SUMMARY OF WATER WITHDRAWALS IN THE UNITED STATES, 1950—80

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ABSTRACT

Estimated use of water in the United States increased from 180 bgd (billion gallons per day) in 1950 to 450 bgd in 1980. During this same time population increased from about 150 million to about 230 million. Data on consumptive use are not available for the first decade of the period; however, from 1960 to 1980, consumptive use increased from 61 bgd to 100 bgd.

From 1950 to 1980, fresh surface-water withdrawals increased from 140 bgd to 290 bgd and fresh ground-water withdrawals increased from 34 bgd to 88 bgd. Withdrawals of saline surface water increased from 10 bgd in 1950 to 71 bgd in 1980. In 1980, 91 percent of the saline surface water withdrawn was used in thermoelectric power plants.

Withdrawals of water for domestic purposes nationwide increased from 16 bgd in 1960 to 25 bgd in 1980. The Northeastern States still are the largest users of water for domestic purposes; however, domestic withdrawals in that region declined from 9.6 bgd in 1975 to 8.8 bgd in 1980. Population in that region also showed a slight decline from 1970 to 1980.

Irrigation withdrawals nationwide increased from 89 bgd in 1950 to 150 bgd in 1980. The Western States continue to be the largest user of irrigation water, 136 bgd in 1980. Irrigation accounted for 81 percent of the total consumptive use for the Nation in 1980.

Industrial withdrawals (exclusive of thermoelectric power generation) increased from 44 bgd in 1960 to about 56 bgd in 1980. The Northeast Region continues to withdraw the largest amount of water for industrial purposes, although withdrawals declined steadily from 33 bgd in 1965 to 27 bgd in 1980.

Total withdrawals for thermoelectric power generation increased from about 99 bgd in 1960 to about 210 bgd in 1980. During that period, saline surface water withdrawals increased from 26 bgd to 71 bgd. Thermoelectric plants accounted for 84 percent of saline surface water withdrawals in 1960 compared to 91 percent in 1980. Withdrawals for thermoelectric power generation continue to be the largest in the Northeast, 113 bgd in 1980, where many of the major industrial and population centers are located.

Agriculture (nonirrigation) water withdrawals nationwide increased from 1.6 bgd in 1960 to about 2.2 bgd in 1980. Withdrawals for this purpose in 1980 were about evenly divided between the West and East.

INTRODUCTION

The U.S. Geological Survey has published national estimates of water use in the United States since 1950 at 5-year intervals. These estimates were derived from a variety of sources and have a wide range of accuracy. 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 a National Water-Use Information Program to complement the Survey's long-standing data on the availability and quality of the Nation's water resources.

The National Water-Use Information Program helped increase the accuracy of the information collected and compiled for the 1980 water-use summary report (Solley and others, 1983) by providing funds to support more comprehensive field data collection and more detailed evaluations of existing water-use data. As more State water-use information systems are developed and refined, the timeliness and accuracy of water-use data at both the State and national levels are expected to continue to improve.

Water use involves the following three factors.

1. Withdrawals--the amount of water withdrawn or diverted from a ground- or surface-water source.

2. Delivery/release--the amount of water delivered at the point of use and the amount released after use. The difference between these volumes will in some instances be the consumptive use, the amount of water that is no longer available for subsequent use.

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

Water use is considered as offstream use and instream use. The difference between these two types of use is explained below.

Offstream use is a water use that depends on water being withdrawn or diverted from a ground- or surface-water source.

Instream use is a water use not dependent on a withdrawal or diversion from a ground- or surface-water source, and is usually classified as flow uses or onsite uses.

This report only considers offstream water withdrawals, and describes the trends in withdrawals from 1950 to 1980 based on data from the 5-year interval water use summary reports. The accuracy of the data is variable from State to State and between each of the 5-year reports. Although trends in water withdrawals in individual States may not provide reliable comparisons, national and regional trends reflect, with some degree of accuracy, changes in demands for water or shifts in these water demands over this period.

The national trends describe the total water withdrawals in the 50 States, Puerto Rico, and the District of Columbia. Regional trends are described for

the 48 conterminous States. The Western Region includes the 17 States west of the Mississippi River and the Eastern Region includes the 31 States and the District of Columbia east of the Mississippi River. The Eastern Region has been further divided into the Northeast, which includes the 20 States and the District of Columbia north of the Ohio river, and the Southeast, which include the 11 remaining States (See figure 1).

TRENDS IN WATER WITHDRAWALS

Total Offstream Withdrawals

Water withdrawals for the offstream categories of use--domestic, agriculture (nonirrigation), irrigation, industry, and thermoelectric power--increased steadily from 180 bgd in 1950 to 450 bgd in 1980, or 2 1/2 times (fig. 2). During this same period the total population has increased from about 150 million in 1950 to about 230 million in 1980, or 1 1/2 times (fig. 3). The per capita use based on the total population and total water withdrawn increased from about 1,190 gallons per capita per day (gpcd) in 1950 to about 1,960 gpcd in 1980.

Total surface-water withdrawals (fresh and saline water) increased from 150 bgd in 1950 to 360 bgd in 1980. Saline surface-water withdrawals increased from 10 bgd in 1950 to 71 bgd in 1980 (fig. 4).

Total ground-water withdrawals increased from 34 bgd in 1950 to 89 bgd in 1980 (fig. 4). Saline ground-water withdrawals in 1980 amounted to only 1 bgd.

Total consumptive use increased from 61 bgd in 1960 to 100 bgd in 1980. Irrigation accounted for 81 percent of the total consumptive use for the Nation in 1980.

Domestic Withdrawals

Nationwide.--Domestic withdrawals nationwide increased from about 16 bgd in 1960 to 25 bgd in 1980. This is an increase in per capita use for the Nation for domestic purposes from 90 gallons per capita per day (gpcd) in 1960 to 111 gpcd in 1980. Figure 5 shows domestic withdrawals for the geographic regions discussed in this report. Figure 6 shows population and domestic per capita use for the geographic regions. "Domestic withdrawals" by definition includes rural domestic use that is self-supplied as well as domestic needs supplied by public supply systems. Before 1960, public supply withdrawals were not separated into domestic, industrial and commercial users.

Western Region.--Domestic withdrawals in the West increased from 5.2 bgd in 1960 to 8.6 bgd in 1980 (fig. 5). Note that for the period 1965 to 1970, the withdrawals remained about constant. From 1960 to 1980, the population in the West increased from 44 million to 64 million. The per capita use increased from 118 gpcd in 1960 to 128 gpcd in 1965, decreased to 117 gpcd in 1970, then steadily increased to 134 gpcd in 1980 (fig. 6).

Eastern Region.--In the East, domestic withdrawals increased from 8.7 bgd in 1960 to 12.7 bgd in 1980 (fig. 5). This is an increase in per capita use from

65 gpcd to 79 gpcd (fig. 6). During this period, the population in the East increased from 134 million to 161 million.

