

Estimated Water Use in Wyoming During 2000

Introduction

The U.S. Geological Survey (USGS) has compiled and published estimates of water withdrawals every 5 years since 1950. This series of water-use reports serves as one of the few sources of information about regional or national trends in water withdrawals (Hutson and others, 2004).

In Wyoming, six categories—irrigation, mining, thermoelectric power, public supply, self-supplied domestic, and industrial—were included in the most



Crop irrigation from the High Plains aquifer.

recent (2000) USGS compilation of estimated water use. For each category, withdrawal volumes were compiled by water source (surface water or ground water), and by county. Irrigation, public supply, and industrial ground-water withdrawals also were compiled by aquifer. With the exception of saline ground-water mining withdrawals totaling 222 million gallons per day (Mgal/d), all withdrawals in Wyoming were freshwater. Estimated withdrawals are listed from largest to smallest throughout this fact sheet.

How Was Water Use Estimated?

Various methods were employed to estimate water withdrawals by category in 2000 (table 1). Methods used to estimate withdrawals during previous compilations were reviewed and used if applicable for 2000. Site-specific data were collected if available for a water-use category (mining and thermoelectric)



Water-supply well in northeast Wyoming.

because this is the most accurate compilation technique. However, for many categories, site-specific data were available for only the largest users (public supply).

Surveys were sent to obtain a selective sampling of typical water users in a water-use category (public supply and domestic). Water withdrawals were estimated using water-use coefficients and ancillary data for categories lacking site-specific data (irrigation, mining, public supply, and industrial).

Table 1. Data sources and calculations used to estimate water withdrawals in Wyoming during 2000.

[Data sources listed in the References Cited section of this fact sheet.]

Category	Data source	Calculation
Irrigation	Wyoming Agricultural Statistics Service, 1997, 2002, 2003 (irrigated acres); Pochop and others, 1992 (crop consumptive-use coefficients).	Irrigated acres of each crop were multiplied by crop consumptive-use coefficients.
Mining	Office of the State Inspector of Mines, 2001 (tons mined); Quan, 1988 (non-fuels coefficients); Denver Research Institute, 1981 (coal coefficients); Wyoming Oil and Gas Conservation Commission, 2002, 2003 (oil, gas, and coalbed natural gas water-use estimates).	Oil, gas, and coalbed natural gas water-use estimates were reported by Wyoming Oil and Gas Conservation Commission. Total tons of other commodities were multiplied by water-use coefficients.
Thermoelectric	Seven operators in the State were contacted directly.	Withdrawals were reported by individual facilities.
Public supply	Major suppliers contacted directly. U.S. Census Bureau, 2003a, 2003b (population), and 1990 and 1995 USGS water-use compilations (coefficient); Wyoming Water Development Commission, 2002a, 2002b (withdrawals and population); U.S. Environmental Protection Agency, 2002a, 2002b (population).	Some withdrawals were reported by the Wyoming Water Development Commission or suppliers. Withdrawals for suppliers not responding were estimated by using population multiplied by 250 gallons per day per person.
Self-supplied domestic	U.S. Census Bureau, 2003a, 2003b (population) and 1990 and 1995 USGS water-use compilations (coefficient).	Self-supplied domestic population was calculated by subtracting the population supplied by public water systems from the total county population. Per-capita water-use withdrawals were estimated by multiplying the self-supplied county population by a per capita-use coefficient of 75 gallons per day per person.
Industrial	U.S. Department of Labor, 2003 (employment); U.S. Army Corps of Engineers, 1987 (coefficients).	Employment by Standard Industrial Classification (SIC) code was compiled by county and multiplied by water-use coefficients.

What Are Some of the Major Uses of Water in Wyoming?

