QUALITY-ASSURANCE PLAN

FOR THE U.S. GEOLOGICAL SURVEY—INDIANA DISTRICT WATER-USE PROGRAM

By Donald V. Arvin

U.S. GEOLOGICAL SURVEY

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BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY

Robert M. Hirsch, Acting Director

For additional information write to:
District Chief
U.S. Geological Survey
5957 Lakeside Boulevard
Indianapolis, IN 46278-1996

Copies of this report can be purchased from:
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CONVERSION FACTORS

Multiply	By	To Obtain
	Length	
inch (in.)	25.4	millimeter
feet (ft)	0.3048	meter
	Area	
acre	43,560	square foot
	4,047	square meter
	0.001562	square mile
	Volume	
gallon (gal)	0.003785	cubic meter
	Flow	
gallon per minute (gal/min)	0.06309	liter per second
gallon per day (gal/d)	0.003785	cubic meter per day
thousand acre-feet per year	0.8921	million gallons per day
	0.001380	thousand cubic feet per second
	0.6195	thousand gallons per minute
	0.003377	million cubic meters per day
Gigawatthour (GWh)	1,000	megawatthour
	1,000,000	kilowatthour

Additional units of measurement, in inch-pound units, are listed below:

		(Approximations)
1 gallon	=	8.34 pounds
1 million gallons	=	3.07 acre-feet
1 cubic foot	=	62.4 pounds
	=	7.48 gallons
1 acre-foot (acre-ft)	=	325,851 gallons
	=	43,560 cubic feet
1 cubic mile	=	1.1 x 10-12 (trillion) gallons
	=	3,379,200 acre-feet
1 inch of rain	=	17.4 million gallons per square mile
	=	27,200 gallons per acre
	=	100 tons per acre

QUALITY-ASSURANCE PLAN FOR THE U.S. GEOLOGICAL SURVEY–INDIANA DISTRICT WATER-USE PROGRAM

by Donald V. Arvin

ABSTRACT

The Indiana District Water-Use Program is an ongoing program with the primary goal of making Indiana water-use data available to Federal, State, and local water managers. The water-use data are obtained from a wide variety of sources. Some data are based on values reported by water users, and other data are based on a variety of estimation techniques. Statements of responsibility, documentation and data-storage requirements, sources of data, and methods of achieving project goals are included in this quality-assurance plan.

INTRODUCTION

The Indiana Water-Use Program is an ongoing effort to make Indiana water-use data available to water managers at the Federal, State, and local levels. The Program is part of the U.S. Geological Survey's National Water-Use Information Program (NWIP), a large-scale project that encompasses the diverse nature of water use in the United States. Because the Indiana Water-Use Program is a continuous project and because it is part of the large-scale NWIP, it is necessary that the Indiana District establish sound and consistent methods of obtaining appropriate data, and establish procedures for the thorough documentation of applied methods for calculations, estimations, and data storage. Specific descriptions, responsibilities, procedures, and objectives of the Indiana District Water-Use Program are presented in this quality-assurance plan.

DESCRIPTION OF THE INDIANA WATER-USE DATA PROGRAM

Since the 1950's, the U.S. Geological Survey (USGS) has published, at 5-year intervals, estimates of water use in the United States. These estimates are derived from a variety of sources and range widely in accuracy (Solley and others, 1988, p.3). The Indiana District provides Indiana water-use estimates for inclusion in these national publications by assembling and forwarding information, including data collected by State and other Federal agencies. Beginning in 1985, estimates of water use in Indiana have been assembled annually, making the information readily available for national, State, and local water-resource studies.

In 1977, the Congress of the United States recognized the need for uniform, current, and reliable information on water use and directed the U.S. Geological Survey to establish the NWIP to complement the USGS's data on availability and quality of the Nation's water resources (Solley and others, 1988, p.3). Under the direction of the NWIP, computer software was designed and distributed to serve as a data base for water-use information. The Water-Use Data System (WUDS) has two components. The first component, the Site-Specific Water-Use Data System (SSWUDS), was created for storage of site-specific data. The Indiana District does not utilize SSWUDS because the site-specific data are stored by State agencies. The second component, the Aggregate Water-Use Data System (AWUDS), was created for storage of water-use data aggregated at the county and 8-digit hydrologic-unit-code (HUC) level. Beyond serving as the tool for storage of aggregate data, AWUDS also serves as the means to transfer the aggregate data for inclusion in the 5-year national publications. Since 1985, the Indiana District has updated AWUDS annually.

Enactment of State data-reporting laws and the development of State and Federal computer data bases have improved water-use data over the years. Thorough documentation of water-use activities, however, was not a priority during the 1970's and 1980's—periods of rapid change in the Indiana District Water-Use Program. Development and application of an effective quality-assurance plan improves consistency of methods, promotes a high level of data quality, and ensures the availability of thorough documentation.

QUALITY-ASSURANCE PLAN

Responsibilities of District Personnel

To accomplish project goals in an efficient manner, it is important that District personnel understand individual responsibilities related to the Indiana Water-Use Program. The following is a list of individuals involved in the program and their respective responsibilities.

The District Chief is responsible for:

1. Managing and directing the District program, including the Water-Use Program.

2. Holding the ultimate responsibility to ensure that the Water-Use Program meets the needs of the Federal Government, the Indiana District, and the cooperating agencies (agencies that provided water-use data).

3. Providing final resolution of any project conflicts or disputes.

4. Keeping the Section Chief and the Project Chief briefed on project expectations and on communications from Region and Headquarters.

5. Providing guidelines to the Project Chief on what extent the Project Chief should maintain direct contact with cooperating agencies.

The Section Chief is responsible for:

1. Managing and directing projects assigned to the section, including the Water-Use Program, and ensuring that the stated objectives are met in a timely manner.

2. Providing the Project Chief with technical and administrative support as needed.

3. Ensuring that project milestones are developed and that program goals are completed on time.

4. Ensuring that the Project Chief receives adequate and appropriate training.

The Project Chief is responsible for:

1. Conducting the technical work of the Water-Use Program, including all phases of data collection, data evaluation, data storage, and report preparation.

2. Communicating project progress, plans, and problems to the Section Chief, District Chief, and the USGS-Water Resources Division's Northeastern Region Water-Use Representative by providing a written quarterly report.

3. Documenting project activities (see "Documentation" section of this quality-assurance plan), updating AWUDS annually, and preparing a written work plan yearly.

4. Maintaining Water-Use Program files by organizing information such as memoranda, personal communication, and other documentation, and placing this information in a centralized location.

5. Identifying agencies or individuals as appropriate data sources, contacting those agencies or individuals, and attempting to maintain a positive working relationship with those agencies or individuals (without violating the cooperator-contact guidelines established by the District Chief).

6. Ensuring that the best possible aggregate data have been correctly entered into AWUDS.

7. Communicating any need for assistance to the Section Chief.

8. Ensuring that program activities are carried out in a timely manner.

9. Instituting improved methods and developing better data sources whenever possible.

The District Administrative Officer is responsible for:

1. Maintaining administrative files for all District projects, including the Water-Use Program (see "Documentation" section of this quality-assurance plan).

2. Providing the Project Chief with administrative support in terms of correspondence, budget information, etc.

The USGS-Water Resources Division's Northeastern Region Water-Use Representative is responsible for:

1. Communicating to the Project Chief and the District Chief the needs of Region and Headquarters.

2. Providing technical assistance to the Project Chief, whether by direct instruction or by assisting the Project Chief in contacting appropriate knowledgeable individuals.

