

Freshwater Use Trends in Maryland, 1985–2000

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Physical Setting and Water Withdrawals

As the demand for freshwater increases in Maryland, stress is placed on the State's ground-water and surface-water resources. Availability of freshwater in a particular area of the State depends on factors such as precipitation, geology, and topography. Water availability also is affected by changing population and development patterns that directly influence water use.

Nearly one-fifth of the total area of Maryland is covered by water. The State has approximately 9,874 mi² (square miles) of land, 703 mi² of rivers and streams, and 1,726 mi² of Chesapeake Bay (Walker, 1970). Maryland receives an average of 55 Bgal/d (billion gallons per day) of water as precipitation and streamflow from adjacent states. An estimated 130,000

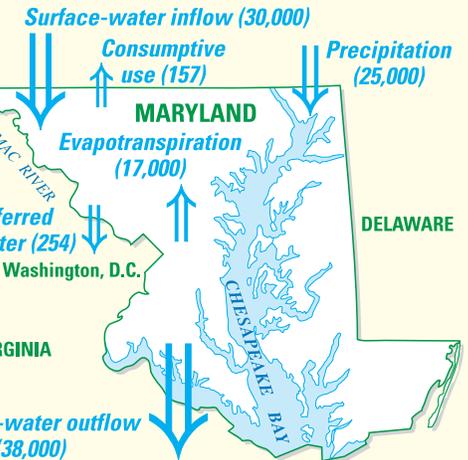
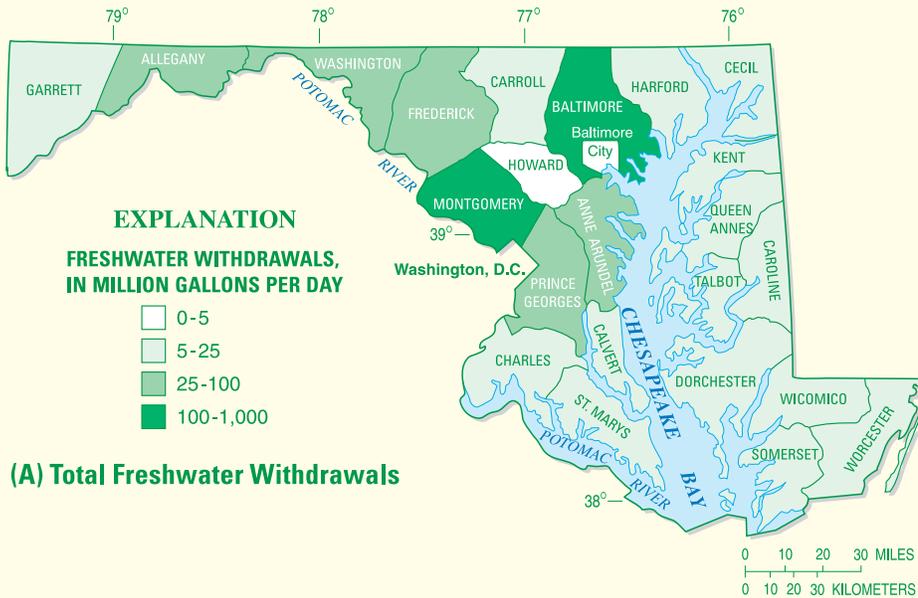


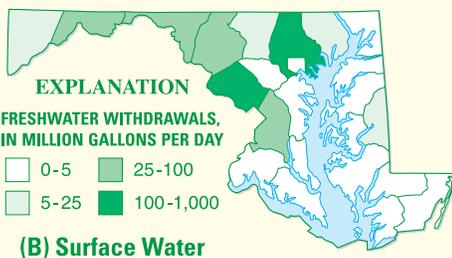
Figure 1. Maryland water budget, in million gallons per day.

