

20 Estimated Use of Water in the United States in 2015

Table 5. Public-supply water withdrawals, 2015.

[Values may not sum to totals because of independent rounding. Values for public supply include fresh and saline-water withdrawals. Abbreviations: Mgal/d, million gallons per day; —, not estimated; n/a, not applicable]

State	Population (thousands)			Withdrawals (Mgal/d)			Public-supply deliveries		
	Total	Served by public supply		By source		Total	Domestic use (Mgal/d)	Thermoelectric-power generation use (Mgal/d)	All other uses and system losses (Mgal/d)
		Population	Population (percent)	Ground-water	Surface water				
Alabama.....	4,860	4,320	89	272	490	762	320	—	441
Alaska.....	738	550	74	37.8	61.4	99.2	61.6	0.60	37.0
Arizona.....	6,830	6,610	97	569	626	1,200	963	0.50	231
Arkansas.....	2,980	2,830	95	94.2	269	363	252	—	111
California.....	39,100	37,700	96	2,370	2,780	5,150	3,230	38.9	1,880
Colorado.....	5,460	5,170	95	109	735	844	637	13.7	194
Connecticut.....	3,590	2,730	76	43.0	197	240	96.0	4.65	139
Delaware.....	946	764	81	45.8	40.6	86.4	61.1	—	25.2
District of Columbia ...	672	672	100	0	0	0	44.8	0	n/a
Florida.....	20,300	17,800	88	2,080	307	2,380	1,500	8.88	874
Georgia.....	10,200	8,700	85	231	839	1,070	661	—	409
Hawaii.....	1,430	1,380	96	252	14.6	267	198	—	68.9
Idaho.....	1,650	1,260	76	247	29.2	276	234	—	41.7
Illinois.....	12,900	11,700	91	367	1,110	1,480	937	—	539
Indiana.....	6,620	4,940	75	339	288	628	376	—	252
Iowa.....	3,120	2,630	84	314	76.8	390	171	0.16	219
Kansas.....	2,910	2,760	95	137	214	351	175	0.25	176
Kentucky.....	4,430	3,980	90	87.4	465	553	279	—	274
Louisiana.....	4,670	4,180	89	354	355	709	497	—	212
Maine.....	1,330	669	50	27.5	57.5	85.0	35.5	2.05	47.4
Maryland.....	6,010	4,580	76	93.9	656	750	320	—	430
Massachusetts.....	6,790	6,180	91	199	449	648	347	47.0	254
Michigan.....	9,920	7,330	74	209	821	1,030	481	—	550
Minnesota.....	5,490	4,310	79	336	179	515	236	—	279
Mississippi.....	2,990	2,560	85	347	53.4	400	251	0.01	149
Missouri.....	6,080	5,260	86	282	516	797	482	1.64	313
Montana.....	1,030	728	71	83.3	69.9	153	86.2	—	67.0
Nebraska.....	1,900	1,720	91	218	57.2	275	129	—	146
Nevada.....	2,890	2,700	93	142	390	531	330	0.49	201
New Hampshire.....	1,330	833	63	35.4	60.1	95.5	50.0	0.53	45.0
New Jersey.....	8,960	7,990	89	379	797	1,180	626	0.71	549
New Mexico.....	2,090	1,790	86	184	78.3	262	145	0.26	116
New York.....	19,800	17,300	87	614	1,810	2,420	1,230	17.1	1,180
North Carolina.....	10,000	7,640	76	158	780	938	534	8.33	395
North Dakota.....	757	711	94	35.4	48.8	84.2	56.8	0.05	27.3
Ohio.....	11,600	9,750	84	450	857	1,310	589	4.19	713
Oklahoma.....	3,910	3,550	91	102	509	611	247	6.96	357
Oregon.....	4,030	3,400	84	147	420	567	355	4.53	207
Pennsylvania.....	12,800	9,330	73	227	1,160	1,390	522	—	869
Rhode Island.....	1,060	943	89	13.8	83.7	97.5	56.0	1.44	40.0
South Carolina.....	4,900	3,710	76	115	518	633	371	3.93	258
South Dakota.....	881	752	85	48.0	24.0	72.0	43.7	—	28.2
Tennessee.....	6,600	6,010	91	256	594	850	486	—	363
Texas.....	27,500	26,200	95	1,170	1,710	2,890	2,120	48.3	712
Utah.....	3,000	2,930	98	359	267	627	496	1.33	129
Vermont.....	626	382	61	13.9	28.8	42.7	16.6	—	26.1
Virginia.....	8,380	6,820	81	82.8	614	697	546	0.29	151
Washington.....	7,170	6,150	86	521	345	867	631	1.63	234
West Virginia.....	1,840	1,450	79	37.7	147	185	116	0.62	68.7
Wisconsin.....	5,770	4,170	72	265	214	479	240	0.23	239
Wyoming.....	586	467	80	54.5	46.8	101	82.3	—	19.0
Puerto Rico.....	3,470	3,470	100	66.6	510	576	338	0.97	237
U.S. Virgin Islands.....	104	51.9	50	0.91	3.36	4.27	2.74	—	1.53
TOTAL	325,000	283,000	87	15,200	23,800	39,000	23,300	220	15,500

Domestic

3,260 million gallons per day (self-supplied)
23,300 million gallons per day (public-supply deliveries)

Domestic water use includes indoor and outdoor uses at residences. Common indoor water uses are drinking, food preparation, washing clothes and dishes, bathing, and flushing toilets. Common outdoor uses are watering lawns and gardens or maintaining pools, ponds, or other landscape features in a domestic environment. Domestic water is either self-supplied or provided by public suppliers. Water for self-supplied domestic use is typically withdrawn from a private source, such as a well, or captured as rainwater in a cistern. Domestic deliveries are provided to homes by public suppliers. The proportion of total domestic water use from public-supply deliveries (88 percent) and self-supplied domestic withdrawals (12 percent) in the United States is shown in figure 5.

The estimated self-supplied and public-supplied populations in each State are listed in table 6, as well as the amounts used by each segment of the population for domestic needs and the respective per capita use in gallons per day (gallons per capita per day, GPCD). Domestic self-supplied withdrawals and public-supplied deliveries are combined in table 6 to show the total estimated domestic use in 2015 and the total per capita use in gallons per day calculated for all domestic use.

An estimated 42.5 million people in the United States, or 13 percent of the population, provided their own water for domestic use in 2015. These self-supplied withdrawals were estimated to be 3,260 Mgal/d (3,650 thousand acre-ft/yr), or about 1 percent of total withdrawals for all uses in 2015. Nearly all (98 percent) of these self-supplied withdrawals were from fresh groundwater sources. Self-supplied domestic withdrawals are rarely metered or reported; typically, this usage is calculated by multiplying an estimate of the population not served by public supply by a coefficient for daily per capita use. For some States, these coefficients were county-specific averages derived from observed residential water use and population estimates in nearby areas served by public suppliers. Other States used the same coefficient for all counties, commonly one used by State regulatory or planning agencies.

Self-supplied domestic per capita use ranged from 36 GPCD in Connecticut to 186 GPCD in Nevada. Generally, per capita use is least in the Northern and Eastern States and greatest in the Mountain and Western States where outdoor watering is more common. The national average self-supplied domestic per capita use in 2015 was 77 GPCD (table 6).

Most people in the United States used water provided by public suppliers. Domestic deliveries by public water suppliers totaled 23,300 Mgal/d in 2015 and represented water provided to 283 million people at single-family and multifamily dwellings. The District of Columbia and Puerto Rico have populations that are almost entirely supplied by public-supply systems. The District of Columbia had zero self-supplied domestic withdrawals estimated in 2015, and less than 1 Mgal/d was estimated for Puerto Rico in 2015. Per capita water use for domestic deliveries ranged from 35 GPCD in Connecticut to 186 GPCD in Idaho. The national average was 82 GPCD for public-supplied domestic water use in 2015. This per capita usage is less than the rate of 101 GPCD observed in 1995, 100 GPCD in 2005, and 88 GPCD in 2010. Domestic deliveries from public supply were not compiled nationally in 2000.

Combined self-supplied domestic withdrawals and public-supply deliveries totaled 26,600 Mgal/d in 2015, with 23,300 Mgal/d from public-supply deliveries (88 percent) and 3,260 Mgal/d from self-supplied withdrawals (12 percent), and the national average per capita use was 82 GPCD. The corresponding average per capita use for total domestic use in 2005 was 98 GPCD, and in 2010, it was 87 GPCD. The geographic distribution of total domestic water use by State is shown in figure 6A. The self-supplied domestic population in each State, in thousands of people and as a percentage of total State population, is shown in figure 6B. Self-supplied domestic populations were largest in Pennsylvania, Michigan, and New York. States where nearly one-half the population has a self-supplied water source were U.S. Virgin Islands and Maine.

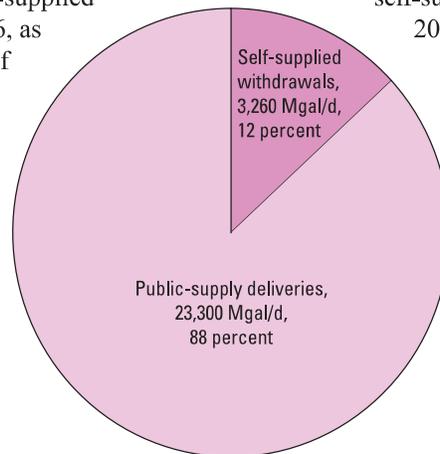


Figure 5. Total domestic water use from public-supply deliveries and self-supplied withdrawals, 2015. (Mgal/d, million gallons per day)

Table 6. Domestic water withdrawals and deliveries, 2015.

