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Office of Ground Water

Guidelines for Preparation of State Water-Use Estimates for 2005

Techniques and Methods Book 4, Chapter E1

U.S. Department of the Interior
U.S. Geological Survey

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Compiled by Susan S. Hutson

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Conversion Factors and Abbreviations

Multiply	By	To obtain
	Length	
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	43,560	square feet (ft^2)
acre	4,047	square meter (m^2)
acre-foot (acre-ft)	1,233	square hectometer (hm^2)
acre-foot per day (acre-ft/d)	0.3259	hectare (ha)
acre-foot per acre (acre-ft/acre)	3,047	cubic meter per hectare (m^3/ha)
	Volume	
gallon (gal)	3.785	liter (L)
gallon (gal)	0.003785	cubic meter (m^3)
gallon (gal)	3.785	cubic decimeter (dm^3)
million gallons (Mgal)	3,785	cubic meter (m^3)
cubic mile (mi^3)	4.168	cubic kilometer (km^3)
acre-foot (acre-ft)	1,233	cubic meter (m^3)
acre-foot (acre-ft)	0.001233	cubic hectometer (hm^3)
	Flow rate	
acre-foot per day (acre-ft/d)	0.01427	cubic meter per second (m^3/s)
acre-foot per year (acre-ft/yr)	1,233	cubic meter per year (m^3/yr)
acre-foot per year (acre-ft/yr)	0.001233	cubic hectometer per year (hm^3/yr)
gallon per minute (gal/min)	0.06309	liter per second (L/s)
gallon per day (gal/d)	0.003785	cubic meter per day (m^3/d)
gallon per day per square mile [(gal/d)/mi^2]	0.001461	cubic meter per day per square kilometer [(m^3/d)/km^2]
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)
million gallons per day per square mile [(Mgal/d)/mi^2]	1,461	cubic meter per day per square kilometer [(m^3/d)/km^2]
inch per hour (in/h)	0 .0254	meter per hour (m/h)
inch per year (in/yr)	25.4	millimeter per year (mm/yr)
mile per hour (mi/h)	1.609	kilometer per hour (km/h)
	Mass	
pound (lb)	453.6	gram (g)
	Energy	
gigawatt-hour (GWh)	1,000	megawatt-hour (kWh)
kilowatt-hour (kWh)	3,412	British thermal unit (Btu)
megawatt	56,920	British thermal unit per minute (Btu/min)
megawatt	1,000,000	watts

Additional abbreviations used in this report

AWUDS — Aggregated Water Use Data System

CHP—Combined Heat and Power

CWS—Community Water System

GWh—Gigawatt-hour

HUC—Hydrologic Unit Code

NAICS—North American Industrial Classification System

NPDES—National Pollutant Discharge Elimination System

NWUIP—National Water Use Information Program

QA/QC—Quality Assurance/Quality Control

SDWIS —Safe Drinking Water Information System

SIC—Standard Industrial Classification

USEPA—U.S. Environmental Protection Agency

USGS—U.S. Geological Survey

Glossary

Water-use terminology has changed in the series of water-use circulars prepared at 5-year intervals. The term *water use*, as initially used in the report for 1950, meant withdrawals of water; in the report for 1960, the term was redefined to include consumptive use of water as well as withdrawals. With the beginning of the U.S. Geological Survey National Water Use Information Program in 1978, the term was again redefined to include withdrawals plus deliveries from public suppliers. In the water-use circular for 2000, water use was defined as it was initially used in 1950 as withdrawals of water. For the 2005 circular, water use was defined as water withdrawals plus deliveries. The following terms are referenced in the text and are part of the water-use circular series.

A

aquaculture water use Water used in the production of organisms that live in water within a confined space and under controlled feeding, sanitation, and harvesting procedures, and establishments primarily engaged in hatching fish and in operating fishing preserves. See also commercial water use, fish farms, and fish hatcheries.

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.

B

blowdown The continuous or intermittent discharge, or purging, of a small amount of circulating water, such as in a boiler. Blowdown normally is expressed as a percentage of the water being circulated. Its purpose is to prevent an increase in the concentration of solids in the water because of evaporation.

C

capacity The average amount of water circulating in the cooling system of a thermoelectric power plant, usually expressed in gallons per minute.

closed-loop cooling system A cooling system in which water is withdrawn, circulated through heat exchangers, then cooled and recycled. Subsequent withdrawals are used to replace water lost to evaporation, blowdown, drift, and leakage.

commercial water use Water used for motels, hotels, restaurants, office buildings, other commercial facilities, and institutions. The water may be obtained from a public supply or may be self-supplied. In previous compilations, commercial water use included water use by fish hatcheries. See also aquaculture water use, public-supply water use, and self-supplied water.

consumptive use The 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. Also referred to as water consumed.

conveyance loss Water that is lost because of leakage or evaporation while in transit through a pipe, canal, conduit, or ditch. Leakage from an irrigation ditch may percolate to a ground-water source and be available for further use.

cooling system Equipment that is used for cooling purposes, such as condensers at power plants or factories. Includes water intakes and outlets, cooling towers, and cooling ponds.

cooling-system type See closed-loop cooling system and once-through cooling system.

D

deliveries Water distributed by public-water suppliers for domestic, commercial, industrial, or thermoelectric-power uses.

desalination Separation of water from salts and minerals using thermal and membrane processes. Sources of water are brackish ground water, brackish surface water, and seawater. See also freshwater and saline water.

dewatering The removal of water through draining or pumping to lower the water table for mining or agriculture.

dissolved solids A measure of the dissolved minerals and organic matter in water, usually expressed in milligrams per liter (mg/L). Water containing 1,000 mg/L or more dissolved solids is considered saline for all purposes except public supply in this report. See also desalination.

domestic deliveries Water provided to domestic users from a public supply.

domestic water use Water used for household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens. Also called residential water use. The water may be obtained from a public supply or may be self-supplied. See also public-supply water use and self-supplied water.

drift Fine water droplets blown out of a cooling tower along with exhaust air, usually expressed as a percentage of water circulated.

E

evaporation Process by which water is changed from a liquid into a vapor. See also evapotranspiration and transpiration.

evapotranspiration Water that is vaporized because of evaporation from the soil or plant transpiration. See also evaporation and transpiration.

F

fish farms Facilities that produce finfish or shellfish under controlled feeding, sanitation, and harvesting procedures for commercial purposes. Water use by fish farms is included in the aquaculture category. See also aquaculture water use and fish farms.

finished water Water that is filtered or treated. See also raw water and water treatment.

freshwater Water that contains less than 1,000 mg/L dissolved solids. Generally, water with more than 500 mg/L dissolved solids is undesirable for drinking and many industrial uses. See also desalination and saline water.

G

gigawatt-hour (GWh) A unit of energy equivalent to 1 thousand megawatt-hours or 1 billion watt-hours.

ground water All subsurface water, distinct from surface water. Specifically, that part of the subsurface water in the saturated zone, which is a zone where all voids are filled with water.

H

hydroelectric power water use The use of water in the generation of electricity at plants where the turbine generators are driven by falling water.

hydrologic cataloging unit An eight-digit cataloging unit that identifies a geographic area representing part or all of a surface drainage basin, a combination of basins, or a distinct hydrologic feature. Sometimes known as a watershed.

I

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

instream use Water that is used within a stream channel for such purposes as hydroelectric power generation, navigation, water-quality improvement, fish propagation, and recreation. Sometimes called nonwithdrawal use or in-channel use.

irrigation district A cooperative, self-governing public corporation with definite geographic boundaries and taxing power. Its function is to obtain and distribute water for irrigation of lands within the district.

irrigation system Equipment used to distribute water to crops or other irrigated lands. Irrigation systems are grouped into the following three broad categories:

> **microirrigation** An irrigation system that wets only a discrete part of the soil surface near the plant by means of applicators operated under low pressure. The applicators can be placed on or below the surface of the ground or can be suspended from supports. Subsurface systems that control the height of the water table are included in this category.
>
> **sprinkler** An irrigation system in which water is applied by means of perforated pipes or nozzles operated under pressure to form a spray pattern.
>
> **surface** Irrigation by means of flood, furrow, or gravity. Flood irrigation is the application of irrigation water in which the entire soil surface is covered by ponded water. Furrow is a partial surface-flooding method of irrigation in which water is applied in furrows or rows of sufficient capacity to contain the design irrigation stream. Gravity is an irrigation method in which water is not pumped, but flows in ditches or pipes and is distributed by gravity.

irrigation water use Application of water on lands to assist in the growing of crops and pastures or to maintain vegetative growth on recreational lands such as parks and golf courses. Includes water applied for pre-irrigation, frost protection, chemical application, leaching salts from the root zone, and dust suppression, as well as water lost in conveyance. Also includes irrigation for cemeteries, turf farms, and other landscaped areas but does not include domestic lawns and gardens, which are included in the domestic water-use category.

K

kilowatt-hour (kWh) A unit of energy equivalent to 1,000 watt-hours.

L

livestock water use Water for livestock watering, feedlots, dairy operations, and other on-farm needs. Livestock includes cattle, sheep, goats, hogs, poultry, horses, and fur-bearing animals.

M

makeup water The water pumped into a closed-loop cooling system to replace the circulating water lost by evaporation, drift, blowdown, and leakage. Makeup water usually is expressed as a percentage of the total amount of water circulated.

mining water use Water used for the extraction of naturally occurring minerals including solids, such as coal and ores; liquids, such as crude petroleum; and gases, such as natural gas. Also includes uses associated with quarrying, well operations, milling, and other preparations customarily done at a mine site or as part of a mining activity. Mining water use does not include water used in processing, such as smelting, refining petroleum, or slurry pipeline operations, which are included in industrial water use.

N

North American Industry Classification System (NAICS) codes Three-digit codes established in 1997 by the Office of Management and Budget in cooperation with its counterparts in Canada and Mexico. NAICS are used in the classification of establishments by type of activity in which they are engaged, thus enabling comparison of industries from the three countries. NAICS replaces the Standard Industrial Classification (SIC) system. See also Standard Industrial Classification (SIC) codes.

O

offstream use Water withdrawn or diverted from a surface-water source for public-water supply, domestic, industry, irrigation, livestock, thermoelectric-power generation, and other uses. Sometimes called off-channel use or withdrawal.

once-through cooling system A cooling system in which water is withdrawn, circulated through heat exchangers, and then returned to a body of water at a higher temperature. Also referred to as an open-loop cooling system.

P

per capita water use The average amount of water used per person during a standard time period, generally per day. Per capita use may be calculated based on total water use, public-supply water use, self-supplied domestic water use, or domestic deliveries from public supply.

pre-irrigation The application of water to cropland before planting to assure adequate soil moisture for crop germination and early plant growth.

public-supply water use Water withdrawn by public and private water suppliers that furnish water to at least 25 persons or have a minimum of 15 connections. Public suppliers provide water for a variety of uses, such as domestic, commercial, industrial, thermoelectric power, and public use. See also domestic water use, industrial water use, thermoelectric-power water use, and public water use.

public water use Water provided by a public supply for such uses as firefighting, street washing, water treatment, municipal buildings, parks, and swimming pools. See also public-supply water use.

R

raw water Water that has not been filtered or treated before use. See also finished water and water treatment.

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

recycled water Water that is used more than once after withdrawal and before it returns to the natural hydrologic system. See also reclaimed water.

return flow Water that reaches a ground-water or surface-water source after it is released from the point of use, and thus becomes available for further use.

reuse Use of water that has undergone wastewater treatment and is delivered to a user as reclaimed wastewater. See also reclaimed wastewater, recycled water, and wastewater treatment.

S

saline water Water that contains 1,000 mg/L or more dissolved solids. For public supply, water that requires desalination or dilution to make it potable is considered saline. See also desalination and freshwater.

self-supplied water Water that is withdrawn directly from a ground-water or a surface-water source by a user, as opposed to water that is delivered by a public supplier.

Standard Industrial Classification (SIC) codes Four-digit codes established by the Office of Management and Budget, last revised during 1987, and used in the classification of establishments by type of activity in which they are engaged. SIC codes are being replaced by NAICS codes. See also North American Industry Classification System codes.

surface water An open body of water, such as a stream, lake, or reservoir.

T

thermoelectric-power water use Water used in the process of generating electricity with steam-driven turbine generators. The water may be obtained from a public supply or may be self-supplied. See also public-supply water use and self-supplied water.

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.

