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ESTIMATED WATER USE IN SOUTH DAKOTA, 1985

by

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U.S. GEOLOGICAL SURVEY
in cooperation with
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OF WATER AND NATURAL RESOURCES

INTRODUCTION

Water withdrawals in South Dakota during 1985 were estimated to average 674 million gallons per day (Mgal/d). This is a slight decrease from the 1980 estimate of 690 Mgal/d (Solley and others, 1983, p. 38). The 1985 estimate was equivalent to 956 gallons per day (gal/d) for each person in the State. The distribution of total water withdrawals by county is shown in figure 1.

The term "water withdrawal" includes both diversions and withdrawals of surface water, as well as withdrawals of ground water. The "water withdrawal" value commonly includes losses that occur between the point of diversion or withdrawal and the point of actual use.

Water withdrawals in the area west of the Missouri River, which has a ranching-based economy, were about 382 Mgal/d (77 percent surface water and 23 percent ground water). Water withdrawals in the area east of the Missouri River, which has a farming-based economy, were about 292 Mgal/d (56 percent ground water and 44 percent surface water). Statewide, about 75 percent of the total water withdrawn was for agriculture, 12 percent was for public-supply, 7 percent was for self-supplied industrial and mining uses, 5 percent was for self-supplied domestic and commercial uses, and 1 percent was for thermoelectric and geothermal uses (fig. 2).

The Missouri River is the most significant source of surface water in the State. All streams tributary to the Missouri River within South Dakota account for only 12 percent of the average annual recorded flow of the Missouri as it leaves the State at Sioux City, Iowa--18,740 Mgal/d, or about 29,000 cubic feet per second (ft^3/s). Most other streams in South Dakota do not provide a dependable supply, unless reservoir storage is available. About 88 percent of surface-water withdrawals during 1985 were for agriculture (fig. 3).

Most of South Dakota is underlain by aquifers that yield varying quantities of water. Sedimentary bedrock aquifers underlie most of the State, whereas glacial-drift and alluvial aquifers underlie most of the State east of the Missouri River. Although some ground-water supplies have excessive mineral content (salinity), ground water generally constitutes the only available source of water for domestic, public-supply, and agricultural uses. Virtually all self-supplied domestic water users and almost 80 percent of the public-supplied water users depend on ground water as a source of supply. About 53 percent of ground-water withdrawals were for agriculture (fig. 4).

The source and disposition of total water use are shown in figure 5. The figure indicates, for example, that surface-water withdrawals were 425 Mgal/d (63 percent) and ground-water withdrawals were 249 Mgal/d (37 percent). Of the total, 594 Mgal/d (about 88 percent) were withdrawn by self-supplied users and 80.4 Mgal/d (about 12 percent) were withdrawn by public suppliers. For all water used in the State, 361 Mgal/d (53.5 percent) were consumptive use and 313 Mgal/d (46.5 percent) were return flow to surface- and ground-water systems after use.

Water use for hydroelectric-power generation in South Dakota is substantial, mainly because of the four hydroelectric powerplants associated with the U.S. Army Corps of Engineers' dams located on the Missouri River. During 1985, about 60,500 Mgal/d were used by the hydroelectric powerplants to generate about 6,095 gigawatt-hours of electricity. Water used for hydroelectric-power generation is considered an instream use and is not included graphically in this report.

PUBLIC SUPPLY

During 1985, there were about 450 public-supply systems in South Dakota that delivered water to domestic, commercial, and industrial users. Total withdrawals by public-supply systems increased from 76 Mgal/d during 1980 to 80.4 Mgal/d during 1985, or about 6 percent, and the population served by public-supply systems increased from 455,000 to 548,000 (about 20 percent). During this same time, the total population of South Dakota only increased about 2 percent (from 691,000 to 706,000). The large increase in population served by public-supply systems can be attributed to the construction of several rural water systems. It is estimated that use by rural water systems accounted for about 11 percent of total public-supply use. The distribution of public-supply withdrawals by county is shown in figure 6.