[Values may not sum to totals because of independent rounding. Abbreviations: gal/d, gallons per day; Mgal/d, million gallons per day]

State	Self-supplied domestic					Public supply				Total domestic use			
	Self-supplied population (thousands)	Percent of total population	Withdrawals (Mgal/d)			Self-supplied per capita use (gal/d)	Population served (thousands)	Water deliveries (Mgal/d)	Public-supply per capita use (gal/d)	Total population (thousands)	Water use (withdrawals and deliveries) (Mgal/d)	Total domestic per capita use (gal/d)	
			By source										
Ground-water	Surface water	Total											
Alabama.....	539	11	36.7	0	36.7	68	4,320	320	74	4,860	357	73	
Alaska.....	189	26	9.83	1.59	11.4	60	550	61.6	112	738	73.0	99	
Arizona.....	218	3	24.0	0	24.0	110	6,610	963	146	6,830	987	145	
Arkansas.....	144	5	12.8	0	12.8	89	2,830	252	89	2,980	265	89	
California.....	1,440	4	108	18.5	127	88	37,700	3,230	86	39,100	3,350	86	
Colorado.....	286	5	35.4	0	35.4	123	5,170	637	123	5,460	672	123	
Connecticut.....	861	24	30.8	0	30.8	36	2,730	96.0	35	3,590	127	35	
Delaware.....	182	19	14.5	0	14.5	80	764	61.1	80	946	75.7	80	
District of Columbia.....	0	0	0	0	0	0	672	44.8	67	672	44.8	67	
Florida.....	2,460	12	177	0	177	72	17,800	1,500	84	20,300	1,680	83	
Georgia.....	1,510	15	104	0	104	69	8,700	661	76	10,200	765	75	
Hawaii.....	56.3	4	0.66	7.44	8.10	144	1,380	198	144	1,430	206	144	
Idaho.....	396	24	70.2	0	70.2	177	1,260	234	186	1,650	304	184	
Illinois.....	1,150	9	92.1	0	92.1	80	11,700	937	80	12,900	1,030	80	
Indiana.....	1,680	25	127	0	127	76	4,940	376	76	6,620	503	76	
Iowa.....	494	16	32.0	0	32.0	65	2,630	171	65	3,120	203	65	
Kansas.....	149	5	17.7	0	17.7	118	2,760	175	63	2,910	192	66	
Kentucky.....	441	10	14.5	7.63	22.1	50	3,980	279	70	4,430	301	68	
Louisiana.....	492	11	39.3	0	39.3	80	4,180	497	119	4,670	537	115	
Maine.....	660	50	31.6	0	31.6	48	669	35.5	53	1,330	67.1	51	
Maryland.....	1,420	24	114	0	114	80	4,580	320	70	6,010	433	72	
Massachusetts.....	616	9	35.1	0	35.1	57	6,180	347	56	6,790	382	56	
Michigan.....	2,600	26	187	0	187	72	7,330	481	66	9,920	668	67	
Minnesota.....	1,180	21	82.2	0	82.2	70	4,310	236	55	5,490	318	58	
Mississippi.....	435	15	48.1	0	48.1	111	2,560	251	98	2,990	299	100	
Missouri.....	821	14	57.5	0	57.5	70	5,260	482	92	6,080	540	89	
Montana.....	305	29	22.6	1.12	23.7	78	728	86.2	118	1,030	110	106	
Nebraska.....	171	9	19.0	0	19.0	111	1,720	129	75	1,900	148	78	
Nevada.....	193	7	35.8	0	35.8	186	2,700	330	122	2,890	365	126	
New Hampshire.....	497	37	29.7	0	29.7	60	833	50.0	60	1,330	79.7	60	
New Jersey.....	966	11	90.7	0	90.7	94	7,990	626	78	8,960	717	80	
New Mexico.....	292	14	24.6	0	24.6	84	1,790	145	81	2,090	170	81	
New York.....	2,500	13	187	0	187	75	17,300	1,230	71	19,800	1,410	71	
North Carolina.....	2,410	24	169	0	169	70	7,640	534	70	10,000	703	70	
North Dakota.....	46.4	6	3.69	0	3.69	80	711	56.8	80	757	60.5	80	
Ohio.....	1,860	16	137	2.72	139	75	9,750	589	60	11,600	729	63	
Oklahoma.....	357	9	30.3	0	30.3	85	3,550	247	69	3,910	277	71	
Oregon.....	632	16	66.4	7.54	73.9	117	3,400	355	105	4,030	429	107	
Pennsylvania.....	3,470	27	208	0	208	60	9,330	522	56	12,800	731	57	
Rhode Island.....	113	11	6.57	0	6.57	58	943	56.0	59	1,060	62.6	59	
South Carolina.....	1,180	24	118	0	118	100	3,710	371	100	4,900	490	100	
South Dakota.....	129	15	5.56	0	5.56	43	752	43.7	58	881	49.3	56	
Tennessee.....	594	9	42.8	0	42.8	72	6,010	486	81	6,600	529	80	
Texas.....	1,320	5	137	0	137	104	26,200	2,120	81	27,500	2,260	82	
Utah.....	61.4	2	10.4	0	10.4	169	2,930	496	169	3,000	506	169	
Vermont.....	244	39	11.0	0	11.0	45	382	16.6	43	626	27.5	44	
Virginia.....	1,560	19	125	0	125	80	6,820	546	80	8,380	671	80	
Washington.....	1,020	14	110	0	110	107	6,150	631	103	7,170	741	103	
West Virginia.....	392	21	31.3	0	31.3	80	1,450	116	80	1,840	147	80	
Wisconsin.....	1,600	28	76.4	0	76.4	48	4,170	240	58	5,770	317	55	
Wyoming.....	119	20	8.93	0	8.93	75	467	82.3	176	586	91.3	156	
Puerto Rico.....	4.71	0	0.52	0	0.52	110	3,470	338	98	3,470	339	98	
U.S. Virgin Islands.....	51.6	50	1.23	2.55	3.78	73	51.9	2.74	53	104	6.52	63	
TOTAL	42,500	13	3,210	49.1	3,260	77	283,000	23,300	82	325,000	26,600	82	

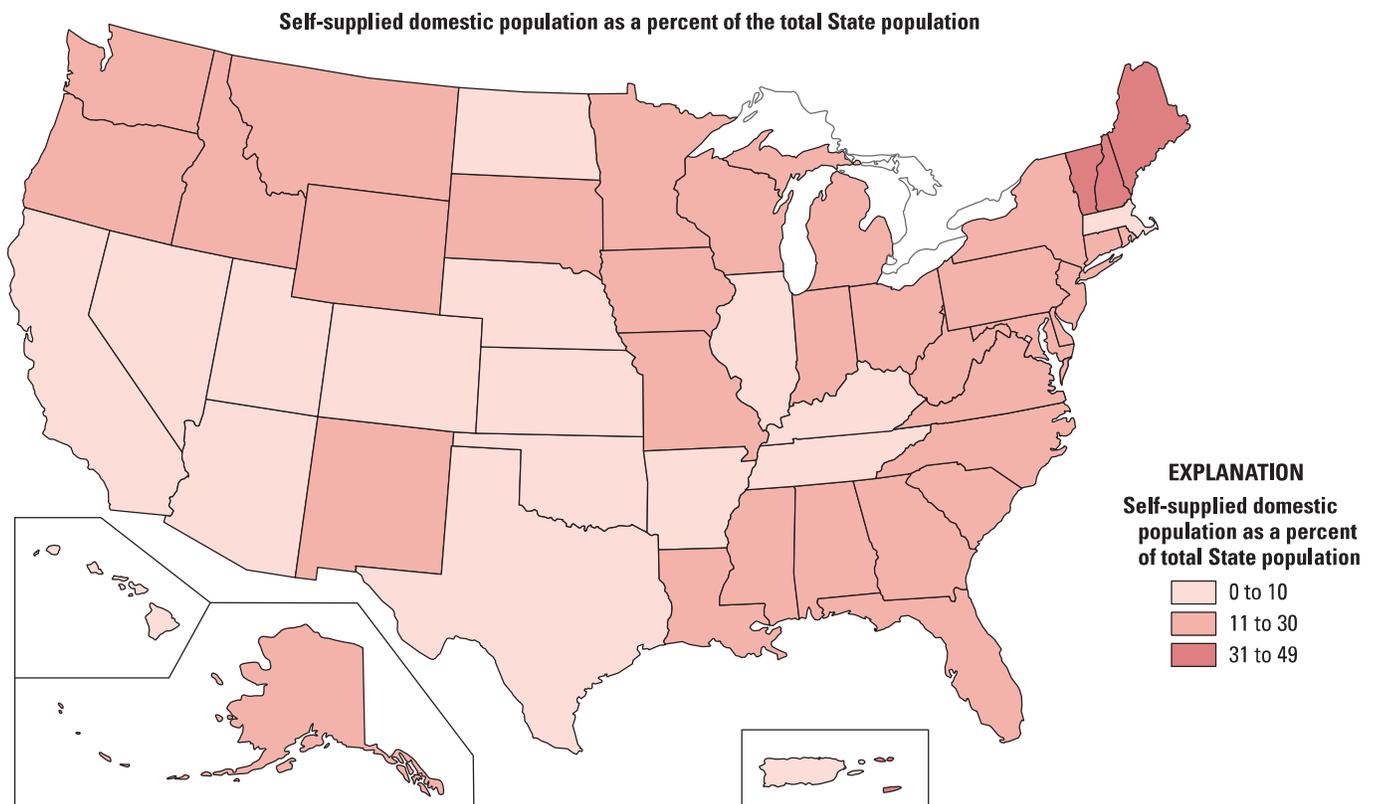
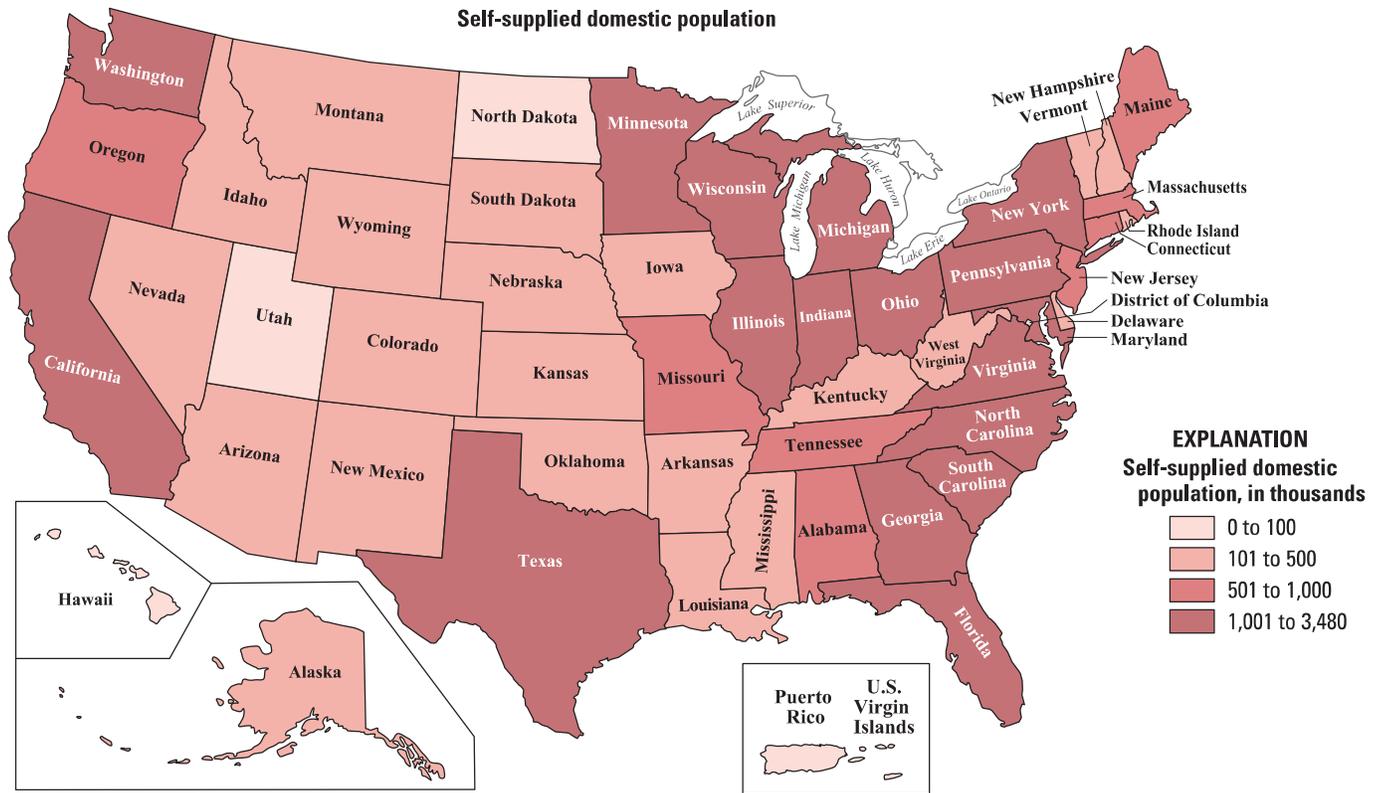


