Domestic and Public Supply

The USGS defines public-supply water use as water withdrawn by private and public water suppliers and delivered to customers who, in turn, use the water for purposes such as **domestic**, commercial, thermoelectric power, industrial, and public water use (Solley and others, 1998). Self-supplied **domestic water use** is water used for drinking, bathing, food preparation, washing clothes and dishes, flushing toilets, and watering lawns and gardens that is not obtained from a public-supply facility (Solley and others, 1998). Domestic consumptive use occurs primarily during outdoor watering of lawns and gardens, sidewalk and car washing, filling and maintaining pools, and to a lesser extent, during indoor cooking, cleaning, showering, and clothes washing (Marilee Horn, U.S. Geological Survey, written commun. February, 2007).

Domestic and public-supply consumptive-use coefficients are grouped because references in the annotated bibliography used a variety of terms for the domestic and public-supply categories (municipal, domestic, self-supplied domestic and public supply, among others). For example, some references reported one consumptive-use coefficient for domestic use, whereas others reported two (self-supplied and publicly supplied domestic). It was not always clear whether the single coefficient was for self-supplied domestic use, publicly supplied domestic use, all public-supply use (including other categories such as industrial and commercial), or a combination of all three.

Self-supplied domestic ground-water use can include consumptive uses like swimming pools.

The ambiguity of the terms "public supply" and "municipal water use" also made it difficult to separate categories. These terms are sometimes defined as just the domestic portion of the public-supplied water use, and sometimes as all categories that public suppliers might serve: domestic, commercial, thermoelectric power, industrial, agriculture, and public water use.

A few publications in a series grouped or split the water-use or consumptive-use categories differently between editions, making compilation for this report difficult. Specifically, in 1985, the USGS changed the aggregation of the public-supply and domestic water-use categories: "consumptive use" was changed to include consumptive use from both the self-supplied domestic withdrawals and the publicly supplied domestic deliveries (Solley and others, 1998). Therefore, because of these changes, only USGS references from 1985 to the present are used in the statistical summary (table 9) for the domestic and public-supply category.

Figure 7 and table 10 were created to help readers navigate through the water-use category summary tables like table 11, which lists the domestic water-use terminology used in each reference.

Table 10. Summary-table terms and descriptions.

Reference	Description
Coefficient	Term used to identify consumptive-use coefficients that were found in references as coefficients or ratios.
CW	References that list withdrawal data and consumption data and for which a consumptive-use coefficient was computed from the equation (coefficient = (consumptive use/ water withdrawal) x 100).
RW	References that list withdrawal and return flow data for self-supplied facilities (or a group of self-supplied facilities) and for which a consumptive-use coefficient was computed from the following equation (coefficient =((water withdrawn – water returned)/ water withdrawn) x 100).
Primary source	A primary source indicates the authors of the referenced work did most of the compilation, analysis, and computation of data. Often the primary-source publication was completed in cooperation with multiple agencies, but the publication was the main product for the multiple-agency effort.
Secondary source	A secondary source is a publication that was primarily completed by some other person or organization, but the data or consumptive-use coefficient was used to discuss or estimate consumptive use for the current report.
Unknown source	An unknown source indicates that the source of the coefficient or data was not described in the reference.
Clim Sim	Refers to Connecticut, Delaware, Iowa, Kentucky, Maine, Maryland, Massachusetts, Missouri, New Hampshire, New Jersey, Rhode Island, Tennessee, Vermont, Virginia, West Virginia, or other study areas climatically similar to the Great Lakes Basin.
Great Lakes	Refers to states, jurisdictions, or study areas that are fully or partly in the Great Lakes Basin.
Other	Refers to references that do not discuss the Great Lakes Basin or climatically similar areas: often used for world or large-country coefficients.

Table 11. Summary of domestic and public-supply consumptive-use coefficients for the Great Lakes Basin, climatically similar areas, and the world.

[See fig. 7 and table 10 for explanation of column headings. All computed numbers are rounded to the whole number, and reported numbers are as listed in reference.]