Northeastern Region.--In the Northeast, domestic withdrawals increased from 6.4 bgd in 1960 to 9.6 bgd in 1975 and declined to 8.8 bgd in 1980 (fig. 5). This is an increase in per capita use from 66 gpcd in 1960 to 87 gpcd in 1975, and a decrease to 80 gpcd in 1980 (fig. 6). During this period, the population in the Northeast increased from about 97 million in 1960 to slightly over 110 million in 1975, declining to just under 110 million in 1980. About 40 percent of the national domestic withdrawals in 1960 and about 35 percent in 1980 was accounted for in the Northeast where many of the major population centers are located.

Southeastern Region.--Domestic withdrawals in the Southeast increased from 2.3 bgd in 1960 to 3.9 bgd in 1980 and remained farily constant during the period 1960 to 1970 (fig. 5). From 1960 to 1980, the population steadily increased from 37 million to 51 million. Per capita use decreased from 62 gpcd in 1960 to 57 gpcd in 1970 and then increased to 76 gpcd in 1980 (fig. 6).

Irrigation Withdrawals

Nationwide.--Total irrigation withdrawals increased from 89 bgd in 1950 to 150 bgd in 1980. There was a slight decline from 1955 to 1960, but since 1960 there has been a steady increase. Figure 7 shows irrigation withdrawals from 1950 to 1980 and acres irrigated from 1960 to 1980. Data on acres irrigated were not available by regions before 1960.

Western Region.--Irrigation withdrawals in the West increased from 85 bgd in 1950 to 136 bgd in 1980. Withdrawals decreased from 106 bgd in 1955 to 103 bgd in 1960 and 1965 and since then irrigation withdrawals have steadily increased. The number of acres irrigated in the West have increased from 36 million in 1960 to 49 million in 1980. Annual irrigation application rates in the West ranged from 2.5 acre foot per acre (ac-ft/ac) to 3.1 ac-ft/ac during this period.

Eastern Region.--Irrigation withdrawals in the East increased from 2.7 bgd in 1950 to 13.5 bgd in 1980. In 1955 and 1960 irrigation withdrawals were about 3.8 bgd and thereafter increased steadily. Acres irrigated increased from 3.3 million in 1960 to 8.4 million in 1980. Irrigation application rates ranged from 1.5 ac-ft/ac to 2.2 ac-ft/ac.

Northeastern Region.--Irrigation withdrawals in the Northeast increased from 0.1 bgd in 1950 to 1.3 bgd in 1980. The withdrawals remained constant at 0.3 bgd in 1955 and 1960. During the period 1960 to 1980, irrigated acres increased from 0.5 million to 2.0 million. Irrigation application rates ranged from 0.6 ac-ft/ac to 0.7 ac-ft/ac.

Southeastern Region.--In the Southeast, withdrawals for irrigation steadily increased from 2.6 bgd in 1950 to 12.2 bgd in 1980 with a slight decrease from 3.5 bgd in 1955 to 3.4 bgd in 1960. During the period 1960 to 1980,

irrigated acres increased from 2.8 million to 6.4 million. Irrigation application rates ranged from 1.4 ac-ft/ac to 2.1 ac-ft/ac.

Industrial Withdrawals

Nationwide.--Total industrial withdrawals increased from about 44 bgd in 1960 to about 55 bgd in 1970, then decreased slightly to about 53 bgd in 1975 and increased to 56 bgd in 1980. Industrial withdrawals include the industrial and commercial withdrawals from public supply systems and withdrawals by industries that supply their own water (self supplied). It does not include the water withdrawn for themoelectric power generation which is discussed in a later section of this report. No data are available for the years 1950 and 1955 because data on public supply withdrawals did not separate industrial and commerical users from domestic users nor did industrial self-supplied withdrawals distinguish between thermoelectrical power and other industrial users. Figure 8 shows industrial withdrawals from 1960 to 1980 for the geographic regions.

Western Region.--Industrial withdrawals in the West increased from 6.5 bgd in 1960 to almost 14 bgd in 1965 and declined slightly to about 12 bgd in 1970. From 1970 to 1980, the withdrawals only increased to about 13 bgd.

Eastern Region.--In the East, industrial withdrawals increased from about 38 bgd in 1960 to about 43 bgd in 1970. From 1970 the withdrawals declined slightly to about 41 bgd in 1975 and increased to about 42 bgd in 1980.

Northeastern Region.--In the Northeast, where many of the major industrial centers are located, industrial withdrawals increased from about 29 bgd in 1960 to about 33 bgd in 1965. Since 1965 the withdrawals steadily declined to about 27 bgd in 1980. The Northeast accounted for about 66 percent of the total industrial withdrawals in 1960 but only accounted for about 48 percent in 1980.

Southeastern Region.--Industrial withdrawals in the Southeast increased from 8.8 bgd in 1960 to about 15 bgd in 1980. However, the withdrawals declined from 8.8 bgd in 1960 to 6.2 bgd in 1965 and then more than doubled to about 13 bgd in 1970.

Thermoelectric-Power-Generation Withdrawals

Nationwide.--Total withdrawals for thermoelectric power generation increased from about 99 bgd in 1960 to about 210 bgd in 1980. During this period, the use of saline water for thermoelectric power generation increased from about 26 bgd to about 65 bgd. Thermoelectric power plants continue to withdraw the largest quantity of water for offstream use. About 99 percent of the total water withdrawn in 1980 by these plants was used for condenser and reactor cooling.

In 1980, 91 percent of the saline surface water withdrawn was used in thermoelectric power plants. In 1960, thermoelectric power plants accounted for 84 percent of the saline surface water withdrawn.

Figure 9 shows withdrawals for thermoelectric power generation from 1960 to 1980 for the geographic regions. Before 1960, the available water data did not separate withdrawals for thermoelectric power generation from withdrawals for other industrial uses.

Western Region.--In the West, withdrawals for thermoelectric power generation increased from about 15 bgd in 1960 to about 25 bgd in 1975. From 1975 to 1980 the withdrawals declined to about 22 bgd.

Eastern Region.--Withdrawals for thermoelectric power generation are largest in the East where most of the major industrial and population centers are located. These withdrawals increased from about 84 bgd in 1960 to about 189 bgd in 1980. The increase in withdrawals was nearly constant between 1960 and 1965 and between 1965 and 1970 at about 28 percent. However, between 1970 and 1975, the increase was about 18 percent and between 1975 and 1980 it was about 14 percent.

Northeastern Region.--Withdrawals for thermoelectric power generation in the Northeast increased from about 59 bgd in 1960 to about 113 bgd in 1980. Between 1960 and 1965, the withdrawals increased about 28 percent; however, between 1975 and 1980 the increase was only about 3 percent.

Southeastern Region.--In the Southeast, withdrawals for thermoelectric power generation steadily increased from about 25 bgd in 1960 to about 76 bgd in 1980. The greatest increase in withdrawals, 38 percent, occurred between 1975 and 1980.

Agriculture (nonirrigation) Withdrawals

Nationwide.--Agriculture (nonirrigation) water withdrawals nationwide were about 1.6 bgd in 1960, which was about 0.6 percent of the total offstream withdrawals. In 1980, the withdrawals increased to 2.2 bgd, about 0.5 percent of the total offstream withdrawals. Agriculture (nonirrigation) withdrawals is defined as including the water used for stock watering, feed lots, dairy operations, and other on-farm needs. It does not include withdrawals for rural domestic needs or irrigation. Figure 10 shows withdrawals for non-irrigation agriculture for the geographic regions.

