

INTRODUCTION

This report presents 1990 freshwater withdrawal estimates for Oklahoma by source and category. Withdrawal source is either ground water or surface water. Withdrawal categories include: irrigation, water supply, livestock, thermoelectric-power generation, domestic and commercial, and industrial and mining. Withdrawal data are aggregated by county, major aquifer, and principal river basin. Only the four major categories of irrigation, water supply, livestock, and thermoelectric-power generation are illustrated in this report, although data for all categories are tabulated. The U.S. Geological Survey (USGS) established the National Water-Use Information Program in 1977 to collect uniform, current, and reliable information on water use. The Oklahoma District of the USGS and the Oklahoma Water Resources Board participate in a cooperative program to collect and publish water-use information for Oklahoma. Data contained in this report were made available through the cooperative program.

Terminology

**Withdrawal** is the amount of water withdrawn or diverted from a ground- or surface-water source. **Use** is the amount of water that is brought into a facility (or to an irrigation area) for use, and is equal to the withdrawal plus delivery from water suppliers minus any losses that occurred prior to use. **Freshwater** in this report is water containing less than 1,000 mg/L of dissolved solids<sup>1</sup>.

The following definitions are used in this report for each category of withdrawal:

- Irrigation** withdrawal is water applied artificially on lands to assist in the growing of crops and pastures or maintaining recreation lands such as parks and golf courses. The water is self supplied or purchased from an irrigation company, irrigation district, or other supplier for irrigation use. It is not obtained from a public supply system for irrigation use.
- Water-supply** withdrawal is water withdrawn by public and private water suppliers and delivered to users that do not supply their own water.

<sup>1</sup> The one exception to this definition is water withdrawn from the Blaine Gypsum aquifer. Water from this aquifer often exceeds 1,000 mg/L of dissolved solids (U.S. Geological Survey, 1988) and is used predominantly for irrigation.

- Livestock** withdrawal is water used by livestock. Livestock includes cattle, sheep, goats, hogs, poultry, horses, rabbits, bees, and fur-bearing animals in captivity.
- Thermoelectric-power generation** withdrawal is water used for cooling purposes in the production of electrical power using fossil-fuel (coal, oil, or natural gas), geothermal, or nuclear energy.
- Domestic** withdrawal is water used for normal household purposes such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens; also termed residential use. The water is self supplied and is not obtained from a water-supply system.
- Commercial** withdrawal is water used by motels, hotels, restaurants, office buildings, commercial facilities, fish hatcheries, and civilian and military institutions. The water is self supplied and is not obtained from a water-supply system. Commercial withdrawals are combined with the domestic category in this report.
- Industrial** withdrawal is water used for purposes such as fabrication, processing, washing, and cooling in the production of steel, chemical and allied products, paper and allied products, mineral processing not performed on mine site, and petroleum refining. The water is self supplied and is not obtained from a water-supply system.
- Mining** withdrawal is water used in the extraction of minerals occurring naturally such as coal, ores, crude petroleum, and natural gas. It also includes quarrying, well operation (dewatering), milling (crushing, screening, washing, and flotation), and other preparations customarily done at the mine site or as part of a mining activity. Mining withdrawals are combined with the industrial category in this report.

Withdrawal data in this report are shown in two types of illustrations. The choropleth maps are those maps that show ranges of withdrawals by county. The choropleth map for thermoelectric-power generation is shown as total withdrawals only, because 98 percent of these withdrawals are from surface water. The maps showing the withdrawals by aquifer and river basin indicate amounts and proportions of withdrawals. The pie charts are sized in proportion to the amount withdrawn in Mgal/d. The colors of the pie slices represent the categories of use for the withdrawals within each aquifer or basin. The amount of estimated freshwater with-

drawals for 1990 by county, use, and source for the 77 counties in Oklahoma are listed in table 1. Amounts listed in table 1 are rounded to three figures.