billion gallons of water is in storage in aquifers underlying the area (Walker, 1970). Cumulative normal storage of water in reservoirs in Maryland in 2000 was about 293 billion gallons (H. Van Aller, Maryland Department of the Environment, written commun., 2003). The water budget for Maryland shown in figure 1 illustrates the estimated amount of water entering and leaving the State. Long-term average (1901-2001) precipitation is about 43 in/yr (inches per year), or 25,000 Mgal/d (million gallons per day) (National Oceanic and Atmospheric Administration, 2002). In general, precipitation is greater in the eastern and extreme western parts of the State than in the central part. Water lost by evapotranspiration is about 28 in/yr, or 17,000 Mgal/d (Walker, 1970). About 254 Mgal/d of freshwater was transferred out of Maryland for use in 2000. Consumptive use is about 157 Mgal/d.

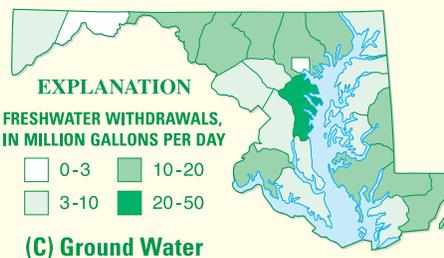
The geographic distribution of freshwater withdrawals from surface-water and ground-water sources in Maryland reflects the physiographic and geologic variability of the State. The selection of a source of water supply is guided primarily by availability or accessibility of the resource. Central and western areas of Maryland are underlain by crystalline and consolidated layers of rocks that in many places do not yield appreciable amounts of water to wells. In these areas, demands for large quantities of freshwater are most readily met by surface-water sources. Conversely, in the eastern and southern areas of Maryland,



(A) Total Freshwater Withdrawals



(B) Surface Water



(C) Ground Water

Figure 2. Freshwater withdrawals in Maryland by County, 2000. (A) Total freshwater withdrawals; (B) Fresh surface-water withdrawals; and (C) Fresh ground-water withdrawals.

unconsolidated deposits, which consist mostly of sand and gravel, commonly provide enough ground water to meet the needs of most users. The area east of Chesapeake Bay (fig. 2) depends almost entirely on ground water for freshwater supply, primarily because the topography of this area is too flat to create surface reservoirs much larger than millponds.

Total Freshwater Withdrawals, 2000

During 2000, about 1,450 Mgal/d of freshwater was withdrawn from surface-water and ground-water sources in Maryland. Withdrawals of freshwater by county are shown in figure 2A. During 2000, about 83 percent of total freshwater withdrawals (1,210 Mgal/d) were from surface-water sources compared to 17 percent (242 Mgal/d) from ground-water sources.

The largest fresh surface-water withdrawals (more than 100 Mgal/d) were in Baltimore and Montgomery Counties (about 272 Mgal/d and 704 Mgal/d, respectively) (fig. 2B). The reservoirs and rivers in these Counties are used by public suppliers to meet water demands of the Baltimore City and Washington, D.C. metropolitan areas.

The largest ground-water withdrawals (46 Mgal/d) were in Anne Arundel County (fig. 2C) and were used mainly for public supply. The smallest freshwater withdrawals (4 Mgal/d) were in Howard County, which is served primarily by public-supply systems in adjacent counties.

Population Trends and Water Withdrawals

Since the early 1600s, water has been important in the economic and cultural development of Maryland. Rivers, bays, and harbors gave early settlers ports and access to inland trade. Freshwater streams, wells, and springs provided water supplies for a growing population. At the beginning of the 20th century, Maryland still was primarily agricultural. The total population in 1900 was about 1 million people (Forstall, 1995). In 1918, the State had only four cities of more than 10,000 inhabitants; the largest, Baltimore, had a population of about 560,000 (Maryland Manual