W

wastewater treatment Removal or reduction of solids, pathogens, or other undesirable constituents from wastewater. See also reclaimed water and recycled water.

water transfer Conveyance of water from one area to another using natural or human made channels.

water treatment Processes such as filtration and disinfection of water prior to delivery and use.

water-use coefficient A factor or ratio used to estimate a quantity of water used based on a related quantity. Examples of water-use coefficients include daily per capita water use, consumptive crop irrigation requirements, livestock water requirements, per employee water use, and per unit of product water use.

withdrawal The removal of ground water or surface water from the natural hydrologic system for uses including public supply, commercial, domestic, industry, irrigation, mining, livestock, aquaculture, and thermoelectric-power generation. See also offstream use.

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Compiled by Susan S. Hutson

Abstract

The U.S. Geological Survey (USGS) has estimated the use of water in the United States at 5-year intervals since 1950. This report describes the water-use categories and data elements required for the 2005 national water-use compilation conducted as part of the USGS National Water Use Information Program. The report identifies sources of water-use information, provides standard methods and techniques for estimating water use at the county level, and outlines steps for preparing documentation for the United States, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands.

As part of this USGS program to document water use on a national scale for the year 2005, estimates of water withdrawals for the categories of public supply, self-supplied domestic, industrial, irrigation, and thermoelectric power at the county level are prepared for each State using the guidelines in this report. Estimates of water withdrawals for aquaculture, livestock, and mining are prepared for each State using a county-based national model, although study chiefs in each State have the option of producing independent county estimates of water withdrawals for these categories. Estimates of deliveries of water from public supplies for domestic use by county also will be prepared for each State for 2005. As a result, domestic water use can be determined for each State by combining self-supplied domestic withdrawals and publicly supplied domestic deliveries. Fresh ground-water and surface-water estimates will be prepared for all categories of use; and saline ground-water and surface-water estimates by county will be prepared for the categories of public supply, industrial, and thermoelectric power. Power production for thermoelectric power will be compiled for 2005. If data are available, reclaimed wastewater use will be compiled for the industrial and irrigation categories.

Optional water-use categories are commercial, hydroelectric power, and wastewater treatment. Optional data elements are public-supply deliveries to commercial, industrial, and thermoelectric-power users; consumptive use; irrigation conveyance loss; and number of facilities. Aggregation of water-use data by eight-digit hydrologic cataloging unit and by principal aquifer also is optional.

Water-use data compiled by the States will be stored in the USGS Aggregate Water-Use Data System (AWUDS). This database is a comprehensive aggregated database designed to store both mandatory and optional data elements. AWUDS contains several routines that can be used for quality assurance and quality control of the data, and produces tables of water-use data compiled for 1985, 1990, 1995, and 2000.

Introduction

The U.S. Geological Survey (USGS) has compiled and published estimates of water use for the Nation at 5-year intervals since 1950. During 1977, Congress provided funding for the USGS to establish the National Water Use Information Program (NWUIP), which is a cooperative effort with States to collect reliable and uniform water-use information. USGS circulars entitled Estimated Use of Water in the United States present data collected for each State in the United States, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands (MacKichan, 1951, 1957; MacKichan and Kammerer, 1961; Murray, 1968; Murray and Reeves, 1972, 1977; Solley and others 1983, 1988, 1993, 1998; and Hutson and others, 2004).

Estimates of fresh ground-water and surface-water withdrawals by county are mandatory for the categories of public-supply, self-supplied domestic, industrial, irrigation, and thermoelectric power. Estimates of saline ground-water and surface-water withdrawals by county are mandatory for the categories of public supply, industrial, and thermoelectric power. Estimates of reclaimed wastewater use by county are mandatory for the irrigation and industrial categories, but null values are allowed if there is an uncertainty about the use of reclaimed wastewater in the county. County estimates for each State for these categories will be prepared for each State using a county-based national model, although study chiefs in each State have the option of producing independent county estimates of water withdrawals for these categories (John Lovelace, U.S. Geological Survey, written commun., 2005). Guidelines for estimating aquaculture, livestock, and mining water use can be accessed at *http://pubs.usgs.gov/tm/2005/tm4A4/*. Aggregating ground-

water or surface-water withdrawals by eight-digit hydrologic cataloging unit is optional for all categories (Kenny, 2004). Aggregating ground-water withdrawals by principal aquifers (U.S. Geological Survey, 2003) also is optional. Estimating ground-water and surface-water withdrawals for the aquaculture, livestock, and mining categories is mandatory for all States. Commercial, hydroelectric-power, and wastewater-treatment categories are optional for all States. This report describes guidelines for estimating data for the mandatory categories of public supply, self-supplied domestic, industrial, irrigation, and thermoelectric power.

In some States, governmental agencies, universities, or private organizations collect water-use information for some categories. For other categories, water-use information is collected from multiple sources or estimated using coefficients and ancillary data. Water-use study chiefs in each USGS Water Science Center are familiar with the availability and reliability of information in their own State and work with their cooperators to produce reliable estimates of water use. This information may be electronically stored in databases developed by an individual State or by the USGS.

The Aggregate Water-Use Data System (AWUDS) is a USGS database that is specifically designed to store and manipulate the aggregate water-use information compiled for the 5-year reports. AWUDS also is capable of storing annual aggregate water-use data compiled for the interval years between national compilations.

Purpose and Scope

The purpose of this report is to provide guidelines for preparation of State water-use estimates. Water-use categories, data elements, aggregation levels, and documentation requirements are defined for the 2005 national water-use compilation. This information is useful both to those who prepare the estimates and to those who use the data.

The scope of the 2005 compilation has been modified from the 2000 compilation. The focus remains on preparing estimates of water withdrawals for the categories of public supply, self-supplied domestic, industrial, irrigation, and thermoelectric power in each State with the addition of domestic deliveries from public supply, thermoelectric-power generation, and reclaimed wastewater use for the industrial and irrigation categories. Combined, public-supply domestic delivery and self-supplied domestic withdrawal data determine total domestic use. Combined, power-generation data and thermoelectric-power withdrawals provide a range of power-production coefficients for use in evaluating the quality of the data. Reclaimed wastewater data gage the scale of use of this secondary water source, and this information may be especially valuable in areas of constrained water availability.

The following estimates are optional for the 2005 compilation.

- Water withdrawals for commercial use
- Instream use, offstream withdrawals, and associated power production for hydroelectric power
- Wastewater-treatment water releases
- Reclaimed wastewater use for commercial, thermoelectric-power, and wastewater-treatment purposes
- Public-supply population served by source of supply
- Consumptive use
- Irrigation conveyance loss
- Deliveries from public-water suppliers to commercial, industrial, thermoelectric-power users
- Number of facilities

Nevertheless, estimates for these categories may be compiled and stored in the AWUDS database as can the optional data aggregated by eight-digit hydrologic cataloging unit (described by Seaber and others, 1987) and principal aquifer (as described by Maupin and Barber, 2005).

The USGS NWUIP, with support from the USGS Office of Ground Water, prepared the guidelines. The document is designed to complement the national water-use workshop that was held November 2005. The methods presented are general in nature and are not intended to replace more specific or detailed methodologies that may be used by some water-use study chiefs. Required documentation of the methodology used by each study chief is part of scientific protocol and is especially important for this study because data availability and reliability vary from State to State. Each USGS Water Science Center maintains documentation as a reference for current data and as a starting point for continued data collection.

Acknowledgments

This report was compiled from material developed over time by personnel from the USGS NWUIP and USGS Water Science Centers. Contributors to this text include Nancy L. Barber, Susan S. Hutson, Joan F. Kenny, Kristin S. Linsey, Deborah S. Lumia, and Molly A. Maupin.

Water-Use Compilation Requirements for 2005

Minimum requirements for the 2005 national compilation are designed to produce a more cost-effective product that meets the scientific priorities of the USGS and NWUIP. The modified national data model is not intended to limit any efforts to meet the needs of local programs and cooperators. Required and optional water-use categories and the associated data elements are summarized on the Coding Forms in the Supplemental Information section at the back of this report.

Water-Use Categories and Data Elements

For 2005, water-use data are required by county and are optional for eight-digit hydrologic cataloging unit and principal aquifer. Fresh ground-water and surface-water estimates will be prepared for the categories of public supply, self-supplied domestic, industrial, irrigation, and thermoelectric power. Saline ground-water and surface-water estimates will be prepared for the categories of public supply, industrial, and thermoelectric power (once-through and closed-loop cooling systems). Irrigation may be reported either as total or as subcategories of crop and golf course irrigation. The choice of reporting a total or subcategories must be consistent for all counties in the State. Reclaimed wastewater use is a required data element for the industrial and irrigation categories. Zeros should be reported for counties where the delivery of reclaimed wastewater does not occur, but null values can be stored in AWUDS for counties where there is an uncertainty about the use of reclaimed wastewater. Compiling domestic deliveries from public supply and power generated by thermoelectric power plants by cooling type is required. Aquaculture (freshwater by source), livestock (freshwater by source), and mining (freshwater and saline water by source) are mandatory categories. Estimates of water withdrawals for these categories will be provided to the study chief for each county in the State by NWUIP. However, a study chief may decide not to use the nationally generated numbers but, instead, use independently estimated values for water withdrawals for the three categories.

Compiling total population served by public-water suppliers is required for each county. Once county population estimates are available from the U.S. Census Bureau, NWUIP will provide the data set to the study chief in a format that can be readily input into AWUDS. County self-supplied domestic-population in AWUDS is calculated automatically as the county population minus the county population served by public supply.

Optional categories and data elements also are summarized in the coding forms in the Supplemental Information section at the back of this report. Data for these categories may be compiled and stored in the AWUDS database. Guidance for compiling data for the optional categories and data elements is available from the guidelines for 1995 (E. James Crompton and Wayne B. Solley, U.S. Geological Survey, written commun., March 27, 1995) and 2000 (Kenny, 2004). Population served by ground water and surface water; commercial, hydroelectric-power, and wastewater-treatment categories of use; deliveries from public suppliers for commercial, industrial, and thermoelectric-power purposes; consumptive use for commercial, self-supplied domestic, industrial, thermoelectric power (once-through and closed loop cooling systems), mining, livestock, irrigation (crop and golf course), and aquaculture categories of use; and irrigation conveyance loss are optional data elements. Compiling power production data for hydroelectric power; number of facilities for public supply, industrial, thermoelectric power, hydroelectric power, and wastewater treatment; and reclaimed-wastewater use for the commercial, public supply, mining, thermoelectric power (once-through and closed-loop cooling systems), and wastewater-treatment categories of use are optional.

Units of Measurement

Water withdrawals are stored in AWUDS in million gallons per day. Population is stored in units of thousands of persons. Acres irrigated are stored in units of thousand acres. Power production is stored in units of gigawatt-hours, which is equivalent to 1 thousand megawatt-hours or 1 billion watt-hours. All values are stored with two places after the decimal point. A value of zero usage for a data element indicates either no usage or usage of less than 0.01 Mgal/d. A null value for reclaimed wastewater use indicates uncertainty as to the presence of the water-use activity in the county.

Aggregation Levels

Water withdrawals for the public-supply, irrigation, industrial, thermoelectric power, mining, livestock, and aquaculture categories will be compiled by county for each State. For this compilation, the District of Columbia, Puerto Rico, and the Virgin Islands are treated as States, and Alaska boroughs, Louisiana parishes, and Virginia independent cities are treated as counties. Refer to "Guidelines for Preparation of State Water-Use Estimates for 2000" at *http://pubs.usgs.gov/tm/2005/tm4A4/* for guidance for aggregating water use by principal aquifer.

Aggregate Water-Use Data System Database

Water-use study chiefs are required to enter aggregate data by county for mandatory water-use categories into AWUDS except self-supplied domestic population, which will be calculated internally and then stored by AWUDS. Since 1980, the USGS has electronically stored aggregate water-use data. The AWUDS database was created during 1985 to store data aggregated by county or hydrologic cataloging unit. AWUDS was redesigned for 2000 and released as a personal computer-based system installed in each USGS Water Science Center and allowed for the storage of selected data by principal aquifer. AWUDS was updated for the 2005 compilation to accommodate the updated compilation requirements. AWUDS also is able to store the optional data elements by county, including selected ground-water categories by principal aquifer, and all the data elements by eight-digit hydrologic cataloging unit.

In addition to meeting the storage requirements for the compilation every 5 years, AWUDS also can store water-use data for any other year. Within AWUDS, data are entered and edited interactively or imported from external files. AWUDS can generate tables by category of use or by county, eight-digit hydrologic cataloging unit, or principal aquifer. Summary

tables show entered data elements or provide calculated values for categories. Quality-assurance and quality-control (QA/QC) programs within AWUDS include checks for erroneous values, comparison of totals by area, and comparison of data between 2 years.

