

*Total withdrawal Statewide by municipal suppliers serving over 1,000 people was 108 billion gallons in 1993. Most of Minnesota's municipal deliveries were for residential purposes. About 87 percent of suppliers withdraw from ground-water and 13 percent withdraw from surface-water sources. Water withdrawn for public supply has steadily risen since 1955 and the increase has mainly come from ground water. Declines in per capita use since 1990 may be related to heavy rainfall, conservation measures, and the installation of more efficient water-using machines.*

## Introduction

Increasing needs for economical supply of municipal water is a concern of State water planners. The laws of Minnesota for 1993 state that every public water supplier serving more than 1,000 people must submit an emergency and conservation plan addressing alternative sources of water by January 1, 1996. A questionnaire and instructional material were submitted by the Minnesota Department of Natural Resources (DNR) in 1993 to each qualifying public supply to implement this law.

This report summarizes results of the DNR questionnaire as they relate to (1) withdrawal and delivery of water by municipal suppliers, and (2) the history of public water supply in Minnesota from both surface and ground water. Only municipal supplies serving over 1,000 people were required to submit data. The municipal supplies are the largest portion of the water-use category termed "public water supply". In Minnesota, "public water supply" also includes non-municipal systems such as rural mobile home parks. By 1990, public water-supply withdrawals had grown to represent 36 percent of the ground water withdrawn (4 percent of all water withdrawn) in Minnesota (Solley, Pierce, and Perlman, 1993, p. 13).

The method used to summarize the questionnaire results compiles municipal-supply withdrawals for each county in Minnesota, summarizes deliveries by customer cate-

gory, and examines trends in surface-water and ground-water use for public supply and per capita use. The Minnesota DNR annually collects and computerizes water-withdrawal data for several water-use categories including public supply (Trotta, 1988). The annual data are obtained from water appropriation-permit reports which are required for all public supplies serving more than 25 people. The major source of information for this report was a 1993 questionnaire, which collected data not normally obtained in the annual effort. The annual appropriation-permit data were used to geographically reference, check, and supplement the 1993 questionnaire results from municipalities serving more than 1,000 people.

## Municipal Withdrawal Estimates by County

Total withdrawal Statewide by municipal suppliers serving over 1,000 people was 108 billion gallons in 1993. Withdrawals in most counties exceeded 100 million gallons for municipal supply in 1993 (fig. 1). Withdrawals in two counties (Anoka and Hennepin) exceeded 15 billion gallons.

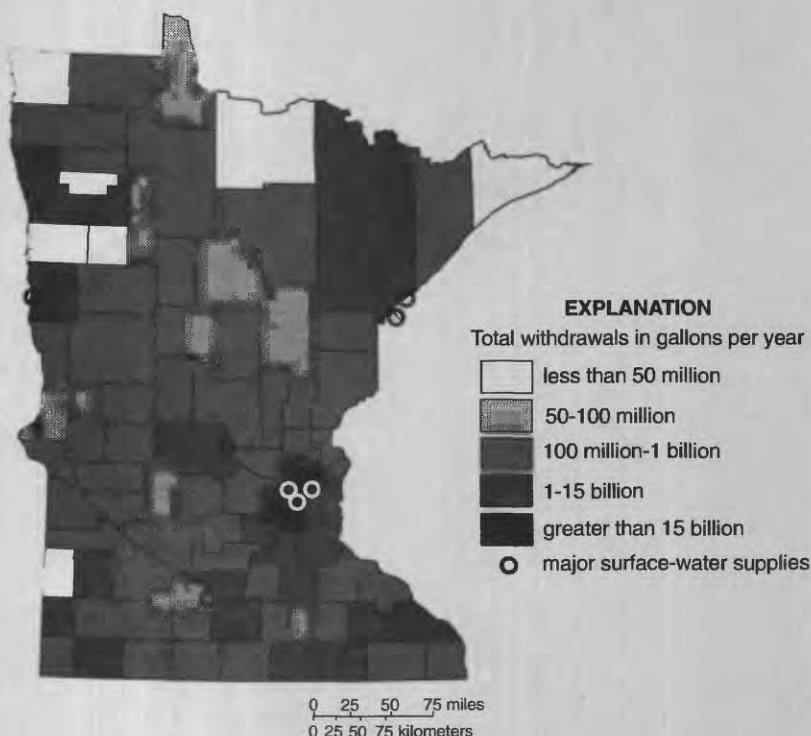


Figure 1.—Municipal water-supply withdrawals in Minnesota, 1993.

## Surface-Water Sources

Thirty-eight Minnesota municipalities (about 13 percent) serving more than 1,000 people use a surface-water source. Major municipal users of surface water (fig. 1), withdrawing over 1 billion gallons per year, are located on the Mississippi River in Hennepin County (Minneapolis, Brooklyn Center) and Stearns County (St. Cloud), and the Red River of the North in Clay County (Moorhead). St. Paul (Ramsey County) withdraws water from the Mississippi River through Anoka County. Duluth (St. Louis County) and most other large cities in the northeastern part of the State, depend on surface water from Lake Superior or mine pits.