Approach

Water-use data were estimated using 1990 Oklahoma Water Resources Board data as the primary data source. The Oklahoma Water Resources Board collects water-use data through an annual survey of permitted water users. Additional data are collected or estimated by:

U.S. Army Corps of Engineers  
U.S. Department of Energy  
Oklahoma Agricultural Statistics Service  
Oklahoma State Corporation Commission  
Oklahoma State Department of Commerce  
Oklahoma State Department of Health  
Oklahoma State University Cooperative Extension Service  
Grand River Dam Authority  
City of Oklahoma City  
City of Tulsa  
U.S. Geological Survey

Different definitions and categories of use are used by different agencies. The different definitions and approach to data compilation require the USGS to recompile the Oklahoma Water Resources Board data and add data from other sources to obtain the information needed for the national program. For example, the USGS and the Oklahoma Water Resources Board primarily compile data by site of withdrawal, but some agencies compile data by site where used or final user. When large quantities of water are transferred between other counties or river basins, these differences in accounting procedures can create differences in reported use. Also, the definitions of the various categories vary between agencies. For example, the Oklahoma Water Resources Board has a public water-supply category that includes deliveries to residential, commercial and industrial users, plus sales to other municipalities. Their industrial and commercial categories are for self-supplied users only. Therefore, the components with public water supply must be extracted and compiled under several other use categories. A USGS animal speciality category such as fish farming had to be extracted from commercial and agricultural (nonirrigation). Thus, all information contained in this report is compiled from several

sources and cannot be compared directly to the Oklahoma Water Resources Board water-use totals.

Total withdrawals by water source were obtained by the Oklahoma Water Resources Board from mail-out surveys. The Oklahoma Water Resources Board developed special data-retrieval procedures for the USGS water-use program. The data were provided to the USGS as withdrawal-site totals by use category by county, and were further sorted by river basin and aquifer within the county. Irrigation withdrawals also were collated by crop so the consumptive use could be estimated. These data were compared with 1990 Oklahoma agricultural statistics (Oklahoma Agricultural Statistics Service, 1991) and the latest irrigation survey (1987) conducted by Oklahoma State University Cooperative Extension Service (Kizer, 1988). Water-supply water-use data were supplemented by unpublished data supplied in written communications by the Cities of Oklahoma City and Tulsa and by the Grand River Dam Authority and were cross-referenced with data supplied by the Oklahoma State Department of Health. Livestock water use was estimated from animal population figures supplied by the Oklahoma Agricultural Statistics Service (1991) and consumption coefficients supplied by Oklahoma State University Agricultural Engineering Department (R.L. Huhnke, written commun., 1991). The average annual precipitation may be helpful in interpreting the estimated withdrawal data for 1990; the 1990 statewide average precipitation was 43.52 in.

Acknowledgments

Water-use data used to derive the estimates contained in this report were made available to the USGS by the Oklahoma Water Resources Board. Specific details about withdrawals, sources, transfers, and retrievals were provided by Joan P. Hook and James B. Summers. Individual water users supplied original withdrawal information to the Oklahoma Water Resources Board.

ESTIMATED FRESHWATER WITHDRAWALS

During 1990 the total quantity of freshwater withdrawn in Oklahoma for all purposes was estimated to be 1,420 Mgal/d. Total surface-water withdrawals were estimated to be 760 Mgal/d or 53 percent of the total, and ground-water withdrawals were about 662 Mgal/d, or 47 percent of the total. Irrigation withdrawals accounted for 42 percent of total withdrawals and

for 74 percent of ground-water withdrawals. Withdrawals for water-supply purposes accounted for 36 percent of total withdrawals. Ground water was the source for 16 percent and surface water was the source for 84 percent of water-supply withdrawals. Livestock withdrawals accounted for 9 percent of the total withdrawals. Withdrawals for thermoelectric-power generation accounted for 6 percent of total withdrawals.

