Commer-cial	Domestic	Indus-trial	Public use and losses	Total deliveries	Per capita use, in gal/d
17050201	0.4	0	0.4	0.2	0	0.2	0	0.1	0	0	0.2	340
17050202	0.6	0	0.6	0.1	0	0.1	0	0.1	0	0	0.1	200
17050203	1.1	9.8	11	0.1	1.6	1.7	0.1	1.2	0.1	0.4	1.7	160
17060104	4.6	12	16	1.3	3.2	4.5	0.6	2.2	0.8	0.9	4.5	280
17060105	0	4.9	4.9	0	1.2	1.2	0.1	0.9	0	0.2	1.2	240
Total	6.7	26	33	1.7	6.0	7.6	0.9	4.5	0.8	1.5	7.6	230

Domestic water use by hydrologic unit, in Northeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

	Self Supplied					Public supplied			Total	
		Water withdrawals, in Mgal/d								
Hydrologic unit	Population, in thousands	Ground water	Surface water	Total	Per capita use, in gal/d	Population served, in thousands	Deliveries from public supply, in Mgal/d	Per capita use, in gal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17050201	1.8	0.2	0	0.3	150	0.4	0.1	320	0.4	0.2
17050202	0.9	0.1	0	0.1	150	0.5	0.1	170	0.2	0.1
17050203	2.7	0.3	0.1	0.4	150	11	1.5	150	1.9	0.5
17060102	0.8	0.1	0	0.1	150	0	0	0	0.1	0.1
17060104	5.9	0.7	0.2	0.9	150	17	2.5	150	3.4	1.0
17060105	1.6	0.2	0.1	0.2	150	4.2	1.1	270	1.4	0.3
17060106	0.4	0.1	0	0.1	150	0	0	0	0.1	0
Total	14	1.7	0.4	2.1	150	32	5.4	170	7.5	2.1

Domestic water use by hydrologic unit, in Northeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; gal/d, gallons per day]

	Self Supplied					Public supplied			Total	
		Water withdrawals, in Mgal/d								
Hydrologic unit	Population, in thousands	Ground water	Surface water	Total	Per capita use, in gal/d	Population served, in thousands	Deliveries from public supply, in Mgal/d	Per capita use, in gal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17050201	1.8	0.2	0.1	0.3	150	0.4	0.1	300	0.4	0.2
17050202	0.9	0.1	0	0.1	150	0.6	0.1	160	0.2	0.1
17050203	2.7	0.3	0.1	0.4	150	11	1.2	110	1.6	0.4
17060102	0.8	0.1	0	0.1	150	0	0	0	0.1	0.1
17060104	7.2	1.0	0.1	1.1	150	16	2.2	140	3.3	1.0
17060105	1.3	0.2	0	0.2	150	4.9	0.9	170	1.1	0.3
17060106	0.4	0.1	0	0.1	150	0	0	0	0.1	0
Total	15	2.0	0.3	2.3	150	33	4.5	140	6.7	2.0

Commercial water use by hydrologic unit, in Northeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d			Deliveries from public supply, in Mgal/d	Total	
	Ground water	Surface water	Total		Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17050201	0.1	0	0.1	0	0.1	0.1
17050203	0	0	0	0.4	0.4	0.1
17060104	0	12	12	1.0	13	0.6
17060105	0	9.4	9.4	0.2	9.6	0.1
Total	0.2	21	22	1.6	23	0.8

Commercial water use by hydrologic unit, in Northeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals in Mgal/d			Deliveries from public supply, in Mgal/d	Total	
	Ground water	Surface water	Total		Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
17050203	0	0	0	0.1	0.2	0
17060104	0	0	0	0.6	0.7	0.1
17060105	0	0	0	0.1	0.1	0
Total	0.1	0	0.1	0.9	0.9	0.2

Industrial water use by hydrologic unit, in Northeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d			Re-claimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
	Ground water	Surface water	Total				
17050203	0	0	0	0	0.4	0.4	0
17060104	0.4	0	0.4	0	0.4	0.8	0.1
17060105	0.3	0	0.3	0	0	0.3	0
Total	0.7	0	0.7	0	0.8	1.5	0.2

