

# Trends in Offstream Water Use in Indiana, 1960–90

By Donald V. Arvin

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Robert M. Hirsch, Acting Director



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

Copies of this report can be purchased from:  
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## CONVERSION FACTORS

<b>Multiply</b>	<b>By</b>	<b>To obtain</b>
gallon per minute (gal/min)	0.06309	liter per second
gallon per day (gal/d)	0.003785	cubic meter per day
million gallons per day (Mgal/d)	0.003785	million cubic meter per day

# Trends in Offstream Water Use in Indiana, 1960-90

By Donald V. Arvin

## ABSTRACT

Total withdrawals of water have increased since 1960, although there have been periods of increases and decreases. The largest water use (14,300 Mgal/d) occurred in 1980; this amount was almost 2.5 times greater than that used in 1960. There has been a general increase in withdrawals by public water suppliers, with a trend toward an increasing percentage of population relying on public supplies as their source of water for domestic use. Water use by industries increased during the 1960's, leveled off during the 1970's, followed by a general decrease in the 1980's. Industries and power plants rely heavily on surface water. In Indiana, more water is used for energy production than all other water-use categories combined.

## INTRODUCTION

In 1977, the Congress of the United States recognized the need for uniform, up-to-date, and reliable information on water use, and directed the U.S. Geological Survey to establish a National Water-Use Information Program. As of 1992, all States are participating in the program at various levels of involvement.

Since 1950, the U.S. Geological Survey (USGS) has been compiling and publishing at 5-year intervals estimates of water use in the United States (MacKichan, 1951, 1957; MacKichan and Kammerer, 1961; Murray, 1968; Murray and Reeves, 1972, 1977; and Solley and others, 1983, 1988, 1993). The Indiana District of the USGS has been compiling estimates of water use in Indiana for inclusion in each of these 5-year reports. These 5-year reports can be used to analyze general trends in water use and plan for the future uses of the State's water resources. Water-use estimates in Indiana are derived from a variety of sources, including the Indiana Department of Natural Resources (IDNR) Division of Water, the Indiana Department of Environmental Management, the Bureau of the Census, and others. Because these estimates range widely in accuracy and consistency, the analyses presented in this report are only general trends.

The focus of this report is on trends in total offstream water use in Indiana and trends in industrial and thermoelectric-power-generation water use from 1960 through 1990—the two water-use categories that use the largest amounts of water in Indiana. Data published in 1950 and 1955 are not included in these analyses because industrial water use and thermoelectric-power-generation water use were not listed as separate categories for those years. A discussion also is presented on withdrawals by public-water suppliers because of their important role in providing water for various uses throughout the State.

## **SOURCES AND ACCURACY OF WATER-USE ESTIMATES**

Many of the techniques used to estimate water use have changed significantly since 1950. The introduction of water-user reporting requirements and the development of computerized data bases have improved the reliability of water-use data.

Prior to 1985, water withdrawals, a major component of water-use information, were estimated by multiplying various forms of population data by water-use coefficients. Water-withdrawal estimates were improved for 1985; the 1983 Indiana General Assembly enacted the Water Resource Management Act (Indiana Code 13-2-6.1), requiring all facilities capable of withdrawing 100,000 gallons of water per day (or about 70 gallons per minute) to register with and report their monthly withdrawals annually to IDNR (U.S. Geological Survey, 1990). Since 1985, the IDNR Division of Water, Water Use Section, has maintained a comprehensive and flexible water-withdrawal data base and has provided reported withdrawal data to the USGS and other interested organizations. Since 1986, IDNR has published an annual report of water use in Indiana, which is a detailed account of reported surface- and ground-water withdrawals by county. Reporting is not required by those who are not capable of withdrawing at the 100,000 gal/d rate; water use is still estimated for users who fall below this threshold.

Because of the limited accuracy of water-use estimates prior to 1985, it is difficult to determine if the general water-use trends during 1960-90 reflect changes in water use or changes in estimation techniques. This uncertainty emphasizes

the need for reliable water-use information, such as the withdrawal data collected and maintained by IDNR since 1985.