Western Region.--Agriculture use in the West steadily increased from about 0.6 bgd in 1960 to 1.0 bgd in 1980.

Eastern Region.--In the East, agriculture use decreased from about 0.9 bgd in 1960 to about 0.8 bgd in 1965. It increased to nearly 1.2 bgd in 1975 and then decreased to about 1.1 bgd in 1980.

Northeastern Region.--Agriculture use in the Northeast decreased from about 0.6 bgd in 1960 to about 0.5 bgd in 1965. It increased to about 0.7 bgd in 1975 and then decreased to about 0.6 bgd in 1980.

Southeastern Region.--In the Southeast, agriculture use has gradually increased from about 0.3 bgd in 1960 to nearly 0.5 bgd in 1980.

Summary

Total water withdrawals for offstream use increased from 180 bgd in 1950 to 450 bgd in 1980, or 2 1/2 times. During that time, the total population increased from about 150 million to about 230 million, or 1 1/2 times.

Withdrawals by source show that total surface-water withdrawals increased from 150 bgd to 360 bgd and total ground-water withdrawals increased from 34 bgd to 89 bgd from 1950 to 1980. Withdrawals of saline surface water increased from 10 bgd in 1950 to 71 bgd in 1980. Saline ground-water withdrawals were negligible. Thermoelectric power generation withdrawals accounted for 91 percent of the saline surface-water withdrawals in 1980.

Domestic withdrawals increased from about 16 bgd in 1960 to 25 bgd in 1980. During this period, domestic withdrawals increased steadily in the West and Southeast. In the Northeast, the withdrawals decreased slightly from 1975 to 1980 and the population also decreased slightly from 1970 to 1980.

Irrigation withdrawals nationwide increased from 89 bgd in 1950 to 150 bgd in 1980. In the West, which accounted for 91 percent of the irrigation withdrawals in 1980, irrigation withdrawals increased from 75 bgd in 1950 to 136 bgd in 1980. In the Northeast and Southeast, irrigation withdrawals increased from 0.1 bgd and 2.4 bgd in 1950, respectively, to 1.3 bgd and 12.2 bgd in 1980, respectively.

Industrial withdrawals nationwide increased from about 44 bgd in 1960 to about 55 bgd in 1970, then decreased slightly to about 53 bgd in 1975 and increased to 56 bgd in 1980. In the West, industrial withdrawals increased from 6.5 bgd in 1960 to almost 14 bgd in 1965, declined slightly to about 12 bgd in 1970 and increased to about 13 bgd in 1980. In the Southeast, industrial withdrawals increased from 8.8 bgd in 1960 to about 16 bgd in 1980. The withdrawals declined from 8.8 bgd in 1960 to 6.2 bgd in 1965 and then more than doubled to about 13 bgd in 1970. Industrial withdrawals in the Northeast increased from 29 bgd in 1960 to about 33 bgd in 1965 and declined steadily to about 27 bgd in 1980. About 66 percent of the total industrial withdrawals in 1960 occurred in the Northeast where many of the major industrial centers are located. By 1980 this percent declined to about 48 percent of the total industrial withdrawals.

Thermoelectric power generation withdrawals increased from about 99 bgd in 1960 to about 210 bgd in 1980. About 65 bgd or 91 percent of the saline surface water withdrawn in 1980 was used in thermoelectric power plants. In the Northeast, withdrawals increased from about 59 bgd in 1960 to about 113 bgd in 1980. This was 60 percent of total thermoelectric power withdrawals in 1960 and 54 percent in 1980. In the West, the thermoelectric power withdrawals increased from 15 bgd in 1960 to about 25 bgd in 1975 and then declined to about 22 bgd in 1980. Withdrawals for thermoelectric power in the Southeast increased from about 25 bgd in 1960 to about 76 bgd in 1980. Between 1975 and 1980, the withdrawals increased 38 percent in the Southeast.

Agriculture (nonirrigation) water withdrawals nationwide were about 1.6 bgd in 1960 and increased to 2.2 bgd in 1980. In both the West and the Northeast agriculture withdrawals were about 0.6 bgd in 1960. In 1980, the withdrawals had increased to about 1.0 bgd in the West and were about 0.6 bgd in the Northeast.

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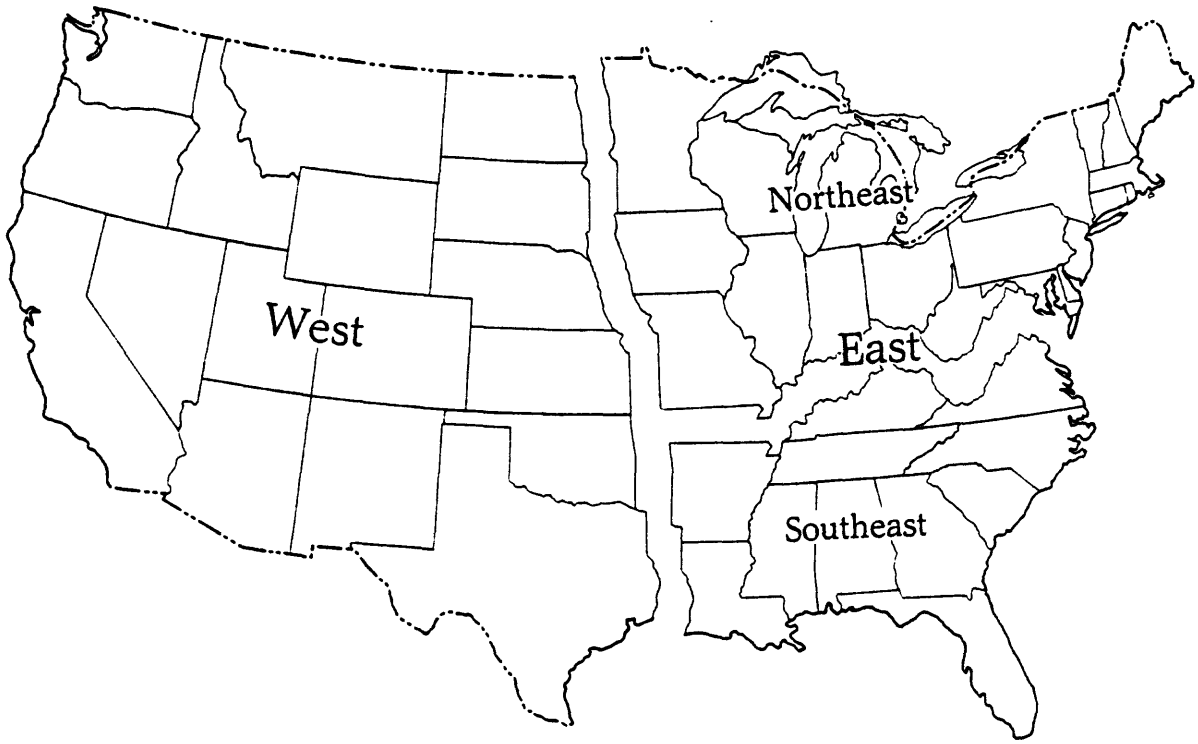

Figure 1. Map of United States showing geographic regions used in this report.