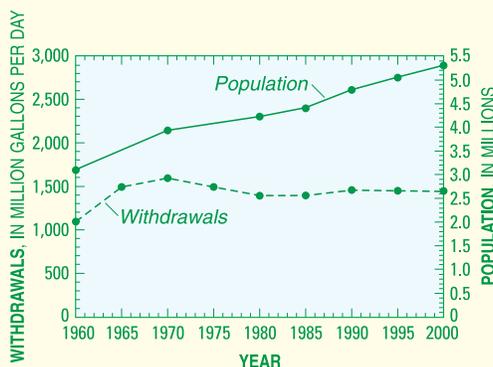
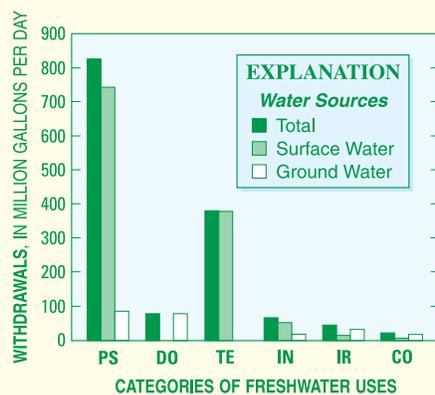


Figure 3. Population and freshwater-withdrawal trends in Maryland, 1960-2000.

1918-1919). By the mid-1990s, Maryland's metropolitan areas had become part of an East Coast megalopolis stretching from Boston, Massachusetts to Washington, D.C., and northern Virginia. By 2000, the State's population had increased to more than 5 million, and Baltimore's population had increased to more than 650,000.

As Maryland's population grew, freshwater withdrawals increased. Population data for 1900 indicate that total freshwater withdrawals may have been 30 to 50 Mgal/d. By 1970, total freshwater withdrawals had increased to about 1,500 Mgal/d. During the 1970s, freshwater withdrawals began to decline despite continued population growth (fig. 3). Since about 1980, freshwater withdrawals appear to have leveled off. Possible explanations for this trend include changing economic conditions, declining water use among certain industries, varying amounts of precipitation, and increasing use of conservation techniques.



[PS, Public Supply; DO, Domestic; TE, Thermoelectric Power; IN, Industrial; IR, Irrigation; CO, Commercial]

Figure 4. Freshwater withdrawals in Maryland, by category of use and water sources, 2000.

Freshwater Uses

Most freshwater in Maryland is withdrawn for public supply, domestic, thermoelectric power, industrial, irrigation, and commercial uses (fig. 4). The total freshwater withdrawals for these uses account for more than 97 percent of the total freshwater withdrawals in the State. The remaining 3 percent are withdrawals for aquaculture, livestock, and mining operations. Water withdrawn by a public or private water utility and delivered to a variety of users is designated as a "public supply." If a public supplier is not available or is not used, the water is classified as "self-supplied." Homes and small communities relying on individual wells are classified as domestic self-supplied water users. Thermoelectric power includes water used for the generation of electricity by steam-electric plants fueled by conventional or nuclear fuels. Commercial use includes not only typical businesses such as restaurants, motels, and car washes, but also includes institutions such as churches, schools, and military installations.

Public Supply

More than 500 public water-supply systems in Maryland provide water to about 4.4 million people (82 percent of the State's population). Total withdrawals for public supply during 2000 were 824 Mgal/d, of which 740 Mgal/d were from surface-water sources and 84 Mgal/d were from ground-water sources. The largest user of surface water for public supply is Baltimore City. During 2000, about 271 Mgal/d was withdrawn by the City from reservoirs located in Baltimore County for use in parts of Anne Arundel, Baltimore, Carroll, Harford, and Howard Counties, as well as Baltimore City itself. Another large user of water for public supply is the Washington Suburban Sanitary Commission, which withdrew 170 Mgal/d from the Potomac and Patuxent Rivers for distribution to most of Montgomery and Prince Georges Counties and part of Howard County. The Potomac River in Maryland is a water source for several neighboring jurisdictions. During 2000, about 78 Mgal/d was transferred to Virginia and West Virginia, and about 176 Mgal/d was distributed for use in Washington, D.C.

