

WATER-USE DATA COLLECTION TECHNIQUES IN THE SOUTHEASTERN UNITED STATES, PUERTO RICO, AND THE U.S. VIRGIN ISLANDS

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CONVERSION FACTORS

Multiply	By	To obtain
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
foot squared per day (ft ² /d)	0.0929	meter squared per day
acre	4,047	square meter
acre-foot (acre-ft)	1,233	cubic meter
gallon (gal)	0.9464	liter
gallon per day (gal/d)	0.003785	cubic meter per day
million gallons per day (Mgal/d)	0.0438	cubic meter per second
ton	0.9072	megagram

WATER-USE DATA COLLECTION TECHNIQUES IN THE SOUTHEASTERN UNITED STATES, PUERTO RICO, AND THE U.S. VIRGIN ISLANDS

**By
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ABSTRACT

This report describes the techniques and methods used by the U.S. Geological Survey, State, and local cooperators to collect water-use data from 1985-90 in the following Southeastern States, Commonwealth, or Territory: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Puerto Rico and the U.S. Virgin Islands, South Carolina, and Tennessee. In 1977, the Congress of the United States directed the U.S. Geological Survey to establish a National Water-Use Information Program to complement the Survey's data on availability and quality of the Nation's water resources. Water-use data are collected in as many as 11 categories as part of this national water-use information program. The water-use categories that are addressed in this report include: public-supply, domestic, industrial, commercial, mining, livestock, irrigation, power generation, and sewage-treatment (Solley and others, 1988). In addition to the previously mentioned categories of water use, Alabama collects water-use information pertaining to navigation and preservation, and Florida collects miscellaneous water-use data. The information in this report is displayed by State or political unit and by water-use category.

Each State section includes the following information: a definition of each category of use, the source of information, a description of how the data are collected, the technique used for estimating water use for the category, a listing of the data components necessary for estimating water use for each category, and a description of how the water-use information is aggregated.

INTRODUCTION

During the last 40 years there have been numerous reports published on the subject of water use. Primarily, these reports described a particular category of water use or geographical area for which data on the various categories of water use are given. Since 1950, the U.S. Geological Survey (USGS) has published national estimates of water use in the United States at 5-year intervals (MacKichan, 1951, 1957; MacKichan and Kammerer, 1961; Murray, 1968, 1977; Murray and Reeves, 1972; and Solley and others, 1983, 1988). These estimates were derived from a variety of sources and ranged widely in accuracy. In most States, the State cooperator defines the categories of water use that are of interest to them and collects water-use data for those categories. In many cases, the definitions and collection techniques used by the cooperators are unique. This situation makes it difficult to standardize terminology and definitions across State boundaries and creates confusion for new and inexperienced water-use personnel. In some cases, water-use data for a particular category may not be directly collected or reported, but rather must be estimated by the best possible method available. It is important to understand the estimation techniques being used in each State or political unit.

Background

In 1977, the U.S. Congress recognized the need for uniform, current, and reliable information on water use and directed the USGS to establish a National Water-Use Information Program to complement the Survey's data on the availability and quality of the Nation's water resources. The USGS, as directed, has established national guidelines and standards to meet regional and national

needs. Prior to 1977, the national 5-year water-use compilations were virtually unfunded, and the accuracy of the estimates varied for each State or political unit. As of 1988, 49 States and Puerto Rico were participating in the cooperative program to varying degrees (Solley and others, 1988).

States now (1992) have personnel specifically funded by and assigned to the water-use program. These water-use specialists become familiar with the availability and reliability of water-use information in their State, and work closely with cooperators in obtaining reliable estimates of water use at the State level. Water-use information can be electronically stored in databases developed and maintained by the USGS. Many states in the southeastern United States store their data in the Site-Specific Water Use Data System (SSWUDS). Estimates of water use are aggregated by State, county, and Hydrologic Cataloging Unit in the Aggregate Water Use Data System (AWUDS). AWUDS is a USGS database and supporting software designed to store and manipulate water-use information. Every 5 years aggregate data are published in a USGS circular (Solley and others, 1988); work is currently underway for the 1990 compilation. Aggregate information included in these circulars illustrates ground- and surface-water withdrawals and deliveries for all categories summarized by hydrologic region and by State. Although water-use data aggregated by hydrologic cataloging unit are published at the hydrologic region level, all data are compiled and stored in AWUDS by hydrologic cataloging unit and by county. Software available through AWUDS can be useful to redistribute and output the data at the hydrologic region or subregion level.

Purpose and Scope

During the national aggregate water-use data collection effort in 1985, each State or political unit was required to document the sources of information, and the techniques used for compilation of these data. These sources and techniques were updated for collecting water-use data between 1985 and 1990.

The purpose of this report is to describe the water-use data collection and estimation techniques currently (1990) being practiced in the southeastern United States (fig. 1), and to reflect the differences in terminology used. In addition, the types and sources of data collected are documented.

The report describes the techniques used to collect water-use data in the southeastern states for the following categories (R.R. Pierce, U.S. Geological Survey, written commun., 1989):

1. public-supply
2. domestic
3. industrial
4. commercial
5. mining
6. livestock
7. irrigation
8. power generation (including hydroelectric, thermoelectric, and nuclear power generation)
9. sewage treatment (releases)

Additionally, in Florida, miscellaneous water-use data (flow data for free-flowing wells and water use for air-conditioning systems) are collected, and, in Alabama, water-use data for recreation, preservation, and navigation are collected.

Information described for each water-use category includes: a definition of the category (if it is different from those listed in the glossary), and the name of the State or Federal agency, or other organization that provides water-use information. Each State section also includes a description of how this information is collected or estimated, a list of the data elements for making the water-use estimate, and a description of the necessary steps required for computations when applicable. A description of the process for converting water-use totals from county aggregates to hydrologic

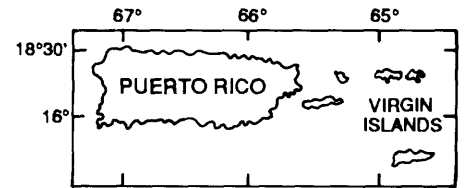
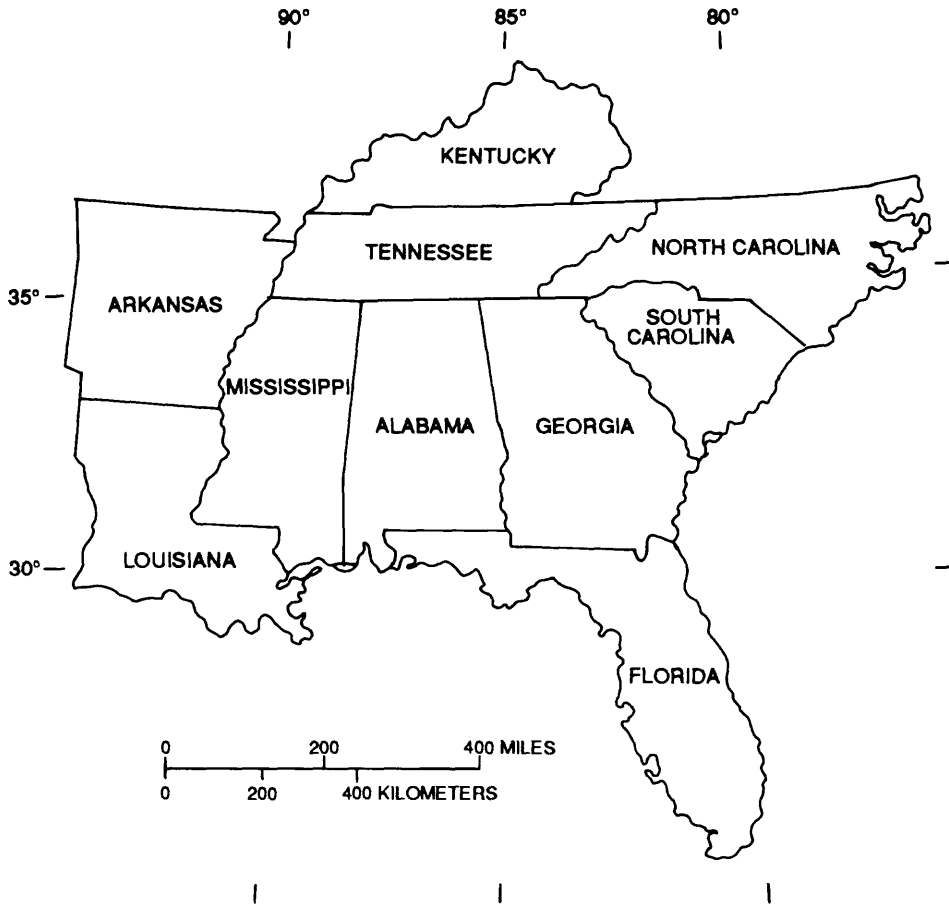


Figure 1.--Southeastern states, Puerto Rico, and the Virgin Islands in the study area.

cataloging units (Seaber and others, 1984) also is discussed. Unless otherwise indicated, water-use totals for each category are compiled for each hydrologic cataloging unit by aggregation of the site-specific data located within each cataloging unit.

Terminology

A general knowledge of the following terms will enhance the reader's ability to understand the types of data collected and the methods used to collect this information. Aggregated and site-specific water-use information are the two types of data collection techniques discussed in this report.

Site-specific water-use data refer to information obtained about an individual withdrawal, transfer, or release point. Site-specific data generally are composed of measured values, or calculations based on specific information about the site (pump capacity, duration of pumping, and amount of water withdrawn), and are used when a high degree of accuracy is important. Site-specific data usually require substantial resources to collect and maintain; however, these data are essential elements in many hydrologic investigations. For example, site-specific data are necessary for determining ground- and surface-water rates of depletion and recharge, and for predicting the availability of future supplies (Baker, 1990).

Aggregated water-use data, as used in this report, refer to a group of sites for each of 11 categories of use. Water-use data can be aggregated by county, hydrologic cataloging unit, water-use category, or any other useful groupings. Aggregated data can be composed of site-specific data that have been grouped or summed, or can be indirectly derived from estimations or calculations based on general information (such as population, total crop acreages, and water-application rates). Estimations and calculations based on general information often are used when existing resources are limited or when a high degree of accuracy is not critical.

Offstream water use describes water that is diverted or withdrawn from a ground- or surface-water source and conveyed to the place of use. To determine the quantity of water used and by whom the water was used, it is necessary to understand the possible routes of conveyance (fig. 2).

1. Withdrawal--the quantity of water diverted or withdrawn from a ground- or surface-water source (A in fig. 2).
2. Delivery/release--the quantity of water delivered at the point of use (B) (self-supply or public-supply) and the quantity released after use (C). The differences between these volumes, in some instances, will be the consumptive use, or the quantity of water that is not returned directly to any water source.
3. Return flow--the quantity of water that is discharged to a stream or well (D) after release from the point of use and thus becomes available for further use.

Instream use describes water uses that are not dependent on diversion or withdrawal from ground- or surface-water sources. They are usually classified as flow uses or onsite uses. Examples of instream uses, which depend on water running freely in a channel, are hydroelectric power generation, freshwater dilution of saline estuaries, maintenance of minimum streamflow to support fish propagation, and the dilution of wastewater.

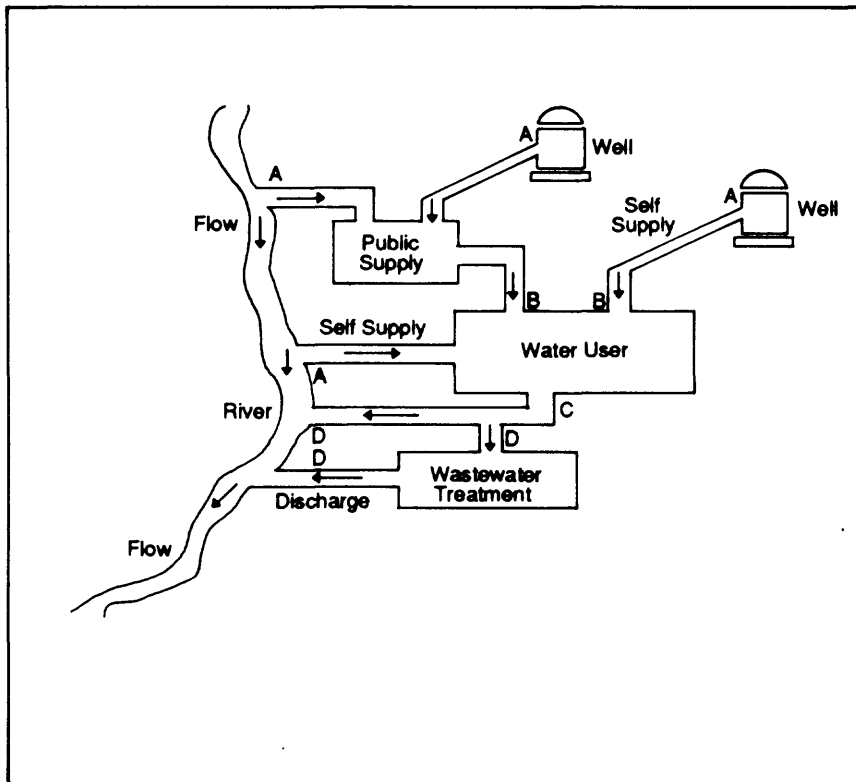


Figure 2.--Example of possible water conveyance routes for offstream water use (Solley and others, 1985).

Hydrologic unit code refers to an 8-digit code identifying the facility's location with reference to the areal breakdown shown of State hydrologic unit maps. The format is (RRSSAACC) where:

- RR is the 2-digit code for the Water Resources Council Region,
- SS is the 2-digit code for the Water Resources Council subregion,
- AA is the 2-digit code for the National Water Data Network Accounting Unit, and
- CC is the 2-digit code for the cataloging unit of the catalog of information on water data maintained by the Office of Water Data Coordination.

Hydrologic unit codes are given in the U.S. Geological Survey Map Series "State Basic Hydrologic Unit Maps." The series provides a uniform, nationally consistent set of maps showing drainage, cultural features, hydrographs, and hydrologic boundaries. Water-use data are collected and compiled at the hydrologic cataloging unit level.

Report Format

The first 11 sections of the report describe water-use data collection techniques used in the Southeastern United States, Puerto Rico, and the U.S. Virgin Islands. These 11 sections are divided by State or political unit and by water-use category. Each section includes the following information:

1. a definition of each category of use,
2. the source of information,
3. a description of how the data are collected,
4. the technique used for estimating water use for the category,
5. a listing of the data components necessary for estimating water use for each category, and
6. a description of how the water-use information is aggregated.

The next three sections of the report include a general summary, selected references, and a glossary, respectively. The final three sections of the report are appendices. The first appendix contains tables that represent sources of water-use information by water-use category. The second appendix contains tables representing the coefficients and formulas used for estimating water use by water-use category. The last appendix contains a variety of water-use data collection forms used in the Southeastern United States, the Commonwealth of Puerto Rico, and territory of the Virgin Islands of the United States.

Acknowledgments

We would like to acknowledge the water-use project personnel in the USGS Southeastern Region and each State cooperator for their assistance in the compilation of information for this report. State water-use project personnel provided water-use information by several methods including: a mail survey, telephone interviews, and in some instances personal interviews.

DATA COLLECTION TECHNIQUES IN ALABAMA

Water-use data in Alabama are collected by the Geological Survey of Alabama (GSA) in cooperation with the USGS. The nine national water-use categories listed in the Introduction are collected in Alabama. Information on navigation, recreation, and preservation water use also are collected. Public-supply, industrial, commercial, mining, power generation, and sewage treatment water-use data are collected by contacting the appropriate agency or facility. Domestic, livestock, and irrigation water use are estimated using population or acreage estimates and water application rates. The categories of water-use data collected in Alabama and the associated sources of information are given in table 1.

Public-Supply Water Use

Public-supply systems in Alabama are classified as facilities that serve either more than 25 people, other public water-supply systems, industrial customers, or commercial customers. There are approximately 680 public-supply facilities in Alabama. Information about public-supply systems is solicited by the GSA by questionnaire. Data collected on these questionnaires include the amount of water withdrawn by month, location of the withdrawal site, source of the withdrawal (ground or surface water), number of connections, population served, and identification of any customer receiving more than 2,000 gal/d. Public-supply water is estimated in Alabama to be 7 percent consumed (Solley and others, 1983). Public-supply water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these hydrologic cataloging units.

Table 1.--Alabama: Categories of water use and sources of information

Water-use category	Data sources
Public supply	Geological Survey of Alabama (withdrawal/delivery questionnaires) U.S. Department of Commerce, Bureau of the Census
Domestic supply	Geological Survey of Alabama Tennessee Valley Authority U.S. Department of Commerce, Bureau of the Census
Industrial	Alabama Department of Economic and Community Affairs Alabama Department of Environmental Management (computer files)
Commercial	Alabama Department of Environmental Management (files)
Mining	Alabama Department of Industrial Relations Alabama Department of Economic and Community Affairs Alabama Department of Environmental Management (files) Alabama Oil and Gas Board (permit files) Geological Survey of Alabama (telephone survey)
Livestock	Alabama Cooperative Extension Service, Auburn University Alabama Crop and Livestock Reporting Service U.S. Department of Agriculture
Irrigation	Alabama Cooperative Extension Service, Auburn University Geological Survey of Alabama
Power generation thermoelectric	Alabama Power Company Alabama Electric Cooperative Southeastern Power Administration U.S. Department of Energy Tennessee Valley Authority
hydroelectric	Alabama Power Company Alabama Electric Cooperative Southeastern Power Administration U.S. Army Corps of Engineers

Table 1.--Alabama: Categories of water use and sources of information--Continued

Water-use category	Data sources
Sewage treatment	Alabama Department of Environmental Management (computer files)
Navigation	U.S. Army Corps of Engineers Tennessee Valley Authority
Recreation/Preservation	Alabama Department of Conservation (Parks and Recreation) Tennessee Valley Authority U.S. Army Corps of Engineers

Domestic Water Use

Water withdrawals for domestic purposes are determined by subtracting the population served by public-supply facilities (from the GSA questionnaire) from the total population of the county or hydrologic unit, then multiplying this number by the water-use coefficient of 75 gal/d per person (Wentz and Baker, 1986). The population served by public-supply facilities is provided by the GSA questionnaires (used to solicit public-supply information). County populations are provided by the U.S. Department of Commerce, Bureau of the Census (1986). Domestic water is considered to be 100 percent consumed. Self-supplied domestic water-use totals for each hydrologic cataloging unit are determined by disaggregation of county data based on the percentage of the population located within each hydrologic cataloging unit.

Industrial Water Use

Industrial water use is determined by collection of individual facility data obtained from the Alabama Department of Environmental Management (ADEM) computer files. These files provide data about the number of employees, source and type of water used, amount of water purchased, amount of water withdrawn (in gal/d), mailing address, and telephone number. In addition, an updated list of manufacturers is obtained from the Alabama Department of Economic and Community Affairs (ADECA) (Alabama Development Office, 1985). From this updated list, GSA conducted a mail survey (appendix 3, page 3-2 and 3-3) of self-supplied industrial users. Consumptive water use is estimated by multiplying the industrial water-use total by county by the national average consumptive use rate of 22 percent (Solley and others, 1983). Industrial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within each hydrologic cataloging unit.

Commercial Water Use

Commercial water-use information is obtained from ADEM computer files. In these files commercial users are classified as "noncommunity systems". Data included in the ADEM files about these commercial users are similar to those for public-supply and industrial water users. Consumptive water-use estimates for commercial water users are determined to be the same as for industrial water users, 22 percent (Solley and others, 1983). Commercial water-use totals for each hydrologic cataloging unit are compiled by aggregation of the site-specific data located within each hydrologic cataloging unit.

Mining Water Use

In Alabama, mining water use is primarily associated with coal extraction, and oil and gas wells. The GSA obtains water-use data by a telephone survey of the larger mining companies in Alabama. The Alabama Development Office provides a master list that contains names, addresses, and telephone numbers of mining operations in Alabama. The survey collects information regarding the location of the mining operation, source of the withdrawal, and amount of water used. Identical information concerning withdrawals from oil and gas wells are provided by the Alabama Oil and Gas Board from its permit files. Consumptive use for mining is considered to be negligible because essentially all the water used is returned to streams. Mining water-use totals for each hydrologic cataloging unit are compiled by aggregation of the site-specific data located within each hydrologic cataloging unit.

Livestock Water Use

The livestock water-use category includes water that is used for aquaculture and livestock operations. Estimates for aquaculture water use are made by multiplying the total pond acreage (used for catfish farming) by the average water-use application rate for catfish (4 ft of water per acre). In Alabama, 75 percent of the water used for aquaculture is estimated to be from ground-water sources and 25 percent is estimated to be from surface-water sources. These aquacultural water-use data (acreage, application rate, and source) are supplied by Curtis and Tyson (1986) and the U.S. Department of Agriculture. The estimated consumptive use rate for aquaculture is 27 percent. This consumptive use estimate is provided through personal consultation with the State Conservationist (Alabama Cooperative Extension Service, oral commun., 1985).

Livestock water use for livestock (animal) operations is estimated based on the number of livestock in each county and the average daily water consumption (in gal/d) for each type of stock. The numbers and types of livestock within the State are provided by the Alabama Crop and Livestock Reporting Service (1985). The rates of use for livestock are as follows:

Type of livestock	Average daily consumption (gallons per day)
Dairy cattle	35
Other cattle	12
Hogs	5
Poultry	.05

In addition, water-use values for a given livestock type are divided by water source based on the following percentages (R.M. Baker, Geological Survey of Alabama, oral commun., 1985):

1. Dairy cattle - 90 percent ground water and 10 percent surface water,
2. Other cattle - 40 percent ground water and 60 percent surface water,
3. Hogs - 40 percent ground water and 60 percent surface water, and
4. Poultry - 90 percent ground water and 10 percent surface water.

Livestock water use is considered to be 100 percent consumed (R.M. Baker, Geological Survey of Alabama, oral commun., 1985). Livestock water-use totals for each hydrologic cataloging unit are determined by disaggregation of county data, based on the percentage of the county area located within each hydrologic cataloging unit.

Irrigation Water Use

Irrigation water use is determined by multiplying the number of irrigated acres per crop type (within a county) by the appropriate application rate. Irrigation water-use estimates are based on information reported by Curtis and Tyson (1986) and from the GSA files. Data reported by these sources include: the number of acres irrigated by county, the type of crops grown, the source of water, and average application rate for each crop. The water-use application rate for the primary crops (corn, soybeans, peanuts, and plant nurseries) is 6 in. per acre. Because most irrigation systems in Alabama are center pivot, it is assumed that there are no conveyance losses. The estimated consumptive rate for irrigation water is 75 percent (Baker and Mooty, 1987). Irrigation water-use totals for each hydrologic cataloging unit are determined by disaggregation of county data based on the percentage of the county area located within each hydrologic cataloging unit.

Power Generation Water Use

Power generation water-use data are collected for both thermoelectric and hydroelectric plants. Water is used and consumed differently at these two types of generation plants. At thermoelectric power generation facilities such as fossil-fuel and nuclear power plants, water is used for cooling purposes and boiler make-up water. At hydroelectric power generation facilities, water is used to turn the turbines that generate electricity.

There are currently (1990) 11 coal-fired and 3 nuclear power plants licensed in Alabama. The largest generation companies or power utility companies in the State--Alabama Power Company, Alabama Electric Cooperative, Southeastern Power Administration of the U.S. Department of Energy, and the Tennessee Valley Authority (TVA)--furnished water-use figures related to power generation. These companies provided the following information: a list of their power generating facilities, facility location, facility type, annual power produced, water withdrawn, and a consumptive water-use estimate. For thermoelectric power generation it is estimated that less than 2 percent of the water withdrawn is consumed.

In Alabama, there are 21 operating hydroelectric facilities. Similar data are collected for the hydroelectric power generating facilities as for thermoelectric. Hydroelectric power generation requires large volumes of water to produce power, but no water is consumed as the water passes through the turbines. Power generation water-use totals for each hydrologic cataloging unit are determined by aggregation of site-specific data located within each hydrologic cataloging unit.

Sewage-Treatment Water Use

Data for sewage-treatment facilities are obtained from ADEM computer files. These files contain the location of the facility, the name and type of wastewater-treatment facility, and the permitted maximum volume of water to be discharged or released. Sewage-treatment release totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within each hydrologic cataloging unit.

Navigation Water Use

Navigation water use occurs in stream channels and reservoirs where surface water is utilized as a means of commercial transportation. There are currently (1990) 4 lock-and-dam or slackwater navigation systems with a total of 14 locks in operation in Alabama. Water use for navigation is determined by multiplying water requirements for the individual locks by the number of lockages per lock per year. To determine the water requirement for each lock, the inside area of the lock is multiplied by the lift range of the lock. The lift range is the amount of water required to lift a vessel within the lock to the appropriate level of water outside the lock. The lock water requirement

multiplied by the number of lockages equals the volume of water per lock for navigation use. The lock dimensions (inside area of the lock), lift ranges, and the number of lockages are provided by the U.S. Army Corps of Engineers and the TVA.

Recreation and Preservation Water Use

Recreation and preservation water use occurs at facilities where bodies of water are used for recreational activities or for preservation, maintenance, or enhancement of a natural resource, including wildlife preserves and wetlands. Recreation use generally is measured in terms of the number of annual site visits per person per facility. The number of site visits is then multiplied by a per capita water-use coefficient. The sum of the per capita water-use coefficient is equal to the amount of water used by visitors for sanitary purposes, drinking, and bathing at various recreational facilities. Preservation area usage is the amount of surface water used for fish and wildlife preserves and wetlands. Data for these categories are provided by the following agencies: the Alabama Department of Conservation (Parks and Recreation), the TVA, and the U.S. Army Corps of Engineers.

DATA COLLECTION TECHNIQUES IN ARKANSAS

Water-use data in Arkansas are monitored by the Arkansas Soil and Water Conservation Commission (ASWCC) in cooperation with USGS. All nine national water-use categories listed in the Introduction are collected in Arkansas (table 2).

Water users that withdraw more than 50,000 gal/d from ground water or divert more than 325,900 gal (1 acre-ft) of surface water per water year must report their water use to ASWCC by completing a water-use registration form (appendix 3, pages 3-4 to 3-7). There are two types of registration forms: (1) the General Water Use Registration Form, which is used for reporting public-supply, industrial, commercial, mining, and power generation (hydroelectric and thermoelectric) water use, and (2) the Agricultural Water Use Registration Form, which is used for irrigation and agricultural (livestock and aquaculture) uses. Domestic withdrawals and sewage-treatment water use are excluded from these registration forms, but water use for these categories is collected or estimated by other methods.

Public-Supply Water Use

Public-supply facilities furnish water for drinking, general domestic, commercial, and industrial use in incorporated municipalities or unincorporated communities consisting of 10 or more connections or of 25 or more people for a period of 60 days or more each year. Water-use information is collected for the public-supply water-use category by a mail survey conducted by ASWCC (appendix 3, pages 3-5 to 3-7). The approximately 700 public-supply facilities in the State on the master list of the Arkansas Department of Health (1989) are mailed General Water Use Registration Forms to be completed by public-supply system operators. A section of the General Water Use Registration Form is designed to obtain the appropriate information for the public-supply water-use category, in addition to withdrawal amounts, such as the amount of water purchased from other facilities, the amount of water sold to other facilities, the domestic population served, the amount of water delivered to various types of users, and the number of connections for each type of user. The format of these forms is designed to match the data-entry requirements of the USGS Site-Specific Water Use Data System to aid in the data entry process.

Consumptive use totals are not collected on water use registration forms. Consumptive use coefficients are determined by previous municipal surveys to be 20 percent of the total amount withdrawn (Holland, 1987). Consumptive use was assumed to be 100 percent of withdrawals for those communities that have no sewage systems. Information on communities having sewage systems is obtained from the Arkansas Department of Pollution Control and Ecology. Public-supply water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within each hydrologic cataloging unit.

Table 2.--Arkansas: *Categories of water use and sources of information*

Water-use category	Data sources
Public supply	Arkansas Soil and Water Conservation Commission (General Water Use Registration Forms) Arkansas Department of Health, Division of Engineering (Arkansas Community Public Water System List)
Domestic	Arkansas Soil and Water Conservation Commission (General Water Use Registration Forms) U.S. Department of Commerce, Bureau of the Census
Industrial	Arkansas Soil and Water Conservation Commission (General Water Use Registration Forms) Arkansas Industrial Development Foundation (Arkansas Directory of Manufacturers)
Commercial	Arkansas Soil and Water Conservation Commission (General Water Use Registration Forms) U.S. Army Corps of Engineers U.S. Department of Agriculture, Forest Service Arkansas Department of Parks and Tourism
Mining	Arkansas Geological Commission U.S. Department of the Interior, Bureau of Mines U.S. Department of Energy Arkansas Oil and Gas Commission
Livestock	Arkansas Soil and Water Conservation Commission (Agricultural Water Use Registration Forms) U.S. Department of the Interior, Fish and Wildlife Service, Fish Farming Experimental Laboratory Arkansas Game and Fish Commission University of Arkansas, Cooperative Extension Service U.S. Department of Agriculture, Crop Reporting Service
Irrigation	Arkansas Soil and Water Conservation Commission (Agricultural Water Use Registration Form)
Power generation	Arkansas Soil and Water Conservation Commission (General Water Use Registration Forms) Arkansas Power and Light Company Arkansas Electric Cooperative U.S. Department of Energy, Southwest Power Administration U.S. Army Corps of Engineers

Table 2.--Arkansas: *Categories of water use and sources of information*--Continued

Water-use category	Data sources
Sewage treatment	Arkansas Department of Pollution Control and Ecology National Pollution Discharge Elimination System (computer files)

Domestic Water Use

Domestic water users are defined as individual families and small communities not served by a public-supply system. Domestic water use is determined by subtracting the population served by public-supply facilities within a county or hydrologic unit area from the total population of the county or hydrologic unit area, then multiplying this number by a per capita use of 89 gal/d. The per capita use is derived by averaging the per capita use in 20 small public-supply systems, minus an estimated 15 percent transmission loss associated with public-water systems. The number of people served by public-supply facilities is estimated from responses to the general registration forms sent to water supply facilities in the State. The county populations are provided by the U.S. Department of Commerce, Bureau of the Census (U.S. Department of Commerce, written commun., 1986). An estimated 95 percent (Holland, 1987) of the rural residents in Arkansas have indoor plumbing in their homes. A water-use coefficient of 20 gal/d per person is applied to the remaining 5 percent of the rural residents. Data on water provided by public-supply facilities for domestic uses are included on the general registration form provided by ASWCC.

In Arkansas, water used for domestic purposes is considered to be 100 percent consumed. Domestic water-use totals for each hydrologic cataloging unit are determined by disaggregation of county data using the percentage of the population located within the hydrologic cataloging unit. These hydrologic cataloging unit subtotals for each county are then regrouped for the State and totaled.

Industrial Water Use

Only self-supplied industrial establishments are included in the industrial water-use category. The industries that make up the majority of this category include the primary metals industry, chemical and allied products industry, paper and allied products, and the petroleum and coal products industry. Industrial water-use information is collected by a mail survey conducted by the ASWCC (appendix 3, pages 3-5 to 3-7). A master list of industrial facilities is obtained from the latest edition of the Arkansas Directory of Manufacturers (Harrington, 1990). This directory lists the industries and manufacturers in the State and contains the following information: location of the facility, mailing address, telephone number, the name of a contact person, the number of employees, type of products produced, and their associated SIC (Standard Industrial Classification) codes. These industries are grouped by the city in which they are located. Periodically, a telephone survey of public-supply facilities is conducted to determine the number of industries that are self supplied within their local area. General Water Use Registration Forms are mailed to approximately 150 self-supplied industrial facilities in the State. Industrial consumptive use is estimated to be 12 percent of the total water withdrawn (Solley and others, 1988). Industrial water-use totals for each hydrologic cataloging unit are determined by aggregation of site-specific data with these specific areas.

Commercial Water Use

Only self-supplied commercial establishments are categorized as commercial water users. In addition to the type of establishments generally listed in the commercial category, in Arkansas, private hunting clubs are included in the commercial category. The ASWCC collects commercial water-use data from a mail survey of selected commercial operations in the State (appendix 3, pages 3-5 to 3-7). These data are reported on General Water Use Registration Forms. The following commercial facilities report their water use to ASWCC: private duck hunting clubs, parks operated by the U.S. Department of Agriculture, Forest Service, several State parks, and several self-supplied military facilities located in the State. Deliveries to commercial facilities from public-supply systems are estimated from information reported on the General Water Use Registration Forms completed by the public-supply facilities.

Water use is estimated for many commercial facilities in the State. These commercial facilities include parks operated by the U.S. Army Corps of Engineers, State parks, national parks, and recreation areas that are not required to report to the ASWCC. Commercial water use is estimated by multiplying a water-use coefficient of 30 gal/d per person (E. Fugate, Arkansas Department of Parks and Tourism, written commun., 1980) by the monthly or yearly park attendance figures obtained directly from the managing agency (table 2). Commercial consumptive use is estimated to be 70 percent of the total water withdrawn (Holland, 1987). Commercial water-use totals for each hydrologic cataloging unit area are determined by aggregation of site-specific data located within these specific areas.

Mining Water Use

Water used by Arkansas mining operations includes water used for the extraction of minerals; naturally occurring solids, such as coal, and ores; liquids, such as crude petroleum; and gases, such as natural gas. This category also includes water used for quarrying, dewatering, and milling (crushing, screening, washing, floatation and other processing customarily performed at a mine site, or as part of the mining operation). Mining water use is estimated by multiplying the quantity of product mined or pumped by the water-use coefficient for that type of product. These water-use coefficients were determined during a 1982 telephone survey (table 3).

Table 3.--*Mined water-use coefficients in Arkansas*

[gallons/ton, gallons per ton; gallons/barrel, gallons per barrel]

Mined product	Water use (per unit mined or pumped)
Abrasives (oil stone and whet stones)	Negligible
Bauxite	140 gallons/ton
Bromine brine	7.5 gallons/barrel
Cement	220 gallons/ton
Clays	30 gallons/ton
Gem stones	Negligible
Gypsum	Negligible
Lime	10 gallons/ton
Quartz	Negligible
Sand and gravel	150 gallons/ton
Stone (crushed and dimension)	30 gallons/ton
Sulphur	Negligible
Talc	Negligible
Tripoli	Negligible

Information on the quantities of products mined is obtained from several sources. The quantities of nonfuel products mined is estimated by the Arkansas Geological Commission in cooperation with the U.S. Department of the Interior, Bureau of Mines (White and Bush, 1988). Information in this report includes the type of nonfuel mineral commodity produced, the name and address of the company, type of activity, and the county in which the operation is located. Similar information concerning coal and other fuel product mining operations is obtained from the U.S. Department of Energy (A. Perry, U.S. Department of Energy, written commun., 1986). Information pertaining to the number of oil and gas wells drilled and the per well water-use coefficient are provided by the Arkansas Oil and Gas Commission (B. Wright, Arkansas Oil and Gas Commission, written commun., 1988). Consumptive use for mining is considered to be 100 percent of the total water withdrawn (Holland, 1987). Mining water-use totals for each hydrologic cataloging unit area are determined by aggregation of site-specific data located within these specific areas.

Livestock Water Use

Livestock water use includes water used for stock watering, feed lots, dairy operations, aquaculture (fish farming), and other on-farm needs. A large part of the water-use information for aquaculture is provided from responses to the Agricultural Water Use Registration Form distributed by ASWCC (appendix 3, page 3-8). Due to the lack of responses in some counties, it is necessary to estimate the water use for aquaculture in some areas. Most fish are raised in large levee ponds. Water withdrawals for aquaculture are used to maintain appropriate pond levels and to provide aeration. Water used for livestock is estimated.

Aquaculture uses the largest amount of water in this category. Water-use estimates for aquaculture by county are calculated by multiplying the acreage used for aquaculture by a water-use application rate. This volume of water is multiplied by the duration of pumping, and the result is an estimate of the total water use for aquaculture in that county. For intensive aquacultural operations the total acreage used for aquaculture by county and the type of fish stocked in each pond is provided by the U.S. Fish and Wildlife Service, Fish Farming Experimental Laboratory, Stuttgart, Arkansas (B. Collins and D. Sample, U.S. Fish and Wildlife Service, written commun., 1989), and the University of Arkansas Cooperative Extension Service (L.W. Dorman, University of Arkansas Cooperative Extension Service, written commun., 1989). For nonintensive (rough fish ponds and fishing lakes) aquacultural operations acreage figures are provided by the Arkansas Game and Fish Commission (J. Farwick, Arkansas Game and Fish Commission, oral commun., 1988).

Application rate estimates are based on water-use studies by the USGS on selected aquacultural operations in the State. These aquacultural operations are monitored to collect well pumpage and duration of pumping information. Well pumpage is measured using one of the following instruments or methods: a noninvasive flow meter, the Trajectory method, or an in-line flow meter. The duration of pumping is recorded by electric meter, a digital vibration time totalizer, or a digital inductive time totalizer attached to the pump. The duration of pumping is multiplied by an average measured pump discharge to calculate a total withdrawal for the well. This withdrawal is then divided by the pond acreage in order to determine the application rate. This process is duplicated for all sites in the study network. Upon completion of these studies, a mean application rate is determined. Consumptive use for aquaculture is estimated to equal approximately 38 percent of the water withdrawn (J.A. Callahan, U.S. Geological Survey, oral commun., 1988).

The livestock category also includes the use of water for the production of livestock (animals). Data components required for the estimation of water use for livestock include county livestock population and the appropriate water-use coefficient for each type of livestock produced within the State. Livestock population values for Arkansas are published by county by the U.S. Department of Agriculture Crop Reporting Service (U.S. Department of Agriculture, 1989). Water-use coefficients for livestock are listed on the next page.

Livestock	Water required (gallons per day)
Dairy cattle	30
Other cattle	15
Hogs	2
Poultry	
100 broilers	4
100 hens	6
100 turkeys	8

Water used for livestock (animal) production was estimated to be 100 percent consumed. Livestock water-use totals for the hydrologic cataloging unit areas are determined by disaggregation of county data, based on the percentage of the county area located within the hydrologic unit.

Irrigation Water Use

Irrigation water users register their water use through Local Conservation District Offices located in every county in Arkansas. Agricultural Water Use Registration Forms (appendix 3, page 3-8) are completed by Conservation District personnel during personal interviews with the farmers. The farmer is required annually to report their water usage (in acre-ft per year) to their Local Conservation District Office according to Act 1051 of 1985. The primary information collected on the Agricultural Water Use Registration Form includes the kind of crops grown, the number of acres irrigated, and ancillary pump data. Upon completion of the data collection process these forms are forwarded to ASWCC. The ASWCC performs quality assurance tests (location verification, mathematical check of monthly and annual amounts) on the data and then these data are forwarded to the USGS for entry into SSWUDS. An example of the Agricultural Water Use Registration Form completed by irrigation water-users is shown in appendix 3. Irrigation water-use totals for each hydrologic cataloging unit are determined in the same manner as was the livestock water-use category.