3. Coordinating the data collection and data transfer for the 5-year national publication.

Documentation

Five major forms of documentation are maintained in the District. The purposes of thorough documentation are to promote consistency during periods of transition from one Project Chief to the next, identify how certain data were obtained or estimated so that methods can be repeated efficiently or improved upon, and provide historical information that enables determinations to be made on whether water-use data from one period of time can be correctly compared to data from another period of time. The five forms of documentation are:

1. The Project Chief prepares written quarterly reports and provides copies to the Section Chief, the District Chief, the District Administrative Officer, and the Northeastern Region Water-Use Representative. These quarterly reports are placed in the District administrative files maintained by the Administrative Officer, and in the project files maintained by the Project Chief. Project files, as discussed in this report, are paper copies of information grouped into well organized and well labeled folders stored in the filing cabinet dedicated to water-use related material.

   The contents of these quarterly reports list progress during the most recent three-month period, such as significant activities, communication with cooperators, types of data obtained or estimated during the period, and status of aggregate-data input. These reports also include a section on plans for the next quarter and a section on problems or potential problems.

2. Each year a specific work plan and budget plan are prepared by the Project Chief. This plan is provided to the Section Chief, District Chief, District Administrative Officer, and the Northeastern Region Water-Use Representative. The Project Chief addresses comments provided by these individuals related to the written plans and modifies them if appropriate. One copy of the finalized plan is placed in the District administrative file maintained by the Administrative Officer. One copy is placed in the project files maintained by Project Chief.

3. The Project Chief maintains a collection of all significant correspondence, including official memoranda and letters to or from cooperators. Cover letters associated with the exchange of water-use data are included. This information is stored as paper copies placed in the project files maintained by the Project Chief.

4. The Project Chief keeps an informal daily log briefly describing significant telephone contacts, requests for data, dates data were received, types of work that are being conducted, and portions of the data base that have been updated. This daily log provides details that can be summarized quickly into quarterly reports. It also lists names, dates, and addresses for future reference. The daily log is kept on a current basis in a three-ring binder located at or near the desk of the Project Chief. As the binder becomes full, the sheets of notes are placed in folders in chronological order, grouped by year, and placed in the project files maintained by the Project Chief. This daily log is stored for an indefinite period of time in order to be readily available for future reference.

5. As the full spectrum of water-use data are collected for the 5-year national reports, thorough documentation is created to specify data sources and methods. The exact form of this documentation was mandated by the National Water-Use Information Program for the 1985 and 1990 efforts. The documentation for the 1990 data compilation can be found in the section "Data Sources and Compilation Procedures" in this quality-assurance plan. For future 5-year compilations, the Project Chief will follow the criteria established at the national level. This information will be stored as paper copies to be included in the project files maintained by the Project Chief. In years between the 5-year efforts, referred to here as the "off years," the Project Chief uses the most recent national documentation format to describe the sources and methods used for that particular year. When assembling data for the off years, any deviations from the methods used for the most recent 5-year national compilation are described in this same documentation, which is stored as paper copies in the project files maintained by the Project Chief for an indefinite period of time. AWUDS-data coding forms for each county, 8-digit HUC, and aquifer for each year are stored in the project files for no less than 10 years.

The limited documentation available for periods prior to 1985 are not detailed enough to determine exactly how estimates were produced for the various water-use categories. Sources for some categories for 1985 were determined through personal communication with the former Project Chief. Sources for 1985, when known, are discussed in the section "Data Sources and Compilation Procedures" in this quality-assurance plan. An attempt was made to thoroughly document the 1990 data sources and methods in this report.

Data Storage

A primary goal of the Indiana Water-Use Program is to promote the availability of Indiana water-use data by maintaining and updating AWUDS, which is designed to store Indiana aggregate data and to upload data into the national data base.

Data Quality

The aggregate data stored in AWUDS vary in accuracy depending on the particular category and type of information. Estimates of withdrawals determined by multiplying an estimated population by a water-use coefficient, for example, would be expected to have a larger margin of error than withdrawals reported by facilities that use inline flowmeters.

Data also vary in accuracy depending on the particular year with which the data are associated. For example, only since 1985 have significant water withdrawers (those capable of withdrawing 100,000 gal/d or more) been required to report their monthly withdrawals on an annual basis to the Indiana Department of Natural Resources (IDNR). The availability of withdrawal data based on individual site-manager estimates was a major improvement over the situation prior to 1985, when the Project Chief attempted to estimate withdrawals for each county. By 1990, the situation had improved over the situation in 1985 because a greater percentage of facilities required to register and report their withdrawals were brought into the reporting program and improved software for aggregating the data had been developed.

It is necessary that the Project Chief have a thorough understanding of the water-use data, their sources, and their sources of error in order to continually research and implement improved methods for obtaining the data and determining estimates. It is also necessary, as mentioned in the "Documentation" section, to document in detail all sources of data and the methods used.

Data Entry and Checking Procedures

One of the goals of the water-use project is to ensure that the water-use data compiled and stored are as accurate as possible within the limits of cost and practicality. Large portions of the data collected are developed by other groups, typically State or Federal agencies. Once the data are obtained by the USGS, they most often require varying amounts of processing by the project staff prior to data entry for computer storage. The quality-assurance activities associated with the data vary in response to the type and source of the data. For the types of compiled data that are presorted and aggregated in a fashion such that the values can be entered directly into AWUDS, the quality assurance is designed to ensure that the values entered and stored in the AWUDS data base agree with the original values received. An example of these types of data are the withdrawal data received from IDNR, who subjects the data to a number of quality-control checks before transferring them to the USGS.

Other data collected by the project require sorting or mathematical manipulation after being received from the supplying agency. An example of this type of data would be the site-specific monthly mean wastewater data provided by the Indiana Department of Environmental Management (IDEM). The quality assurance for this type of data is designed to ensure that the data are manipulated in a way that produces the proper output values and that the original and interim data are not changed to incorrect values.

The third type of data are the result of calculations between census data multiplied by a coefficient. Examples of these types of data include estimates of domestic withdrawals and livestock withdrawals. The quality assurance for these types of data include confirming the use of the most recent census data and the best documented coefficients, and checking for mistakes such as coding errors, erroneous Fortran calculations, and the incorrect use of statistical packages.

Data-coding forms are created by the Project Chief for each county, 8-digit HUC, and each major aquifer. The format of the coding forms follows the example provided by the NWIP for the most recent 5-year compilation. Data are entered from the coding form into AWUDS (future use of spreadsheets is encouraged so that spreadsheet-checking routines can be incorporated into quality-control procedures). All coding forms are kept in an orderly group, such as in a three-ring binder, and are kept in the project file for no less than 10 years.

Data are entered at a computer terminal by typing in information found on the coding forms. Large volumes of data provided to the USGS on floppy disks, such as withdrawal data from IDNR, are loaded directly into AWUDS, when possible, using automated data transfer programs. (Automatic loading of data into AWUDS does not preclude the need to write the data onto the coding forms.)

After all water-use data for the year have been entered into AWUDS, each value in each county, HUC, and aquifer are checked against values written on the coding forms. It is preferable that the individual who enters the data be different from the individual who checks the input data. The AWUDS quality-control utilities are used to assist in identifying errors. These utilities include multi-year comparisons, State total comparisons, and ranked tables (to identify outliers). It is necessary that county sums equal sums for 8-digit HUC's for the corresponding categories.