The largest use by a municipality during 1985 was 25 Mgal/d by Rapid City (Pennington County). However, this use was about three times the use of the previous year and is due to increased lawn watering as a result of a drought in western South Dakota during 1985. Sioux Falls (Minnehaha County), South Dakota's largest city, used 12.8 Mgal/d during 1985. The largest use by a rural water system during 1985 was 1.39 Mgal/d by the Randall Community Water District (Charles Mix County), which delivers water to towns and rural customers within a three-county area (Brule, Charles Mix, and Douglas Counties).

Of the 15.6 Mgal/d of surface-water withdrawn by public-supply systems, about 78 percent occurred in the area east of the Missouri River. About 81 percent, or 64.8 Mgal/d, of total public-supply withdrawals were from ground water and about 51 percent of the ground-water withdrawals occurred in the area east of the Missouri River. Of the total 80.4 Mgal/d of public-supply use, about 75 percent was delivered for domestic use, 18 percent for commercial use, and 7 percent for industrial use.

DOMESTIC AND COMMERCIAL

Domestic and commercial water users obtain water from both public-supply systems and self-supplied facilities. Total domestic use during 1985 was 76.8 Mgal/d. Of this, 60.6 Mgal/d were delivered by public-supply systems that served 78 percent of the population, and 16.2 Mgal/d were self supplied. Per capita domestic use was 110 gal/d for public-supplied users and 103 gal/d for self-supplied users.

Commercial water use during 1985 was 31.9 Mgal/d, of which 14.4 Mgal/d were delivered by public-supply systems and 17.5 Mgal/d were from self-supplied systems. The distribution of self-supplied withdrawals for domestic and commercial use by county is shown in figure 7.

AGRICULTURAL

Agricultural water withdrawals in South Dakota during 1985 totaled 507 Mgal/d. Irrigation withdrawals were 516,000 acre-feet (acre-ft), or about 460 Mgal/d, which is the same as in 1980. Nonirrigation withdrawals, mainly for livestock, totaled only 47.1 Mgal/d. The distribution of total agricultural withdrawals by county is shown in figure 8. Because irrigation use is seasonal rather than year-round, irrigation use will hereafter be given in acre-feet, with million gallons per day in parenthesis.

About 397,000 acres were irrigated during 1985--324,000 acres by sprinkler methods and 73,000 acres by flooding techniques. The statewide withdrawal rate was 1.30 acre-ft per acre, or 15.6 inches. Due to conveyance losses of about 135,000 acre-ft (121 Mgal/d), the average statewide delivery rate to irrigated fields was about 0.96 acre-ft per acre, or 11.5 inches.

Primary irrigated crops included corn, alfalfa, and soybeans. Center pivots were used for about two-thirds of the sprinkler irrigation, and electricity was the source of power for almost 80 percent of the irrigated acreage.

Comparison of irrigation withdrawals between the area east of the Missouri River and the area west of the Missouri River also is of interest. For the east-river area, about 195,000 acre-ft (174 Mgal/d) were withdrawn to irrigate about 251,000 acres, resulting in a withdrawal rate of 0.78 acre-ft per acre, or 9.3 inches. With conveyance losses of about 7,500 acre-ft (6.70 Mgal/d), the actual delivery rate to irrigated fields was about 0.75 acre-ft per acre, or 9.0 inches. For the west-river area, about 321,000 acre-ft (287 Mgal/d) were withdrawn to irrigate about 146,000 acres, resulting in a withdrawal rate of 2.20 acre-ft per acre, or 26.4 inches. Due to conveyance losses of about 127,000 acre-ft (113 Mgal/d), the delivery rate to irrigated fields was about 1.33 acre-ft per acre, or 16 inches.

The largest user of irrigation water in South Dakota is the Belle Fourche Project, a Bureau of Reclamation project located in Butte County, which withdrew 161,620 acre-ft (144 Mgal/d) to irrigate 53,825 acres during 1985. The second largest user of irrigation water is the Angostura Unit in Fall River County, also a Bureau project, which withdrew 48,441 acre-ft (43.2 Mgal/d) to irrigate 11,423 acres during 1985. The other Bureau project located in South Dakota, the Rapid Valley Unit in Pennington County, withdrew 17,035 acre-ft (15.2 Mgal/d) to irrigate 7,735 acres during 1985 (U.S. Bureau of Reclamation, 1986).