Figure 6B. Self-supplied domestic population and percentage of total population by State, 2015.

Irrigation

118,000 million gallons per day

Irrigation water use includes water that is applied by an irrigation system to sustain plant growth in agricultural and horticultural practices. In addition to the irrigation of crops, irrigation of golf courses, parks, nurseries, turf farms, cemeteries, and other self-supplied landscape-watering uses are included in the estimates. Irrigation also includes water that is used for other related processes, including pre-growing season application, frost protection, chemical application, weed control, field preparation, crop cooling, harvesting, dust suppression, and leaching salts from the root zone. Irrigation withdrawals generally are accounted for at the point of diversion (wells, springs, streams, ponds) and include water that was originally withdrawn from the source and water that is lost in conveyance prior to application on fields, as well as water that may subsequently return to a surface-water body as runoff after application, water consumed as evapotranspiration (ET) from plants and evaporation on ground surfaces, or water that recharges aquifers as it seeps past the root zone. Irrigation water use includes self-supplied withdrawals and deliveries from irrigation companies or districts, cooperatives, or governmental entities. All irrigation groundwater and surface-water withdrawals are considered freshwater. Included separately in the irrigation category is reclaimed wastewater from nearby treatment facilities or industries that is used as a source of irrigation water. Irrigated acres are reported for three types of irrigation methods: sprinkler, microirrigation, and surface (flood) systems.

Sources of data for irrigation withdrawals and irrigated acres included State and Federal crop reporting programs, irrigation districts, canal companies, incorporated management areas, satellite data depicting 2015 cropland landscapes, and evapotranspiration estimates. Withdrawals were estimated using information on irrigated crop acreages by crop type and specific crop water-consumption coefficients, or irrigation-system application rates, as well as soil-moisture balance models. Estimation methods varied from one State to the next and sometimes between geographic areas within a State. Estimation methods ideally included adjustments for climate, system efficiencies, conveyance losses, and other irrigation practices, such as pre-growing season irrigation, salt leaching, or frost protection. Other methods for estimating irrigation withdrawals included extrapolation of sample data on crop water-application rates or power-consumption coefficients. Although estimation methods vary by State and within States, irrigation estimates for the Nation provide a cohesive dataset with which to compare agricultural water use spatially and over time.

Irrigation withdrawals, reclaimed wastewater, and irrigated land by type of irrigation system are listed by State in table 7. For 2015, total groundwater and surface-water irrigation withdrawals were 118,000 Mgal/d, or 132,000 thousand acre-ft/yr, which accounted for 42 percent of total freshwater withdrawals and 64 percent of total freshwater withdrawals for all categories, excluding thermoelectric



Flood irrigation of cotton, Graham County, Arizona. Photograph by Saeid Tadayon, USGS.

Table 7. Irrigation water use, 2015.

[Values may not sum to totals because of independent rounding. Abbreviations: Mgal/d, million gallons per day; thousand acre-ft/yr, thousand acre-feet per year; —, not estimated]

State	Irrigated land (thousand acres)				Withdrawals (Mgal/d)			Re-claimed waste- water (Mgal/d)	Con- sump- tive use (Mgal/d)	Withdrawals (thousand acre-ft/yr)			Re- claimed waste- water (thou- sand acre- ft/yr)	Con- sump- tive use (thou- sand acre- ft/yr)
	By type of irrigation				By source					By source				
	Sprinkler	Micro- irrigation	Surface	Total	Ground- water	Surface water	Total			Ground- water	Surface water	Total		
Alabama.....	189	0	0	189	98.8	124	223	—	223	111	139	250	—	250
Alaska.....	2.95	0	0.07	3.02	1.50	0.02	1.52	—	1.39	1.68	0.02	1.70	—	1.56
Arizona.....	252	57.4	730	1,040	1,970	2,560	4,530	106	3,660	2,210	2,870	5,080	119	4,100
Arkansas.....	348	0	4,080	4,430	9,280	2,290	11,600	0	7,580	10,400	2,560	13,000	0	8,500
California.....	1,690	3,530	4,110	9,320	13,900	5,130	19,000	289	14,700	15,500	5,750	21,300	324	16,500
Colorado.....	1,430	2.70	1,600	3,040	1,310	7,690	9,000	4.28	2,650	1,460	8,620	10,100	4.80	2,970
Connecticut.....	17.5	0.71	0	18.2	3.02	8.29	11.3	—	10.7	3.39	9.29	12.7	—	12.0
Delaware.....	127	1.06	0	128	95.4	17.5	113	—	94.7	107	19.6	127	—	106
District of Columbia ...	0.12	0	0	0.12	0	0.05	0.05	—	0.04	0	0.06	0.06	—	0.04
Florida.....	590	720	716	2,030	1,150	1,290	2,450	195	1,700	1,290	1,450	2,740	219	1,900
Georgia.....	1,390	55.0	0	1,450	564	175	738	—	738	632	196	827	—	827
Hawaii.....	11.6	123	0	135	73.8	311	385	—	323	82.7	349	432	—	362
Idaho.....	2,570	3.08	1,220	3,790	4,900	10,400	15,300	—	8,920	5,490	11,600	17,100	—	10,000
Illinois.....	625	0	0	625	219	14.6	234	1.62	219	245	16.3	262	1.82	245
Indiana.....	449	0	0	449	93.1	40.0	133	—	120	104	44.8	149	—	134
Iowa.....	165	0	0	165	32.2	2.84	35.0	—	28.1	36.1	3.18	39.2	—	31.5
Kansas.....	2,990	39.8	92.7	3,120	2,560	122	2,680	3.94	2,200	2,870	136	3,000	4.42	2,460
Kentucky.....	68.4	10.3	0.63	79.3	2.84	36.7	39.6	—	35.7	3.18	41.2	44.3	—	40.0
Louisiana.....	90.2	0	881	972	720	333	1,050	—	700	807	373	1,180	—	784
Maine.....	40.0	0.05	0.81	40.9	5.06	13.8	18.9	—	18.0	5.67	15.5	21.2	—	20.2
Maryland.....	110	8.95	0.68	120	48.3	15.8	64.1	—	56.9	54.1	17.7	71.8	—	63.8
Massachusetts.....	25.7	2.06	12.7	40.5	114	24.1	139	—	29.8	128	27.0	155	—	33.4
Michigan.....	563	32.7	1.68	598	261	70.6	332	—	299	293	79.2	372	—	335
Minnesota.....	667	0	26.5	694	242	33.9	276	0	218	272	38.0	310	0	245
Mississippi.....	393	0	1,260	1,650	1,640	130	1,770	—	1,350	1,840	145	1,980	—	1,510
Missouri.....	492	53.6	635	1,180	1,300	75.3	1,370	—	436	1,460	84.4	1,540	—	489
Montana.....	1,280	0.64	1,190	2,470	59.6	9,390	9,450	—	2,370	66.8	10,500	10,600	—	2,660
Nebraska.....	7,350	16.6	2,210	9,580	5,420	674	6,090	—	5,540	6,070	755	6,830	—	6,210
Nevada.....	365	0.18	332	698	972	1,090	2,070	5.75	1,560	1,090	1,230	2,320	6.45	1,750
New Hampshire.....	6.46	0.84	0.25	7.55	1.09	4.11	5.20	—	4.94	1.22	4.61	5.83	—	5.54
New Jersey.....	81.0	31.0	2.98	115	55.1	38.8	93.9	—	63.9	61.8	43.5	105	—	71.6
New Mexico.....	385	18.8	355	759	1,050	1,320	2,370	4.43	1,410	1,180	1,490	2,660	4.97	1,580
New York.....	84.9	15.6	1.07	102	17.8	35.7	53.5	—	51.0	20.0	40.0	60.0	—	57.1
North Carolina.....	222	6.39	0	228	83.8	241	325	—	325	93.9	270	364	—	364
North Dakota.....	226	0	52.1	278	102	130	233	0	81.3	115	146	261	0	91.2
Ohio.....	66.9	7.70	0	74.6	17.9	37.1	55.0	0	49.4	20.0	41.6	61.6	0	55.3
Oklahoma.....	471	23.9	58.0	553	787	144	931	0	761	882	161	1,040	0	853
Oregon.....	1,350	88.3	520	1,960	1,220	3,940	5,160	—	3,440	1,360	4,420	5,780	—	3,860
Pennsylvania.....	58.0	19.5	0.44	78.0	17.5	16.8	34.3	—	31.0	19.6	18.9	38.5	—	34.8
Rhode Island.....	5.69	0.83	0.02	6.54	3.78	0.47	4.25	—	4.04	4.24	0.53	4.76	—	4.53
South Carolina.....	176	10.9	6.03	193	87.9	38.3	126	0	126	98.5	43.0	141	0	141
South Dakota.....	213	0	59.3	273	139	71.2	211	0	110	156	79.8	236	0	124
Tennessee.....	124	10.3	15.9	150	36.4	27.4	63.8	—	51.1	40.8	30.7	71.6	—	57.3
Texas.....	4,150	468	1,040	5,660	4,480	1,010	5,490	45.3	4,280	5,020	1,140	6,150	50.8	4,800
Utah.....	609	0.94	689	1,300	537	2,490	3,030	13.0	2,060	602	2,790	3,390	14.6	2,310
Vermont.....	4.68	1.47	0.65	6.80	1.02	2.09	3.11	—	2.93	1.14	2.34	3.49	—	3.28
Virginia.....	95.5	11.1	0	107	7.93	43.8	51.7	—	44.0	8.89	49.0	57.9	—	49.3
Washington.....	1,260	76.4	223	1,560	720	1,800	2,520	0	1,990	807	2,020	2,830	0	2,230
West Virginia.....	4.14	0	1.67	5.81	0.40	3.75	4.15	—	3.52	0.45	4.20	4.65	—	3.95
Wisconsin.....	508	6.09	20.0	534	287	173	460	—	293	322	194	515	—	329
Wyoming.....	237	5.56	1,190	1,440	537	7,250	7,790	—	2,150	602	8,130	8,730	—	2,410
Puerto Rico.....	15.6	27.9	0.77	44.2	41.6	34.1	75.7	—	73.2	46.6	38.2	84.8	—	82.0
U.S. Virgin Islands.....	0	0	0	0	0	0	0	—	0	0	0	0	—	0
TOTAL	34,700	5,490	23,300	63,500	57,200	60,900	118,000	669	73,200	64,100	68,300	132,000	750	82,000