Estimated water use totaled about 5,160 Mgal/d during 2000 (fig. 1). Most (85 percent) of the water used was withdrawn from surface-water sources. Ground-water withdrawals accounted for the remaining 15 percent of water used. Irrigation withdrawals accounted for 87 percent of the estimated total water use in the State. Ninety-one percent of the water used for irrigation was from surface-water sources and the remaining 9 percent was withdrawn from ground-water sources. Public-supply withdrawals accounted for about 2 percent of the estimated total water use in the State and was the fourth most prevalent water use. Estimated water use for public supply was relatively evenly divided between ground water (54 percent) and surface water (46 percent).

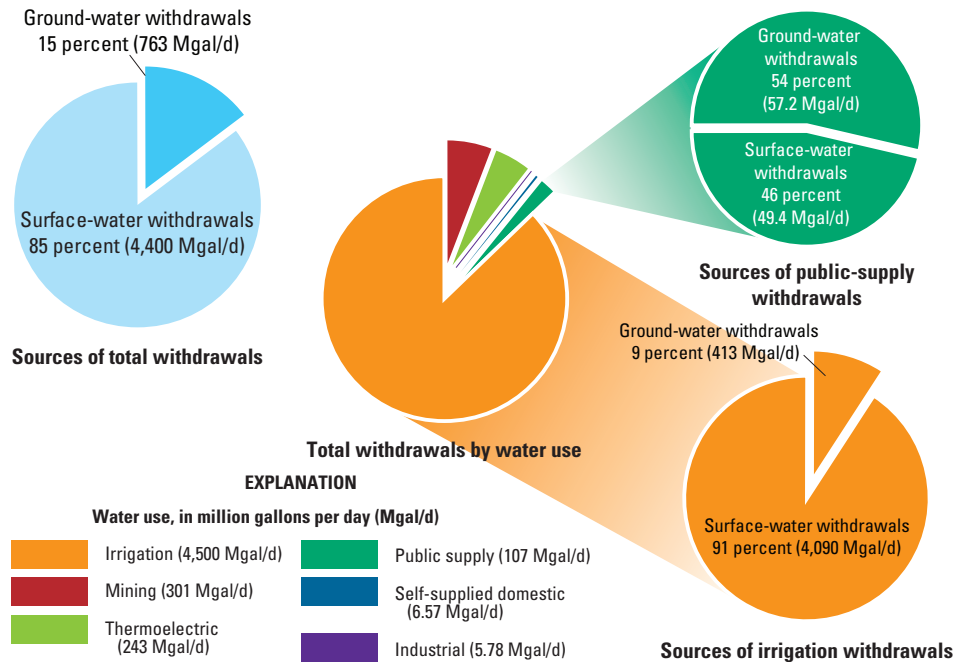


Figure 1. Estimated water withdrawals by category and source in Wyoming during 2000.