Power Generation Water Use

Power generation water use refers to water used to generate hydroelectric power or for cooling purposes in thermoelectric power generation. Water-use information is collected for the power generating facilities in the State by a mail survey conducted by the ASWCC (appendix 3, pages 3-5 to 3-7). The mailing list for this survey is compiled through contacts with the following organizations: Arkansas Power and Light Company, Arkansas Electric Cooperative, U.S. Department of Energy Southwest Power Administration, and the U.S. Army Corps of Engineers.

The 12 fossil fuel, 1 nuclear, and 9 hydroelectric power facilities in the State are mailed General Water Use Registration Forms to be completed by the plant manager or engineer. These forms are designed to obtain the appropriate information for the power generation water-use category and to match the data-entry requirements of SSWUDS to aid in the data entry process. Additional information such as the power generated annually and monthly and the installed generating capacity must be solicited through a second mail survey to the above mentioned facilities, although there is some power generation information provided by Southwest Power Administration. Power generation water-use totals for hydrologic cataloging units are determined by aggregation of site-specific data located within these areas.

Sewage-Treatment Water Use

The sewage-treatment water-use category includes water released by public, industrial, and commercial wastewater-treatment facilities. A list of sewage treatment facilities is obtained from the National Pollution Discharge Elimination System (NPDES) computer files. This information

originally is collected by Arkansas Department of Pollution Control and Ecology. Other data contained in these computer files include the location (latitude and longitude) of the release point of the treated wastewater and the amount of wastewater treated and released. These release values are compared with public-supply, industrial, and commercial withdrawal values to determine the accuracy of the release discharge numbers. Sewage-treatment release totals for each hydrologic cataloging unit are determined by aggregation of site-specific data located within these areas.

DATA COLLECTION TECHNIQUES IN FLORIDA

Water-use data in Florida are collected by the Florida Department of Environmental Regulation (FDER), Northwest Florida Water Management District, St. Johns River Water Management District, South Florida Water Management District, Southwest Florida Water Management District, and the Suwannee River Water Management District in cooperation with the USGS. Data collection forms used by the water management districts are provided in appendix 3, pages 3-9 to 3-18. The nine national water-use categories listed in the Introduction are collected in Florida, in addition to miscellaneous water use. Public-supply, industrial, commercial, mining, power generation, sewage-treatment, and miscellaneous water-use data are collected by contacting the appropriate agency or facility. Domestic, livestock, and irrigation water use are estimated using population or acreage estimates and water application rates. The categories of water-use data collected in Florida and the associated sources of information are given in table 4.

Public-Supply Water Use

The public-supply category includes water used by both public and private water suppliers. Those facilities that serve 400 or more people, or withdraw more than 0.01 Mgal/d are inventoried. Public-supplied water is utilized for all of the major use categories in Florida including: domestic (less than 400 residents), commercial, industrial, irrigation, and thermoelectric power generation. In addition to these five categories, public-supply water use also is reported for utility use, which includes water used in firefighting, system maintenance (system flushing), and water lost to leakage.

Data are collected by each of the five water management districts in Florida using information from their Consumptive Use Permit (CUP) files, mail or telephone contact, and supplied by the FDER monthly operating reports (appendix 3, pages 3-10 and 3-16). The information concerning each user obtained from these sources includes the mailing address, facility location, source of water withdrawn (ground or surface), monthly pumpage, and number of connections or population served.

Consumptive use is calculated by subtracting returns from the public wastewater facilities from withdrawal values for these facilities with the difference representing the amount of water (33 percent, 1985) consumed by public-supplied facilities. The residential component of public-supply consumptive use is estimated to be 21 percent (Solley and others, 1988). Values for return flows are supplied by the FDER, Domestic Wastewater Section. Public-supply water-use totals for each hydrologic subregion unit within the State are determined by aggregation of site-specific data located within these specific areas.

Domestic Water Use

Domestic water use is defined as water provided by individual domestic wells or by small utility companies (serving fewer than 400 residents). The total population served by domestic supplies is calculated by subtracting the number of residents served by public-supplied systems from the total county populations (University of Florida, 1986). The domestic water use for a county is calculated by multiplying the county per capita use (in gal/d) by the domestic self-supplied population for each county. The individual county per capita use value is determined by dividing the public-supplied withdrawal figure for each county by the population served by public-supply facilities in that county. Generally, self-supplied domestic per capita water use is lower than that for public-supply domestic

Table 4.--*Florida: Categories of water use and sources of information*

Water-use category	Data sources
Public supply	Florida Department of Environmental Regulation, Drinking Water Section St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District
Domestic	Florida Department of Environmental Regulation (population data) St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District University of Florida, College of Business Administration, Bureau of Economic and Business Research (population program)
Industrial	St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District, Consumptive Use Permit files and Compliance records, and questionnaire and telephone surveys Florida Department of Environmental Regulation, Drinking Water Section, Monthly Operating Report for Noncommunity Systems
Commercial	St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District, Consumptive Use Permit files and Compliance records, and questionnaire and telephone surveys Florida Department of Environmental Regulation, Drinking Water Section, Monthly Operating Report for Noncommunity Systems
Mining	St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District, Consumptive Use Permit files and Compliance records, and questionnaire and telephone surveys Florida Department of Environmental Regulation Drinking Water Section, Monthly Operating Report for Noncommunity Systems

Table 4.--*Florida: Categories of water use and sources of information*--Continued

Water-use category	Data sources
Agriculture	St. Johns River Water Management District Southwest Florida Water Management District South Florida Water Management District Suwannee River Water Management District Northwest Florida Water Management District, Consumptive Use Permit and Compliance files Florida Crop and Livestock Reporting Service, Florida Agricultural Statistics University of Florida, Institute of Food and Agricultural Science, main office and County Extension Service
Irrigation	St. Johns River Water Management District Southwest Florida Water Management District South Florida Water Management District Suwannee River Water Management District Northwest Florida Water Management District Consumptive Use Permit and Compliance files Soil Conservation Service: Crop Requirement Needs Manual Florida Institute of Food and Agriculture, County Extension agents Florida Crop and Livestock Reporting Service U.S. Geological Survey Report: Benchmark Farms Program--A Method for Estimating Irrigation Water Use in Florida
Power generation	St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District, Consumptive Use Permit and Compliance files and mail survey
Sewage treatment	Florida Department of Environmental Regulation Domestic Wastewater Section, monthly operation report files
Miscellaneous	St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District, Consumptive Use Permit files and Compliance records

use. However, in Florida, the individual county per capita water use is used because it accounts for small commercial and industrial users that are not included under the commercial or industrial categories in the following sections. Domestic water-use totals for hydrologic subregion unit areas are determined by disaggregation of county data using the percentage of the population located within the hydrologic unit. These hydrologic unit subtotals for each county are then regrouped for the State and totaled.

Industrial Water Use

Industrial water use includes water that is used for production in the following industries: pulp and paper, chemical, food processing, and miscellaneous manufacturing operations. Each water management district collects information about the industries in the district, including the location, withdrawal sources, and other unique facility information. The amount of water withdrawn and deliveries from public supply are obtained by each water management district through their CUP file, telephone or mail contact (appendix 3, pages 3-9 and 3-17), or from FDER monthly reports. Consumptive use for the industrial use category is estimated to be 33 percent of the amount of water withdrawn and delivered from public-supply facilities (Marella, 1988). Industrial water-use totals for each hydrologic subregion unit within the State are determined by aggregation of site-specific data located within these specific areas.

Commercial Water Use

Each water management district collects information about the commercial facilities in the district, including the location, withdrawal sources, and other unique facility information. Water withdrawal and delivery information are obtained by each water management district through their CUP file, telephone or mail contact (appendix 3, pages 3-9 and 3-17), or by going through the FDER monthly reports. Consumptive use for the commercial water-use category is estimated to be 33 percent of the amount of water withdrawn or delivered by public-supplied facilities (Marella, 1988). Commercial water-use totals for each hydrologic subregion unit within the State are determined by aggregation of site-specific data located within these specific areas.

Mining Water Use

Mining water use refers to water that is used in the dewatering or washdown process in a mining operation. The primary users of water for mining purposes in Florida include companies mining sand, limestone, phosphates, and other commodities. Each water management district collects information (appendix 3, page 3-10) about the mining operations in a district, including the location, withdrawal sources, and other unique facility information. Water withdrawal and delivery information are obtained by each water management district through their CUP file, telephone, or mail contact. Mining water-use totals for each hydrologic subregion unit within the State are determined by aggregation of site-specific data located within these specific areas.

Livestock Water Use

Livestock water use includes water used for livestock (animal), both drinking and washdown, and surface-water augmentation for aquaculture. Water-use withdrawals for livestock and aquaculture are estimated from district CUP files and data provided by the Florida Crop and Livestock Reporting Service. These data include the permitted water-use value or the type and number of livestock in each county. The livestock population values are then multiplied by a published water-use coefficient. The coefficients for livestock in Florida (St. Johns River Water Management District, 1984) are shown on the next page.

Livestock	Water required (gallons per day)
Beef cattle	12
Chickens	.10
Dairy cattle	15
Dogs	.10
Goats	2
Hogs	2
Horses	12
Rabbits	.05
Sheep	2
Turkeys	1

Water used for livestock (animal) is estimated to be 100 percent consumed. Livestock water-use totals for each hydrologic subregion unit were determined by disaggregation of county data using the percentage of the livestock population located within the hydrologic unit. These hydrologic subregion subtotals for each county are then regrouped for the State and totaled.

Irrigation Water Use

Irrigation water use refers to water used to supplement rainfall for the growth of vegetables, fruit, field crops, ornamental plants, and grasses. Data are collected for 29 individual crops within these crop categories: vegetable, fruit, field, ornamental, and grasses. Irrigation acreage also is delineated by the method of irrigation, such as flood, low pressure, and sprinkler.

Withdrawals are calculated for irrigation water use by multiplying the supplemental irrigation requirement by the number of acres irrigated for each county. First, the number of acres irrigated and method of irrigation are collected for each of the 29 crops inventoried for each county. These data are supplied by each water management district (appendix 3, pages 3-11 to 3-14) and by the University of Florida, Institute of Food and Agricultural Science agricultural extension agent in each county. Other sources of data on the number of acres irrigated include water management district CUP files and the Florida Crop and Livestock Reporting Service. The amount of supplemental irrigation water needed to grow each crop, and the water necessary to overcome the inefficiency of the irrigation system is determined. These determinations are made by each water management district utilizing a variety of methods and information services (U.S. Soil Conservation Service, 1970, 1982; and Smajstrla, 1986). The amount of water consumed by the plant or crop is derived by using the evapotranspiration rates generated by computer models for each crop.

Irrigation water-use totals for hydrologic subregion units are determined by manual assignment of crop acreage on a county to county basis. The county information is then regrouped by hydrologic cataloging unit areas at the discretion of the water-use specialist according to the topography of the area being assigned.

Power Generation Water Use

Withdrawal and power-generation data are collected for 50 self-supplied thermoelectric powerplants and 2 hydroelectric plants. More than 99.8 percent of the total water withdrawn is used for cooling purposes. This water may be used for one-time cooling or recirculated several times before being returned to its surface-water source. The remaining 0.2 percent of water, which is primarily ground water, is used for boiler make-up or domestic purposes throughout the plant and is almost 100 percent consumed. Data are collected by the water management districts (appendix 3, page 3-16) and the USGS through CUP files, by mail, or telephone contact. Withdrawal data (for ground and surface water, from fresh and saline sources), deliveries from public suppliers and power generation

information are collected through these files or contacts. Power generation water-use totals for each hydrologic subregion units within the State are determined by aggregation of site-specific data located within these specific areas.

Sewage-Treatment Water Use

Release data from the sewage-treatment (public wastewater) facilities are provided by the FDER, Domestic Wastewater Section. Wastewater discharge data are collected for 774 municipal (public or private) sewage-treatment facilities and 125 industrial facilities. Sewage-treatment release totals for each hydrologic subregion units within the State are determined by aggregation of site-specific data located within these specific areas.

Miscellaneous Water Use

Miscellaneous water use in Florida includes water not supplied by public systems used for residential lawn irrigation and residential heat pump and air conditioning units. The information pertaining to this category is collected by the water management districts (appendix 3, page 3-15), and is stored in their CUP and compliance files. These miscellaneous uses are not included in other categories because they fail to fit in any one category. A total of 34 counties have withdrawal data in this category. Consumptive use for this category is not estimated due to the lack of data.

Residential lawn irrigation refers to withdrawals (primarily from wells) for the sole purpose of irrigating a residential lawn with no domestic or other use involved. This category is not included under grass in irrigation primarily because grass included only commercial irrigation and not residential. Data are estimated for only 17 of 67 counties.

Residential heat pumps and air conditioning units use water (from wells) for heat exchange. Many of these withdrawals also serve as lawn irrigation when the unit is operating. Many heat pump and air conditioning units have discharge pipes connected to their sprinkler system. This allows the released water to be used in the sprinkler system. Restrictions on new systems require that they discharge used water to wells, but existing systems continue to discharge to the surface. Data for these withdrawals are available in only 4 of 67 counties.

Unused discharge from free-flowing wells is included in this category. An estimated 15,000 free-flowing wells exist in the State (Healy, 1978), and many of these wells have been plugged as a result of water management district programs. Data are available for 19 of the 67 counties.

DATA COLLECTION TECHNIQUES IN GEORGIA

Water-use data in Georgia are collected through the Georgia Water-Use Program, a cooperative effort between the Georgia Geologic Survey and the USGS. Water-use data are collected for the principal water users in the State each year. Public-supply (appendix 3, page 3-19), industrial, commercial, mining, power generation, and sewage-treatment water-use data are collected by contacting the appropriate agency or facility. Domestic, livestock, mining, commercial, and irrigation water use are estimated using various methods and coefficients. The categories of water-use data collected in Georgia and the associated sources of information are given in table 5.

Public-Supply Water Use

Small communities and subdivisions that furnish water to at least 25 people, or that have a minimum of 15 hookups are considered to be public-supply systems. Public-supply water-use data collected for the State include the amount of ground or surface water withdrawn. In 1990, a survey of the 74 largest public supply systems was conducted and produced information, such as population

Table 5.--Georgia: Categories of water use and sources of information

Water-use category	Data sources
Public supply	Georgia Environmental Protection Division, Water Resources Management Branch, Surface Water Program Office Georgia Environmental Protection Division, Water Resources Management Branch, Ground Water Program Office
Domestic	U.S. Department of Commerce, Bureau of the Census Georgia Environmental Protection Division, Water Resources Management Branch, Ground Water Program Office
Industrial	Georgia Environmental Protection Division, Water Resources Management Branch, Surface Water Program Office Georgia Environmental Protection Division, Water Resources Management Branch, Ground Water Program Office
Commercial	Georgia Environmental Protection Division, Water Resources Management Branch, Surface Water Program Office Georgia Environmental Protection Division, Water Resources Management Branch, Ground Water Program Office U.S. Army Corps of Engineers, Savannah Office
Mining	Georgia Environmental Protection Division, Water Resources Management Branch, Surface Water Program Office
Livestock	University of Georgia, Cooperative Extension Service Georgia Crop Reporting Service U.S. Department of Agriculture, Equine Program
Irrigation	University of Georgia, Cooperative Extension Service Georgia Water Protection Branch, Municipal Wastewater Office
Power generation	Georgia Environmental Protection Division, Water Resources Management Branch, Surface Water Program Office U.S. Department of Energy Georgia Power Company
Sewage treatment	Georgia Water Protection Branch, Municipal Wastewater Office Georgia Water Protection Branch, Industrial Wastewater Office

served or the number of domestic connections, as well as the percent deliveries to domestic, industrial, and commercial customers. Water-use information for the water-supply category is obtained by various methods and from several sources.

The Georgia Environmental Protection Division (EPD), Water Resources Management Branch (WRMB) provides permitted ground- and surface-water withdrawal information (appendix 3, page 3-19). The WRMB, Surface Water Program Office provides a list of distribution systems for the entire State that is used to determine the status of the major water suppliers. Population served information and public-supply deliveries were obtained from a 1985 mail survey of the largest public-supply systems in Georgia (74 systems). This survey represents 85 percent of the total public-supply water use in the State. Population and the number of connections served by mobile home parks, trailer parks, and housing subdivisions are obtained from the WRMB, Ground Water Permits Office. Water-use estimates for mobile home parks, trailer parks, and housing subdivisions are made by multiplying the number of connections by a water-use coefficient of 75 gal/d per person. Telephone surveys are conducted to contact city and plant managers in order to supplement withdrawal information not collected by the State offices. Public-supply water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Domestic Water Use

Domestic water use is defined as water used for normal household purposes, and includes both public-supplied and self-supplied users. Self-supplied domestic water users are comprised of two user groups, rural self-supplied households, and small cities not classified as public-supplied systems. Domestic water use is estimated (appendix 2, page 2-4) using a coefficient of 75 gal/d per person (Trent and others, 1990) along with county populations and population served values from public-supply facilities (1987 estimate, U.S. Department of Commerce, Bureau of the Census).

Water delivered from public-supply facilities for domestic purposes is determined by a 1985 mail survey of the 74 largest public-supply systems. Deliveries from small public supply systems were estimated at 85 percent for domestic use. Small towns without public supply systems are considered to have 100 percent domestic use. Information pertaining to mobile home parks, trailer parks, and subdivisions is collected by WRMB, Ground Water Program Office.

A domestic consumptive use coefficient of 18 percent (appendix 2, page 2-4) is used to determine consumptive use (R.R. Pierce, U.S. Geological Survey, written commun., 1989). Domestic water use within each hydrologic cataloging unit is determined by disaggregation of county data, based on the percentage of the county area within each hydrologic cataloging unit and multiplying that percentage by the county water-use value. These hydrologic unit subtotals for each county are then regrouped for the State and totaled.

Industrial Water Use

Water is withdrawn for various self-supplied industrial systems throughout Georgia. Paper, textile, and chemical industries are some of the largest in the State. Industrial water-use data are collected from the WRMB, Ground Water and Surface Water permit and program files. The current manufacturing directory (Georgia Department of Industry and Trade and Tourism, 1983) is used as a reference for telephone numbers, SIC codes, and the county location of these industries.

Information contained in the public-supply mail survey includes a percentage of water delivered by public-supply systems to industrial users. This survey also includes the name of the facilities, location, and the amount of water purchased by the larger industrial users. It was estimated that 5 percent of the total water use is considered to be delivered from water supply facilities.

The consumptive use for self-supplied industries varies by the type of industry. The percentages are determined by comparing percentages from the United States, South Atlantic, and actual consumptive use figures from some Georgia industries. Industrial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Commercial Water Use

Withdrawals for commercial users (greater than 100,000 gal/d) are obtained from WRMP. Water-use estimates are compared to other businesses of similar size and type. Other commercial use information is provided by the Regional EPD offices and a 1986 inventory of population served by commercial users.

Commercial deliveries from public-supply facilities are provided by a survey of the largest water suppliers in Georgia. This survey provides the percentage of water delivered for commercial use. Small public systems are considered to deliver 10 percent of the water withdrawn for commercial purposes.

Consumptive use is estimated to be 18 percent of the total water use (withdrawals + deliveries). Although the coefficient is calculated for domestic use, it is used because commercial consumptive use is estimated to be similar to domestic consumptive use. Withdrawal and discharge data for some military bases support this 18 percent estimate. Commercial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Mining Water Use

Mining water use is primarily mining and mineral processing in the State. The source of water-use information for all permitted mining facilities is the WRMB permits files. Additional water-use data are obtained by telephone surveys, and the "Mining Directory of Georgia" (Steele and O'Connor, 1986). The directory is used to produce a master list of the mining operations in the State. Data in this publication include type of product mined, location of facility, and contact person. Information obtained by the telephone contact includes water used as part of the mining operation, location of the diversion, and the amount of tons of product mined. The consumptive use coefficient for mining is 12 percent. Mining water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Livestock Water Use

Water use for livestock (animal) is estimated by multiplying a water-use coefficient (varies by type of livestock) by the population of each type of livestock produced. Rates per capita (water-use coefficient) are obtained from county agents of the University of Georgia, Cooperative Extension Service (CES). These coefficients vary by type of livestock and by county.

Livestock	Water required (gallons per day)
Beef cattle	7.9
Dairy cattle	28.7
Sheep and lambs	.3
Hogs and pigs	2.9
Poultry	.05

Livestock populations in Georgia are obtained from several publications. Population values for the poultry industry are subdivided by type (layers, broilers, pullets, broiler/breeder, and turkeys) and by county (Strong and Wildey, 1986). The number of cattle, hogs and pigs by county are provided by the U.S. Department of Agriculture Crop Reporting Service (1980). Water-use data for aquaculture (catfish farms) are provided by the Georgia Cooperative Extension Service (Lewis, 1984). Consumptive use for livestock is estimated to be 100 percent of the amount withdrawn or diverted. Livestock water-use totals for hydrologic cataloging unit areas are determined by disaggregation of county data using the percentage of the county land area located within the hydrologic cataloging unit. The resulting hydrologic cataloging unit subtotals for each county are then regrouped for the State and totaled.

Irrigation Water Use

Irrigation water use is defined as water that is used for crops, large nurseries, athletic fields, and golf courses. Irrigation water-use information is provided by the CES. Every 3 years county agents determine the water application rate by crop type for each kind of irrigation system for each county in the State. This information, along with the acres irrigated by crop type, location of withdrawal site, and the kind of irrigation systems used within each county, is summarized within a report published by the CES (Harrison and Tyson, 1987). These data along with the following formula are used to make water-use estimates for crop irrigation:

$$(\text{acres/crop}) \times (\text{inches of water applied}) = (\text{acre-inch/crop})$$

When the amount of water applied is not reported for a county, an estimated application rate of 3 to 6 in. per acre is used, depending on the average crop production values for that area or adjacent county. Water applied by drip irrigation systems is not included.

Water use for athletic fields and golf courses is estimated using an application rate of 26.9 in. of water per year for each acre of land in use. This coefficient was determined during a sample survey conducted from 1979 to 1980.

The amount of reclaimed sewage used for irrigation purposes is provided by the Georgia Water Protection Branch Municipal Wastewater Office. They provide a list of all land application systems in Georgia, in addition to system flow amounts, operating status, and location.

Consumptive water use for irrigation is estimated to be 100 percent of the amount of water withdrawn. Irrigation water-use totals for hydrologic cataloging unit areas were determined by disaggregation of county data using the percentage of the county land area located within the hydrologic cataloging unit. The resulting hydrologic cataloging unit subtotals for each county are then regrouped for the State and totaled.

Power Generation Water Use

Thermoelectric

Water use for thermoelectric power generation includes water that is used for potable uses, cooling purposes, and boiler makeup. Water-use data for thermoelectric power generation include the following information: annual and monthly amounts withdrawn, annual and monthly power generated, installed generating capacity, and location of facility. These data are obtained from several sources.

Thermoelectric withdrawal information is obtained from the WRMB, Ground Water permit files, including nuclear facilities. The Georgia Power Company provides withdrawal information through a mail and telephone survey of their facilities. Power generation information is provided by the Department of Energy (EIA-759) data from monthly powerplant reports. Consumptive use varies from plant to plant, and this information is supplied by the power plant owners. There are no deliveries from public-supplied facilities for thermoelectric power generation. Power generation water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Hydroelectric

Water-use data for hydroelectric power generation include the following information: annual and monthly amount of water diversion, annual and monthly power generated, installed generating capacity, and location of facility and diversion. A mail survey is used to collect water-use information for hydroelectric power generating facilities. Power generation information is provided by the Department of Energy (EIA-759) data from monthly powerplant reports. Each hydroelectric plant provides the number of gallons used by each plant to generate 1 megawatt hour of electricity, which is used to determine monthly water-use figures in million gallons per day. A report on hydroelectric power (Westinghouse Hanford Laboratories, written commun., 1988) is used to verify the accuracy of the data. Power generation water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Sewage-Treatment Water Use

The sewage-treatment water-use category includes water released by public, industrial, and commercial wastewater-treatment facilities. The Georgia Water Protection Branch Municipal Wastewater Office provides release amounts and location information for municipal sewage-treatment facilities. These data are collected by personnel in the four regional offices located in Atlanta, Brunswick, Macon, and Albany. The Georgia Water Protection Branch Industrial Wastewater Office provides information pertaining to release amounts and location information for industrial and other types of sewage-treatment facilities for Georgia. Sewage-treatment release totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

DATA COLLECTION TECHNIQUES IN KENTUCKY

Water-use data in Kentucky are collected by the Kentucky Natural Resources and Environmental Protection Cabinet (KNREPC), Division of Water, in cooperation with the USGS. The nine national water-use categories listed in the Introduction are collected in Kentucky. Public-supply, industrial, commercial, mining, power generation, and sewage-treatment water-use data are collected by contacting the appropriate agency or facility. Domestic, livestock, and irrigation water use are estimated using population or acreage estimates and water application rates. The categories of water-use data collected in Kentucky and the associated sources of information are given in table 6.

Table 6.--*Kentucky: Categories of water use and sources of information*

Water-use category	Data sources
Public supply	Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Water Withdrawal Permit Program U.S. Department of Commerce, Bureau of the Census Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Drinking Water File
Domestic	Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Drinking Water File U.S. Department of Commerce, Bureau of the Census
Industrial	Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Water Withdrawal Permit Program
Commercial	Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Water Withdrawal Permit Program
Mining	Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Water Withdrawal Permit Program University of Kentucky
Livestock	U.S. Department of Commerce, Bureau of the Census
Irrigation	U.S. Department of Commerce, Bureau of the Census University of Kentucky
Power generation	Kentucky Public Service Commission
Sewage treatment	Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Wastewater Branch

KNREPC has implemented a Water Withdrawal Permit Program that requires water users to report their monthly withdrawals (biannually and by calendar year) for public-supply, industrial, commercial, and mining water use. Examples of the application for water withdrawal permit, and water supply surveys for municipal users and self-supplied industrial and commercial users are provided in appendix 3, pages 3-20 to 3-36. The data collected include the monthly permitted amount withdrawn, location of diversion (latitude and longitude), hydrologic unit code, category of use, and name of facility. The above information is provided annually to the USGS by the KNREPC.

Public-Supply Water Use

Public-supply systems are defined by KNREPC as those that withdraw more than 10,000 gal/d, or any facility that serves 25 or more people, or has 15 or more connections. Information about public-supply systems is reported to the KNREPC.

Water withdrawal permit forms (appendix 3, pages 3-29 to 3-32) are provided to the individual public-supply facilities throughout Kentucky. These forms request the following information about the public-supply systems: county name, system name, source of water (ground or surface water), intake location, and storage capacity. These data are collected biannually and by calendar year. Population values for persons serviced by public-supply systems are provided by the U.S. Department of Commerce, Bureau of the Census (1984), supplementing the population values that are provided by KNREPC.

Deliveries from public-supply systems to commercial, industrial, domestic, and public use, in addition to losses and transfers, are obtained by questionnaires sent by the KNREPC to public-supply facilities requesting information about deliveries to various water users within a 27-county study area in western Kentucky (Sholar and Wood, 1986). Public-supply facilities outside the study area are estimated based on an average percentage of the amount of water delivered to commercial, industrial, domestic, and public uses within the 27-county study area of the report. Public-supply water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Domestic Water Use

Domestic use also is referred to as residential water use. The water may be obtained from a public-supply facility or may be self-supplied. The KNREPC provides population serviced values by facility. These values are aggregated by county and totaled. County population values are provided by the U.S. Department of Commerce, Bureau of the Census (1984).

Water used for domestic (self-supplied) purposes is determined by multiplying a 50 gal/d per person coefficient by the population not serviced by public-supplied facilities within a county.

$$(\text{County population}) - (\text{population served by public-supply systems}) \times (50 \text{ gal/d per person})$$

There is a 70 gal/d per person coefficient used to estimate domestic use by those customers that are furnished by public-supply systems. This coefficient is determined by dividing the population serviced by the public-supply system by the amount of water billed for domestic purposes within a specified area. Consumptive use for domestic purposes is estimated by adding the amount of water withdrawn for domestic purposes plus the volume of water delivered by public suppliers for domestic uses, and this total is multiplied by a coefficient of 0.57. All of the previously mentioned coefficients are determined by KNREPC from previous studies or from data on file. Domestic water-use totals for hydrologic cataloging unit areas are determined by disaggregation of county data using the percentage of the county land area located within the hydrologic cataloging unit. These percentages are multiplied by the county water-use totals. The resulting hydrologic cataloging unit subtotals for each county are then regrouped for the State and totaled.

Industrial Water Use

Industrial water use is defined as water that is used to manufacture or produce food, textiles, pulp and paper products, chemicals, metals, and distillery products. The water may be obtained from a public-supply facility or it may be self-supplied. Industries that withdraw more than 10,000 gal/d are required to report their water use to the KNREPC Water Withdrawal Permit Program (appendix 3, pages 3-33 to 3-36). Consumptive use is considered to be 4 percent, based on estimates from the western Kentucky inventory results (Sholar and Wood, 1986). Industrial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Commercial Water Use

Water used for commercial purposes may be obtained from a public-supply facility or be self-supplied. Commercial water users not supplied from public water systems, that withdraw more than 10,000 gal/d, report their water usage to the KNREPC Water Withdrawal Permit Program (appendix 3, pages 3-33 to 3-36). Approximately 4 percent of all water withdrawn for commercial use is considered to be consumed. The consumptive use estimate is based on the western Kentucky inventory results (Sholar and Wood, 1986). Commercial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of the site-specific data located within these specific areas.

Mining Water Use

The primary uses of water for mining are in conjunction with dewatering deep mine operations and for coal washing. Mining data for permitted users are obtained from the KNREPC Water Withdrawal Permit Program (appendix 3, pages 3-33 to 3-36). Permitted users are those that use at least 10,000 gal/d. Consumptive use for mining is estimated to be 3 percent of the amount withdrawn (Dr. Joe Leon, University of Kentucky, oral commun., 1985). Mining water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of the site-specific data located within these specific areas.

Livestock Water Use

Water used for livestock (animal) purposes is estimated by multiplying a per capita water use in gallons per day by the county livestock population. A report published by the U.S. Department of Commerce, Bureau of the Census (1984) contains population figures for livestock and poultry by county, and water requirements for livestock. Data indicate that there are no aquacultural operations in Kentucky. The water requirements for livestock in Kentucky are as follows:

<u>Livestock</u>	<u>Water required (gallons per day)</u>
Poultry	0.1
Hogs	6
Dairy cattle	65
Beef cattle	12
Horses	12
Sheep	2

Consumptive use for livestock purposes is estimated to be 100 percent. Livestock water-use totals for hydrologic cataloging unit areas are determined by disaggregation of county data using the percentage of the county land area located within the hydrologic cataloging unit. The resulting hydrologic cataloging unit subtotals for each county are then regrouped for the State and totaled.

Irrigation Water Use

Water use for irrigation is estimated by multiplying the number of irrigated acres (within a county) by an application rate (0.4 ft per year). Irrigated acreage is provided by the U.S. Department of Commerce, Bureau of the Census (1984). These acreage values are reported by county and by crop. Kentucky's primary crops are tobacco, corn, wheat, and soybeans. The application rate of 0.4 ft per acre per year is determined by the State Irrigation Specialist at the University of Kentucky (University of Kentucky, written commun., 1985). Consumptive use for irrigation is estimated to be 95 percent of the amount withdrawn, with the remaining 5 percent accounting for conveyance losses. Irrigation

water-use totals for hydrologic cataloging unit areas were determined by disaggregation of county data using the percentage of the county land area located within the hydrologic cataloging unit. The resulting hydrologic cataloging units for each county are then regrouped for the State and totaled.

Power Generation Water Use

Thermoelectric

The primary use of water in thermoelectric power generating facilities is for cooling purposes. Thermoelectric power data are provided for 22 fossil-fuel plants by the Kentucky Public Service Commission. Site-specific data received from the Public Service Commission contain information about the location of the diversion (latitude and longitude), address of the plant, amount of water withdrawn, ground- or surface-water delineation, installed generating capacity of the facility, and the amount of power produced monthly and annually. Power generation water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Hydroelectric

Hydroelectric power generation information for seven hydroelectric plants is provided by the Kentucky Public Service Commission. Site-specific data received from the Public Service Commission contain information about the location of the diversion, address of the plant, amount of water that flows through the turbines, source of water (stream, river, or lake), installed generating capacity of the facility, and amount of power produced monthly and annually. Power generation water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Sewage-Treatment Water Use

Information about sewage-treatment facility releases is obtained from the Kentucky Pollutant Discharge Elimination System Branch of the KNREPC. The Wastewater Branch provides the following data: the number of public, industrial, and other sewage-treatment facilities, locations for these facilities, locations for the release point, and the amount of water released. Sewage-treatment release totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

DATA COLLECTION TECHNIQUES IN LOUISIANA

Water-use data in Louisiana are collected by the Louisiana Department of Transportation and Development, Office of Flood Control and Water Management, in cooperation with the USGS. The nine national water-use categories listed in the Introduction are collected in Louisiana. Public-supply, industrial, commercial, mining, power generation, and sewage-treatment water-use data are collected by contacting the appropriate agency or facility. Examples of data collection forms are provided in appendix 3, pages 3-37 to 3-43. Domestic, livestock, and irrigation water use are estimated using population or acreage estimates and water application rates. The categories of water-use data collected in Louisiana and the associated sources of information are given in table 7.

Public-Supply Water Use

A public-supply facility is defined as a water system that provides water to 250 or more people during the year. The public-supply water-use category is made up of the following user groups: municipal, private water systems, rural water systems, and parish water districts. A master list of public-supply systems was compiled from information received from the following sources: the Louisiana Department of Health and Hospitals (municipal systems and private water systems), the

Table 7.--Louisiana: Categories of water use and sources of information

Water-use category	Data sources
Public supply	Louisiana Department of Transportation and Development Louisiana Department of Health and Hospitals Farmers Home Administration Louisiana Rural Water Association Capital Area Ground Water Conservation Commission
Domestic	U.S. Department of Commerce, Bureau of the Census Louisiana Department of Health and Hospitals Farmers Home Administration Louisiana Rural Water Association Capital Area Ground Water Conservation Commission
Industrial	Louisiana Department of Transportation and Development Louisiana Department of Commerce Capital Area Ground Water Conservation Commission
Commercial	Louisiana Department of Transportation and Development Louisiana Department of Health and Hospitals Capital Area Ground Water Conservation Commission
Mining	Louisiana Department of Transportation and Development Capital Area Ground Water Conservation Commission
Livestock	Louisiana Department of Transportation and Development Louisiana State University Extension Service U.S. Agricultural Stabilization and Conservation Service
Irrigation	Louisiana Department of Transportation and Development Louisiana State University Extension Service U.S. Agricultural Stabilization and Conservation Service
Power generation	Louisiana Department of Transportation and Development Sabine River Compact Commission
Sewage treatment	Louisiana Department of Transportation and Development Louisiana Department of Health and Hospitals

Farmers Home Administration, and the Louisiana Rural Water Association (rural systems and parish water districts). Water-use data in the public-supply category are provided by information received from a mail survey (appendix 3, pages 3-37 to 3-40, 3-43). Additionally, the Capital Area Ground Water Conservation Commission provides pumpage information for the major users located within the five parishes under their jurisdiction (appendix 3). Public-supply water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Domestic Water Use

Domestic water use is defined as water that is used by residents of a parish for household purposes that are not being served by public-supply systems. Domestic water use in Louisiana is estimated by multiplying a water-use coefficient by the population served by domestic self-supplied systems. The population value for domestic (self-supplied) users is determined by subtracting the number of persons served by municipal, private, rural water systems, or parish water districts within a parish from the parish population total, with the remaining population being domestic (self-supplied). The parish population totals are provided by the U.S. Department of Commerce, Bureau of the Census (1982a). The domestic water-use coefficient was 80 gal/d. Domestic water use is considered to be 100 percent consumed.

Domestic water use within the hydrologic cataloging unit areas is computed by disaggregation of parish water-use information based on the percentage of the population located within the hydrologic cataloging unit. This percentage is then multiplied by the water-use value for the parish. The resulting hydrologic cataloging unit subtotals for each parish are then regrouped for the State and totaled.

Industrial Water Use

Data collected in the industrial category include self-supplied water and water delivered from public-supply systems. A mail survey (appendix 3, pages 3-37 to 3-40, 3-43) is the primary source of industrial water-use information (same questionnaire that is used for public-supply water use category). A listing of industrial users is obtained from the Louisiana Department of Commerce (1986). In addition to the data provided by the survey, the Capital Area Ground Water Conservation Commission provides pumpage information for the major users located within the five parishes under their jurisdiction. Industrial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Commercial Water Use

The majority of the data collected in the commercial category are obtained by a mail survey (same questionnaire that is used for public-supply water-use category). The Department of Health and Hospitals provides a list of large and small commercial establishments. The smaller commercial establishments listed include service stations, truck stops, and bars. In addition to the data provided by the survey, the Capital Area Ground Water Conservation Commission provides pumpage information for the major users located within the five parishes under their jurisdiction. Commercial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Mining Water Use

Water used in Louisiana mining operations is for solution mining of salt and sulfur. A mail survey is the primary source of water-use information for mining (same questionnaire that is used for public-supply water-use category). A listing of these mining operations was obtained from the U.S. Department of Commerce, Bureau of the Census (1982c). In addition to the data provided by the

survey, the Capital Area Ground Water Conservation Commission provides pumpage information for the major users located within the five parishes under its jurisdiction. Mining water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Livestock Water Use

Livestock water use in Louisiana includes water used for the propagation of livestock (cattle, horses, hogs, sheep, chickens, and turkeys) and aquaculture (primarily catfish and crawfish farming and fish hatcheries). Water use for livestock is estimated by multiplying the livestock population by parish by a water-use coefficient. Water use for aquaculture is estimated by multiplying the number of acres of ponds in each parish by an appropriate application rate for the type of aquacultural products produced.