## Ground-Water Sources

About 87 percent of Minnesota municipalities withdraw their water supply from a ground-water source. Withdrawals of ground water for public supply come from both glacial-drift and bedrock aquifers. Assuming suitable chemical quality, sustainable rates of ground-water use depend

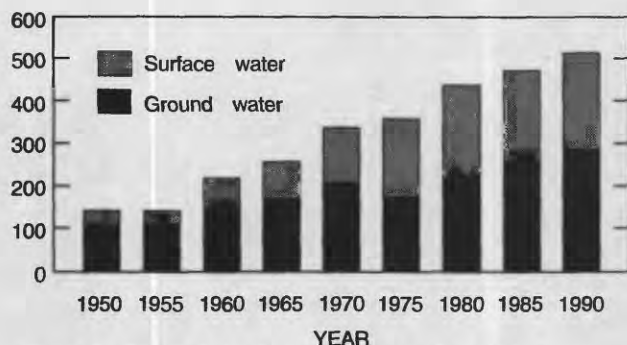


Figure 2.—Trends in surface-water/ground water use for public supply in Minnesota, 1950-90.

on the amount of water stored in the aquifer and the rate of recharge.

Water withdrawn for public supply has steadily risen since 1955 and the increase has come mainly from ground water (fig. 2). The rising trend to ground-water dependence started earlier with recommendations from the Minnesota State Board of Health in 1906 to use ground water and has continued with population growth outside established surface-water supply areas (Trotta, 1988, p. 314).

### Water Deliveries

Customer categories were requested on the 1993 questionnaire to describe types of delivery, and were listed as follows:

1. Residential - Water used for normal household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens.
2. Commercial - Water used by motels, hotels, restaurants, office buildings, commercial facilities, and institutions, both civilian and military.
3. Industrial - Water used for thermoelectric power (electric utility generation) and other industrial uses such as steel, chemical and allied products, paper and allied products, mining, and petroleum refining.
4. Unaccounted for - The volume of water withdrawn minus the volume sold. This would include line losses, unauthorized or inaccurately-metered water use, and municipal withdrawals for fire hydrant use,
5. Other - Water used for other purposes such as for irrigation of crops, pastures, parks, or golf courses or for lake-level maintenance.

Deliveries are summarized based on the 329 municipalities responding to the DNR questionnaire, not just the 286 municipalities serving more than 1,000 people. The

percentage of deliveries metered was determined by type of delivery for those municipalities which recorded each customer category separately. Metered deliveries included 80 percent of residential use, 80 percent of commercial use, 42 percent of industrial use, 1 percent of unaccounted-for use, and 27 percent of other uses. This means that 47 percent of all water withdrawn by Minnesota municipalities surveyed reached a metered customer.

Where customer categories were not metered separately, questionnaire respondents reported the volume of water delivered for a combination of delivery types. Seventy-six percent of responding municipalities were able to separate volumes by delivery type. Based on those able to make the breakdown, the percentage of water delivered by customer type (fig. 3) is largest for residential deliveries, nearly 54%.



Figure 3.—Water delivered by Minnesota public supplies by type of delivery, 1993.

### Trends in Per Capita Use

Per capita use for municipalities is determined by dividing water delivered for all customer categories (not just residential customers) by the population served. Per

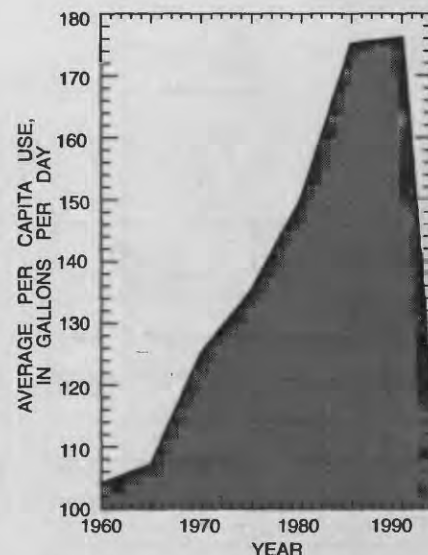


Figure 4.—Average per capita use in gallons per day for public supply in Minnesota, 1960-93.

capita use in Minnesota (Solley and others, 1993) rose sharply from 104 gallons per day (gal/d) per person in 1960 to 175 gal/d per person in 1985 (fig. 4). It stayed at about that level through 1990 and then (based on the DNR survey of municipalities) declined to only 119 gal/d per person in 1993. Factors affecting per capita use include adequacy of the source, lawn-watering variations as related to rainfall conditions, technological changes in water-using machines, advances in the standard of living to afford such machines, and conservation measures. The year 1993 was characterized by heavy rains that made lawn-watering restrictions unnecessary (Jim Japs, DNR, 1995, oral commun.). Industrial installation of more water-efficient machines and residential conservation programs may also have contributed to the decline in per capita use.

### References Cited

- Solley, W.B., Pierce, R.R., and Perlman, H.A., 1993, Estimated use of water in the United States in 1990: U.S. Geological Survey Circular 1081, 76 p.
- Trotta, L.C., 1988, Minnesota water supply and demand, in National Water Summary, 1987—Hydrologic events and water supply and demand: U.S. Geological Survey Water-Supply Paper 2350, p. 313-320.

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