In addition to checking all values in AWUDS for a given data year against corresponding values written on the coding forms, where data on the coding forms are not considered the original data, at least 20 percent of the values for that category are checked against the original data. For data stored on floppy disks and provided to the USGS by other agencies, such as withdrawal data received from IDNR and wastewater data received from IDEM, the data on the disk are considered to be the original data. For data written on coding forms that are the product of census estimates and coefficients, the written values on the coding forms are considered to be the original data.

Data Sources and Compilation Procedures

This section describes the procedures used by the Indiana District Water-Use Program for compiling the data to be entered into AWUDS. A list of 13 separate sources of water-use information is presented in the appendix located at the back of this report. For each source, a reference number is assigned and the various types of information provided by each source are described. Methods of estimating water use for 1990 are presented in this section of the report, citing the sources and associated reference numbers listed in the appendix. All of the sources and methods described in this section are based on the sources and procedures used in 1990. Although it would be beneficial to describe the sources of data and methods of estimation used prior to 1985, there are no detailed accounts available. Some documentation for 1985 is available, but the documentation is vague and is not considered reliable. General comparisons with procedures used in 1985, when known, are included, however.

Methods of Estimating Water Use

This subsection describes specific methods used to produce the 1990 estimates of water use. The methods described in this section should be used as a guide for future compilation efforts. When improved methods become available, the Project Chief should update this section accordingly.

Public Water Supply

Withdrawals.—Withdrawals for the Public Supply (PS) category were provided to the USGS by IDNR (Source #1). Withdrawal values provided by IDNR were used for the 1990 effort with no changes or recalculations.

Withdrawal data provided by IDNR reflected values reported by each PS facility for the 1990 calendar year. In Indiana, nearly all PS facilities were metered. Withdrawals reported by PS facilities were considered relatively accurate because they were metered. IDNR's site-specific data base was sorted by SIC (Standard Industrial Classification) code in accordance with the USGS definition of a PS facility. The 1990 data were provided to the Indiana District in the aggregate form on a 3.5-inch machine-readable disk.

Population Served.—Although the 1990 Census questionnaire included questions on the population's domestic source of water, Census results on that information were not available at the time of the 1990 compilation. What was known at the time of compilation was the population by county (Source #8) in 1990 and the source of water by housing unit for 1980 (Source #7). The results of the 1990 Census will be available for future compilations.

Two assumptions were made. First was the assumption that the percentage of housing units linked to a PS was the same as the percentage of the population linked to a PS (this assumes there is a uniform number of persons per housing unit, no matter what their source of water may be). Second was the assumption that the percentage of the population receiving water from a PS was the same in 1990 as was true in 1980. These two assumptions were made because no specific data were available to provide a basis for alternate percentage calculations. The future availability of 1990 Census data will provide new information on what percentage of the population receives water from a PS.

The 1980 percent of housing units linked to a PS was calculated for each county. The 1990 population then was multiplied by that percentage to determine the number of people on a PS. Domestic water use was determined by multiplying the number of people on a PS by 76 gal/d (Source #9). Also, the total county population minus the number of people served by PS, times 76 gal/d, equaled the Domestic withdrawal.

Of the number of people served by PS, the number served by ground water and the number served by surface water was assumed to be proportional to the relative amounts of ground-water withdrawals and surface-water withdrawals by PS facilities in each county.

The number of people in each HUC served by PS was based on the percent-county population in each HUC (Source #7). This determination was based on the assumptions that population percentage of each county in each HUC has not changed since 1980, and that the percent of population served by PS is evenly distributed over the entire county population. These assumptions were made because 1990 population percentages (county population within each HUC) were not available at the time of the 1990 compilation.

Total Population.—Total population for each county was based on the 1990 Census data. The population values provided by the NWIP in late August 1991 were not used to compute the 1990 HUC-population totals. Certain problems existed with the data, such as some county-to-HUC percentages that were greater than 100 percent, inclusion of a non-existent county, and missing data for some counties. The 1990 HUC population totals were computed by multiplying the Bureau of the Census 1990 county populations by the 1985 percentages of county population in each HUC. The use of this method may have lacked a high level of accuracy but seemed to introduce fewer errors than the use of the late-available 1990 percentages.

Number of Facilities.—The number of PS facilities within each county, HUC, and aquifer were provided by IDNR (Source #1). In Indiana, all facilities capable of withdrawing 100,000 gal/d (or about 70 gal/min) are required to register with IDNR and annually report their monthly withdrawals. The sum of these registered facilities for each county, HUC, or aquifer was considered to be the number of facilities in the data base. A registered facility was included in the tally, even if the reported withdrawals for the 1990 year was 0.00 Mgal/d. The number of facilities was considered comprehensive and accurate.

Domestic

Withdrawals.—Withdrawals were estimated for the "Domestic" category based on the county population not served by PS (Source #8) multiplied by the use coefficient, 76 gallons per person per day (Source #9). All Domestic withdrawals were assumed to be ground water from the surficial aquifer.

The assumption that Domestic self-supplied withdrawals come from the surficial aquifer could be debated. Some parts of the State, especially southern Indiana, have very little water-holding surficial material except near streams. In those areas, homes that do have wells (rather than cisterns or ponds, or are served by PS) may have wells drilled into bedrock lineaments or into true water-producing bedrock. Lacking good site-specific information on low-capacity home wells, the assumption that withdrawals for this category are from the surficial aquifer is probably reasonable. Most locations in northern and central Indiana have a readily accessible water table.

Withdrawals in 8-digit HUC's were determined based on percent-county populations in each HUC (Source #7). These percentages were provided for the 1985 compilation. In this way, HUC values were derived from county values. Data of greater detail were not available to allow a better alternative for distributing the population. The assumption was made that those persons who were self-supplied were

distributed evenly over the entire population. This assumption was made because more detailed data were not available to distribute the population in another way. Minitab, a statistical software package on the Prime computer, was used to ensure that county sums equaled HUC sums.

Deliveries.—Deliveries to the Domestic population were determined by multiplying the public-supplied population (Source #7) by 76 gal/d (Source #9).

Water withdrawn in one county can be transferred for use in another county. For the six counties listed below, deliveries from PS for domestic use were greater than PS total withdrawals for each of those counties. For those six counties, and only those six counties, the transfer of water from a nearby county into the deficit county was calculated. Source #13 was referenced to determine which county supplied the water. Because more specific data were not available to determine exact amounts of transfer, it was assumed that only enough water was transferred to the county to cover the amount of deficit. No data were available to establish amounts of inter-county transfers in areas where no evidence of deficits existed. No transfers were entered into AWUDS other than for these six counties. The six inter-county transfers are as follows:

-- Adams received 0.62 Mgal/d from Allen.

-- Miami received 0.14 Mgal/d from Howard.

-- Union received 0.07 Mgal/d from Franklin.

-- Brown received 0.66 Mgal/d from Monroe.

-- Clay received 0.37 Mgal/d from Owen.

-- Warrick received 1.23 Mgal/d from Vanderburgh.

The previous paragraph discussing inter-county transfers of water is significant for the "Commercial" and "Industrial" categories because the deliveries to these categories are a function of the remainder of PS withdrawals minus Domestic deliveries.