Irrigation well in Puerto Rico. Photograph by José A. Santiago-Saez, USGS.

power. Total irrigation withdrawals were about 2 percent more than in 2010. Withdrawals from surface-water sources were 60,900 Mgal/d, which accounted for 52 percent of the total irrigation withdrawals, and were about 8 percent less than in 2010. Groundwater withdrawals for 2015 were 57,200 Mgal/d, which accounts for 48 percent of the total irrigation withdrawals, and were 16 percent more than in 2010. About 63,500 thousand acres were irrigated in 2015, an increase of 1,130 thousand acres (2 percent) from 2010. About 34,700 thousand acres (55 percent) were irrigated with sprinkler systems, 23,300 thousand acres with surface (flood), and 5,490 thousand acres with microirrigation systems.

In addition to irrigation withdrawals from groundwater and surface-water sources, the use of reclaimed wastewater as a source of irrigation water was reported in 10 States (California, Florida, Arizona, Texas, Utah, Nevada, New Mexico, Colorado, Kansas, and Illinois) and accounts for 669 Mgal/d or less than 1 percent of the total irrigation water used. California, Florida, and Arizona were the largest users of reclaimed wastewater for irrigation with uses of 289, 195, and 106 Mgal/d, respectively. Although still a minor overall source of irrigation water in the Nation, reclaimed wastewater use increased from 472 Mgal/d in 2010 to 669 Mgal/d in 2015 (a 42-percent increase).

Five states (California, Idaho, Arkansas, Montana, and Colorado) accounted for 54 percent of the national total of irrigation withdrawals. The geographic distribution of total groundwater and surface-water withdrawals for irrigation is shown in figure 7. Most of the total irrigation withdrawals (81 percent) in the United States and irrigated acres (74 percent) were in the 17 conterminous Western States (west of the solid line in fig. 7). The 17 Western States cumulatively accounted for 91 percent of total surface-water irrigation withdrawals and 71 percent of total groundwater irrigation withdrawals in the Nation. Additionally, 9 of the 10 States with the highest irrigation withdrawals are Western States. Agricultural regions in the conterminous Western States are typically in areas where average annual precipitation is less than 20 inches, which is generally insufficient to support crops without supplemental water. Surface water accounted for 58 percent of the total withdrawals in the arid West, but groundwater was the dominant source of irrigation water in California, Nebraska, Texas, Kansas, South Dakota, and Oklahoma. Irrigation water is typically applied in the more humid conterminous Eastern States (east of the solid line in fig. 7), as well as in Hawaii and Puerto Rico, to supplement precipitation during critical periods of the growing season, increase yields of crops, and increase the number of plantings

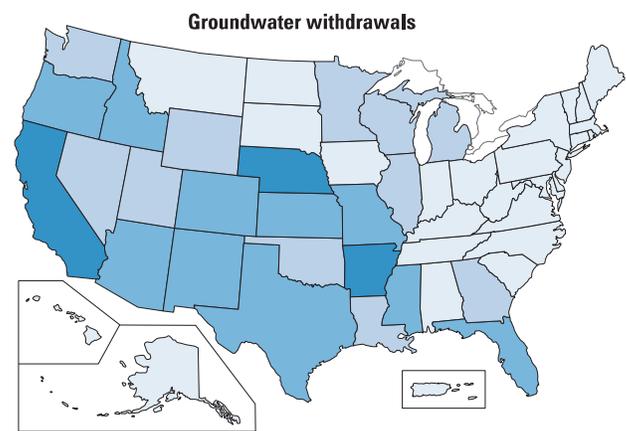
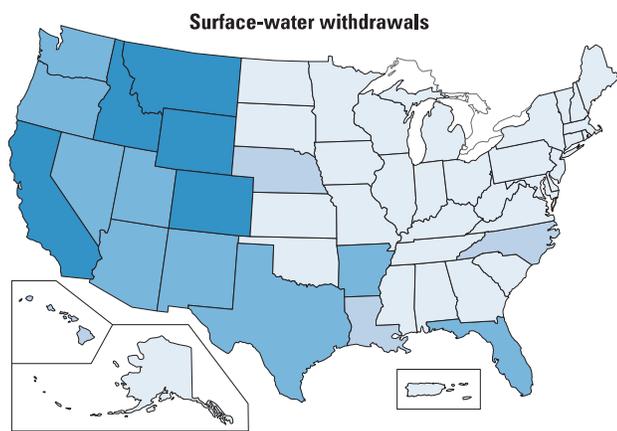
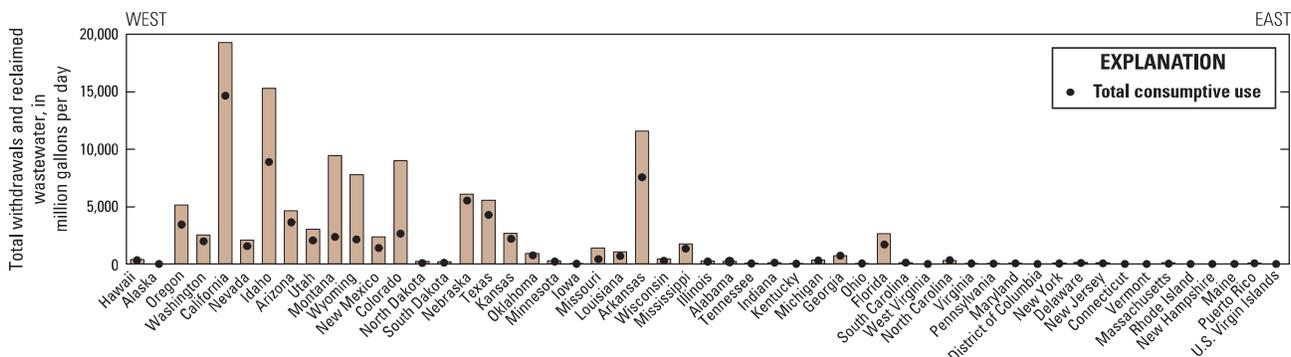
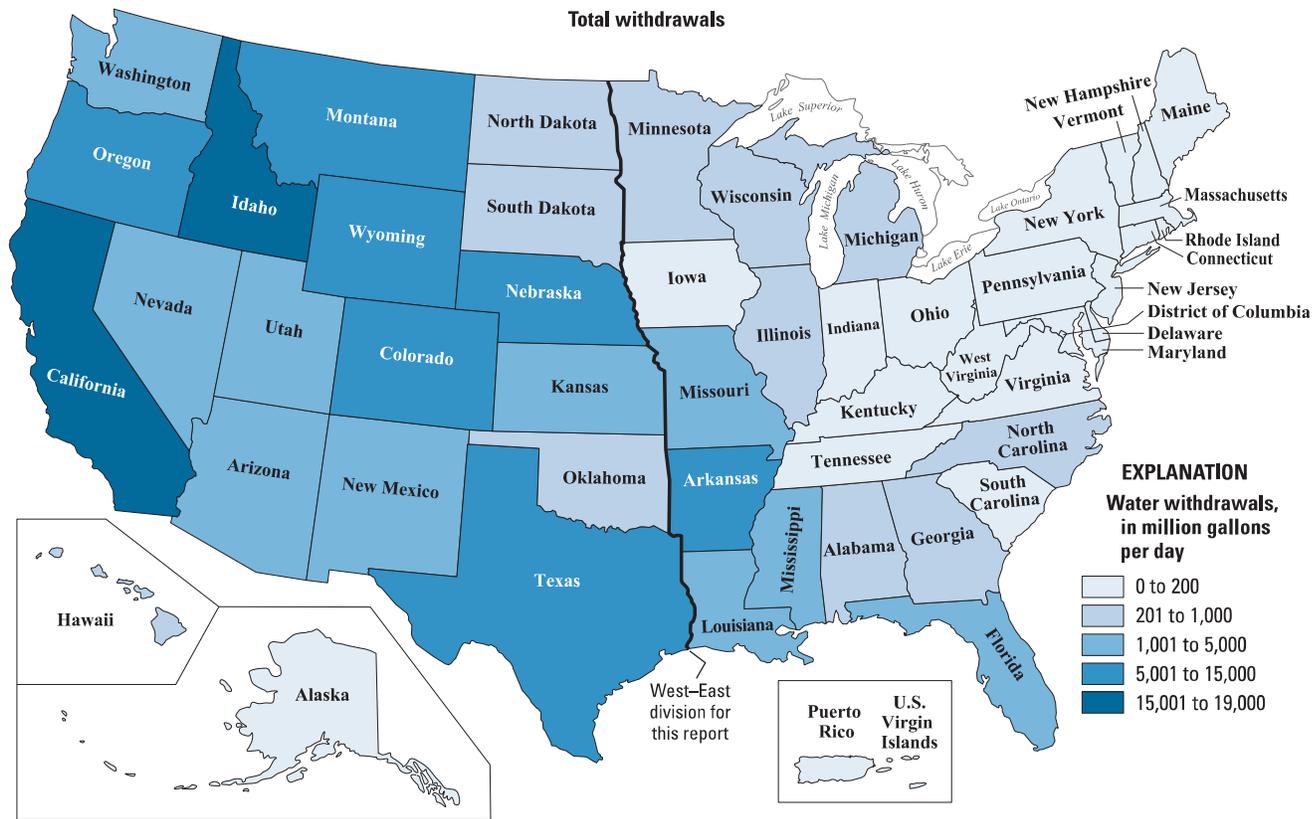