Documentation

Documentation of data sources and methodology is required as part of the 2005 compilation. Documentation corroborates the data that will be published in the USGS water-use circular and provides a guideline for subsequent compilations. The water-use study chief determines the format for each State's documentation. All documentation must include the following elements.

- Sources of data and coefficients used
- Agency and contact information
- Methods, techniques, and coefficients used to collect or estimate data
- Location and types of data files
- Explanation of significant changes from the 2000 water-use data
- Results of QA/QC on acquired or estimated data

If the 2005 water-use estimates of values for the data elements differ substantially from those reported during 2000, possible explanations for these differences should be included in the documentation. For example, a major nuclear-fueled power plant may have started operation, several pulp and paper industries may have closed, or irrigation may have been encouraged or limited in an area of the State. Any information that can add to the understanding of water use in the State should be included in the documentation.

Water-use study chiefs will transmit completed documentation in electronic form to the respective USGS regional water-use specialist. A standardized naming convention for the documentation file includes the ZIP code and the date. For example, for Alabama, the name of the documentation file will be "ALdoc*yymmdd*."

Compilation Methods

The compilation of water-use data for 2005 should begin with the review of the documentation, if available, from the previous compilations. Although the format of the documentation has changed with time, the documentation should provide the water-use study chief with a starting point for developing an approach and a time-task plan. The previous documentation should contain the location and types of electronic and paper water-use files; agency and contact information; sources of data; and methods, techniques, and coefficients used to collect or estimate data. Several methods are described in each section of the guidelines. If needed, study chiefs are encouraged to investigate other methods outside of those suggested.

General Methodologies and Techniques

The availability of data, the year of the most recent data, and the completeness of the data can vary among States and among the counties within a State. Accessing the data for estimating water use can be as uncomplicated as asking agencies or organizations for the data reported to them or as involved as designing a survey to collect the data. When data are not readily available, for some categories, water-use data can be collected by either an inventory of all sites or a partial inventory of the water-use sites using several sampling techniques. Site-specific water-use data more commonly are available for public-supply, industrial, and thermoelectric-power facilities and less commonly available for self-supplied domestic, irrigation, aquaculture, livestock, and mining water-use sites. When site-specific data are not available, water-use estimates may be determined using ancillary data and a water-use coefficient.

An inventory accounts for all of the individual sites and ancillary data in contrast to a partial inventory that queries selected water-use sites using several sampling criteria. Once an inventory has been developed, some or all of the users can be surveyed to determine water usage. Federal agencies cannot distribute surveys without meeting the requirements of the Paper Reduction Act of 1995 (U.S. Congress, 1995). Generally, the guidelines for developing a survey are as listed.

- Identify agencies with the authority or legal mandate to collect the data;
- Identify the type of facilities information needed;
- Identify the agency and organization sources of facility information for the category of use;
- Construct a master list of facilities;
- Decide on a sampling approach if not all users are to be surveyed;
- Create a survey form that is short and easy for the user to complete;
- Write a concise description of the requested data;
- Provide a contact name and phone number for which to direct questions;
- Provide a desired completion date;
- Include a statement of confidentiality;
- Identify an agency or organization to cooperate in distributing the surveys; the entity may be different from the agency with the authority and legal mandate to collect the data;

- Send survey forms by mail, fax, or e-mail; or conduct the survey by phone;
- Develop a tracking process for receiving and managing the returned survey forms; and
- Implement a follow-up procedure for contacting facilities that do not respond by the requested time.

A detailed discussion of methodology specific to each category occurs in the category sections.

To produce the most complete and defensible data for each State, the greatest effort and time are spent collecting information about the largest users and the largest categories of use in individual States. Compilation of accurate data for the largest public suppliers, industries, agricultural regions, and power plants produces State totals that are fairly reliable. As time and resources permit, data on smaller-volume water users also should be collected within each category.

Without site-specific data, water use often is estimated using a coefficient that represents a unit-use water requirement and number of units such as population served, number of employees, acres of cropland, or number of golf courses or golf holes. Some water-use coefficients already have been developed and are part of the technical literature or administrative and legislative documents for a State. If water-use coefficients are not available or perhaps no longer suitable, coefficients can be developed from a representative sample of typical users that are more pertinent to a specific facility, county, or State. The source of the coefficients, the source of the ancillary data, and the date they were accessed should be documented.

A glossary of terms in the front of this report provides definitions of the mandatory data elements to be collected as part of the 2005 compilation. Some general hydrologic and water-use concepts also are included.

Internet Resources

Numerous agencies and organizations are listed in this report as possible sources of information for compiling water-related data for the several categories of use. Many of these agencies and organizations maintain information and databases on the Internet. Specific Internet addresses are listed in this report as they appeared on the date last accessed.

Quality Assurance and Quality Control

Errors can occur in both the compiled and entered data. QA/QC are scientific protocols implemented to ensure the quality of the water-use estimate. By definition, quality assurance is the program for the systematic monitoring and evaluation of the several aspects of a project to ensure that standards of quality are being met. Quality control is an aggregate of activities designed to ensure adequate data quality. AWUDS provides a system of QA/QC procedures to check for errors. The following basic checks can be made during data compilation and after AWUDS data entry.

- Use AWUDS quality-assurance programs to check for erroneous data and to compare State totals with principal aquifer or hydrologic unit totals by category.
- Review spatial distribution of data using choropleth or other types of geographic information system (GIS) maps.
- Compare 2005 data with those from the previous compilations years. Examine changes based on percentage change, statistical analysis, or general geographic patterns of use within a State.
- Use sorting routines to check for possible errors in largest and smallest water withdrawals.
- Examine calculated values such as per capita use and irrigation application rates.
- Check county and State data for population served to ensure that they do not exceed total census populations.

Much of the data that will be used in the compilation will be received from other entities. A preliminary QA/QC should be performed, if possible, before the data are integrated into the USGS analysis and database. The QA/QC should document the level of completeness, degree of accuracy, and amount of QA/QC given to the data by the entities from whom the data were received. The QA/QC should determine whether the data are based on a census enumeration or are statistically derived data, like the National Agricultural Statistics Service (NASS) data. Completeness of the data can be examined by determining, for example, if reported crop acreages include all crop acreages or just irrigated acreages; if irrigated acreages and water deliveries are reported for a management area of a particular agency, or for an entire county; or if some data are censored for privacy reasons. Additionally, any data obtained from surveys, questionnaires, or cooperator reports should be checked for reporting consistency (against former data) and consistency in reporting location over time; some site visits should be conducted, if possible; outliers in the data should be identified; and units of measurement should be verified.

Standard Industrial Classification Coding System

The Standard Industrial Classification (SIC) coding system was developed to promote the comparability of establishment data describing several facets of the U.S. economy (Office of Management and Budget, 1987). The SIC coding system was intended to cover the entire field of economic activities—agriculture, forestry, fishing, hunting, and trapping; mining; construction; manufacturing; transportation, communications, electric, gas, and sanitary services; wholesale trade; retail trade; finance, insurance, and real estate; personal, busi-

ness, professional, repair, recreation, and other services; and public administration. The SIC coding system is based on the primary activity in which the industry is engaged. The structure of the classification makes it possible to tabulate, analyze, and publish industry data based on a two-digit major group, a three-digit industry group, or a four-digit industry code.

The USGS has assigned each four-digit industry code in the 1987 SIC manual (Office of Management and Budget, 1987) to a water-use category. In some cases, a code may be listed under more than one water-use category. The SIC codes can be useful for assigning withdrawals to the public-supply, industrial, mining, and thermoelectric-power categories. A list of SIC codes by water-use category is shown at *http://pubs.usgs.gov/tm/2005/tm4A4/* (table 3).

A newer system of classification, the North American Industry Classification System (NAICS), went into effect in 1997. The U.S. Census Bureau (U.S. Department of Commerce, 2000, 2002) published descriptions of the NAICS codes and correlation with SIC codes. USGS water-use study chiefs may continue to identify industries using SIC codes for the 2005 compilation.

Public Supply

Public supply refers to water withdrawn from ground and surface sources by public and private water systems for use by cities, towns, rural water districts, mobile-home parks, Native American Indian reservations, and military bases. Public-supply facilities provide water to at least 25 persons or have a minimum of 15 service connections and are classified as SIC 4941. Water withdrawn by public suppliers may be delivered to users for domestic, commercial, industrial, and thermoelectric-power purposes, as well as to other public-water suppliers. Public-supply water is used for public services (public uses)—such as pools, parks, and public buildings—or may be unaccounted (losses) because of system leaks or such nonmetered services as firefighting or the flushing of water lines. Some public-supply water may be used in the processes of water and wastewater treatment. Some public suppliers treat saline water before distributing the water.

Public-supply deliveries for domestic purposes will be estimated for 2005 as described below. In addition, guidelines for estimating self-supplied domestic withdrawals are described in the Self-Supplied Domestic section of this report. Estimates of saline ground-water and surface-water withdrawals for public supply are mandatory for 2005. The definition of saline water for public supply has been changed from the previous one used in earlier circulars from water that contains 1,000 mg/L or more of dissolved solids to water that has been treated to reduce the concentration of dissolved solids through the process of desalination or dilution. The criterion was changed because there had been little advantage or opportunity to measure dissolved solids and to compare the measurement to the 1,000 mg/L standard.

Data Elements

The category of public supply consists of the following mandatory and optional data elements. Data for the optional elements may be compiled and entered into AWUDS, but will not be part of the national water-use analysis for 2005 as published in the water-use circular series. The optional data, however, will be available for other types of water studies.

Mandatory

- Ground-water withdrawals, freshwater, by county
- Surface-water withdrawals, freshwater, by county
- Ground-water withdrawals, saline water, by county
- Surface-water withdrawals, saline water, by county
- Domestic deliveries, by county (also see Self-Supplied Domestic section in this report)
- Total population served, by county

Optional

- Population served by total ground water, by county
- Population served by total surface water, by county
- Commercial, industrial, and thermoelectric-power (once-through and closed-loop systems) deliveries, by county
- Number of facilities, by county
- Reclaimed wastewater use, by county
- Any data aggregated by hydrologic cataloging unit
- Ground-water withdrawals, freshwater, by principal aquifer
- Ground-water withdrawals, saline water, by principal aquifer
- Population served, by principal aquifer

Sources of Information

For each USGS Water Science Center, the documentation for the previous compilations should be the starting point for planning the data collection for the 2005 compilation. The previous documentation for the public-supply category may contain the location and types of electronic and paper files; agency and contact information; agency and Internet resources; and methods, techniques, and coefficients used to collect or estimate data. With this information, one should

know where to begin to create or update a master list of public-supply systems and collect data on public-supply withdrawals, sources of water, and population served. Additional information concerning public-supply water use may be obtained from the following sources. Other sources of information may be available in each State.

Agencies or Other Entities

Possible contacts for public-supply water-use data are listed as follows. Water-use data from these sources can range from reported water withdrawals to coefficients and ancillary data that can be used to estimate water withdrawals and domestic deliveries. Multiple data sets can be used to determine the best estimates and provide QA/QC.

- Individual public suppliers
- State agencies that administer water rights, allocate water to users, or collect water-use data
- State agencies that enforce the Safe Drinking Water Act and issue permits for water discharge
- State public health agencies
- State agencies that regulate utility rates
- State, regional, county or community planning, development or zoning agencies
- State natural-resource agencies
- Consulting firms

Internet Resources

Many agencies and other entities maintain public supply water-use information and databases on the Internet. Specific Internet addresses are listed as they appeared on the date last accessed.

- U.S. Census Bureau, accessed June 6, 2006, at <*http://www.census.gov/*>
  - American FactFinder database, the U.S. Census Bureau's online data source, containing information on population and housing, accessed June 6, 2006, at <*http://factfinder.census.gov/*>
- U.S. Environmental Protection Agency (USEPA), accessed June 6, 2006, at <*http://www.epa.gov/*>
  - Safe Drinking Water Information System (SDWIS), access to data that States must report to USEPA as required by the Safe Drinking Water Act.