Reference	Water-use term	Geographic area	Single coefficient	Median coefficient	N	Statistics area	Used in statistics	Coefficient or other	Data source
Barlow, 2003[1]	Domestic use	Rhode Island, Massachusetts	15		1	Clim sim	Yes	Coefficient	Secondary
Brill and others, 1977	Municipal water consumption	Illinois, Indiana, Kentucky, and Ohio	20		-	Clim sim	No	Coefficient	Primary
College of Exploration, [n.d.]	Domestic	World	17		-	Other	No	CW	Unknown
Cosgrove and Rijsberman, 2000	Municipal water use	World							
1900			25		-	Other	No	CW	Secondary
1950			17		-	Other	No	CW	Secondary
1995			14		-	Other	No	CW	Secondary
Delaware River Basin Commission, [n.d]	Public water-supply facilities	Delaware River Basin (Pennsylvania, Delaware, New Jersey)	10		1	Clim sim	Yes	Coefficient	Primary
Endreny, 2005	Domestic	New York	5		1	Great Lakes	Yes	CW	Secondary
European Environment Agency, 2005	Domestic	Europe	20		-	Other	No	Coefficient	Primary
Great Lakes Commission, 2005a	Self-supply domestic	Great Lakes Basin		11	50	Great Lakes	Yes	CW	Secondary
	Public supply			10	45	Great Lakes	Yes	CW	Secondary
Government of Canada and the U.S. Environmental Protection Agency, 1995	Municipal	Great Lakes:							
		Canada, Lake Superior	25		1	Great Lakes	Yes	CW	Secondary
		Canada, Lake Huron	17		1	Great Lakes	Yes	CW	Secondary
		Canada, Lake Erie	16		1	Great Lakes	Yes	CW	Secondary
		Canada, Lake Ontario	15		1	Great Lakes	Yes	CW	Secondary
		United States, L. Superior	14		1	Great Lakes	Yes	CW	Secondary
		United States, L. Michigan	6		1	Great Lakes	Yes	CW	Secondary
		United States, L. Huron	55		1	Great Lakes	Yes	CW	Secondary
		United States, L. Erie	10		1	Great Lakes	Yes	CW	Secondary
		United States, L. Ontario	18		1	Great Lakes	Yes	CW	Secondary
Horn and others, 1994	Domestic	Rhode Island	15		1	Clim sim	Yes	Coefficient	Secondary
Horn, 2000	Domestic	Massachusetts	15		1	Clim sim	Yes	Coefficient	Primary
Hutson, 1998	Domestic	Tennessee	10		1	Clim sim	Yes	CW	Primary
Hutson and others, 2004b	Public supply	Tennessee	43		1	Clim sim	Yes	RW	Primary
International Great Lakes Diversions and Consumptive Use Study Board, 1981a, b[2]	Municipal water consumption		20		1	Great Lakes	Yes	Coefficient	Primary
	Rural residential		60		1	Great Lakes	Yes	Coefficient	Primary
Kay, 2002[z]	Rural domestic	By state:							
		Kentucky	10-15		-	Clim sim	No	CW	Secondary
		Indiana	10-15		-	Great Lakes	No	CW	Secondary
		Michigan	10-15		-	Great Lakes	No	CW	Secondary
		Iowa	40		-	Clim sim	No	CW	Secondary
		Missouri	25		-	Clim sim	No	CW	Secondary
		Illinois	10		-	Great Lakes	No	CW	Secondary
		Wisconsin	20		-	Great Lakes	No	CW	Secondary
LaTour, 1991[4]	Domestic	Illinois	6		-	Great Lakes	No	Coefficient	Primary
Loper and others, 1989	Public supply	Pennsylvania	10		1	Great Lakes	Yes	Coefficient	Secondary
	Self-supplied domestic use		10		1	Great Lakes	Yes	Coefficient	Secondary
Ludlow and Gast, 2000	Public supply	Pennsylvania	37		1	Great Lakes	Yes	CW	Primary
	Domestic		10		1	Great Lakes	Yes	CW	Primary
Marcuello and Lallana, 2003[5]	Urban use	Europe	20		-	Other	No	Coefficient	Secondary

Table 11. Summary of domestic and public-supply consumptive-use coefficients for the Great Lakes Basin, climatically similar areas, and the world. —Continued

[See fig. 7 and table 10 for explanation of column headings. All computed numbers are rounded to the whole number, and reported numbers are as listed in reference.]

Reference	Water-use term	Geographic area	Single coefficient	Median coefficient	N	Statistics area	Used in statistics	Coefficient or other	Data source
Medalie, 1996	Domestic use	New England	14		1	Clim sim	Yes	Coefficient	Secondary
Mullaney, 2004	Public supply	Connecticut, New York	20		1	Clim sim	Yes	Coefficient	Primary
Nawyn, 1997[6]	By category	New Jersey							
By category:									
Public-supply deliveries									
Domestic			18		1	Clim sim	Yes	Coefficient	Secondary
Commercial			4		-	Clim sim	No	Coefficient	Secondary
Industrial			8		-	Clim sim	No	Coefficient	Secondary
Public water use			20		-	Clim sim	No	Coefficient	Secondary
Self-supply withdrawals									
Domestic			20		1	Clim sim	Yes	Coefficient	Secondary
Nimiroski and Wild, 2005	Domestic, publicly supplied	Rhode Island	15		1	Clim sim	Yes	Coefficient	Secondary
	Domestic, self-supplied		15		1	Clim sim	Yes	Coefficient	Secondary
Ohlsson, 1997	Domestic	World	17		-	other	No	Coefficient	Secondary
Paulson and others, 1988	Domestic	United States	19.5		-	other	No	Coefficient	Secondary
Pebbles, 2003b	Self-supply	By state and province:							
Self-supply domestic	domestic	Illinois	10-15[7]		1	Great Lakes	Yes	Coefficient	Secondary
		Indiana	15		1	Great Lakes	Yes	Coefficient	Secondary
		Michigan	10-15[7]		1	Great Lakes	Yes	Coefficient	Secondary
		Minnesota	10-15[7]		1	Great Lakes	Yes	Coefficient	Secondary
		New York	10		1	Great Lakes	Yes	Coefficient	Secondary
		Ohio	10-15[7]		1	Great Lakes	Yes	Coefficient	Secondary
		Ontario	15		1	Great Lakes	Yes	Coefficient	Secondary
		Pennsylvania	10		1	Great Lakes	Yes	Coefficient	Secondary
		Quebec	10-15[7]		1	Great Lakes	Yes	Coefficient	Secondary
		Wisconsin	10-15[7]		1	Great Lakes	Yes	Coefficient	Secondary
Public supply	Public supply								
		Illinois	10-15[7]		1	Great Lakes	Yes	Coefficient	Secondary
		Indiana	15		1	Great Lakes	Yes	Coefficient	Secondary
		Michigan	10-15[7]		1	Great Lakes	Yes	Coefficient	Secondary
		Minnesota	10-15[7]		1	Great Lakes	Yes	Coefficient	Secondary
		New York	10		1	Great Lakes	Yes	Coefficient	Secondary
		Ohio	10-15[7]		1	Great Lakes	Yes	Coefficient	Secondary
		Ontario	15		1	Great Lakes	Yes	Coefficient	Secondary
		Pennsylvania	10		1	Great Lakes	Yes	Coefficient	Secondary
		Quebec	10-15[7]		1	Great Lakes	Yes	Coefficient	Secondary
		Wisconsin	10-15[7]		1	Great Lakes	Yes	Coefficient	Secondary
Pennsylvania Department of Environmental Resources, 1975-83	Municipal	Pennsylvania	10		-	Great Lakes	No	Coefficient	Primary
Postel, 1996	Municipalities	World	17		-	Other	No	CW	Secondary
Postel and others, 1996	Municipalities	World	17		-	Other	No	CW	Primary
Shiklomanov and Rodda, 2003	Domestic	Europe	12		-	Other	No	CW	Primary
		World, 1995	19		-	Other	No	CW	Primary
		World, 1900 - 1995	22		-	Other	No	CW	Secondary
Sholar and Lee, 1988	Domestic	Kentucky	26		1	Clim sim	Yes	CW	Primary
		Kentucky River Basin	38		-	Clim sim	No	CW	Primary
Sholar and Wood, 1995	Domestic	Kentucky	18		1	Clim sim	Yes	CW	Primary
Snavely, 1987	Domestic use	Great Lakes	26		1	Great Lakes	Yes	Coefficient	Secondary