Estimates of livestock populations and associated water requirements are provided by the Louisiana State University Extension Service. The Extension Service also provides estimates of the amount of water supplied by ground- and surface-water sources. In addition, the Extension Service provides estimates of pond acreage used for aquacultural purposes in each parish, and the application rate for each type of aquacultural product produced (appendix 3, pages 3-41 and 3-42). The following table lists the livestock water users in Louisiana and their associated water requirements:

Stock type	Water requirements (gallons per day)	Fisheries	Application rates (feet of water per acre)
Dairy cattle	20	Catfish	average 4.5, range 3 - 6
Other cattle	10	Crawfish	average 2.5, range 1 - 4
Horses, mules	10	Hatcheries	average 5.0, range 3 - 15
Hogs	3		
Sheep, goats	2		
Chickens	.04		
Turkeys	.06		

Consumptive use for livestock is considered to be 100 percent of the amount of water withdrawn. Livestock water-use estimates are determined for hydrologic cataloging unit areas by disaggregation of parish data based on the percentage of the parish land area located within the hydrologic cataloging unit. The resulting hydrologic cataloging unit subtotals for each parish are then regrouped for the State and totaled.

Irrigation Water Use

Water use for irrigation in Louisiana is estimated by multiplying the number of irrigated acres (by crop type) by the appropriate water application rate. The U.S. Agricultural Stabilization and Conservation Service and Louisiana State University Extension Service provide the number of acres irrigated by crop and delineate the source of water withdrawal (ground or surface water) within each parish, as well as the appropriate water application rate for each crop (appendix 3, pages 3-41 and 3-42). The primary crops in Louisiana and their associated application rates are shown on the next page.

Crop	Application rates	
	Ground water (feet/acre)	Surface water (feet/acre)
Rice	3	5
Cotton	average 0.5	range 0.25 - 1.25
Soybeans	average 0.5	range 0.25 - 1.00
Strawberries	average 0.5	
Truck crops	average 1.0	range 0.15 - 1.66
Corn	1.5 rarely irrigated	
Sorghum	1.3 rarely irrigated	
Peaches	average 1.5 rarely irrigated	
Nurseries	average 2.0	

Consumptive use for general irrigation is considered to be 100 percent of the amount of water withdrawn. However, consumptive use for rice irrigation is estimated to be from 30 to 50 percent.

Irrigation water-use estimates are determined for hydrologic cataloging unit areas by disaggregation of parish data based on the percentage of the parish land area located within the hydrologic cataloging unit. This percentage is multiplied by the parish water-use total, with the total representing the water-use value of the hydrologic cataloging unit. These hydrologic cataloging unit subtotals for each parish are then regrouped for the State and totaled.

Power Generation Water Use

Water-use data collected for 18 fossil-fuel, two nuclear, and one hydroelectric power generation include: monthly and annual water used, installed generating capacity, and annual and monthly power produced. In addition to the above mentioned data collected for all power generation facilities, the amount of water delivered by public-supply facilities, and consumptive use are collected for thermoelectric facilities.

Information pertaining to fossil-fuel power generation is provided by a mail survey (appendix 3, pages 3-39 and 3-40). The only hydroelectric plant using water from Louisiana is located on the Toledo Bend Reservoir. Water from the Sabine River is impounded in the Toledo Bend Reservoir and released to turn turbines at the powerhouse near Burkeville, Texas. Because the Sabine River forms the Louisiana-Texas boundary, one-half of the water flowing through the power plant is counted in Louisiana's water withdrawal inventory. This water body is governed by the Sabine River Compact Administration. Therefore, all data relevant to hydroelectric power generation at this facility are provided by this organization. Power generation water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Sewage-Treatment Water Use

The Louisiana Department of Health and Hospitals provides return flow information from sewage-treatment facilities located within the State. This information is acquired from a complete inventory of these facilities.

Information concerning the number of municipal, industrial, and other wastewater-treatment facilities and their associated locations and releases also is provided by the Louisiana Department of Health and Hospitals. Sewage-treatment release totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

DATA COLLECTION TECHNIQUES IN MISSISSIPPI

Water-use data in Mississippi are collected by the Mississippi Department of Natural Resources, Bureau of Land and Water Resources in cooperation with the USGS. Eight national water-use categories are inventoried in Mississippi. Public-supply, industrial, mining, power generation, and sewage-treatment water-use data are collected by contacting the appropriate agency or facility. Domestic, livestock, and irrigation water use are estimated using population or acreage and water application rates. The categories of water-use data collected in Mississippi and the associated sources of information are given in table 8.

Table 8.--Mississippi: Categories of water use and sources of information

Water-use category	Data sources
Public supply	U.S. Geological Survey Mississippi Department of Environmental Quality, Bureau of Land and Water Resources Mississippi State Department of Health, Division of Water Supply
Domestic	U.S. Department of Commerce, Bureau of the Census Mississippi Department of Environmental Quality, Bureau of Natural Resources
Commercial	Mississippi State Department of Health, Division of Water Supply
Industrial	Mississippi Department of Economic and Community Development
Mining	Mississippi State Geological Survey
Irrigation	Mississippi Department of Agriculture and Commerce National Agricultural Statistics Service Mississippi State University, Cooperative Extension Service, Agricultural Engineering Extension
Agriculture Aquaculture	Mississippi State University, Wildlife and Fisheries Extension
Livestock	Mississippi Department of Agriculture and Commerce National Agricultural Statistics Service Mississippi State University, Cooperative Extension Service, Agricultural Engineering Extension
Power generation	Mississippi Power and Light Company Southern Mississippi Electric Association Mississippi Power Company Clarksdale Municipal Power Company Greenwood Municipal Power Company
Sewage treatment	Mississippi Department of Environmental Quality, Bureau of Pollution Control

Public-Supply Water Use

Public-supply water use is defined as a municipal or rural supply system, whether publicly or privately owned, that furnishes water to cities, towns, and villages. The Directory of Mississippi Municipalities provides a list of municipal supply systems (Mississippi Municipal Association, 1981). A large percentage of the approximately 1,400 municipal supply systems report their data, some by well or point of withdrawal. These site-specific data are reported monthly to the USGS through a mail survey solicited by the Mississippi Department of Environmental Quality, Bureau of Land and Water Resources or by a telephone survey. Primarily, water-use information collected for public-supply systems is based on discharge measurements at these facilities, readings from systems with master meters, and by monthly billing records. In addition to water-use values, the monthly billing records reflect the population served (either by the number of connections served or number of persons served).

Many of the rural systems do not report the water withdrawals or population served. Therefore, the values are estimated. The source of this water is primarily ground water. Withdrawals for rural systems and unmetered municipal systems are estimated from population served (estimated from billing records). A per capita use estimate of 60 gal/d per person is used for rural systems, and for municipal systems that do not report their usage. An additional 20 percent is added to the per capita estimate where withdrawal data are not available (to account for internal use and loss by the systems). A value of 3.2 people per water meter is used to estimate the population served by rural systems that did not maintain population serviced records and that could furnish only the number of metered connections. These estimates are based on a survey of billing records for a number of rural water associations distributed throughout the State.

The following percentages are used to estimate domestic, commercial, and industrial water deliveries from public-supply systems where billing records are not available:

	Population	Domestic	Commercial	Industrial
Small towns	3,000-15,000	80 percent	7 percent	3 percent
Larger towns	15,000-50,000	65 percent	15 percent	10 percent

System losses account for the remaining 10 percent not accounted for in the billing records. Public-supply water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Domestic Water Use

The domestic water-use category reflects those persons not serviced by public-supply systems within the State. Water use for this category is determined by multiplying a water-use coefficient by the self-supplied domestic population. The self-supplied domestic population is determined by subtracting the number of persons served by municipal supply and rural water systems within a county from the county population total (U.S. Department of Commerce, Bureau of the Census, 1981), with the remaining population representing those persons that are domestic (self-supplied). The domestic water-use coefficient used is 50 gal/d (appendix 2, page 2-4) for households with indoor plumbing, and 10 gal/d for those households without plumbing. These population data for households with indoor plumbing are obtained from the U.S. Department of Commerce, Bureau of the Census (1981) and these figures are adjusted to recent Bureau of the Census data.

Domestic water-use totals for hydrologic cataloging unit areas were determined by disaggregation of county data using the percentage of the county land area located within the hydrologic cataloging unit. These percentages are then multiplied by the county water-use totals. The resulting hydrologic cataloging unit subtotals for each county are then regrouped for the State and totaled.

Industrial Water Use

Industrial water use is determined by telephone and mail surveys conducted by the Mississippi Bureau of Land and Water Resources. The Mississippi Manufacturers Directory (Mississippi Research and Development Center, 1985) is used to compile a list of self-supplied industrial users. These industries are listed and subdivided by the city in which they are located. Additional information in this directory includes mailing address of the industry, telephone number, contact person, SIC codes, type of products produced or services rendered, and the number of employees. The Manufacturers Directory is used and each city water superintendent is contacted and queried as to whether each industry under that particular city's industrial list is supplied by the city's municipal water system. Once the city's (self-supplied) industries are identified, those industries are contacted and queried about the source of their water withdrawals (ground or surface water), the number of withdrawal sites and their locations, and the amount of water withdrawn and consumed or incorporated into the product. The location of the plant and the name of the contact person responsible for reporting or estimating the water use is verified by the USGS. This process is repeated for all cities within the State. Industrial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Mining Water Use

Mining water use consists primarily of clay and gravel operations in Mississippi. Water-use data are obtained by a telephone survey of the major mining operations within the State. The Mississippi State Geological Survey provides the USGS with a list of mining facilities operating within the State. These industries are contacted for the following information: the amount of withdrawal, the source of water withdrawn (ground or surface water), location of withdrawal site, and annual production. Mining water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Livestock Water Use

Livestock water use includes water used for stock watering, feed lots, dairy operations, aquaculture (catfish farming), and other farm needs. The livestock water-use category consists primarily of the summation of two user groups. The first and foremost is catfish farming. The second user group consists of the livestock industry. Due to the size of the catfish farming industry in Mississippi, the large amounts of water used, and the impact on the State's economy, water used for catfish farming is monitored as a separate category. Therefore, the first part of the livestock section describes livestock data collection and the second section discusses data collection techniques used to monitor aquaculture (catfish farming).

The livestock category includes the use of water for the production of livestock (dairy cattle, other cattle, hogs, and chickens). Data components required for the estimation of water use for livestock include county livestock populations and the appropriate water-use requirement for each type of livestock produced within the State.

Livestock population values for Mississippi are provided by county (Mississippi Department of Agriculture and Commerce, 1987). Water-use requirements for livestock are as follows:

Livestock	Water required (gallons per day)
Dairy cattle	20
Other cattle	10
Hogs	3
Chickens	.04

The sources of water for livestock water use are estimated to be 40 percent withdrawn from ground water and the remaining 60 percent supplied by surface water. The ground- and surface-water percentages are derived by consultation with the State Agriculture Engineer (Mississippi State University, Cooperative Extension Service, Agricultural Engineering Extension, oral commun., 1985) and from previous State surveys. Consumptive use for livestock water use is estimated to be 100 percent. Water-use totals for the hydrologic cataloging units within Mississippi are assigned by the USGS in the same manner as described for aquacultural water use.

Catfish farming is the dominant aquacultural water user. Water withdrawals for catfish farming are used to maintain appropriate pond levels and in the past were used to provide aeration. Approximately 96 percent of all catfish farming in the State takes place in the Delta, where ground water from the shallow Mississippi River alluvial aquifer is the only source of water supply used. Elsewhere in the State, water use for catfish farming is estimated to be 40 percent surface water and 60 percent ground water.

Water-use estimates for catfish farming are calculated by multiplying the total county catfish farm acreage by an application rate times the duration of pumping. Information pertaining to pond acreage and the type of fish stocked in each pond is furnished by Mississippi State University (Mississippi State University, Cooperative Extension Service, Wildlife and Fisheries Extension and Agricultural Engineering Extension, written commun., 1985). Acreage is reported by county and application rate estimates are based on water-use studies of selected catfish farming operations in the Delta. Selected catfish farms are monitored to collect withdrawal information and the duration of pumping. Two types of time totalizers are used to record the duration of pumping for aquaculture; the digital vibration time totalizer and the digital inductive time totalizer. Another method of monitoring duration of pumping is reading the electric meter attached to the pump.

The pump duration data are applied to the measured pump discharge of the monitor withdrawal site and a total withdrawal is calculated for the site. The withdrawal then is divided by the pond acreage in order to determine the application rate. This process is duplicated for all sites in the study network. Upon completion of these studies a mean application rate for the monitor network is determined. Consumptive uses for catfish farming are estimated to equal approximately 38 percent of the water withdrawn.

Water-use totals for the hydrologic cataloging units within Mississippi are assigned by the USGS. These assignments are based on the percentage of land area of the hydrologic cataloging units located within the county. Allowances are made in the hydrologic cataloging units assignment process for variations in topography within a county. Topographic maps and aerial photographs, Soil Conservation Service contacts, and farmer consultation are also key components in these assignment decisions.

Irrigation Water Use

Water used for irrigation is estimated by multiplying an application rate by the number of irrigated acres for each crop type. In Mississippi, the major irrigated crops are rice, cotton, and soybeans. Irrigation is used mainly in the northwestern part of Mississippi, commonly known as the Delta. Irrigated acreage for crops raised in the State are provided by the Mississippi Department of Agriculture and Commerce (1987).

Application rates used in Mississippi for irrigation are as follows: rice irrigation requirements are approximately 4.1 ft of water per acre and for other crops (cotton and soybeans) about 1.3 ft per acre. These values are variable and are dependent on climatic conditions from year to year. They are determined by studies conducted in the Delta. The values are updated annually by determining water withdrawals from monitor farm withdrawal sites within the Delta and through contacts with the State Agriculture Engineer. Withdrawals from the monitor withdrawal sites are calculated using data from

time totalizers placed on the pumps to record the duration of pumping. This value is multiplied by the measured pump discharge to obtain withdrawal values. Another method for estimating time of operation for electrical pumps is by reading the electric meter on the pump to verify the time of operation with the servicing electric power company.

Consumptive use of irrigation water is estimated to be approximately 40 percent and conveyance losses equal 10 percent of the total water withdrawn. Water-use totals for the hydrologic cataloging units within Mississippi are assigned by the USGS in the same manner as described for aquacultural water use.

Power Generation Water Use

Water use for power generation is represented by the water withdrawn for once-through or condenser cooling of the 12 fossil-fuel and 1 nuclear plants in the State. Both fresh and saline surface water is used for cooling purposes. Also, a small amount of ground water is used primarily for boiler feed water.

The following power companies in Mississippi are inventoried for data relevant to thermoelectric power generation: Mississippi Power Company, Mississippi Power and Light Company, and South Mississippi Electric Power Association, including Greenwood and Clarksdale Municipal Power Companies. The following power generation data are furnished by these companies: monthly water withdrawn (either by ground or surface water, saline or fresh), annual amounts of water withdrawn, monthly power produced, annual power produced, and installed generating capacity. These data are collected annually from personal contacts with power company plant supervisors and engineers. Power generation water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Sewage-Treatment Water Use

Data about sewage-treatment facilities (both industrial and municipal) are provided by the Mississippi Department of Environmental Quality, Division of Pollution Control. These data are received upon request by the USGS on a magnetic tape. Information on this tape includes: name and location of facility, the estimated average daily treated release for each plant, and the location of the release point by latitude and longitude. Sewage-treatment release totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

DATA COLLECTION TECHNIQUES IN NORTH CAROLINA

Water-use data in North Carolina are primarily collected by the North Carolina Department of Environment, Health, and Natural Resources (EHNR) in cooperation with the USGS. Water-use information also is derived from other State agencies, universities, and private companies that maintain records pertaining to water use or water requirements. The nine national water-use categories listed in the Introduction are collected in North Carolina. Public-supply, industrial, commercial, mining, power generation, and sewage-treatment water-use data are collected by contacting the appropriate agency or facility. Domestic, livestock, and irrigation water use are estimated using population or acreage estimates and water application rates. The categories of water-use data collected in North Carolina and the associated sources of information are given in table 9.

Public-Supply Water Use

Public-supply water use is defined as water withdrawn for all uses by public and private water suppliers and delivered to users that do not supply all their own water. Water-use data are collected by the EHNR by site visits and mail survey (appendix 3, pages 3-44 and 3-45), and by accessing North

Table 9.--North Carolina: Categories of water use and sources of information

Water-use category	Data sources
Public supply	North Carolina Department of Environment, Health, and Natural Resources, Division of Water North Carolina Department of Human Resources, Division of Health Services, Environmental Health, Section, Water Supply Branch
Domestic	North Carolina Department of Environment, Health, and Natural Resources, Division of Water U.S. Department of Commerce, Bureau of the Census North Carolina State University U.S. Geological Survey
Industrial	North Carolina Department of Environment, Health, and Natural Resources, Division of Water North Carolina Department of Commerce, Industrial Development Division U.S. Geological Survey
Commercial	North Carolina Department of Environment, Health, and Natural Resources, Division of Water North Carolina Department of Human Resources, Division of Health Services, Environmental Health Section, Water Supply Branch
Mining	North Carolina Department of Environment, Health, and Natural Resources, Division of Land Resources North Carolina Department of Commerce, Industrial Development Division U.S. Geological Survey
Livestock	North Carolina State University, Agricultural Extension Service North Carolina Crop and Livestock Reporting Service
Irrigation	North Carolina Department of Environment, Health, and Natural Resources, Division of Water North Carolina State University, Agricultural Extension Service North Carolina State University, Department of Agricultural Engineering
Power generation	North Carolina Department of Environment, Health, and Natural Resources, Division of Water U.S. Environmental Protection Agency Duke Power Company Carolina Power and Light Company Nantahala Power and Light Company Virginia Electric Company Tennessee Valley Authority U.S. Department of Energy U.S. Army Corps of Engineers

Table 9.--North Carolina: Categories of water use and sources of information--Continued

Water-use category	Data sources
Sewage treatment	North Carolina Department of Environment, Health, and Natural Resources, Department of Environmental Management U.S. Environmental Protection Agency (EPA-National Pollution Discharge Elimination System computer file)

Carolina Department of Human Resources (DHR) data files. Also, the USGS maintains pumpage or withdrawal data collected for other projects that are incorporated into the water-use files. EHNR conducts an inventory of public-supply water use for the State. Water-use information is collected primarily during site visits conducted as part of specific water-use studies or in conjunction with the water loss and leak detection program administered by EHNR. As part of this program, interviews are conducted with superintendents about operation of the facilities. It is estimated that approximately 5 percent of the State is covered annually by site visits to these facilities.

Periodically, EHNR will conduct a mail survey (appendix 3, pages 3-44 and 3-45) of all public-supply facilities in the State, to update their files with a complete statewide record of water use in a particular year, but these surveys are not made on an annual basis. When additional or current water-use information is required that is not already reported on the EHNR questionnaire or that has not been updated by site visits, data from DHR are accessed. DHR's primary function is to monitor the quality of the drinking water in the State and ensure that water systems are complying with drinking water regulations and standards. The DHR is considered the secondary source of water-use data for the public-supply category.

According to DHR, public suppliers can be subdivided into four types of systems: (1) community ground-water systems, (2) community surface-water systems, (3) nontransient and noncommunity systems, and (4) noncommunity systems. Community ground-water systems are those that supply 15 or more service connections or regularly serve 25 or more year-round residents. Community surface-water systems are facilities whose source of water comes from a river, stream, or lake system that provides 15 or more service connections or regularly serves 25 or more year-round residents. Non-transient-noncommunity systems regularly serve at least 25 of the same persons for 6 or more months per year. Noncommunity systems serve 25 or more people at least 60 days per year.

Water-use data are collected by DHR monthly. These reports are submitted to DHR by the water-treatment plant operators or other water managers and primarily contain water-treatment information about the facility, but also include the withdrawal rates, population served, and the source of the water supply. Public-supply water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Domestic Water Use

Domestic water users are defined as individual families and small communities not served by a public-supply system. Domestic water use is estimated by multiplying the domestic population for a county by a per capita water-use coefficient. In North Carolina, the domestic (self-supplied) population is determined by subtracting the total population of a county (U.S. Department of Commerce, Bureau of the Census, written commun., 1985) from the total population served by municipal or community water systems in that county. The population values served by public-supply systems are derived from EHNR and USGS interviews with the public-supply facilities or by DHR data. A water-use coefficient of 60 gal/d per person (appendix 2, page 2-4) is used (Sneed, 1961). This water-use coefficient also is substantiated by examining actual metered water use for rural domestic housing units.

Self-supplied domestic consumptive use is calculated as a percentage of the self-supplied domestic withdrawals and the delivered water to domestic users (households) by public-supply facilities. It is estimated that 80 percent of the water withdrawn by self-supplied domestic users was consumed, and 5 percent of the delivered water was consumed. This rate is derived from the USGS estimates.

Self-supplied domestic water use for hydrologic cataloging units is determined by disaggregation of county water use and population served data for public and community water systems. The population served for each hydrologic cataloging unit is determined and then subtracted from the estimated population in that hydrologic cataloging unit. Water use for the hydrologic cataloging units is determined by applying the same per capita factor (60 gal/d per person) that is used for the county values. The hydrologic accounting units are determined by summing the water use in the hydrologic cataloging units in each accounting unit.

Industrial Water Use

Industrial water use includes all water associated in any way with the manufacture of a product, the operation of the manufacturing facility, or the safety and welfare of the facility's employees. Industrial water-use data are obtained from a complete inventory obtained from EHNR. The industries surveyed are identified by using the "Directory of North Carolina Manufacturing Firms" (North Carolina Department of Commerce, 1987). During a preliminary survey in 1981, approximately 1,200 industrial water users were contacted by questionnaire (appendix 3, pages 3-47 and 3-48), telephone interviews, and some site visits. In 1987, a mail survey was conducted of industries that withdrew more than 80,000 gal/d, thus reducing the number of sites inventoried to about 250.

Currently (1990) industrial water-use data are being updated by the EHNR and the USGS. Industrial water-use data are collected by a mail survey (appendix 3, pages 3-47 and 3-48) and followed by telephone interviews. Site visits are made when necessary and in conjunction with special projects that require site-specific water-use data.

Consumptive use is estimated for all (self-supplied) industrial facilities by subtracting the returns from the withdrawals whenever return flows are available. When return flow data are not available, estimates of consumptive use are based on the water-use values computed for similar types of industry that had reliable return flow and consumptive use data. Industrial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Commercial Water Use

Commercial establishments using their own water-source facilities and those that receive deliveries from public-supply facilities are categorized as commercial water users. EHNR collects commercial water-use information by completing questionnaires (appendix 3, pages 3-47 to 3-49, 3-59) during site visits to the facilities or by telephone or mail contacts. Data are collected by EHNR for the following commercial users: universities, military facilities, prisons, campgrounds, parks, and recreational services. These data are collected on the same form used for public-supply facilities. DHR data are used whenever EHNR or USGS data are not available.

The amount of water delivered to commercial water users from public-supply systems is obtained from EHNR files. The public supplier provides EHNR with information concerning the percentage of water they delivered to various user groups.

Consumptive use information is obtained for major self-supplied commercial users by direct contacts from EHNR and USGS personnel. For other commercial users, the estimated consumptive use rates for the domestic category are applied to commercial use (80 percent for self-supplied

commercial and 5 percent for commercial deliveries from public-supply systems). Commercial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Mining Water Use

Mining water use or mineral extraction is water removed from a quarry for the purpose of working below the natural water table and water used to wash, sort, and separate mineral products. Mining water-use estimates are obtained by EHNR from personal contacts by telephone, mail, or site visits in the same manner as for the industrial category of use. Questionnaires (appendix 3, pages 3-47 to 3-49) are completed during site visits to the facilities and from telephone interviews with facility managers. The site visits usually are conducted in conjunction with a special water-use project or project that requires water-use information with priority based on regional requirements. The telephone interviews are sometimes followed by a site visit to gather additional information that could not be obtained from the telephone interview. Mail surveys are conducted to complete statewide data-collection requirements for report purposes. The mail survey is different and more concise than the regular interview forms and primarily focuses on sources of water supply and amount of water withdrawals and returns.

A complete inventory of mining operations in the State can be obtained from the Directory of Manufacturing Firms (North Carolina Department of Commerce, 1987) and the Directory of North Carolina Mineral Producers (North Carolina Department of Environment, Health, and Natural Resources, 1981). Data obtained for mining operations include withdrawal amounts, location of diversion, source of diversion, and return flows.

All consumptive use estimates for the mining category are obtained from personal contacts. The values for consumptive use were made by subtracting return flows for the facility from the amount of water withdrawn. Mining water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Livestock Water Use

Livestock water use in North Carolina includes water used for the propagation of livestock (cattle, horses, hogs, sheep, chickens, and turkeys). Livestock water use is estimated by applying a per capita water requirement (Sneed, 1961) for livestock and multiplying this coefficient by county livestock population totals. The per capita water requirements are:

Livestock type	Water required (gallons per day)
Dairy cattle	40
Horses	12
Dry or beef cattle	12
Hogs	4
Sheep	2
Chickens	9 per 100 chickens
Turkeys	9 per 50 turkeys

Livestock populations for each county are acquired from the North Carolina Crop and Livestock Reporting Service (1985). The proportion of water withdrawn from surface water versus ground water is estimated for various regions in the State based on topographic and climatic variability for the various regions of the State. It is estimated that approximately 85 percent of the withdrawals for livestock use were ground-water withdrawals.

Livestock water-use totals for hydrologic cataloging unit areas were determined by disaggregation of county data using the percentage of the county land area located within the hydrologic cataloging unit.

Irrigation Water Use

Information required for estimating irrigation water use is provided by EHNR and North Carolina State University (NCSU) Agricultural Extension Service. EHNR conducts field surveys in cooperation with county extension agents in selected river basins. Also, NCSU periodically estimates irrigation water use with the assistance of the county extension agents. The primary factors for estimating irrigation water use are: (1) obtaining the amount of irrigated acreage by crop type for each county, (2) the irrigation frequency and duration periods, (3) type of irrigation systems used (including information on pumps and power source), and (4) water-use coefficient (water requirement for crop type).

Irrigation water use for approximately 50 percent of the State is acquired from the surveys conducted by EHNR (appendix 3, page 3-46). The remainder of the State is estimated by using coefficients based on research conducted by the Department of Agricultural Engineering at NCSU, in addition to other data collected by EHNR. The Department of Agricultural Engineering periodically conducts surveys to record the amount of irrigated acreage by crop in each county. Also, they have established estimates of water requirements and application rates for each crop (table 10). Irrigated acreage values are obtained from a complete inventory provided by field interviews conducted by EHNR personnel and from the biannual surveys conducted by the Agricultural Extension Service, NCSU.

Consumptive use and conveyance losses are estimates made by the Department of Agricultural Engineering at NCSU and from EHNR inventories. The consumptive use for irrigation is estimated to be 100 percent of the withdrawals minus the conveyance loss. Conveyance losses are estimated to be 30 percent of the withdrawal amount.

Table 10.--Average irrigation application rates used for calculation of water use in North Carolina

Crop type	Application rate
Tobacco	4 inches/acre (average)
Corn	7 inches/acre (average)
Peanuts	5 inches/acre (average)
Soybeans	4 inches/acre (average)
Small fruits (strawberries, blueberries)	9 inches/acre
Tree fruits (apples, peaches)	6 inches/acre
Irish potatoes	4 inches/acre
Sweet potatoes	4 inches/acre
Vegetables	4 inches/acre
Wheat	2 inches/acre
Hay	8 inches/acre
Other small grains	2 inches/acre
Alfalfa (coastal)	6 inches/acre
Alfalfa (other areas)	8 inches/acre
Pasture	2 inches/acre

Water-use estimates for each hydrologic cataloging unit are determined by two methods. In areas where site-specific data are available, the water-use values are aggregated by location of the diversion within the hydrologic cataloging unit. In the remaining areas of the State, irrigation water-use totals

for hydrologic cataloging unit areas are determined by disaggregation of county data using the percentage of the county land area located within the hydrologic cataloging unit. The resulting hydrologic cataloging unit subtotals for each county are then regrouped for the State and totaled.

Power Generation Water Use

The amount of water used for the generation at 40 hydroelectric, 16 fossil-fuel, and 3 nuclear power generation facilities is obtained from a complete inventory of the power generating plants in the State. EHNR collects these data by a mail survey (appendix 3, pages 3-49 to 3-58). Also, the USGS receives data compiled by U.S. Department of Energy and private entities who maintain records on power generation operations.

Data collected on the EHNR form includes amount of surface-water withdrawn (fresh or saline), power generation, water releases, and the location of the withdrawal site. The following companies are sources of data for EHNR and the USGS: Duke Power Company, Carolina Power and Light Company, Nantahala Power and Light Company, Virginia Electric Company, TVA, U.S. Department of Energy, and the U.S. Army Corps of Engineers. Consumptive use for these facilities is estimated by subtracting the return flows from the amount of water withdrawn for each facility. Power generation water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Sewage-Treatment Water Use

Return flow information for sewage-treatment facilities located within the State is provided by the EHNR Department of Environmental Management (DEM) and the U.S. Environmental Protection Agency (EPA-NPDES computer file). This information is acquired from an inventory of these facilities.

Information concerning the number of municipal wastewater-treatment facilities and their associated locations and releases is provided by EHNR, DEM, and EPA-NPDES files. These same values for industrial and other wastewater-treatment facilities are provided by DEM and EPA. Sewage-treatment release totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

DATA COLLECTION TECHNIQUES IN PUERTO RICO AND THE U.S. VIRGIN ISLANDS

Water-use data collected for the Commonwealth of Puerto Rico and the territory of the Virgin Islands of the United States are monitored by the Caribbean District of the USGS located in San Juan, Puerto Rico. Water-use data are collected for Puerto Rico by the Commonwealth of Puerto Rico Aqueduct and Sewer Authority, Puerto Rico Department of Natural Resources, Puerto Rico Electric Power Authority, Puerto Rico Environmental Quality Board, and Puerto Rico Department of Agriculture in cooperation with the USGS. These data also are collected for the U.S. Virgin Islands in cooperation with the U.S. Virgin Islands Water and Power Authority; U.S. Virgin Islands Public Works Department; and the Caribbean Research Institute, College of the Virgin Islands, St. Thomas, U.S. Virgin Islands.

The nine national water-use categories listed in the Introduction are collected in the Caribbean District. Public-supply industrial, commercial, mining, power generation, and sewage-treatment water-use data are collected by contacting the appropriate agency or facility. Domestic, livestock, and irrigation water use are estimated using population or acreage estimates and water application rates. The categories of water-use data collected in Puerto Rico and the U.S. Virgin Islands and the associated sources of information are given in table 11. Data collection techniques will be explained for each water-use category, first for Puerto Rico and then for the U.S. Virgin Islands.

Table 11.--*Puerto Rico and the U.S. Virgin Islands: Categories of water use and sources of information*

Water-use category	Data sources
Public supply	
Puerto Rico	<p>Puerto Rico Aqueduct and Sewer Authority (monthly and annual operating reports) U.S. Department of Commerce, Bureau of the Census (Census of Population and Housing) Puerto Rico Planning Board</p>
U.S. Virgin Islands	<p>U.S. Virgin Islands Water and Power Authority U.S. Virgin Islands Public Works Department</p>
Domestic	
Puerto Rico	<p>Puerto Rico Aqueduct and Sewer Authority (monthly and annual operating reports) U.S. Department of Commerce, Bureau of the Census (Census of Population and Housing)</p>
U.S. Virgin Islands	<p>U.S. Virgin Islands Public Works Department U.S. Virgin Islands Department of Commerce Virgin Islands Caribbean Research Institute, Water Resources Research Branch U.S. Virgin Islands Department of Conservation and Cultural Affairs National Weather Service U.S. Geological Survey (rain gage data)</p>
Industrial	
Puerto Rico	<p>Puerto Rico Department of Natural Resources (permit records) Puerto Rico Aqueduct and Sewer Authority (monthly operating report)</p>
U.S. Virgin Islands	<p>U.S. Geological Survey U.S. Virgin Islands Public Works Department</p>
Commercial	
Puerto Rico	<p>Puerto Rico Aqueduct and Sewer Authority</p>
U.S. Virgin Islands	<p>U.S. Geological Survey U.S. Virgin Islands Water and Power Authority</p>
Mining	
Puerto Rico	<p>Puerto Rico Department of Natural Resources (permit records)</p>
U.S. Virgin Islands	<p>Mining operations in the U.S. Virgin Islands have negligible water use</p>

Table 11.--*Puerto Rico and the U.S. Virgin Islands: Categories of water use and sources of information*--Continued

Water-use category	Data sources
Livestock	
Puerto Rico	U.S. Department of Commerce, Bureau of the Census
U.S. Virgin Islands	Currently (1992) a negligible amount of livestock water use is reported in the U.S. Virgin Islands
Irrigation	
Puerto Rico	Puerto Rico Department of Agriculture U.S. Department of Commerce, Bureau of the Census Puerto Rico Electric Power Authority Puerto Rico Sugar Corporation
U.S. Virgin Islands	Currently (1992) no accountable irrigation water use reported in the U.S. Virgin Islands
Power generation thermoelectric	
Puerto Rico	Puerto Rico Aqueduct and Sewer Authority (monthly and annual operating reports) Puerto Electric Power Authority
U.S. Virgin Islands	Virgin Islands Water and Power Authority
Power generation hydroelectric	
Puerto Rico	Puerto Electric Power Authority
U.S. Virgin Islands	Currently (1990) there are no hydroelectric power facilities located in the U.S. Virgin Islands
Sewage treatment	
Puerto Rico	Puerto Rico Aqueduct and Sewer Authority
U.S. Virgin Islands	U.S. Virgin Islands Public Works Department

Public-Supply Water Use

Puerto Rico

Public-supply water use refers to water that is used by a public water supplier for the purpose of supplying 25 or more users. Water withdrawals and water-use data for public-supply systems of Puerto Rico and the offshore islands of Vieques and Culebra are obtained from the Puerto Rico Aqueduct and Sewer Authority (PRASA). PRASA is responsible for maintaining records for these facilities pertaining to water withdrawals and dispersion from public-supply systems, in addition to records of return flows to public sewage-treatment facilities in Puerto Rico. The sources of water for Puerto Rico's 583 public-supply facilities are primarily ground water for 413 facilities and primarily surface water for 170 facilities.

Water use and distribution are published monthly and annually in reports by PRASA. These reports list water and sewer withdrawals (in cubic meters) by municipio, the number of connections (both metered and unmetered) for residential, commercial, industrial, government deliveries, public fountains and hydrants, and category totals. The term "municipio" is the minimum legal or jurisdictional unit in Puerto Rico as used by the U.S. Department of Commerce, Bureau of the Census. A "municipio" essentially is equivalent to a county in the United States. Puerto Rico is made up of 78 municipios. For report purposes, the municipios are grouped together into six districts: San Juan, Arecibo, Mayagüez, Ponce, Guayama, and Humacao. The water-use values in these reports are in metric units and must be converted to English units before data can be aggregated, stored, or published. This information is from a complete survey of the larger public-supply systems.

Water-use estimates are made by hydrologic cataloging units by multiplying the domestic-use coefficient by a hydrologic cataloging unit population value. Hydrologic cataloging unit population values for public-supply systems are determined from "Census of Population and Housing" (U.S. Department of Commerce, Bureau of the Census, 1984) and by consulting with the Puerto Rico Planning Board. Population values and the number of connections per housing unit are listed in this publication for each municipio and are subdivided into smaller units called wards. The domestic use coefficient is determined from PRASA reports (Puerto Rico Aqueduct and Sewer Authority, 1987). The hydrologic cataloging unit population values are determined by regrouping the wards to fit within the hydrologic cataloging unit boundaries. The ward populations then are totaled within the hydrologic cataloging unit boundaries and multiplied by the domestic use coefficient. Consumptive uses for public-supply systems are difficult to determine for Puerto Rico because of system distribution leaks, defective metering equipment, or unmetered connections, but the average consumptive use value is approximately 30 percent.

U.S. Virgin Islands

Public-supply water use refers to water that is withdrawn by a public water supplier for the purpose of supplying 25 or more users. The U.S. Virgin Islands consist of more than 40 small islands and cays. The three largest islands are St. Croix, St. Thomas, and St. John. Water use for public-supply systems is supplied primarily from 2 seawater desalination plants and from 15 ground-water wells located within the islands. Water-use data for public-supply systems are supplied by the U.S. Virgin Islands Water and Power Authority and the U.S. Virgin Islands Public Works Department (VIPW).

The U.S. Virgin Islands public-supply facilities furnish water for domestic and commercial customers and for thermoelectric power production. Ground-water use by public-supply facilities is provided upon request from the VIPW. The seawater supply system of St. Thomas and St. Croix consists of single distribution systems involving only the urban areas. The purpose of the seawater systems are twofold--they provide a secondary water supply for sanitary use and supply fire hydrants and other fire protection needs. Water-use values pertaining to the seawater supply distribution system are provided by the VIPW. Public-supply water-use totals for each hydrologic cataloging unit within the Territory are determined by aggregation of site-specific data located within these specific areas.

Domestic Water Use

Puerto Rico

Self-supplied domestic water use reflects the population outside the urban areas of Puerto Rico not serviced by public-supply facilities. Water is withdrawn from wells or springs to provide for personal household needs. Self-supplied domestic water use in Puerto Rico is estimated by multiplying the population not served by public-supply systems by a water-use coefficient. The population values for self-supplied domestic water users are determined by subtracting the municipio population (public-

supplied) from the total population; the remaining population is that of self-supplied domestic water users. The U.S. Department of Commerce, Bureau of the Census (1984) publishes municipio population values and the Puerto Rico Aqueduct and Sewer Authority (1987) furnish population values for public supplied customers by municipio.

The water-use coefficient for the self-supplied domestic population is 40 gal/d per person (appendix 2, page 2-4). This value was determined by averaging billing records for domestic deliveries of public supplied customers. Hydrologic cataloging unit aggregation estimates are made the same way as for public supply. The U.S. Department of Commerce, Bureau of the Census (1984) report is used for making population assignments. Ward population values are subtracted from population-served figures for public suppliers and the remaining population is self-supplied domestic users. These ward totals then are regrouped by land area located within their respective hydrologic cataloging units. These hydrologic cataloging unit population totals are multiplied by the water-use coefficient for domestic use. Water used for self-supplied domestic purposes is considered to be 100 percent consumed.

U.S. Virgin Islands

Individuals located outside urban areas, which are not connected to public-supply systems, are considered to be self-supplied domestic. Water used for these purposes is supplied by rainfall and wells. Cisterns that store roof rainfall runoff are required by law and are an important source of water supply for most rural homes. The quantity of rainfall collected in a cistern is a result of the amount of rainfall, roof area and configuration, wind velocity, and other weather conditions. Estimates of monthly rainfall recovery and cistern yield were made considering the following factors: (1) number of nonserved housing units in each district of the islands, (2) roof area of 1,000 square ft per housing unit, (3) monthly rainfall in each district that is applied, and (4) a total rainfall recovery rate of 70 percent (Jordan and Cosner, 1973) (appendix 2, page 2-4). The number of nonserved housing units in each planning district of the Virgin Islands was provided by the Virgin Islands Department of Commerce. The estimated roof area assumption of 1,000 square ft per housing unit was derived after consultation with the Virgin Islands Department of Conservation and Cultural Affairs. Rainfall and other climatological information are provided by the National Weather Service (National Weather Service, oral commun., 1985), with some supplemental rainfall data obtained from rain gages installed by the USGS.