    Search the SDWIS database for selected public supply information. Includes data on water-system name, county, population served, and primary water-source type. Focus should be on community water systems that serve comparatively greater populations in the State. SDWIS also contains information on noncommunity systems that are further categorized according to type of population served during the day (transient or nontransient).
  - Safe Drinking Water Query Form, accessed June 6, 2006, at <*http://www.epa.gov/enviro/html/sdwis/sdwis_query.html*>
  - Office of Ground Water and Drinking Water, accessed June 6, 2006, at <*http://www.epa.gov/OGWDW/*>
  - Water Discharge Permits, Permit Compliance System (PCS) database, accessed June 6, 2006, at <*http://www.epa.gov/enviro/html/pcs/pcs_query_java.html/*>

    Access to data regarding facilities holding National Pollutant Discharge Elimination System (NPDES) permits. Specify the facilities by using any combination of facility name, geographic location, SIC code, and chemicals.
- American Water Works Association, accessed June 6, 2006, at <*http://www.awwa.org/*>
  - Links to local Web sites and contacts, accessed June 6, 2006, at <*http://www.awwa.org/sections/SechomePage.cfm*>
  - Links to information on individual public suppliers, accessed June 6, 2006, at <*http://www.awwa.org/community/links.cfm*>
  - Association of State Drinking Water Administrators (ASDWA), accessed June 6, 2006, at <*http://www.asdwa.org/*>

Links to a variety of Internet resources including a page with links for each State's drinking water program pages and the primary State agency responsible for drinking water.

- National Rural Water Association, accessed June 6, 2006, at <*http://www.nrwa.org/*> Organizations whose membership rosters include public or private utilities, such as League of Municipalities or State rural water associations.

Compilation Techniques

Constructing a master list of public-supply systems is fundamental to all of the compilation techniques. A master list, at a minimum, consists of the names and locations of public-water suppliers, populations served, and sources of water. The information to build or update this list may be available from previous documentation, one or more State agencies, or USGS water-use databases. The USEPA SDWIS database is

a secondary source containing information on public supplies obtained from the State agencies that administer water-quality regulations for drinking water. The SDWIS database includes information on the names and locations of systems, source of supply, location of water intakes, and population served for all community water systems (CWS), which are those serving at least 25 persons or 15 or more service connections on a year-round basis. SDWIS does not include any information on quantity of water withdrawn. In some cases, the State agencies providing the data to SDWIS may have more up-to-date and complete information than SDWIS.

Water Withdrawals

Public-supply withdrawals are compiled for the county in which the withdrawals occur, although the water subsequently may be distributed and used elsewhere. State reporting programs and individual public-water suppliers are good sources of data. Individual State reporting agencies have varying criteria for obtaining public-supply water-use data; these criteria may be based on such permit requirements as size of system or magnitude of withdrawals. Return rates of the required surveys to the State reporting agency, as well as the amount of QA/QC review, also may vary from State to State. For these reasons, some needed public-supply system information may not have been collected by the State agency and, therefore, must be obtained directly from the public-supply system or be determined from other ancillary information.

Study chiefs may survey public-water suppliers by telephone calls or visits to the systems. Mail surveys may be used if a State cooperator or other entity participates in the mailing, or if requirements of the 1995 Paper Reduction Act (U.S. Congress, 1995) are met. Usually, information can be obtained from a director of public works, city engineer, city clerk, bookkeeper, manager, or operator. The level of detail obtained depends on the availability of the information and the necessary resources available to collect the data. Useful information to request from these contacts includes the following list of items.

- **Source(s) of water.** Well information (local name or number, depth, location) and names of aquifers used for ground-water sources, names and locations of surface-water sources (streams, lakes, reservoirs), and sources of any purchased water. Some water suppliers use combinations of ground water, surface water, or purchased water.
- **Total withdrawals during 2005.** Amounts of water pumped may have been measured by flowmeters or calculated using pump rates and number of hours pumped. The rate of withdrawal may be by day, month, or year.
- **Metering points.** Water may be metered before treatment, during transport to another location, or as it is delivered to users. Knowing the metering point allows for the accounting of treatment or transit losses and avoids double counting of water.
- **Type of treatment plant.** Surface water usually requires more water for treatment processes, such as backwashing filters, than ground water does. If total reported water is finished rather than raw water, an amount or percentage of water for treatment should be added for systems with a great amount of water-treatment usage.
- **Names of other connected water suppliers and amounts of water purchased or sold.** Many water suppliers purchase and sell water.
- **Number of service connections by type.** Numbers of active residential, commercial, industrial, or other meters may be used with a coefficient to estimate delivery amounts by customer types. Coefficients also may be derived from the number of meters, delivery volumes, and population or employment counts. Numbers of active residential meters, including single-family and multifamily housing, are useful for determining population served.
- **Amounts of water delivered for several purposes during 2005.** Total water use for a public supply is accounted for through deliveries to other public supplies; domestic, commercial, industrial, and thermoelectric-power customers; and public use and losses. Delivery data can be used to develop water-use coefficients for estimating withdrawals for similar public suppliers. Total metered uses also can be subtracted from total withdrawals to determine amounts of public use and losses.
- **Location of retail service areas.** Many public-water suppliers serve customers outside city limits or in multiple counties or States.

Estimating public water and losses and transfer water amounts for public supply is not required; however, the data are likely to be collected as part of the survey. This information can be used to estimate water withdrawals. The difference between total raw water and metered uses is equivalent to public use and losses in USGS Circular 1200, Estimated use of water in the United States in 1995 (Solley and others, 1998). This publication indicates that public use and losses averaged 15 percent of public-supply withdrawals in the United States during 1995 (Solley and others, 1998). Public use and losses vary substantially among water suppliers, depending on treatment needs, system efficiency, and the amount of public-supply water use. For example, older systems and those that are undergoing repairs to lines or towers have greater losses because of leaks, flushing, and tower draining than systems with few problems. Often public use and system losses cannot be separated.

Information on water transfers is necessary for estimating public-supply withdrawals. Estimates of total water use for suppliers using a combination of their own withdrawals and purchased water, or for those selling water wholesale, should

be adjusted to identify withdrawals by the county in which they occur.

An effort should be made to estimate water withdrawals for each public-supply system in the county. At a minimum, water-withdrawal data should be obtained for the public suppliers of greater amounts of water in each county. For public suppliers of smaller amounts of water, especially those not surveyed, water use may be estimated based on water-right allocations, average water production, previously reported usage, or changes in population or population served. Sometimes estimates of total withdrawal for a public-supply system are based on estimates of water delivered to residential, commercial, or industrial customers or perhaps only on estimates of public-supply deliveries to residential customers. Depending on the size of the public-supply system and on the available time and resources, estimates of commercial and industrial deliveries and public use and losses should be added to domestic-delivery estimates to approximate total public-supply water use.

Public-supply water withdrawals for the smaller systems also may be estimated using population served and a total public-supply per capita use coefficient. Preferably, the coefficient is derived from public-supply systems of similar size, similar customer base, similar rate structures, similar demographic and socioeconomic characteristics, or similar climatic and geographic settings.

Per Capita Use Coefficients

A per capita use coefficient may be used to estimate total public-supply water use or domestic deliveries from public supply. In each case, the per capita use coefficient usually has a different value. Per capita coefficients for both total public-supply withdrawals and domestic deliveries are commonly expressed in terms of gallons per person per day and require an estimate of population served. For this report, the *per capita use* term is differentiated for convenience of discussion: *total public-supply per capita use coefficient* and *public-supply domestic per capita use coefficient*. A related term is *self-supplied domestic per capita use coefficient*, which is described in the Self-Supplied Domestic section in this report. Total public-supply per capita use is derived by dividing average daily total public-supply water use by the population served only by the system. Total water-use accounts for the water withdrawn and purchased by a system and subtracts from that amount the water sold to other systems. Total public-supply per capita use coefficients are generally larger for systems that serve industrial and commercial users or have large losses. Public-supply domestic per capita use is derived by dividing average daily domestic deliveries by the population served only by the system. Other sources of total public-supply per capita use and public-supply domestic per capita use coefficients include the documentation from previous compilations, technical literature, or State administrative or legislative documents.

Population Served

Population served refers to the population within a county receiving water from a public-supply system on a year-round basis and excludes vacationers and second-home owners. Persons living on military bases, on Native American Indian reservations, and in prisons constitute a population served by the public-water system serving those communities. Population served by public-water suppliers is estimated for all public-water suppliers regardless of the source of the water (ground water, surface water, purchased water, or a combination of sources of water). Population served is compiled in the county of residence, which is not necessarily the county where the withdrawals occur. Population served within a county cannot exceed the total county population. For the 2005 compilation, population served is required at the county level, but not required by source of supply—ground water or surface water.

A reliable county estimate of population served depends on collecting information from public-water suppliers that serve customers in that particular county. Crosschecking among several sources is recommended to get a sense of what the population served actually might be for a county. Individual public-water systems, State agencies, and SDWIS are sources of population-served data. Additionally, county estimates of the percent of housing units with public-supply capability were published in the 1990 Census of Population and Housing, Summary Social, Economic, and Housing Characteristics, 1990 (U.S. Department of Commerce, 1991, and *http://factfinder.census.gov/* 1990 census, table H023, Source of Water Data Set: Summary Tape File 3 (STF 3)—Sample data). Although the data are 15 years old and apply to the number of housing units rather than the number of occupied-housing units, the 1990 census data can be an important part of the overall analysis of population served in a county and perhaps serve as a baseline from which to compare the population-served data received from the other sources.

Population-served numbers may be unreliable for several reasons and should be checked. Some potential problems include service-area boundaries, which for many public suppliers do not correspond to political boundaries such as city limits or county lines; therefore, census population is adjusted to accommodate customers living outside city limits or county lines to account for total population served. For water suppliers with service areas that span more than one county, an estimate is made of the population residing in each county.

In estimating population served, other errors may be caused by counting the population served more than once, especially if a supplier providing wholesale water supplies to other systems reports a population-served number that may erroneously include both retail and wholesale population-served numbers. Errors in a reported population served sometimes can be detected when comparing aggregated county population served to total county census populations.

If population-served numbers are not available, population served can be estimated based on the number of residential connections and the number of persons per household. This technique is useful for determining population in service areas for which no precise population is available, such as large water suppliers that serve parts of multiple metropolitan areas, rural water districts, or self-supplied housing developments. Individual water suppliers can provide the number of residential connections, which may include multifamily dwellings. Because the number of billed residential connections often approximates the number of households that are occupied in the service area, this statistic, although not always available, is preferred to the more general statistic, total number of residential connections. The use of total residential connections would likely overestimate the population served.

Census data on housing characteristics for counties and the incorporated places within the counties include ratios of average persons per household. As with the population served numbers from different sources, the reliability of the number of persons per household also should be checked. The population served that is reported by public-water suppliers may be over-reported, if it is estimated using a ratio of persons per household that is too large.

Vacationers and users of second homes in publicly supplied areas—also referred to as nonresidents—are not included in the population-served number because they have been counted in the location of their primary residence. The reduced domestic deliveries from public supplies from residents temporarily leaving their community are generally minimal compared to the increased domestic deliveries that result from concentrating a nonresident population, for example, in resort areas. In a resort or second-home community, the population that is actually served is undercounted resulting in a comparatively larger public-supply domestic per capita use coefficient. For example, a county population of 13,000 persons, of which 10,000 are supplied by a public supply, is supplemented by a steady influx of 5,000 nonresidents year-round, so that the public supply provides water for 15,000 persons. In calculating a public-supply domestic per capita use coefficient, domestic deliveries are divided by the 10,000 persons, not 15,000. To determine if this is a major problem, local public supplies, planners, or consulting firms may be able to provide an estimate of the percentage of second homes in areas that may house a large number of nonresidents.

Domestic Deliveries

Public-supply deliveries for domestic purposes will be estimated for 2005. Domestic-delivery data may be collected from the appropriate State agency or from the public-supply system, estimated using population served and a public-supply domestic per capita use coefficient, or estimated from a sampling of the public-supply systems. Techniques for compiling public-supply data have been described at the beginning of this section and apply to public-supply domestic-delivery data. Useful information to request from the appropriate State agency or public-supply system by mail, fax, or phone surveys are included in the earlier sample survey information in the Public Supply section in this report. In particular, these two items from the earlier list are helpful.

- Number of residential service connections
- Amounts of water delivered for domestic purposes during 2005

Billing records maintained by a public supply are a good source of information for water delivered to domestic users—that is, residential water sold. Domestic deliveries may be approximated by looking at amounts of water billed to single-family and multifamily buildings. Meter sizes are another method of distinguishing residential deliveries from other deliveries. For example, meter sizes of $^{5}/_{8}$ and $^{3}/_{4}$ inch are common for households, although in many areas larger meters are installed for residences because of additional water needed for outdoor watering.

Estimating Domestic Deliveries Using Population Served and a Coefficient

Domestic deliveries from public supply can be estimated using population served and a public-supply domestic per capita use coefficient. More than one public-supply domestic per capita use coefficient may have to be determined for a State. Residential use varies from household to household; however, households served by the same public-supply system often have a common pattern of use influenced by factors such as water rates, water-conservation programs, lot size, customer affluence, climate, and topography. As a result, a public-supply domestic per capita use coefficient can be determined for a system (described earlier in this section). Although public-supply systems with similar water-use characteristics are likely to have similar per capita use coefficients, among systems, a common pattern of residential use, especially outdoor use, may not exist because of variation in the above set of factors. Therefore, the coefficient for one system may or may not be valid for all systems within the State.