Table 11. Summary of domestic and public-supply consumptive-use coefficients for the Great Lakes Basin, climatically similar areas, and the world. —Continued

[See fig. 7 and table 10 for explanation of column headings. All computed numbers are rounded to the whole number, and reported numbers are as listed in reference.]

Reference	Water-use term	Geographic area	Single coefficient	Median coefficient	N	Statistics area	Used in statistics	Coefficient or other	Data source
Snavely, 1988[8]: Domestic	Domestic	Great Lakes							
		1975 Study Board	60		-	Great Lakes	No	CW	Secondary
		1975 USGS	21		-	Great Lakes	No	CW	Secondary
		1980 Study Board	64		-	Great Lakes	No	CW	Secondary
		1980 USGS	27		-	Great Lakes	No	CW	Secondary
		1985 Study Board	62		1	Great Lakes	Yes	CW	Secondary
		1985 USGS	74		1	Great Lakes	Yes	CW	Secondary
Public supply	Public supply								
		1975 Study Board	11		-	Great Lakes	No	CW	Secondary
		1975 USGS	13		-	Great Lakes	No	CW	Secondary
		1980 Study Board	11		-	Great Lakes	No	CW	Secondary
		1980 USGS	8		-	Great Lakes	No	CW	Secondary
		1985 Study Board	11		1	Great Lakes	Yes	CW	Secondary
		1985 USGS	--		-	Great Lakes	No	CW	Secondary
Sweat and Van Til, 1988	Public supply	Michigan	10		1	Great Lakes	Yes	CW	Secondary
Tate and Harris, 1999a	Municipal	Canadian part of Great Lakes Basin	20		1	Great Lakes	Yes	Coefficient	Secondary
U.S. Department of Agriculture, 1994	Public and rural supplies	United States	17		-	Other	No	Coefficient	Secondary
U.S. Department of Agriculture, 1997	Public and rural supplies	United States	17		-	Other	No	Coefficient	Secondary
U.S. Department of Agriculture, 2003	Public and rural supplies	United States	17		-	Other	No	Coefficient	Secondary
USGS Circulars, 1988, 1993, 1998[9]:	Domestic water use (includes publicly and self-supplied)	By state:							
		Great Lakes States		14	24	Great Lakes	Yes	CW	Secondary
		Climatically similar states		15	48	Clim sim	Yes	CW	Secondary
		By basin or region:							
		Great Lake		14	-	Great Lakes	No	CW	Secondary
		Mid-Atlantic		11	-	Clim Sim	No	CW	Secondary
		New England		16	-	Clim Sim	No	CW	Secondary
		Ohio		14	-	Clim Sim	No	CW	Secondary
		Tennessee		15	-	Clim Sim	No	CW	Secondary
		Upper Mississippi		21	-	Clim sim	No	CW	Secondary
USGS and Tennessee Department of Environment and Conservation, 2003	Domestic and public losses	Tennessee	24		1	Clim sim	Yes	Coefficient	Primary
Veeger and others, 2003	Domestic	Rhode Island	15		1	Clim Sim	Yes	Coefficient	Secondary
Water Resources Council (U.S), 1978[10]	Domestic	By region or basin:							
		New England	15		-	Clim Sim	No	CW	Secondary
		Mid-Atlantic	18		-	Clim Sim	No	CW	Secondary
		Great Lakes	15		-	Great Lakes	No	CW	Secondary
		Ohio	19		-	Clim Sim	No	CW	Secondary
		Tennessee	22		-	Clim sim	No	CW	Secondary
		Upper Mississippi	19		-	Clim sim	No	CW	Secondary
	Domestic, central	New England	9		-	Clim Sim	No	CW	Secondary
		Mid-Atlantic	14		-	Clim Sim	No	CW	Secondary
		Great Lakes	10		-	Great Lakes	No	CW	Secondary
		Ohio	11		-	Clim Sim	No	CW	Secondary
		Tennessee	12		-	Clim sim	No	CW	Secondary
		Upper Mississippi	14		-	Clim sim	No	CW	Secondary
	Domestic, non-central	New England	61		-	Clim Sim	No	CW	Secondary
		Mid-Atlantic	61		-	Clim Sim	No	CW	Secondary
		Great Lakes	61		-	Great Lakes	No	CW	Secondary
		Ohio	62		-	Clim Sim	No	CW	Secondary
		Tennessee	62		-	Clim sim	No	CW	Secondary
		Upper Mississippi	61		-	Clim sim	No	CW	Secondary

Table 11. Summary of domestic and public-supply consumptive-use coefficients for the Great Lakes Basin, climatically similar areas, and the world. —Continued

[See fig. 7 and table 10 for explanation of column headings. All computed numbers are rounded to the whole number, and reported numbers are as listed in reference.]