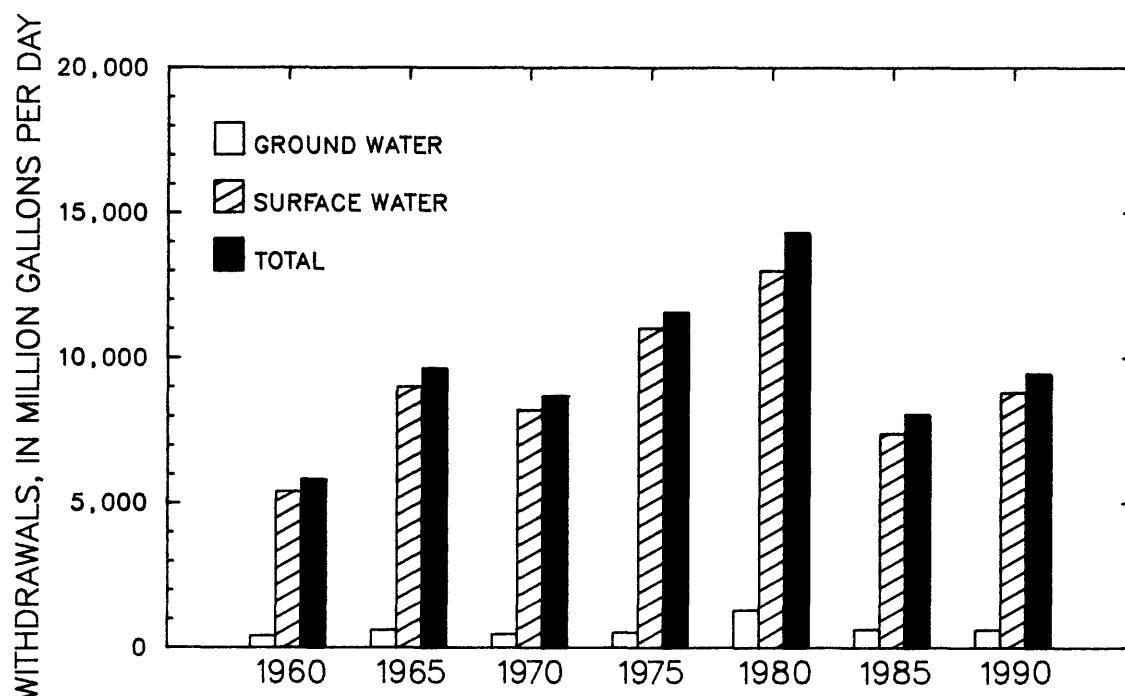
## **TRENDS IN OFFSTREAM WATER USE**

Offstream water use includes any water that is diverted or withdrawn from a surface- or ground-water source and conveyed to the place of use. Instream water use (not included in this report) is a water use that occurs within the channel, such as for recreation, navigation, or hydroelectric-power generation (Solley, 1993).

Total water use for the five major offstream water-use categories—domestic, irrigation, industry, thermoelectric-power generation, and livestock—have increased since 1960, although there have been periods of increases and decreases (fig. 1). The largest amount of water use occurred in 1980, when 14,300 million gallons per day (Mgal/d) were used. This amount was almost 2.5 times greater than the amount used in 1960 (5,800 Mgal/d). Total water use during 1985 (8,040 Mgal/d) was 44 percent less than in 1980; a 5,000 Mgal/d decline in water use for thermoelectric-power generation occurred during that same period.

### **Public Supply**

Public-water suppliers are public or private facilities that withdraw water from surface- or ground-water sources and deliver the water to other users. Although public-water suppliers, by definition, are not water users, public-water suppliers do provide water for a variety of use categories.