The largest total amount of freshwater withdrawn for irrigation purposes was in Texas County, followed by Cimarron and Beaver Counties, all in the Oklahoma Panhandle. The largest amount of water withdrawn for water-supply purposes was in Rogers County, followed by Mayes and Oklahoma Counties. Livestock withdrawals were largest from Grady, Caddo, and Bryan Counties. The largest total amount of freshwater withdrawn for thermoelectric-power generation purposes was in Muskogee County, followed by Pawnee and Seminole Counties, which accounted for almost three-fourths of the withdrawals.

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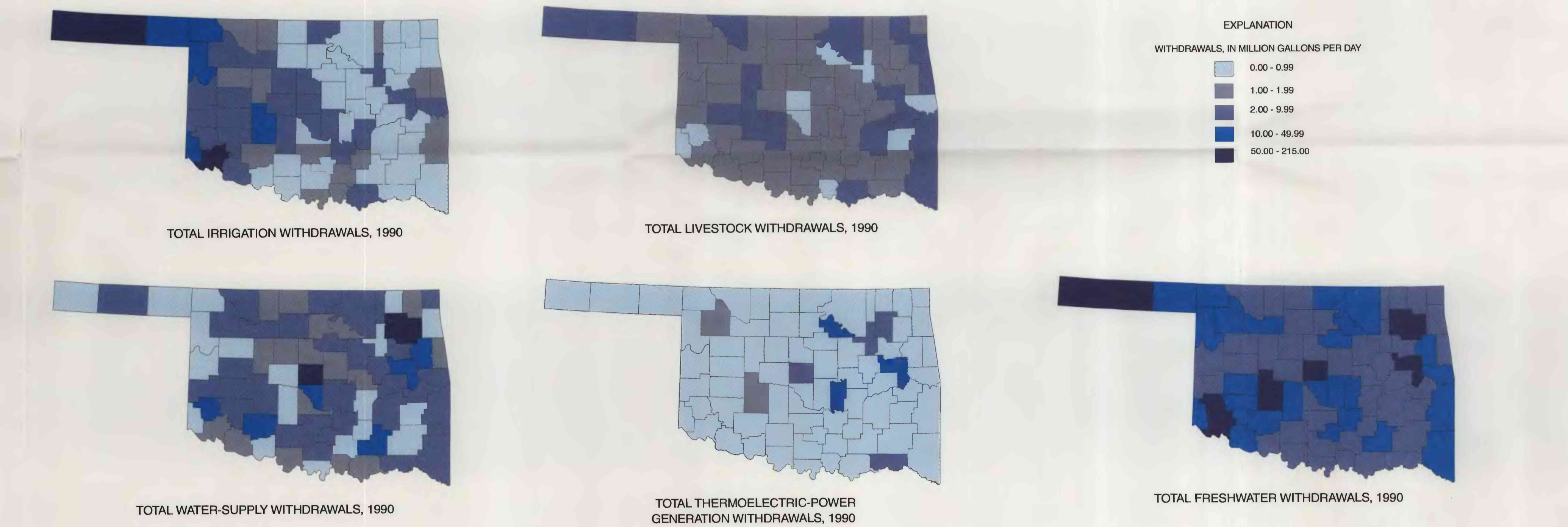


Table 1. Estimated freshwater withdrawals in Oklahoma, 1990, by county, use, and source  
[Amounts are in million gallons per day. Figures may not add to totals because of independent rounding.]