Reference	Water-use term	Geographic area	Single coefficient	Median coefficient	N	Statistics area	Used in statistics	Coefficient or other	Data source
Wild and Nimiroski, 2004	Domestic, publicly supplied	Rhode Island, Connecticut	9		1	Clim sim	Yes	Coefficient	Secondary
	Domestic, self-supplied		21		1	Clim sim	Yes	Coefficient	Secondary
Wild and Nimiroski, 2005	Domestic, publicly supplied	Rhode Island	6		1	Clim sim	Yes	Coefficient	Secondary
	Domestic, self-supplied		46		1	Clim sim	Yes	Coefficient	Secondary
Woldorf, 1959	Rural home	Ohio	3		-	Great Lakes	No	CW	Primary

[1] The consumptive-use coefficient is noted as "New England traditional rates."

[2] Two consumptive-use coefficients were listed; however, 20 percent was used in this report for statistical analysis. The other coefficient was the sum of 15 percent plus water uses and estimated losses.

[3] Numbers were estimated from a graph and were not used in the statistical analysis. The numbers were not tabulated in the report. In Solley and others (1998), it appears that these numbers are the total domestic freshwater consumptive use and withdrawals (includes self-supplied withdrawals and public-supply deliveries).

[4] LaTour found domestic consumptive-use coefficients ranging among specific areas but overall stated that domestic consumptive uses amounted to 6 percent ± 2 percent. This range was not used in the statistical analysis.

[5] Marcuello and Lallana (2003) said that the consumptive-use coefficients were "widely accepted."

[6] Nawyn (1997) stated that "coefficients of consumptive water use that were developed in other studies were modified and applied to data on water users in Camden County."

[7] For the summary statistics, the average of the consumptive-use coefficient range was used.

[8] The USGS 1975 and 1980 domestic consumptive-use coefficients were based on self-supplied water use only, whereas the 1985 consumptive-use coefficient represented both self-supplied and publicly supplied water use.

[9] The median numbers and numbers used to calculate statistics in the statistical summary are from appendix 1.

[10] Domestic central is from the U.S. Department of Interior (U.S. Geological Survey) and Water Resources Council. Domestic non-central is from the U.S. Department of Agriculture (formerly, Soil Conservation Service; currently National Resources Conservation Service).

With the exception of Hutson and others (2004b), the domestic and public-supply consumptive-use coefficients in table 11 are either **coefficients** or computed values from consumptive use and withdrawal data (*CW*). Direct measurement of consumptive use (withdrawals – return flow (*RW*)) may not work at the public supply/wastewater-discharge level for the following reasons:

- The customer base may not be the same. (For instance, a large municipal public supplier serves 100,000 people, but the municipal wastewater facility serves 125,000; the difference of 25,000 people results from a combination of small public supply facilities and private wells.)
- Withdrawals and discharges by individual facilities may be unequal. (A city has multiple large industrial facilities that use self-supplied water, but the facilities discharge large amounts of water into the municipal wastewater system.)
- Infiltration or inflows into the sewer pipes may be misinterpreted as return flow, thus making the consumptive use of the customers seem less than it is. (Water from surface runoff or through storm drains (termed "inflow") and ground water (infiltration) can be entering the wastewater system and making the return flow appear higher than it really is. Quantifying the proportion of inflow and infiltration can be difficult.)
- **Unaccounted-for use** (public uses and conveyance losses) may be unknown.

If the customer base of the public supplier and wastewater treatment plant are the same, any imports and exports are quantifiable; therefore withdrawals, return flow, infiltration, inflow, and unaccounted for water are known, and consumptive use can be computed from the following equation:

$$\textit{Consumptive use} = (\textit{Withdrawals} + \textit{Imports} + \textit{Infiltration} + \textit{Inflow}) - (\textit{Unaccounted-for water} + \textit{Exports} + \textit{Return flow}) \quad (5)$$

During the research for this study, several references were found that discussed unaccounted-for water (conveyance losses and public uses) in public-supply systems. Unaccounted-for water is important locally and at the facility level. In order to use the complex equation above, unaccounted-for water needs to be considered. As water becomes scarce and the cost of water increases, minimizing losses becomes more important to municipalities. Information about unaccounted-for water is given in tables 12 and 13.

Table 12. References that include discussions on unaccounted-for water (conveyance losses and public uses).

Reference	Discussion
Barlow, 2003	Barlow (2003) found that losses ranged from 0.007 to 0.944 Mgal/d in Rhode Island and Massachusetts; 62 percent of the water lost was from leakage, 12 percent in fighting fires, 6.4 percent because of major waterline breaks, and the remainder for a variety of other reasons.
Environment Canada, 2004	Environment Canada (2004) found that about 20 percent of total daily municipal water use in Canada is lost in the distribution system or is unaccounted for.
European Environment Agency, 2005	The European Environment Agency (2005) stated that reducing leakage rates in water-distribution systems has the greatest potential for saving water. Water losses (through leakage) accounted for more than a third of the withdrawals in some older cities in Europe. Although some of this water recharges ground water and can be pumped and used again, in other locations the water cannot be used again because the water beneath the city is too contaminated.
Hutson, 1998	Hutson (1998) found that, for public utilities in Tennessee, about 10 percent of the withdrawals was either used for public uses (parks, fire fighting, and municipal swimming pools) or lost in conveyance.
LaTour, 1991	LaTour (1991) noted that the national median for conveyance loss was 11 percent and that for most northern Illinois cities, public-supply conveyance loss ranged from 0.5 to 40.0 percent of public-supply withdrawals. LaTour (1991) also noted that the public-supply conveyance losses are affected by the age and the size of the public-supply conveyance systems and public-supply maintenance programs. Conveyance losses were 12 percent (Rockford, Ill. area) and 17 percent (Kankakee, Ill. area).
Nawyn, 1997	Using water-use reports from public-supply facilities in New Jersey Nawyn (1997) found that unaccounted-for water was 12 percent; however, because a loss reported by one public-supply facility was unusually high and skewed the average, 10 percent was used to estimate losses for facilities that did not submit a report in New Jersey.
Sholar, 1988	For Kentucky, Sholar (1988) noted that 10 percent of the public-supply deliveries was either lost in the distribution systems or was used for public uses such as firefighting.
Sholar and Wood, 1991	For the Kentucky River Basin, Sholar and Wood (1991) found that 21 percent of water was either lost in the distribution system or used in public uses such as firefighting.