**Figure 1.** Trends in total withdrawals in Indiana, 1960–90.

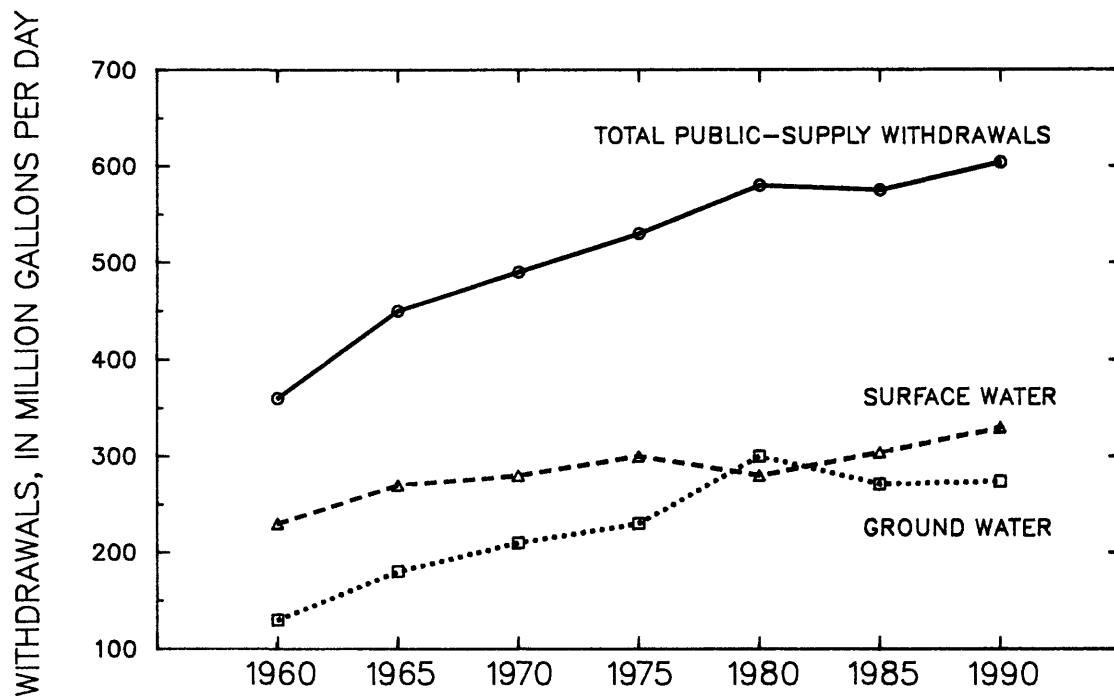
Total withdrawals by public-water suppliers have increased from 1960 through 1990. An exception was a slight decrease in withdrawals in 1985 (fig. 2). Withdrawals in 1990 (604 Mgal/d) were nearly 68 percent greater than those in 1960 (360 Mgal/d). Some of the increase in withdrawals by public-water suppliers can be attributed to the steady increase in the State's population (fig. 3). Since 1980, an increasing percentage of the population has relied on public supplies as a source of water for domestic use.

### Industrial Water Use

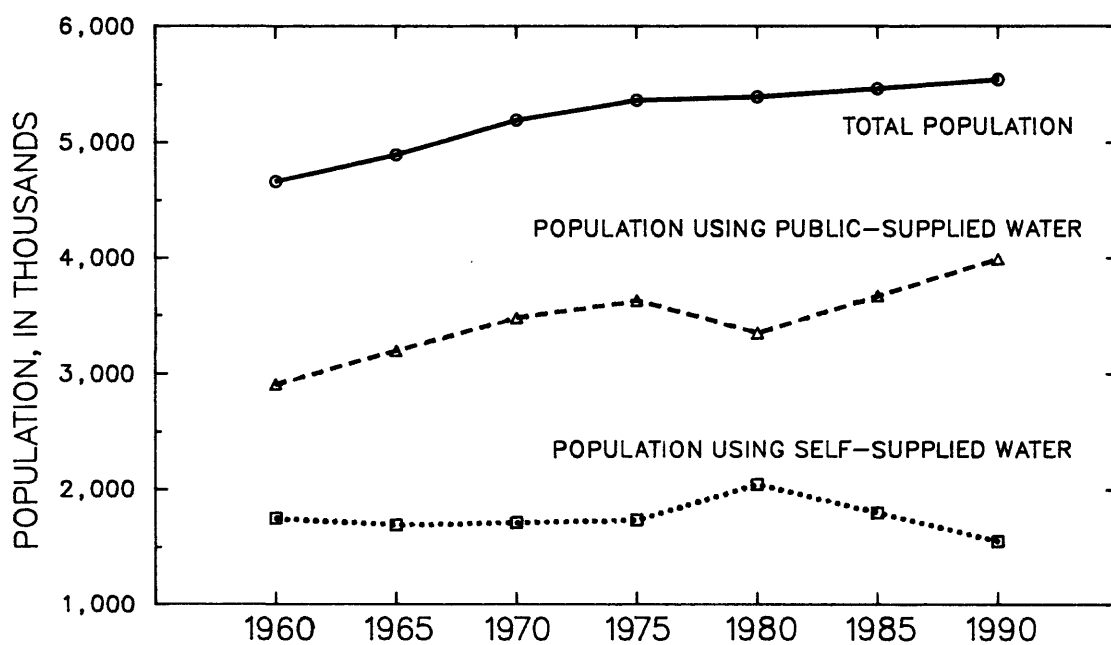
Industrial water use, as presented here, includes water used for industrial, commercial, and mining purposes. Estimates of total industrial water use (which is the sum of self-supplied