Most public suppliers that rely on ground-water sources are in the eastern

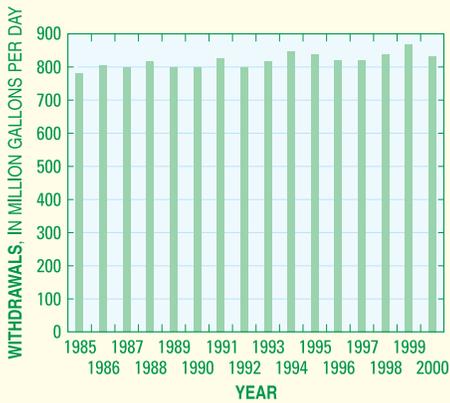


Figure 5. Public-supply freshwater withdrawals in Maryland, 1985-2000.

and southern parts of Maryland. In counties east of Chesapeake Bay, all public suppliers rely on ground water. The largest ground-water withdrawals for public supply, however, are west of the Bay in Anne Arundel County. During 2000, public suppliers in the County withdrew about 29 Mgal/d for distribution. Public-supply freshwater withdrawal data from 1985 through 2000 are shown in figure 5. The data show an overall increasing trend in public-supply withdrawals over the 15-year period from 771 Mgal/d in 1985 to 824 Mgal/d in 2000.

Domestic

Domestic users in Maryland obtain freshwater from public suppliers and from their own wells (self-supplied). During 2000, total use (withdrawals and deliveries) was 483 Mgal/d, of which 406 Mgal/d was delivered by public suppliers. About 932,000 Marylanders (18 percent of the State's population) withdrew an estimated 77 Mgal/d from individual house wells for water supply. All self-supplied domestic withdrawals were assumed to be from ground water. Domestic freshwater withdrawal data

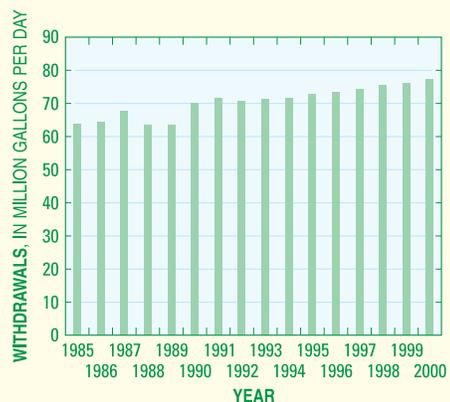


Figure 6. Domestic freshwater withdrawals in Maryland from self-supplied sources, 1985-2000.

from 1985 through 2000 are shown in figure 6. The data show a steady increase in withdrawals since 1985, from about 63 Mgal/d to about 77 Mgal/d in 2000.

Thermoelectric Power

Fourteen steam-generating thermoelectric powerplants operate in Maryland: 13 are fossil-fueled and 1 is nuclear-fueled. Both freshwater and saline water are used to cool operating equipment. During 2000, freshwater use by powerplants was 379 Mgal/d, of which 377 Mgal/d was from surface-water sources and 2 Mgal/d was from ground-water sources. In addition, about 6,260 Mgal/d of saline surface water was used for cooling condensers, of which more than 98 percent was returned to the water source. Withdrawals for thermoelectric power generation vary from

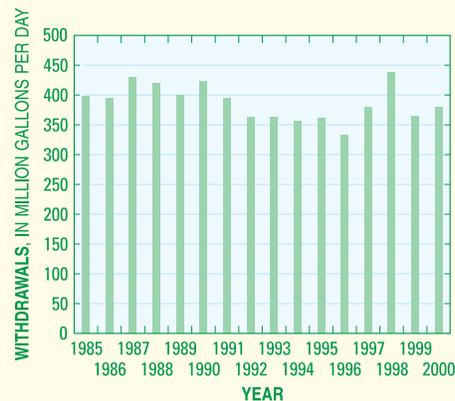


Figure 7. Thermoelectric-power freshwater withdrawals in Maryland, 1985-2000.

year to year because of changes in energy demands. These demands may be affected by variables such as changes in weather or industrial processing needs. Thermoelectric-power freshwater withdrawal data from 1985 through 2000 are shown in figure 7.