Table 13. Selected state standards for unaccounted-for water (water losses).

[Modified from Beecher (2002). Standard is in percent.]

State[1]	Agency	Standard
Indiana	Department of Environmental Management	10 to 20
Kentucky	Department of Energy, Water and Sewer Branch	15
Massachusetts	Department of Environmental Protection	15
Minnesota	Department of Natural Resources	10
Missouri	Department of Natural Resources	10
Ohio	Public Utility Commission and Environmental Protection Agency	15
Pennsylvania	Public Utility Commission	10-15
Pennsylvania	Bureau of Water and Wastewater Management	10-15
Rhode Island	Water Resources Board	10-15
West Virginia	Public Service Commission	15
Wisconsin	Public Service Commission	15 (large) 25 (small)
Delaware River Basin Commission	Delaware River Basin Commission	15

[1] Original table included many states; only Great Lakes Basins states or climatically similar states are listed above. Delaware River Basin Commission is based on facilities in New Jersey, Pennsylvania, and Virginia.

LaTour (1991) noted that public-supply conveyance systems are under pressure and water is typically lost, not gained; but when conveyance systems are not adequately pressurized (for example when water-main breaks are being repaired), they may gain water. LaTour (1991) also estimated sewer-conveyance gains (inflow and infiltration) by determining the difference between sewage-treatment returns and releases, but he stated that unrecognized releases or significant meter errors could result in erroneous estimates. The sewer-conveyance gains for the Rockford and Kankakee, Ill., areas were 35 percent of the public-supply withdrawals.

Although many references were considered **primary sources**, only a few gave details about computing consumptive-use coefficients for domestic and public-supply categories. LaTour (1991) used three methods to derive consumptive-use ratios for domestic water use:

- types of use,
- maximum lawn-watering, and
- winter base-rate methods.

Of these three methods, LaTour concluded that the winter base-rate method was a reasonable means of estimating domestic consumptive use. The winter base-rate method focuses on outdoor water use (specifically, lawn watering), which LaTour assumed to make up most of domestic consumptive use. Outdoor water use is predominantly consumptive use because of evapotranspiration (LaTour, 1991). Other outdoor domestic water uses include landscape and garden irrigation, car washing, and swimming pool filling.

The winter-base rate method involves the following steps:

- Determine the winter base rate by averaging the domestic use during November through April. (During this time, outside water use is minimal in Illinois.)
- Calculate outside domestic water by subtracting the winter base rate from the domestic use for May through October,
- Multiply the outside domestic water use by 80 percent to determine consumptive use. (LaTour assumed that 80 percent of the water applied to lawns was domestic consumptive use due to evapotranspiration and whereas the remaining 20 percent was direct return to ground water.)

Mullaney (2004) using a method similar to the winter-base rate method, estimated consumptive use (outdoor water use) by subtracting the winter water-use data from the average daily water use.

Mullaney (2004) and LaTour (1991) are two of many references listed in table 11 and further described in the annotated bibliography. The coefficients noted as used in the statistics (table 11) were statistically analyzed as shown in table 9 and figure 9. The statistics (median, 25th and 75th percentiles) for the domestic and public-supply consumptive-use coefficients were similar for the Great Lakes Basin and climatically similar areas.

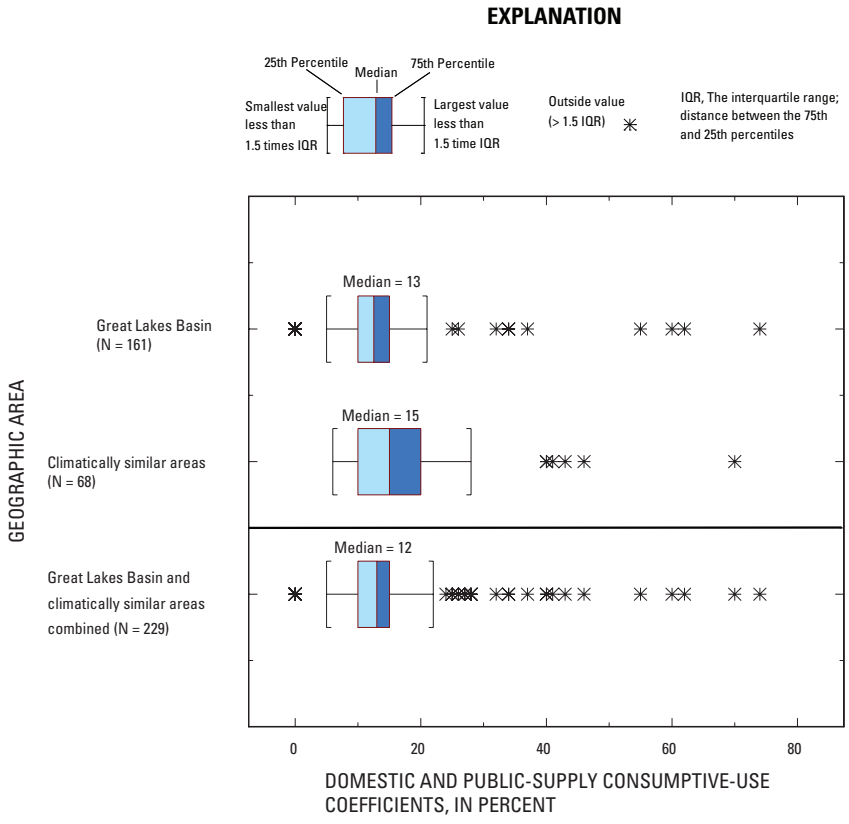


Figure 9. Distribution of domestic and public-supply consumptive-use coefficients for the Great Lakes Basin and climatically similar areas.