surface-water withdrawals, self-supplied ground-water withdrawals, and deliveries from public-water suppliers) indicate increasing use during the 1960's, a leveling off during the 1970's, followed by a decline in the 1980's (fig. 4). Techniques for estimating industrial water use were greatly improved beginning with the 1985 estimates (see "Sources and Accuracy of Water-Use Estimates" section). Some of the decrease shown in the 1980's could be a result of improved estimation techniques or the result of more efficient water use by industries and changing economic conditions.

Industries in the State rely heavily on surface-water sources. During 1990, the use of self-supplied surface water (2,470 Mgal/d) was over 14 times that of self-supplied ground water

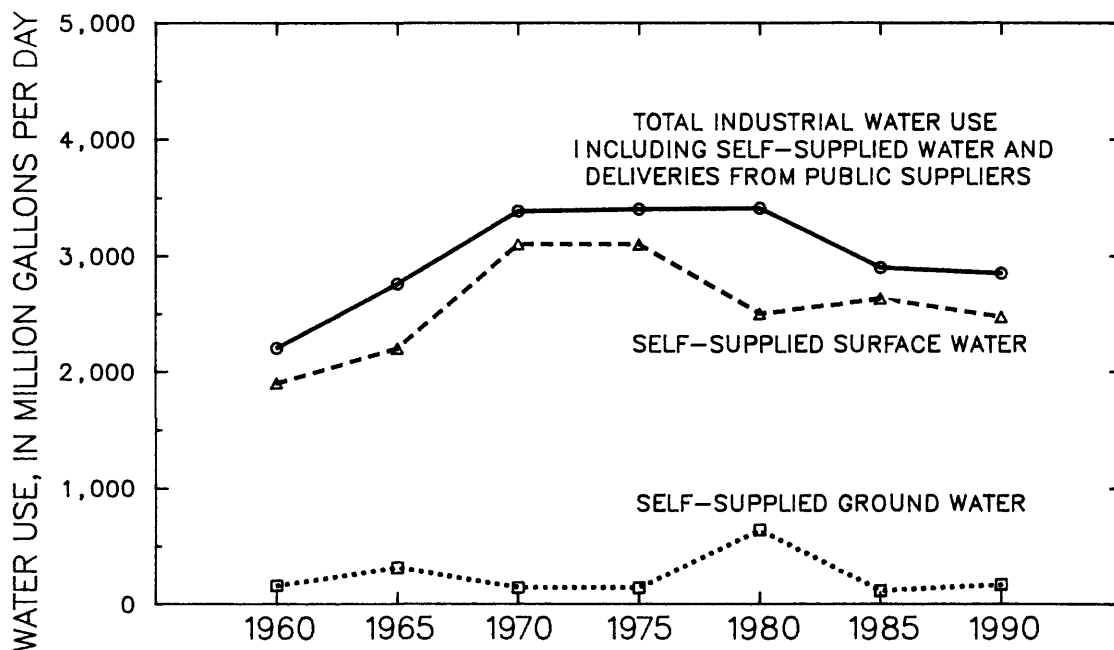


**Figure 2.** Trends in withdrawals by public water suppliers in Indiana, 1960–90.



**Figure 3.** Total, public-supplied, and self-supplied population in Indiana, 1960–90.





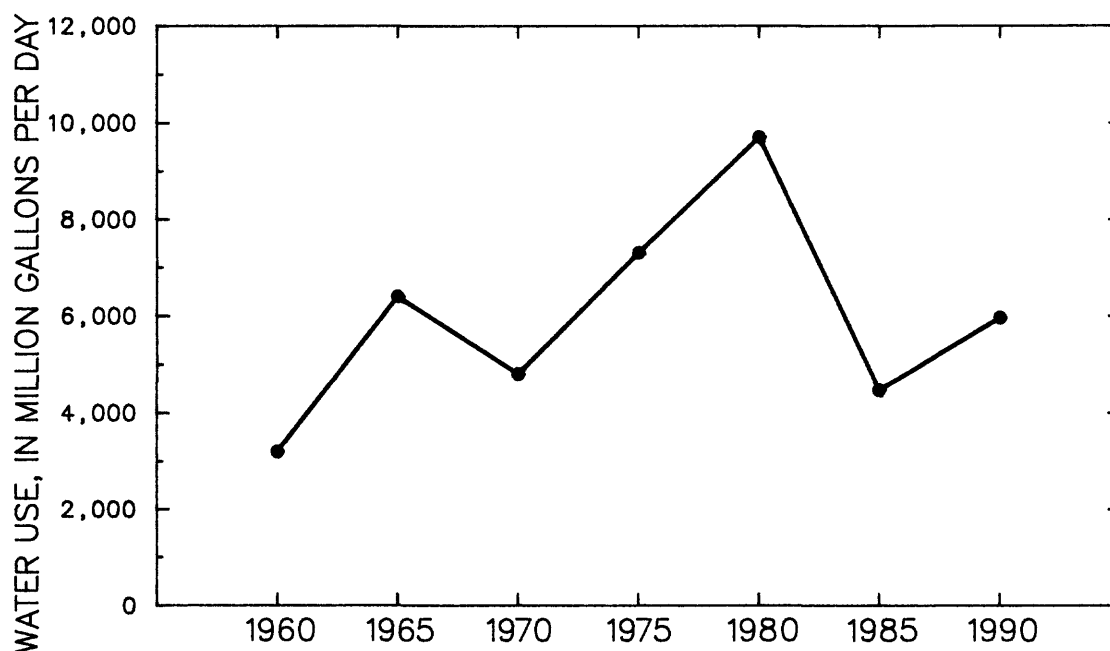
**Figure 4.** Trends in industrial water use in Indiana, 1960–90.

(172 Mgal/d). During the period 1960 through 1990, use of self-supplied surface water ranged from 4 to 22 times that of self-supplied ground water.

#### **Thermoelectric-Power-Generation Water Use**

Each of the 5-year estimates made from 1960 through 1990 indicates that more water was used in Indiana for thermoelectric-power generation than for all other offstream water-use categories combined. Most of this water was used for cooling purposes and was returned to the natural system, making the water available for other uses.