Ground-water withdrawal information is provided by the Virgin Islands Department of Conservation and Cultural Affairs (oral commun., 1983). Deliveries from wells operated by private water haulers are obtained from a complete survey conducted by the VIPW. Domestic water-use totals for hydrologic cataloging unit areas are determined by disaggregation of data based on the percentage of the population located within the hydrologic cataloging unit.

Industrial Water Use

Puerto Rico

Industrial water use in Puerto Rico refers to water that is used in the petroleum industry, pharmaceutical and electronic industries, rum refining, and paper products. A listing of these industries is provided upon request from the Puerto Rico Department of Natural Resources. These data come from a listing of their permit records. From this listing a complete survey is conducted to determine the self-supplied users, and the amount of water used by each industry. Deliveries from public-supplied facilities are provided by the monthly operating reports from PRASA. Consumptive use for industrial purposes is estimated to be 20 percent. Industrial water-use totals for each hydrologic cataloging unit within the Commonwealth are determined by aggregation of site-specific data located within these specific areas.

U.S. Virgin Islands

The largest self-supplied industrial users are a petroleum refinery and several rum distilleries that are located in St. Croix. Water used by the petroleum refinery is for cooling and desalination purposes. At the refinery, brackish ground water is used for processing crude oil. Rum distilleries use ground water and rainwater collected in cisterns. Data relevant to the self-supplied industrial water-use category are collected from a complete inventory of industrial users. Deliveries of water from public-supply systems are provided by the VIPW. Consumptive use is considered to be 100 percent for industrial uses. Industrial water-use totals for each hydrologic cataloging unit within the Territory are determined by aggregation of site-specific data located within these specific areas.

Commercial Water Use

Puerto Rico

Commercial water use is defined as water used by office buildings, hotels, motels, restaurants, and warehouses. Water supply for commercial purposes is provided by public-supply systems. These data are provided by PRASA and are compiled by municipio and by district (Puerto Rico Aqueduct and Sewer Authority, 1987). The report displays the deliveries from each municipio by the number of metered and unmetered customers, amount of consumptive use, and gross revenues. These data are reported in metric units and must be converted to English units before storage and publication. Commercial water-use totals for each hydrologic cataloging unit within the Commonwealth are determined by aggregation of site-specific data located within these specific areas.

U.S. Virgin Islands

The principal self-supplied commercial users in the U.S. Virgin Islands are hotels and condominiums. The water used primarily is seawater and is used as feedwater for small desalination plants, for swimming pools, and flushing toilets. Information pertaining to self-supplied commercial users is obtained from a mail or telephone survey of the users themselves. These surveys have indicated that the various hotels and condominiums maintain good records for water production at these small desalination plants as well as visitation records. Some additional water is provided by rainfall. The rainfall is collected in water catchments and stored in cisterns. Ground water also is used, to a lesser extent, at other commercial facilities, such as airports, laundries, and gasoline stations. Deliveries from public-supply systems are provided by the U.S. Virgin Islands Water and Power Authority. Commercial water-use totals for each hydrologic cataloging unit within the Territory are determined by aggregation of site-specific data located within these specific areas.

Mining Water Use

Puerto Rico

Water used for mining in Puerto Rico primarily is for sand and gravel operations. These plants use surface water for washing the sand and gravel. These facilities are classified as self-supplied users. The Puerto Rico Department of Natural Resources supplies permitted withdrawal amounts for these operations. Consumptive use for mining is negligible, because essentially all the water withdrawn is returned to its source. Mining water-use totals for each hydrologic cataloging unit within the Commonwealth are determined by aggregation of site-specific data located within these specific areas.

U.S. Virgin Islands

Water use for mining operations in the U.S. Virgin Islands is considered negligible; therefore, no estimates are made in this category.

Livestock Water Use

Puerto Rico

Livestock water use refers to water that is used for livestock purposes, such as feedlot, stock watering, and dairy operations. Water withdrawals for livestock (agriculture) use are based on a fixed amount of water used per head for each type of animal. The following daily livestock water requirements (Kirk and others, 1982) provide the basis for these calculations.

Livestock	Water required (gallons per day)
Dairy cattle	35
Non-dairy cattle, horses, mules	12
Hogs	4
Sheep, goats	2
Rabbits	1
Chickens	.06

The livestock population by municipio is provided by the "Census of Agriculture" (U.S. Department of Commerce, Bureau of the Census, 1984). Livestock water-use totals for hydrologic cataloging unit areas are determined by disaggregation of municipio data based on the percentage of the livestock population located within the hydrologic cataloging unit. Consumptive use for livestock is 100 percent.

U.S. Virgin Islands

Water use for livestock is considered negligible; therefore, no estimates are made in this category.

Irrigation Water Use

Puerto Rico

Irrigation water use refers to water distributed on lands for the purpose of growing crops and pasture or maintaining recreational lands, such as parks and golf courses. Sugar cane, rice, and vegetables are the primary crops irrigated in Puerto Rico. The Puerto Rico Department of Agriculture operates the wells on most of these government-owned irrigation districts. The method of irrigation on these farms is by drip, flood, or gravity feed. Water-use estimates for the irrigation category are made by multiplying the number of acres of land irrigated by the amount of water diverted from irrigation canals or withdrawn from ground-water wells. The total of this calculation is the amount of water used by crop type for irrigation.

In order to obtain the data components necessary to make a water-use estimate for irrigation, it is necessary to obtain the following data: (1) the number of acres irrigated for all crop types by municipio, (2) the amount of water diverted for irrigation by canal, and (3) the amount of ground water withdrawn for each well. Acquiring this information requires contacting several sources. Irrigated acreage values by crop type are published by the U.S. Department of Commerce, Bureau of the Census (1984). Surface-water withdrawals used by government irrigation districts are supplied by the Irrigation Services Division of the Puerto Rico Electric Power Authority. Ground-water withdrawals for irrigation on the south coast are collected by the Puerto Rico Sugar Corporation. Consumptive use for irrigation in Puerto Rico is estimated to be 65 percent, with a 10 percent value assigned for conveyance losses (Solley and others, 1983). Irrigation water-use totals for hydrologic cataloging unit areas were

determined by disaggregation of municipio data using the percent of the municipio land area located within the hydrologic cataloging unit. The resulting hydrologic cataloging unit subtotals for each municipio are then regrouped for the Commonwealth and totaled.

U.S. Virgin Islands

The U.S. Virgin Islands currently (1990) have no accountable irrigation water use.

Power Generation Water Use (Thermoelectric)

Puerto Rico

Power generation water use refers to water that is used to generate electric power, such as hydroelectric and thermoelectric. There are four thermoelectric fossil-fuel power facilities in Puerto Rico. The withdrawal of seawater for thermoelectric cooling in the production of electricity accounts for 100 percent of all seawater withdrawals in Puerto Rico. Freshwater usage consists of ground-water withdrawals and deliveries from public-supply systems.

Water-use information pertaining to thermoelectric power generation is supplied by the Puerto Rico Electric Power Authority (PREPA). There are three PREPA offices in Puerto Rico where information about power generation is obtained: (1) hydroelectric power production data comes from the office in Toa Baja, (2) thermoelectric power production data are maintained in the Santurce office, and (3) information pertaining to discharge information and other power related data reside in the PREPA headquarters office in San Juan. Deliveries from public-supply systems for thermoelectric generation are provided by PRASA. Consumptive use for thermoelectric power generation is estimated to be less than 1 percent. Power generation water-use totals for each hydrologic cataloging unit within the Commonwealth are determined by aggregation of site-specific data located within these specific areas.

U.S. Virgin Islands

Power generation water use refers to water that is used to generate electric power, such as hydroelectric and thermoelectric. Thermoelectric power generation is the largest water user in the U.S. Virgin Islands. The two fossil-fuel plants are located on St. Croix and St. Thomas. These plants are operated by the Virgin Islands Water and Power Authority (VIWAPA). Seawater is used as the primary source of water for thermoelectric power generation. The seawater is used for condenser cooling at these facilities. In addition to the seawater, approximately 1 percent of water used is freshwater obtained directly from the desalination plants and mainly used for boiler feed. Consumptive use is estimated to be 20 percent of the freshwater used for thermoelectric power generation. All water-use data relevant to thermoelectric power in the U.S. Virgin Islands are provided by the VIWAPA. Power generation water-use totals for each hydrologic cataloging unit within the Territory are determined by aggregation of site-specific data located within these specific areas.

Power Generation Water Use (Hydroelectric)

Puerto Rico

Water used for hydroelectric power generation is the only instream use of water in Puerto Rico. Hydroelectric power is produced at seven hydroelectric facilities. Surface-water withdrawal information and power generation values are provided by PREPA. Power generation water-use totals for each hydrologic cataloging unit within the Commonwealth are determined by aggregation of site-specific data located within these specific areas.

U.S. Virgin Islands

There are no hydroelectric power facilities located in the U.S. Virgin Islands; therefore, no water-use estimates are made.

Sewage-Treatment Water Use

Puerto Rico

Sewage-treatment water use (releases) refers to the collection of sewage from 25 or more sources by wastewater-treatment systems to improve water quality before it is returned. The PRASA maintains records pertaining to sewage-treatment or public wastewater-treatment releases in Puerto Rico. These data are reported by municipio, and contain information about the number of domestic, commercial, and industrial connections. PRASA records include data pertaining to monthly and annual discharges for all 78 municipios. This information is published monthly and annually (Puerto Rico Aqueduct and Sewer Authority, 1987). Sewage-treatment release totals for each hydrologic cataloging unit within the Commonwealth are determined by aggregation of site-specific data located within these specific areas.

U.S. Virgin Islands

Sewage-treatment water use (releases) refers to the collection of sewage from 25 or more sources by wastewater-treatment systems to improve water quality before it is returned. The VIPW provides information about public wastewater-treatment facilities for the U.S. Virgin Islands. These data are for the seven facilities on St. Thomas and the one on St. Croix. Information relevant to the number and type of connections as well as their treated releases for each facility also are provided by VIPW. Sewage-treatment release totals for each hydrologic cataloging unit within the Territory are determined by aggregation of site-specific data located within these specific areas.

DATA COLLECTION TECHNIQUES IN SOUTH CAROLINA

Water-use data in South Carolina are collected by the South Carolina Water Resources Commission (SCWRC) in cooperation with the USGS. Most of South Carolina's water-use data are collected from water-use reporting forms. In South Carolina, anyone with a single-day maximum water usage equal to or exceeding 100,000 gal/d is mandated by law to report their withdrawals to the SCWRC (South Carolina Water Use Reporting and Coordination Act of 1982). Reports are submitted to the Commission on a quarterly basis by complying users, except for livestock users, who report their withdrawals annually because of the seasonal nature of their water usage. In addition, all water users who are required to report, must complete a one-time-only Water Use System Report (appendix 3, pages 3-69 and 3-70) in which they describe their water pumping system and the location of the withdrawal site. The SCWRC uses these forms to collect water-use information. SCWRC also provide handout form WV-A that describes methods for estimating water use (appendix 3, pages 3-60 to 3-78).

Public-supply, industrial, commercial, mining, power generation, and sewage-treatment water-use data are collected by contacting the appropriate agency or facility. Both domestic and livestock water use are estimated using population estimates and water application rates. The categories of water-use data collected in South Carolina and the associated sources of information are given in table 12.

Public-Supply Water Use

Water-use amounts for public supply are based on monthly reports (appendix 3, pages 3-80) submitted to the South Carolina Department of Health and Environmental Control (DHEC) as required by the State Safe Drinking Water Act of 1976. Systems unaccounted for in the DHEC files include a few small public suppliers not applying treatment. There are approximately 1,800 public-

Table 12.--*South Carolina: Categories of water use and sources of information*

Water-use category	Data sources
Public supply	South Carolina Department of Health and Environmental Control South Carolina Water Resources Commission
Domestic	South Carolina Department of Health and Environmental Control U.S. Department of Commerce, Bureau of the Census
Industrial	South Carolina Water Resources Commission (Water Use System Description Report)
Commercial	South Carolina Water Resources Commission (Water Use System Description Report)
Mining	South Carolina Water Resources Commission (Water Use System Description Report)
Livestock	South Carolina Crop and Livestock Reporting Service
Irrigation	South Carolina Water Resources Commission (Agricultural and Golf Course Water Use Report forms) Clemson University Cooperative Extension Service
Power generation thermoelectric and hydroelectric	U.S. Geological Survey (interviews) South Carolina Power and Gas Company Duke Power Company Carolina Power and Light Company South Carolina Public Service Authority Regal Textile Company Spartanburg Water Company
Sewage treatment	South Carolina Department of Health and Environmental Control

supply facilities in the files maintained by DHEC. Data in DHEC files include daily water withdrawals for each withdrawal site for each facility, total hours of pumping per day (by well), static water level, pumping level, flow information for each well, and population served by each facility. Additional information collected includes chemical treatment data for each facility, pounds of chemicals used, chemical dosage, and the chemical analyses for each plant.

In addition to the DHEC files, the SCWRC has water-use information for approximately 330 public-supply facilities in their data base. These data are reported to SCWRC on the Water Use System Report form (appendix 3, pages 3-69 and 3-70). These data include monthly water withdrawals by facility, address of the facility, contact person, SIC code (primary and secondary), whether water used by the facility is purchased or withdrawn, and location of withdrawal and treatment facilities. There also is information concerning deliveries from public suppliers to domestic, commercial, industrial, agricultural, and institutional users; resale to other public suppliers; lost or unaccounted water; and untreated water sales. This information is transferred to the USGS annually by magnetic computer tape. Public-supply water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Domestic Water Use

Domestic water use describes water that is used by individual families and small communities not served by a public-supply system. Domestic use is calculated by multiplying the county population not served by municipalities or water districts by a rate of 75 gal/d per person (appendix 2, page 2-4). The self-supplied domestic population is determined by subtracting the population served by public supplied systems (by county) from the county census totals. The DHEC provides data on the population served by public-supplied systems, and the U.S. Department of Commerce, Bureau of the Census provides total county population values. Water used for domestic purposes is considered to be 100 percent consumed.

Estimating domestic water use for the hydrologic cataloging units is accomplished by estimating the percentage of the land area for each of the hydrologic cataloging units that is encompassed within each county. This percentage is then multiplied by the water-use value for the county. This process is duplicated for every county in the State. These totals then are regrouped by hydrologic cataloging units and summed to represent hydrologic cataloging unit totals for the State.

Industrial Water Use

Industrial water use is defined as the use of water for the purpose of manufacturing a product, including water employed in once-through cooling. The SCWRC collects water-use information quarterly for self-supplied industrial facilities. These data are reported to SCWRC by each facility using the Industrial Water Use System Description Report (appendix 3, pages 3-69 to 3-74). The users inventoried are primarily chemical, paper, and textile industries. Industrial consumptive use is estimated to be 15 percent of the amount of water withdrawn. Industrial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Commercial Water Use

The SCWRC collects water-use information quarterly for self-supplied commercial facilities. These data are reported to SCWRC by the facility using the Industrial Water Use System Description Report. The information provided by commercial establishments is the same as that provided by industrial water users (appendix 3, pages 3-69 to 3-74). Commercial consumptive use is estimated to be negligible, according to reported SCWRC information. Commercial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Mining Water Use

Mining water use or mineral extraction is water removed from a quarry or mine for the purpose of working below the natural water table and water used to wash, sort, and separate mineral products. Mining water use is reported to the SCWRC (appendix 3, pages 3-69 to 3-74). The primary mining

industries monitored in South Carolina are sand and gravel, stone (crushed), limestone, and clay. These data are reported on the Industrial Water Use System Description Report, and is the same type of information described in the section for Industrial Water Use. Consumptive water use for mining is estimated to be zero according to a 1980 mail survey by SCWRC. Mining water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Livestock Water Use

Livestock water use refers to water that is used for livestock purposes such as feedlot, stock watering, and dairy operations. Livestock water use is based on the estimated number of farm animals (South Carolina Agricultural Statistics Service, 1986) and estimates of water needs for each type of livestock and poultry (MacKichan and Kammerer, 1961). Livestock populations for each county are multiplied by the appropriate water-use coefficient for each type of livestock. Water requirements for livestock are as follows:

Livestock	Water required (gallons per day)
Livestock: (per animal)	
Cattle	12
Dairy cattle	35
Goats	2
Hogs	4
Horses	12
Mules	12
Sheep	2
Steers	12
Poultry:	
Chickens (per 100)	5-10
Turkeys (per 100)	10-18

Livestock water-use totals for hydrologic cataloging unit areas were determined by disaggregation of county data using the percent of the county land areas located within the hydrologic cataloging unit. The resulting hydrologic cataloging unit subtotals for each county are then regrouped for the State and totaled.

Irrigation Water Use

Irrigation water use is defined as an application of water to any agricultural crop (including golf courses) for the purpose of maturing that crop. Water use for irrigation is reported to the SCWRC on the Agricultural Water Use Report Form (appendix 3, page 3-75). These forms are completed by farmers on an annual basis and contain information relevant to the previous years' water use for irrigation. Forms are sent to the Clemson University Cooperative Extension Service in each county where they are reviewed for completeness. Those forms not properly completed are set aside and the farmers are contacted to fill in the missing data. Completed forms then are forwarded to the Cooperative Extension Service office at Clemson University where they are rechecked and forwarded to the SCWRC for computer entry. The consumptive use value for irrigation is estimated to be 100 percent of the amount of water withdrawn.

In addition to irrigation data, golf course water-use information is reported to SCWRC. These data are collected on a form that is identical to the Water Use System Report used by public-supply facilities. Irrigation water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Power Generation Water Use

Water-use figures for thermoelectric and hydroelectric plants were obtained by interviewing the owners of the facilities. There are 14 thermoelectric and 40 hydroelectric plants inventoried in South Carolina. The following companies (both private and public) are contacted for power generation information about their facilities: South Carolina Power and Gas, Carolina Power and Light, Duke Power, South Carolina Public Service Authority, Regal Textile Company, and Spartanburg Water Company. The data collected include the installed generating capacity of the facility, total power generated, monthly power generated, location of facility, and the amount of water withdrawn (monthly and annually) by the facility for power generation. Power generation water-use data also are provided to SCWRC on data collection forms (appendix 3, pages 3-76 to 3-79). Power generation water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Sewage-Treatment Water Use

Sewage-treatment water use refers to sewage-treatment facilities engaged primarily in the collection and disposal of wastewater conveyed through a sewer system. A list of sewage-treatment facilities is furnished from the NPDES files maintained by the DHEC. These data contain the latitude and longitude of the release point of the treated wastewater. These data also include the amount of water treated and released. Sewage-treatment release totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

DATA COLLECTION TECHNIQUES IN TENNESSEE

Water-use data in Tennessee are collected by the Tennessee Department of Health and Environment (TDHE) in cooperation with the USGS. The nine national water-use categories listed in the Introduction are collected in Tennessee. Public-supply, industrial, commercial, irrigation, mining, power generation, and sewage-treatment water-use data are collected by contacting the appropriate agency or facility. Domestic and livestock water use are determined using population estimates and per capita coefficients. The categories of water-use data collected in Tennessee and the associated sources of information are given in table 13.

Public-Supply Water Use

The definition of a public-supply system in Tennessee is a water supplier that provides water for a minimum of 25 people or 15 connections for 6 months or more during a year. Information pertaining to the amount of water used for public supply is maintained in manual files by the TDHE Division of Water Supply.

The data collection process is performed within the five basin offices of the TDHE. The engineers within each of the five basin offices are assigned the responsibility of collecting public-supply facility information for users within their basin areas. These data are provided by personal contacts. Data collection forms are provided in appendix 3, pages 3-81 to 3-84. These data are updated routinely for approximately 700 public suppliers in Tennessee.

Deliveries of public-supplied water use in 1985 are projected from the results of a complete public-supply survey in 1980, and a partial survey conducted in 1985. The information collected during these surveys was the basis for projecting the commercial and industrial deliveries from the current reported withdrawals. Data indicating the number of persons per household by county collected by the U.S. Census Bureau in 1970 were used to derive a number of persons per connection coefficient. The coefficient is multiplied by the number of connections for a public supplier to determine the population served. The number of connections per public-supply system is updated every 3 years. Consumptive

use and conveyance losses for public-supplied water users are estimated to be 10 percent. Public-supply water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Table 13.--*Tennessee: Categories of water use and sources of information*

Water-use category	Data sources
Public supply	Tennessee Department of Health and Environment, Division of Water Supply
Domestic	Tennessee Department of Health and Environment, Division of Water Supply Shelby County Health Department University of Tennessee, Department of Sociology
Industrial	Tennessee Department of Health and Environment, Division of Water Quality Control (Discharge Monitoring Report) Shelby County Health Department U.S. Geological Survey, Tennessee District
Commercial	Tennessee Department of Health and Environment, Division of Water Supply Shelby County Health Department
Mining	Tennessee Department of Health and Environment Tennessee Department of Conservation, Division of Geology Tennessee Department of Labor, Division of Mine Permits U.S. Department of the Interior, Office of Surface Mining Tennessee Department of Health and Environment, Division of Surface Mining and Reclamation EPA-National Pollution Discharge Elimination System (permits)
Livestock	U.S. Geological Survey, Mississippi District Tennessee Wildlife Resources Agency Tennessee Agriculture Statistical Service Tennessee Agricultural Extension Service
Irrigation	U.S. Department of Agriculture, Soil Conservation Service
Power generation	Tennessee Valley Authority
Sewage treatment	Tennessee Department of Health and Environment, Division of Water Quality Control (Discharge Monitoring Report) EPA-National Pollution Discharge Elimination System (computer files)

Domestic Water Use

Water use for domestic purposes is estimated, but some site-specific data are available. Estimates for domestic water use are computed using a domestic use coefficient and an estimate of the population using domestic wells (based on the number of persons not served by public supply facilities within a county). The domestic use coefficient (60-70 gal/d per person) is determined by a TDHE survey of public suppliers conducted in 1980 requesting information on the amount of water delivered for domestic purposes and the number of people served. The amount of water delivered to domestic users was divided into the population served resulting in a coefficient for domestic usage for each public supplier. These coefficients (appendix 2, page 2-4; representing the public suppliers located within a county) are averaged for the particular county, reviewed, a range table was developed, and then plotted on a choropleth map. Upon completion of the plot, it was possible to geographically organize the coefficients within regions and the coefficients identified with the region that is used for all the public suppliers (domestic users) located within the area. Census values for the counties of Tennessee are provided by the University of Tennessee (1985). Consumptive use for domestic purposes is estimated to be 100 percent. Domestic water-use totals for hydrologic cataloging unit areas are determined by disaggregation of county data using the percentage of the county land area located within the hydrologic cataloging unit. These percentages are then multiplied by the county water-use totals. The resulting hydrologic cataloging unit subtotals for each county are then regrouped for the State and totaled.

Industrial Water Use

The primary (self-supplied) industrial water users in Tennessee are the chemical, pulp and paper, munitions, textiles, and food processors. A telephone survey of industries was conducted by TDHE, Division of Water Supply. Data collected by the survey included location (city and county), mailing address, and source of supply. An example of the survey form and instructions are provided in appendix 3, pages 3-84 to 3-86.

A master list of self-supplied industries is updated by referring to the most current copy of the Directory of Manufacturers of Tennessee, cross-referencing of city telephone directories, and then conducting a telephone survey to determine active or inactive industrial users or adding new users to the list. This list is updated every 5 years.

The TDHE also collects monthly pumpage for industries in Shelby County. These data are collected by a mail survey, and in cases where there is no response with a telephone call. Consumptive use is calculated using 9 percent of the total withdrawals and deliveries (Solley and others, 1983). Industrial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Commercial Water Use

Commercial water use is subdivided into two categories: large commercial and noncommunity public supply. Large commercial water users include military facilities, penal facilities, and universities, as well as retail stores, restaurants, and laundry services. Noncommunity public suppliers (small commercial users) are water systems that serve less than 25 people or fewer than 15 connections for 6 months or less. These users include churches, truck stops, campgrounds, and some trailer parks.

The TDHE Division of Water Supply provides the USGS with commercial facility data for the State. Data collection forms are provided in appendix 3, pages 3-84 to 3-86. Water use is estimated by multiplying the transient or nontransient population figures by a standard per capita consumption coefficient (MacKichan and Kammerer, 1961). Consumptive use for commercial purposes is estimated

to be 9 percent (Solley and others, 1983). Commercial water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Mining Water Use

Water is used in the mining industry for dust control, process washing, and dewatering. Both surface and underground mining are active in Tennessee. The various mined products include: coal, phosphate, barite, copper, zinc, limestone, gravel, sand, and clay.

Mining water use is estimated by using tonnage data (for all mined products in Tennessee) and multiplying it by a water-use coefficient of 200 gallon per ton. The mining water-use coefficient (200 gallon per ton) was determined during a 1986 survey by the TDHE. Data sources pertaining to coal mining are as follows: coal mine listings are provided by the Tennessee Department of Conservation, Division of Geology; and annual tonnage production is from the Tennessee Department of Labor, Division of Mines Permits and U.S. Department of the Interior, Office of Surface Mining (since 1978). Data relevant to mining other than coal are provided by TDHE, Division of Surface Mining and Reclamation, and NPDES permits. This information is part of the mining permits file and contains data relevant to number of mining sites and their acreage, location (latitude and longitude), and mailing address.

Consumptive use is considered to be 11 percent of the total withdrawals and deliveries (Solley and others, 1983). Mining water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Livestock Water Use

Livestock water use includes water withdrawn for aquaculture and livestock watering. Aquacultural water use is determined by two techniques. The first technique requires multiplying the number of pounds of fish produced per acre of pond surface area by a water-use coefficient (8 gallon per pound of fish produced). Aquacultural production values and pond acreage are provided upon request from the Tennessee Wildlife Resources Agency. In areas where production data are not available the other technique is used. The other technique requires multiplying a water-use coefficient of 1.5 ft per acre by the pond surface acreage to estimate annual water use for fish farms and catch-out basins. Both coefficients were determined during field studies in Mississippi and were transferred to Tennessee (J.C. Callahan, U.S. Geological Survey, oral commun., 1985).

Water used for livestock is determined by multiplying the stock population by the water-use coefficient appropriate for each species of livestock. The per capita water-use coefficients were developed by the Tennessee Agricultural Extension Service. The coefficients were determined by measuring the amount of water used per ton of feed consumed per livestock type produced. The coefficients (water requirements) for livestock are as follows:

Livestock	Water required (gallons per day)
Beef cattle	10
Pigs and hogs	5
Horses	10
Dairy cattle	35
Poultry	.05

Livestock population values are reported by the Tennessee Agricultural Statistics Service, except for horse populations, which are maintained by several horse associations located throughout the State.

Livestock water-use totals for hydrologic cataloging unit areas were determined by disaggregation of county data using the percentage of the county land area located within the hydrologic cataloging unit. The resulting hydrologic cataloging unit subtotals for each county are then regrouped for the State and totaled.

Irrigation Water Use

Three methods are used to estimate water withdrawals for irrigation purposes in Tennessee: (1) the number of water applications during a cropping season is multiplied by the average number of hours a pump is used per application, and by the pump capacity in gallons per minute; (2) the number of water applications during a cropping season is multiplied by the recommended rate of application for a given crop type and soil classification (U.S. Department of Agriculture, 1962); and (3) the crop consumptive irrigation requirement (U.S. Department of Agriculture, 1976) is multiplied by the number of irrigated acres. Data collection forms are listed in appendix 3, page 3-87 and 3-88. The method selected depends on the type of data collected for the site. The most accurate estimates are derived using the first method. The second and third methods are less accurate. Both of these latter methods assume that consistent and highly efficient management criteria are always used for scheduling irrigation. Further, both of these methods rely on coefficients describing regional soil moisture or precipitation distributions, rather than site-specific conditions.

Method I

About two-thirds of those surveyed provided information on the number of applications, the estimated number of hours per application, and the pump capacity. Water withdrawals were calculated as follows:

$$A \times H \times C \times Cf = Q,$$

- A = number of applications during cropping season;
- H = average time per application, in hours;
- C = pump capacity, in gallons per minute;
- Cf = conversion factor, to million gallons per day; and
- Q = water withdrawal, in million gallons per day.

Method II

The second method is used with the following data: crop type, acreage, number of applications, and location. This method relies on recommended application amounts for nine crops, by soil classification and region (either western Tennessee or central and eastern Tennessee). Soil data are not collected at each site; therefore, the application coefficient for each crop is averaged by region. Water-use estimates for Method II are calculated using the following equation:

$$A \times R \times Ac \times Cf = Ae,$$

- A = number of applications during cropping season;
- R = rate of application, acre-feet per acre;
- Ac = acreage;
- Cf = conversion factor, to million gallons per day; and
- Ae = estimation application amount.

Method III

The third method uses crop consumptive irrigation requirements (CIR), which are calculated monthly for 12 crops for the major basins in Tennessee. Water-use data are expressed in acre-feet per acre. CIR is the consumptive use or evapotranspiration of an individual crop, less the effective precipitation, over a particular period of time (usually monthly or annually). It does not include water requirements for leaching, germination, frost protection, or cooling. Nearly all CIRs were computed using the Modified Blaney-Criddle Method. CIRs were developed by the Soil Conservation Service for dry and normal rainfall years. A normal year is one in which a 50 percent level is assumed on the irrigated area, meaning that the total precipitation amount for that year is equaled or exceeded 5 out of 10 years. A dry year is a year in which an 80 percent precipitation level is assumed on the irrigated area, meaning that the total precipitation amount for that year is equaled or exceeded 8 out of 10 years.

April through August comprise the cropping season in Tennessee (Paul Lucas, State Conservationist, Soil Conservation Service, oral commun., 1985). Irrigation demand was calculated as follows:

$$A \times Ac \times CIR \times Cf = I,$$

- A = number of applications during cropping season;
- Ac = acreage;
- CIR = crop consumptive irrigation requirement (normal season);
- Cf = conversion factor, to million gallons per day; and
- I = seasonal irrigation demand for a particular crop, in million gallons per day.

Irrigation water-use totals for hydrologic cataloging unit areas are determined by disaggregation of county data using the percentage of the county land area located within the hydrologic cataloging unit. The resulting hydrologic cataloging unit subtotals for each county are then regrouped for the State and totaled.

Power Generation Water Use

Power generation is divided into two categories; hydroelectric and thermoelectric. Water used for hydroelectric power generation refers to the volume of water released through the turbines for each facility. Water use at thermoelectric plants includes water for condenser cooling and emergency raw cooling water. The TVA provides water use and power production information to the USGS. Power production facilities in Tennessee consist of 8 fossil-fuel plants, 2 nuclear plants, 28 hydroelectric plants and 1 pump-storage facility.

TVA provides site-specific records for all their plants within the State. These data include site location information, monthly and annual discharge, and power production values. The responsibility of maintaining these data are divided among two TVA offices in the State. The TVA office in Knoxville provides data pertaining to water pumpage or release values, whereas the office in Chattanooga provides the power production values. Power generation water-use totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

Sewage-Treatment Water Use

The sewage-treatment category consists of an inventory of public, industrial, and commercial wastewater-treatment facilities and the water released by community facilities. The primary source of facilities information is a computer-generated list provided by the Tennessee Division of Water Control. This list is compared to a list of wastewater dischargers that is furnished from the NPDES computer files maintained by EPA. These data are maintained in manual files and contain the location

of the release point of the treated wastewater, and the amount of water treated and released. Sewage-treatment release totals for each hydrologic cataloging unit within the State are determined by aggregation of site-specific data located within these specific areas.

SUMMARY

This report describes the techniques and methods as of 1990 used by the USGS and cooperators to collect water-use data in Puerto Rico, the U.S. Virgin Islands, and the following southeastern United States: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, and Tennessee. Water-use data are collected in nine major categories as part of the National water-use information program.

In the southeastern United States, both site-specific and aggregated water-use data are collected and aggregated annually. Because only a small percentage of the total water-use information collected or reported is site-specific, it is necessary to obtain an understanding of the techniques used for estimating water use. The purpose of this report is to describe for the Southeastern States, Puerto Rico, and the U.S. Virgin Islands, the data collection techniques used for estimating water use and consumption for all categories. These techniques are an updated version of the documentation used for the 1985 national water-use data collection; therefore, the time period encompassed during the updating of these techniques was from 1985 to 1990.

This report describes the techniques used to collect water-use data in each State, Puerto Rico, and the U.S. Virgin Islands for the following nine categories: public-supply water use, domestic water use, industrial water use, commercial water use, mining water use, livestock water use, irrigation water use, power generation water use (including hydroelectric, thermoelectric, and nuclear power generation), and sewage-treatment water use (releases). Additionally, in Florida miscellaneous water-use data (flow data for free-flowing wells and water use for air-conditioning systems) are collected, and in Alabama recreation, preservation, and navigation water-use data are collected.

Information described in each water-use category includes: (1) a definition of the water-use category as defined by the cooperator, (2) the name of the agency or other organization that provides water-use data, (3) a description of how data are collected or estimated, (4) a list of the data elements for making the water-use estimate, and (5) description of the steps required for computations or conversion when applicable. A description of the process for converting water-use totals from county aggregates or site-specific values to hydrologic cataloging unit aggregates also are discussed.

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GLOSSARY

Water-use terminology continues to evolve as the field grows and expands. The following is a list of definitions for terms, phrases, and various data collection components commonly used in the process of water-use data collection and compilation.

Acre-foot of water (acre-ft)--The volume of water required to cover 1 acre of land (43,560 square ft) to a depth of 1 ft.

Acres irrigated--The total number of acres of the crop that was irrigated during the year.

Annual power produced--The total power that the facility generated during the calendar year. The units of measure for these data are determined at the State level.

Aquaculture--Farming of organisms that live in water, such as fish, shellfish, and algae.

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

Commercial water use--Water for motels, hotels, restaurants, office buildings, and other commercial facilities and institutions, both civilian and military. The water may be obtained from a public-supply facility or may be self-supplied. See also public-supply and self-supplied water.

Consumptive use--The part of the 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 and water depletion.

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

Cooling water--Water used for cooling purposes, such as cooling of condensers and nuclear reactors.

Delivery/release--The amount of water delivered to the point of use and the amount released after use; the difference between these amounts is usually the same as the consumptive use. See also consumptive use.

Domestic population served--The total number of people served by the public supplier during the calendar year.

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 facility or may be self-supplied. See also public supply and self-supplied water.

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

Evapotranspiration--A collective term that includes water discharged to the atmosphere as a result of evaporation from the soil and surface-water bodies and by plant transpiration. See also evaporation and transpiration.

Freshwater--Water that contains less than 1,000 mg/L (milligrams per liter) of dissolved solids; generally, more than 500 mg/L of dissolved solids is undesirable for drinking and many industrial uses.

GLOSSARY--Continued

- Generating capacity--The maximum rate of power that the facility is capable of producing. The units of measure for these data are determined at the State level.
- Gigawatthour (GWh)--One billion watt-hours.
- Ground water--Generally all subsurface water as distinct from surface water; specifically, that part of the subsurface water in the saturated zone (a zone in which all voids are filled with water) where the water is under pressure greater than atmospheric.
- Hydroelectric power water use--The use of water in the generation of electricity at plants where the turbine generators are driven by falling water; an instream use.
- Hydrologic unit code--An eight-digit code identifying the facility's location with reference to the areal breakdown shown of State hydrologic unit maps. The format is (RRSSAACC) where:
RR is the 2-digit code for the Water Resources Council Region.
SS is the 2-digit code for the Water Resources Council subregion.
AA is the 2-digit code for the National Water Data Network Accounting Unit.
CC is the 2-digit code for the cataloging unit of the catalog of information on water data maintained by the Office of Water Data Coordination.
Hydrologic unit codes are given in the U.S. Geological Survey Map Series "State Basic Hydrologic Unit Maps." The series provides a uniform, nationally consistent set of maps showing drainage, cultural features, hydrographs, and hydrologic boundaries.
- In-channel use--See instream use.
- 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, mining, and petroleum refining. The water may be obtained from a public-supply facility or may be self-supplied. See also public-supply and self-supplied water.
- Instream use--Water use taking place within the 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--Refers to the process of supplementing rainfall with water that is needed to produce a crop.
- Irrigation return flow--Part of irrigation water that is not consumed by evapotranspiration and that migrates to an aquifer or surface-water body.
- Irrigation water use--Artificial application of water on lands to assist in the growing of crops and pastures or to maintain vegetative growth in recreational lands, such as parks and golf courses.
- Livestock water use--Water for stock watering, feed lots, dairy operations, fish farming, and other on-farm needs. Livestock as used here includes cattle, sheep, goats, hogs, and poultry. Also included are such animal specialties as horses, rabbits, bees, pets, fur-bearing animals in captivity, and fish in captivity. See also rural water use.
- Mining water use--Water use for the extraction of minerals occurring naturally, including solids, such as coal, clay, and ores; liquids, such as crude petroleum; and gases, such as natural gas. Also includes uses associated with such as sand, gravel, and quarrying for rock aggregates, well operations (dewatering), milling (crushing, screening, washing, floatation, and other), and other preparations customarily done at the mine site or as part of a mining activity.

GLOSSARY--Continued

Monthly power produced--The total power that the facility generated during a month of the year. The units of measure for these data are determined at the State level.

Nonwithdrawal use--See instream use.

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

Per capita use--The average amount of water used per person during a standard time period, generally per day.

Power generation water use--See hydroelectric power water use and thermoelectric power water use.

Public supply--Water withdrawn by public and private water suppliers and delivered to groups of users. Public suppliers provide water for a variety of uses, such as domestic, commercial, thermoelectric power, industrial, and public water use. See also commercial water use, domestic water use, industrial water use, and public water use.

Public-supply deliveries--Water provided for multiple users through a public-supply distribution system.

Public water use--Water supplied from a public water supply and used for such purposes as firefighting, street washing, and municipal parks and swimming pools. See also public supply.

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

Recycled water--Water that is used more than one time before it passes back into the natural hydrologic system.

Residential water use--See domestic water use.

Reverse osmosis--A process of desalination of saline water that removes chlorides or other dissolved solids from saline water to make it potable.

Return flow--The water that reaches a ground- or surface-water source after release from the point of use and thus becomes available for further use.

Reuse--See recycled water.