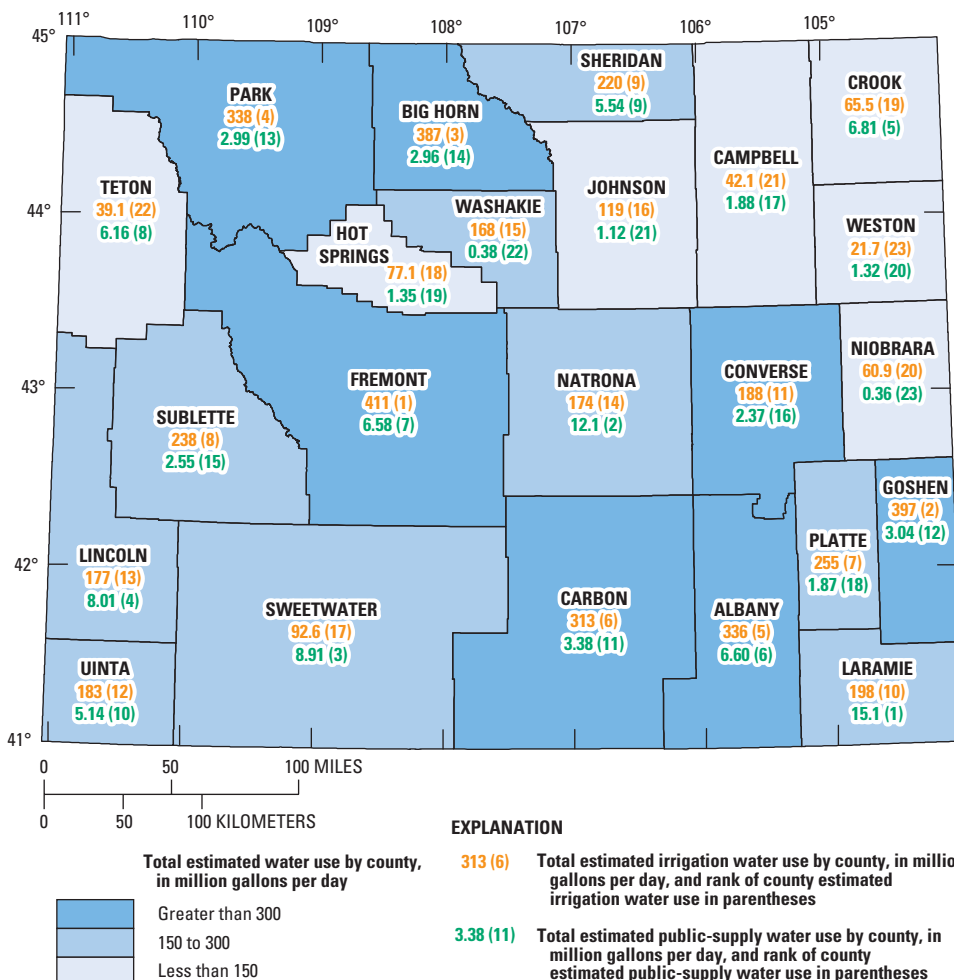


Figure 2. Estimated total, irrigation, and public-supply water withdrawals by county in Wyoming during 2000.

Was Estimated Water Use Evenly Distributed Across the State?

Estimated water use was compiled by county in 2000. Seven counties had estimated total water withdrawals exceeding 300 Mgal/d (fig. 2). Fremont County had the largest estimated total water use (433 Mgal/d). Fremont County also led the State in estimated irrigation use (411 Mgal/d). Because irrigation use constitutes the majority of total water use, counties with large estimated irrigation water use generally ranked high in estimated total water use (fig. 2). Weston County had the lowest estimated total water use (24.8 Mgal/d) in the State. Estimated public-supply use was greatest in Laramie (15.1 Mgal/d) and Natrona Counties (12.1 Mgal/d), home to Wyoming's two largest cities (Cheyenne and Casper).

What are the Sources of Ground Water?

The availability of ground water in the State is determined largely by geology. Rock type largely determines the water-yielding characteristics of aquifers and aquifer systems (Whitehead, 1996). Aquifers that are at or near land surface

and that consist primarily of semiconsolidated and consolidated rocks are shown in figure 3. An aquifer system is composed of two or more aquifers, often vertically stacked, that are grouped together because of physical connection or sharing of similar geologic and hydrologic characteristics that are best described and studied together. Consequently, aquifers that readers may be familiar with (such as the Madison aquifer) are not shown separately on figure 3 because they are either buried below another aquifer or they are grouped with other aquifers into an aquifer system. Unconsolidated deposits and consolidated sedimentary rocks are the most productive aquifers, whereas crystalline rocks generally are less permeable and less productive (Whitehead, 1996).

Withdrawals of ground water for irrigation, public supply, and industrial categories during 2000 totaled about 475 Mgal/d (fig. 4). The High Plains aquifer was the source of about 62 percent of those water withdrawals. Although mining constitutes a substantial part of total ground-water use (about 280 Mgal/d), the category was not summed with other ground-water withdrawals in figure 4 because estimates were not made by principal aquifer or aquifer system.