Table 14 lists summary statistics for references or groups of references that reported multiple domestic and public-supply coefficients from 1985 to 1995. An attempt was made in table 15 to subdivide the domestic and public-supply consumptive-use coefficients:

- Only coefficients that were used in the statistics in table 9 (noted in table 11 with "Yes" under the column heading "Used in statistics" or "N" equal to 1 (or more)) were used.
- Coefficients that used the water-use terms "rural residential," and "rural domestic" were not used.
- Any coefficients that were called "domestic-publicly supplied" were considered domestic coefficients.
- Coefficients with the water-use term "municipal" were considered "public supply."

For the domestic and public-supply consumptive-use-coefficient statistics listed in table 15, the 25th and 75th percentile were the same (10 and 15 percent), and the medians were similar (15 and 12).

Domestic consumptive-use coefficients for the Great Lakes States from two data sources are compared in figure 10. Coefficients for 1995 from Solley and others (1998) were calculated from the amount of water withdrawn and consumed for domestic use (CW) and are listed in Appendix table 1-1. Coefficients from Pebbles (2003b) were reported by state agencies for domestic and public-supply water use (often, a range was given). The coefficients from Pebbles (2003b) can be found in many other GLC documents and are listed in appendix table 3–1.

Solley and others (1998) reported data for the entire state, whereas the states included by Pebbles (2003b) reported coefficients for only the part of the state in the Great Lakes drainage basin. The range of coefficients from Solley and others (1998) was larger than that from Pebbles (2003b) but the medians were similar.

Table 14. Summary statistics of domestic and public-supply consumptive-use coefficients from Great Lakes Commission annual reports, 1998–2002 and USGS Circulars, 1988–98.

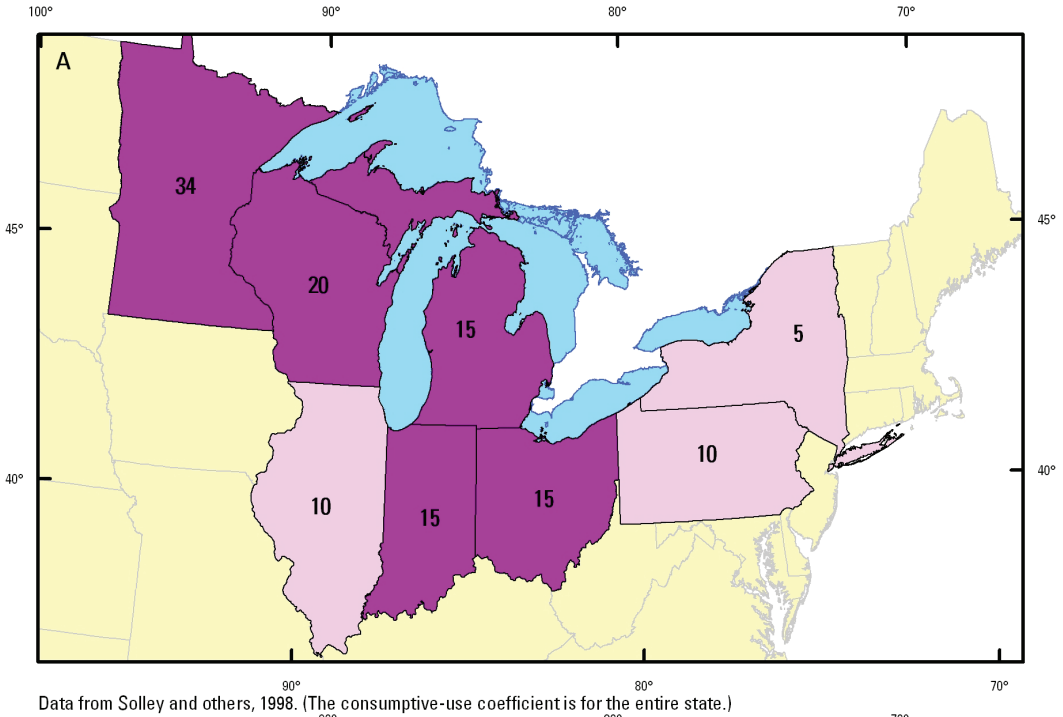
[Reference refers to the annotated-bibliography reference. The geographic area is defined by states or water-resources regions (or river basins). N is the number of coefficients used in the summary-statistics tables (tables 9 and 43) and shown in the boxplots. References with more than one coefficient are listed in the appendix. The minimum (min), 25th percentile, median, 75th percentile, and maximum (max) numbers are rounded to the nearest whole number.]

Reference	Domestic water-use term	Geographic area	N	Coefficient statistics				
				Min	25th	Median	75th	Max
Great Lakes Commission, 2005a	Public supply	Great Lakes States and Provinces	50	0	10	11	15	21
	Domestic		45	0	10	10	15	15
USGS Circulars, 1988, 1993, and 1998 Data from 1985, 1990, and 1995	Domestic water use (includes publicly supplied and self-supplied)	By state:						
		Great Lakes States	24	5	10	14	15	34
		Climatically similar states	48	10	10	15	20	70
		By river basin or region:						
		Great Lake	-	12	13	14	14	14
		Mid-Atlantic	-	9	10	11	12	13
		New England	-	14	15	16	21	26
		Ohio	-	13	14	14	14	15
		Tennessee	-	14	14	15	15	15
		Upper Mississippi	-	19	20	21	21	21