Figure 7. Irrigation water use by source and State, 2015.

per year. Notable Eastern States include Arkansas with the third largest withdrawals (11,600 Mgal/d) and fourth largest number of irrigated acres (4,430) and Florida with the fourteenth largest irrigation withdrawals (2,450 Mgal/d) and ninth largest number of irrigated acres (2,030).

Average application rates are calculated as a function of total irrigation withdrawals and total irrigated acres. The national application rate (total withdrawals for irrigation divided by the total acres irrigated) for 2015 was 2.09 acre-feet per acre, which is near that of the 2010 average of 2.08 acre-feet per acre. The median State application rate is 0.94 acre-feet per acre. The highest application rates occur in the arid Western States (Wyoming, Arizona, Idaho, and Montana had the highest application rates with values of 6.08, 4.89, and 4.52, and 4.29 acre-feet per acre, respectively) in order to meet the crop water requirements in these areas with limited precipitation. Many Western States rely on surface water as a primary source of irrigation water, and surface (flood) irrigation systems are common, which ultimately results in higher application rates. Additionally, surface water is often conveyed in canals and ditches and can lose substantial amounts of water via evaporation and infiltration before the remaining water reaches the irrigation systems and is applied to the land surface. Transmission losses are likely minimal for groundwater as water is commonly transferred from a well through pipes to an irrigation system. In addition, 33 percent of irrigated lands in the Western States is irrigated with relatively inefficient surface (flood) irrigation. Considerable amounts of excess applied water may result in return flow (surface runoff that reaches a surface-water source or infiltrates past the root zone to potentially recharge the groundwater system), thus returning to the local hydrologic system.

Although national total irrigation withdrawals were similar in 2010 and 2015, notable changes were observed at the State level. Of the States with the largest total irrigation withdrawals (greater than 5,000 Mgal/d), Arkansas, Montana, and Wyoming had notable increases of irrigation withdrawals, and Texas and California had notable decreases. Arkansas irrigation withdrawals increased 2,850 Mgal/d (33 percent) from 2010 to 2015, although total irrigated acres decreased 5 percent. Arkansas application rates increased from 2.09 acre-ft/acre in 2010 to 2.93 acre-ft/acre in 2015. Montana irrigation withdrawals increased 2,070 Mgal/d (28 percent) from 2010 to 2015, which corresponds with a 48 percent increase in estimated total irrigated acres during the same period. Because total irrigation withdrawals and total irrigated acres increased, application rates in Montana decreased from 4.95 acre-ft/acre in 2010 to 4.29 acre-ft/acre in 2015. Wyoming irrigation withdrawals increased 3,420 Mgal/d (78 percent), and irrigated acres increased 33 percent from 2010 to 2015. Despite the increase in irrigated acres, Wyoming application rates increased from 4.53 acre-ft/acre in 2010 to 6.08 acre-ft/acre in 2015. Texas irrigation withdrawals

decreased 1,340 Mgal/d (20 percent), and irrigated acres decreased 4 percent from 2010 to 2015. Texas was nearing the end of a multiyear drought in 2015 and experienced very moist conditions in June 2015 (fig. 8A) and extreme drought conditions in September 2015 (fig. 8B) (National Oceanic and Atmospheric Administration, 2016b). Texas application rates decreased from 1.29 acre-ft/acre in 2010 to 1.09 acre-ft/acre in 2015. California irrigation withdrawals declined 4,070 Mgal/d (18 percent), and irrigated acres decreased by 10 percent from 2010, likely as a result of the intense drought conditions in the region in 2015 (fig. 8A). Historically (1950–2010), surface water has been the primary source of irrigation water in California. However, groundwater was the primary source of irrigation water in California in 2015, likely as a result of limited available surface-water resources during the period of intense drought (fig. 8A) (National Oceanic and Atmospheric Administration, 2016b).

Nationwide estimates of consumptive use of water withdrawn for irrigation are included in this report for the first time since 1995. Consumptive use of irrigation water represents the fraction of water that was originally withdrawn from a source for irrigation and is subsequently removed from availability owing to evaporation, transpiration, or incorporation into crops. Reliable estimates of consumptive use are oftentimes difficult to determine. In most States, consumptive use was based on coefficients, irrigation-system efficiencies, or theoretical crop requirements from various sources. The NWUSP provided USGS personnel with evapotranspiration estimates based on 1-kilometer scale MODIS satellite data that were analyzed through the SSEBop model (Senay and others, 2013) to aid in interpretation of consumptive use estimates on irrigated lands. Consumptive-use estimates in California, Colorado, Delaware, Kansas, Missouri, Montana, North Dakota, South Dakota, and Wyoming were based primarily on the SSEBop model data; however, other methods were used to estimate consumptive use for the other States.

Of the 118,000 Mgal/d of groundwater and surface water withdrawn and the 669 Mgal/d of reclaimed wastewater used in the United States for irrigation in 2015, it is estimated that 73,200 Mgal/d (62 percent of the total water used) was consumed. State estimates of consumptive use range from 22 percent to 100 percent of the withdrawn irrigation water and reclaimed wastewater used for irrigation. Four States (Alabama, Georgia, North Carolina, and South Carolina) assumed 100 percent consumptive use where consumptive use was set equal to the water withdrawn for irrigation. The four States with the lowest percentage of estimated consumptive use (less than 30 percent) include Massachusetts, Montana, Wyoming, and Colorado; therefore, it is estimated that less than 30 percent of the water originally used for irrigation was actually evaporated, evapotranspired, or incorporated into the irrigated crops in those States.