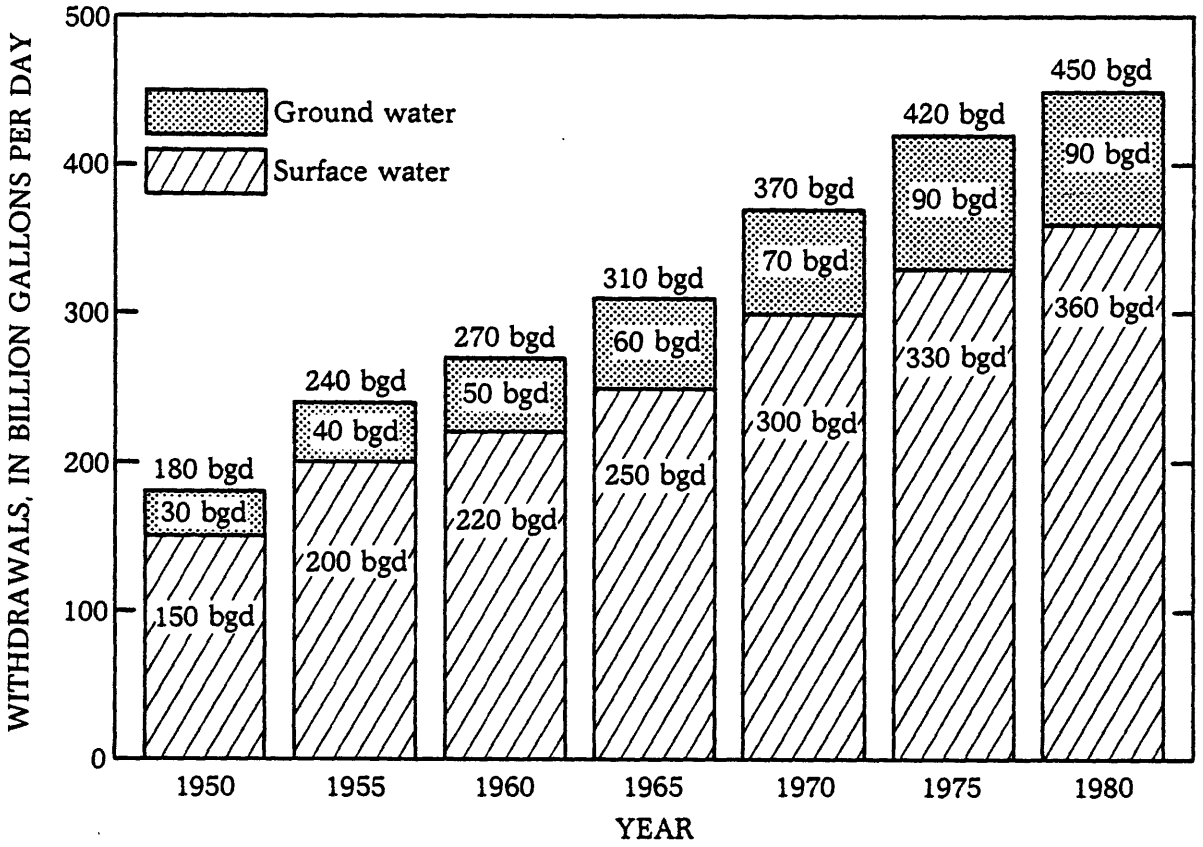

Figure 2. Total offstream water withdrawals, 1950-80.

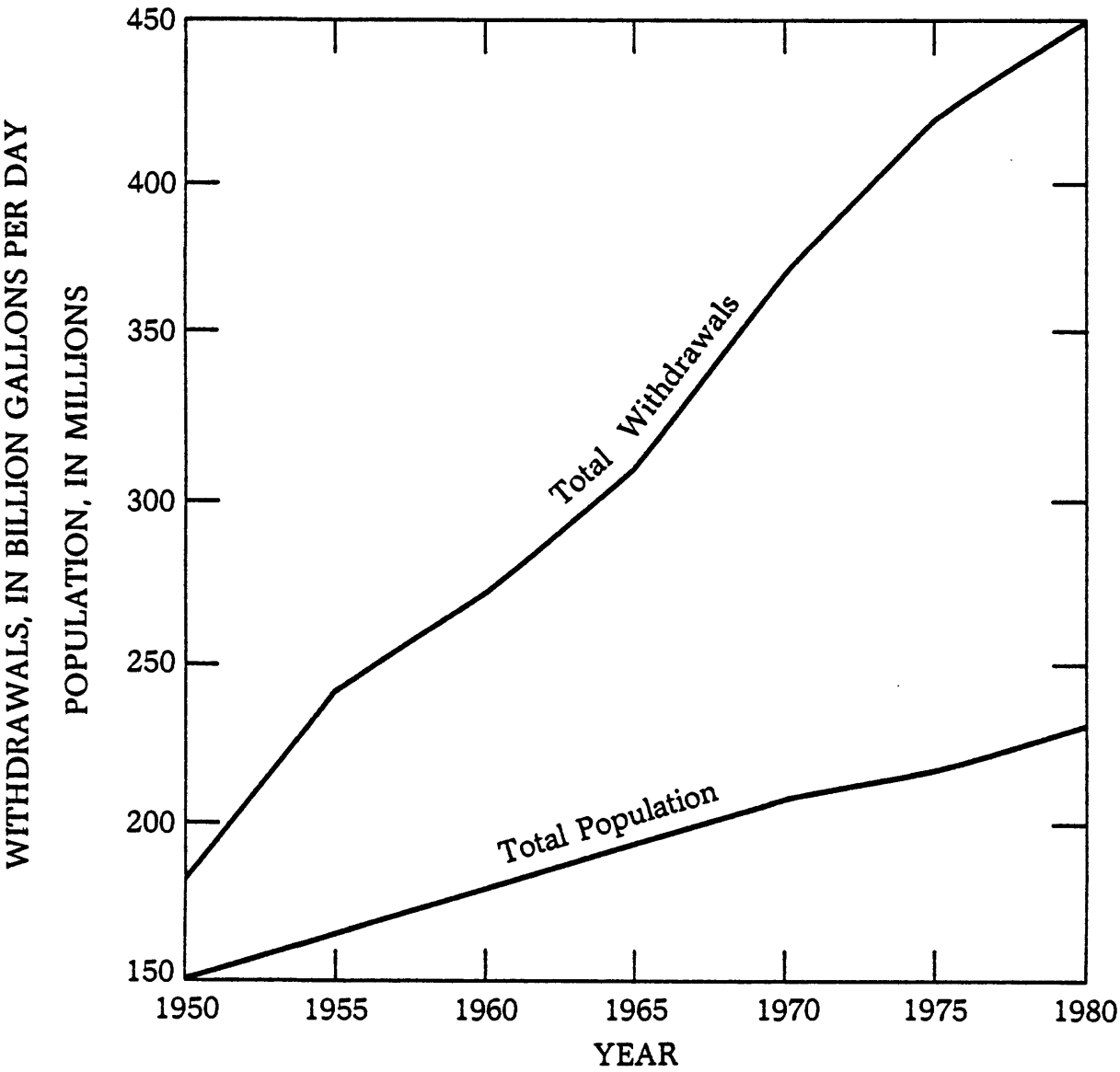

Figure 3. Total offstream water withdrawals and total population, 1950-80.