Outdoor water use can be a significant component of domestic deliveries, especially in arid climates; this outdoor usage is reflected in the per capita use coefficient. In some areas, residential communities may receive potable water from a public-water supplier for indoor use and nonpotable water through a separate distribution system for outdoor irrigation of lawns and gardens. An example of a “dual-use” area is where developers provide the nonpotable water to houses in urban areas built on former farmland, using water previously allocated for agricultural irrigation use. Public-supply domestic per capita use coefficients in these dual-use areas generally are lower than in areas where customers use publicly supplied water for indoor and outdoor uses.

Estimating Domestic Deliveries as a Percent of Total Public-Supply Water Use

In previous compilations, domestic deliveries had been estimated for some States as a percentage of the total water use for a system, a county, or a State. Because the customer base of public suppliers may vary a great deal, caution should be used in applying county- or State-wide percentages. Some of the percentages applied to total public-supply use for domestic deliveries date back several compilations. Just as the trends in water-use withdrawals have changed, especially since 1980, it is likely that the proportion of the deliveries from the public supply to domestic and other customers has changed, especially for commercial and industrial deliveries. In determining the percentage of domestic deliveries compared to total deliveries, an exploratory sampling of a selected sets of public-supply delivery data should be taken to test if applying a percent to total deliveries would be a valid approach and then to determine what a representative percentage would be for either a county, a region, or the State.

Self-Supplied Domestic

Domestic water use is water used for both indoor and outdoor household purposes. Common indoor uses include water for drinking, food preparation, bathing, washing clothes and dishes, and flushing toilets. Major outdoor uses include watering lawns and gardens and washing cars. Water for domestic use may be delivered from a public supplier, withdrawn from a private source such as a well or spring, or captured as rainwater in a cistern.

Data Elements

The category of self-supplied domestic consists of the following mandatory and optional data elements. Data for the optional elements may be compiled and entered into AWUDS, but will not be part of the national water-use analysis for 2005 as published in the water-use circular series. The optional data, however, will be available for other types of water studies.

Mandatory

- Ground-water withdrawals, freshwater, by county
- Surface-water withdrawals, freshwater, by county

Optional

- Consumptive use, freshwater, by county
- Any data aggregated by eight-digit hydrologic cataloging unit
- Ground-water withdrawals, by principal aquifer

Sources of Information

For each USGS Water Science Center, the documentation for the previous compilations should be the starting point for planning the data collection for the 2005 compilation. The previous documentation for the self-supplied domestic category may contain the location and types of electronic and paper files; agency and contact information; agency and Internet resources; and methods, techniques, and coefficients used to collect or estimate data. Other sources of information may be available in each State. Additional information concerning self-supplied domestic water use may be obtained from the following sources.

Agencies or Other Entities

Possible contacts for self-supplied domestic water-use data are listed as follows. Water-use data from these sources can range from reported water withdrawals to coefficients and ancillary data that can be used to estimate water withdrawals and domestic self-supplied population. Multiple data sets can be used to determine the best estimates and provide QA/QC.

- Governmental agency responsible for well permits for individual households
- Public-water supply records of residential use
- Public-water supply records of population served
- State pollution-control agencies
- State agency responsible for water permitting
- Ground-water resource studies
- Local chambers of commerce
- State public health agencies
- Wastewater-treatment facility billing
- Local wastewater lagoon designs
- Tax appraiser’s office
- State and regional planning agencies
- Technical literature
- State administrative or legislative documents
- State projections of water demand
- American Water Works Association research
- Consulting firms

Internet Resources

Many agencies and other entities maintain self-supplied domestic water-use information and databases on the Internet. Specific Internet addresses are listed as they appeared on the date last accessed.

- U.S. Census Bureau, accessed June 6, 2006, at <*http://www.census.gov/*>
  - American FactFinder, the U.S. Census Bureau's online data source, accessed June 6, 2006, at <*http://factfinder.census.gov/*>

    Summary File 1, in "Data Sets," includes selected population and housing characteristics to the block/census tract level.
- USEPA, accessed June 6, 2006, at <*http://www.epa.gov/*>
  - Water Discharge Permits, PCS database, accessed June 6, 2006, at <*http://www.epa.gov/enviro/html/pcs/pcs_query_java.html*>

    Access to data regarding facilities holding NPDES permits. Specify the facilities by using any combination of facility name, geographic location, SIC code, and chemicals.
- American Water Works Association, accessed June 6, 2006, at <*http://www.awwa.org/*>
  - WaterWiser, the Water Efficiency Clearinghouse, accessed June 6, 2006, at <*http://www.awwa.org/waterwiser/*>

Compilation Techniques

The approach to estimating self-supplied domestic water withdrawals depends on the type of data available to the study chief. Self-supplied domestic water withdrawals typically are estimated by multiplying the self-supplied population by a self-supplied domestic per capita use coefficient. Self-supplied population is calculated by subtracting total population served by a public supply in a county from the total census population in the county. The reliability of the estimate of self-supplied population depends on the reliability of the population-served numbers. Self-supplied domestic water withdrawal estimates may be more accurate if the self-supplied domestic per capita use coefficient is determined for separate geographic areas of the State that have distinctive climatic or water-use characteristics. A public-supply domestic per capita use coefficient may be substituted for a self-supplied domestic per capita use coefficient if the publicly supplied and self-supplied populations are believed to be similar in terms of water use. A suggested method for developing public-supply domestic per capita use coefficients is to obtain data on public-supply water withdrawals or domestic deliveries—depending on available data—and population served from a cross section of several small water suppliers that likely serve only residential customers. Public-supply water withdrawals—or domestic deliveries—divided by the population served will result in an estimate of public-supply domestic per capita use. The public-supply domestic per capita use is likely to be similar to a self-supplied domestic per capita use, unless extraordinary conditions influence the patterns of use within the system or within in the self-supplied area. If public-supply domestic per capita use rates are similar throughout the State, an average public-supply domestic per capita use for the entire State may be appropriate. If public-supply domestic per capita use rates developed from the sampling indicate regional differences within the State, an average public-supply domestic per capita use should be estimated for each county or region.

Self-supplied or publicly supplied domestic per capita use coefficients also may be obtained from estimates provided by other agencies or from technical, administrative, or legislative literature. Some States have published projections of future water demands and may have calculated per capita use rates. Regional and State planning agencies, State natural-resource agencies, or the State's public health agency are possible sources for this information. Per capita use coefficients also have been determined as part of research conducted by professional organizations, such as the American Water Works Association, and by consulting firms.

Self-supplied domestic withdrawals sometimes can be estimated using information from wastewater-treatment facilities that set fees according to metered water use. In areas where sewer districts serve houses that are not on public water supplies, wastewater-treatment facilities often maintain information about self-supplied residences for billing purposes. This information can be used to estimate withdrawals for areas and to develop per capita use coefficients along with population and housing data. State pollution-control agencies also estimate per capita uses when designing wastewater lagoons. These design values, usually from about 80 to 100 gallons per capita per day (gpcd), may provide a good estimate of domestic per capita use. Other coefficients, such as gallons per day per household or gallons per day per household market value, are available from the literature and can be used to determine domestic self-supplied withdrawals in areas for which ancillary data on housing are available.

Domestic self-supplied withdrawals typically are from wells. The source for about 98 percent of self-supplied domestic withdrawals during 2000 was ground water (Hutson and others, 2004). Information on the use of surface water for domestic supply may be obtained from the State public health agency, the State agency responsible for permitting or water-use data collection, census housing data, or local knowledge of areas where surface water is used. Cisterns used to collect rainwater for domestic use generally are considered as surface-water sources. Springs are considered surface water in some States and ground water in others.

Industrial

Industrial water use includes water used for such purposes as fabricating, processing, washing, diluting, cooling, or transporting a product; incorporating water into a product; or for sanitation, maintenance, or landscaping needs of the facility. Industrial water users are businesses classified in the SIC codes under construction and manufacturing. Industrial water supplies may be derived from ground water, surface water (self-supplied industrial withdrawals) or reclaimed wastewater or provided by a public-water supplier (public-supply industrial deliveries). For 2005, reclaimed wastewater use is a mandatory data element for the industrial category. Zeros should be reported for counties where the delivery of reclaimed wastewater does not occur, but null values can be stored in AWUDS for counties where the use of reclaimed wastewater is uncertain.

Data Elements

The category of industrial consists of the following mandatory, mandatory but null values allowed, and optional data elements. Data for the optional elements may be compiled and entered into AWUDS, but will not be part of the national water-use analysis for 2005 as published in the water-use circular series. The optional data, however, will be available for other types of water studies.

Mandatory

- Ground-water withdrawals, freshwater, by county
- Ground-water withdrawals, saline water, by county
- Surface-water withdrawals, freshwater, by county
- Surface-water withdrawals, saline water, by county

Mandatory but Null Values Allowed

- Reclaimed wastewater, by county

Optional

- Deliveries from public supply, by county
- Consumptive use, freshwater, by county
- Consumptive use, saline water, by county
- Number of facilities, by county
- Any data aggregated by hydrologic cataloging unit
- Ground-water withdrawals aggregated by principal aquifer

Sources of Information

For each USGS Water Science Center, the documentation for the previous compilations should be the starting point for planning the data collection for the 2005 compilation. The previous documentation for industrial water-use category may contain the location and types of electronic and paper files; agency and contact information; agency and Internet resources; and methods, techniques, and coefficients used to collect or estimate data. Additional information on industrial facilities and the associated water use may be obtained from the following sources. Other sources of information may be available in each State.

Agencies or Other Entities

Possible contacts for industrial water-use data are listed as follows. Water-use data from these sources can range from reported water withdrawals to coefficients and ancillary data that can be used to estimate water withdrawals. Multiple data sets can be used to determine the best estimates and provide QA/QC.

- State agencies that administer water rights, allocate water to users, or collect water-use data
- State agencies that issue permits for the discharge of water
- Health departments or public-water suppliers—many industries receive treated water for sanitary uses
- Wastewater-treatment facilities
- State department of labor
- State and county planning departments
- State directories of manufacturers
- Local chambers of commerce
- County assessors and zoning boards

Internet Resources

Many agencies and other entities maintain industrial water-use information and databases on the Internet. Specific Internet addresses are listed as they appeared on the date last accessed.

- U.S. Census Bureau, accessed June 6, 2006, at *<http://www.census.gov/>*
  - 2002 Economic Census and Surveys, accessed June 6, 2006, at *<http://www.census.gov/econ/census02/>*
  - County-level data; number of establishments/employees by manufacturing industry; accessed through the American FactFinder, U.S. Census Bureau's online data source, accessed June 6, 2006, at *<http://factfinder.census.gov/servlet/DatasetMainPageServlet?_program=ECN&_lang=en&_ts=/ >*

  - Sector-specific reports by State, accessed June 6, 2006, at <*http://www.census.gov/econ/census02/guide/geosumm.htm*>
  - Industry series reports—Manufacturing, accessed June 6, 2006, at <*http://www.census.gov/econ/census02/guide/INDRPT31.HTM*>

- USEPA, accessed June 6, 2006, at <*http://www.epa.gov/*>
  - Water Discharge Permits, PCS database, accessed June 6, 2006, at <*http://www.epa.gov/enviro/html/pcs/pcs_query_java.html*>

    Access to data regarding facilities holding NPDES permits. Specify the facilities by using any combination of facility name, geographic location, SIC code, and chemicals.

- Dun and Bradstreet, accessed June 6, 2006, at <*http://www.dnb.com/us/index.asp*>

  Source for lists of manufacturing establishments that includes SIC codes and number of employees, among other information.

- Harris InfoSource, accessed June 6, 2006, at <*http://www.harrisinfo.com/*>

  Source for purchasing lists of manufacturing establishments. Profile reports include primary and secondary SIC codes, number of employees, Internet address of company, if available.

Compilation Techniques

Self-supplied industrial withdrawals tend to occur within particular industry groups that require large amounts of water for fabricating, processing, washing, diluting, cooling, or transporting a product or incorporating water into a product. There are exceptions in which the more water-use-intensive industries are publicly supplied and the less water-use-intensive industries are self-supplied. Major industrial groups that historically have been self-supplied include food and kindred products (SIC 2011–2099), paper and allied products (SIC 2611–2679), chemicals and allied products (SIC 2812–2899), petroleum-refining and petroleum-related industries (SIC 2911–2999), and primary metals industries (SIC 3312–3399). Although these types of industries historically have used the most water per facility, the most important industry in any given county may not fall into one of these five groups. Therefore, it is important to consider any industries outside these groups.