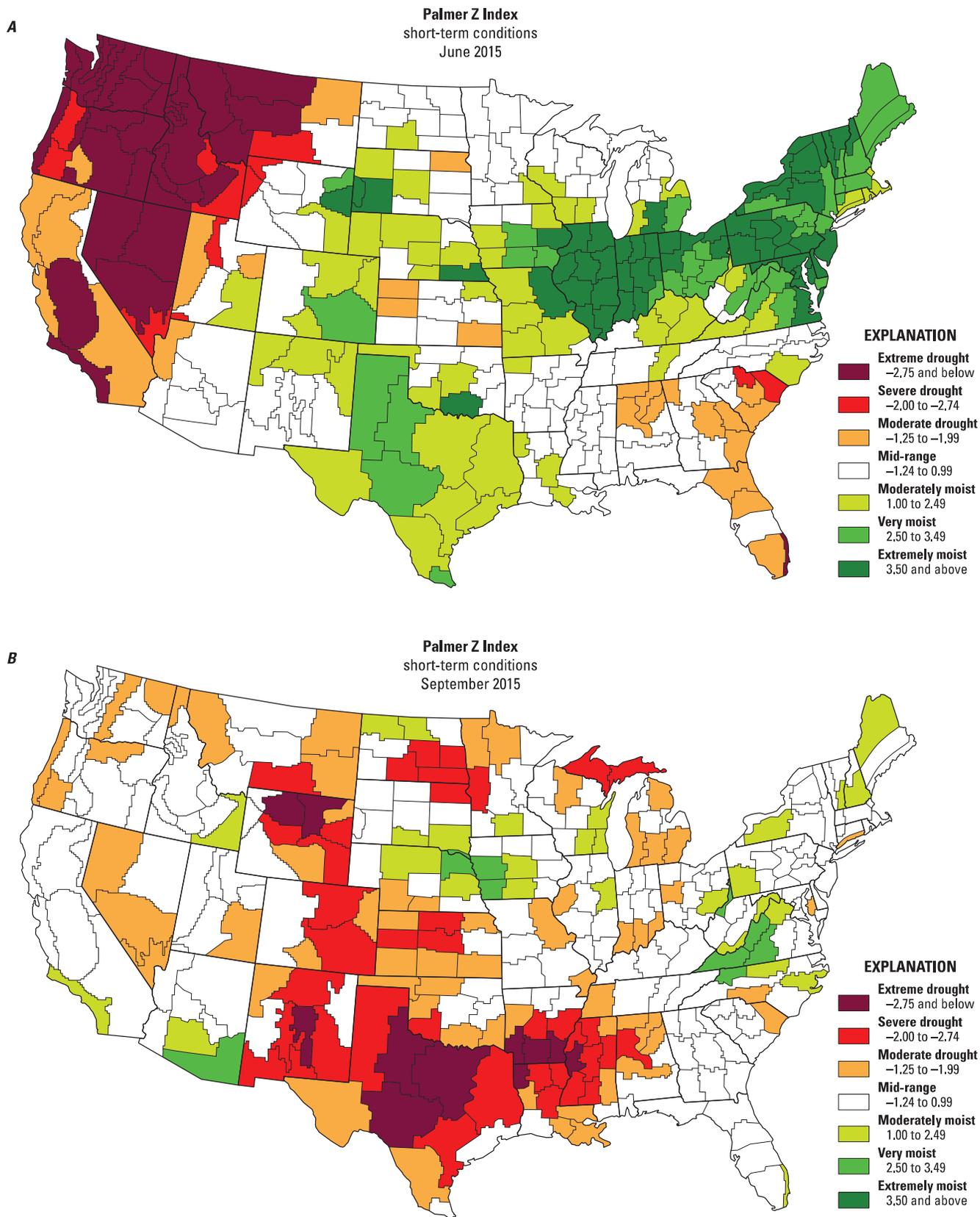


Figure 8. Drought index maps for the conterminous United States for *A*, June and *B*, September 2015. [Original map does not include Hawaii, Puerto Rico, or U.S. Virgin Islands. From National Oceanic and Atmospheric Administration, 2016b.]

Livestock

2,000 million gallons per day

Livestock water use is water associated with livestock watering, feedlots, dairy operations, and other on-farm needs. Livestock includes dairy cows and heifers, beef cattle and calves, sheep and lambs, goats, hogs and pigs, horses, and poultry. Other livestock water uses include cooling of facilities for the animals and products, dairy sanitation and wash down of facilities, animal waste-disposal systems, and incidental water losses. All withdrawals were considered freshwater and self-supplied. The livestock category excludes on-farm domestic use, lawn and garden watering, and irrigation water use.

Few State agencies require livestock operations to report water withdrawals; therefore, most estimates of livestock withdrawals were derived using animal population data and water-use coefficients, in gallons per head per day for each animal type. Animal population data generally are available from State agricultural agencies and the USDA NASS. Coefficients vary by State and, for many States, were provided by agricultural extension agents or water-permitting agencies. Coefficients may reflect facility maintenance needs and effects of climate on animal watering. Many of the 2015 withdrawals for livestock were estimated according to methods described by Lovelace (2009a), using livestock population data compiled for the USDA NASS 2012 Census of Agriculture (U.S. Department of Agriculture, 2014a) and water-use coefficients.

Livestock withdrawals for 2015 are listed by State in table 8. During 2015, withdrawals for livestock use were an estimated 2,000 Mgal/d, or 2,240 thousand acre-ft/yr (table 2B). Livestock withdrawals were about less than 1 percent of total freshwater withdrawals and about 1 percent of total freshwater withdrawals for all categories, excluding thermoelectric power. Groundwater was the source for 62 percent of total livestock withdrawals. Estimated total livestock withdrawals for 2015 were the same as 2010.

The geographic distribution of total, surface-water, and groundwater livestock withdrawals is shown in figure 9. Texas, California, Iowa, Nebraska, and Kansas each used more than 100 Mgal/d for livestock and together accounted for 42 percent of total livestock withdrawals in 2015. Texas, Iowa, Nebraska, Kansas, and California each used more than 80 Mgal/d of groundwater for livestock (table 8) and accounted for 42 percent of groundwater withdrawals for this use. Texas and California each used more than 100 Mgal/d of surface water for livestock, and accounted for 31 percent of surface-water withdrawals for livestock. It is likely that a large portion of the withdrawals for livestock was used for cattle, which typically require more water than other livestock species, with the exception of horses, and milk cows require additional water for sanitation of milking facilities and equipment (Lovelace, 2009a). In 2012, Texas, California, Iowa, Nebraska, and Kansas together accounted for 36 percent of all cattle and calves and 29 percent of all milk cows in the United States (U.S. Department of Agriculture, 2014a).

Table 8. Livestock water withdrawals, 2015.

[Values may not sum to totals because of independent rounding]

State	Withdrawals (million gallons per day)		
	By source		Total
	Groundwater	Surface water	
Alabama.....	11.5	14.7	26.2
Alaska.....	0.04	0.09	0.13
Arizona.....	38.9	0	38.9
Arkansas.....	13.6	20.5	34.1
California.....	82.0	101	183
Colorado.....	22.7	10.6	33.3
Connecticut.....	1.15	0	1.15
Delaware.....	1.34	0	1.34
District of Columbia.....	0	0	0
Florida.....	25.7	0.35	26.1
Georgia.....	27.5	17.4	44.9
Hawaii.....	0.51	1.10	1.61
Idaho.....	41.2	9.57	50.8
Illinois.....	36.2	0	36.2
Indiana.....	26.2	13.0	39.2
Iowa.....	124	41.0	165
Kansas.....	83.5	20.4	104
Kentucky.....	2.07	38.7	40.8
Louisiana.....	3.16	3.19	6.35
Maine.....	1.54	0.51	2.05
Maryland.....	5.85	2.15	8.00
Massachusetts.....	0.64	0.39	1.03
Michigan.....	21.4	2.33	23.7
Minnesota.....	58.9	0	58.9
Mississippi.....	6.85	10.3	17.1
Missouri.....	16.1	47.6	63.7
Montana.....	12.3	29.9	42.2
Nebraska.....	89.7	20.4	110
Nevada.....	4.94	0	4.94
New Hampshire.....	0.63	0.21	0.84
New Jersey.....	0.88	0	0.88
New Mexico.....	29.8	2.25	32.0
New York.....	16.8	8.89	25.7
North Carolina.....	51.9	14.6	66.5
North Dakota.....	12.5	8.30	20.8
Ohio.....	7.83	16.8	24.6
Oklahoma.....	27.4	43.3	70.6
Oregon.....	3.02	13.2	16.3
Pennsylvania.....	36.3	3.17	39.5
Rhode Island.....	0.11	0.01	0.12
South Carolina.....	4.36	5.51	9.87
South Dakota.....	19.3	28.6	47.9
Tennessee.....	12.0	11.5	23.4
Texas.....	138	137	276
Utah.....	7.46	8.44	15.9
Vermont.....	4.41	1.46	5.87
Virginia.....	6.52	20.5	27.0
Washington.....	20.8	8.82	29.7
West Virginia.....	1.70	3.38	5.08
Wisconsin.....	67.0	7.44	74.5
Wyoming.....	6.17	10.0	16.2
Puerto Rico.....	4.23	1.60	5.83
U.S. Virgin Islands.....	0.01	0.01	0.02
TOTAL	1,240	760	2,000