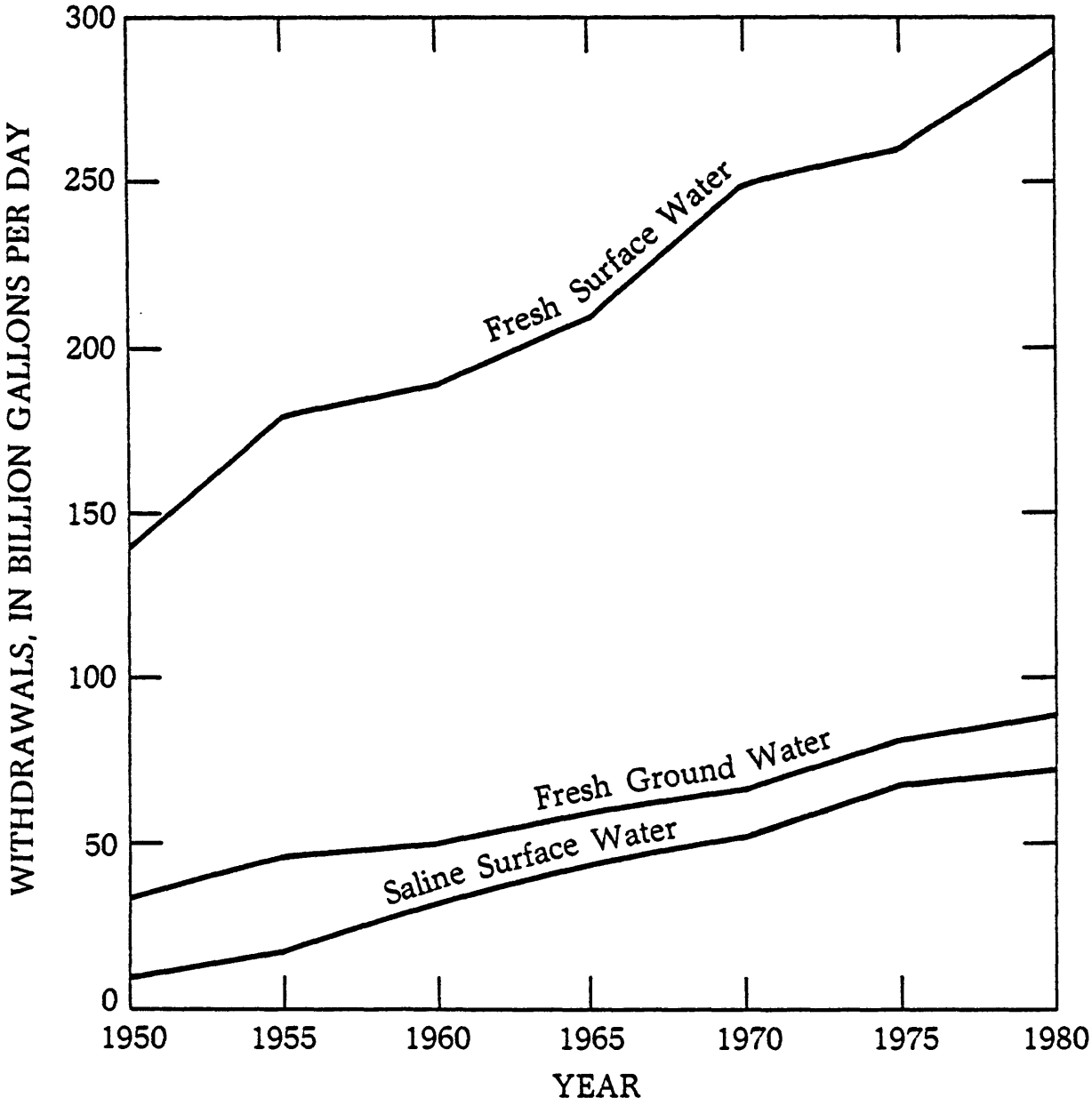

Figure 4. Total offstream water withdrawals by source, 1950-80.