Industrial water use by hydrologic unit, in Northeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Self-supplied withdrawals, in Mgal/d			Re-claimed sewage in Mgal/d	Deliveries from public supply, in Mgal/d	Withdrawals and deliveries, in Mgal/d	Consumptive use, in Mgal/d
	Ground water	Surface water	Total				
17050202	0.1	0	0.1	0	0	0.1	0.1
17050203	0	0	0	0	0.1	0.1	0
17060104	0	0.3	0.3	0	0.8	1.0	0.1
17060105	0	1.5	1.5	0	0	1.5	0.1
Total	0.1	1.7	1.8	0	0.8	2.6	0.2

Mining water use by hydrologic unit, in Northeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total	
17050203	0	0.1	0.1	0
17060104	0.2	0.1	0.1	0.1
Total	0.2	0.2	0.4	0.1

Mining water use by hydrologic unit, in Northeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d			Consumptive use, in Mgal/d
	Ground water	Surface water	Total	
17050201	0	0.5	0.5	0.1
17050202	0	1.4	1.4	0.3
17050203	0	0.7	0.7	0.2
17060104	0.1	0	0.1	0.1
Total	0.1	2.5	2.6	0.7

Thermoelectric power water use by hydrologic unit, in Northeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
Total	0	0	0	0

Thermoelectric power water use by hydrologic unit, in Northeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Ground water, in Mgal/d	Surface water, in Mgal/d	Consumptive use, in Mgal/d	Power generated, in gigawatt hours
Total	0	0	0	0

Hydroelectric power water use by hydrologic unit, in Northeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
17050201	15,000	2,300
17050203	6.5	2.7
17060105	2.8	3.8
Total	15,000	2,400

Hydroelectric power water use by hydrologic unit, in Northeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day; GWh, gigawatt hours]

Hydrologic unit	Water use, in Mgal/d	Power generated, in GWh
17050201	23,000	3,600
Total	23,000	3,600

Livestock water use by hydrologic unit, in Northeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock: Withdrawals, in Mgal/d: Ground water	Stock: Withdrawals, in Mgal/d: Surface water	Stock: Withdrawals, in Mgal/d: Total	Stock: Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Animal specialties: Withdrawals, in Mgal/d: Surface water	Animal specialties: Withdrawals, in Mgal/d: Total	Animal specialties: Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Total livestock: Withdrawals, in Mgal/d: Surface water	Total livestock: Withdrawals, in Mgal/d: Total	Total livestock: Consumptive use, in Mgal/d
17050201	0	0.2	0.2	0.2	0	0	0	0	0	0.2	0.2	0.2
17050202	0	0.3	0.3	0.3	0	0	0	0	0	0.3	0.3	0.3
17050203	0.1	1.0	1.2	1.2	0	0	0	0	0.1	1.1	1.2	1.2
17060101	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17060102	0	0.1	0.1	0.1	0	0	0	0	0	0.1	0.1	0.1
17060104	0	0.3	0.3	0.3	0	0	0	0	0	0.3	0.3	0.3
17060105	0.1	0.5	0.6	0.6	0	0	0	0	0.1	0.6	0.6	0.6
Total	0.3	2.5	2.8	2.8	0	0.1	0.1	0.1	0.3	2.5	2.8	2.8

Livestock water use by hydrologic unit, in Northeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Stock: Withdrawals, in Mgal/d: Ground water	Stock: Withdrawals, in Mgal/d: Surface water	Stock: Withdrawals, in Mgal/d: Total	Stock: Consumptive use, in Mgal/d	Animal specialties: Withdrawals, in Mgal/d: Ground water	Animal specialties: Withdrawals, in Mgal/d: Surface water	Animal specialties: Withdrawals, in Mgal/d: Total	Animal specialties: Consumptive use, in Mgal/d	Total livestock: Withdrawals, in Mgal/d: Ground water	Total livestock: Withdrawals, in Mgal/d: Surface water	Total livestock: Withdrawals, in Mgal/d: Total	Total livestock: Consumptive use, in Mgal/d
17050201	0	0.2	0.2	0.2	--	--	--	--	0	0.2	0.2	0.2
17050202	0	0.2	0.2	0.2	--	--	--	--	0	0.2	0.2	0.2
17050203	0.1	1.1	1.3	1.3	--	--	--	--	0.1	1.1	1.3	1.3
17060104	0.1	0.4	0.5	0.5	--	--	--	--	0.1	0.4	0.5	0.5
17060105	0	0.7	0.7	0.7	--	--	--	--	0	0.7	0.7	0.7
17060106	0	0.2	0.2	0.2	--	--	--	--	0	0.2	0.2	0.2
Total	0.3	2.9	3.2	3.2	--	--	--	--	0.3	2.9	3.2	3.2