Large fluctuations in water use for thermoelectric-power generation occurred during the period from 1960 through 1990 (fig. 5). During 1980, the amount of water used (9,700 Mgal/d), was 3 times greater than the amount used during 1960 (3,200 Mgal/d). The amount used during 1985 (4,470 Mgal/d) represented a 54-percent decrease from the amount used during 1980. Although some of the decrease might reflect changes in estimation techniques, much of the decrease might be the result of changes in power-production technology, including more recycling of water for use in cooling towers.



**Figure 5.** Trends in water use for thermoelectric-power generation in Indiana, 1960–1990.

Most water used for thermoelectric-power generation was self-supplied surface water. During the period 1960 through 1990, it was estimated that ground-water withdrawals never exceeded 1 percent of the total amount of water used for this category.

## SUMMARY

Water-use information included in the 5-year reports published by the USGS from 1960 through 1990 were analyzed to determine general trends of offstream water use in Indiana. Total withdrawals have increased since 1960. The largest

amount of water use during this interval (14,300 Mgal/d) occurred during 1980. There has been a general increase in withdrawals by public-water suppliers, with a trend toward an increasing percentage of the population relying on public supplies as their source of water for domestic use. Industries and powerplants rely heavily on surface water sources. In Indiana, more water is used for energy production than all other water-use categories combined. Beginning in 1985, reliability of the water-withdrawal data improved when facilities capable of withdrawing 100,000 gallons per day were required to report their monthly withdrawals annually to IDNR.

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