Rural water use--Water used in suburban or farm areas for domestic and livestock needs. The water generally is self-supplied, and includes domestic use, drinking water for livestock, and other uses, such as dairy sanitation, evaporation from stock-watering ponds, and cleaning and waste disposal. See also domestic water use, livestock water use, and self-supplied water.

Saline water--Water that contains more than 1,000 mg/L of dissolved solids.

Self-supplied industrial use--See industrial water use and self-supplied water.

Self-supplied water--Water withdrawn from a ground- or surface-water source by a user rather than being obtained from a public-supply facility.

GLOSSARY--Continued

Sewage--Wastewater carried off by sewers and drains.

Sewage treatment--The processing of wastewater for the removal or reduction of contained solids or other undesirable constituents.

Sewage-treatment return flow--Water returned to the hydrologic system by sewage-treatment facilities.

Surface water--An open body of water, such as a stream or a lake.

Thermoelectric power--Electrical power generated using fossil-fuel (coal, oil, or natural gas), geothermal, or nuclear energy.

Thermoelectric power water use--Water used in the process of the generation of thermoelectric power. The water may be obtained from a public-supply facility or may be self-supplied. See also public-supply 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.

Wastewater--Water that carries wastes from homes, businesses, and industries.

Water consumed or consumptive use--Refers to that part of water withdrawn that is no longer available because it has evaporated, been incorporated into products and crops, consumed by man or livestock, or otherwise removed from the water environment.

Water transfer--Artificial conveyance of water from one area to another.

Water-resources region--Designated natural drainage basin or hydrologic area that contains either the drainage area of a major river or the combined drainage areas of 2 or more rivers; of 21 regions, 18 are in the conterminous United States, and 1 each is in Alaska, Hawaii, and the Caribbean.

Water-resources subregion--The 21 designated water-resources regions of the United States are subdivided into 222 subregions. Each subregion includes that area drained by a river system, a reach of a river and its tributaries in that reach, a closed basin(s), or a group of streams forming a coastal drainage system.

Water use--Describes how and where the water was used and in what amounts. See offstream use and instream use.

Watt-hour (Wh)--An electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electrical circuit steadily for one hour.

Withdrawal--The amount of water withdrawn from a source (ground or surface, fresh or saline). This is equivalent to "intake," "water diversion," or "pumpage," terms commonly used by industry, and for irrigation, and public supply, respectively. See also offstream use and self-supplied water.

Appendix 1

Tables representing the sources of information by water-use category

Appendix 1.--*Public-supply water use by State or political unit and data sources*

State	Data sources
Alabama	Geological Survey of Alabama (withdrawal/delivery questionnaires) U.S. Department of Commerce, Bureau of the Census
Arkansas	Arkansas Soil and Water Conservation Commission (General Water Use Registration Forms) Arkansas Department of Health, Division of Engineering (Arkansas Community Public Water System List)
Florida	Florida Department of Environmental Regulation, Drinking Water Section St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District
Georgia	Georgia Environmental Protection Division, Water Resources Management Branch, Surface Water Program Office Georgia Environmental Protection Division, Ground Water Program Office
Kentucky	Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Water Withdrawal Permit Program U.S. Department of Commerce, Bureau of the Census Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Drinking Water File
Louisiana	Louisiana Department of Transportation and Development Louisiana Department of Health and Hospitals Farmers Home Administration Louisiana Rural Water Association Capital Area Ground Water Conservation Commission
Mississippi	U.S. Geological Survey Mississippi Department of Natural Resources, Bureau of Land and Water Resources Mississippi State Department of Health, Division of Water Supply

Appendix 1.--*Public-supply water use by State or political unit and data sources*

State	Data sources
North Carolina	North Carolina Department of Environment, Health, and Natural Resources, Division of Water North Carolina Department of Human Resources, Division of Health Services, Environmental Health Section, Water Supply Branch
Puerto Rico	Puerto Rico Aqueduct and Sewer Authority (monthly and annual operating reports) U.S. Department of Commerce, Bureau of the Census (Census of Population and Housing) Puerto Rico Planning Board
U.S. Virgin Islands	U.S. Virgin Islands Water and Power Authority U.S. Virgin Islands Public Works Department
South Carolina	South Carolina Department of Health and Environmental Control South Carolina Water Resources Commission
Tennessee	Tennessee Department of Health and Environment, Division of Water Supply

Appendix 1.--Domestic water use by State or political unit and data sources

State	Data sources
Alabama	Geological Survey of Alabama Tennessee Valley Authority U.S. Department of Commerce, Bureau of the Census
Arkansas	Arkansas Soil and Water Conservation Commission (General Water Use Registration Forms) U.S. Department of Commerce, Bureau of the Census
Florida	Florida Department of Environmental Regulation (population data) St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District University of Florida, College of Business Administration, Bureau of Economic and Business Research (population program)
Georgia	U.S. Department of Commerce, Bureau of the Census Georgia Environmental Protection Division, Water Resources Management Branch, Ground Water Program Office
Kentucky	Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Drinking Water File U.S. Department of Commerce, Bureau of the Census
Louisiana	U.S. Department of Commerce, Bureau of the Census Louisiana Department of Health and Hospitals Farmers Home Administration Louisiana Rural Water Association Capital Area Ground Water Conservation Commission
Mississippi	U.S. Department of Commerce, Bureau of the Census Mississippi Department of Natural Resources, Division of Natural Resources
North Carolina	North Carolina Department of Environment, Health, and Natural Resources, Division of Water U.S. Department of Commerce, Bureau of the Census North Carolina State University U.S. Geological Survey

Appendix 1.--*Domestic water use by State or political unit and data sources*

State	Data sources
Puerto Rico	Puerto Rico Aqueduct and Sewer Authority (monthly and annual operating reports) U.S. Department of Commerce, Bureau of the Census (Census of Population and Housing)
U.S. Virgin Islands	U.S. Virgin Islands Public Works Department U.S. Virgin Islands Department of Commerce Virgin Islands Caribbean Research Institute, Water Resources Research Branch U.S. Virgin Islands Department of Conservation and Cultural Affairs National Weather Service U.S. Geological Survey (rain gage data)
South Carolina	South Carolina Department of Health and Environmental Control U.S. Department of Commerce, Bureau of the Census
Tennessee	Tennessee Department of Health and Environment, Division of Ground Water Protection Shelby County Health Department University of Tennessee

Appendix 1.--*Industrial water use by State or political unit and data sources*

State	Data sources
Alabama	Alabama Department of Economic and Community Affairs Alabama Department of Environmental Management (computer files)
Arkansas	Arkansas Soil and Water Conservation Commission (General Water Use Registration Forms) Arkansas Industrial Development Foundation (Arkansas Directory of Manufacturers)
Florida	St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District (Consumptive Use Permit files and Compliance records, and questionnaire and telephone surveys) Florida Department of Environmental Regulation Drinking Water Section (Monthly Operating Report for Noncommunity Systems)
Georgia	Georgia Environmental Protection Division, Water Resources Management Branch, Surface Water Program Office Georgia Environmental Protection Division, Water Resources Management Branch, Ground Water Program Office
Kentucky	Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Water Withdrawal Permit Program
Louisiana	Louisiana Department of Transportation and Development Louisiana Department of Commerce Capital Area Ground Water Conservation Commission
Mississippi	Mississippi Development and Services Bureau
North Carolina	North Carolina Department of Environment, Health, and Natural Resources, Division of Water North Carolina Department of Commerce, Industrial Development Division U.S. Geological Survey

Appendix 1.--*Industrial water use by State or political unit and data sources*

State	Data sources
Puerto Rico	Puerto Rico Department of Natural Resources (permit records) Puerto Rico Aqueduct and Sewer Authority (monthly operating report)
U.S. Virgin Islands	U.S. Geological Survey U.S. Virgin Islands Public Works Department
South Carolina	South Carolina Water Resources Commission (Industrial Water Use System Description Report)
Tennessee	Tennessee Department of Health and Environment, Division of Water Quality Control (Discharge Monitoring Report) Shelby County Health Department

Appendix 1.--Commercial water use by State or political unit and data sources

State	Data sources
Alabama	Alabama Department of Environmental Management (files)
Arkansas	Arkansas Soil and Water Conservation Commission (General Water Use Registration Forms) U.S. Army Corps of Engineers U.S. Department of Agriculture, Forest Service Arkansas Department of Parks and Tourism
Florida	St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District (Consumptive Use Permit files and Compliance records, and questionnaire and telephone surveys) Florida Department of Environmental Regulation Drinking Water Section (Monthly Operating Report for Noncommunity Systems)
Georgia	Georgia Environmental Protection Division, Water Resources Management Branch, Surface Water Program Office Georgia Environmental Protection Division, Water Resources Management Branch, Ground Water Program Office U.S. Army Corps of Engineers, Savannah Office
Kentucky	Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Water Withdrawal Permit Program
Louisiana	Louisiana Department of Transportation and Development Louisiana Department of Health and Hospitals Capital Area Ground Water Conservation Commission
Mississippi	Data Not Collected
North Carolina	North Carolina Department of Environment, Health, and Natural Resources, Division of Water North Carolina Department of Human Resources, Division of Health Services, Environmental Health Section, Water Supply Branch

Appendix 1.--Commercial water use by State or political unit and data sources

State	Data sources
Puerto Rico	Puerto Rico Aqueduct and Sewer Authority
U.S. Virgin Islands	U.S. Geological Survey U.S. Virgin Islands Water and Power Authority
South Carolina	South Carolina Water Resources Commission (Industrial Water Use System Description Report)
Tennessee	Tennessee Department of Health and Environment, Division of Water Supply Shelby County Health Department

Appendix 1.--*Mining water use by State or political unit and data sources*

State	Data sources
Alabama	Alabama Department of Industrial Relations Alabama Department of Economic and Community Affairs Alabama Department of Environmental Management Alabama Oil and Gas Board (permit files) Geological Survey of Alabama (telephone survey)
Arkansas	Arkansas Geological Commission U.S. Department of the Interior, Bureau of Mines U.S. Department of Energy Arkansas Oil and Gas Commission
Florida	St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District (consumptive Use Permit files and Compliance records, and questionnaire and telephone surveys) Florida Department of Environmental Regulation Drinking Water Section (Monthly Operating Report for Noncommunity Systems)
Georgia	Georgia Environmental Protection Division, Water Resources Management Branch, Surface Water Program Office
Kentucky	Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Water Withdrawal Permit Program University of Kentucky
Louisiana	Louisiana Department of Transportation and Development Capital Area Ground Water Conservation Commission
Mississippi	Mississippi State Geological Survey
North Carolina	North Carolina Department of Environment, Health, and Natural Resources, Division of Land Resources North Carolina Department of Commerce, Industrial Development Division U.S. Geological Survey

Appendix 1.--*Mining water use by State or political unit and data sources*

State	Data sources
Puerto Rico	Puerto Rico Department of Natural Resources (permit records)
U.S. Virgin Islands	Mining operations in the U.S. Virgin Islands have negligible water use
South Carolina	South Carolina Water Resources Commission (Industrial Water Use System Description Report)
Tennessee	Tennessee Department of Health and Environment Tennessee Department of Conservation, Division of Geology Tennessee Department of Labor, Division of Mine Permits U.S. Department of the Interior, Office of Surface Mining Tennessee Department of Health and Environment, Division of Surface Mining and Reclamation EPA-National Pollution Discharge Elimination System (permits)

Appendix 1.--*Livestock water use by State or political unit and data sources*

State	Data sources
Alabama	Alabama Cooperative Extension Service, Auburn University Alabama Crop and Livestock Reporting Service U.S. Department of Agriculture
Arkansas	Arkansas Soil and Water Conservation Commission (Agricultural Water Use Registration Forms) U.S. Department of the Interior, Fish and Wildlife Service, Fish Farming Experimental Laboratory Arkansas Game and Fish Commission University of Arkansas, Cooperative Extension Service U.S. Department of Agriculture, Crop Reporting Service
Florida	St. Johns River Water Management District Southwest Florida Water Management District South Florida Water Management District Suwannee River Water Management District Northwest Florida Water Management District (Consumptive Use Permit and Compliance files) Florida Crop and Livestock Reporting Service, Florida Agricultural Statistics University of Florida, Institute of Food and Agricultural Science, main office and County Extension Service
Georgia	University of Georgia, Cooperative Extension Service Georgia Crop Reporting Service U.S. Department of Agriculture, Equine Program
Kentucky	U.S. Department of Commerce, Bureau of the Census
Louisiana	Louisiana Department of Transportation and Development Louisiana State University Extension Service U.S. Agricultural Stabilization and Conservation Service

Appendix 1.--*Livestock water use by State or political unit and data sources*

State	Data sources
Mississippi Aquaculture	Mississippi State University, Wildlife and Fisheries Extension
Livestock	Mississippi Department of Agriculture and Commerce National Agricultural Statistics Service Mississippi State University, Cooperative Extension Service, Agricultural Engineering Extension
North Carolina	North Carolina State University, Agricultural Extension Service North Carolina Crop and Livestock Reporting Service
Puerto Rico	U.S. Department of Commerce, Bureau of the Census
U.S. Virgin Islands	Currently (1990) a negligible amount of agricultural water use are used in the U.S. Virgin Islands
South Carolina	South Carolina Crop and Livestock Reporting Service
Tennessee	U.S. Geological Survey, Mississippi District Tennessee Wildlife Resources Agency Tennessee Agricultural Extension Service

Appendix 1.--Irrigation water use by State or political unit and data sources

State	Data sources
Alabama	Alabama Cooperative Extension Service, Auburn University Geological Survey of Alabama
Arkansas	Arkansas Soil and Water Conservation Commission (Agricultural Water Use Registration Form)
Florida	St. Johns River Water Management District Southwest Florida Water Management District South Florida Water Management District Suwannee River Water Management District Northwest Florida Water Management District (Consumptive Use Permit and Compliance files) Soil Conservation Service (Crop Requirements Needs Manual) Florida Institute of Food and Agriculture, County Extension agents Florida Crop and Livestock Reporting Service U.S. Geological Survey Report: Benchmark Farms Program--A Method for Estimating Irrigation Water Use in Florida
Georgia	University of Georgia, Cooperative Extension Service Georgia Water Protection Branch, Municipal Wastewater Office
Kentucky	U.S. Department of Commerce, Bureau of the Census University of Kentucky
Louisiana	Louisiana Department of Transportation and Development Louisiana State University Extension Service U.S. Agricultural Stabilization and Conservation Service
Mississippi	Mississippi Department of Agriculture and Commerce National Agricultural Statistics Service Mississippi State University, Cooperative Extension Service, Agricultural Engineering Extension

Appendix 1.--*Irrigation water use by State or political unit and data sources*

State	Data sources
North Carolina	North Carolina Department of Environment, Health, and Natural Resources, Division of Water North Carolina State University, Agricultural Extension Service North Carolina State University, Department of Agricultural Engineering
Puerto Rico	Puerto Rico Department of Agriculture U.S. Department of Commerce, Bureau of the Census Puerto Rico Electric Power Authority Puerto Rico Sugar Corporation
U.S. Virgin Islands	Currently (1990) no accountable irrigation water use reported in the U.S. Virgin Islands
South Carolina	South Carolina Water Resources Commission (Agricultural and Golf Course Water Use Report Forms) Clemson University Cooperative Extension Service
Tennessee	U.S. Department of Agriculture, Soil Conservation Service

Appendix 1.--Power generation water use by State or political unit and data sources

State	Data sources
Alabama	
thermoelectric	Alabama Power Company Alabama Electric Cooperative U.S. Department of Energy, Southeastern Power Administration Tennessee Valley Authority
hydroelectric	Alabama Power Company Alabama Electric Cooperative Southeastern Power Administration U.S. Army Corps of Engineers
Arkansas	Arkansas Soil and Water Conservation Commission (General Water Use Registration Forms) Arkansas Power and Light Company Arkansas Electric Cooperative U.S. Department of Energy, Southwest Power Administration U.S. Army Corps of Engineers
Florida	St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District (Water Management Districts Consumptive Use Permit and Compliance files and mail survey)
Georgia	Georgia Environmental Protection Division, Water Resources Management Branch, Surface Water Program Office Georgia Geological Survey U.S. Department of Energy Georgia Power Company
Kentucky	Kentucky Public Service Commission
Louisiana	Louisiana Department of Transportation and Development Sabine River Compact Commission

Appendix 1.--*Power generation water use by State or political unit and data sources*

State	Data sources
Mississippi	Mississippi Power and Light Company Southern Mississippi Electric Association Mississippi Power Company Clarksdale Municipal Power Company Greenwood Municipal Power Company
North Carolina	North Carolina Department of Environment, Health, and Natural Resources, Division of Water U.S. Environmental Protection Agency Duke Power Company Carolina Power and Light Company Nantahala Power and Light Company Virginia Electric Company Tennessee Valley Authority U.S. Department of Energy U.S. Army Corps of Engineers
Puerto Rico thermoelectric	Puerto Rico Aqueduct and Sewer Authority (monthly and annual operating reports) Puerto Electric Power Authority
U.S. Virgin Islands	Virgin Islands Water and Power Authority
Puerto Rico hydroelectric	Puerto Electric Power Authority
U.S. Virgin Islands	Currently (1990) there are no hydroelectric power facilities located in the U.S. Virgin Islands
South Carolina	U.S. Geological Survey (interviews) South Carolina Power and Gas Company Duke Power Company Carolina Power and Light Company South Carolina Public Service Authority Regal Textile Company Spartanburg Water Company
Tennessee	Tennessee Valley Authority

Appendix 1.--*Sewage-treatment water use by State or political unit and data sources*

State	Data sources
Alabama	Alabama Department of Environmental Management (computer files)
Arkansas	Arkansas Department of Pollution Control and Ecology National Pollution Discharge Elimination System (computer files)
Florida	Florida Department of Environmental Regulation (Domestic Wastewater Section monthly operation report files)
Georgia	Georgia Water Protection Branch, Municipal Wastewater Office
Kentucky	Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, Wastewater Branch
Louisiana	Louisiana Department of Transportation and Development Louisiana Department of Health and Hospitals
Mississippi	Mississippi Department of Natural Resources, Bureau of Pollution Control
North Carolina	North Carolina Department of Environment, Health, and Natural Resources, Department of Environmental Management U.S. Environmental Protection Agency (EPA-National Pollution Discharge Elimination System (computer file)
Puerto Rico	Puerto Rico Aqueduct and Sewer Authority
U.S. Virgin Islands	U.S. Virgin Islands Public Works Department
South Carolina	South Carolina Department of Health and Environmental Control
Tennessee	Tennessee Department of Health and Environment, Division of Water Quality Control (Discharge Monitoring Report) EPA-National Pollution Discharge Elimination System (computer files)

Appendix 1.--*Other miscellaneous categories of water use by State or political unit and data sources*

State	Data sources
Alabama Navigation	U.S. Army Corps of Engineers Tennessee Valley Authority
Recreation/Preservation	Alabama Department of Conservation (Parks and Recreation) Tennessee Valley Authority U.S. Army Corps of Engineers
Florida Miscellaneous	St. Johns River Water Management District Suwannee River Water Management District Southwest Florida Water Management District South Florida Water Management District Northwest Florida Water Management District (Consumptive Use Permit files and Compliance records)

Appendix 2

Tables representing coefficients and formulas used for estimating
water use by water-use category

Appendix 2.--Daily water requirements for livestock in the southeastern United States,
Puerto Rico, and the U.S. Virgin Islands

[--, no data reported; all values in gallons per day per head]

Livestock	AL	AR	FL	GA	KY	LA	MS	NC	PR/VI	SC	TN
Beef cattle	12	15	12	7.9	12	10	10	12	12	12	10
Milk cows	35	30	15	28.7	65	20	20	40	35	35	35
Steers	--	--	--	--	--	--	--	--	--	12	--
Sheep	--	--	2	.2	1	2	--	2	2	2	--
Lambs	--	--	--	.2	--	--	--	--	--	--	--
Goats	--	--	2	--	--	2	--	--	2	2	--
Hogs	12	2	2	2.9	6	3	3	4	4	4	5
Pigs	--	--	--	2.9	--	--	--	--	--	--	5
Horses	--	--	12	--	12	10	--	12	12	12	10
Mules	--	--	--	--	--	10	--	--	12	12	--
Poultry	.05	--	--	.05	.10	--	--	--	--	--	.05
Chickens	--	--	.10	--	--	.04	.04	.09	.06	.08	--
Hens	--	.06	--	--	--	--	--	--	--	--	--
Broilers	--	.04	--	--	--	--	--	--	--	--	--
Turkeys	--	.08	1	--	--	.06	--	.18	--	.14	--
Dogs	--	--	.10	--	--	--	--	--	--	--	--
Rabbits	--	--	.05	--	--	--	--	--	1	--	--

AL--Alabama	MS--Mississippi
AR--Arkansas	NC--North Carolina
FL--Florida	PR/VI--Puerto Rico and the U.S. Virgin Islands
GA--Georgia	SC--South Carolina
KY--Kentucky	TN--Tennessee
LA--Louisiana	

Appendix 2.--Water-use coefficients used for estimating irrigation use in the southeastern United States, Puerto Rico, and the U.S. Virgin Islands

[**, site-specific data reported; --, no data reported; all values in inches per acre]

Crop type	AL	AR	FL	GA	KY	LA	MS	NC	PR/VI	SC	TN
Corn	6	**	**	**	5	18	--	7	--	--	**
Soybeans	6	**	**	--	5	6	16	4	--	--	--
Peanuts	6	--	**	**	--	--	--	5	--	--	--
Plant nurseries	6	--	--	**	--	24	--	--	--	**	--
Rice	--	**	**	--	--	42	49	--	**	--	--
Wheat	--	**	**	--	5	--	--	2	--	--	--
Sorghum	--	**	**	--	--	18	--	--	--	--	--
Milo	--	**	--	--	--	--	--	--	--	--	--
Alfalfa (coastal)	--	--	--	--	--	--	--	6	--	--	--
Alfalfa (other)	--	--	--	--	--	--	--	8	--	--	--
Pasture	--	--	--	--	--	--	--	2	--	--	--
Hay	--	--	--	--	--	--	--	8	--	--	--
Cash grains	--	**	--	--	--	--	--	2	--	--	--
Cotton	--	**	--	--	--	6	16	--	--	--	--
Vegetables	--	**	--	--	--	--	--	4	**	--	**
Berries	--	**	--	--	--	--	--	--	--	--	--
Grapes	--	**	**	--	--	--	--	--	--	--	--
Fruit trees	--	**	--	--	--	--	--	--	--	--	**
Sod	--	**	**	--	--	--	--	--	--	--	--
Irish potatoes	--	--	--	--	--	--	--	4	--	--	--
Sweet potatoes	--	--	--	--	--	--	--	4	--	--	--
Cabbage	--	--	**	--	--	--	--	--	--	--	--
Carrots	--	--	**	--	--	--	--	--	--	--	--
Cucumbers	--	--	**	--	--	--	--	--	--	--	--
Peppers	--	--	**	--	--	--	--	--	--	--	--
Tomatoes	--	--	**	--	--	--	--	--	--	--	--
Truck crops	--	--	--	--	--	12	--	--	--	--	--
Watercress	--	--	**	--	--	--	--	--	--	--	--
Blueberries	--	--	**	--	--	--	--	9	--	--	--
Citrus	--	--	**	--	--	--	--	--	--	--	--
Peaches	--	--	**	--	--	18	--	6	--	**	--
Apples	--	--	**	--	--	--	--	6	--	--	--
Pecans	--	--	**	--	--	--	--	--	--	--	--
Strawberries	--	--	**	--	--	6	--	9	--	--	--
Watermelons	--	--	**	--	--	--	--	--	--	--	--
Sugarcane	--	--	**	--	--	--	--	--	**	--	--
Tobacco	--	--	**	**	4	--	--	4	--	--	--
Ferns	--	--	**	--	--	--	--	--	--	--	--
Flowers/Foliage	--	--	**	--	--	--	--	--	--	--	--
Ornamentals	--	--	**	--	--	--	--	--	--	--	--
Orchards	--	--	--	--	--	--	--	--	--	**	--
Improved pasture	--	--	**	--	--	--	--	--	--	--	--
Turf grass	--	--	**	--	--	--	--	--	--	--	--
Miscellaneous	--	--	**	--	--	--	--	--	--	--	--
Athletic fields	--	--	--	26.9	--	--	--	--	--	--	--
Golf courses	--	--	--	26.9	--	--	--	--	--	**	--

AL--Alabama
AR--Arkansas
FL--Florida
GA--Georgia
KY--Kentucky
LA--Louisiana

MS--Mississippi
NC--North carolina
PR/VI--Puerto Rico and the U.S. Virgin Islands
SC--South carolina
TN--Tennessee

Appendix 2.--*Formulas and coefficients used for estimating (self-supplied) domestic water use and consumptive use in the southeastern United States, Puerto Rico, and the U.S. Virgin Islands*

[gal/d, gallon per day per person; *, County or hydrologic cataloging unit; --, no data reported; ft², square foot]

State	Water-use formula	Consumptive-use coefficient
Alabama	(County population) - (population served) x (75 gal/d)	(Domestic water-use total *) x 1.00
Arkansas	(County population) - (population served) x (89 gal/d)	(Domestic water-use total *) x 1.00
Florida	(County population) - (population served) x (75 gal/d)	(Domestic water-use total *) x 1.00
Georgia	(County population) - (population served) x (75 gal/d)	(Domestic water-use total *) x 0.18
Kentucky	(County population) - (population served) x (50 gal/d)	(Domestic water-use total *) x 0.57
Louisiana	(County population) - (population served) x (80 gal/d)	(Domestic water-use total *) x 1.00
Mississippi	(County population) - (population served) x (50 gal/d)	(Domestic water-use total *) x --
N. Carolina	(County population) - (population served) x (60 gal/d)	(Domestic water-use total *) x 0.80
Puerto Rico	(County population) - (population served) x (40 gal/d)	(Domestic water-use total *) x 1.00
U.S. Virgin Islands	(number of nonserved housing unit per district) x (cistern-roof area 1,000 ft ² per housing unit) x (monthly rainfall by district) x (rainfall recovery rate 0.70)	(Domestic consumptive use is not collected)
S. Carolina	(County population) - (population served) x (75 gal/d)	(Domestic water-use total *) x 1.00
Tennessee	(County population) - (population served) x (60-70 gal/d)	(Domestic water-use total *) x 1.00

Appendix 3

Water-use data collection forms used in the southeastern United States,
Puerto Rico, and the U.S. Virgin Islands

**PUBLIC WATER SUPPLY
 WATER-USE DATA
 1985**

1. Name of water supply system _____

2. Street address _____
 City _____ County _____ State _____ Zip Code _____

3. Contact person _____ Phone _____ Position _____

4. Source(s) a. Purchased from _____
 b. Surface water name _____
 c. Ground water _____

	WELL NAME	LOCATION (section, township, range)
1)	_____	_____
2)	_____	_____
3)	_____	_____
4)	_____	_____
5)	_____	_____
6)	_____	_____

5. Monthly withdrawals for each source (specify unit of measurement). MG/month

SOURCE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
a.												
b.												
c.												
d.												
e.												
f.												

6. Monthly deliveries (amount sold to customers--specify unit of measurement). M/G Month

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

7. Industrial/commercial customers (those purchasing more than 2,000 gallons per day).

NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

(continue on reverse if needed)

7. (continued)

NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

8. Total number of customers or services during 1985: _____

INSTRUCTIONS

PUBLIC WATER SUPPLY

Question Numbers

1. Give the name of your water system.
2. Give the street address of the plant itself. If there is no precise address, give name of the nearest road or highway.
3. Give the name of an individual who has access to water-use information and could be called if questions arise or further information is needed.
4. Give the source of your water supply. If purchased, give the name of the system supplying you. If surface water, give the water bodies names (lake, river or stream). If ground water, list all active wells and their approximate locations (township, section and range; EX: SE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 1, T. 2 S., R. 3 W. or highway directions to well).
5. Give the average amount of water withdrawn from each source each month during the calendar year 1985. Please give these figures in millions of gallons per month. If this is not possible, be sure to state the units used.
6. Give the average amount of water delivered to customers each month during the calendar year 1985. Please give these figures in millions of gallons per month. If this is not possible, be sure to state the units used.
7. Give the name and address of your industrial/commercial customers who use more than 2,000 gallons per day. Also give their average monthly use. This information will be kept strictly confidential.
8. List the number of customers or services during 1985. (EX: total number of customers served = 1,000.)

TOMBIGBEE-BLACK WARRIOR RIVER BASIN
WATER-USE DATA
1987

1. Name of water-supply system _____
2. Street address _____
City _____ County _____ State _____ Zip Code _____
3. Contact person _____ Phone _____ Position _____
4. Source(s) of water a. Purchased from _____
 b. Surface-water name _____
 c. Ground water _____

WELL NAME

LOCATION

- 1) _____
- 2) _____
- 3) _____
- 4) _____
- 5) _____
- 6) _____

5. Average monthly or annual withdrawals from each source of water (please specify unit of measurement)

SOURCE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1987
a.													
b.													
c.													
d.													
e.													
f.													

6. Location of sewage treatment facility _____
Release point of water (lake, river, creek) _____

7. Average monthly or annual releases of water (please specify unit of measurement)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1987
a.													
b.													
c.													
d.													
e.													
f.													

GENERAL WATER-USE REGISTRATION FORM

1. Name of Facility _____
2. Water-user Id. _____
3. Use of water: (check one)

WS - Public Supply Use _____	PF - Fossil Fuel Power _____
CO - Commercial Use _____	PG - Geothermal Power _____
IN - Industrial Use _____	PN - Nuclear Energy Power _____
MI - Mining _____	PH - Hydroelectric Power _____
4. SIC Code (1) _____ (2) _____ (3) _____
5. Permit# or PWS# _____
6. Telephone Number (____) _____
7. Location of Facility: Latitude _____ Longitude _____
8. Hydrologic Unit Code _____
9. Address _____
10. City _____
11. ZIP Code _____

***** COMPLETE 12-18 FOR PUBLIC WATER SUPPLY FACILITIES ONLY *****

12. Total Ground & Surface Water withdrawals(MILLION GALS.) _____
13. Water Purchased From Other Facilities (Amount in MILLION GALS.):

Facility Name _____	Amount: _____
Facility Name _____	Amount: _____
14. Water Sold To Other Facilities (Amount in MILLION GALS.):

Facility Name _____	Amount: _____
Facility Name _____	Amount: _____
15. Water Used For Facility Maintenance (backflushing, plant operations losses due to seepage and leaks - MILLION GALS.) _____
16. Domestic Population Served _____
17. Deliveries to Users (Do not include water sold to other facilities):

<u>Water Furnished To: Total Water Delivered Number of Connections</u>		
Domestic Households	_____	_____
Commercial	_____	_____
Industrial	_____	_____
Mining	_____	_____
Agriculture	_____	_____
Irrigation	_____	_____
18. Current Rate Structure: _____

 (Name of Plant Manager) (Date) (County of Diversion)

FILL OUT A SEPARATE PAGE FOR EACH WELL OR SURFACE WATER DIVERSION POINT

19. Measurement Point ID _____

20. Local Descriptive ID _____

*** If CENTROID, amount of water withdrawn (#29-30) represents the sum ***
*** of water withdrawn from all withdrawal points for this facility. ***

21. Action Code _____ (If Action Code is DL skip to #29)

22. Source of Water (Ground, Surface, or Transfer) _____

23. If Surface Water withdrawal:

A. Name of Lake or Stream: _____

24. If Ground Water withdrawal:

A. Name of Aquifer: _____

B. Depth of Well _____

C. Name of Driller _____

25. Pump Information:

A. Pump Capacity (Horsepower) _____

B. Type of Power (check one): Electric _____ LPGas _____
Diesel _____ Other _____

C. Type of Pump (check one): Stationary _____ Portable _____
Gravity _____ Other _____

D. Diameter of Well or Intake Pipe: _____

26. Location of Well or Withdrawal Point (Well or Intake Structure):

Latitude _____ Longitude _____

27. Hydrologic Unit Code _____

28. Withdrawal Amounts Obtained From (check one):

Billing Records _____ Pump Capacity + Hours Operation _____
Meter Readings _____ Other (list) _____

**** For questions 29-30, withdrawal values reported in (check one):****

Gallons _____ Thousand Gallons _____ Million Gallons _____

29. Total Water Withdrawn From This Withdrawal Point (nn): _____

30. Amount of Water Withdrawn From This Withdrawal Point (nn):

nn	nn	nn
JAN _____	FEB _____	MAR _____
APR _____	MAY _____	JUN _____
JUL _____	AUG _____	SEP _____
OCT _____	NOV _____	DEC _____

31. **Generating Capacity** _____

32. **Annual Power Produced** _____

33. **Monthly Power Produced:**

JAN _____ FEB _____ MAR _____

APR _____ MAY _____ JUN _____

JUL _____ AUG _____ SEP _____

OCT _____ NOV _____ DEC _____

AGRICULTURE AND IRRIGATION WATER USE REGISTRATION FORM
Diversions registered on this form are for the twelve (12) month
Water Year Oct. 1 - Sep. 31

- 1. Name of Landowner _____
- 2. Water User ID. _____
- 3. Use of WATER:(check one)
 _____ AG Agriculture (livestock, fish farms) _____ IR Irrigation
- 4. Measurement Point Id: _____ 5. Phone number _____
- 6. Name of Diverter _____
- 7. Hydrologic Unit Code _____
- 8. Street Address _____
- 9. City name _____ 10. ZIP Code _____
- 11. Residential County _____ 12. FIPS State Code _____
- 13. State _____ 14. Action Code _____ 15. Source type. _____ GW _____ SW
- 16. Conservation District Permit #: Topographic Quad# _____
 Operator # _____ WELL # _____
- 17. Aquifer (GW only) _____
- 18. Reclaimed waste (GW only) _____ YES _____ NO
- 19. Name of lake, ditch, bayou, or tributary (SW only) _____
- 20. Was a dam or other obstruction of streamflow utilized (SW only)?
 _____ YES _____ NO
- 21. Method of Irrigation: _____ Flood, _____ Furrow, _____ Sprinkler, _____ Other
- 22. Diameter of pipe _____ 23. Depth of well _____
- 24. Location of diversion or withdrawal point (Legal description):
 _____ 1/4 of _____ 1/4, Section _____, Township _____, Range _____
- 25. Location of withdrawal: Latitude _____ Longitude _____
- 26. Method of Diversion:
 _____ Stationary pump _____ Portable Pump _____ Gravity
- 27. Type of power _____ ELC _____ LPG _____ Diesel _____ Other
- 28. Pump Horsepower _____ 29. Year 19 _____
- 30. Annual amount withdrawn(acre ft.) 19nn _____ 19nn _____
- 31. Measuring Method: (circle one)
 _____ E _____ Estimated _____ M _____ Measured _____ C _____ Calculated.
- 32. Restrictions: (circle one) _____ Y _____ N
- 33. Local descriptive Id: _____
- 34. Estimate total withdrawal per month.

	19nn	19nn	19nn	19nn	19nn	19nn
JAN	_____	_____	FEB	_____	MAR	_____
APR	_____	_____	MAY	_____	JUN	_____
JUL	_____	_____	AUG	_____	SEP	_____
OCT	_____	_____	NOV	_____	DEC	_____

35. (a) Kind of crop	(b) Number of irrigated acres	(c) Amount of water applied (ft)	(d) Total acre-ft. (b x c)
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

(Signature) _____ (Date) _____ (County of Diversion)

1990 COMMERCIAL/INDUSTRIAL SELF-SUPPLIED WATER-USE DATA FORM - NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT

GENERAL DATA

Industry Name: _____ County: _____
 Address: _____ City/State: _____ Zip: _____
 Phone number: _____ SIC number (if none): _____
 Form completed by: _____ Title: _____ Date: _____
 Plant or facility name: _____

PUMPAGE DATA - Water withdrawn in Million gallons per month (MGM) for the calendar year, 1990

Water Source:	<u>Fresh Ground</u>	<u>Saline Ground</u>	<u>Fresh Surface</u>	<u>Saline Surface</u>	<u>Reclaimed Water</u>
JANUARY :	_____	_____	_____	_____	_____
FEBRUARY :	_____	_____	_____	_____	_____
MARCH :	_____	_____	_____	_____	_____
APRIL :	_____	_____	_____	_____	_____
MAY :	_____	_____	_____	_____	_____
JUNE :	_____	_____	_____	_____	_____
JULY :	_____	_____	_____	_____	_____
AUGUST :	_____	_____	_____	_____	_____
SEPTEMBER :	_____	_____	_____	_____	_____
OCTOBER :	_____	_____	_____	_____	_____
NOVEMBER :	_____	_____	_____	_____	_____
DECEMBER :	_____	_____	_____	_____	_____

REMARKS/COMMENTS: _____

Please return form to; **Mr. Chris Howell**
 Northwest Florida Water Management District
 Rt. 1, Box 3100
 Havana, Florida 32333

1990 WATER-USE DATA ENTRY FORM - SITE SPECIFIC DATA

GENERAL DATA

County: _____ FDER office: _____ Date: _____

Facility or Utility name: _____

Water Management District: NWFWD SJRWMD SFWMD SRWMD SWFWMD

Plant or facility name: _____

FDER ID # : _____

Water Source: _____

PUMPAGE DATA

JANUARY	:	_____	_____	_____	_____	_____
FEBRUARY	:	_____	_____	_____	_____	_____
MARCH	:	_____	_____	_____	_____	_____
APRIL	:	_____	_____	_____	_____	_____
MAY	:	_____	_____	_____	_____	_____
JUNE	:	_____	_____	_____	_____	_____
JULY	:	_____	_____	_____	_____	_____
AUGUST	:	_____	_____	_____	_____	_____
SEPTEMBER	:	_____	_____	_____	_____	_____
OCTOBER	:	_____	_____	_____	_____	_____
NOVEMBER	:	_____	_____	_____	_____	_____
DECEMBER	:	_____	_____	_____	_____	_____

POPULATION DATA

# Service Connections:	_____	_____	_____	_____	_____
# of PPHH:	_____	_____	_____	_____	_____
Population Served :	_____	_____	_____	_____	_____

SUWANNEE RIVER WATER MANAGEMENT DISTRICT

1990 Irrigated Acreage/Water Use Survey

COUNTY : _____

EXTENSION OFFICE: _____ CONTACT PERSON: _____ PHONE: _____

MAILING ADDRESS: _____ CITY: _____ ZIP: _____

Please fill in the appropriate categories for the calendar year: 1990

CROP	GROWING SEASON (Month) to (Month)	IRRIGATED ACRES	IRRIGATED ACRES BY SYSTEM			WATER SOURCE (%)	
			Sprinkler	Drip	Flood	Surface	Ground
VEGETABLE CROPS:							
Cabbages	-						
Cucumbers	-						
String Beans	-						
Peppers	-						
Potatoes	-						
Tomatoes (Spring)	-						
Tomatoes (Fall)	-						
Sweet Corn	-						
Misc. Vegetables	-						
FRUIT CROPS:							
Blueberries	-						
Grapes	-						
Peaches	-						
Pecans	-						
Strawberries	-						
Watermelons	-						
Misc. Fruit	-						
PASTURE & GRASSES:							
Improved Pasture	-						
Sod	-						
Turf (Golf Courses)	-						

CROP	GROWING SEASON (Month) to (Month)	IRRIGATED ACRES	IRRIGATED ACRES BY SYSTEM			WATER SOURCE (%)	
			Sprinkler	Drip	Flood	Surface	Ground
FIELD CROPS:							
Field Corn	-						
Cotton	-						
Peanuts	-						
Sorghum	-						
Soybeans	-						
Tobacco	-						
Wheat	-						
Other Crops:	-						
	-						
	-						
OTHER:							
	-						
	-						
ORNAMENTALS:							
Flowers & Foliage	-						
Woody Ornamentals	-						

LIVESTOCK: No. Head 1990 _____ Fish Farms: _____ No. of Ponds _____ No. of Acres _____

Beef Cattle _____
 Dairy Cows _____
 Horses _____
 Hogs _____
 Chickens _____

REMARKS: _____

THANKS FOR YOUR HELP!