Constructing a master list of industrial facilities is fundamental to all of the compilation techniques. A master list, at a minimum, consists of the names and locations of industries, and sources of water. The information to build or update this list may be available from previous documentation, one or more State agencies, or from USGS water-use databases. State reporting programs and individual industries are good sources of data. Reporting agencies have varying criteria for obtaining industrial water-use data; these criteria determine if withdrawals are permitted, registered, or monitored; the trigger levels for reporting and the application of the trigger level to groundwater or surface-water sources; and whether the reporting is Statewide or applies to selected counties or watersheds. If the reporting criterion is a minimum water withdrawal rate and that withdrawal rate is large, a significant number of small industries may not be surveyed. For this reason, some needed industrial facility information may not have been collected by the State agency and, therefore, must be obtained directly from the industry or be determined from other ancillary information.

Water Withdrawals

There are three general approaches used to compile withdrawal data by industries:

1. Acquire site information and withdrawal data for individual industries, focusing on larger ones while striving for an adequate representation of the withdrawals in each county.
2. Acquire site information with ancillary data on employment or production, and estimate water withdrawals using water-use coefficients. These coefficients are usually in the form of usage in gallons per day per employee or per unit of product.
3. Combine the two approaches by acquiring industrial facility information and water withdrawals for the larger industries and using these data to develop water-use coefficients for estimating withdrawals for the smaller industries.

Industrial water information may be acquired through telephone contacts, site visits, or surveys sent out by cooperating agencies. The level of detail obtained depends on the availability of the information and the necessary resources available to collect the data. Confidentiality should be considered. Useful data to acquire include:

- Facility name, mailing address, physical plant facility address
- County
- Contact name, title, telephone and fax number, and e-mail
- Industry description or principal products
- SIC codes—primary and secondary
- Estimated annual quantity of product produced
- Total number of employees

- Number of ground-water sources, aquifer names, number and depth of well(s)
- Number of surface-water sources, names of streams or water bodies
- Latitude and longitude of wells or intakes
- Maps of facility and water intakes
- Name of public water-supply sources
- Amounts of water withdrawn and time period of withdrawal for each source
- Amount or percentage of total withdrawal that is freshwater or saline water, ground water or surface water
- Method of determining withdrawals (meters, other)
- Percentage of total or amount of water used for cooling, processing, sanitary use, boiler feed, power generation, other
- Amount of water recycled or reused
- Wastewater discharge—average amount or percentage
- Number of days operating each year
- Average number of hours operating each day
- Approximate age of the facility
- Confidentiality statement

Water-Use Coefficients

In the absence of reported data, industrial water withdrawals can be estimated using water-use coefficients and ancillary data such as numbers of employees, units of production, or annual sales. The largest industries should be contacted to acquire actual water-use withdrawal data. These withdrawals then can be used to develop locally adjusted water-use coefficients to estimate withdrawals for smaller industries.

The use of coefficients to estimate industrial water use is imprecise because of the variability in factors affecting water use by industries. The specific processes, age of the facility, cost of the water and wastewater treatment, and amount of recycling all contribute to the amounts of water needed by an industry. These factors should be considered when using national coefficients or when developing and adjusting local coefficients for industries not surveyed.

Allocation of Water Withdrawals by Source

Allocating industrial water withdrawals by source and quality of water is often best done by combining local knowledge of water sources for neighboring industrial or public-supply facilities and applying spatial analysis. Plotting possible areas or locations of industrial activity on watershed and principal aquifer coverage maps can help determine the probable sources of water. Many industries are located in specific areas of ample supply of water from rivers or productive aquifers. Determining freshness or salinity of water also may require some knowledge of the type of industrial activity. Spatial analysis may indicate the possibility of tapping into a saline water source; however, the industrial process for which the water is needed may require freshwater. Seawater and estuary-bay water are the primary sources of saline surface water in the United States. Generally, because the use of saline ground water for industrial use is so specific and unique, the saline ground water is known within the State rather than surmised. The USGS ground-water specialist in each State may be able to help identify areas noted for having saline ground water that would strengthen the spatial analysis. For industry, saline water is water that contains 1,000 mg/L or more of dissolved solids.

Irrigation

Water for irrigation is applied by an irrigation system to sustain growth in agricultural and horticultural vegetation and also is applied for the purposes of pre-irrigation, frost protection, weed control, field preparation, crop cooling, harvesting, dust suppression, leaching of salts from the root zone, and the application of chemicals (SIC 0111–0191 and 4971). Irrigation withdrawals include conveyance losses. Irrigation of golf courses (SIC 7992 and 7997), parks, nurseries, turf farms, cemeteries, and other self-supplied landscape-watering uses also are included in the irrigation category. Water may be withdrawn by the irrigator or delivered from irrigation companies, irrigation districts, irrigation cooperatives, or governmental entities, but not purchased from a public supply. Instead, public-supply deliveries for irrigation users, golf courses, parks, cemeteries, and landscaping irrigation are either commercial deliveries or public-use water. The number of irrigated acres by type of irrigation system—sprinkler, surface (flood), and microirrigation are in the irrigation category. Reclaimed wastewater use is a mandatory data element for the irrigation category. Zeros are reported for counties where the delivery of reclaimed wastewater does not occur, but null values can be stored in AWUDS for counties where the use of reclaimed wastewater is uncertain.

For the 2005 compilation, States may divide total irrigation water use into crop irrigation and golf course irrigation. In this case, only golf course irrigation withdrawals are included in golf course irrigation; all other landscape irrigation is included with crop withdrawals. If irrigation is divided in this manner, county-level totals for both crop and golf course irrigation are mandatory where applicable, and total irrigation water withdrawals are calculated as the sum of the two subcategories. If irrigation withdrawals are not divided into crop and golf course withdrawals, then all irrigation is reported as total withdrawals and may include both types.

Data Elements

The category of irrigation consists of the following mandatory, mandatory but null values allowed, and optional data elements. Data for the optional elements may be compiled and entered into AWUDS, but will not be part of the national water-use analysis for 2005 as published in the water-use circular series. The optional data, however, will be available for other types of water studies.

Mandatory

- Ground-water total withdrawals, freshwater, by county
- Surface-water total withdrawals, freshwater, by county
- Acres irrigated by sprinkler systems, by county
- Acres irrigated by surface systems, by county
- Acres irrigated by microirrigation systems, by county

Mandatory but Null Values Allowed

- Reclaimed wastewater, by county

Optional

- Divided crop and golf course ground-water withdrawals, freshwater, by county
- Divided crop and golf course surface-water withdrawals, freshwater, by county
- Consumptive use, by county
- Conveyance loss, by county
- Any data aggregated by hydrologic cataloging unit
- Total ground-water withdrawals, by principal aquifer

Sources of Information

For each USGS Water Science Center, the documentation for the previous compilations should be the starting point for planning the data collection for the 2005 compilation. The previous documentation for the irrigation category may contain the location and types of electronic and paper files; agency and contact information; agency and Internet resources; and methods, techniques, and coefficients used to collect or estimate data. Additional information concerning irrigation water use may be obtained from the following sources. Other sources of information may be available in each State.

Agencies or Other Entities

Possible contacts for irrigation water-use data are listed as follows. Water-use data from these sources can range from reported water withdrawals to coefficients and ancillary data that can be used to estimate water withdrawals and determine irrigated acreage by irrigation system type. Multiple data sets can be used to determine the best estimates and provide QA/QC.

- State agencies that administer water rights, allocate water to users, or collect water-use data
- U.S. Department of Agriculture (USDA), Agricultural Statistics Service for a specific State
- USDA, NASS
- USDA, Natural Resources and Conservation Service (NRCS), State or county offices
- USGS research or studies
- Watermasters
- Equipment manufacturers
- Federal or State crop and livestock reporting services
- State and local turf-grower associations
- County assessor
- Land-grant universities—college of agriculture, departments of watershed science, soil science, plant science, crop science, or irrigation engineering
- Water management districts, irrigation districts, irrigation companies
- Irrigation equipment dealers
- Farm and crop improvement associations
- Golf courses, parks, and other recreational areas
- Professional, technical, and trade journals
- State departments of commerce and tourism

Internet Resources

Many agencies and other entities maintain irrigation water-use information and databases on the Internet. Specific Internet addresses are listed as they appeared on the date last accessed.

- USDA, accessed June 6, 2006, at <*http://www.usda.gov/*>
- 2003 Natural Resource Inventory, accessed June 6, 2006, at <*http://www.nrcs.usda.gov/technical/NRI/*>

- NRCS Irrigation Page, accessed June 6, 2006, at <*http://www.wcc.nrcs.usda.gov/nrcsirrig/*>
- Farm Service Agency, accessed June 6, 2006, at <*http://www.fsa.usda.gov/*>
- Cooperative State Research, Education, and Extension Service (CSREES), accessed June 6, 2006, at <*http://www.csrees.usda.gov/*>
- State partners of the CSREES (includes agricultural experiment stations and county cooperative extension offices), accessed June 6, 2006, at <*http://www.csrees.usda.gov/qlinks/partners/state_partners.html*>
- Local partners, accessed June 6, 2006, at <*http://www.csrees.usda.gov/Extension/index.html*>
- NASS, accessed June 6, 2006, at <*http://www.usda.gov/nass/*>
  - Links to NASS Web sites for each State, accessed June 6, 2006, at <*http://www.nass.usda.gov/Statistics_by_State/index.asp*>

    State Web sites may include links to information such as agricultural statistics, publications (including annual bulletins), and general information on agriculture in that State; other State agricultural agencies; and agricultural census data.
  - Quick Stats: Agricultural Statistics Database—custom queries for agricultural statistics, down to the county level, accessed June 6, 2006, at <*http://www.nass.usda.gov/QuickStats/*>
  - 2002 Census of Agriculture, accessed June 6, 2006, at <*http://www.nass.usda.gov/Census_of_Agriculture/index.asp*>
  - Farm & Ranch Irrigation Survey, accessed June 6, 2006, at <*http://www.nass.usda.gov/census/census02/fris/fris03.htm*>

    State-level data on acres irrigated by irrigation method; application rates by irrigation method, source of water, and crop type.
  - 1998 Census of Horticultural Specialties, accessed June 6, 2006, at <*http://www.nass.usda.gov/census/census97/horticulture/horticulture.htm*>

    State-level data on acres for horticultural crops, including acres irrigated by source of water and acres irrigated by type of irrigation system.
- U.S. Department of the Interior, Bureau of Reclamation, accessed June 6, 2006, at <*http://www.usbr.gov/*>
  - Annual operating plans for federally owned dams and reservoirs operated by irrigation or reclamation districts, accessed June 6, 2006, at <*http://www.usbr.gov/gp/water/index.cfm*>
  - AgriMet is a network of automated agricultural weather stations located in irrigated agricultural areas throughout the Pacific Northwest and Montana:
    - Pacific Northwest Region, accessed June 6, 2006, at <*http://www.usbr.gov/pn/agrimet/*>
    - Great Plains Region (Montana), accessed June 6, 2006, at <*http://www.usbr.gov/gp/agrimet/index.cfm*>
- USEPA, accessed June 6, 2006, at <*http://www.epa.gov/*>
  - Water Discharge Permits, PCS database, accessed June 6, 2006, at <*http://www.epa.gov/enviro/html/pcs/pcs_query_java.html*>

    Access to data regarding facilities holding NPDES permits. Specify the facilities by using any combination of facility name, geographic location, SIC code, and chemicals.
- Food and Agriculture Organization (FAO) of the United Nations, accessed June 6, 2006, at <*http://www.fao.org*>
  - Crop evapotranspiration – Guidelines for computing crop water requirements—FAO Irrigation and Drainage Paper 56, accessed June 6, 2006, at <*http://www.fao.org/docrep/X0490E/X0490E00.htm*>
- GolfServ.com, accessed June 6, 2006, at <*http://www.golfserv.com/apps/courses/search.asp*>

  Users can search the database for a listing of golf courses in each State—includes data on public and private courses, number of holes, location, and links to each course's profile and Web site (if they have one). Registration on the Web site (free) is required to access specific course data.
- Golfonline.com, accessed June 6, 2006, at <*http://www.golfonline.com/golfonline/coursefinder*>

  Users can search the database for a listing of golf courses in each State—includes information on number of holes. No registration is required.