Consumptive Use.—Consumptive use was said to be 15 percent of the sum of deliveries and withdrawals. This 15-percent coefficient was used for consistency with that used by the Great Lakes Commission. A 10-percent coefficient was used for the 1985 compilation. It is not known on what the 1985 10-percent coefficient was based.

Commercial

Withdrawals.—Withdrawals were provided by IDNR (Source #1). The data received from IDNR represented site-specific data sorted by SIC codes (USGS definitions), and aggregated by county, HUC, and aquifer.

Deliveries.—The following equation for determining Commercial deliveries from PS was suggested on page 35 of Source #12.

(Commercial deliveries) = (PS withdrawals) - (distribution losses)
- (deliveries to other users)

An equation to determine Commercial deliveries in Indiana was derived from this relation. The equation used for Indiana was:

(PS withdrawals) - (.15 * PS withdrawals) - (Domestic delivery)
= (Commercial delivery + Industrial delivery)

The distribution loss coefficient was selected to be 15 percent (Source #12, page 15). Deliveries to Thermoelectric were said to be 0.00 Mgal/d because Thermoelectric facilities in Indiana generally are self-supplied. Deliveries to the "Domestic" category are a population-based calculation presented in the methods discussion for the "Domestic" category of this report.

Whenever possible, estimated Commercial and Industrial deliveries for each county for 1990 were based on the same Commercial-to-Industrial ratio used in the 1985 compilation. Although it is unknown how these 1985 deliveries were determined, no improved delivery data have become available since 1985. The 1985 ratios were used in 1990 to provide consistency.

Deliveries for HUC's were determined based on the percent population of each county in each HUC (Source #7). No 8-digit HUC values for Indiana were reported for any categories for the 1985 compilation.

The use of billing information from individual PS facilities was not a method used to estimate deliveries. Obtaining delivery information from PS facilities would be of benefit in improving the quality of delivery estimates.

Consumptive Use.—The consumptive use for Commercial was said to be 15 percent of the sum of withdrawals plus deliveries. This coefficient was used for consistency with that used by the Great Lakes Commission.

Industrial

Withdrawals.—Withdrawals for the Industrial category were provided by IDNR (Source #1). Data received from IDNR represented site-specific data already sorted by SIC codes (USGS definition) and aggregated by county, HUC, and aquifer.

Deliveries.—The following equation for determining Industrial deliveries from PS was suggested on page 41 of Source #12.

(Industrial deliveries) = (PS withdrawals) - (distribution losses)
- (deliveries to other users)

An equation to determine Industrial deliveries in Indiana was derived from this relation. The equation used for Indiana was:

(PS withdrawals) - (.15 * PS withdrawals) - (Domestic delivery)
= (Commercial delivery + Industrial delivery)

The PS distribution loss coefficient was selected to be 15 percent of PS withdrawals (Source #12, page 15). In Indiana, Thermoelectric facilities are generally self-supplied and, therefore, deliveries to the Thermoelectric category are said to be 0.00 Mgal/d. Deliveries to Domestic are a population-based calculation presented in the methods discussion for the "Domestic" category of this report.

Whenever possible, estimated Industrial and Commercial deliveries for each county for 1990 were based on the same Commercial-to-Industrial water-use ratio used in the 1985 compilation. (See the methods discussion concerning 1985 water-use ratios in the "Commercial" category of this report.)

The 8-digit HUC values were determined based on the percent population of each county in each HUC used for the 1985 compilation (Source #7). HUC deliveries for "Commercial" and "Industrial" categories could not be compared to 1985 data because 8-digit HUC data were not calculated for Indiana in 1985. Also, see the discussion on inter-county transfers in the "Domestic" category of this report.

Consumptive Use.—Industrial consumptive use was said to be 6 percent of the sum of Industrial withdrawals plus deliveries. This coefficient was used for consistency with that used by the Great Lakes Commission.

Number of Facilities.—The "number of facilities" includes the number of industrial withdrawal facilities registered with IDNR. A facility was counted even if 0.00 Mgal/d was reported as the amount of water withdrawn during the year. All facilities in Indiana capable of withdrawing 100,000 gal/d are required to register with IDNR and report their monthly withdrawals annually. The facility number was considered to be comprehensive and accurate. In any given county, however, there can be any number of industries that used water entirely supplied by PS facilities. This appeared to be the situation in Dubois County, where there was a large amount of industrialization but no registered self-supplied industrial facilities. The compiler listed the number of industrial facilities for 1990 in Dubois County as 0.

Reclaimed Wastewater.—There were no significant amounts of reclaimed wastewater used by industry in Indiana.

Thermoelectric

Withdrawals.—Withdrawals were obtained from IDNR (Source #1). Withdrawal values were entered into AWUDS for 1990 as provided by IDNR with no changes or recalculations. All significant energy production in Indiana is either from hydroelectric power generation or from the burning of fossil fuels (the latter is much more significant in terms of the amounts of energy produced). No production of nuclear or geothermal power occurred in Indiana in 1990. Hydroelectric power production is discussed as a separate category.

Deliveries.—Withdrawal data indicated that there were probably no significant deliveries to Thermoelectric from PS facilities in 1990. It was possible that some plants used PS deliveries for drinking water, lavatory use, or other low-volume purposes. Deliveries for those purposes were considered to be relatively insignificant.

Consumptive Use.—Consumptive use for Thermoelectric was said to be 2 percent of withdrawals. This 2-percent coefficient was used for consistency with that used by the Great Lakes Commission.

Number of Facilities.—The "number of facilities" included the number of withdrawal facilities registered with IDNR. This number was considered to be comprehensive and accurate. The number of facilities registered with IDNR in 1990 was cross-checked with the list provided by the Department of Energy (DOE) (Source #3) and found to be consistent.

Mining

Withdrawals.—Withdrawal data for the "Mining" category were provided by IDNR (Source #1). The data represented withdrawals sorted by SIC code and aggregated by county, HUC, and aquifer. Withdrawals were entered into AWUDS with no recalculations or modifications.

Consumptive Use.—Consumptive use for Mining was said to be 6 percent of withdrawals. This coefficient was used for consistency with that used by the Great Lakes Commission.

Livestock - Stock

Withdrawals.—Livestock-population data were based on the Bureau of the Census 1987 Census of Agriculture (Source #4). Animal populations by county for 1987, when available, were used. For the purpose of calculating water-use estimates, animal-population estimates for 1990 were considered equal to the 1987 estimates because more current information was not available. If 1987 values for cattle were unavailable, the 1982 values were used. If totals for "chickens 3 months old and older," plus "pullet chicks and pullets under 3 months old," plus "turkeys," were available for 1987, this total was considered the poultry population. If 1987 poultry populations were not listed for a county and 1987 sales were available, a ratio of the 1982 population to 1982 sales was used to determine the 1987 poultry population based on 1987 sales. If neither 1987 populations nor sales were available and 1982 populations were listed in the Census publication, the 1982 populations were used as the 1987 poultry population. If there are very few facilities in each county, the Bureau of the Census does not make some of the individual county data available because it may result in the disclosure of information on individual facilities.