PLEASE RETURN TO: Dennis Price
 SUWANNEE RIVER WATER MANAGEMENT DISTRICT
 ROUTE 3, BOX 84
 LIVE OAK, FLORIDA 32060

NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT
1990 WATER USE SURVEY

COMPANY NAME: _____ CONTACT PERSON: _____ PHONE: _____

MAILING ADDRESS: _____ CITY: _____ ZIP: _____ COUNTY OF OPERATION: _____

Please fill in the appropriate categories for 1985:

CROP	GROWING SEASON (Month) to (Month)	IRRIGATED ACRES			IRRIGATED ACRES BY SYSTEM		WATER SOURCE (%)	
		IRRIGATED ACRES	Sprinkler	Drip	Flood	Surface	Ground	
<u>VEGETABLE CROPS:</u>								
Cabbages	-							
Cucumbers	-							
String Beans	-							
Peppers	-							
Potatoes	-							
Tomatoes (Spring)	-							
Tomatoes (Fall)	-							
Sweet Corn	-							
Misc. Vegetables	-							
<u>FRUIT CROPS:</u>								
Blueberries	-							
Grapes	-							
Peaches	-							
Pecans	-							
Strawberries	-							
Watermelons	-							
Misc. Fruit	-							
<u>PASTURE & GRASSES:</u>								
Improved Pasture	-							
Sod	-							
Turf (Lawns, Golf Courses)	-							

CROP	GROWING SEASON		IRRIGATED ACRES	IRRIGATED ACRES BY SYSTEM			WATER SOURCE (%)	
	(Month)	to (Month)		Sprinkler	Drip	Flood	Surface	Ground
FIELD CROPS:								
Field Corn	-							
Cotton	-							
Peanuts	-							
Sorghum	-							
Soybeans	-							
Tobacco	-							
Wheat	-							
Other Crops:	-							
	-							
	-							
OTHER:								
	-							
	-							
ORNAMENTALS:								
Flowers & Foliage	-							
Woody Ornamentals	-							

No. Head 1990 _____
 No. of Ponds _____
 No. of Acres _____
 Fish Farms: _____
 REMARKS: _____

THANKS FOR YOUR HELP!

1986 INSTITUTION - RECREATION WATER USE DATA

FACILITY NAME _____
 ADDRESS _____ CITY _____ ZIP _____
 COUNTY _____ BASIN _____
 MANAGER / SUPERINTENDENT _____ TELEPHONE _____
 1986 POPULATION SERVED _____

Please fill in the appropriate category below for 1986 gross withdrawals:

A) FRESH GROUND WATER WITHDRAWN IN MILLION GALLONS PER MONTH (MGM)

JAN _____ FEB _____ MAR _____ APR _____ MAY _____ JUN _____
 JUL _____ AUG _____ SEP _____ OCT _____ NOV _____ DEC _____

B) *SALINE GROUND WATER WITHDRAWN (MGM)

JAN _____ FEB _____ MAR _____ APR _____ MAY _____ JUN _____
 JUL _____ AUG _____ SEP _____ OCT _____ NOV _____ DEC _____

C) FRESH SURFACE WATER WITHDRAWN (MGM)

JAN _____ FEB _____ MAR _____ APR _____ MAY _____ JUN _____
 JUL _____ AUG _____ SEP _____ OCT _____ NOV _____ DEC _____

FORM COMPLETED BY _____ DATE _____
 REMARKS _____

* WATER WITH OVER 1000 PPM OR TREATED BY R/O PLANT IS CONSIDERED GROUND SALINE.

USGS - WATER MANAGEMENT DISTRICT

PUBLIC / DOMESTIC WITHDRAWALS

----- 1985 WATER USE DATA ENTRY FORM -----

COUNTY : _____ POPULATION IN WMD : _____ OWNER ID # : _____

PUBLIC WATER WITHDRAWALS (MG)

WATER SOURCE : FRESH SALINE (R/O)
 GROUND SURFACE GROUND SURFACE

SOURCE ID # : _____

PUMPAGE DATA -----

	FRESH GROUND	FRESH SURFACE	SALINE (R/O) GROUND	SALINE (R/O) SURFACE
JANUARY : _____	_____	_____	_____	_____
FEBRUARY : _____	_____	_____	_____	_____
MARCH : _____	_____	_____	_____	_____
APRIL : _____	_____	_____	_____	_____
MAY : _____	_____	_____	_____	_____
JUNE : _____	_____	_____	_____	_____
JULY : _____	_____	_____	_____	_____
AUGUST : _____	_____	_____	_____	_____
SEPTEMBER : _____	_____	_____	_____	_____
OCTOBER : _____	_____	_____	_____	_____
NOVEMBER : _____	_____	_____	_____	_____
DECEMBER : _____	_____	_____	_____	_____

POPULATION DATA -----

POPULATION SERVED BY PUBLIC SUPPLY : _____ DOMESTIC POPULATION : _____

PERCAPITA : _____

DOMESTIC WATER USE (MGD) : _____

DOMESTIC (PUBLIC SUPPLIED) WASTE WATER IN MGD : _____ NUM. OF FACILITIES : _____

PERCENT OF USE = 100%

- RESIDENTIAL =
- COMMERCIAL =
- INDUSTRIAL =
- WATER UTILITY=
- OTHER =

USGS - WATER MANAGEMENT DISTRICT

INDUSTRIAL / COMMERCIAL WITHDRAWALS

----- 1985 WATER USE DATA ENTRY FORM -----

COUNTY : _____ NUM. OF FACILITIES : _____ OWNER ID # : _____

MONTHLY WATER WITHDRAWALS (MG)

WATER SOURCE :	COMMERCIAL		INDUSTRIAL		SALINE SURFACE
	GROUND	FRESH SURFACE	GROUND	FRESH SURFACE	
SOURCE ID # :	-----				
PUMPAGE DATA	-----				
JANUARY :	_____	_____	_____	_____	_____
FEBRUARY :	_____	_____	_____	_____	_____
MARCH :	_____	_____	_____	_____	_____
APRIL :	_____	_____	_____	_____	_____
MAY :	_____	_____	_____	_____	_____
JUNE :	_____	_____	_____	_____	_____
JULY :	_____	_____	_____	_____	_____
AUGUST :	_____	_____	_____	_____	_____
SEPTEMBER :	_____	_____	_____	_____	_____
OCTOBER :	_____	_____	_____	_____	_____
NOVEMBER :	_____	_____	_____	_____	_____
DECEMBER :	_____	_____	_____	_____	_____

ADDITIONAL DATA -----

INDUSTRIAL WASTE WATER IN MGD : _____ NUM. OF FACILITIES : _____

USE BY SIC CODES IN MGD :

	GROUND	F.SURFACE	S.SURFACE
CODE # _____ :	_____	_____	_____
CODE # _____ :	_____	_____	_____
CODE # _____ :	_____	_____	_____
CODE # _____ :	_____	_____	_____
CODE # _____ :	_____	_____	_____
CODE # _____ :	_____	_____	_____

USGS - WATER MANAGEMENT DISTRICT

THERMOELECTRIC WITHDRAWALS

----- 1985 WATER USE DATA ENTRY FORM -----

COUNTY : _____ NUM. OF FACILITIES : _____ OWNER ID # : _____

POWER WATER WITHDRAWALS (MG)

WATER SOURCE : FRESH SALINE
 GROUND SURFACE GROUND SURFACE

SOURCE ID # :

PUMPAGE DATA -----

	FRESH GROUND	FRESH SURFACE	SALINE GROUND	SALINE SURFACE
JANUARY : _____	_____	_____	_____	_____
FEBRUARY : _____	_____	_____	_____	_____
MARCH : _____	_____	_____	_____	_____
APRIL : _____	_____	_____	_____	_____
MAY : _____	_____	_____	_____	_____
JUNE : _____	_____	_____	_____	_____
JULY : _____	_____	_____	_____	_____
AUGUST : _____	_____	_____	_____	_____
SEPTEMBER : _____	_____	_____	_____	_____
OCTOBER : _____	_____	_____	_____	_____
NOVEMBER : _____	_____	_____	_____	_____
DECEMBER : _____	_____	_____	_____	_____

ADDITIONAL DATA -----

FACILITY DATA :

	POWER PRO. GWH	GROUND MGD	F.SURFACE MGD	S.SURFACE MGD
FOSSIL FUEL : _____	_____	_____	_____	_____
GEOHERMAL : _____	_____	_____	_____	_____
NUCLEAR : _____	_____	_____	_____	_____
HYDRO-ELEC. : _____	_____	_____	_____	_____

PERCENT OF USE = 100%
DOMESTIC = _____
COOLING = _____
WATER UTILITY= _____
OTHER = _____

SYSTEM NAME:

COUNTY:

**AMOUNT OF WATER USED BY SYSTEM:
ANNUALLY (MGD OR GALLONS)**

IS SYSTEM METERED OR NONMETERED?

**POPULATION SERVED BY WATER SYSTEM
OR NUMBER OF CONNECTIONS/METERS:**

WATER SOURCE: GROUND-WATER OR SURFACE-WATER

CONTACT NAME:

POSITION:

PHONE NUMBER:

BE SURE TO SAY THANK-YOU!!!!!!

COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER
FRANKFORT, KENTUCKY 40601

APPLICATION FOR WATER WITHDRAWAL PERMIT

(Type or Print Clearly)

New application _____ Application to revise permit _____ (permit no. _____)

I. FACILITY INFORMATION

Name of business, municipality, company, etc., requesting permit

Street address of facility

City

State

Zip Code

County

Facility Site: _____

Latitude

Longitude

Major Products or Services (list below):

Standard Industrial Classification (SIC) Code: _____

(If known)

Average Annual Production: _____

units

units

II. WATER WITHDRAWAL INFORMATION

Requested withdrawal amounts (average gallons per day)

Jan. _____ Apr. _____ July _____ Oct. _____

Feb. _____ May _____ Aug. _____ Nov. _____

Mar. _____ June _____ Sept. _____ Dec. _____

Raw Water Storage Capability (number, type and capacity) _____

Attach a USGS 7½ minute quadrangle map for this site with the following information marked:

- a. Surface intake facilities or wells
- b. Raw water storage facilities
- c. Pumping plant(s)
- d. Water treatment plant(s)
- e. Waste water discharge site
- f. Dams and reservoirs

USGS maps can be obtained from the Kentucky Commerce Cabinet, Map Sales Office, 133 Holmes Street, Frankfort, Kentucky 40601. Phone: (502) 564-4715.

**IF WITHDRAWAL IS FROM A GROUND WATER SOURCE, COMPLETE SECTION A
IF WITHDRAWAL IS FROM A SURFACE WATER SOURCE, COMPLETE SECTION B**

A. Ground Water Withdrawal

Number of wells Average depth Drawdown Maximum sustained yield

Location of well or well field: _____
County Latitude Longitude

B. Surface Water Withdrawal

Name of surface stream or spring

Location of intake site: _____
County Latitude Longitude

If Surface Withdrawal Is From An Impoundment:

Impoundment Name Approximate Volume

Impoundment Owner Address

Attach documentation of owner's consent to the proposed withdrawal, if applicable.

III. WATER RETURN

Name of stream or spring receiving discharge

Location of discharge site: _____
County Latitude Longitude

Average amount of water returned (**gallons per day**) _____

Method used to estimate discharge rate _____

Discharge Permit Number(s) _____

KENTUCKY DIVISION OF WATER
WATER WITHDRAWAL PERMITTING SUMMARY

The Water Withdrawal Permit Program is in the Division of Water, Water Resources Branch, Water Quantity Section. Contact: Dionne Fields (502/564-3410).

Permit Required (no fee) -- KRS 151.140

All withdrawals, diversions or transfers of any surface, ground, or spring water averaging more than 10,000 gpd must be permitted, in most cases regardless of the purpose for which the water is used. This requirement applies even if the land surrounding the water source is privately owned (including underground reservoirs, irrigation, storage, or sediment impoundments). In addition to the traditional uses of drinking water and industrial process water, this includes such diverse uses as deep mine and quarry dewatering operations, golf course withdrawals for irrigation, trout farms, artificial water falls, coal prep plant recycling ponds, etc.

Exemptions: no permit is required for

1. domestic purposes (needs for one household);
2. withdrawal, transfer or diversion of 10,000 average gpd or less (401 KAR 4:010);
except: permits may be required for withdrawals of less than 10,000 gpd where the Division determines that the water withdrawn represents a significant portion of the available water supply or that collection of withdrawal data is necessary for water resource planning purposes;
3. agricultural withdrawals including irrigation
except: the agricultural exemption does not include withdrawals from impoundments -- agricultural users must have permits to withdraw more than an average of 10,000 gpd if the water is impounded (KRS 151.210);
4. water used in the production of electricity by steam generating plants of companies whose retail rates are regulated by the KY Public Service Commission or for which plants a certificate of environmental compatibility from such commission is required by law; or
5. injection underground in conjunction with operations for the production of oil and gas.

Application Required (no fee) -- KRS 151.150

All persons wishing to withdraw public water must register with the Division and submit a permit application. Withdrawal without a permit is subject to penalties provided in KRS 151.990.

Temporary or emergency: All persons wishing to withdraw public water on a temporary or emergency basis must first notify the Department, and obtain agency authorization prior to commencement of such withdrawals.

Reporting Required -- KRS 151.160

All permittees must record their use and report it to the Department (daily average withdrawals recorded monthly and reported to the Division semi-annually, 401 KAR 4:010). Additional recording and reporting of withdrawals, groundwater levels, and/or stream flows may be required on a case by case basis. Failure to report may result in revocation of the permit.

Public Water Defined -- KRS 151.120

"Water occurring in any stream, lake, groundwater, subterranean water or other body of water in the Commonwealth which may be applied to any useful and beneficial purpose is hereby declared to be a natural resource and public water of the Commonwealth and subject to control or regulation for the public welfare..."

MULTIPLE GROUNDWATER WITHDRAWALS

This chart is to be completed if application is for multiple withdrawal sources. Please list in the chart all groundwater sources of withdrawal currently on the property including active, inactive, abandoned, dry and unused wells. Do not include wells which are permanently sealed or plugged.

On the topographic map requested in Part II of the regular permit application form, show locations of all wells on the property, indicating status of each well, whether proposed, existing, inactive, or abandoned. Include any wells proposed for groundwater monitoring and recharge, if applicable. If any existing withdrawal wells are already permitted, please indicate permit number.

Well ID #	EXAMPLE				
Existing? (E) or Proposed? (P)	E				
Well Diameter	6"				
Well Depth	120'				
Casing Depth	80'				
Screened Interval	80-100'				
Screen Diameter	24"				
Pump Type & Location	submersible				
Pump Capacity	100 gpm				
Status*	Active				
Average Daily W/D	100,000 gal				
Maximum Daily W/D	120,000 gal				
Metered? Y/N & Type	Yes Johnson				
Beginning W/D Date	6/1/81				
Use	heat/cool				
Well surface elevation	650'				
Static water level	60'				
Log Available?	Yes				
Method of Drilling	Driven				
Well Develop. Method	surging				

*Status: A = Active; B = Abandoned; C = Capped; D = Dry F = Filled;
I = Inactive; P = Plugged. (Choose one or more)

Commonwealth of Kentucky
Natural Resources and Environmental Protection Cabinet
Department for Environmental Protection
Division of Water
18 Reilly Road
Frankfort, Kentucky 40601

GROUNDWATER WITHDRAWAL SUPPLEMENT

If the proposed withdrawal is from a groundwater source, please complete this supplement, and return it to the Division of Water, along with the regular permit application form.

WITHDRAWAL METHOD

Is the proposed withdrawal source a well? [] Yes. [] No. If yes, answer the questions below. If no, attach a detailed description of the method of withdrawal, including size, equipment used, method of operation, and purpose. If permit will be for multiple wells, use chart on reverse side.

- (a) Well number: _____
- (b) Well diameter: _____
- (c) Depth of casing: _____ Total well depth: _____
- (d) Length of well screen: _____
- (e) Interval screened from: _____ (feet), to: _____ (feet), depth
- (f) Screen diameter: _____ and slot size: _____
- (g) Pump power rating: _____
- (h) Pump type and location (surface, submerged, etc.): _____

- (i) Surface elevation of well: _____
- (j) Static water level: _____

DRAWDOWN TEST - INCLUDE THE FOLLOWING:

- (a) Date of test: _____
- (b) Discharge in GPM: _____
- (c) Static water level before pumping: _____
- (d) Test method: pump _____, bailer _____, other _____
- (e) Drawdown: _____ feet, after _____ hours
Pumping at _____ GPM
- (f) Method of calculating drawdown: _____
- (g) Type of water level measuring device used: _____

LOCATION

On the USGS topographic map requested in Part II of the regular permit application, show locations of all wells on the property, indicating status of each well, whether proposed, existing, inactive, or abandoned. Include any wells proposed for groundwater monitoring and recharge, if applicable. If any existing withdrawal wells are already permitted, please indicate permit number.

WATER WITHDRAWAL PERMIT APPLICATION SUPPLEMENT

I. Name of Facility: _____

II. Date proposed water withdrawals would begin: _____

III. Activities for which the water would be used:

If the proposed withdrawal is from surface waters, complete the following:

IV. Elevation of intake structure: _____

V. Depth of water over intake at normal pool or average flows: _____

VI. Minimum depth of water required for operation of the intake: _____

In cases where water is being used for irrigation, complete the following:

VII. The number of acres being irrigated: _____

VIII. The normal rate of application (for example, 2 inches per acre per week): _____

IX. The maximum amount of drawdown permissible in a pond where appearance is a factor: _____

Signature of Preparer: _____

- X. In the area below, draw and label a sketch map of the proposed water intake(s) and transfer of water at the facility.
- Include the following:
- (a) location of all surface and ground water supplies and intake sites;
 - (b) location of pumps and metering devices;
 - (c) course and direction of flow through the facility;
 - (d) course and amount of water being recycled;
 - (e) location of the discharge site(s).

COMPLETE SECTION IV ONLY IF THE APPLICANT IS A PUBLIC WATER SUPPLIER

IV. PUBLIC WATER SUPPLIER

Number of people served _____ Number of connections served _____

ATTACH A MAP DISPLAYING SERVICE BOUNDARIES

Water Treatment Plant Capacity (gpd) _____ Average Plant Output _____

Finished water storage capability (number, type and capacity) _____

List the approximate percentage of water distributed to each of the following:

	Percentage		Percentage
Residential	_____	Public/Institutional	_____
Industrial	_____	Other	_____
Commercial	_____	Sold to other water suppliers	_____

If water is sold to other water systems or suppliers, please list:*

- | | |
|-------------------------------------|-------------------------------------|
| 1. _____
<i>Name of Supplier</i> | 3. _____
<i>Name of Supplier</i> |
| _____ | _____ |
| <i>Address</i> | <i>Address</i> |
| _____ | _____ |
| <i>Gallons per day sold</i> | <i>Gallons per day sold</i> |
| 2. _____
<i>Name of Supplier</i> | 4. _____
<i>Name of Supplier</i> |
| _____ | _____ |
| <i>Address</i> | <i>Address</i> |
| _____ | _____ |
| <i>Gallons per day sold</i> | <i>Gallons per day sold</i> |

If additional water is purchased from another water system, please list:*

- | | |
|-------------------------------------|-------------------------------------|
| 1. _____
<i>Name of Supplier</i> | 3. _____
<i>Name of Supplier</i> |
| _____ | _____ |
| <i>Address</i> | <i>Address</i> |
| _____ | _____ |
| <i>Gallons per day purchased</i> | <i>Gallons per day purchased</i> |
| 2. _____
<i>Name of Supplier</i> | 4. _____
<i>Name of Supplier</i> |
| _____ | _____ |
| <i>Address</i> | <i>Address</i> |
| _____ | _____ |
| <i>Gallons per day purchased</i> | <i>Gallons per day purchased</i> |

*Attach additional listing if necessary.

V. REPORTING OF ACTUAL WATER WITHDRAWAL

KRS 151.160 requires that permit holders report actual water withdrawals to the Department. At present, special forms are sent to permit holders in January and July for reporting withdrawals for the previous six months.

Please provide the name and address of the contact person to be in charge of reporting actual withdrawals to the Department and to whom the special report forms are to be sent.

Contact Person _____

Title _____

Address _____

Telephone _____

How will withdrawal rates be measured? Metered _____ Calculated _____ Estimated _____

If calculated or estimated, describe method used: _____

Anticipated accuracy of withdrawal rate measurement (check one)

Excellent
(within 5% of actual rate)

Good
(accurate within 5-10% of
actual rate)

Fair
(accurate within 10-25% of
actual rate)

Poor
(contains more than 25%
error)

Name of person preparing application _____

Title _____

Signature _____ Date _____

If application is prepared by a consultant or other person independent of the business, municipality, company, etc., requesting permit, please provide contact information below:

Name of consulting company or other entity

Address

Telephone

If approved, who do you wish the permit be mailed to: _____
You *Your Client*

WATER SUPPLY SURVEY

MUNICIPAL USERS

The attached questionnaire is part of a study of water supplies in Eastern Kentucky, being conducted by the Kentucky Division of Water in cooperation with the U.S. Geological Survey. The purpose is to better serve the water users of Kentucky, including this facility. You will probably not be able to provide all of the information requested. Please provide as much and as accurate information as you can. Your cooperation is appreciated. Please return to the following address by September 10, 1985:

Mail to: Pamla Wood, Program Development
Kentucky Division of Water
Fort Boone Plaza , 19 Reilly Road
Frankfort, Kentucky 40601

Please return completed questionnaire by September 10.

Your cooperation is appreciated.

If you have questions, call 502-564-3410 extension 406 (Pamla Wood).

Note: You are welcome to use additional paper as necessary.
You may not be able to answer all of the questions. Please provide the best information you have.

WATER SUPPLY SURVEY

NATURAL RESOURCE AND ENVIRONMENTAL PROTECTION CABINET - DIVISION OF WATER

Thank you for your cooperation.

NAME OF FACILITY: _____

Location of Operation:

MAILING ADDRESS: _____

City: _____

CITY: _____ STATE: _____ ZIP: _____

County: _____

Name and position of person to contact for further information (plant manager, owner, etc.):

Phone: _____

1. Please fill in the following source information:

Names	Number	Intake Location ★	Average Daily Amount Withdrawn or Purchased on Operating Days	Percent of Total
Streams			GPD	%
			GPD	%
			GPD	%
Wells			GPD	%
Springs			GPD	%
Ponds or lakes			GPD	%
Other supplies **			GPD	%
TOTAL	X	X		100 %

* Intake location Give latitude and longitude if available. If give River Mile Index or geographic location

** Other supply Please state, on another piece of paper if necessary, whether other supply source is private or public

If more than one other source is used, please give amount supplied from each source

2. Well yield: _____ gallons per minute or Pumping rate: _____ gallons per minute

Well drawdown: _____ feet Depth to water table: _____ feet Depth of well(s): _____ feet

Answer only if you withdraw from a well! If pump test has been done, give the maximum sustained yield from the test. Otherwise, give pumping rate

Well drawdown is the difference between the water level before and after pumping

3. If you have a reservoir, what is the maximum usable storage (above the intake pipe level)?

(If you have neither measurement, please give any relevant measurement you have)

_____ gallons or _____ acre-feet?: _____

How was this determined? (Check one): Estimated: ___ Calculated: ___

4. Do you expect the amount of water you withdraw to change in 5 years? _____

What daily average would you expect at that time? _____ GPD

Please explain the reasons for expected changes: _____

5. Have you recently made or do you expect any major facilities changes in the next five years, ? _____
 Please explain any changes and give a completion date or anticipated completion date: _____

6. Maximum daily withdrawal or peak use in 1984: _____ GPD

7. Treatment plant capacity (maximum treatment capability) : _____ GPM or _____ GPD

8. Age of treatment plant: _____ years

9. Percent of water withdrawn which is: Metered: ___% Calculated: ___%

10. Percent of water distributed which is: Metered: ___% Estimated: ___%

11. Number of people served: _____

12. Please give the number of customers in each category and an estimate of average daily use per category:

	Number of Connections	Average Daily Amount (GPD)
(A) Other towns or utility districts:	_____	_____
(B) Industry:	_____	_____
(C) Commercial:	_____	_____
(D) Residential:	_____	_____
(E) Other (Please explain):	_____	_____

TOTAL	_____	_____

Total should equal the total average given in question 1

13. Please list individual towns and districts to whom water is sold and the amount purchased by each:

14. Please list industrial customers which use more than 2,000 GPD, and give amount purchased by each:

Information concerning individual industries will be held confidential

15. Please assist us in this survey effort by listing other municipal, commercial, or industrial water users in your county who may be withdrawing more than 10,000 GPD: _____

16. Do you store water before treatment? _____ If yes, how much? _____ gallons
 Raw water is stored in: Tank__ Instream impoundment__ Off-stream impoundment__ Other__
 Age of storage structure: _____ years

17. Is the amount in question 16 the original design volume? _____

18. Maximum storage capacity for treated water : _____ gallons

19. Describe how and what water use records you maintain Please specify whether any of these are computerized, and what sort of categories you use: _____

20. Do you prepare an annual water management and operations report? _____ If yes, please enclose the most recent copy.
21. Who owns the system?(check one): Public, local government: _____ Private, reports to local government: _____
 Private, separate from local government: _____ Other (specify): _____
22. Source of operating revenue: _____
23. What is your present rate structure? (check one) Uniform : _____ Declining block: _____ Increasing block: _____
 Varies by user: _____ Other: _____
24. Do you have any chemical or biological information about your water before treatment? _____ If so, please enclose.
25. How many times in the last 5 years has your system experienced some water shortage? _____
26. What water problems, if any, have you experienced? (For example raw water supply, water storage, water quality, turbidity, pump or system failure, or other). Please state the frequency and/or year of occurrence:

27. Does your service area have a public information program relative to water conservation and the potential for supply shortage? (Please describe): _____

28. Does your system have an active leakage detection program? _____
29. What conservation measures and/or ordinances are in effect in your service area? _____
30. Have you used other source(s) of water because of shortage? (Specify source, amount, owner, and/or water district):

31. Do you have a possible alternate source(s) of water in case of future shortages? (Specify source, amount, owner and/or water district):

32. Do you have emergency or back-up supply agreements with other water systems? (Specify source, amount, owner and/or water district): _____

33. What percent of your customers use septic tanks? (Estimate if necessary) _____ %
 Percent with sewer service? _____ % Other: _____ %
34. Average amount of water returned to a municipal wastewater system: _____ GPD
35. Do your sewer and water supply systems have combined billing? _____

Thank you for your cooperation. Please return completed questionnaire to Pamla Wood, Kentucky Division of Water, Fort Boone Plaza, 19 Reilly Road, Frankfort, Kentucky 40601.
 If you have questions, call 502-564-3410 extension 406

MUNICIPAL USERS

WATER SUPPLY SURVEY

SELF-SUPPLIED INDUSTRIAL AND COMMERCIAL USERS

The attached questionnaire is part of a study of water supplies in Eastern Kentucky, being conducted by the Kentucky Division of Water in cooperation with the U.S. Geological Survey. The purpose is to better serve the water users of Kentucky, including this facility. You will probably not be able to provide all of the information requested. Please provide as much and as accurate information as you can. Your cooperation is appreciated. Please return to the following address by September 10, 1985:

Mail to: Pamla Wood, Program Development
Kentucky Division of Water
Fort Boone Plaza , 19 Reilly Road
Frankfort, Kentucky 40601

Please return completed questionnaire by September 10.

Your cooperation is appreciated.

If you have questions, call 502-564-3410 extension 406 (Pamla Wood).

Note: You are welcome to use additional paper as necessary.
You may not be able to answer all of the questions. Please provide the best information you have.

WATER SUPPLY SURVEY

NATURAL RESOURCE AND ENVIRONMENTAL PROTECTION CABINET - DIVISION OF WATER

Thank you for your cooperation.

NAME OF FACILITY: _____

Location of Operation:

MAILING ADDRESS: _____

City: _____

CITY: _____ STATE: _____ ZIP: _____

County: _____

Name and position of person to contact for further information (plant manager, owner, etc.):

Phone: _____

1. Please fill in the following source information:

Names	Number	Intake Location *	Average Daily Amount Withdrawn or Purchased on Operating Days	Percent of Total
Streams			GPD	%
			GPD	%
			GPD	%
Wells			GPD	%
Springs			GPD	%
Ponds or lakes			GPD	%
Other supplies **			GPD	%
TOTAL	X	X		100 %

* Intake location: Give latitude and longitude if available. If give River Mile Index or geographic location

** Other supply: Please state, on another piece of paper if necessary, whether other supply source is private or public.

If more than one other source is used, please give amount supplied from each source.

2. Well yield: _____ gallons per minute or Pumping rate: _____ gallons per minute

Well drawdown: _____ feet Depth to water table: _____ feet Depth of well(s): _____ feet

Answer only if you withdraw from a well. If pump test has been done, give the maximum sustained yield from the test. Otherwise, give pumping rate.

Well drawdown is the difference between the water level before and after pumping.

3. If you have a reservoir, what is the maximum usable storage (above the intake pipe level)?

(If you have neither measurement, please give any relevant measurement you have)

_____ gallons or _____ acre-feet?: _____

How was this determined? (Check one): Estimated: ___ Calculated: ___

4. Do you expect the amount of water you withdraw to change in 5 years? _____

What daily average would you expect at that time? _____ GPD

Please explain the reasons for expected changes: _____

5. Have you recently made or do you expect any major facilities changes in the next five years. ? _____
 Please explain any changes and give a completion date or anticipated completion date: _____

6. Normal pumping operation is _____ hours per day, _____ days per week, _____ weeks per year.

7. Maximum daily withdrawal or peak use in 1984: _____ GPD

8. Average number of employees occupying this facility: _____ Hours per day: _____

9. Major product(s) or service(s) (give the four digit Standard Industrial Classification number if known):

10. Major byproducts: _____

11. Major raw materials used: _____

12. Minimum amount of water necessary to maintain a minimum production level : _____ GPD

13. Please fill in to show how water is used:

Use	Percent of Total Use	Percent Recirculated (A)	Percent Consumed (B)	Percent Discharged (C)	Total (A + B + C)
Cooling or condensing					100 %
Processing (including process washing)					100 %
Domestic (including general sanitation)					100 %
Boiler					100 %
Lost in system					100 %
TOTAL	100 %	X	X	X	X

14. Please assist us in this survey effort by listing other municipal, commercial, or industrial water users in your county who may be withdrawing more than 10,000 GPD: _____

15. Maximum impoundment or storage capacity for raw water, according to design specifications : _____ gallons
 Is this the original design volume? _____ Age of storage structure: _____ years

16. Describe how and what water use records you maintain. Please specify whether any of these are computerized, and what sort of categories you use: _____

17. Cost of water withdrawal: \$ _____ per _____ gallons OR \$ _____ per day

18. What percent of water is treated prior to use? _____ %
 Please specify the type of treatment being applied: _____

19. How many times in the last 5 years has your system experienced some water shortage? _____

20. What water problems, if any, have you experienced (for example, water supply, water storage, water quality, pump or system failure, turbidity, or other) ? Please state the frequency and/or year of occurrence:

21. Average amount of water reused or recirculated on normal operating days: _____ GPD
The average daily amount reused or recirculated may be based on the capacity of the pump used to pump recirculated or reused water, and the duration of that pumping.
22. Have you recently made or do you plan to make, in the next five years, any major facilities or operational changes to improve water use efficiency? _____ Please explain any changes and give completion date or anticipated completion date:

23. Based on available information and your water use/supply situation, do you think that the increased reuse or recirculation of water would be practical and cost-effective for your operation? _____ If yes; what legal, institutional, financial, and physical modifications, if any, would be needed to achieve this higher level of water reuse?

24. What conservation measures are used in addition to recirculation? _____
25. Have you used other source(s) of water because of shortage? (Specify source, amount, owner, and/or water district):

26. Do you have a possible alternate source(s) of water in case of future shortages? (Specify source, amount, owner and/or water district): _____

27. Do you have emergency or back-up supply agreements with other water systems? (Specify source, amount, owner and/or water district): _____

28. Average daily discharge: _____ GPD
 Type of treatment applied to discharge: _____
29. Average amount of water returned to a wastewater system: _____ GPD
30. Percent of total discharge returned to:
- | | | | |
|-----------------------------|---------|---|-------|
| Stream | _____ % | Name of stream: | _____ |
| | | Location on stream (river mile or geographic location): | _____ |
| Sinkhole | _____ % | | |
| Well injection | _____ % | | |
| Septic tank &
field tile | _____ % | | |
| Spray irrigation | _____ % | Gallons pumped per day: | _____ |
| Public system | _____ % | Name of system: | _____ |
| Other | _____ % | Specify if by sale, etc: | _____ |

Thank you for your cooperation. Please return completed questionnaire to Pamela Wood, Kentucky Division of Water, Fort Boone Plaza, 19 Reilly Road, Frankfort, Kentucky 40601 If you have questions, call 502-564-3410 Extension 406.

CONTACT
TITLE
FACILITY
STREET
CITY ZIP

Dear

Thank you for your continued cooperation in the State Water Use Program. The Louisiana Department of Transportation and Development is currently engaged in updating water use records and collecting background information on water users throughout the State in preparation for the five-year State Water Use Report. Along with the usual quarterly pumpage information, please take a few minutes to complete the rest of this form and return it to the U.S. Geological Survey in the envelope provided. If you are reporting information for more than one facility, please complete the extra form for each facility. If you have any questions about the form, please call Mr. John Lovelace at (504) 389-0391.

.....

1991 PUMPAGE:

Pumpage from:
SOURCE-1
Apr. _____
May _____
June _____

Pumpage from:
SOURCE-2
Apr. _____
May _____
June _____

Pumpage from:
SOURCE-3
Apr. _____
May _____
June _____

Pumpage from:
SOURCE-4
Apr. _____
May _____
June _____

Pumpage from:
SOURCE-5
Apr. _____
May _____
June _____

Pumpage from:
SOURCE-6
Apr. _____
May _____
June _____

Pumpage from:
SOURCE-7
Apr. _____
May _____
June _____

Pumpage from:
SOURCE-8
Apr. _____
May _____
June _____

Pumpage was: (circle one) Metered Calculated Estimated

1990 WATER USE REPORTING FORM

Facility name: _____

If use is Industrial, state major product(s): _____

If use is Public Supply, please respond to the following:

Total number of service connections _____ Population served: _____

Percentage of residential use: _____

Percentage of industrial use: _____

Percentage of commercial use: _____

Percentage of unsold water (system losses and public use) _____

.....

Water source: (circle) Ground water Surface water Both

Ground water quality: (circle) Fresh Saline Unknown

Surface water quality: (circle) Fresh Saline Unknown

Number of surface water intakes: Canal _____ Lake _____ River _____ other _____

Name(s) of body of water: _____

Number of wells: _____

USGS well number(s), if known: _____

Owner's well names or numbers: _____

Aquifer(s) or depth(s), if known: _____

Area or water body to which water is returned: _____

Percentage of ground water consumed or not discharged: _____

Percentage of surface water consumed or not discharged: _____

If water is purchased, how much and from whom: _____

Please supply sketch or map showing location of wells, if available.

Signature _____ Date _____



LOUISIANA DEPARTMENT OF
TRANSPORTATION AND DEVELOPMENT



AND THE

UNITED STATES GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

P.O. Box 66492
Baton Rouge, Louisiana 70896
(504) 389-0281

1990 WATER USE REPORTING FORM

Name of water user: _____

Person supplying information: _____ Phone: () _____

Mailing address: _____

City: _____ State: _____ Zip code: _____

Physical location: _____

City: _____ State: _____ Zip code: _____

Use of water: (circle one)

- | | | | |
|-------------|-------------|---------------|------------------|
| Agriculture | Domestic | Industrial | Power Generation |
| Irrigation | Commercial | Public Supply | Sewage Treatment |
| Mining | Aquaculture | | |

If use is Industrial, state major product(s): _____

If use is Irrigation, state major crop(s): _____

If use is Public Supply, please respond to the following:

Percentage of commercial use: _____ Percentage of industrial use: _____

Percentage of residential use: _____ Percentage of other uses: _____

Number of residential connections: _____ Population served: _____

Water source: (circle) Ground water Surface water Both

Ground water quality: (circle) Fresh Saline Unknown

Surface water quality: (circle) Fresh Saline Unknown

Number of surface water intakes: Canal _____ Lake _____ River _____ other _____

Name(s) of body of water: _____

Number of wells: _____

USGS well number(s), if known: _____

Owner's well names or numbers: _____

Aquifer(s) or depth(s), if known: _____

1989 PUMPAGE:

Ground water	Surface water	Ground water	Surface water
Jan _____	_____	Jul _____	_____
Feb _____	_____	Aug _____	_____
Mar _____	_____	Sep _____	_____
Apr _____	_____	Oct _____	_____
May _____	_____	Nov _____	_____
Jun _____	_____	Dec _____	_____

TOTAL PUMPAGE IN 1989 _____

Pumpage was: (circle one) Metered Calculated Estimated

Area or water body to which water is returned: _____

Percentage of water consumed or not discharged: _____

If water is purchased, how much and from whom: _____

Please supply sketch or map showing location of wells, if available.

For questions regarding this form, contact John Lovelace at (504) 389-0281.