Compilation Techniques

Irrigation water withdrawals and reclaimed wastewater use are compiled according to the county in which the withdrawals or diversions occur. The number of acres irrigated is counted where the irrigation water is applied. In most cases, irrigation water is applied close to where it is withdrawn or

diverted; in some cases, the irrigation water is transported long distances through canals. Problems in estimating irrigation water use include:

- Unknown number of irrigated acres
- Possibility of single or multiple cropping patterns
- Possibility of multiple sources of water: surface water, ground water, or reclaimed wastewater
- The effect of age and design on application rates for irrigation systems
- Unexpected seasonal irrigation needs such as frost protection or harvesting
- Gap in permitted amounts compared to use amounts
- Censoring of data for privacy reasons
- Spatial scale (watershed, irrigation district, etc.) of primary-source data compared to the needed county-scale data for the compilation

Direct methods for compiling information on irrigation withdrawals and irrigated acres include use of reported data, surveys, and personal contact. Indirect approaches for estimating withdrawals include calculation of crop water needs and statistical sampling. Data on irrigated acres by crop type and golf course, coupled with irrigation system type are used in most estimation methods for determining withdrawals. Total withdrawals need to be disaggregated to ground-water and surface-water sources if information on site-specific withdrawals is not available.

Reported Data

Some States require individual water users or water right holders to measure and report their withdrawals and irrigated acreages for each well or surface-water diversion. These data are considered the best because the location of the withdrawals can be accurately assigned and aggregated to a county, aquifer, or other area. Other sources of reported data may yield partial coverage of irrigation use. USGS cooperative studies may include measurement of site-specific data in local areas within a State. Irrigation districts or other agencies may own water rights and distribute water to users; these entities usually measure both withdrawals and deliveries. Watermasters may have been assigned to measure or compile measured withdrawals and deliveries in some areas, in which case they are excellent sources of data.

Reported measurements are the most defensible data; however, the completeness of reported data varies among States. Before using data that are reported to or by other Federal, State, and local agencies, it is important to understand the level of completeness, the degree of accuracy, and the amount of QA/QC given to data. USGS water-use study chiefs need to verify whether the data are based on full and complete enumerations, like a census, or are statistically based, like the NASS data. Reported crop acreages may include all crop acreages or just irrigated acreages. Irrigated acreages and water deliveries may be reported for an area of management of a particular agency, or for an entire county. Some data may be censored for privacy reasons in areas with few irrigators. Reported withdrawals and acreage data need to be reviewed for errors, either by the reporting agency or by the USGS water-use study chief. Knowing the level of QA/QC for data that are reported by other agencies may prevent calculations that are based on incorrect assumptions.

Surveys and Personal Contact

Another method of estimating irrigation water use is by a local survey. Surveys that are conducted by USGS rather than a cooperator need to comply with the requirements of the 1995 Paper Reduction Act. Ideally, survey forms include a complete background about why the information is being requested, how it will be used, and by whom. Other important components of the survey are (1) a concise description of the requested data, (2) a contact name and phone number to direct questions to, and (3) a desired completion date. In any case, efficient collection and processing of survey data can be best achieved if the survey forms are short and easy for the user to complete. Typically, other State and local agencies distribute surveys, and the data are shared with the USGS.

It is important to get accurate data on water users who use the greater amounts of water; these users typically have more data available than water users who use lesser amounts of water. When developing survey lists, data sources such as the USDA's Census of Agriculture can be used to target counties with the water users who use the greater amount of water. Some of the most beneficial survey information includes:

- Total irrigated acreage
- Crop and pasture acreage
- Type and efficiency of irrigation system(s)
- Quantity or flow rate of water by source
- Irrigation scheduling and frequency
- Number of irrigation wells
- Total depth of well(s)
- Capacity of well(s)
- Contributing aquifer system(s)
- Total annual energy usage
- Power consumption coefficient(s) if known

Other useful data include information on crop water shortages, acres harvested and yields by crop, energy sources, water and agricultural management practices, and any agricultural resources that generally are contacted when the irrigator needs additional guidance.

Estimates of Crop Water Needs

A commonly used method to estimate irrigation withdrawals involves calculating consumptive use for irrigated crops using crop water-consumption coefficients for several crops and system types (see Allen and others, 1998; U.S. Department of Agriculture, 1970, 1976, 1997, 2002). The amount of water consumed by crops, plus additional water used in conveyance or needed for other irrigation uses, is the total withdrawal. This method requires that ancillary data exist for total irrigated acres for each type of crop, irrigation system efficiencies, conveyance losses, climatic variables, and other irrigation management practices—such as pre-irrigation, frost protection, weed control, and leaching salts from soils. This consumptive-use technique assumes that the irrigation water applied is adequate for optimal plant growth and that the plants are not being irrigated with more or less water than needed.

Application efficiency is a measure of the effectiveness of the irrigation system in applying the right amount of water to the soil and root zones over time. Application efficiency must be taken into account if irrigation withdrawals are estimated from crop water-consumption coefficients. Application efficiencies vary with the type of irrigation system and soil, crop, topographic, and climatic conditions. Pertinent climatic conditions that have large effects on irrigation efficiencies include wind speed, relative humidity, and air temperature.

In many cases, compilation of State withdrawals based on crop consumptive use, plus additional climatic and soil factors, is not feasible because of the amount of work and level of detailed data necessary. Use of previously determined crop consumption values may be the most cost-effective method of estimating irrigation withdrawals. These values may be obtained from sources such as the USDA irrigation guide (U.S. Department of Agriculture, 1970).

Statistical Sampling

For large irrigated areas where few measurements exist, statistical sampling represents a cost-effective way to estimate irrigation withdrawals. For this method, withdrawals are measured at sample sites where data also are available for such variables as power consumption, lift, or crop type. Water-use coefficients are developed from these sample data and then are used to estimate withdrawals at unsampled sites where the predictor variable(s) is known.

Statistical approaches may have transfer value to other areas if there is good understanding of the predictor variables, the statistical significance of the predictor variables, and the level of expected accuracy. For example, by understanding the variability of the predictor variable, a specific number of sample sites may be determined that will enable calculations of withdrawals for all sites with a probability that the calculated values are within a specific margin of error. Luckey (1972) and Helsel and Hirsch (1995) provide a complete description of how to determine a sufficient sample size.

Allocation of Withdrawals by Source

If site-specific measurements of withdrawals are unavailable, then the estimates of total withdrawals need to be allocated between ground-water and surface-water sources. Geographic location is the greatest determinate of water availability from each source. Often, there is a predominating source of supply for a given State or geographic area. The best sources of information about water for irrigation are State personnel and county extension agents who work with the political and managerial aspects of water resources. Irrigation districts and equipment dealers are other good sources of local information.

Acres Irrigated by System Type

Estimates of irrigated acres by system type are compiled for each State at the county level. Irrigated acreage is reported by three general methods of application—sprinkler, surface, and microirrigation. Many types of irrigation systems are included in each of these categories.

- Sprinkler methods include all boom, center-pivot, lateral-move, low-energy precision application (LEPA), permanent, portable, side-move, side-roll, solid-set, traveling-gun, towed, and other sprinkler irrigation systems
- Surface methods include all borders, ditch, flood, furrow, gated-pipe, surge-flow, water-spreading, and other gravity systems
- Microirrigation methods include all bubbler, drip, micro-jet, mist, porous trickle-tubing, spray, trickle, and other low-volume irrigation systems, and subsurface systems

Reliable data on irrigated acreage also are essential for most methods of estimating irrigation water withdrawals. Site-specific irrigated acres by irrigation system type generally are difficult to obtain, except if State agencies require irrigators to report detailed information that includes irrigation methods. The USDA census of agriculture, conducted in years ending in "2" and "7," provides the most recent national data set of irrigated crop acreages by county (U.S. Department of Agriculture, 2002). The USDA farm and ranch irrigation survey, last released during 2003, provides a national data set of irrigated acreage by irrigation method by State. County assessors also are possible sources for county-level information on irrigated acreage and irrigation system type. Remote sensing has been used as an indirect method of determining acres irrigated and crop types (Raymond and others, 1992), but is not a common tool used in this study.

In some parts of the United States, the growing season is long enough that double and triple cropping can occur on the same irrigated acreage. In these cases, irrigated acres are counted each time the acre is irrigated to reflect the total acreage irrigated during the year; therefore, when any acre of land

is cropped twice, it is counted as 2 irrigated acres. Counting acreage in this manner produces an application rate that is comparable to a single-cropping season. The irrigation method used on subsequent crops may be different. If multiple irrigation methods are used on a crop in a single growing season, acreages are reported under the method that provides most of the water to the crop.

Golf Course Irrigation

Golf courses may use water from ground or surface sources, purchased water (from a public supplier or irrigation district), reclaimed water from a public wastewater-treatment facility, or a combination of these sources. For golf courses, the best information on source of water is obtained directly from the golf course maintenance personnel. These people usually know how much water is diverted, withdrawn, or delivered from each of the possible sources.

Factors affecting the amount of irrigation water used at golf courses include course design, climatic conditions, acreage, irrigation systems, soils, availability of water for irrigation, and local irrigation practices. Normally, more water per unit of area is applied to the greens and tees than to the fairways. It is best to obtain metered withdrawals for specific golf courses. If site-specific data are not available, irrigation withdrawals may be estimated using coefficients developed from surveys of golf courses in a State. A survey should include all of the information necessary to compute an application rate based on the consumptive needs of the grasses and the irrigated acres.

Thermoelectric Power

Thermoelectric-power water use is the amount of water used in the process of generating thermoelectric power. All thermoelectric power plants are classified as SIC 4911. The source of the power may be fossil fuels, nuclear fission, or geothermal energy. Thermoelectric power plants typically generate electricity with a boiler, where water is heated to turn it into steam. The steam then is used to turn turbines, which generate electricity. After the steam is used to turn the turbines, the steam is condensed to water by cooling it in a heat exchanger. The condensed water then is routed back to the boiler, where the cycle begins again. The predominant use of water is to cool the steam. Boiler water must be freshwater; however, cooling water may be fresh or saline.

Water withdrawal requirements at thermoelectric-power-generation facilities primarily depend on whether or not the cooling water is recirculated. The two general types of cooling are once-through (open-loop) cooling and closed-loop (recirculation) cooling. For the 2005 compilation, water withdrawal and net thermoelectric-power-generation estimates will be compiled for each type of cooling system. Once-through cooling requires the largest amounts of water withdrawal because the water is not recirculated within the facility. The water is withdrawn from a source, circulated through the heat exchangers, and then returned to a water body at a higher temperature. This technology is common in older facilities but generally is not used for new facilities because of increasingly restrictive thermal and other water-quality requirements for return water.

Closed-loop cooling systems use cooling ponds and cooling towers to recirculate water within the system, thus reducing the overall water withdrawal requirement. Withdrawals to replace cooling water lost to evaporation, blowdown, drift, and leakage are considered “makeup” water. A cooling pond is a shallow reservoir with a large surface area to remove heat from circulation water. The rate of heat loss may be enhanced by using spray nozzles. A cooling tower is a structure designed to remove heat from water. The heated circulation water is sprayed into the tower and is cooled by radiation from the sides of the tower or contact with the cooler air. Cooling towers commonly are used where land and water are expensive, or where local regulations prohibit the release of thermal water.

For 2005, net power generated is a mandatory data element and the value will be stored in AWUDS in units of gigawatt-hours (GWhs). A GWh is equivalent to 1 thousand megawatt-hours or 1 billion watt-hours.

Some industrial facilities also generate thermoelectric power. These facilities are combined heat and power plant operation (CHP or cogeneration) facilities. If the data provided from the industrial facility are sufficient to identify water used in power generation, then that amount of water and the power generated are compiled with other county thermoelectric-power water-use data.

Data Elements

The category of thermoelectric power consists of the following mandatory and optional data elements. Data for the optional elements may be compiled and entered into AWUDS, but will not be part of the national water-use analysis for 2005 as published in the water-use circular series. The optional data, however, will be available for other types of water studies.