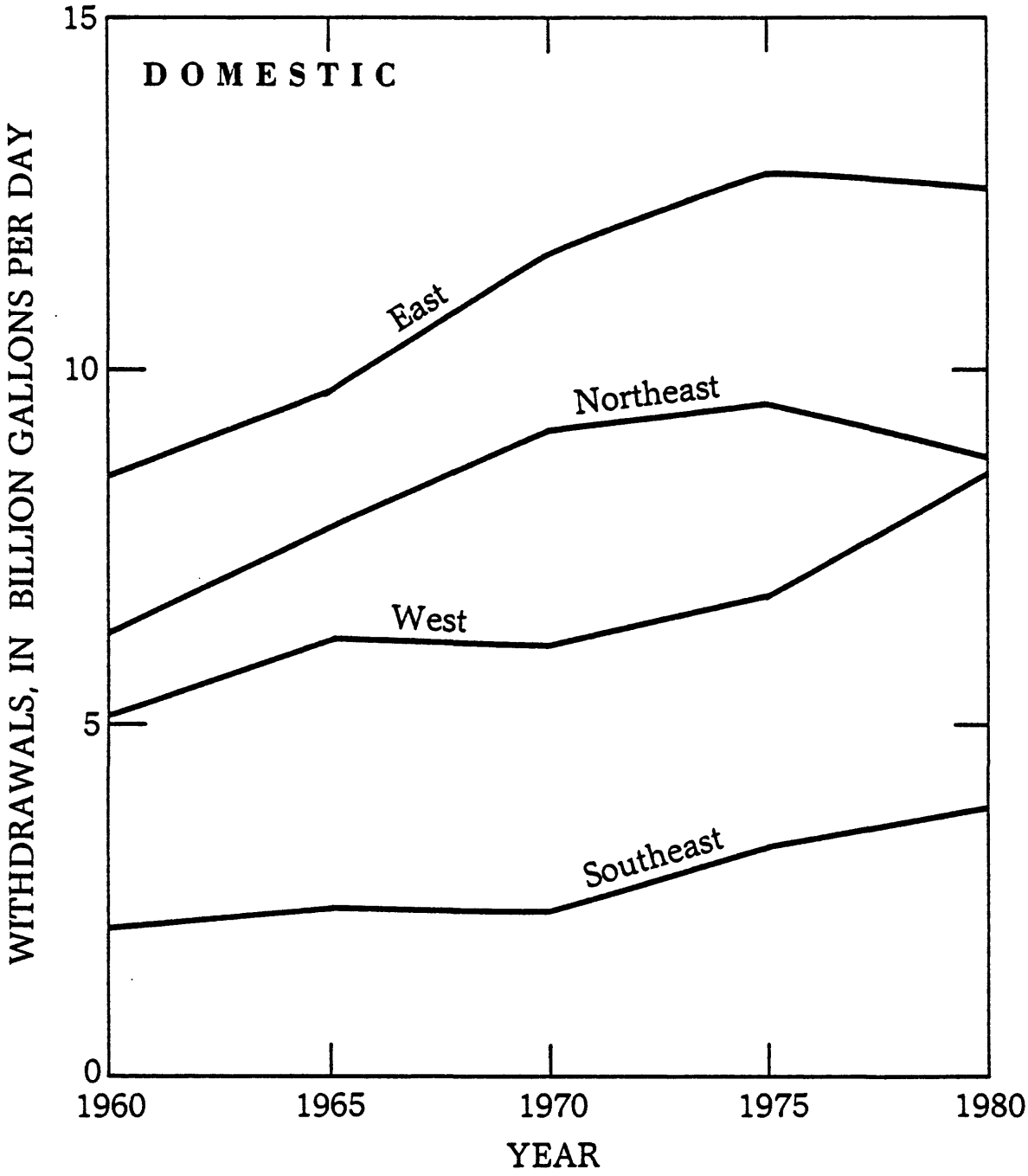

Figure 5. Domestic water withdrawals, 1960-80. National totals ranged from 16 bgd in 1960 to 25 bgd in 1980.

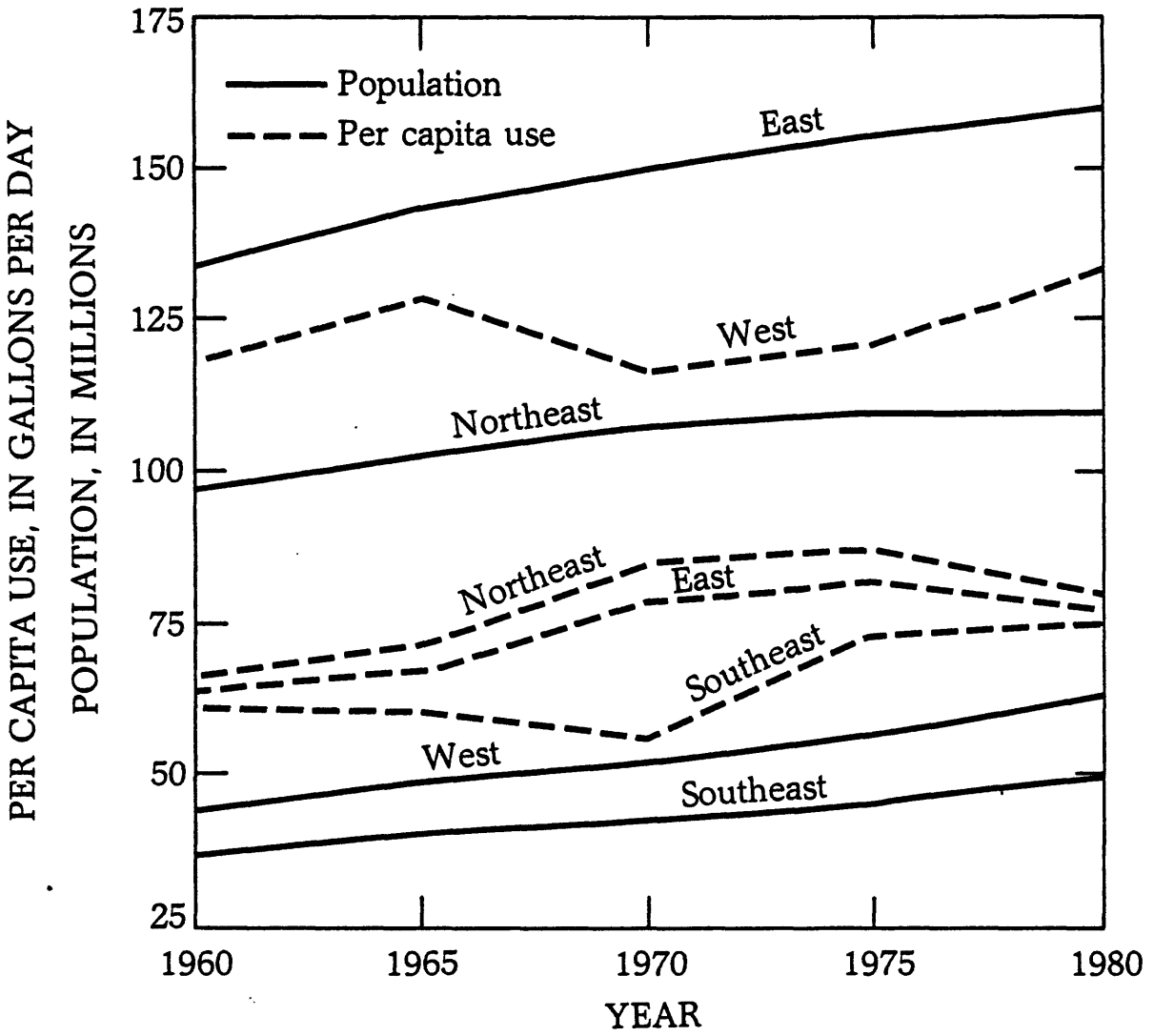

Figure 6. Population and domestic per capita use, 1960-80. Total population ranged from 150 million in 1950 to 230 million in 1980.