Signature _____ Date _____

1990 AGRICULTURAL WATER USE QUESTIONNAIRE

Parish: _____ County Agent _____

Please estimate the average amount of water, in inches or feet per acre, applied in 1989 for the following: (please indicate units used)

Rice _____

Cotton _____

Soybeans _____

Strawberries _____

Truck crops _____

Catfish _____

Crawfish _____

Other (list) _____

Please list major surface water sources in your parish for:

Livestock Watering _____

Irrigation _____

Aquaculture _____

Please indicate the percentage of ground water and surface water used in your parish for the following :

	%GW	%SW
Livestock watering	_____	_____
Aquaculture	_____	_____
Crop Irrigation	_____	_____

Notes:

PARISH _____

FSN _____

IRRIGATED CROP(S) _____

ACREAGE IRRIGATED WITH GROUND WATER _____

ESTIMATED TOTAL AMOUNT OF GROUND
WATER APPLIED FOR YEAR
(INCHES PER ACRE) _____

ACREAGE IRRIGATED WITH SURFACE WATER _____

SOURCE OF SURFACE WATER _____

ESTIMATED TOTAL AMOUNT OF SURFACE
WATER APPLIED FOR YEAR
(INCHES PER ACRE) _____

CAPITAL AREA GROUND WATER CONSERVATION COMMISSION
P. O. BOX 64526
BATON ROUGE, LOUISIANA 70896

TRANS.
#3

TO:

PARISH	YEAR			USE	QUARTER		
	Cols.					Cols.	
	03	04	05			12	13

	USGS NO.						OWNER NO.	DEPTH FT.	TOTAL PUMPAGE, BY MONTH IN THOUSAND GALLONS			ACT CODE	COMMENTS
	Cols.								Month	Month	Month	Col.	
	06	07	08	09	10	11						79	
1	-												
2	-												
3	-												
4	-												
5	-												
6	-												
7	-												
8	-												
9	-												
10	-												
11	-												
12	-												
13	-												
14	-												
15	-												
16	-												
17	-												
18	-												
TOTAL PUMPAGE, By Month:													
TOTAL PUMPAGE, BY QUARTER													
In Thousands of Gallons:													

Person Completing Form: _____
Title: _____
Phone: _____

INSTRUCTIONS: Give pumpage by well
Charges: \$1.50 per million gallons
IMPORTANT: PLEASE RETURN WHITE FORM WITH CHECK

FOR COMMISSION USE ONLY:
Voucher NO.:

Public Water Supplier Data Sheet

Name and Mailing Address _____ PWS # _____

Contact Person _____ Telephone # _____

Ownership: Authority or District Municipality State Mobile Home

Subdivision Non-profit association Business Federal County

County _____ # _____ HUC # _____

Population serviced _____

Average annual daily water use _____ MGD

Amount from ground-water sources _____ MGD

% of ground water from various aquifers:

Water Pumped MGD	Aquifer	Well Depth	Screen/Casing Depth
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Amount from surface-water sources _____ MGD

Average Monthly Water Use:

Jan. _____ MGD	July _____ MGD
Feb. _____ MGD	Aug. _____ MGD
Mar. _____ MGD	Sep. _____ MGD
Apr. _____ MGD	Oct. _____ MGD
May _____ MGD	Nov. _____ MGD
June _____ MGD	Dec. _____ MGD

Average Annual Water Use

Type	Metered Connections		Nonmetered Connections	
	Number	Water Use MGD	Number	Water Use MGD
Residential	_____	_____	_____	_____
Commercial	_____	_____	_____	_____
Industrial	_____	_____	_____	_____
Institutional	_____	_____	_____	_____
Bulk sales to other suppliers	_____	_____	_____	_____
Un-accounted water	_____	_____	_____	_____
Total	_____	_____	_____	_____

Top Ten Water Users

Name	Water Use MGD
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Connections to other water suppliers

suppliers name	receiver name	Water Transferred
_____	_____	_____ MGD
_____	_____	_____
_____	_____	_____
_____	_____	_____

Wastewater discharge

NPDES permit #	Ave Annual Daily Discharge	Receiving stream	lat.	long.
_____	_____ MGD	_____	_____	_____
_____	_____ MGD	_____	_____	_____
_____	_____ MGD	_____	_____	_____
_____	_____ MGD	_____	_____	_____

FARM IRRIGATION DATA SHEET

County: _____ Co#: _____ HUC: _____

Contact Person: _____ Phone #: _____

Crop Type:

Acreage	Application Rate
Tobacco _____	_____
Corn _____	_____
Grains _____	_____
Cotton _____	_____
Peanuts _____	_____
Hay _____	_____
Veggies _____	_____
Other _____	_____
Other _____	_____

Type of Irrigation: _____

Source:

Ground

Aquifer: _____ Well depth: _____ Withdraw. _____ MGD

Surface

Source: _____ Withdraw. _____ MGD

PWS

Source: _____ Withdraw. _____ MGD

Reclaimed Waste

Source: _____ Withdraw. _____ MGD

Application Rate: _____ MGD

Consumptive Use: _____ MGD

Conveyance Loss: _____ MGD

INDUSTRIAL QUESTIONNAIRE 1990

Facility Name: _____
 Location (City/County): _____
 Contact Person: _____ Phone # _____
 Mailing Address: _____
 Street Address (if different from mailing address): _____

 River Basin: _____

Is your facility Self-supplied _____ or Publicly Supplied ? _____
 If it is Publicly supplied, what is the name of the supplier ? _____

 If your facility is publicly supplied, skip the Water Sources section and
 procede to the Production Usage section.

WATER SOURCES

Ground Water Sources (MGD = Million Gallons per Day)

Well No.	Well Dia. in.	Well Depth ft	Screen Interval ft	Average Daily Use MGD	Maximum Daily Use MGD	Well Location Lat.	Well Location Long.	Saline or Fresh Water
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____

Surface Water Sources

Name of Stream &/or Reservoir	Ave. daily Withdrawal MGD	Max. daily Withdrawal MGD	Intake Location Lat.	Intake Location Long.	Saline or Fresh Water
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Production Useage

Cooling: _____ MGD Production: _____ MGD

Sanitation: _____ MGD Others: _____ MGD

Projected Average Annual Water Use

_____ MGD 1995 _____ MGD 2000 _____ MGD 2005 _____ MGD 2010

Historic Water Use

_____ MGD 1970 _____ MGD 1975 _____ MGD 1980 _____ MGD 1985

1990 Water Use Summary For Facility

<u>Month</u>	<u>Withdrawal MGD</u>	<u>Discharge MGD</u>	<u>Consumptive Use MGD</u>
January	_____	_____	_____
February	_____	_____	_____
March	_____	_____	_____
April	_____	_____	_____
May	_____	_____	_____
June	_____	_____	_____
July	_____	_____	_____
August	_____	_____	_____
September	_____	_____	_____
October	_____	_____	_____
November	_____	_____	_____
December	_____	_____	_____
Annual Avg.	_____	_____	_____
Max. Daily	_____	_____	_____

Location of Returns:

<u>NPDES Permit No.</u>	<u>Stream Location</u>	<u>Latitude</u>	<u>Longitude</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Industrial Activity: _____

Standard Industrial Classification Code (SIC Code #)

Primary _____ Secondary _____

1990 HYDROELECTRIC POWER WATER USE DATA SHEET

Company Name: _____

Office Address _____

Contact Person: _____ Telephone No. _____

Plant Name: _____

Plant Location: _____

County _____

Latitude _____ Longitude _____

Hydrologic Unit Code _____ River Basin _____

Source Name: _____

Withdrawal Location: Latitude _____ Longitude _____

Return Location: Latitude _____ Longitude _____

1990 Average Daily _____ Million Gallons per Day (MGD)
Water Use

Average Daily Water Use by Month in MGD

Jan. _____ MGD

July _____ MGD

Feb. _____

Aug. _____

Mar. _____

Sep. _____

Apr. _____

Oct. _____

May _____

Nov. _____

June _____

Dec. _____

1990 HYDROELECTRIC POWER WATER USE DATA SHEET, continued

Total 1990 Annual Power Production in Gigawatt-hours (GWh) _____

Monthly 1990 Power Production GWh

Jan. _____ GWh

July _____ GWh

Feb. _____

Aug. _____

Mar. _____

Sep. _____

Apr. _____

Oct. _____

May _____

Nov. _____

June _____

Dec. _____

WATER USE DATA SHEET
1990 THERMOELECTRIC - FOSSIL FUEL POWER

Company Name: _____

Office Address _____

Contact Person: _____ Telephone No. _____

Plant Name: _____

Nearest City: _____

County _____

Latitude _____ Longitude _____

Hydrologic Unit Code _____ River Basin _____

1990 Average Daily Withdrawal _____ Million Gallons per Day (MGD)

Average Daily Withdrawal by Month in MGD

Jan. _____ MGD	July _____ MGD
Feb. _____ MGD	Aug. _____ MGD
Mar. _____ MGD	Sep. _____ MGD
Apr. _____ MGD	Oct. _____ MGD
May _____ MGD	Nov. _____ MGD
June _____ MGD	Dec. _____ MGD

1990 Peak Daily Water Use _____ MGD

Projected Average Daily Water Use for Year 2000 _____ MGD

Projected Capacity Need for Year 2000 _____ Gigawatt-hours (GWh)

WATER USE DATA SHEET
1990 THERMOELECTRIC - FOSSIL FUEL POWER--Continued

Surface water Withdrawal Locations:

Source Name	Latitude	Longitude	Fresh or Saline Water	1990 Average Daily Water Withdrawal
1. _____	_____	_____	_____	_____ MGD
2. _____	_____	_____	_____	_____ MGD
3. _____	_____	_____	_____	_____ MGD
4. _____	_____	_____	_____	_____ MGD
5. _____	_____	_____	_____	_____ MGD
6. _____	_____	_____	_____	_____ MGD
7. _____	_____	_____	_____	_____ MGD
8. _____	_____	_____	_____	_____ MGD

Ground water Withdrawal Locations:

Well Name	Latitude	Longitude	Well Depth	Aquifer	Average Daily Water Withdrawal
1. _____	_____	_____	_____ ft	_____	_____ MGD
2. _____	_____	_____	_____ ft	_____	_____ MGD
3. _____	_____	_____	_____ ft	_____	_____ MGD
4. _____	_____	_____	_____ ft	_____	_____ MGD
5. _____	_____	_____	_____ ft	_____	_____ MGD
6. _____	_____	_____	_____ ft	_____	_____ MGD
7. _____	_____	_____	_____ ft	_____	_____ MGD
8. _____	_____	_____	_____ ft	_____	_____ MGD

Aquifer A _____ Aquifer B _____
 Aquifer C _____ Aquifer D _____

WATER USE DATA SHEET
 1990 THERMOELECTRIC - FOSSIL FUEL POWER--Continued

Name of Public Water Supplier _____

Return Location: Latitude _____ Longitude _____

Average Daily Annual Discharge _____ MGD

Average Daily Annual Consumptive Use Fresh Water _____ MGD

Average Daily Annual Consumptive Use Saline Water _____ MGD

	Deliveries from Public Water supply	Ave. Daily Monthly Discharge	Consumptive use	
			Fresh water	Saline water
Jan.	_____ MGD	_____ MGD	_____ MGD	_____ MGD
Feb.	_____ MGD	_____ MGD	_____ MGD	_____
Mar.	_____ MGD	_____ MGD	_____ MGD	_____
Apr.	_____ MGD	_____ MGD	_____ MGD	_____
May	_____ MGD	_____ MGD	_____ MGD	_____
June	_____ MGD	_____ MGD	_____ MGD	_____
July	_____ MGD	_____ MGD	_____ MGD	_____
Aug.	_____ MGD	_____ MGD	_____ MGD	_____
Sep.	_____ MGD	_____ MGD	_____ MGD	_____
Oct.	_____ MGD	_____ MGD	_____ MGD	_____
Nov.	_____ MGD	_____ MGD	_____ MGD	_____
Dec.	_____ MGD	_____ MGD	_____ MGD	_____

Percent of Total Water Withdrawals that is Consumptively Used _____

Cooling Method: _____

Forced Evaporation _____ MGD

WATER USE DATA SHEET
1990 THERMOELECTRIC - FOSSIL FUEL POWER--Continued

Total 1990 Annual Power Production in Gigawatt-hours (GWh) _____

Monthly 1990 Power Production GWh

Jan. _____ GWh	July _____ GWh
Feb. _____ GWh	Aug. _____ GWh
Mar. _____ GWh	Sep. _____ GWh
Apr. _____ GWh	Oct. _____ GWh
May _____ GWh	Nov. _____ GWh
June _____ GWh	Dec. _____ GWh

WATER USE DATA SHEET
1990 THERMOELECTRIC - NUCLEAR POWER

Company Name: _____

Office Address _____

Contact Person: _____ Telephone No. _____

Plant Name: _____

Nearest City: _____

County _____

Latitude _____ Longitude _____

Hydrologic Unit Code _____ River Basin _____

1990 Average Daily Withdrawal _____ Million Gallons per Day (MGD)

Average Daily Withdrawal by Month in MGD

Jan. _____ MGD July _____ MGD

Feb. _____ MGD Aug. _____ MGD

Mar. _____ MGD Sep. _____ MGD

Apr. _____ MGD Oct. _____ MGD

May _____ MGD Nov. _____ MGD

June _____ MGD Dec. _____ MGD

1990 Peak Daily Water Use _____ MGD

Projected Average Daily Water Use for Year 2000 _____ MGD

Projected Capacity Need for Year 2000 _____ Gigawatt-hours (GWh)

WATER USE DATA SHEET
1990 THERMOELECTRIC - NUCLEAR POWER--Continued

Surface water Withdrawal Locations:

Source Name	Latitude	Longitude	Fresh or Saline Water	1990 Average Daily Water Withdrawal
1. _____	_____	_____	_____	_____ MGD
2. _____	_____	_____	_____	_____ MGD
3. _____	_____	_____	_____	_____ MGD
4. _____	_____	_____	_____	_____ MGD
5. _____	_____	_____	_____	_____ MGD
6. _____	_____	_____	_____	_____ MGD
7. _____	_____	_____	_____	_____ MGD
8. _____	_____	_____	_____	_____ MGD

Ground water Withdrawal Locations:

Well Name	Latitude	Longitude	Well Depth	Aquifer	Average Daily Water Withdrawal
1. _____	_____	_____	_____ ft	_____	_____ MGD
2. _____	_____	_____	_____ ft	_____	_____ MGD
3. _____	_____	_____	_____ ft	_____	_____ MGD
4. _____	_____	_____	_____ ft	_____	_____ MGD
5. _____	_____	_____	_____ ft	_____	_____ MGD
6. _____	_____	_____	_____ ft	_____	_____ MGD
7. _____	_____	_____	_____ ft	_____	_____ MGD
8. _____	_____	_____	_____ ft	_____	_____ MGD

Aquifer A _____ Aquifer B _____
 Aquifer C _____ Aquifer D _____

WATER USE DATA SHEET
1990 THERMOELECTRIC - NUCLEAR POWER--Continued

Name of Public Water Supplier _____

Return Location: Latitude _____ Longitude _____

Average Daily Annual Discharge _____ MGD

Average Daily Annual Consumptive Use Fresh Water _____ MGD

Average Daily Annual Consumptive Use Saline Water _____ MGD

	Deliveries from Public Water supply	Ave. Daily Monthly Discharge	Consumptive use	
			Fresh water	Saline water
Jan.	_____ MGD	_____ MGD	_____ MGD	_____ MGD
Feb.	_____ MGD	_____ MGD	_____ MGD	_____
Mar.	_____ MGD	_____ MGD	_____ MGD	_____
Apr.	_____ MGD	_____ MGD	_____ MGD	_____
May	_____ MGD	_____ MGD	_____ MGD	_____
June	_____ MGD	_____ MGD	_____ MGD	_____
July	_____ MGD	_____ MGD	_____ MGD	_____
Aug.	_____ MGD	_____ MGD	_____ MGD	_____
Sep.	_____ MGD	_____ MGD	_____ MGD	_____
Oct.	_____ MGD	_____ MGD	_____ MGD	_____
Nov.	_____ MGD	_____ MGD	_____ MGD	_____
Dec.	_____ MGD	_____ MGD	_____ MGD	_____

Percent of Total Water Withdrawals that is Consumptively Used _____

Cooling Method: _____

Forced Evaporation _____ MGD

WATER USE DATA SHEET
1990 THERMOELECTRIC - NUCLEAR POWER--Continued

Total 1990 Annual Power Production in Gigawatt-hours (GWh) _____

Monthly 1990 Power Production GWh

Jan. _____ GWh

July _____ GWh

Feb. _____ GWh

Aug. _____ GWh

Mar. _____ GWh

Sep. _____ GWh

Apr. _____ GWh

Oct. _____ GWh

May _____ GWh

Nov. _____ GWh

June _____ GWh

Dec. _____ GWh

GOLF DATA SHEET

Golf Course Name: _____

Address: _____

City: _____ County: _____ Co. #: _____

Contact Person: _____ Phone #: _____

HUC: _____

Acres: _____ No. of holes _____

Type of irrigation: _____

Source:

Ground

Aquifer: _____ Well depth: _____ Withdraw. _____ MGD

Surface

Source: _____ Withdraw. _____ MGD

PWS

Source: _____ Withdraw. _____ MGD

Reclaimed Waste

Source: _____ Withdraw. _____ MGD

Type of Grass: _____

Application Rate: _____ MGD

Consumptive Use: _____ MGD

Conveyance Loss: _____ MGD

CONVERSION FACTOR

FOR CALCULATING WATER USE VOLUME FROM ENERGY CONSUMPTION

This is the hand-out describing a way to calculate water usage, referred to in Method 4, which appears on both Forms WU-1 and WU-IR-1. By using this method, it is assumed that you have no means available to you to directly measure water use. This hand-out will describe the simple calculations necessary to obtain the conversion factor to convert energy usage to water usage. Also covered are various methods of measuring three quantities necessary to calculate the conversion factor. These are:

1. The amount of energy consumed
2. The rate of water pumpage
3. Length of time the pump test run.

Time is easily measured but you will have to buy metering devices or improvise, as described herein with the equipment available at your farm, to measure the other two quantities listed above. You will need to determine a conversion factor for each pump employed in your water withdrawal system.

A pumping test is conducted for each water pump you employ, to determine the pumping rate of the pump plant and the energy use amount over a measured time period, say 3 to 4 hours. The pump test should be run for at least one hour to allow a long enough period to establish credible water pumpage and energy usage rates. When the pump is started the water pumping rate and energy rate could be quite variable from the average. The longer the pumping test, the more any momentary variation or inconsistency will be dampened out. For the pump test, the water pump will need to be disconnected from the irrigation system.

With the quantities measured in the pumping test, water usage can be calculated in two ways:

Method 2 - the farmer can use the pumping rate determined in the pumping test to multiply the number of hours the pump is run to calculate water use.

Method 4 - the farmer will need to keep track of the energy used and multiply this volume by the conversion factor to calculate water usage.

If care is taken to make accurate measurements of the three quantities then a good conversion factor will result. If care is not taken the resultant conversion factor could cause incorrect calculation of the water use volume.

Three sections follow, the first one covering the basic calculation to derive the conversion factor, the second

describing various methods of measuring energy use, and the third dealing with several ways of measuring or estimating water pumping rate.

BASIC CALCULATION

With the three quantities described above the conversion factor can be calculated as follows:

Given: pumping time 4 hours
energy consumed 200 kilowatt-hours electricity
pumping rate 1500 gallons per minute

A. Determine how much water was pumped:

multiply PUMPING RATE times PUMPING TIME.

Note: make sure that the units of each quantity match. If the pumping rate is in gallons per minute and the pumping time is in hours, convert the hours to minutes by multiplying by 60 as follows:

$$4 \text{ hrs.} \times 60 \text{ min./hour} = 240 \text{ minutes.}$$

Now multiply:

$$1500 \text{ gpm} \times 240 \text{ minutes} = 360,000 \text{ gallons.}$$

B. Divide this volume of water by the amount of ENERGY CONSUMED:

$$360,000 \text{ gal.} / 200 \text{ kw-hours} = \underline{1800 \text{ gal./kw-hour}}$$

THIS IS YOUR CONVERSION FACTOR.

Most likely, the pumping rate measured with the irrigation equipment disconnected is greater than it would be if the equipment were connected. The pipes, elbows, and nozzles of the irrigation equipment all create friction which produces additional hydraulic head for the pump to work against. This additional head can be determined from tables and this head value can be compared with the pump curve, supplied by the pump manufacturer, to arrive at the probable pumping rate. However, a simple pressure gage installed at the well head indicates the pressure the pump works against when in typical operation. When the irrigation equipment is disconnected, the water flow can be valved down until the pump is working against the same pressure head as noted for typical operation. The water flow rate determined with this modification will be fairly accurate and usefull.

METHODS TO MEASURE ENERGY CONSUMPTION

Below are a few methods to measure the energy used during the pumping test. Keeping track of this fuel consumption will not only be important during the pumping test, but will be vitally important while operating irrigation equipment. This is the quantity the conversion factor is used with to calculate the

water usage. Therefore, finding a fool-proof method for keeping fuel consumption records will make using this Method 4 easy.

ELECTRICITY Reading the meter on the main power box before and after pump operation and subtracting the beginning reading from the ending reading will result in the total power used.

However, an important consideration is whether or not the pump is the only electrical device connected to the meter. If not, then some way will have to be devised to determine these other devices power usage and deduct this from the total power usage during pumping. For instance, if two other devices are connected to the meter, operate each of them separately for a period of time and then calculate each devices energy use per hour. Then all you have to keep track of is how many hours each device was operating while the irrigation pump was operating, calculate the power used by the other devices, and subtract that value from the total power used.

If this additional power usage is not subtracted from the total, particularly if the pumping test for the water pump was run without the other devices operating, then the conversion factor will be multiplying an energy value greater than what should be considered for water pumping. The resultant calculation will estimate a greater water usage than actually occurred.

GASOLINE or DIESEL FUEL Both of these fuels have to be stored in a tank of one sort or another. One measuring method would be to fill the tank at the pump site to the brim or a set level each time and keep track of how much fuel is needed to refill the tank after each pumping period. Another method would be to estimate contents of the tank. This is done by knowing the size and volume of the tank and be able to measure the depth of the fuel in the tank in inches. This data can be used to find in special tables the conversion factor for calculating the fuel volume.

METHODS TO MEASURE WATER PUMPING RATE

Several methods exist for measuring or estimating the pumping rate. Some provide accurate measurements while others only rough estimates. The descriptions below will start with the most accurate and work towards the least accurate.

Two important considerations to note when using these methods are first that the pump will have to be disconnected from the irrigation equipment and second, that a great deal of water will be pumped during the test. Catching or diverting the water for later re-use will make the test less wasteful.

Other methods exist for measuring smaller pumping rates but are not presented here because pumping rates expected are too great.

ORIFICE TUBE Instructions below accompany the diagram and table for describing how to use this method of measuring pumping rate. The set-up for this method requires the following:

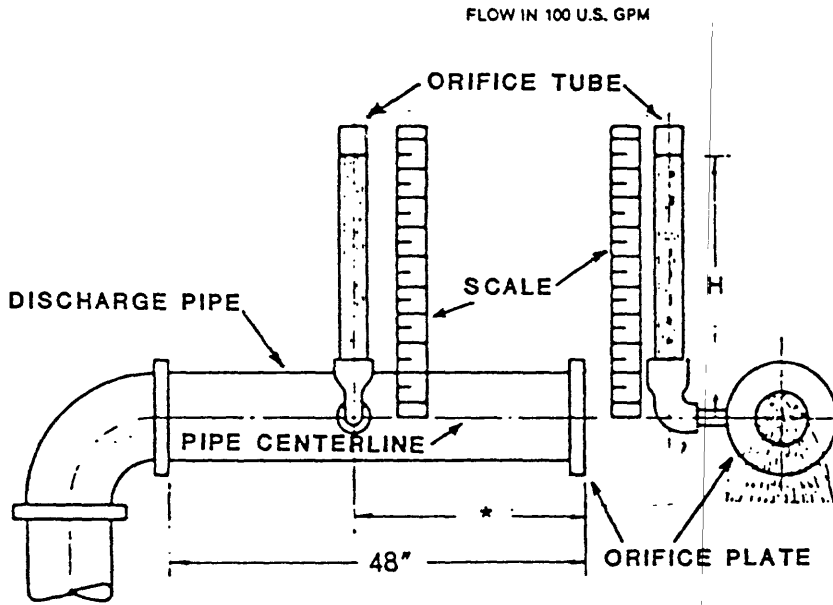
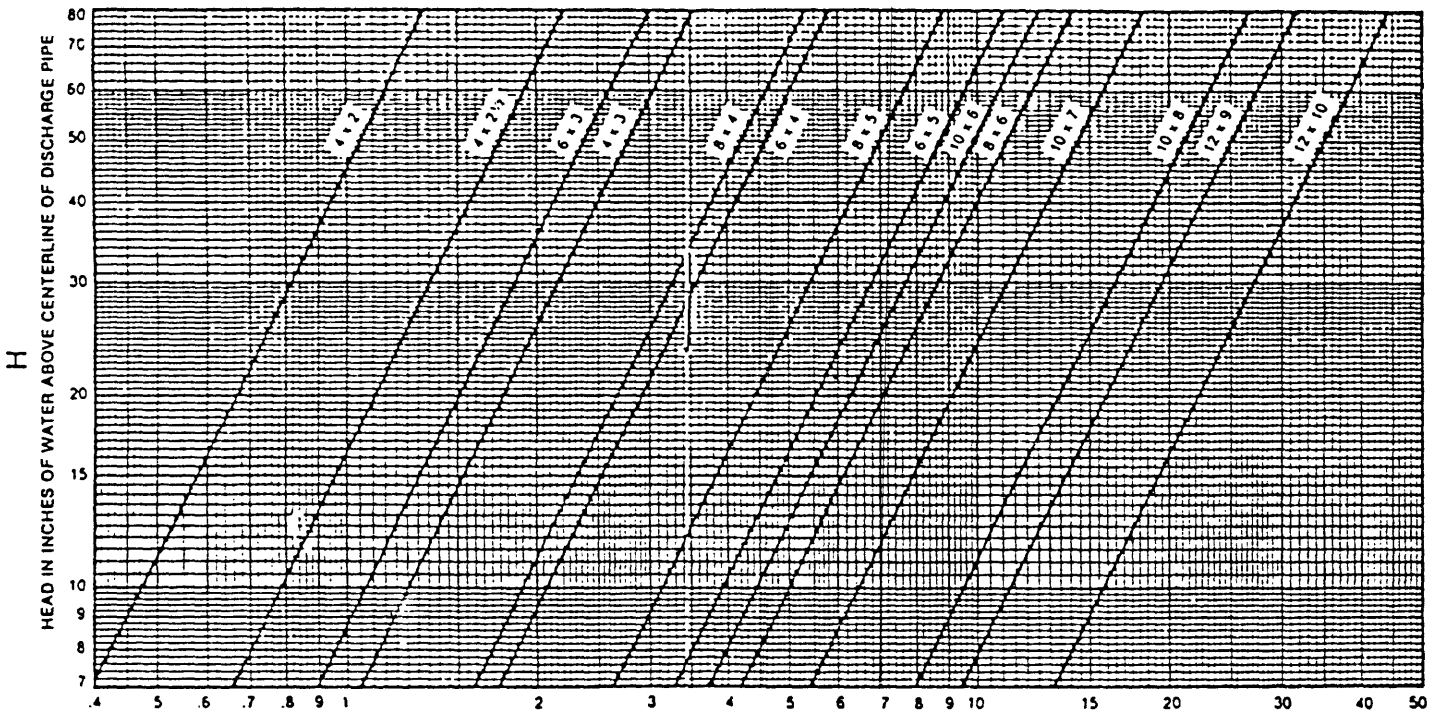
- A. The hole, or orifice, in the orifice plate must be perfectly round and centered on the end of discharge pipe. The orifice diameter should be about 1/2 to 3/4 pipe dia.
- B. Orifice must have clean, square edges.
- C. Edge of hole must be beveled to 1/16-inch thick.
- D. Orifice plate must be vertical (pipe horizontal).
- E. Bore of pipe should be smooth and free of obstructions.
- F. Discharge pipe must be straight and level for a distance of at least 4 feet, but preferably 6 feet.
- G. A device, called the piezometer tube, measures the water level or pressure in the discharge pipe. This tube is attached to a 1/8-inch or 1/4-inch diameter nipple tapped into the discharge pipe exactly 24 inches from the orifice plate, midway between the top and bottom of the pipe.
- H. Piezometer tube consists of a rubber or plastic hose, 4-5 feet long with a glass tube at the end. This hose is raised or lowered until the water level is seen in the clear tube.
- I. An accurate scale, labeled in inches, and oriented vertically, must be fastened to the discharge pipe. This allows the vertical distance, in inches, to be measured from the center of the piezometer tube port, in the discharge pipe, up to the water level, as seen in the piezometer tube. The zero level of the scale rests at the center-line of the piezometer tube hole in the discharge pipe.
- J. No air should be allowed to be trapped in piezometer tube. To prevent this, let the piezometer tube hang down between readings so that water will flow through the tube.

Make several water level measurements with the piezometer tube on the scale to make sure the pumping rate stays constant. Use the graph on the following page to determine the pumping rate.

Note: If you have decided to go to the trouble to construct this orifice tube, keep in mind that you can use this same pump device to check the efficiency of your pump. Conduct the pump test as you would for determination of the conversion factor and check to see if the rates stay the same. A lower pumping rate and a higher energy usage could indicate that your pump is not working as efficiently as it did. More on this is available from the Commission and hopefully in a future hand-out.

PIPE CAP ORIFICE CHART

Pipe Diameter (Inches) X Orifice Diameter (Inches)



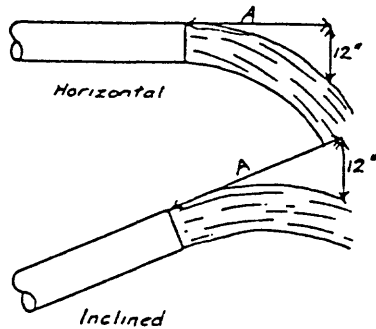
*24" or 3 x pipe diameter whichever is greater.

FREE FLOWING HORIZONTAL or INCLINED PIPE

This method gives a fairly good estimation of pumping rate. See discussion below for details. —Courtesy U. S. Geological Survey

ESTIMATING FLOW FROM HORIZONTAL OR INCLINED PIPES

(FULL PIPES)



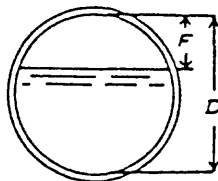
A fairly close determination of the flow from full open pipes may be made by measuring the distance the stream of water travels parallel to the pipe in falling 12 inches vertically.

Measure the inside diameter of the pipe accurately (in inches) and the distance (A) the stream travels in inches parallel to the pipe for a 12-inch vertical drop. (See diagrams)

The flow, in gallons per minute, equals the distance (A) in inches multiplied by a constant K obtained from the following table:

I.D. Pipe	K	I.D. Pipe	K	I.D. Pipe	K	I.D. Pipe	K	I.D. Pipe	K	I.D. Pipe	K
2	3.3	4	13.1	6	29.4	8	52.3	10	81.7	12	118.
1/4	4.1	1/4	14.7	1/4	31.9	1/4	55.5	1/4	85.9	1/2	123.
1/2	5.1	1/2	16.5	1/2	34.5	1/2	59.0	1/2	90.1	13	138.
3/4	6.2	3/4	18.4	3/4	37.2	3/4	62.5	3/4	94.4	1/2	149.
3	7.3	5	20.4	7	40.0	9	66.2	11	98.9	14	160.
1/4	8.6	1/4	22.5	1/4	42.9	1/4	69.9	1/4	103.	1/2	172.
1/2	10.0	1/2	24.7	1/2	45.9	1/2	73.7	1/2	108.	15	184.
3/4	11.5	3/4	27.0	3/4	49.0	3/4	77.7	3/4	113.	16	209.

(PARTIALLY FILLED PIPES)

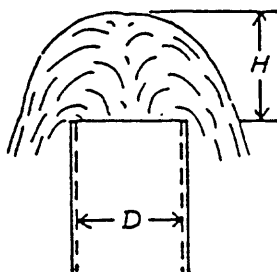


For partially filled pipes, measure the freeboard (F) and the inside diameter (D) and calculate the ratio of F/D (in percent). Measure the stream as explained above for full pipes and calculate the discharge. The actual discharge will be approximately the value for a full pipe of the same diameter multiplied by the correction factor from the following table:

F/D Percent	Factor	F/D Percent	Factor	F/D Percent	Factor	F/D Percent	Factor
5	0.981	30	0.747	55	0.436	80	0.142
10	.948	35	.688	60	.375	85	.095
15	.905	40	.627	65	.312	90	.062
20	.858	45	.564	70	.253	95	.019
25	.806	50	.500	75	.195	100	.000

VERTICAL PIPE OR CASING

This method gives an approximate pumping rate value. See discussion below for instructions.



The approximate flow from vertical pipes or casings can be determined by measuring the maximum height (H) in inches to which the water jet rises above the pipe, and the inside diameter of the pipe (D) in inches.

The flow in gallons per minute is given in the following table for different sizes of Standard Pipe and for different heights of the water jets.

Height (H) in Inches	Nominal Diameter of Standard Pipe (Inches)							
	2	3	4	5	6	7	8	10
3	36	77	136	217	311	425	569	950
3 1/2	38	85	149	238	341	465	626	1065
4	41	92	161	252	369	503	687	1115
4 1/2	44	98	172	270	396	540	733	1200
5	47	104	182	286	420	575	779	1280
5 1/2	49	109	192	301	444	606	825	1350
6	52	115	202	316	469	638	872	1415
6 1/2	54	121	211	331	490	667	913	1475
7	57	126	219	346	509	700	949	1530
8	61	136	236	370	548	761	1025	1640
9	66	144	251	396	585	802	1095	1740
10	69	153	265	418	621	850	1155	1840
12	76	169	294	463	685	933	1275	2010
14	83	184	319	502	740	1020	1380	2170
16	89	197	342	540	796	1090	1480	2320
18	96	209	364	575	845	1160	1560	2460
20	101	221	386	607	890	1225	1645	2600
25	113	249	433	680	998	1375	1840	2900
30	124	273	476	746	1095	1505	2010	3180
36	136	298	516	810	1175	1630	2160	3420
40	145	319	551	865	1270	1745	2320	3680

For other pipe sizes and heights of jet, use the formula:

$$GPM = 5.68 \times C \times D^2 \times \sqrt{H}$$

where GPM = gallons per minute; D = inside diameter of pipe in inches;
H = height of jet in inches; and C = a constant varying from 0.87 to 0.97 for
pipes of 2 to 6 inches in diameter and heights of from 6 to 24 inches.

—Courtesy U. S. Geological Survey

For other pipe sizes and heights of jet, use the formula:
gal./min. = $5.68 \times C \times D^2 \times H^{1/2}$

where D = inside diameter of pipe
H = height of jet in inches
(square root of this value used)
C = a constant varying from 0.87 to 0.97 for
pipes of 2 to 6 inches in diameter and
heights of from 6 to 24 inches.

WEIRS

The use of a weir will give an average approximation of the pumping rate. This is an indirect measuring method, and as such, allows room for additional error. The pump will need to discharge into a trench or small basin with the weir located at the down-flow end. The basin or trench will fill and start spilling through the weir notch until a water level is attained where flow into the water body from the pump equals flow out through the weir. The measurement made is of the height of the water flowing through the weir notch.

Below are diagrams and tables for the two weirs most commonly used; a rectangular and a triangular notch weir. Note the design relationships shown on the diagrams. Also, make sure the notch you employ is large enough to measure the quantity of flow you will be pumping.

ALTERNATIVE METHOD BASED ON ELECTRICAL ENERGY USED

If you know some specific information for the pump and motor water usage can be estimated by multiplying the amount of energy used by a term derived from the pump and motor efficiency. The relationship is as follows:

$$\text{no of gal.} = \text{KW-hours used} \times \left(\frac{\text{Eff}_p}{\text{Eff}_m} \right) (317,500) / \text{HEAD}$$

Where:

HEAD = pumping water level + water level in storage tank.

or

= pumping water level + (water pressure x 2.307).

Eff_p = .60 to .85 (depending on age and design of pump)

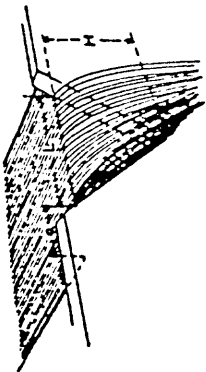
Eff_m = .60 to .93 (depending on horse power of motor - see table below).

TYPICAL MOTOR EFFICIENCY (%)
60 CYCLE

MOTOR HP	SINGLE PHASE		3 PHASE	
	1750 RPM	3450 RPM	1750 RPM	3450 RPM
1/3	60	59		
1/2	64	61		
3/4	68	65		69
1	70	66	79.5	76
1 1/2	72	72	82.0	79.5
2	76	73	84 1/2	83.0
3	76	75	84 1/2	85.0
5	76	78	86	84.5
7			87	86.5
10			87.5	85.5
15			88.5	87.5
20			89.5	87.5
25			89.5	89.0
30			90.5	89.5
40			90.5	90.0
50			91.0	90.5
60			91.5	90.5
75			92.0	91.0
100			92.0	92.0
125			92.5	91.5
150			92.5	92.5

From: BERKELEY PUMP CATALOG, 10/1/79

Discharge from Triangular Notch Weirs with End Contractions



Head (H) in Inches	Flow in Gallons Per Min.		Head (H) in Inches	Flow in Gallons Per Min.		Head (H) in Inches	Flow in Gallons Per Min.	
	90° Notch	60° Notch		90° Notch	60° Notch		90° Notch	60° Notch
1	3.19	1.37	6 1/2	15	1104			
1 1/4	3.83	1.61	7	15 1/2	1197			
1 1/2	4.05	1.74	7 1/2	16	1297			
1 3/4	4.87	1.83	8 1/4	16 1/2	1401			
2	12.4	7.15	7 1/2	17	1609			
2 1/4	14.7	8.62	8	17 1/2	1625			
2 1/2	16.7	9.42	8 1/4	18	1741			
2 3/4	17.8	10.1	8 1/2	18 1/2	1864			
3	34.2	19.7	8 3/4	19	1993			
3 1/4	41.8	24.1	9	19 1/2	2127			
3 1/2	46.3	26.0	9 1/4	20	2266			
3 3/4	51.7	28.5	9 1/2	20 1/2	2410			
4	70.2	40.5	9 3/4	21	2560			
4 1/4	81.7	47.2	10	21 1/2	2718			
4 1/2	94.3	54.3	10 1/4	22	2875			
4 3/4	108	62.3	11	22 1/2	3041			
5	122	70.8	11 1/4	23	3213			
5 1/4	139	80.0	12	23 1/2	3391			
5 1/2	158	89.3	12 1/2	24	3576			
5 3/4	174	100	13	24 1/2	3768			
6	193	112	13 1/2	25	3958			
6 1/4	214	124	14					
6 1/2	236	136	14 1/2					

Based on formula: $Q = (C) (4/15) (L) (H) \sqrt{2gh}$

in which Q = flow of water in cu. ft. per sec.