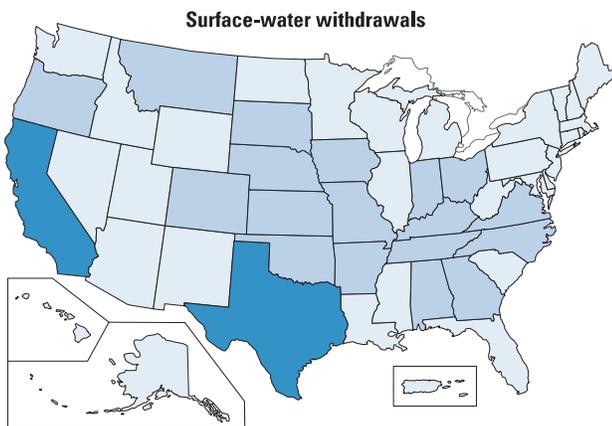
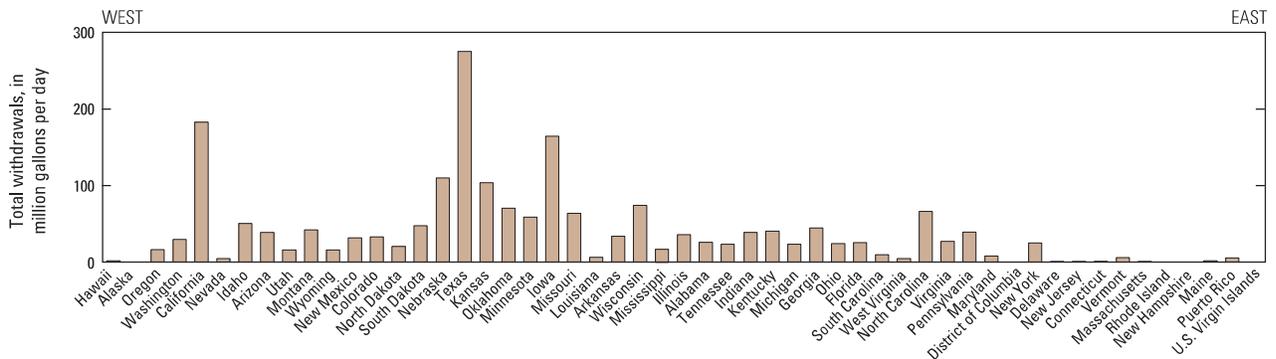
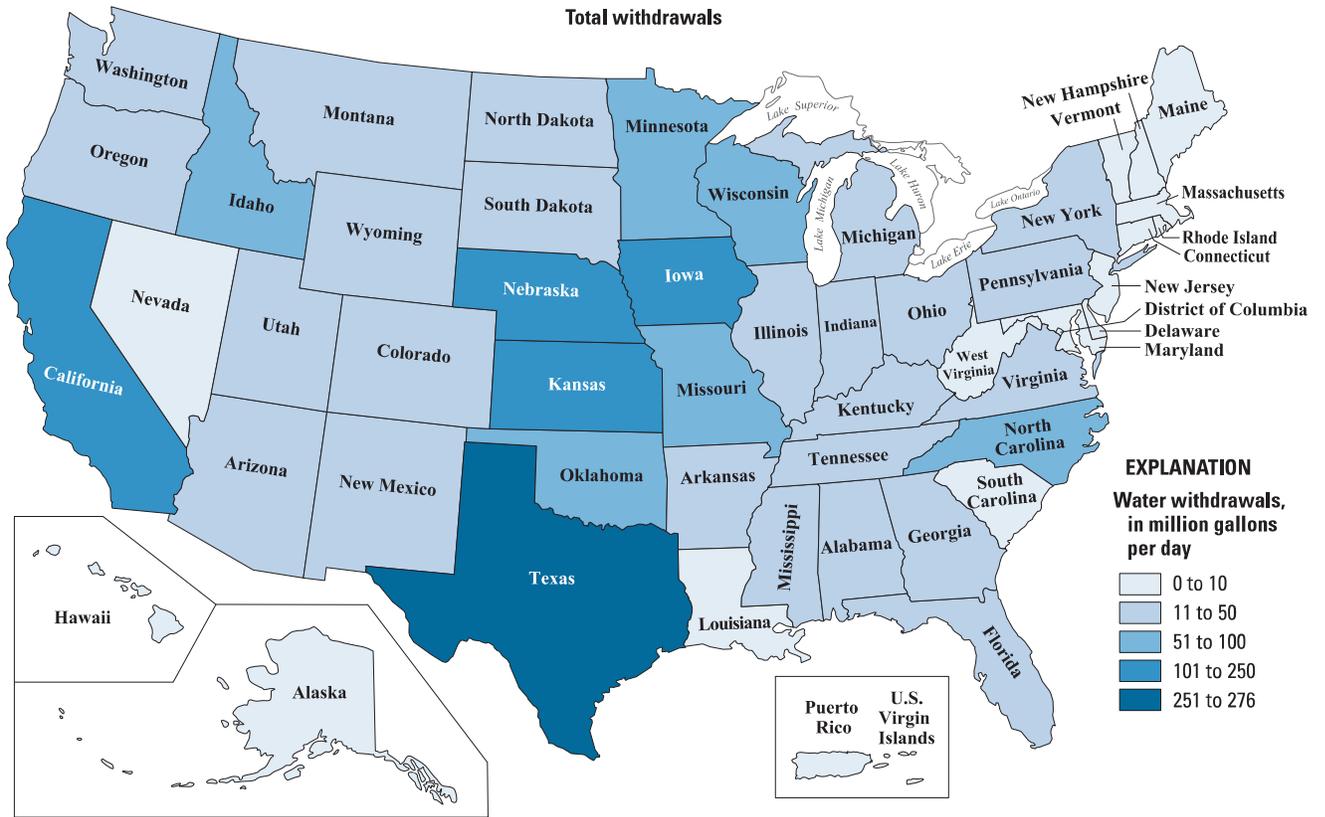


Figure 9. Livestock withdrawals by source and State, 2015.

Aquaculture

7,550 million gallons per day

Aquaculture water use is water associated with raising organisms that live in water, such as finfish and shellfish, for food, restoration, conservation, or sport. Aquaculture production occurs under controlled feeding, sanitation, and harvesting procedures primarily in ponds, flow-through raceways, and, to a lesser extent, cages, net pens, and closed-recirculation tanks. All aquaculture withdrawals were considered self-supplied.

Many of the 2015 withdrawals for aquaculture were estimated according to methods described by Lovelace (2009b), using aquaculture data compiled for the USDA NASS 2013 Census of Aquaculture (U.S. Department of Agriculture, 2014b) with standardized water-use coefficients and water-replacement rates. The USDA NASS 2013 data include statistics for various aquacultured species and aquaculture ponds, raceways, tanks, egg incubators, pens, and cages at commercial and noncommercial aquaculture operations. Several other sources of information were also used to estimate 2015 aquaculture withdrawals. These other sources include State permits from which estimates were derived from reported water withdrawals or return flows for aquaculture facilities. The EPA Permit Compliance System database also was a source of return-flow data that were used to estimate water withdrawals. Individual aquaculture operations, State regulatory agencies, State offices of the USDA NASS, and Cooperative Extension Service offices also provided information that was used to estimate aquaculture withdrawals in some States.

Total withdrawals for aquaculture during 2015, 7,550 Mgal/d, or 8,460 thousand acre-ft/yr (table 2B), are listed by State in table 9. Surface water was the source for about 79 percent of the withdrawals for this category. Much of the surface water was used for flow-through raceways and was returned to the source after use. A combined total of 6.30 Mgal/d saline surface-water withdrawals, less than 0.1 percent of total aquaculture withdrawals, was reported in Connecticut (3.02 Mgal/d), Florida (2.02 Mgal/d), Texas (0.86 Mgal/d), and Maine (0.40 Mgal/d); these amounts are not shown separately in table 9, but are included in the total. Aquaculture withdrawals were about 2 percent of total withdrawals and about 4 percent of total withdrawals for all categories, excluding thermoelectric power. Estimated aquaculture withdrawals in 2015 were 16 percent less than in 2010.

The geographic distribution of total, surface-water, and groundwater withdrawals for aquaculture is shown in figure 10. Idaho, North Carolina, California, and Oregon each used more than 500 Mgal/d for aquaculture, about 57 percent of the total and about 67 percent of the surface-water withdrawals for aquaculture. Louisiana, California, Alaska, and Arkansas each used more than 100 Mgal/d of groundwater and combined accounted for 57 percent of the total groundwater withdrawals for aquaculture.

Table 9. Aquaculture water withdrawals, 2015.

[Values may not sum to totals because of independent rounding. Values include fresh and saline-water withdrawals]

State	Withdrawals (million gallons per day)		Total
	By source		
	Groundwater	Surface water	
Alabama.....	27.2	22.2	49.4
Alaska.....	169	240	410
Arizona.....	23.8	10.7	34.5
Arkansas.....	152	98.9	251
California.....	247	480	727
Colorado.....	16.0	244	260
Connecticut.....	9.15	16.0	25.2
Delaware.....	1.98	0	1.98
District of Columbia ..	0	0	0
Florida.....	12.8	2.10	15.0
Georgia.....	14.5	70.6	85.1
Hawaii.....	8.58	10.0	18.6
Idaho.....	46.2	1,920	1,960
Illinois.....	5.23	5.47	10.7
Indiana.....	6.46	8.00	14.5
Iowa.....	7.46	12.2	19.7
Kansas.....	3.16	3.23	6.39
Kentucky.....	0.58	47.8	48.4
Louisiana.....	337	156	493
Maine.....	10.9	43.1	54.0
Maryland.....	5.91	2.07	7.98
Massachusetts.....	8.13	1.80	9.93
Michigan.....	1.06	72.8	73.8
Minnesota.....	1.72	14.8	16.5
Mississippi.....	87.5	39.3	127
Missouri.....	6.77	157	164
Montana.....	3.49	13.6	17.1
Nebraska.....	10.5	16.0	26.5
Nevada.....	11.6	22.4	34.0
New Hampshire.....	6.46	10.7	17.2
New Jersey.....	9.78	0	9.78
New Mexico.....	18.7	5.45	24.1
New York.....	11.0	49.5	60.4
North Carolina.....	13.3	990	1,000
North Dakota.....	0	5.32	5.32
Ohio.....	13.3	26.0	39.3
Oklahoma.....	0.06	3.23	3.29
Oregon.....	32.8	601	634
Pennsylvania.....	48.8	47.2	96.0
Rhode Island.....	6.72	0.09	6.81
South Carolina.....	0.61	6.08	6.69
South Dakota.....	3.57	24.9	28.5
Tennessee.....	11.7	45.2	56.9
Texas.....	11.6	11.6	23.2
Utah.....	83.1	0	83.1
Vermont.....	4.17	7.84	12.0
Virginia.....	0.15	113	113
Washington.....	50.6	194	245
West Virginia.....	8.10	31.2	39.3
Wisconsin.....	25.5	22.6	48.2
Wyoming.....	4.92	23.9	28.8
Puerto Rico.....	0	0.63	0.63
U.S. Virgin Islands.....	0	0	0
TOTAL	1,600	5,950	7,550