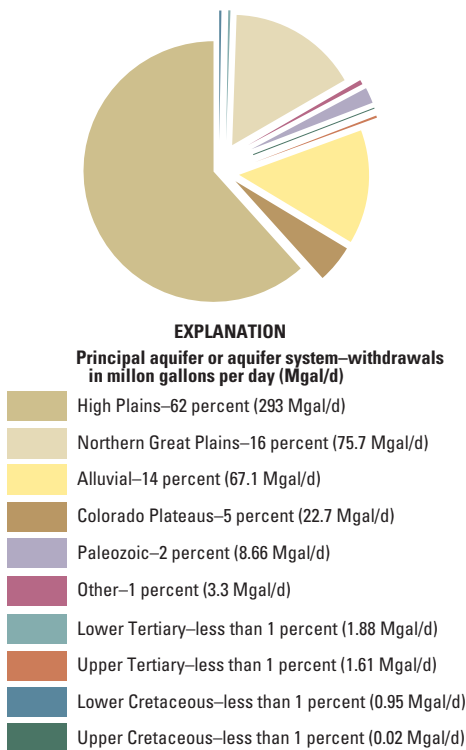


Figure 4. Summed irrigation, public supply, and industrial ground-water withdrawals by principal aquifer or aquifer system in Wyoming during 2000.