County	Irrigation			Water supply			Livestock			Thermoelectric-power generation			Domestic and commercial			Industrial and mining			Total		
	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total
Adair	0.07	1.79	1.86	0.00	1.86	1.86	0.00	2.00	2.22	0.00	0.00	0.00	1.25	0.00	1.25	0.00	0.01	0.01	1.54	5.66	7.20
Alfalfa	1.11	.42	1.53	1.33	.00	1.33	1.95	.00	1.95	.00	.00	.00	.25	.00	.25	.12	.476	.42	5.18		
Atoka	.01	.60	.61	.11	34.0	34.2	.15	1.29	1.44	.00	.05	.05	.52	.00	.52	.00	.00	.79	36.0	36.8	
Beaver	39.2	.53	39.7	.78	.00	.78	1.93	.00	1.93	.00	.00	.00	.34	.00	.34	.22	.625	.33	43.00		
Beckham	2.42	.36	2.78	3.09	.00	3.09	.28	.84	1.12	.00	.00	.00	.31	.00	.31	.00	.00	.610	1.20	7.30	
Blaine	1.43	.15	1.58	1.33	.02	1.35	.52	1.51	2.03	.00	.00	.00	.35	.00	.35	.25	.00	3.78	1.68	5.46	
Bryan	1.33	3.18	3.31	.38	.48	1.06	.29	2.64	2.93	.00	.00	.00	.00	.00	.00	.06	1.36	6.34	7.70		
Caddo	34.3	3.33	37.7	1.14	8.07	9.21	.90	2.70	3.60	.19	1.29	1.48	.27	.00	.27	.01	.00	36.8	15.4	52.2	
Canadian	2.61	.20	2.81	.47	.00	.47	.18	1.67	1.85	.32	.00	.32	2.02	.01	2.03	.08	.00	.68	5.68	1.88	7.56
Carter	.12	.56	.68	.79	3.93	4.72	.13	1.21	1.34	.00	.00	.00	.12	.00	.12	.08	.01	.09	1.24	5.71	6.95
Cherokee	.01	1.62	1.63	.07	17.5	17.6	.12	1.07	1.19	.00	.00	.00	.08	.00	.08	.11	.11	.28	20.3	20.6	
Choctaw	.00	.21	.21	.12	2.28	2.40	.20	1.77	1.97	.00	2.56	2.56	.53	.00	.53	.00	.00	.85	6.82	7.67	
Cimarron	96.3	1.56	97.9	.51	.00	.51	2.43	.00	2.43	.00	.00	.00	.12	.00	.12	.00	.00	99.4	1.56	101	
Cleveland	.31	1.97	2.28	2.72	16.8	19.5	.08	.80	.88	.00	.00	.00	3.10	.00	3.10	.00	.00	6.21	19.6	25.8	
Cole	.00	1.04	1.04	.11	.76	.87	.16	1.50	1.66	.00	.00	.00	.10	.00	.10	.00	.00	.37	3.30	3.67	
Comanche	.84	.65	1.49	.71	11.0	11.7	.41	1.46	1.87	.00	.00	.00	1.24	.00	1.24	.12	22.2	22.3	33.2	35.3	38.6
Cotton	.12	.38	.50	.21	.33	.54	.33	1.12	1.45	.00	.00	.00	.20	.00	.20	.00	.00	.86	1.83	2.69	
Craig	.00	.00	.00	.10	1.40	1.50	.24	2.20	2.44	.00	.00	.00	.26	.00	.26	.00	.00	.60	3.60	4.20	
Creek	.00	.15	.15	.76	4.59	5.35	.11	1.03	1.14	.00	.00	.00	.217	.00	2.17	.00	.00	3.04	5.77	8.81	
Custer	1.73	.44	2.17	3.02	1.68	4.70	.47	1.42	1.89	.00	.00	.00	.34	.00	.34	.00	.00	5.56	3.54	9.10	
Delaware	.00	.43	.43	.17	.03	.20	.24	2.13	2.37	.00	.00	.00	.18	.00	.18	.00	.00	2.03	1.34	3.37	
Dewey	1.29	.00	1.29	.06	.00	.06	.40	1.34	1.74	.00	.00	.00	.15	.00	.15	.00	.00	26.0	.14	26.2	
Ellis	23.0	.14	23.1	.98	.00	.98	1.92	.00	1.92	.00	.00	.00	.72	.00	.72	.47	.47	4.53	1.90	6.43	
Garfield	.35	.15	.50	2.77	.02	2.79	.22	1.73	1.95	.00	.00	.00	.25	.00	.25	.25	.29	.29	2.35	4.54	6.89
Grady	.60	.55	1.15	1.03	2.31	3.34	.18	1.68	1.86	.00	.00	.00	.140	.00	1.40	.00	.00	6.41	7.48	13.8	
Grant	.01	.12	.13	1.31	.00	1.31	.15	1.45	1.60	.00	.00	.00	.10	.00	.10	.00	.00	1.57	1.57	3.14	
Greer	2.81	.01	2.82	1.06	47.5	48.6	.20	.47	.87	.00	.00	.00	.10	.00	.10	.00	.00	4.17	48.2	52.4	