Two Indian Tribes also irrigated large acreages within South Dakota during 1985. The Lower Brule Sioux Tribe withdrew 7,500 acre-ft (6.70 Mgal/d) to irrigate 5,500 acres in Lyman and Stanley Counties. The Crow Creek Sioux Tribe withdrew 5,780 acre-ft (5.16 Mgal/d) to irrigate 3,910 acres in Buffalo and Hughes Counties (U.S. Bureau of Indian Affairs, oral communication, 1986). The largest private irrigation development in South Dakota is J.E.S. Farms in Hughes and Sully Counties that withdrew 13,287 acre-ft (11.9 Mgal/d) to irrigate 12,219 acres during 1985 (South Dakota Department of Water and Natural Resources, written communication, 1986).

Of the 47.1 Mgal/d of nonirrigation agricultural withdrawals, about 60 percent was from surface water and 40 percent was from ground water. This use was distributed among some 4,000,000 cattle, 1,765,000 hogs, 753,000 sheep, and 1,800,000 poultry (U.S. Bureau of the Census, 1984).

INDUSTRIAL AND MINING

During 1985, water use for industry and mining was 51.4 Mgal/d. Major industrial water users in South Dakota are the South Dakota Cement Plant near Rapid City (Pennington County) and numerous meat packing plants and creameries. A major mining water user is the Homestake Mining Company in Lead (Lawrence County), whose production makes South Dakota the leading gold-producing State in the Union.

Self-supplied systems provided 40.4 Mgal/d of water for mining activities; about 61 percent was from surface-water sources and about 39 percent was from ground-water sources. Self-supplied systems also provided 4.75 Mgal/d of ground water and 0.89 Mgal/d of surface water for other industrial uses. The remainder of the water used by industry, 5.37 Mgal/d, was delivered by public-supply systems. The distribution of self-supplied withdrawals for industrial and mining use by county is shown in figure 9.

THERMOELECTRIC AND GEOTHERMAL

Withdrawals for thermoelectric and geothermal uses are quite small in South Dakota. Total withdrawals during 1985, 7.28 Mgal/d, were only about 1 percent of the total offstream water use in the State. The distribution of self-supplied withdrawals for thermoelectric and geothermal uses by county is shown in figure 10.

Water withdrawn for thermoelectric-power generation by powerplants using fossil fuels totaled 4.24 Mgal/d; 61 percent was from surface-water sources and 39 percent was from ground-water sources. The Big Stone Powerplant, located in Grant County, was the largest thermoelectric water user with a surface-water withdrawal of 2.59 Mgal/d. South Dakota does not have any operating nuclear powerplants.

The use of geothermal water totaled 3.04 Mgal/d during 1985. About 80 percent of this water use was from flowing wells completed in the Madison aquifer that are used for heating (water temperatures are as high as 130 degrees Fahrenheit).

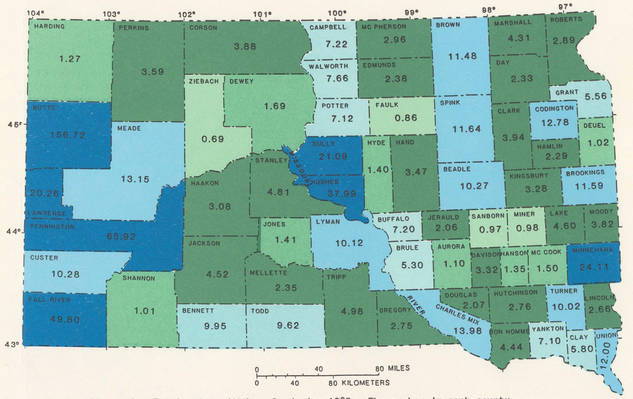
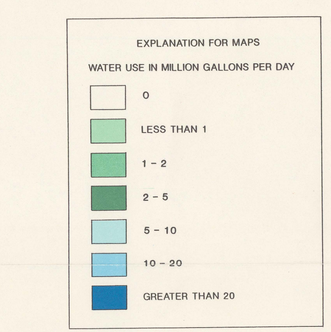


Figure 1.--Total water withdrawals during 1985. The number in each county is the withdrawal in million gallons per day (Mgal/d).