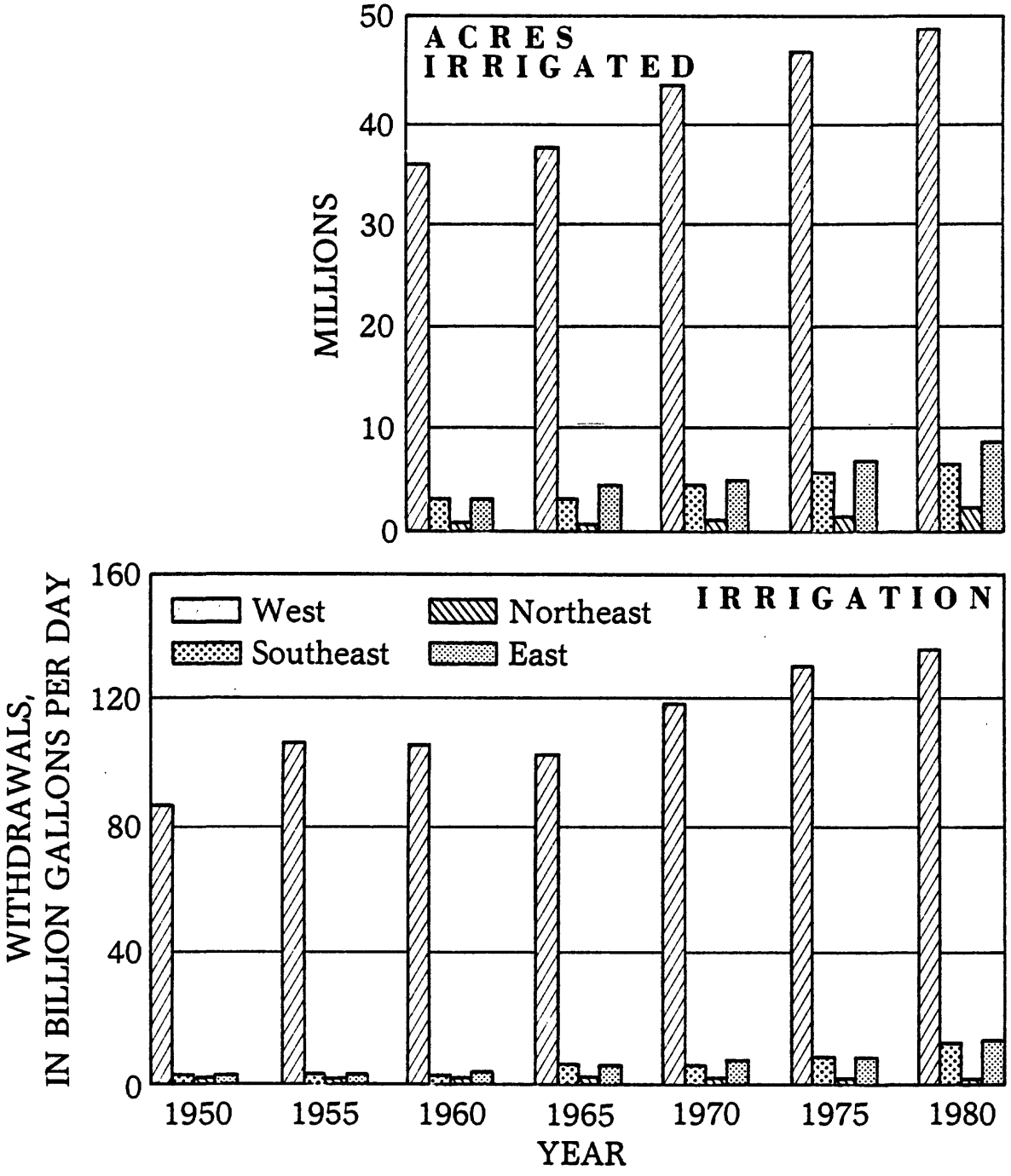

Figure 7. Irrigation water withdrawals, 1950-80, and acres irrigated 1960-80. Total irrigation withdrawals ranged from 89 bgd in 1950 to 150 bgd in 1980; total acres irrigated ranged from 25 million acres in 1950 to 58 million acres in 1980.

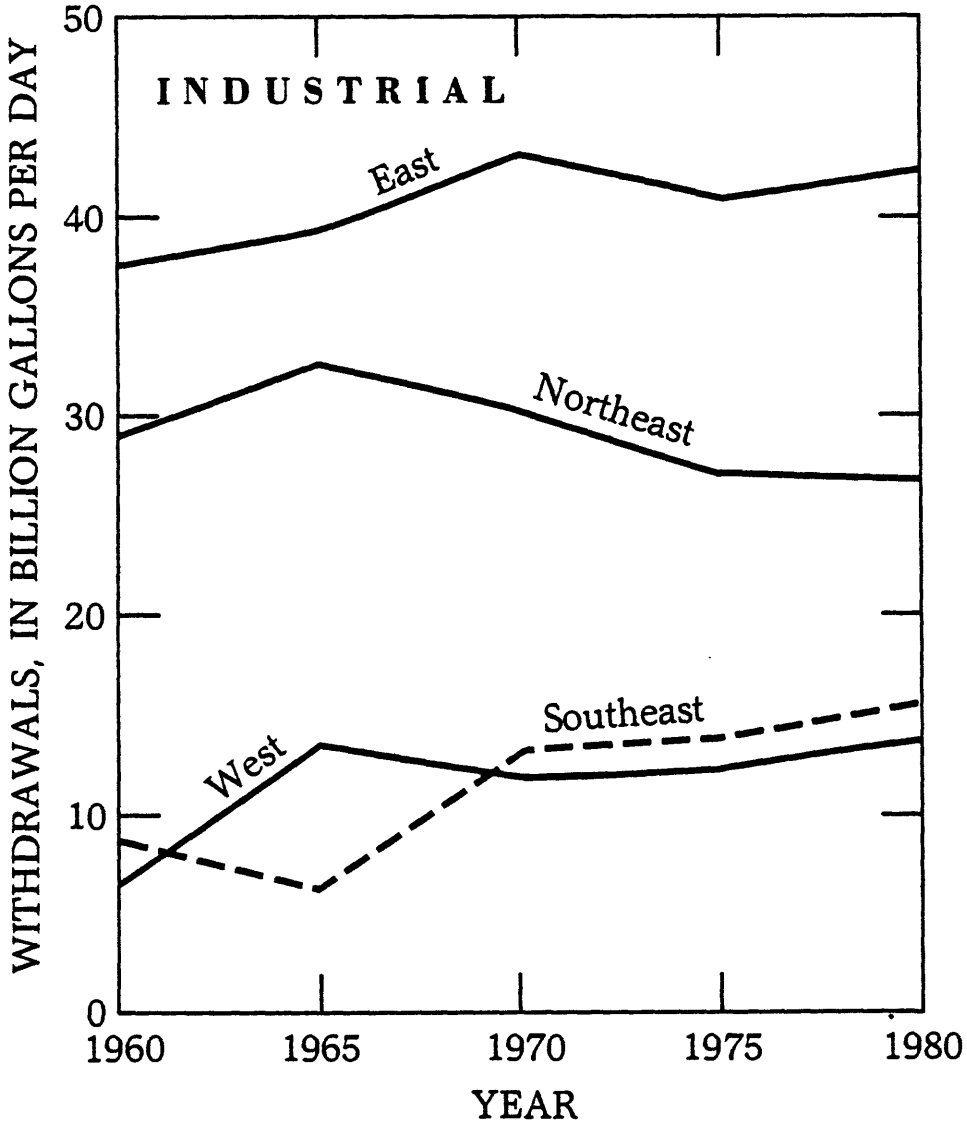

Figure 8. Industrial water withdrawals, 1960-80. National totals ranged from 44 bgd in 1960 to 56 bgd in 1980.