Ranges of per capita water-use rates in Indiana were listed in the publication, "The 1980 survey of domestic self-supplied and livestock water use rates in Indiana," by the Indiana Department of Natural Resources, Division of Water (Source #9). The selected rates for calculations used in the 1990 compilation were as follows:

--Cattle: 15 gal/head/day

--Dairy cattle: 25 gal/head/day

--Hogs: 5 gal/head/day

--Sheep: 2 gal/head/day

--Poultry: .15 gal/head/day

Many livestock operations were not required to report their water withdrawals because only significant facilities (those capable of withdrawing 100,000 gal/d) were required to register with IDNR and report their withdrawals. For this reason, estimates of livestock populations multiplied by the water-use coefficients were used for determining Livestock withdrawals rather than reported values. Using only the reported values tended to underestimate withdrawals by excluding the smaller producers.

Water used by cattle was considered to be surface water. The remaining water use (by hogs, poultry, and sheep) was considered to be ground water. These assumptions were based on the idea that the large hog and poultry farms generally are confined operations, and cattle generally are raised in a less confined situation. Some error was introduced by use of these assumptions because water for hogs could have come from a pond or creek, or even from a PS. Likewise, cattle could be watered with tanks filled from ground water. It is known that during very dry periods some farmers in southern Indiana supplement ground-water withdrawals with emergency surface-water withdrawals from nearby creeks or rivers, but often fail to report these surface-water withdrawals to IDNR. These emergency surface-water withdrawals are, therefore, not reflected in IDNR's data base or in AWUDS. All ground-water withdrawals were said to be from the surficial aquifer because generally it is the least expensive and most readily available source.

The animal-population data provided in the Bureau of the Census 1987 Census of Agriculture were listed by county. HUC data were determined based on the percent area of each county in each HUC (Source #7). Minitab was used to ensure that HUC totals equaled county totals.

Deliveries.—Deliveries were not a required element for the 1990 Stock category. Had they been a required element, deliveries from PS to this category would have been considered insignificant and listed as 0.00 Mgal/d. In future compilations, deliveries to Stock may become significant, especially in Southern Indiana where ground-water availability is limited in some areas and Rural Public Water Supplies are playing an increasing role in providing water to the population.

Consumptive Use.—The consumptive use coefficient for Livestock - Stock was said to be 80 percent of withdrawals. This coefficient was used for consistency with that used by the Great Lakes Commission.

Livestock - Animal Specialties

Withdrawals.—The number of horses (or ponies) in each county was obtained from the 1987 Census of Agriculture (Source #4). The amount of water withdrawn was calculated as the number of horses times 12 gallons per horse per day (Source #11). Withdrawals for 8-digit HUC's were determined based on the percent area of each county within each HUC (Source #7). Because more current information was not available, the numbers of head listed in the 1987 Census publication were considered equal to the numbers of head in 1990.

The amount of fish farming and production of fur-bearing animals was so small, according to the 1987 Census of Agriculture, withdrawal values for all counties rounded off to 0.00 Mgal/d.

For the 1990 compilation, withdrawals were based on estimated animal populations, rather than on the withdrawals reported to IDNR by significant users (100,000 gal/d). Because many of the facilities within the "Animal Specialty" category do not withdraw enough water to be considered significant users, they are not required to report their withdrawals to IDNR. Therefore, most of these facilities would be excluded from the data base.

Because more detailed data were unavailable, it was assumed that all water used in this category was from a ground-water source, specifically the surficial aquifer. This assumption was based on the premise that this generally was the most readily available source of potable water.

Deliveries.—Deliveries for Livestock - Animal Specialties were not a required element for 1990. Had deliveries been a required element, the estimated value would have been considered insignificant and listed as 0.00 Mgal/d.

Consumptive Use.—Consumptive use for Livestock - Animal Specialties was said to be 80 percent of withdrawals. This coefficient was used for consistency with that used by the Great Lakes Commission.

Irrigation

Withdrawals.—Irrigation withdrawals were provided by IDNR (Source #1). The information represented data sorted by SIC codes and aggregated by county, HUC, and aquifer. Although IDNR publishes data in units of Mgal/d averaged over a 90-day year, IDNR supplied irrigation-withdrawal data to the Indiana District averaged over a 365-day year. Data entered into AWUDS for 1990 Irrigation Water Use were those values provided by IDNR for a 365-day year, with no adjustments or recalculations. Data were provided by IDNR in units of Mgal/d.

Consumptive Use.—Consumptive use was said to be 90 percent of withdrawals. This coefficient was used for consistency with that used by the Great Lakes Commission.

Conveyance Losses.—Conveyance losses for irrigation in Indiana were said to be 0.00 Mgal/d. The source of water for irrigation generally was found near the point of application. Even if a ground-water well pump or center pivot is leaking, most of that water probably spills out onto the irrigated crop. The amounts of water lost in conveyance are considered insignificant, in contrast to the situations found in the Western States where long, open canals allow large amounts of leakage and evaporation.

Acres Irrigated.—In counties for which data were presented, the number of irrigated acres in each county was obtained from the 1987 Census for Agriculture, volume 1, Geographic Area Series, Chapter 2, Table 7 (Source #4). For counties with very few facilities, acres irrigated were not made available in the Census publication in order to prevent the disclosure of information on individual facilities. For those counties where acreage data were unavailable, estimates were made by taking the number of registered farm-irrigation facilities for that county in the IDNR data base and multiplying that number by the average acres per facility in the surrounding counties. This method ignores the possibility that the number of acres irrigated on any one farm has nothing to do with the number of acres irrigated by neighboring farms. It is possible that farms in the same geographic area may follow similar farming practices.

Census estimates of 1987 irrigated acreage for a few individual counties appeared very low when compared to the number of facilities registered with IDNR and the withdrawals reported to IDNR in 1987. For those individual counties, the estimated number of acres were increased according to the same criteria mentioned in the previous paragraph.

The location of irrigators registered with IDNR in 1988 were plotted based on Universal Transverse Mercator (UTM) coordinates on a HUC map by Paul Solliven of the Indiana District office. The plots were made by spotting the location on a 7.5-minute topographic map and transferring the location to the larger scale HUC map based on nearby geographic features. When converting the number of acres of irrigated land per county to number of acres of irrigated land per HUC, it was not assumed that irrigated land was dispersed evenly over a county. Rather, clusters of irrigation facilities were observed on the HUC map, and estimated acreages were split out of each county by weighting acreage by the proportion of facilities in the area. Minitab was used to ensure that county acreage totals equaled 8-digit HUC acreage totals.

There were a few facilities around the State, such as the Hamstra farms and the Hoffman farm in Jasper County, where land was flood irrigated. Generally, the amount of acreage in flood irrigation was not considered significant by the 1990 data compiler in Indiana. All data for "acres irrigated" were placed within the "sprayed" grouping.

Reclaimed Wastewater.—There were no significant amounts of reclaimed wastewater used for irrigation in Indiana.

Hydroelectric

Total Water Use.—Total water use was estimated for the "Hydroelectric" category using 1990 generated-power data in combination with 1985 water-use-per-power-generated ratios. In counties of HUC's where no hydroelectric facilities existed, Hydroelectric water use was entered into AWUDS as 0.00 Mgal/d. In counties or HUC's where at least one hydroelectric facility existed, data reported for the 1985 compilation (Source #10) were used to determine a ratio of water-use per power-generated. The 1985 ratio was used with the 1990 power-generated data to produce 1990 water-use estimates. It is not known how hydroelectric water-use estimates were determined in 1985, and better ratios were not available at the time of the 1990 compilation.