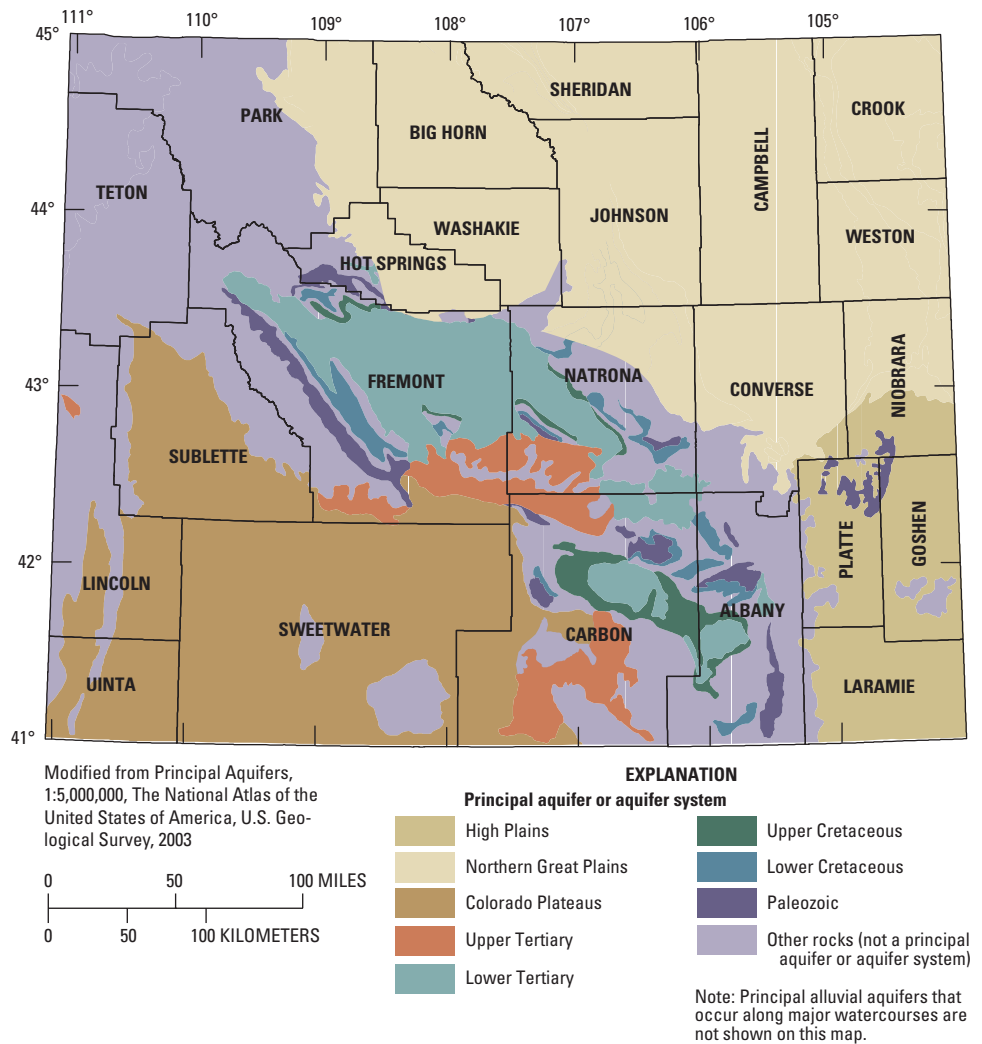


Figure 3. General extent of principal aquifers and aquifer systems at or near land surface in semiconsolidated and consolidated rocks in Wyoming.

How Does Wyoming's Estimated Per-Capita Freshwater Use Compare to Other States?

Estimated per-capita total freshwater use in Wyoming during 2000 was about 10,000 gallons per day per person (fig. 5). That value was the second largest in the country; only Idaho (15,100 gallons per day per person) was greater (fig. 5). The State with the lowest estimated per-capita total freshwater use during 2000 was Rhode Island (fig. 5). For comparison purposes, the average estimated per-capita total freshwater use for the entire United States (U.S.) and for the Western U.S. (17 western-most states in the U.S., not including Alaska and Hawaii) also are shown on figure 5. Large estimated per-capita freshwater use values are typical for sparsely populated States that withdraw substantial amounts of water for irrigation (Solley and others, 1993).

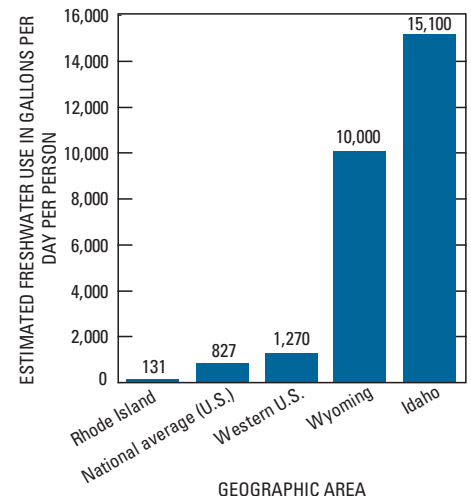


Figure 5. Per-capita freshwater use in Wyoming compared to other geographic areas in the U.S. in 2000.

What Factors Affect Water Availability in Wyoming?

Three natural factors—climate, geology, and physical geography—primarily determine the availability of surface water and ground water for various uses in Wyoming. In addition, the location and extent of infrastructure associated with irrigation and flood control (dams and canals) determine when and where a large proportion of Wyoming's water use occurs.

Climate varies substantially across the State. Precipitation is highest in the mountains where annual totals may exceed 30 inches per year. However, precipitation is less than 15 inches annually in the semiarid high plains and intermontane basins that comprise more than three-fourths of the State's land surface. In addition, natural variations in climate from year to year determine how much water is available for various uses in any given year.

The physical characteristics of rocks within the State (geology), in combination with climate and physical geography, affect the amount, location, and movement of water—both on the land surface in streams and below it in aquifers. Because climate, geology, and physical geography vary considerably based on location, and climate also varies through time, the amount of water available for use at a given location in Wyoming can vary considerably.

Estimates of the amount, source, and location of surface- and ground-water use are an important component in an overall

strategy to plan for future water needs of the State.