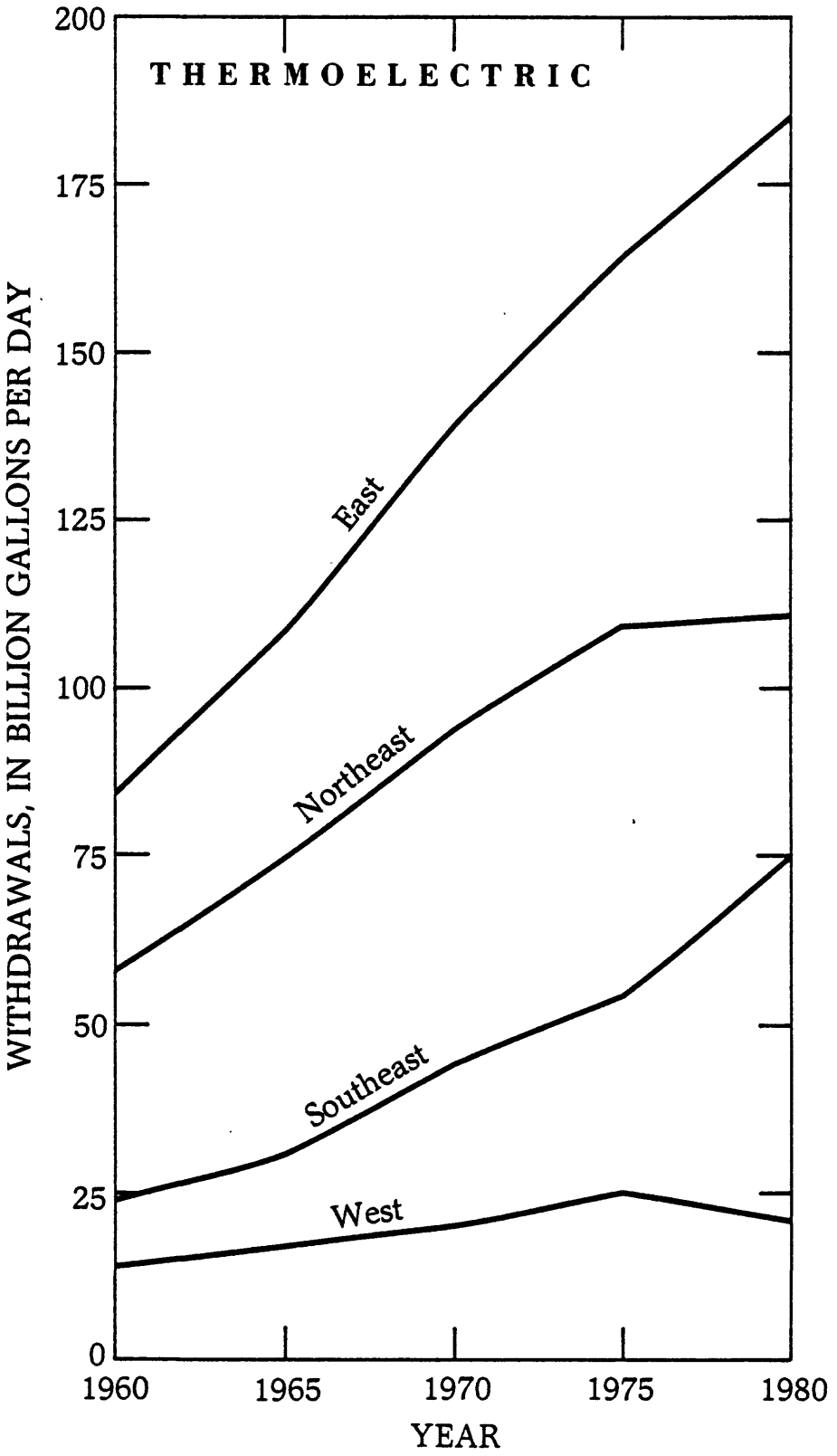

Figure 9. Thermoelectric power water withdrawals, 1960-80. National totals ranged from 99 bgd in 1960 to 210 bgd in 1980.

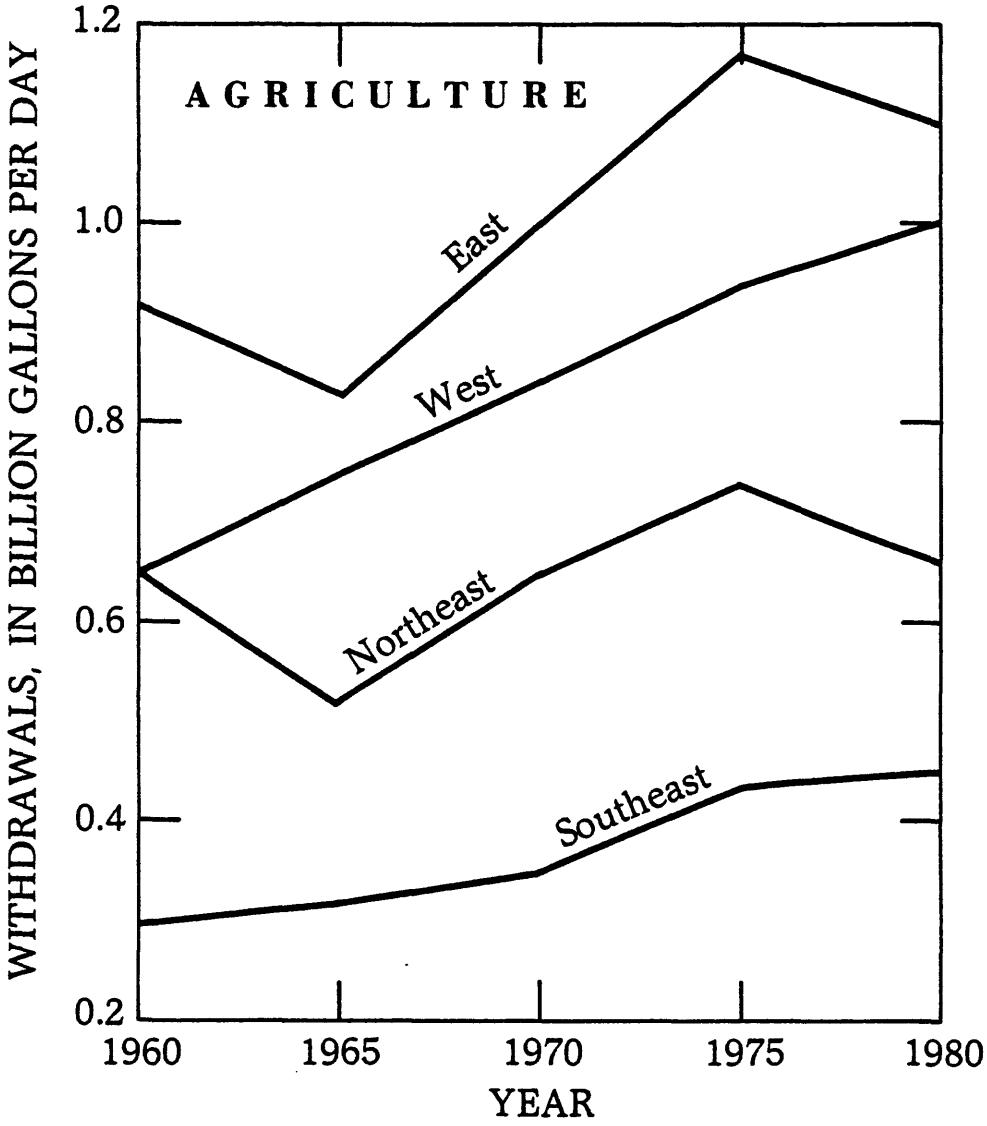

Figure 10. Agriculture (nonirrigation) water withdrawals, 1960-80. National totals ranged from 1.6 bgd in 1960 to 2.2 bgd in 1980.