Mandatory

- Ground-water withdrawals, once-through cooling, freshwater, by county
- Ground-water withdrawals, once-through cooling, saline water, by county
- Surface-water withdrawals, once-through cooling, freshwater, by county
- Surface-water withdrawals, once-through cooling, saline water, by county
- Ground-water withdrawals, closed-loop cooling, freshwater, by county
- Ground-water withdrawals, closed-loop cooling, saline water, by county
- Surface-water withdrawals, closed-loop cooling, freshwater, by county
- Surface-water withdrawals, closed-loop cooling, saline water, by county
- Power generated, once-through cooling, by county
- Power generated, closed-loop cooling, by county

Optional

- Deliveries from public supply, once-through cooling, by county
- Deliveries from public supply, closed-loop cooling, by county
- Consumptive use, once-through cooling, freshwater, by county
- Consumptive use, once-through cooling, saline water, by county
- Consumptive use, closed-loop cooling, freshwater, by county
- Consumptive use, closed-loop cooling, saline water, by county
- Number of facilities, once-through cooling, by county
- Number of facilities, closed-loop cooling, by county
- Reclaimed wastewater, once-through cooling, by county
- Reclaimed wastewater, closed-loop cooling, by county
- Any data aggregated by hydrologic cataloging unit

Sources of Information

For each USGS Water Science Center, the documentation for the previous compilations should be the starting point for planning the data collection for the 2005 compilation. The previous documentation for the thermoelectric-power category may contain the location and types of electronic and paper files; agency and contact information; agency and Internet resources; and methods, techniques, and coefficients used to collect or estimate data. Additional information concerning thermoelectric-power use may be obtained from the following sources. Other sources of information may be available in each State.

The NWUIP will provide a data file with average daily water withdrawals, water releases, consumptive use, and net power generated by thermoelectric power plants and cooling type and net power generated by CHP plants, respectively, in million gallons per day and giga-watt hours. The source of data for the derivative data file is the USDOE–EIA (U.S. Department of Energy–Energy Information Administration) electricity databases. USDOE–EIA maintains site-specific data for thermoelectric power and CHP plants with a name-plate rating of 10 megawatts or more. Since 2001, nuclear-fueled power plant data have not been collected through the water survey (EIA-767). However, nuclear-fueled power plants are included in the files that have power-generated (EIA-906) data and that available data will be included in the USGS derivative data file.

Agencies or Other Entities

Possible contacts for thermoelectric-power water-use data are listed as follows. Water-use data from these sources can range from reported water withdrawals to coefficients and ancillary data that can be used to estimate water withdrawals and power generation by cooling system type. Multiple data sets can be used to determine the best estimates and provide QA/QC.

- State agencies that administer water rights, allocate water to users, or collect water-use data
- State agency responsible for compliance with USEPA's Clean Water Act Program through the NPDES and PCS.
- State agency for power administration
- Regional "power pools" (groups of electric utility companies)
- Individual facilities
- Public suppliers (for deliveries)

Internet Resources

Many agencies and other entities maintain thermoelectric-power water-use information and databases on the Internet. Specific Internet addresses are listed as they appeared on the date last accessed.

- U.S. Department of Energy (DOE), accessed June 6, 2006, at <*http://www.energy.gov*>
  - Energy Information Administration (EIA, part of DOE), accessed June 6, 2006, at <*http://www.eia.doe.gov/*>
  - List of EIA electric power forms, accessed June 6, 2006, at <*http://www.eia.doe.gov/oss/forms.html*>

    This list includes contact information for each type of report.
  - EIA-906 (Monthly Utility Power Plant Database report, formerly EIA-759)—net generation, fuel type; monthly data for plants with nameplate capacity of 50 megawatts or more, annual data for plants with nameplate capacity of less than 50 megawatts, accessed June 6, 2006, at <*http://www.eia.doe.gov/cneaf/electricity/page/eia906u.html*>
  - EIA-767 (Annual Steam-Electric Plant Operation and Design Data)—net generation, fuel type, cooling-water process/source/rate; only plants with generating capacity of 10 or more megawatts, accessed June 6, 2006, at <*http://www.eia.doe.gov/cneaf/electricity/page/eia767.html*>
  - EIA-920 (Combined (Utility, Non-Utility, and Combined Heat & Power Plant)—monthly and annual data on generation and fuel consumption at the power plant and prime mover level. Data for utility plants are available from 1970 and for non-utility plants from 1999. Beginning with January 2004 data collection a new form, the EIA-920, has been used to collect data from the combined heat and power plant (cogeneration) segment of the non-utility sector, accessed June 6, 2006, at <*http://www.eia.doe.gov/cneaf/electricity/page/eia906_920.html*>
  - Energy data for each State (summaries, profiles, graphics), accessed June 6, 2006, at <*http://www.eia.doe.gov/emeu/states/_states.html*>
- USEPA, accessed June 6, 2006, at <*http://www.epa.gov/*>
  - Water Discharge Permits, PCS database, accessed June 6, 2006, at <*http://www.epa.gov/enviro/html/pcs/pcs_query_java.html*>

    Access to data regarding facilities holding NPDES permits. Specify the facilities by using any combination of facility name, geographic location, SIC code, and chemicals.

Compilation Techniques

Most water for thermoelectric use is self-supplied from freshwater or saline surface-water sources. Smaller quantities are derived from ground-water sources or provided by public suppliers. The recommended approach for compiling data for thermoelectric power is to use site-specific water-withdrawal data and power-generation data. Site-specific data can be that from USDOE–EIA (with the exception of nuclear-fueled power plants) that will be provided by the NWUIP, or can be collected from other sources. Federally mandated information collected and maintained by the USDOE–EIA, includes power-plant ownership, location, method of cooling, sources of water, average withdrawal rates, average discharge rates, operating status, and power generated. This information is collected from monthly and annual surveys of power plants. Information on net power generation and energy source may be found in the EIA-920 combined utility, nonutility, and combined heat and power plant database, formerly and successively, EIA-906 and EIA-759. Beginning with January 2004 data collection, the EIA-920 has been used to collect data from the CHP plants. EIA-767, Annual Steam-Electric Plant Operation and Design Data, contains cooling water information for all natural gas and fossil- and biomass-fueled plants with a generator nameplate rating of 10 or more megawatts. Average rate of water withdrawal, water release, and consumptive use to the nearest cubic foot per second by cooling system type for each generator and power plant are included in the EIA-767 database.

Water-withdrawal and power-generation data for the nuclear–fueled power plants and for the smaller plants with a generator rating of less than 10 megawatts will have to be collected using a different approach such as contacting the individual utility. If the contact person for a utility is not known, a good place to start is the person at the utility who prepares the Discharge Monitoring Reports (DMRs) for USEPA. DMRs contain information on volume discharged from all pipes in the facility and can be compared to the permit or permit application as to the source of the water and how it was used. The following selected terminology may help in conversations with utility personnel—blowdown, capacity, drift, and makeup water. These terms are defined in the Glossary section.

State agencies that administer water rights or monitor water use may have water-withdrawal information. The State agency that is responsible for compliance with USEPA's Clean Water Act is an important source for this information. USEPA administers the PCS database, which was designed to track permit, compliance, and enforcement status data for the NPDES program under the Clean Water Act. An NPDES permit is required for all point discharges into U.S. waterways. The PCS database contains descriptive information on major power-generating facilities, their location, and monthly return flows. The NPDES permit application and the permit itself usually include detailed descriptions of the plant that provide basic information on all the sources of supply for the plant, the different ways in which water is used in the plant, and water included in the reported discharge values.

Power-generation data can be used to estimate thermoelectric-power water withdrawals. A coefficient to estimate the gallons of water used per unit-hour of electricity generated is calculated using information on water withdrawals and power generation from plants of similar age, design, and cooling methods. This coefficient then can be multiplied by the amount of electricity generated during a specified time period by the plant for which withdrawals are being estimated. Coefficients ideally are derived using the gross power produced, if available. Monthly net power generation, in megawatt-hours, is available in the EIA-920 database but does not include the electricity used to run the power plant itself. The in-power plant electricity use that can be added to the net power is available from other EIA databases, but will not be part of the NWUIP derivative data file provided to the study chiefs.

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Supplemental Information

Coding Forms

The coding forms represent data matrices showing the category names as columns and the associated data elements as rows. The cells or boxes on the forms are either open or closed; a closed box is black and indicates that data cannot be stored in AWUDS for the data element corresponding to that cell. The forms are not intended to be used as manual coding forms, but as references summarizing the scope of the 2005 water-use compilation. The first form shows the data elements required for all States at the county aggregation level. There are no mandatory data elements for aquifers or Hydrologic Unit Codes (HUC) for 2005, and no state-level aggregations are allowed. The second, third, and fourth forms show all data elements supported in the Aggregate Water-Use Data System (AWUDS), with mandatory elements shaded in yellow, mandatory but null values allowed elements in yellow stripes, and optional elements in blue. Note that for irrigation, subdividing **Irrigation** into **Crop Irrigation** and **Golf Course Irrigation** is optional. If Golf Course Irrigation is not subdivided as a separate category, water use for golf course irrigation must be included in the **Irrigation** estimate.

Mandatory Data Elements for County

ESTIMATED USE OF WATER IN THE UNITED STATES

2005 Data Collection Form

County Name: _____ County Code: _____ Total Population (000s) †

Data Element	Public Supply	Domestic	Industrial	Thermoelectric: Once-through	Thermoelectric: Closed-loop	Mining	Livestock	Aquaculture	Irrigation
Withdrawals - GW - fresh						•	•	•	
Withdrawals - GW - saline						•			
Withdrawals - SW - fresh						•	•	•	
Withdrawals - SW - saline						•			
Population served - Total (000s)									
Deliveries from public supply									
Acres irrigated - sprinkler (000s)									
Acres irrigated - micro (000s)									
Acres irrigated - surface (000s)									
Power generated (gigawatt-hours)									
Reclaimed wastewater									

† Data will be provided by the National Water Use Program for all States.

• Data will be provided by the National Water Use Program for all States: States may make independent estimates if desired

Data Elements for County

ESTIMATED USE OF WATER IN THE UNITED STATES

2005 Data Collection Form

County Name: _____ County Code: _____ Total Population (000s): †

Data Element	Public Supply	Commercial	Domestic	Industrial	Thermoelectric: Once-through	Thermoelectric: Closed-loop	Mining	Livestock	Aquaculture	Irrigation (Crop/Golf is optional): Total	Irrigation (Crop/Golf is optional): Crop irrigation	Irrigation (Crop/Golf is optional): Golf-course irrigation	Hydroelectric: Instream	Hydroelectric: Offstream	Wastewater Treatment
Instream water use															
Withdrawals - GW - fresh							•	•	•						
Withdrawals - GW - saline							•								
Withdrawals - SW - fresh							•	•	•						
Withdrawals - SW - saline							•								
Population served - Total (000s)															
Population served - GW (000s)															
Population served - SW (000s)															
Deliveries from public supply															
Consumptive use - fresh															
Consumptive use - saline															
Conveyance loss															
Power generated (gigawatt-hours)															
Acres irrigated - sprinkler (000s)															
Acres irrigated - micro (000s)															
Acres irrigated - surface (000s)															
Facilities (number)															
Wastewater returns-public facil.															
Reclaimed wastewater															

† Data will be provided by the National Water Use Program for all States.

• Data will be provided by the National Water Use Program for all States: States may make independent estimates if desired

Data Elements for Aquifer

Aquifer Name: _____ Aquifer Code: _____ Total Population (000s): [ ]

Data Element	Public Supply	Commercial	Domestic	Industrial	Thermoelectric: Once-through	Thermoelectric: Closed-loop	Mining	Livestock	Aquaculture	Irrigation (Crop/Golf is optional): Total	Crop irrigation	Golf-course irrigation
Withdrawals - GW - fresh												
Withdrawals - GW - saline												
Population served - GW (000s)												

ESTIMATED USE OF WATER IN THE UNITED STATES

2005 Data Collection Form

HUC Name: _____ HUC: _____ Total Population (000s): [ ]

Data Element	Public Supply	Commercial	Domestic	Industrial	Thermoelectric: Once-through	Thermoelectric: Closed-loop	Mining	Livestock	Aquaculture	Irrigation (Crop/Golf is optional): Total	Irrigation (Crop/Golf is optional): Crop irrigation	Irrigation (Crop/Golf is optional): Golf-course irrigation	Hydroelectric: Instream	Hydroelectric: Offstream	Wastewater Treatment	Reservoir Evaporation
Instream water use																
Withdrawals - GW - fresh																
Withdrawals - GW - saline																
Withdrawals - SW - fresh																
Withdrawals - SW - saline																
Population served - Total (000s)																
Population served - GW (000s)																
Population served - SW (000s)																
Deliveries from public supply																
Consumptive use - fresh																
Consumptive use - saline																
Conveyance loss																
Power generated (gigawatt-hours)																
Acres irrigated - sprinkler (000s)																
Acres irrigated - micro (000s)																
Acres irrigated - surface (000s)																
Facilities (number)																
Wastewater returns-public facil.																
Reclaimed wastewater																
Reservoir surface area (thous. ac)																
Reservoir evaporation (thous ac-ft)																