Power Generation.—Site-specific power-generation information was provided by the DOE (Source #3). The compiler was able to determine for each facility the site location in terms of county and HUC, based on similar data located in the paper files from the 1985 compilation. The monthly data provided by the DOE for each site was summed to produce total GWh of energy production for the year.

Number of Facilities.—The "number of facilities" in each county and HUC were determined by summing the number of facilities listed for each county and HUC provided by the DOE (Source #3). If there were sites missing from the DOE list, they were not included in the 1990 AWUDS data base.

Sewage Treatment

Number of Facilities.—Site-specific information for all wastewater-discharge facilities was provided by Gary Starks of IDEM (Source #2). "Public" facilities were separated from "industrial and other" facilities by the compiler on an individual basis, based on the name of the facility. The facilities within each county or within each HUC were summed to determine the number of facilities for each respective area.

Because wastewater-discharge facilities are required to register with IDEM in Indiana, the IDEM data base was considered comprehensive. Because the names of the facilities generally were descriptive, the "public" facilities were separated from "industrial and other" facilities with reasonable accuracy.

Total Wastewater Returns.—As directed in the national guidelines (Source #12), only "public" facility data were included when summing the site-specific discharge data to determine the total wastewater flows. Monthly values for each registered facility were used to determine a mean for the year for each facility.

Number of Public Wastewater Facilities.—See "Number of Facilities" section above.

Number of Industrial and Other Wastewater Facilities.—See "Number of Facilities" section above.

Amount of Water Returned to Beneficial Use.—No significant amounts of reclaimed wastewater were used in Indiana for irrigation, cooling, or other similar types of reuse.

Reservoir Evaporation

Consumptive Use.—The amount of water evaporated was calculated by multiplying the reservoir surface area by the rate of evaporation. For 1990, these data were required for 8-digit HUC's only.

The rates of evaporation of lakes and reservoirs were provided in map form in the Weather Bureau publication, Technical Paper number 37 (Source #6). The rate of 2.67 ft/yr of evaporation was used for northern Indiana (HUC's 04040001, 04050001, 04100003, 04100004, 04100005, 04100007, 05120101, 05120102, 05120103, 05120104, 05120106, 05120107, 05120108 [north of the town of Silverwood], 05120109, 07120001, 07120002, and 07120003). The rate of 2.75 ft/yr of evaporation was used for central Indiana (HUC's 05080001, 05120108 [south of the town of Silverwood], 05120110, 05120201, 05120203, and 05120204). The rate of 2.83 ft/yr was used for southern Indiana (HUC's 05080002, 05080003, 05090203, 05120111, 05120113, 05120202, 05120205, 05120206, 05120207, 05120208, 05120209, 05140101, 05140104, 05140201, and 05140202). Pan evaporation rates and reservoir evaporation rates were presented in Technical Paper number 37, and the latter rates were used for water-use determinations.

Surface Area.—The surface area of reservoirs for a HUC was determined by summing the surface area of all reservoirs in that HUC. The surface area at normal capacity of all reservoirs (of at least 5,000 acre-feet, or a maximum capacity of at least 25,000 acre-feet) in Indiana were listed beginning on page 99 in the USGS publication Open-File Report 90-163 (Source #5). Only those reservoirs listed in this publication were included in the 1990 compilation.

The Kentucky District volunteered for the responsibility of estimating evaporation on the Ohio River. The Ohio River is heavily controlled by locks and dams. Kentucky reportedly had difficulty in obtaining published data on the surface area of the Ohio River. The Illinois District volunteered for the responsibility of estimating the Wabash River evaporation.

Corrective Actions

As discussed in the section "Data Entry and Checking Procedures," all values stored in AWUDS for the year will be checked against values written on the coding forms. Additionally, at least 20 percent of values for each category will be checked against the original data, if the values written on the coding forms are not considered original data. Any values in AWUDS found to be incorrect when checked against values on the coding forms will be corrected immediately. If any values stored in AWUDS are found to be incorrect when checked against original data, all values in that category will be checked and corrected in AWUDS (and corrected on the coding forms). If any other categories contain values that were derived from the erroneous value, or were used to derive the erroneous data, all values in those categories also will be checked against the original data. All corrections will be documented in the daily log maintained by the Project Chief.

It is ultimately the responsibility of the Project Chief to ensure that quality-assurance procedures are followed. Whenever a violation of an Indiana District quality-assurance objective is identified, it is the responsibility of the Project Chief to propose a solution to the problem. If the Project Chief is unable to develop a solution, the Section Chief would be expected to provide guidance. Violations of quality-assurance objectives will be documented in quarterly reports, along with actions taken to correct the situation. It is not a requirement that a separate quality-assurance section be included in all written quarterly reports.

REFERENCES CITED

Indiana Department of Natural Resources, 1982, The 1981 survey of public water supply service areas in Indiana: Indiana Department of Natural Resources, Division of Water, 192 p.

Indiana Department of Natural Resources, 1982, The 1980 survey of domestic self-supplied and livestock water uses in Indiana: Indiana Department of Natural Resources, Division of Water, 17 p.

Kohler, M.A., Nordenson, T.J., and Baker, D.R., 1959, Evaporation maps for the United States: U.S. Department of Commerce, Weather Bureau, Hydrologic Services Division, Technical Paper number 37, 13 p.

Ruddy, B.C., and Hitt, K.J., 1990, Summary of selected characteristics of large reservoirs in the United States and Puerto Rico, 1988: U.S. Geological Survey Open-File Report 90-163, 295 p.

Solley, W.B., Merk, C.F., and Pierce, R.R., 1988, Estimated use of water in the United States in 1985: U.S. Geological Survey Circular 1004, 82 p.

U.S. Bureau of the Census, 1987 Census of agriculture, volume 1, geographic area series, part 14 Indiana State and county data: U.S. Bureau of Census AC87-A-14, 477 p.

U.S. Bureau of the Census, 1987 Census of agriculture, volume 3, related surveys, part 1 farm and ranch irrigation survey (1988): U.S. Bureau of Census AC87-RS-1, 114 p.

U.S. Bureau of the Census, 1980 Census of housing, detailed housing characteristics: U.S. Bureau of Census HC80-1-B16, 220 p.

U.S. Bureau of the Census, 1980 Census of population, general social and economic characteristics: U.S. Bureau of Census TC80-1-C16, 621 p.

APPENDIX

Data Sources

DATA SOURCES

SOURCE #1

AGENCY: Indiana Department of Natural Resources, Division of Water, Section of Water Use.

CONTACT PERSON/REFERENCE CITATION: 1987-90, Siavash Beik, Chief, Water Use Section. 1991 and after, Jim Hebenstreit, Deputy Director, Division of Water, or Scott Dinwiddie, Water Use Section.
402 West Washington Street, Room W264
Indianapolis, IN 46204
Phone: 317-232-4160
Fax: 317-233-4579

WATER-USE CATEGORIES: Public Water Supply, Commercial, Industrial, Fossil Fuel, Nuclear, Mining, Irrigation (partial information on Stock and Animal Specialties).

TYPE OF DATA: Ground-water and surface-water withdrawals, consumptive use, numbers of facilities, and numbers of facilities in data base.