Industrial

Maryland is within a regional manufacturing belt that extends along the eastern seaboard of the United States. Heavy industries include steel, chemical products, and truck assembly. Prominent light industries include food processing, electronics, and pharmaceutical manufacturing. During 2000, about 110 Mgal/d of freshwater was used by industries in Maryland. Of that amount, 44 Mgal/d was provided by public suppliers. The remaining 66 Mgal/d was self-supplied, of which 50 Mgal/d was

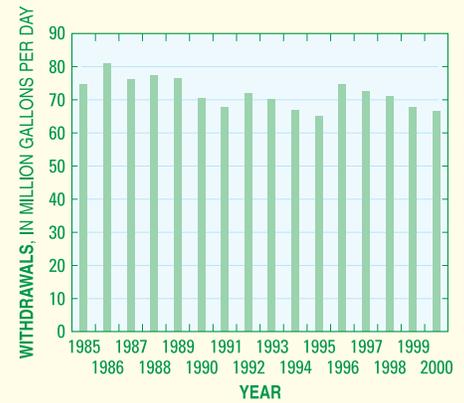


Figure 8. Industrial freshwater withdrawals in Maryland from self-supplied sources, 1985-2000.

from surface-water sources and 16 Mgal/d was from ground-water sources. Industrial freshwater withdrawal data from 1985 through 2000 are shown in figure 8.

The data indicate a slightly downward trend in withdrawals since 1985, from about 74 Mgal/d to 66 Mgal/d in 2000. This trend may result, in part, from the decline of a number of industries in Maryland over the years, and also from the implementation of water-conservation methods.

Irrigation

The amount of freshwater used for irrigation can vary from year to year and among users. Differences in rainfall distribution, crops grown, and soil type appreciably affect the amount of water used for irrigation. During 2000, about 42 Mgal/d of freshwater was used for irrigating farm crops, golf courses, and nursery stock. Of this amount, 12 Mgal/d was from surface-water sources and 30 Mgal/d was from ground-water sources.

Freshwater withdrawal data for irrigation from 1985 through 2000 are shown in figure 9. The data show that

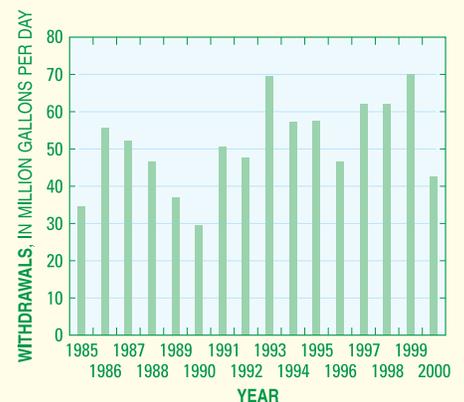


Figure 9. Irrigation freshwater withdrawals in Maryland, 1985-2000.

withdrawals varied from 1985 to 2000 and indicate that the amount of withdrawal depended upon the amount of rainfall during the growing season of a particular year. The greatest withdrawals for irrigation during the 15-year period were in 1993 and 1999. These were years during which rainfall was well below the normal annual average of 33 to 55 inches in many areas of the State (National Oceanic and Atmospheric Administration, 2003).

Commercial

Commercial users, including educational institutions and military installations, obtained freshwater from public suppliers and from self-supplied sources. Total commercial use during 2000 was about 134 Mgal/d, of which 113 Mgal/d (84 percent) was provided by public suppliers. The remaining 21 Mgal/d (16 percent) was self-supplied, of which 4

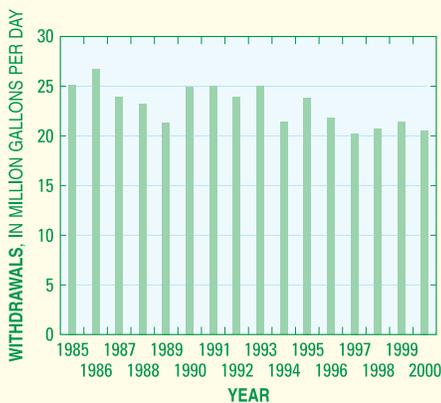


Figure 10. Commercial freshwater withdrawals in Maryland from self-supplied sources, 1985-2000.