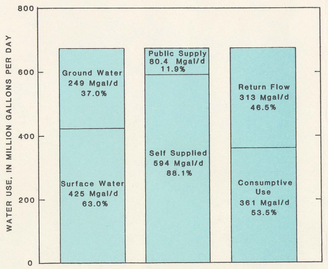


Figure 5.--Source and disposition of total water use during 1985, in million gallons per day (Mgal/d) and percent (%).

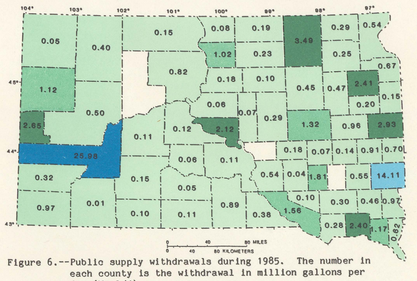


Figure 6.--Public supply withdrawals during 1985. The number in each county is the withdrawal in million gallons per day (Mgal/d).

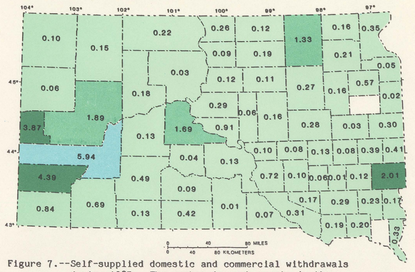


Figure 7.--Self-supplied domestic and commercial withdrawals during 1985. The number in each county is the withdrawal in million gallons per day (Mgal/d).

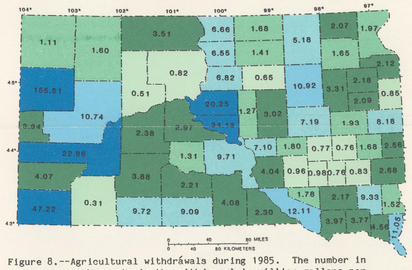


Figure 8.--Agricultural withdrawals during 1985. The number in each county is the withdrawal in million gallons per day (Mgal/d).

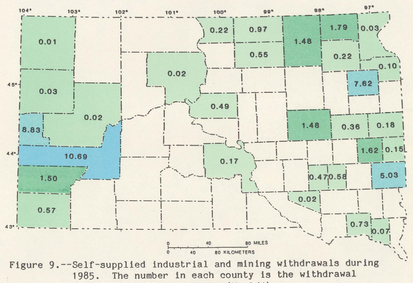


Figure 9.--Self-supplied industrial and mining withdrawals during 1985. The number in each county is the withdrawal in million gallons per day (Mgal/d).

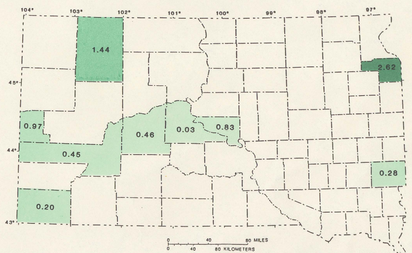


Figure 10.--Thermoelectric and geothermal withdrawals during 1985. The number in each county is the withdrawal in million gallons per day (Mgal/d).

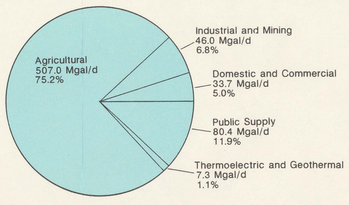


Figure 2.--Total water withdrawals by category during 1985, in million gallons per day (Mgal/d) and percent (%).

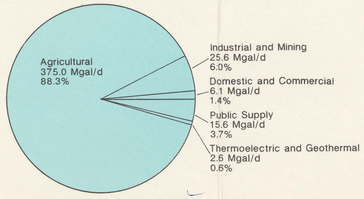


Figure 3.--Surface-water withdrawals by category during 1985, in million gallons per day (Mgal/d) and percent (%).

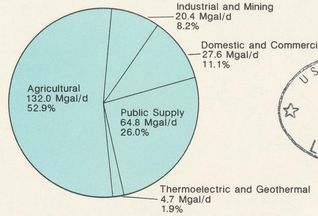


Figure 4.--Ground-water withdrawals by category during 1985, in million gallons per day (Mgal/d) and percent (%).