ACCURACY (poor, fair, good, excellent): Good. Each facility that is capable of withdrawing 100,000 gal/d (or about 70 gal/min) is required by Indiana State law to register with IDNR and report its monthly withdrawals on an annual basis. Nearly all public water-supply (PS) facilities have inline flowmeters to measure their withdrawals. Some other types of facilities, such as industrial sites, also have flowmeters. In 1989, it was estimated by IDNR that about 25 percent of the registered facilities utilized flowmeters, while 75 percent estimated withdrawals by use of various estimation techniques. At this time, IDNR does not require the use of flow-meters or time totalizers. IDNR does require managers to use one or more of the accepted reasonable estimation techniques, and to describe on the annual reporting forms what methods were used to determine withdrawal estimates.

AREAL EXTENT (site specific, county, HUC, other): Data provided by IDNR were aggregated by county, HUC, and aquifer. IDNR has a site-specific data base, which can be sorted by Standard Industrial Classification (SIC) code according to USGS definitions, then aggregated into the three mentioned groupings.

FORMAT (printout, publication, verbal communication, other): The 1990 aggregate data were transferred to the USGS by paper copy and by 3.5-inch computer disk. These data have been transferred to the USGS District Office on an annual basis.

REMARKS:

In the State of Indiana, all facilities that are capable of withdrawing 100,000 gal/d of water are required to submit their estimates of monthly withdrawals to IDNR on an annual basis. IDNR maintains a computer site file in which facilities are flagged by descriptors such as SIC code, county, aquifer, HUC, and UTM (Universal Transverse Mercator) coordinates of surface-water intakes or ground-water wells. They also maintain withdrawal-data files, in which reported surface- and ground-water withdrawal data are stored. IDNR mails a form to these registered facilities, then enters the returned responses into IDNR's computer data base (all facilities must return the completed forms or pay significant fines until they do return the forms). IDNR takes the withdrawal information, aggregates the data by county, 8-digit HUC, and aquifer (for ground water), then transfers the aggregate data to the USGS District Office by hard copy and computer disk.

The primary contact in the IDNR Section of Water Use during the years 1987-90 was the Section Chief, Siavash Beik. Beik managed the original construction of IDNR's data base, and expanded the data base to fit USGS needs by attaching SIC codes, 8-digit HUC's, and aquifer identifiers to the IDNR site-header files. Beik wrote the SAS (Statistical Analysis System) program which sorts and aggregates the withdrawal data based on USGS needs and definitions. All official written correspondence went through the Division Director, John Simpson.

In 1985, withdrawal data were aggregated according to IDNR water-use-category definitions, not USGS definitions. Certain differences existed. Withdrawals by schools, for example, were considered a public water-supply withdrawal by IDNR, but considered a commercial withdrawal by USGS. By assigning SIC codes to the site files, the data were grouped by USGS definitions for 1990. Also, prior to the 1990 effort, data could not be grouped by 8-digit HUC or by aquifer. With the new site-file flags, pre-1990 data now can be aggregated according to USGS definitions.

The SAS program that Beik constructed to sort and aggregate the withdrawal data also outputs the number of facilities in a county, HUC, or aquifer. The consumptive-use coefficients used by the Great Lakes Commission were included in the SAS output.

SOURCE #2

AGENCY: Indiana Department of Environmental Management (IDEM), Office of Water Management, Data Management Section.

CONTACT PERSON/REFERENCE CITATION: Gary Starks.
Indiana Department of Environmental Management
Office of Water Management, Data Management Section
Attn: Gary Starks, Room 709
105 South Meridian Street
Indianapolis, IN 46206-6015

Phone: 317-232-8694

WATER-USE CATEGORIES: Sewage Treatment.

TYPE OF DATA: Total wastewater returns (public facilities), number of public facilities, number of industrial and other facilities.

ACCURACY (poor, fair, good, excellent): Good. Release facilities report data for their own site to IDEM. In Indiana, all sites are required to be metered. For sites that were in violation during a given month (did not have a working flowmeter), no release values were listed for that month in the data provided to USGS from IDEM. For 1990, there appeared to be no large-release sites in violation. It was possible, however, that sites reported poor estimates or erroneous data.

AREAL EXTENT (site specific, county, HUC, other): Site specific data, flagged by county and receiving stream, were provided to the USGS by IDEM. Monthly release values were listed in units of million gallons per day (Mgal/d) for the 1990 calendar year.

FORMAT (printout, publication, verbal communication, other): Data were provided on high-density floppy disk.

SOURCE #3

AGENCY: Department of Energy (DOE), Energy Information Administration.

CONTACT PERSON/REFERENCE CITATION: 1990 data were provided to the USGS District offices by Robert R. Pierce, WRD, Doraville, GA, through the National Water-Use Information Program.

WATER-USE CATEGORIES: Thermoelectric, Hydroelectric.

TYPE OF DATA: Power production.

ACCURACY (poor, fair, good, excellent): Good.

AREAL EXTENT (site specific, county, HUC, other): Site specific.

FORMAT (printout, publication, verbal communication, other): The data printout listed energy production for each facility on a monthly basis for the entire 1990 calendar year. These data included fossil-fuel plants and hydroelectric plants. There were no nuclear or geothermal plants operating in Indiana in 1990.

REMARKS:

The energy production rates at the hydroelectric plants were used to determine the amounts of water used. Mgal/d-per-GWh ratios from 1985 were applied to the 1990 GWh values to determine 1990 total water use for hydroelectric. It is not known how total water use for hydroelectric was determined in 1985. It is believed that 1985 power-production data came from the same source as the 1990 data.

SOURCE #4

AGENCY: U.S. Department of Commerce, Bureau of the Census.

CONTACT PERSON/REFERENCE CITATION:

State Data Center, Indiana State Library
2nd Floor, Room 206
Contact Steve Fisher or Roberta Eads (librarians) 317-232-3733

Washington, D.C. customer service 301-763-4100
American Housing Survey, Ed Montford 301-763-8551
Census--Housing and Family 301-763-7987
Census--Housing Data 301-763-8553

Publications used:
1987 Census of Agriculture, Geographic Area Series, Indiana State and County Data
1987 Census of Agriculture, Farm and Ranch Irrigation Survey (1988)
1980 Census of Housing, Detailed Housing Characteristics
1980 Census of Population, General Social and Economic Characteristics

WATER-USE CATEGORIES: Water Supply, Domestic, Livestock - Stock, Livestock - Animal Specialties, and Irrigation.

TYPE OF DATA: Ground-water and surface-water population served by Public Water Supply, Domestic water withdrawals, deliveries from Public Water Supply, Stock and Animal Specialties water withdrawals, and irrigated acres.

ACCURACY (poor, fair, good, excellent): Poor to fair.

AREAL EXTENT (site specific, county, HUC, other): County data.

FORMAT (printout, publication, verbal communication, other): Publications.

SOURCE #5

AGENCY: U.S. Geological Survey.

CONTACT PERSON/REFERENCE CITATION: Publication: Summary of selected characteristics of large reservoirs in the United States and Puerto Rico, 1988. USGS Open-File Report 90-163, by B.C. Ruddy and K.J. Hitt, 1990.

WATER-USE CATEGORIES: Reservoir evaporation.

TYPE OF DATA: Amount of evaporation and surface area of reservoirs.

ACCURACY (poor, fair, good, excellent): Good.

AREAL EXTENT (site specific, county, HUC, other): HUC.

FORMAT (printout, publication, verbal communication, other): Publication.