Irrigation water use by hydrologic unit, in Northeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Withdrawals, in Mgal/d: Fresh water: Surface	Withdrawals, in Mgal/d: Reclaimed wastewater	Withdrawals, in Mgal/d: Total	Irrigated land by irrigation type, in thousand acres: Spray	Irrigated land by irrigation type, in thousand acres: Flood	Irrigated land by irrigation type, in thousand acres: Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
17050201	1.9	82	0	84	1.4	17	19	15	33
17050202	0	130	0	130	2.2	27	29	25	49
17050203	17	410	0	430	26	86	110	78	180
17060101	0	15	0	15	3.6	2.2	5.7	1.9	7.5
17060102	0	16	0	16	3.9	2.3	6.2	2.0	8.1
17060104	8.1	77	0	85	26	11	37	8.0	49
17060105	1.2	100	0	100	24	15	39	13	51
17060106	3.1	1.8	0	4.8	1.0	0.6	1.6	0.2	2.1
Total	31	830	0.1	860	88	160	250	140	380

Irrigation water use by hydrologic unit, in Northeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Withdrawals, in Mgal/d: Fresh water: Ground	Withdrawals, in Mgal/d: Fresh water: Surface	Withdrawals, in Mgal/d: Reclaimed wastewater	Withdrawals, in Mgal/d: Total	Irrigated land by irrigation type, in thousand acres: Spray	Irrigated land by irrigation type, in thousand acres: Flood	Irrigated land by irrigation type, in thousand acres: Total	Conveyance losses, in Mgal/d	Consumptive use, in Mgal/d (fresh)
17050201	0.1	72	0.1	72	10	18	28	15	28
17050202	0	83	0	83	11	9.5	20	24	23
17050203	8.7	330	0.1	340	62	52	110	51	130
17060101	0	0.1	0	0.1	0	0	0.1	0	0
17060102	0	18	0	18	1.0	0.7	1.6	3.1	1.3
17060104	23	73	0.1	95	38	16	54	3.5	58
17060105	5.6	96	0	100	31	19	50	40	39
17060106	0	0.8	0	0.8	0.6	0.4	0.9	0.3	0.3
Total	37	670	0.2	710	150	120	270	140	280

Reservoir evaporation water use by hydrologic unit, in Northeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding]

Hydrologic unit	Amount evaporated, in thousand acre-feet	Reservoir area, in thousand acres
17050201	27	9.2
17050202	2.1	0.7
17050203	6.1	2.1
17060101	3.3	1.1
17060105	0.2	0
Total	38	13

Wastewater-treatment water releases by hydrologic unit, in Northeast Region, Oregon, 1990

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities			Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
	Public	Industrial and other	Total		
17050201	1	1	2	0.1	0
17050202	1	0	1	0	0
17050203	5	1	6	1.1	0
17060104	4	1	5	1.4	0
17060105	3	1	4	0.9	0
Total	14	4	18	3.4	0.1

Wastewater-treatment water releases by hydrologic unit, in Northeast Region, Oregon, 1985

[Individual values may not add to totals because of independent rounding; Mgal/d, million gallons per day]

Hydrologic unit	Number of facilities			Total public releases, in Mgal/d	Reclaimed waste water from public waste-water facilities
	Public	Industrial and other	Total		
17050201	2	0	2	0.1	0.1
17050202	2	0	2	0	0
17050203	5	0	5	0.9	0.1
17060104	4	0	4	1.5	0
17060105	3	0	3	1.1	0
Total	16	0	16	3.6	0.2

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