References Cited

- Denver Research Institute, 1981, Water and energy in Colorado's future—The impacts of energy development on water use in 1985 and 2000: Boulder, Colo., Westview Press, 303 p.
- Hutson, S.S., Barber, N.L., Kenny, J.F., Linsey, K.S., Lumia, D.S., and Maupin, M.A., 2004, Estimated use of water in the United States in 2000: U.S. Geological Survey Circular 1268, 46 p.
- Office of the State Inspector of Mines, 2001, Annual report of the State Inspector of Mines of Wyoming for the year ending December 31, 2000, 81 p.
- Pochop, Larry, Teegarden, Travis, Kerr, Greg, Delaney, Ronald, and Hasfurther, Victor, 1992, Consumptive use and consumptive irrigation requirements in Wyoming: Laramie, University of Wyoming, Water Resources Research Institute report 92-06, 59 p.
- Quan, Choon Kooi, 1988, Water use in the domestic nonfuel minerals industry: U.S. Bureau of Mines Information Circular 9196, 62 p.
- 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.
- U.S. Army Corps of Engineers, 1987, IWR—Main water use forecasting system version 5.1 user's manual and system description: IWR Report 88-R-6, various pagination.
- U.S. Census Bureau, 2003a, Population, housing units, area, and density—2000: accessed March 6, 2003, at http://factfinder.census.gov/servlet/GCTTable?ds_name=DEC_2000_SF1_U&geo_id=04000US56&_box_head_nbr=GCT-PH1&format=ST-7
- U.S. Census Bureau, 2003b, Wyoming county populations: accessed March 11, 2003, at http://factfinder.census.gov/servlet/DTable?_ts=65472682425
- U.S. Department of Labor, 2003, Bureau of Labor statistics, covered employment and wages: accessed February 2, 2003, at <http://data.bls.gov/labjava/outside.jsp?survey=ew>
- U.S. Environmental Protection Agency, 2002a, Public drinking water systems—Facts and figures: accessed March 7, 2003, at <http://www.epa.gov/safewater/pws/factoids.html>
- U.S. Environmental Protection Agency, 2002b, Safe Drinking Water Query: accessed February 22, 2002, at http://oaspub.epa.gov/enviro/sdw_form.create_page?state_abbr=WY
- U.S. Geological Survey, 2003, Principal aquifers, in National Atlas of the United States of America, 1 sheet, accessed October 5, 2005, at <http://nationalatlas.gov/mld/aquifrp.html>
- Whitehead, R.L., 1996, Ground-water atlas of the United States—Segment 8, Montana, North Dakota, South Dakota, Wyoming: U.S. Geological Survey Hydrologic Investigations Atlas 730-I, 24 p.
- Wyoming Agricultural Statistics Service, 1997, U.S. Census of Agriculture—Farm and ranch irrigation survey: accessed December 10, 2002, at <http://www.nass.usda.gov/census/census97/fris/tbl04.pdf>
- Wyoming Agricultural Statistics Service, 2002, Wyoming Agricultural Statistics Book: accessed December 10, 2002, at <http://www.nass.usda.gov/wy/bulletin/bulmtoc.htm>
- Wyoming Agricultural Statistics Service, 2003, county data: accessed February 25, 2003, at <http://www.nass.usda.gov/wy/internet/cntydata.htm>
- Wyoming Oil and Gas Conservation Commission, 2002, 2000 County report with percentage of State total: accessed June 3, 2002, at http://wogcc.state.wy.us/cfdocs/2000STATS_files/sheet003.htm
- Wyoming Oil and Gas Conservation Commission, 2003, Download menu—020503_CBM data in Excel (zipped): accessed on March 12, 2003, at <http://wogcc.state.wy.us/urecordsMenu.cfm?Skip='Y'&oops=ID7670>
- Wyoming Water Development Commission, 2002a, Wyoming Water Development Commission 2000 Water System Survey Report, System Data: accessed January 29, 2003, at <http://wwdc.state.wy.us/watsys/2000/system.html>
- Wyoming Water Development Commission, 2002b, Wyoming Water Development Commission 2000 water system survey report, system use: accessed January 29, 2003, at <http://wwdc.state.wy.us/watsys/2000/wateruse.html>

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Seminole Dam in south-central Wyoming.

For additional information on water use, visit the USGS Web site at <http://water.usgs.gov/watuse/> or contact:

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