L = width of notch in ft. at H distance above apex.

H = head of water above apex of notch in ft.

C = constant varying with conditions, .37 being used for this table.

a = should be not less than 1/2 L.

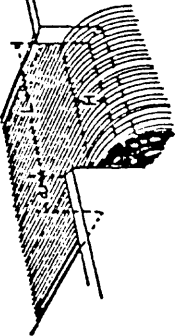
For 90° notch the formula becomes

$Q = 2.43811 H^{3/2}$

For 60° notch the formula becomes

$Q = 1.4076 H^{3/2}$

Discharge from Rectangular Weir with End Contractions



Figures in Table are in Gallons Per Minute

Head (H) in Inches	Length (L) of weir in feet			Head (H) in Inches	Length (L) of weir in feet			Addi- tional g.p.m. for each ft. over 8 ft.
	1	3	8		1	3	8	
1	35.8	107.8	178.8	8	2338	3956	814	
1 1/4	49.8	150.4	260.4	8 1/4	2412	4140	850	
1 1/2	61.9	187	329.8	8 1/2	2510	4312	890	
1 3/4	81	246	418	8 3/4	2658	4611	929	
2	98.8	302	508	9	2765	4899	970	
2 1/4	117	361	603	9 1/4	2876	4899	1011	
2 1/2	136.2	422	706	9 1/2	2985	4904	1051	
2 3/4	167	488	818	9 3/4	3101	5248	1091	
3	177.8	552	928	10	3216	5490	1138	
3 1/4	199.8	624	1047	10 1/4	3480	5940	1220	
3 1/2	222	696	1187	11	3716	6358	1270	
3 3/4	246	766	1352	11 1/4	3960	6780	1310	
4	269	846	1524	12	4185	7168	1365	
4 1/4	292.8	925	1698	12 1/4	4430	7618	1418	
4 1/2	318	1008	1898	13	4660	8010	1480	
4 3/4	344	1091	2126	13 1/4	4950	8410	1560	
5	370	1178	2386	14	5218	8980	1655	
5 1/4	396.8	1262	2672	14 1/4	5478	9440	1755	
5 1/2	421.8	1352	2982	15	5740	9920	1860	
5 3/4	448	1442	3316	15 1/4	6018	10400	1968	
6	476.8	1535	3680	16	6290	10900	2080	
6 1/4		1632	4080	16 1/4	6568	11380	2190	
6 1/2		1742	4520	17	6928	11970	2320	
6 3/4		1826	5000	17 1/4	7160	12410	2460	
7	1928	2200	5520	18	7410	12900	2618	
7 1/4	2029	2436	6096	18 1/4	7688	13410	2690	
7 1/2	2130	2699	6738	19	7980	13940	2770	
7 3/4	2238	2988	7458	19 1/4	8280	14480	2860	

This table is based on Francis formula:

$Q = 3.33 (L - 0.2H) H^{3/2}$

which

Q = cu. ft. of water flowing per second.

L = length of weir opening in feet. (should be 4 to 8 times H).

H = head on weir in feet (to be measured at least 8 ft. back of weir opening)

a = should be at least 3 H.

WATER RESOURCES COMMISSION

WATER USE SECTION

1201 Main Street, Suite 1100
Columbia, South Carolina 29201

WATER USE SYSTEM REPORT

SHADED AREAS FOR OFFICIAL USE ONLY



WATER USER ID _____ Primary SIC _____ Secondary SIC _____

FIPS City Code _____ FIPS County Code _____ FIPS State Code _____

COMPLETION OF THIS FORM WILL BE REQUIRED ONLY ONCE UNLESS SUBSTANTIAL ALTERATIONS ARE MADE TO YOUR WITHDRAWAL, USE, OR DISCHARGE SYSTEMS.

Fill in the appropriate blanks or check proper spaces. Make best estimates of percentages and volumes requested. These forms are designed to provide ample space for complex system descriptions. Therefore, Public Supply systems of a simple configuration may require completion of only a few spaces in each section. If more space is required to complete any section of this report, make additional listings on a separate sheet in a similar manner as on this form.

As specified in Regulation 121-10.8(A), you have the right to indicate that any data supplied on this form may be held confidential by this Commission. Any information will be held confidential by marking a check in front of the specific information section heading (such as II B, III C, etc.) where the information is contained.

If you have any questions, contact the Water Use Section at the address or telephone number listed above. The completed PUBLIC SUPPLY SYSTEM DESCRIPTION REPORT FORM is to be submitted to the address listed at the top of this form.

I. WATER USER IDENTIFICATION (Section 49-4-20(a)(b))

For questions A3, A4, and A5, fill in the information for the person who will be completing WATER USAGE REPORTING.

A. USER NAME

- 1. Facility _____ 2. Telephone _____
- 3. Contact Person _____ 4. Telephone _____
- 5. Address _____

II. WITHDRAWAL SOURCE INFORMATION

LOCATION: Plot the location of treatment plants, wells, and surface water withdrawal points, that you will describe below, on the county highway map attached. (Sec. 49-4-20(a)(b)(c)(d)(i-2))

A. PURCHASE WATER (Sec. 49-4-20(c)(k))

- 1. If all or part of your water supply is purchased list the name of your water supplier _____
- 2. User ID Code _____
- 3. Full Time () or for peak demand periods ()
- 4. Percentage of water supply that is purchased _____ %

B. GROUND WATER SOURCES (Sec. 40-4-20(b)(c)(e))

Fill in requested information below one column for each well.

	1.	2.	3.	4.
SCWRC WELL #	_____	_____	_____	_____
Owner's Well ID.	_____	_____	_____	_____
Source Status: Primary	()	()	()	()
Stand-by	()	()	()	()
Well depth below land (ft)	_____ ft	_____ ft	_____ ft	_____ ft
Screen Locations:				
1. Top / bottom	_____ ft / _____ ft	_____ ft / _____ ft	_____ ft / _____ ft	_____ ft / _____ ft
2. Top / bottom	_____ ft / _____ ft	_____ ft / _____ ft	_____ ft / _____ ft	_____ ft / _____ ft
3. Top / bottom	_____ ft / _____ ft	_____ ft / _____ ft	_____ ft / _____ ft	_____ ft / _____ ft
Pump Setting depth	_____ ft	_____ ft	_____ ft	_____ ft
Pump Capacity	_____ gpm	_____ gpm	_____ gpm	_____ gpm
Motor Capacity	_____ HP	_____ Hp	_____ HP	_____ HP
Latitude / Longitude	_____ / _____	_____ / _____	_____ / _____	_____ / _____
Hydrologic Unit	_____	_____	_____	_____

C. SURFACE WATER SOURCES (Sec. 49-4-20(a)(c)(d)(h))

Treatment Facility Owner's Name	Treatment Capacity MGD	Reservoir, river, or Stream	County	Latitude	Longitude
_____	_____	_____	_____	_____ / _____	_____ / _____
_____	_____	_____	_____	_____ / _____	_____ / _____
_____	_____	_____	_____	_____ / _____	_____ / _____

D. STORAGE CAPACITY (Sec. 49-4-20(h))

Treated Water Storage Facility: List volumes of each facility in thousands of gallons

								Total
1. Elevated	_____	_____	_____	_____	_____	_____	_____	_____
2. Ground	_____	_____	_____	_____	_____	_____	_____	_____
3. Pressure Tanks	_____	_____	_____	_____	_____	_____	_____	_____
4. Reservoir	_____	_____	_____	_____	_____	_____	_____	_____

III. WATER DISTRIBUTION AND GENERAL USAGE (Sec. 49-4-20(a)(k))

Summarize your water usage breakdown with estimated usage volumes and/or percentages of total usage (a total of that listed in sections II A, B, and C above). Make best estimates of percentages or volumes requested.

A. WATER DISTRIBUTION DESCRIPTION (Reg. 121-10.3 (B-11))

Use Type	Number of Connections Metered	and/or	Percentage of Wholesale	Percentage of Total Use
1. Domestic	_____	and/or	_____	_____ %
Town or water district residents served directly				
	Avg use			User ID
_____	_____ mgd			_____
_____	_____ mgd			_____
_____	_____ mgd			_____
2. Resale (other public suppliers)				_____ %
Towns or water districts who buy water for their distribution				
	Avg Purchase			User ID
_____	_____ mgd			_____
_____	_____ mgd			_____
_____	_____ mgd			_____
3. Commercial	_____	and/or	_____	_____ %
4. Institutional	_____	and/or	_____	_____ %
5. Industrial	_____	and/or	_____	_____ %
	Avg Purchase			User ID
Industry sold to	_____ mgd			_____
_____	_____ mgd			_____
_____	_____ mgd			_____
6. Agricultural	_____	and/or	_____	_____ %
7. Lost and Unaccounted for				_____ %
8. Other: _____		and/or		_____ %

G. UNTREATED WATER SALES

Purchaser's Name	User ID	Type of Water Use	Avg Purchase mgd
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

IV. CERTIFICATION

The information supplied with this form and that attached (maps, charts, diagrams) are true and complete to the best of my knowledge.

Signature of Owner or Authorized Representative

Reporting Date

State of South Carolina
WATER RESOURCES COMMISSION



WATER USE SECTION

1201 Main Street, Suite 1100
 Columbia, South Carolina 29201



WATER USE REPORT

Section I. Water User Identification

Owner _____ Phone _____

Address _____

City _____ State _____ Zip Code _____

Section II. Monthly Use

MONTHLY USAGE (in millions of gallons)

Owners ID	Source ID	Calc. Method			
-----------	-----------	--------------	--	--	--

Section III. The above is true and correct to the best of my knowledge.

Water User Name _____

Authorized Representative _____

Date _____

Section IV. Instructions

The Water Use Reporting and Coordination Act (282 of 1982) requires all users of 100,000 gallons or more per day on any day of water (Sec. 49-4-50) to report their water usage for that quarter and the maximum amount of water withdrawn in a single day for each month of the quarter. A report of the total monthly use for each source will suffice. Please report all figures in millions of gallons (Mg.) and round off to the nearest 1,000 gallons (3,072,854 becomes 3 073 Mg.)

Immediately following the list of sources on the front of this form are two blanks which should be used to record the use of any water sources not already listed. If the source is new or not in the Water Use files, you will be sent the appropriate form to describe the water source.

If any of the sources in the list are no longer in use or there is a mistake in the 'Owners ID', please draw a line through the Owners ID and list any corrections in 'Section IV' below.

As specified in Reg. 121-10.8(3), you may claim the reported water-use volume as confidential. The claimant must demonstrate that disclosure of such information would reveal a trade secret, process, or other confidential information or impair national security. Please refer to the regulations for further details concerning the request for confidentiality.

The completed WATER USE REPORT is to be submitted to the South Carolina Water Resources Commission at the address listed on this form no later than the 30th day of the month after the close of each quarter (Reg. 121-10.5(D)) (January 30, April 30, July 30, October 30) unless accelerated reporting is required. However, if you already submit the Ground or Surface Water Supply Monthly Operation Reports or Discharge Monitoring Reports (DMR) to the South Carolina Department of Health and Environmental Control, attach and submit this form WU-1 with SCDHEC's Form, at the end of each quarter.

Section V. Calculation Methods

Listed below are five methods commonly used to determine water use. If you have any questions concerning the calculation of your water use figures, contact the Water Resources Commission and arrangements will be made for someone to assist you.

Method 1. Totalizing Meter: Where a meter has been installed, read the meter at the required intervals and report the millions of gallons used.

Method 2. Rated Pump Capacity Times Hours of Operation: If a water user knows both the rated capacity of the pump and the total pumping time (850 gpm for 72 hours in one month) then multiply $(850) \times (72) \times (60) = 3,672,000$ gallons (or 3.672 Mg). The pump rating can be obtained by recording on and off times or by reading a simple electric hour meter on the pump motor.

Method 3. Inches Applied Per Acre: If an irrigator knows the amount of water he is applying to a field of a known size (1 inch over 350 acres) then multiply $(1) \times (350) \times (27.154) = 9,503,900$ gallons (or 9.504 Mg).

Method 4. Water Pumpage Volume Per Energy Consumption Rate Conversion Factor: This method requires the measuring of both the rate of water pumped and the energy amount (gallons of fuel or KW-hours) required by the pump to calculate a conversion factor. This will allow quick conversion from tabulated energy usage to water use. Obtain form WU-A detailing this procedure from your County Extension Agent or the SCWRC main office.

Method 5. Wier and Gage or Parshall Flume Methods: Use these methods where surface water is transported to the site by gravity flow. Employment of either of these methods will require a description of your system, how flow rating was determined, and any system calibration discussion. This description will be required only once if the equipment is permanent and submitted with the first Water Use Report. Contact your Clemson County Extension Agent, SCS District Conservationists, or the SCWRC Main office for assistance.

Method 6. Other: Describe the method used in 'Section VI' or on a separate sheet of paper.

Section VI. Comments



State of South Carolina
WATER RESOURCES COMMISSION
 1201 Main Street, Suite 1100, Columbia, S.C. 29201



CAPACITY USE REPORT

Owner/Authorized Agent _____

Facility _____ Phone _____

Address _____

City _____ State _____ Zip Code _____

The above is true and correct to the best of my knowledge.

 Print your name

 Signature

 Date

(Authorized agent as designated on records of Water Resources Commission)

Instructions

1. Review form for correctness: (a) owner/authorized agent name, (b) address, (c) owner's well name/number.
2. Complete form as follows:
 - (a) enter monthly withdrawal for each well in column under the correct month
 - (b) record the last meter reading of the quarter for each well in Meter Reading column
 - (c) fold and staple the water-use report with the Commission's address facing outward
3. Mail form by the 10th day after the end of the quarter to avoid fine for late reporting.

Place
Stamp
Here

South Carolina Water Resources Commission
1201 Main Street Suite 1100
Columbia, S. C. 29201

State of South Carolina WATER RESOURCES COMMISSION WATER USE SECTION

1201 Main Street, Suite 1100
Columbia, South Carolina 29201

1 Former or Owner Name: _____ Telephone: _____
 Facility Name: _____ State: _____ Zip: _____
 Address: _____ City: _____

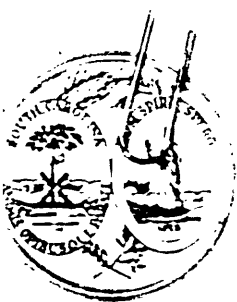
2

Owners ID	Source Descript.	Irrigation Equipment	Crops / Acres	Calc. Method	MONTHLY USAGE (in millions of gallons)																	
					JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC						
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<input type="text"/>			/																			
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3-75

3 The above is true and correct to the best of my knowledge.

Water User Name _____ Authorized Representative _____ Date _____



State of South Carolina Water Resources Commission

1201 Main Street
Columbia, S.C. 29201



THERMOELECTRIC POWER GENERATION WATER USE SYSTEM DESCRIPTION REPORT

SHADED AREAS FOR OFFICIAL USE ONLY

Water User ID _____ Primary SIC _____ Secondary SIC _____
 FIPS City Code _____ FIPS County Code _____ FIPS State Code _____ Plant Hydrologic Unit _____

COMPLETION OF THIS FORM WILL BE REQUIRED ONLY ONCE UNLESS SUBSTANTIAL ALTERATIONS ARE MADE TO YOUR WATER WITHDRAWAL, USE, OR DISCHARGE SYSTEMS.

Fill in the appropriate blanks or check proper spaces. Make the best estimates of percentages and volumes requested. These forms are designed to provide ample space for complex system descriptions. Therefore Thermoelectric power plants of a simple configuration may require completion of only a few spaces in each section. If more space is required to complete any section of this report, make additional listings on a separate sheet in a similar manner as on this form.

As specified in Reg. 121-10.8(a), you have the right have any data supplied on this form held confidential by this Commission. Information will be held confidential by marking a check in front of the specific information section heading (such as IB, IIC, etc.) where the information is contained.

If You have any questions contact the Water Use Section at the address or telephone number listed above. The completed Thermoelectric Power Generation Water Use System Description Report is to be submitted to the address listed at the top of this form.

I. PLANT DESCRIPTION

A. PLANT IDENTIFICATION

1. Plant Name _____ 2. Plant Owner _____
 3. Contact Person _____ 4. Telephone _____
 5. Address _____

B. PLANT OPERATION DESCRIPTION

Describe each power generating unit at the above named power generating station. Check or fill in the appropriate blank.

Power Unit Number	Fuel Type			Unit Capacity (MW)	Type Cooling Process				Cooling Pond	Spray Pond	Once Through	First Year Commercial Operation
	Fossil	Nuclear	Gas Turbine		Natural Draft		Mechanical-Draft					
					Wet	Dry	Wet	Dry				
_____	()	()	()	_____	()	()	()	()	()	()	()	19_____
_____	()	()	()	_____	()	()	()	()	()	()	()	19_____
_____	()	()	()	_____	()	()	()	()	()	()	()	19_____
_____	()	()	()	_____	()	()	()	()	()	()	()	19_____
_____	()	()	()	_____	()	()	()	()	()	()	()	19_____

II. WITHDRAWAL SOURCE INFORMATION

LOCATION: Plot the location of your facilities, surface water withdrawal points, wells, and water treatment plants, that you will describe below, on the county road map attached. [Sec. 49-4-20(a)(b)(c)(d)(i)-(2)]

A. PURCHASE WATER [Sec. 49-4-20(c)(k)]

1. If all or part of your water supply is purchased list the name of your water supplier.

2. User ID Code

3. Percent of water supply that is purchased _____ %

4. Purchase water source status: Primary (), Stand-by ()

B. GROUND WATER SOURCES [Sec. 40-4-20(b)(c)(e)]

Fill in requested information below, one column for each well.

	1	2	3	4
SCWRC WELL #				
Owner's Well ID				
Source Status: Primary	()	()	()	()
: Stand by	()	()	()	()
Well Depth Below Land	_____ ft	_____ ft	_____ ft	_____ ft
Screen Locations:				
1. Top/Bottom	_____ ft/_____ ft	_____ ft/_____ ft	_____ ft/_____ ft	_____ ft/_____ ft
2. Top/Bottom	_____ ft/_____ ft	_____ ft/_____ ft	_____ ft/_____ ft	_____ ft/_____ ft
3. Top/Bottom	_____ ft/_____ ft	_____ ft/_____ ft	_____ ft/_____ ft	_____ ft/_____ ft
Pump Setting Depth	_____ ft	_____ ft	_____ ft	_____ ft
Pump Capacity	_____ gpm	_____ gpm	_____ gpm	_____ gpm
Motor Capacity	_____ hp	_____ hp	_____ hp	_____ hp
Latitude/				
Longitude				
Hydrologic Unit				

C. SURFACE WATER SOURCES [Sec. 49-4-20(a)(c)(d)(h)]

Reservoir, river or stream name, and treatment plant name, if applicable.	Hydrologic Unit	Withdrawal or Treatment Plant Capacity (GPM)	Source Status		Location		
			Primary	Stand-by	County Code	Latitude D M S	Longitude D M S
_____	_____	_____	()	()	_____	_____	_____
_____	_____	_____	()	()	_____	_____	_____
_____	_____	_____	()	()	_____	_____	_____
_____	_____	_____	()	()	_____	_____	_____
_____	_____	_____	()	()	_____	_____	_____

D. "OTHER" WATER SOURCES [Sec. 49-4-20(a)(c)(f)(k)]

1. In your operation do you use from outside your plant:

a. Treated wastewater? Yes () No () Percentage of total use _____%

b. Untreated wastewater? Yes () No () Percentage of total use _____%

2. Do you recycle your own wastewater at your plant? Yes () No () Percentage of total _____%

III. ON-SITE WATER USE BREAK-DOWN

1. Indicate the percentage of total withdrawal water use (as listed in II A, B, C, & D) used, on the average, from the following sources. Please NOTE: the total withdrawal use should include only the water withdrawal directly from the source of supply, ie "New Water", and not include any recycled water usage.

<u>SELF SUPPLIED SOURCES</u>				
Ground Water	Surface Water	Saline Water	Purchased Water	"Other" Water
_____ %	_____ %	_____ %	_____ %	_____ %

2. If you do recirculate water, how much "new water" would have been required to operate your plant if the water had not been recirculated? _____ mgd.

IV. INCREASED ENVAPORATION RATE [Reg. 121-10.3(b)(10)]

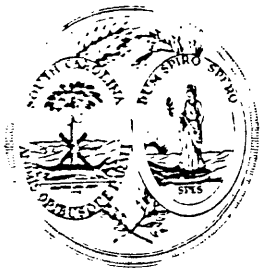
Describe, in the space provided below, the method you use to estimate the increased evaporation rates of the surface water body receiving heated discharge water from your facility.

E. CERTIFICATION

The information supplied with this form and that attached (maps, charts, diagrams) are true and complete to the best of my knowledge.

Signature of Owner or Authorized Representative

Reporting Date



State of South Carolina Water Resources Commission

1201 Main Street
Columbia, S.C. 29201



**HYDROELECTRIC POWER GENERATION
WATER USE SYSTEM DESCRIPTION REPORT**

SHADED AREAS ARE FOR OFFICIAL USE ONLY

WATER USER ID _____ Primary SIC _____ Secondary SIC _____

FIPS City Code _____ FIPS County Code _____ FIPS State Code _____

COMPLETION OF THIS FORM WILL BE REQUIRED ONLY ONCE UNLESS SUBSTANTIAL ALTERATIONS ARE MADE TO YOUR WATER WITHDRAWAL, USE, OR DISCHARGE SYSTEMS.

Fill in the appropriate blanks or check proper spaces. If more space is required to complete any section of this report, make additional listings on a separate sheet in a similar manner as on this form.

As specified in Reg. 121-10.8(A), you have the right to indicate that any data supplied on this form may be held confidential by this Commission. Any information will be held confidential by marking a check in front of the specific information section heading such as A3, B1, etc) where the information is contained.

If you have any questions contact the Water Use Section at the address or telephone number listed above. The completed Hydroelectric Power Generation Water Use System Description Report is to be submitted to the address listed at the top of this form.

A. PLANT IDENTIFICATION

- 1. Plant Name _____ 2. Plant Owner _____
- 3. Contact Person _____ 4. Telephone _____
- 5. Address _____
- 6. Type Ownership: Private ___ Non-Federal, Publically Owned ___ Federal ___ Industrial ___

B. PLANT DESCRIPTION

- 1. Location: River or Reservoir Name _____
(NOTE: Plot location on county road map)
- 2. County _____ Lat: _____° _____' _____" Long: _____° _____' _____"
- 3. Number of Turbines: Primary _____ Secondary (standby) _____
- 4. Energy Production Capacity _____
- 5. First Year Commercial Operation: 19 _____ 6. Hydrologic Unit: _____

C. CERTIFICATION

The information supplied with this form and that attached (maps, charts, diagrams) are true and complete to the best of my knowledge.

Signature of Owner or Authorized Representative

Report Date

South Carolina data collection form in pocket at the back of this report.

INSTRUCTIONS FOR COMPLETEING THE WATER-USE SURVEY
QUESTIONNAIRE FOR PUBLIC SUPPLIES

GENERAL INFORMATION: Name of agency, organization, or utility district, mailing address, and details regarding location of water source or operation. Indicate the year data reflect. If water use is seasonal, indicate months.

1. If source is an instream impoundment, provide name of stream. Indicate the amount of water withdrawn (in million gallons per day) from each source and the percent of the total each source represents. For example, 25 % from a municipal system and 75 % from a stream.
2. The amount of water withdrawn or purchased may be both metered and estimated, especially if from several sources.
3. Water obtained from a public-supply system, or purchased from an industry is not considered a "natural" source.
4. Self-explanatory. Indicate if pumps are automatic.
5. Describe any problems experienced within the last 12 months. This information may help the Division evaluate available resources.
6. An estimate of the number of persons or population served on an average day during the last year.
7. Number of connections, including commercial, industrial, and residential customers.
8. The amount of water (in million gallons per day) distributed as described in the questions. The total amount should equal the total amount of water withdrawn. The distribution amounts include distribution losses. Free service includes no charge water used at parks, zoos, libraries, schools, etc.
- 9-11. Self-explanatory.
12. May be several treatment schemes.
13. The average daily amount of water returned to a wastewater system is helpful in determining the amount of water consumed.

TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT
 DIVISION OF WATER SUPPLY

WATER-USE SURVEY FOR PUBLIC SUPPLIES
 UPPER DUCK RIVER BASIN
 1990

WATER USER: _____
 MAILING ADDRESS: _____
 CITY _____ STATE _____ ZIP _____

Location of
 Operation: _____ CITY _____ COUNTY _____

WATER USE DATA ARE BASED ON
 12 MONTH PERIOD BEGINNING: _____ MONTH _____ YEAR

Seasonal use: _____ month _____ year to _____ month _____ year

1. SOURCE	Average daily amount withdrawn and/or purchase on operating	Percent of total withdrawal
Stream(s) intake location	Mgal/d	%
Total number of wells	Mgal/d	%
Total number of springs	Mgal/d	%
Total number of ponds	Mgal/d	%
Name(s) of public supply(ies)	Mgal/d	%
1.		
2.		
3.		
4.		
5.		
Name(s) of other source(s)	Mgal/d	%
1.		
2.		
3.		

2. Amount of water withdrawn is: Metered _____ Estimated _____
 If response is "Metered" and "Estimated", indicate which sources are
 estimated.

3. Maximum water withdrawn from a
 natural source for any one day within the last year: _____ Mgal/d

4. Normal operation is ___ hours per day, ___ days per week, ___ weeks per
 year. Indicate if pumps are automatic. Yes ___ No ___

5. What water problems have you experienced (e.g. water supply, water storage, water quality, flooding, turbidity, etc.)?
6. Population served:
7. Number of connections:
Metered connections:
8. Total water use _____ Mgal/d

Average daily amounts (Mgal/d)

(A) Served to other towns or utility districts:

(B) Served to industry:

(C) Served to commercial:

(D) Served to homes:

(E) Distribution losses:

(F) Free service:

Facility _____

Average annual _____ Mgal/d

Maximum daily _____ Mgal/d

Facility _____

Average annual _____ Mgal/d

Maximum daily _____ Mgal/d

Facility _____

Average annual _____ Mgal/d

Maximum daily _____ Mgal/d

Facility _____

Average annual _____ Mgal/d

Maximum daily _____ Mgal/d

Facility _____

Average annual _____ Mgal/d

Maximum daily _____ Mgal/d

Facility _____

Average annual _____ Mgal/d

Maximum daily _____ Mgal/d

Facility _____

Average annual _____ Mgal/d

Maximum daily _____ Mgal/d

Facility _____

Average annual _____ Mgal/d

Maximum daily _____ Mgal/d

9. Treatment plant capacity:

10. Storage capacity for treated water:

11. Storage capacity for untreated water:

12. Treatment applied to water prior to use:

Treatment _____

Disinfection only _____

No treatment _____

13. Average daily amount returned to public wastewater treatment plant:

_____ Mgal/d

**INSTRUCTIONS FOR COMPLETING THE WATER-USE SURVEY
QUESTIONNAIRE FOR INDUSTRIES AND
COMMERCIAL ESTABLISHMENTS**

GENERAL INFORMATION: Name of business or organization, mailing address, and details regarding location of water source or operation. Indicate the year data reflect. If water use is seasonal, indicate months.

1. If source is an instream impoundment, provide name of stream. Indicate the amount of water withdrawn (in million gallons per day) from each source and the percent of the total each source represents. For example, 25% from a municipal system and 75% from a stream.
2. The amount of water withdrawn or purchased may be both metered and estimated, especially from several sources.
3. Water obtained from a public-supply system or purchased from an industry is not considered a "natural" source.
4. EXAMPLE: "Water is used 8 hours per day, 5 days per week, 50 weeks per year."
5. Describe any problems experienced within the last 12 months. This information may help the Division evaluate available resources.
6. "Total water use" is the sum of the average daily amount withdrawn or purchased.
7. What percent increase or decrease in "total water use" is anticipated in the next two years.
8. List principal product(s) or service, preferably by SIC.
9. "Percent of Total" water by type of use should equal 100%. Percent of each use which is consumed and discharged on an average day.
10. Maximum amount of water used during the reported period during any one calendar day.
11. The maximum amount of raw or untreated water stored, in- and off-stream.
12. Self-explanatory
- 13-14. The average daily amount discharged to a stream or returned to a public-wastewater system, etc. is helpful in determining the amount of water consumed.
15. Confidentially handled. A possible indicator of the magnitude of water use by general industry type.

TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT
 DIVISION OF WATER SUPPLY

WATER-USE SURVEY FOR INDUSTRIAL AND COMMERCIAL ESTABLISHMENTS

1990

WATER USER: _____
 MAILING ADDRESS: _____
 CITY _____ STATE _____ ZIP _____

Location of
 Operation: _____ CITY _____ COUNTY _____

WATER USE DATA ARE BASED ON
 12 MONTH PERIOD BEGINNING: _____ MONTH _____ YEAR

Seasonal use: _____ month _____ year to _____ month _____ year

1. SOURCE	Average daily amount withdrawn and/or purchase on operating	Percent of total withdrawal
Stream(s) intake location	Mgal/d	%
Total number of wells	Mgal/d	%
Total number of springs	Mgal/d	%
Total number of ponds	Mgal/d	%
Name(s) of public supply(ies)	Mgal/d	%
1.		
2.		
3.		
4.		
5.		
Name(s) of other source(s)	Mgal/d	%
1.		
2.		
3.		

2. Amount of water withdrawn is: Metered _____ Estimated _____. If response is "Metered" and "Estimated", indicate which sources are estimated.
3. Maximum water withdrawn from a natural source for any one day within the last year: _____ Mgal/d
4. Normal operation is ___ hours per day, ___ days per week, ___ weeks per year.
5. What water problems have you experienced (e.g. water supply, water storage, water quality, flooding, turbidity, etc.)?
6. Total water use _____ Mgal/d

7. What percent change in "total water use" (Question 6) do you plan to make in the next two years (indicate increase or decrease)? ____ %
8. Major product(s) or service(s)
(Standard Industrial Classification number if known): _____.
9. Water is used for:
(Total must equal "Total Water Use", Question 6)

	Percent of Total	Percent Consumed A	Percent Recirculated (if known) B	Percent Discharge C	A+B+C equals
Cooling or condensing					100%
Process (including process wash)					100%
Domestic (including general sanitation)					100%
Boiler					100%
Total	100 %				

10. Maximum amount of water used in one day: _____ Mgal/d
11. Impoundment or storage capacity: _____ Mgal/d
12. What percent of water is treated prior to use: _____ %
13. Average daily effluent: _____ Mgal/d
14. Percent of total effluent returned to:

Stream _____ % Name of stream _____

Well injection _____ % Depth of well _____ feet
Injection zone _____ ft to _____ ft

Septic tank & field tile _____ %

Spray irrigation _____ % _____ Mgal/d

Public system _____ % _____ Mgal/d

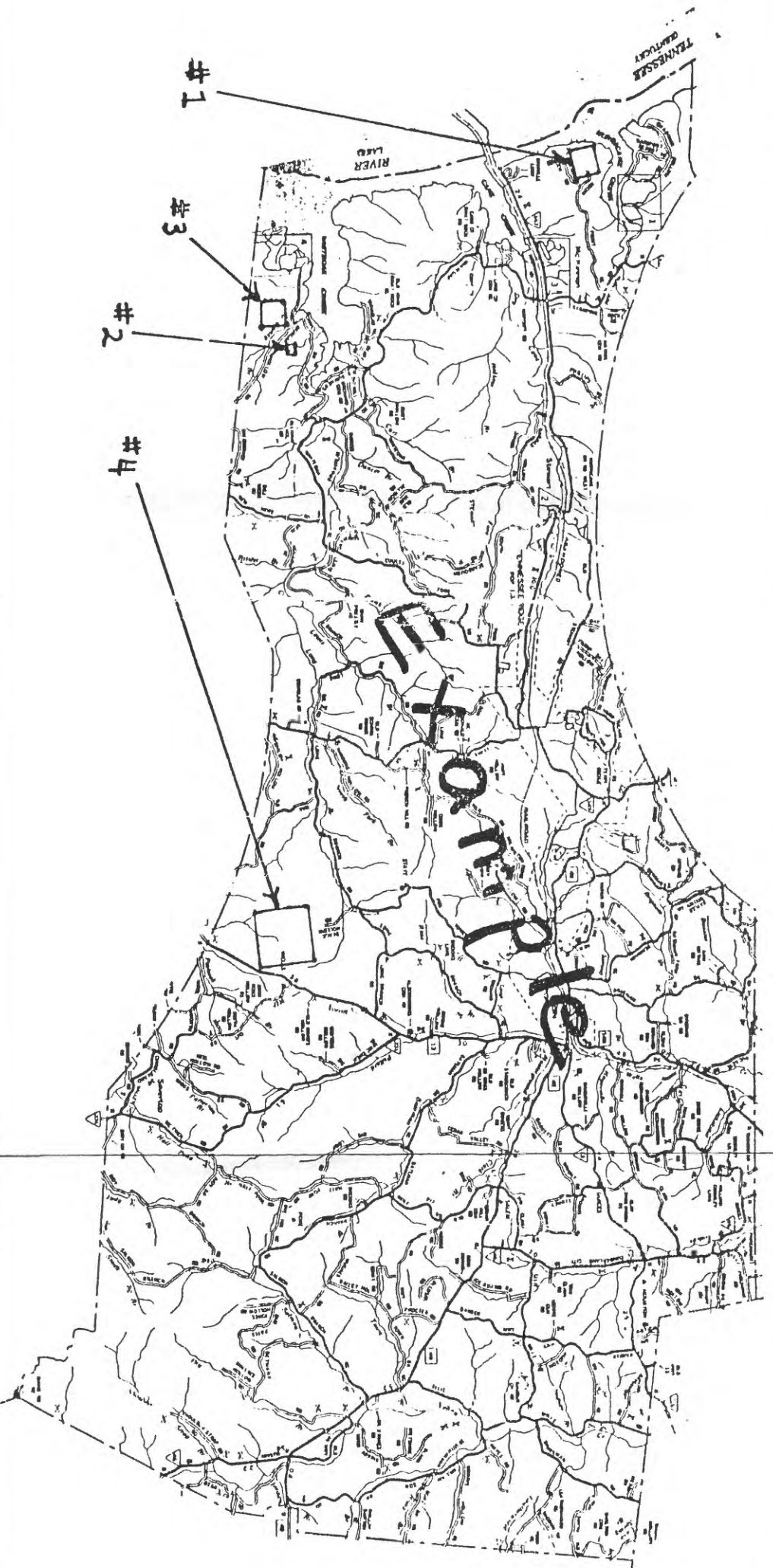
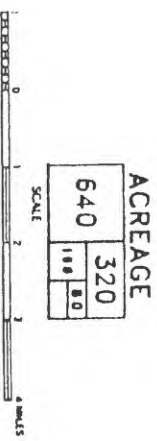
Other _____ % Specify , if by sale, etc. _____

15. Number of employees: _____
Number of production employees: _____
Name and position of person to contact for further information (e.g. plant manager, etc): _____

_____ Date: _____

Phone: _____

Acreage Estimate
 An acreage scaler is recommended; an alternative is to use the scale on each map in the same manner it is used in the example.



COUNTY: *Howards* DISTRICT CONSERVATIONIST: *Susan Hudson* ADDRESS: *777 Walnut Grove Rd. Memphis, 38128* PHONE: *901-744-2177*

Irrigator	Crop	Source of Water	System Type	Map Number	Acreage	Application	Hours	Pump Capacity	Source of Power	Age of system, in years	Average percent increase in productivity due to irrigation.
<i>Howards A.W.</i>	<i>C</i>	<i>A</i>	<i>F</i>	<i>1</i>	<i>160</i>	<i>4</i>	<i>8</i>	<i>1500</i>	<i>a</i>	<i>3</i>	<i>40</i>
<i>Howards B.B.</i>	<i>I</i>	<i>B</i>	<i>J</i>	<i>2</i>	<i>80</i>	<i>20</i>	<i>4</i>	<i>750</i>	<i>D</i>	<i>10</i>	<i>50</i>
<i>Howards A.F.</i>	<i>H</i>	<i>G</i>	<i>B</i>	<i>3</i>	<i>160</i>	<i>3</i>	<i>12</i>	<i>350</i>	<i>B</i>	<i>2</i>	<i>30</i>
<i>Howards C.F.</i>	<i>H</i>	<i>E</i>	<i>A</i>	<i>4</i>	<i>240</i>	<i>6</i>	<i>12</i>	<i>250</i>	<i>C</i>	<i>1</i>	<i>30</i>

COUNTY:		DISTRICT CONSERVATIONIST:						ADDRESS:					PHONE:				
Irrigator	Crop	Source of Water	System Type	Map Number	Acreage	Application	Hours	Pump Capacity	Source of Power	Age of system in years	Average percent increase in productivity due to irrigation.						
Give the company name or last name and first initial of the irrigator. This is a helpful identifier in knowing if someone was missed.	Indicate by letter (One crop per line): (A) feed grains: soybeans, milo, corn, etc. (B) food grains: rye, oats, wheat, sorghum, etc. (C) cotton (D) berries, nuts, grapes (E) horticulture (F) pasture, hay, silage (G) tobacco (H) tree fruits (I) turf, recreation (J) vegetables (K) other, specify	Indicate by letter, give name if B, C, D, F, G: (A) well (B) spring (C) stream/river (D) lake (E) pond (F) municipal (G) reclaimed waste (H) other, specify	Indicate by letter: (A) drip trickle (B) flood (C) surge (D) furrow (E) other gravity (F) center pivot (G) boom (H) gun (I) hand-move (J) solid-set (K) traveller	Using the county map, indicate the irrigation site and give it a number. Use one line for each crop.	Estimate number of irrigated crop or activity. Exclude acreage with gross sales less than \$3,000.	Estimated number of applications during 1990 growing season.	Hours pump was typically used per application.	Estimated or rated pump capacity in gallons per minute, if known.	Indicate by letter: (a) diesel (b) LP gas (c) gasoline (d) electric (e) other, specify								