REMARKS:

Report provided to each District Office by the National Water-Use Information Program. Report includes data on reservoirs complete by January 1, 1988, that have a normal capacity of at least 5,000 acre-feet.

SOURCE #6

AGENCY: U.S. Department of Commerce, Weather Bureau.

CONTACT PERSON/REFERENCE CITATION: Publication: Evaporation maps for the United States. Technical Paper number 37 by M.A. Kohler, T.J. Nordenson, and D.R. Baker, Hydrologic Services Division, 1959.

WATER-USE CATEGORIES: Reservoir Evaporation.

TYPE OF DATA: Amount of evaporation at reservoirs.

ACCURACY (poor, fair, good, excellent): Fair.

AREAL EXTENT (site specific, county, HUC, other): Evaporation-rate isopleth lines are statewide.

FORMAT (printout, publication, verbal communication, other): Publication.

SOURCE #7

AGENCY: U.S. Department of Commerce, Bureau of the Census.

CONTACT PERSON/REFERENCE CITATION: Data provided to District Offices during the 1985 compilation by the NWIP.

WATER-USE CATEGORIES: Public Water Supply, Domestic.

TYPE OF DATA: PS population served, Domestic withdrawals, Domestic deliveries from PS.

ACCURACY (poor, fair, good, excellent): Good.

AREAL EXTENT (site specific, county, HUC, other): County and HUC.

FORMAT (printout, publication, verbal communication, other): Prime computer files provided through NWIP data sharing. The computer files show county-to-HUC population ratios and HUC-to-county population ratios (allowing proportional splitting of various population-based estimates of county data, then reaggregation to determine HUC data). Also, the computer files show what portions of populations are served by PS and what portions are on wells or other sources of water.

SOURCE #8

AGENCY: U.S. Department of Commerce, Bureau of the Census.

CONTACT PERSON/REFERENCE CITATION: Howard Perlman provided the 1990 population data by county through Prime file data exchange. Perlman is with the USGS Georgia District Office and works with the National Water-Use Information Program.

WATER-USE CATEGORIES: Public Water Supply and Domestic.

TYPE OF DATA: PS population served, Domestic withdrawals, and Domestic deliveries from PS.

ACCURACY (poor, fair, good, excellent): Good.

AREAL EXTENT (site specific, county, HUC, other): County data.

FORMAT (printout, publication, verbal communication, other): Prime computer file.

REMARKS:

These county population values were from the 1990 Census.

SOURCE #9

AGENCY: Indiana Department of Natural Resources, Division of Water.

CONTACT PERSON/REFERENCE CITATION: Publication: The 1980 Survey of Domestic Self-Supplied and Livestock Water Uses in Indiana, by IDNR, Division of Water, 1982.

WATER-USE CATEGORIES: Domestic and Livestock - Stock.

TYPE OF DATA: Domestic water-withdrawal estimates, Stock water-withdrawal estimates.

ACCURACY (poor, fair, good, excellent): The source of data and methods used to produce the coefficients presented in this report are well documented, but it is difficult to determine the range of accuracy of the coefficients.

AREAL EXTENT (site specific, county, HUC, other): County data were used to produce large-scale coefficients.

FORMAT (printout, publication, verbal communication, other): Publication.

REMARKS:

This publication presents water use per capita (page 3 of the report), livestock water-use coefficients (page 2), and Indiana water-use inventories (page 1). Tables of county data for various animals are presented in the report.

SOURCE #10

AGENCY: U.S. Geological Survey.

CONTACT PERSON/REFERENCE CITATION: 1985 data stored in AWUDS data base (which was called the EUOWITUS data base prior to the revisions made for 1990).

WATER-USE CATEGORIES: Domestic, Livestock - Stock, Livestock - Animal Specialty, and Hydroelectric.

TYPE OF DATA: Consumptive-use coefficients for Domestic and Livestock, and total water use for Hydroelectric.

ACCURACY (poor, fair, good, excellent): Fair.

AREAL EXTENT (site specific, county, HUC, other): County.

FORMAT (printout, publication, verbal communication, other): Printout and Prime-system computer data base.

REMARKS:

Consumptive-use coefficients used in 1990 were the same as those used in 1985 for Domestic water use and Livestock water use. The ratio of water used to hydroelectric energy produced for each county also matched those used in 1985. This ratio was applied to hydroelectric energy values produced in 1990 to determine total water use in hydroelectric. These coefficients and ratios are the reason for this source listing. Although it is unknown how these consumptive use and hydroelectric total water-use values were determined for 1985, no better values were available for 1990. The use of these 1985 coefficients and ratios in 1990 provide some consistency.

SOURCE #11

AGENCY: Preparation of this preliminary report (subject to revision) was a cooperative effort by agencies of the U.S. Government, under the sponsorship of the Office of Water Data Coordination, USGS. The report is intended to be included eventually in the national handbook of recommended methods for water-data acquisition.

CONTACT PERSON/REFERENCE CITATION: Publication: USGS National handbook of recommended methods for water-data acquisition, Chapter 11--water use, by Richard A. Herbert and others, in review.

WATER-USE CATEGORIES: Livestock - Animal Specialties.

TYPE OF DATA: Water-withdrawal estimate based on the water-use coefficient for horses.

ACCURACY (poor, fair, good, excellent): Overall accuracy of this coefficient is undetermined.

AREAL EXTENT (site specific, county, HUC, other): The coefficient used for the Indiana 1990 compilation was the coefficient developed from Illinois data.

FORMAT (printout, publication, verbal communication, other): Publication--preliminary, subject to revision.

SOURCE #12

AGENCY: Publication produced by the USGS, Branch of Water-Use Information, for internal use only.

CONTACT PERSON/REFERENCE CITATION: Publication (personal communication): Guidelines for preparation of State water-use estimates, by Leslie D. Patrick and others, USGS, October 1990.

WATER-USE CATEGORIES: Industrial and Commercial.

TYPE OF DATA: Distribution-loss coefficient, used to determine deliveries from Public Water Supply to Industrial and Commercial.

ACCURACY (poor, fair, good, excellent): Overall accuracy of distribution-loss coefficient as it pertains to Indiana is undetermined.

AREAL EXTENT (site specific, county, HUC, other): Coefficient applied to county data.

FORMAT (printout, publication, verbal communication, other): Publication, for internal agency use only.

REMARKS:

Distribution-loss coefficients are discussed on page 25 of the "Guidelines" publication. The distribution-loss coefficient of 15 percent of withdrawals is the default value used in the IWR-MAIN model, which is a widely used water-use projection model.

SOURCE #13

AGENCY: Indiana Department of Natural Resources, Division of Water.

CONTACT PERSON/REFERENCE CITATION: Publication: The 1981 Survey of Public Water Supply Service Areas in Indiana, by IDNR, Division of Water, 1982.

WATER-USE CATEGORIES: Industrial and Commercial.

TYPE OF DATA: Deliveries from Public Supply.

ACCURACY (poor, fair, good, excellent): Fair.

AREAL EXTENT (site specific, county, HUC, other): County maps which show the estimated distribution areas for each Public Water Supply company.

FORMAT (printout, publication, verbal communication, other): Publication.

REMARKS:

In producing the IDNR report, each PS facility was provided with a map of its local area. The manager of each facility was asked to delineate on that map the areas to which the facility distributed water. The manager also was asked to indicate, by arrows, neighboring PS facilities to which water was sold or from which water was purchased.

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