Table 1. Estimated freshwater withdrawals in Oklahoma, 1990, by county, use, and source—Continued

County	Irrigation			Water supply			Livestock			Thermoelectric-power generation			Domestic and commercial			Industrial and mining			Total		
	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total	Ground water	Surface water	Total
Harmon	20.6	0.13	20.7	0.79	0.00	0.79	0.15	0.53	0.68	0.00	0.00	0.00	0.03	0.00	0.03	0.00	0.00	0.00	21.6	0.66	22.2
Harper	4.58	6.51	11.1	.83	.00	.83	1.82	.00	1.82	.00	.00	.00	.06	.00	.06	.00	.00	7.29	6.51	13.8	
Haskell	.00	.96	.96	.00	2.97	2.97	.21	1.96	2.17	.00	.00	.00	.43	.00	.43	.00	.00	.64	5.80	6.53	
Hughes	1.35	4.05	5.40	.04	.00	.04	.09	1.15	1.24	.00	.00	.00	.86	.00	.86	.00	.00	2.34	5.20	7.54	
Jackson	7.17	43.0	50.1	.19	.87	1.06	.36	1.08	1.44	.00	.00	.00	.10	.00	.10	.16	.00	7.98	44.9	52.9	
Jefferson	.08	.20	.28	.17	1.02	1.19	.18	1.59	1.77	.00	.00	.00	.15	.00	.15	.00	.00	.58	2.81	3.39	
Johnson	.04	1.28	1.32	.31	.67	.98	.12	1.22	1.34	.00	.00	.00	.20	.86	1.06	.07	.05	.12	.74	4.08	4.82
Kay	3.27	.15	3.42	1.14	7.17	8.31	.12	1.10	1.22	.00	.00	.00	.14	.00	.14	.00	1.59	1.59	4.67	10.0	14.7
Kiowa	2.92	1.30	4.22	1.27	.00	1.27	.18	1.65	1.83	.00	.00	.00	.44	.00	.44	.56	.01	.57	5.37	2.96	8.33
LeFlore	2.06	.82	2.88	.39	6.81	7.20	.43	1.52	1.95	.00	.00	.00	.29	.00	.29	.01	.00	3.18	9.15	12.3	
Lincoln	.00	.09	.09	.00	.99	.99	.07	.72	.79	.00	.00	.00	.62	.00	.62	.00	.04	.69	1.84	2.53	
Logan	1.07	.89	1.96	.00	3.45	3.45	.23	2.16	2.39	.00	.00	.00	1.25	.00	1.25	.00	1.23	1.23	2.55	7.73	10.3
McClain	.00	.08	.08	.44	.71	1.15	.15	1.43	1.58	.00	.00	.00	.84	.00	.84	.00	.00	1.43	2.22	3.65	
McIntosh	.70	1.77	2.47	1.57	.00	1.57	.16	1.49	1.65	.00	.00	.00	.77	.00	.77	.12	.15	.27	3.32	3.41	6.73
Major	1.25	.33	1.58	.68	.00	.68	.11	1.07	1.18	.00	.00	.00	.28	.00	.28	.00	.00	2.32	1.40	3.72	
Marshall	.27	.53	.80	1.01	.00	1.01	.14	1.35	1.49	.00	.00	.00	.88	.00	.88	.00	.00	2.30	1.88	4.18	
McCurain	.00	.25	.25	.07	3.77	3.84	.29	2.58	2.87	.00	.00	.00	1.26	.00	1.26	.00	3.60	3.60	16.2	10.2	11.8
McFadden	.00	.00	.00	.13	2.16	2.29	.15	1.32	1.47	.00	.00	.00	.24	.00	.24	.04	.00	.64	12.0	.04	12.1