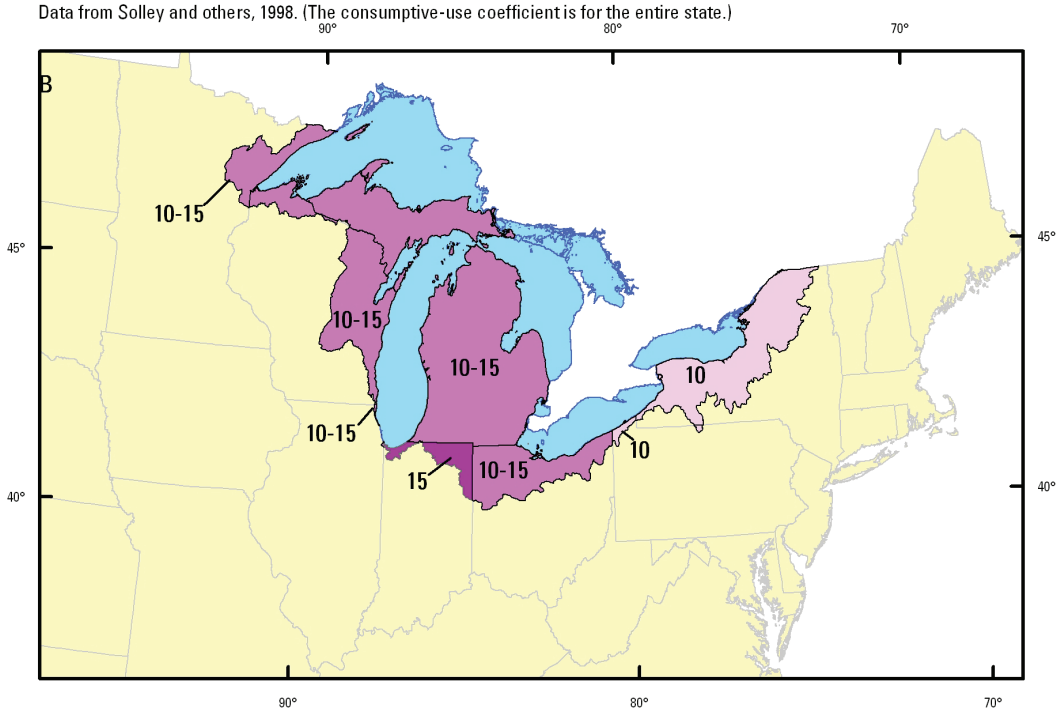
Table 15. Consumptive-use-coefficient statistics for domestic and public-supply water-use categories for the Great Lakes Basin and climatically similar areas.

[Great Lakes Basin and climatically similar references are the combination of references from these two areas. References are only from publications after 1985 (domestic and public supply) and do not include all Canada coefficients, all U.S. coefficients, or continent coefficients because they include areas that are not climatically similar to the Great Lakes Basin. Minimum (min), median, maximum (max), 25th percentile, and 75th percentile are in percent and rounded to the nearest whole number. N is the number of references used in the statistical analysis.]

Water-use category	Statistics					
	Min	25th	Median	75th	Max	N
Domestic	0	10	15	15	74	149
Public supply	0	10	12	15	55	78



Data from Solley and others, 1998. (The consumptive-use coefficient is for the entire state.)



Data from Pebbles, 2003b. (The consumptive-use coefficient is for the Great Lakes Basin part of the state.)

Map A

EXPLANATION

Consumptive-use coefficents (in percent)

- 5 - 10
- 11 - 14
- 15 - 34

Map B

EXPLANATION

Consumptive-use coefficents (in percent)

- 5-10
- 10-15
- 15

Figure 10. Domestic consumptive-use coefficients from various sources for the Great Lakes States.

Consumptive-use coefficients for the world, countries, and continents also are included in this report to serve as a basis for comparison by

- showing how comparable regional coefficients are to world and other regional coefficients,
- broadening the understanding of the coefficients (if definitions and use are similar), and
- showing whether climatic or economic factors may contribute to coefficients.

Shiklomanov and Rodda (2003) compiled domestic and public-supply consumptive-use coefficients for eight years of data between 1900 and 1995 (1900, 1940, 1950, 1960, 1970, 1980, 1990, 1995); these coefficients are listed in table 16 and grouped by continent. Units in table 16 and subsequent tables based on Shiklomanov and Rodda's work are in cubic kilometers per year, as reported in the original document. The derived consumptive-use coefficient is unitless and is comparable to coefficients derived from inch-pound units. From 1900 to 1995, the domestic and public supply consumptive-use coefficients ranged from 11 to 77 percent; in the 1995 assessment, the range was 12 to 68 percent. The maximum values (68 and 77) are listed for rural use for North America and may be describing a different type of water use than on the other continents. Rural use is self-supplied domestic use that may or may not include livestock water use. Most livestock withdrawals are considered consumed and not returned to the immediate environment. If the North America rural-use category is excluded and the public-supply category is used for North America, the range of consumptive-use coefficients is 11 to 67 percent for 1900 to 1995 and 12 to 19 for 1995 (Shiklomanov and Rodda, 2003). All the consumptive-use coefficients decreased from 1900 to 1980. Coefficients for 1990 and 1995 are very similar within a continent. The largest consumptive-use coefficients listed in table 16 are for the earliest assessments (1900), when less water was withdrawn. The water withdrawals for domestic and public supply have steadily increased over the last 95 years, but the consumptive-use coefficients have decreased. This decrease may be attributed to

- more water being returned to wastewater-treatment plants and then released, and
- more water being used (indoor plumbing, water technology is more widespread, or population increases), but consumptive use staying constant, decreasing, or increasing at a smaller rate than water use.

Additional consumptive-use coefficients for the world, continents, and major countries are listed in table 17. The domestic and public-supply water use and consumptive use for the world, continents, and major countries were examined to confirm that the definitions, "water use" and "consumptive use" were similar to those used for the Great Lakes Basin and that consumptive-use coefficients were therefore similar.

Table 18 lists water withdrawals, consumptive use, and consumptive-use coefficients by European regions for 1980, 1990 and 1995 (Shiklomanov and Rodda, 2003).

Table 16. Public-supply or domestic water withdrawals, consumptive use, and consumptive-use coefficients listed by continent, for selected years from 1900 through 1995.