Mgal/d was from surface-water sources and 17 Mgal/d was from ground-water sources. Commercial freshwater withdrawal data from 1985 through 2000 are shown in figure 10. The downward trend in withdrawals from about 25 Mgal/d in 1985 to 21 Mgal/d in 2000 may be due, in part, to businesses connecting to a public-water supply, changing water-use patterns at military installations, and utilizing water conservation methods.

Maryland Water-Use Program

The Maryland Water-Use Program was developed in the late 1970s as a cooperative effort between the Maryland Department of Natural Resources (MD

DNR) and the U.S. Geological Survey (USGS). Over the years, the program has grown and now includes the Maryland Department of the Environment, Water Management Administration; the MD DNR, Maryland Geological Survey; and the USGS. Through this multi-agency cooperative program, comprehensive computerized databases of water-withdrawal information have been maintained and updated annually since 1979. The guidelines and procedures for estimating water use in Maryland were developed by the USGS National Water-Use Program (U.S. Geological Survey, 2001) and were used in generating the data presented in this Fact Sheet.

Maryland water-use data were published in statewide reports annually from 1985 to 1987, and biennially from 1988 to 1993. Maryland water-use data also are included in USGS National Water-Use Circulars, which have been published every 5 years since 1950. State data for 1995 are in USGS Circular 1200, "Estimated Use of Water in the United States in 1995" (Solley, Pierce, and Perlman, 1998). The 1990 and 1995 Circulars are available on the USGS National Water-Use Program website at <http://water.usgs.gov/watuse/>.

Selected References

- Forstall, R.L., 1995,** Population by counties by decennial census: 1900 to 1990: Washington, D.C., U.S. Bureau of the Census, Population Division, accessed September 25, 2003, at <http://www.census.gov/population/cencounts/md190090.txt>
- Johns Hopkins University, 1893,** Maryland, its resources, industries, and institutions: Baltimore, Maryland, The Sun Printing Office, 504 p.
- Maryland Manual 1918-1919,** A compendium of legal, historical, and statistical information relating to the State of Maryland: Annapolis, Maryland, Press of Advertiser-Republican, p. 199.
- Maryland Water Resources Administration, 1987,** Maryland water withdrawal and use report for 1985: Annapolis, Maryland, Maryland Department of Natural Resources, 40 p.
- National Oceanic and Atmospheric Administration, 2002,** Climatological data annual summary Maryland and

Delaware 2001: National Climate Data Center, v. 125, no. 13, p. 3-4.
 _____, **2003,** National Weather Service Middle Atlantic River Forecast Center, Map showing 30-year (1961-1990) mean precipitation for Maryland, accessed September 26, 2003, at <http://www.erh.noaa.gov/er/marfc/Maps/averages/average.html>

- Solley, W.B., Pierce, R.R., and Perlman, H.A., 1998,** Estimated use of water in the United States in 1995: U.S. Geological Survey Circular 1200, 71 p.
- U.S. Geological Survey, 2001,** Estimated use of water in the United States in 2000—Guidelines for preparation of state water-use estimates: U.S. Geological Survey, Office of Ground Water, Reston, Virginia, 102 p.
- Walker, P.N., 1970,** Water in Maryland: A review of the Free State's liquid assets: Maryland Geological Survey Educational Series Report No. 2, 52 p.
- Wheeler, J.C., 1997,** Water withdrawal and use in Maryland, 1992-93: U.S. Geological Survey Water-Resources Investigations Report 96-4314, 42 p.
- _____, **1998,** Freshwater use in Maryland, 1995; U.S. Geological Survey Fact Sheet FS-115-98, 2 p.

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The USGS National Water-Use Program website is:
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