[Modified from Shiklomanov and Rodda (2003). Total withdrawn and consumptive use are in cubic kilometers per year and are as listed in reference; coefficient is the percentage of water withdrawn that was consumed, computed from the total withdrawn and consumptive-use figures and rounded to the nearest whole number.]

Statistic	1900	1940	1950	1960	1970	1980	1990	1995	1900–1995
Europe (Public supply)[1]									
Total withdrawn	8.5	12.7	15.6	21.0	33.7	58.5	67.1	69.9	287
Consumptive use	1.8	2.3	2.7	3.0	4.2	7.2	8.4	8.6	38.2
Coefficient	21	18	17	14	12	12	13	12	13
Asia (Domestic)[2]									
Total withdrawn	2	6	11	20	38	65	143	160	445
Consumptive use	1	3	5	9	14	18	29	31	110
Coefficient	50	50	45	45	37	28	20	19	25
Africa (Domestic)[3]									
Total withdrawn	.3	.7	1.3	3.1	5.8	11.4	12.8	17.2	52.6
Consumptive use	.2	.3	.5	.9	1.2	1.8	1.7	2.1	8.7
Coefficient	67	43	38	29	21	16	13	12	17
North America (Public supply)[4]									
Total withdrawn	4.8	-	22.0	33.0	44.0	56.3	67.1	72.5	299.7
Consumptive use	1.0	-	4.8	5.8	9.8	12.0	9.1	10.9	53.4
Coefficient	21	-	22	18	22	21	14	15	18
North America (Rural use)[4]									
Total withdrawn	3.5	-	6.1	7.3	9.6	12.4	16.8	17.7	73.4
Consumptive use	2.7	-	4.7	5.4	7.0	8.6	11.5	12.0	51.9
Coefficient	77		77	74	73	69	68	68	71
South America (Domestic)[5]									
Total withdrawn	.25	.8	1.9	4.4	6.9	12.4	28.1	32.6	87.35
Consumptive use	.14	.4	.7	1.2	1.5	2.5	4.9	5.3	16.64
Coefficient	56	50	37	27	22	20	17	16	19
Australia and Oceania (Public supply)[6]									
Total withdrawn	.14	.33	.75	1.10	1.50	2.80	3.10	3.30	13.02
Consumptive use	.03	.08	.16	.21	.25	.30	.36	.38	1.77
Coefficient	21	24	21	19	17	11	12	12	14
Total									
Total withdrawn	19.49	20.53	58.65	89.9	139.5	218.8	338	373.2	1,258.07
Consumptive use	6.87	6.08	18.56	25.51	37.95	50.4	64.96	70.28	280.61
Coefficient	35	30	32	28	27	23	19	19	22
Total without North America (Rural use)									
Total withdrawn	15.99	20.53	52.55	82.6	129.9	206.4	321.2	355.5	1,184.67
Consumptive use	4.17	6.08	13.86	20.11	30.95	41.8	53.46	58.28	228.71
Coefficient	26	30	26	24	24	20	17	16	19

[1] Shiklomanov and Rodda (2003; p. 85, from table 4.19).

[2] Ibid., p. 135, from table 5.25.

[3] Ibid., p. 192, from table 6.18.

[4] Ibid., p. 258, from table 7.22.

[5] Ibid., p. 316, from table 8.19.

[6] Ibid., p. 346, from table 9.21.

Table 17. Domestic and public-supply consumptive-use coefficients for major countries, continents, and the world.

[Coefficient is in percent and rounded to the nearest whole number]

Reference	Geographic area	Coefficient
College of Exploration [n.d]	World	17
Cosgrove and Rijsberman, 2000	World	14
European Environment Agency, 2005	Europe	20
Marcuello and Lallana, 2003	Europe	20
Postel and others, 1996	World	17
Shiklomanov and Rodda, 2003 (1995 assessment only)[1]	World	16
	By continent:	
	Europe	12
	Asia	19
	Africa	12
	N. America (public supply)	15
	N. America (public supply and domestic)	25
	S. America	16
	Australia and Oceania	12
Solley and others, 1998[2]	United States	26

[1] The world coefficient excludes North American rural domestic. If this included, the world consumptive-use coefficient is 19 percent, and the North America consumptive-use coefficient is 25 percent instead (22.9 divided by 90.2).

[2] Includes both self-supplied domestic and publicly supplied domestic.

Table 18. Public-supply water withdrawals, consumptive use, and consumptive-use coefficients listed by European regions for selected years from 1980 through 1995.

[Modified from Shiklomanov and Rodda (2003), page 88. Total withdrawn and consumptive use are in cubic kilometers per year and are as listed in reference; coefficient is the percentage of water withdrawn that was consumed, computed from the total withdrawn and consumptive-use figures and rounded to the nearest whole number.]

Statistic	1980	1990	1995	1980–1995
Northern Europe				
Total withdrawn	2.72	2.98	3.01	8.71
Consumptive use	.22	.24	.22	.68
Coefficient	8	8	7	8
Central Europe				
Total withdrawn	21.9	25.1	26.5	73.5
Consumptive use	1.7	2.0	2.1	5.8
Coefficient	8	8	8	8
Southern Europe				
Total withdrawn	38.3	40.5	45.1	123.9
Consumptive use	3.1	2.8	2.9	8.8
Coefficient	8	7	6	7
Northern slope of European territory of former Soviet Union				
Total withdrawn	2.10	2.60	2.55	7.25
Consumptive use	.60	.60	.60	1.8
Coefficient	29	23	24	25
Southern slope of European territory of former Soviet Union				
Total withdrawn	11.8	14.7	14.7	41.2
Consumptive use	2.8	3.8	3.8	10.4
Coefficient	24	26	26	25
Total				
Total withdrawn	76.82	85.88	91.86	254.46
Consumptive use	8.42	9.44	9.62	27.48
Coefficient	11	11	10	11