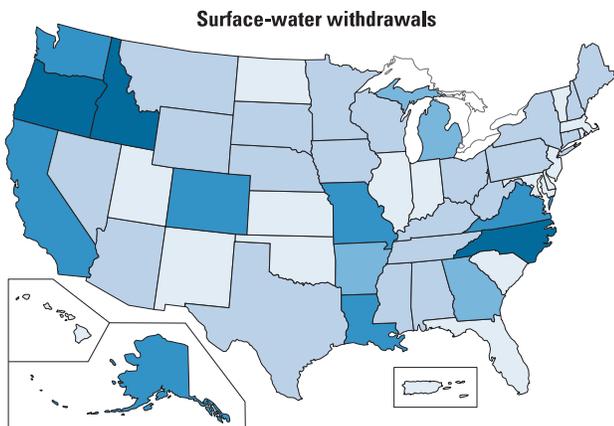
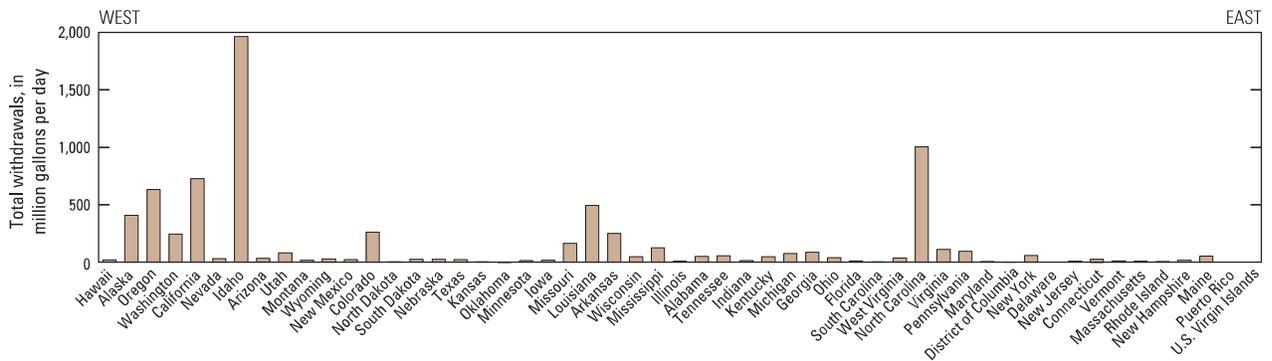
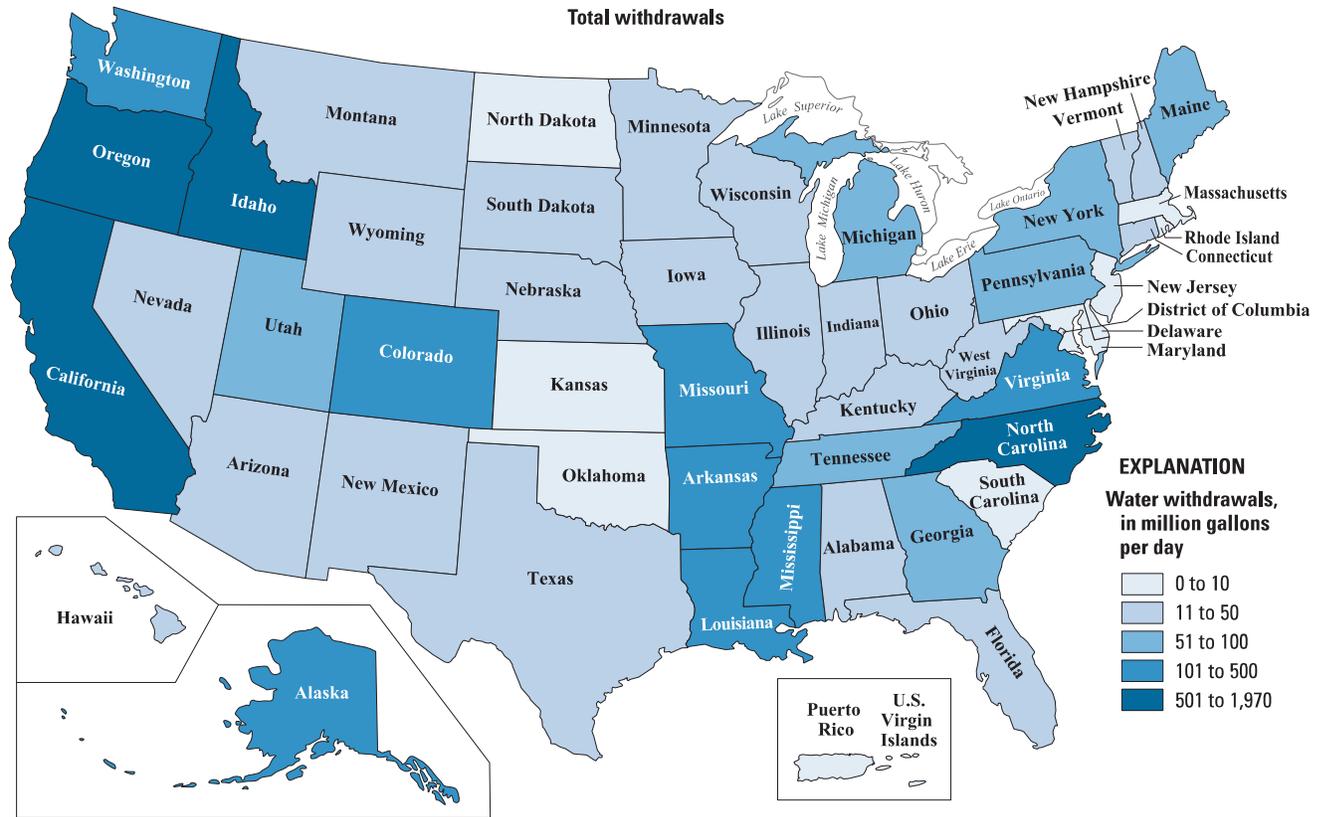


Figure 10. Aquaculture withdrawals by source and State, 2015.

Industrial

14,800 million gallons per day

Industrial withdrawals provide water for such purposes as fabricating, processing, washing, diluting, cooling, or transporting a product; incorporating water into a product; or sanitation needs within the manufacturing facility. Some industries that use large amounts of water produce such commodities as food, paper, chemicals, refined petroleum, or primary metals. Water for industrial use may be delivered from a public supplier or be self-supplied. In this report, industrial use refers to self-supplied industrial withdrawals only. Water withdrawals associated with industrial users that receive water from public suppliers are included in the Public Supply category (table 5, “All other uses and system losses” column). Withdrawals were reported as freshwater or saline water. As in the 2005 and 2010 reports, estimates for public-supply deliveries for industrial and consumptive uses for 2015 were not mandatory for 2015 and are not discussed in this report.

Industrial withdrawals are listed by State in table 10. For 2015, withdrawals were an estimated 14,800 Mgal/d, or 16,600 thousand acre-ft/yr (table 2B). Industrial withdrawals were about 5 percent of total withdrawals and about 8 percent of total withdrawals for all categories, excluding thermoelectric power. Surface water was the source for 82 percent of total industrial withdrawals; 94 percent of the surface-water withdrawals for industrial use was freshwater. More than 98 percent of the groundwater withdrawals for industrial use was freshwater. Industrial water withdrawals in the United States decreased 9 percent from 2010 to 2015.

The geographic distribution of total, total surface-water, and total groundwater withdrawals for industrial use is

shown in figure 11. Indiana, Louisiana, and Texas accounted for 36 percent of total industrial withdrawals, and Indiana and Louisiana accounted for 36 percent of the total fresh surface-water withdrawals for industrial use. Leading sectors in these States likely contributing to water use in the industrial processes include auto manufacturing (Indiana), medical/orthopedic devices (Indiana), pharmaceuticals (Indiana) (Groenfeldt, 2015), petroleum refining (Louisiana and Texas), chemicals and petrochemicals (Texas and Louisiana) (Jones, 2015; Downie, 2016) and electronics (Texas) (Downie, 2016). Although it is not a leading sector in Indiana, metals are processed within the State to provide the materials, namely steel and aluminum, to support auto and appliance manufacture (Clark County Indiana Community Portal, 2018). The processing of these metals contributes to industrial water use in Indiana (Indiana Department of Natural Resources, 2016). Texas accounted for 81 percent of the saline surface-water industrial withdrawals, primarily from counties along the Gulf coast. The largest fresh groundwater industrial withdrawals were in California (397 Mgal/d), which accounted for 15 percent of the total national fresh groundwater industrial withdrawals (table 10). The largest groundwater saline withdrawals for industrial purposes in 2015 were in Utah (36.6 Mgal/d) (table 10), which accounted for 85 percent of saline groundwater withdrawals for industrial use in the United States (table 10). Texas and West Virginia each accounted for about one-half of the remaining 15 percent of saline groundwater withdrawals for industrial use (table 10).



Pulp mill. Photograph by Alan Cressler, USGS.

Table 10. Industrial self-supplied water withdrawals, 2015.

[Values may not sum to totals because of independent rounding]

State	Withdrawals (million gallons per day)								
	By source and type						Total		
	Groundwater			Surface water			Fresh	Saline	Total
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Alabama	32.7	0	32.7	461	0	461	494	0	494
Alaska	6.70	0	6.70	1.65	1.83	3.48	8.35	1.83	10.2
Arizona	6.12	0	6.12	0	0	0	6.12	0	6.12
Arkansas.....	29.5	0	29.5	127	0	127	157	0	157
California	397	0	397	1.13	0	1.13	399	0	399
Colorado.....	4.22	0	4.22	79.9	0	79.9	84.1	0	84.1
Connecticut	40.1	0	40.1	141	41.6	182	181	41.6	222
Delaware	10.7	0	10.7	291	0	291	302	0	302
District of Columbia ...	0	0	0	0	0	0	0	0	0
Florida.....	181	0	181	63.6	1.08	64.7	245	1.08	246
Georgia.....	193	0	193	283	0	283	475	0	475
Hawaii.....	0.24	0	0.24	0	0	0	0.24	0	0.24
Idaho	45.0	0	45.0	12.7	0	12.7	57.6	0	57.6
Illinois.....	132	0	132	299	0	299	431	0	431
Indiana.....	79.9	0	79.9	2,210	0	2,210	2,290	0	2,290
Iowa.....	92.8	0	92.8	195	0	195	288	0	288
Kansas.....	30.5	0	30.5	7.63	0	7.63	38.1	0	38.1
Kentucky	77.3	0	77.3	148	0	148	225	0	225
Louisiana.....	250	0	250	1,890	0	1,890	2,140	0	2,140
Maine	5.83	0	5.83	176	42.9	219	182	42.9	225
Maryland.....	10.8	0	10.8	38.6	1.37	40.0	49.4	1.37	50.8
Massachusetts	15.2	0	15.2	12.7	0	12.7	27.9	0	27.9
Michigan.....	64.6	0	64.6	453	0	453	518	0	518
Minnesota.....	49.0	0	49.0	210	0	210	259	0	259
Mississippi	72.8	0	72.8	109	0	109	182	0	182
Missouri	42.4	0	42.4	42.8	0	42.8	85.2	0	85.2
Montana	5.22	0	5.22	4.45	0	4.45	9.67	0	9.67
Nebraska	42.0	0	42.0	2.32	0	2.32	44.3	0	44.3
Nevada	1.02	0	1.02	4.69	0	4.69	5.71	0	5.71
New Hampshire	4.21	0	4.21	8.41	0	8.41	12.6	0	12.6
New Jersey.....	30.0	0	30.0	64.1	0	64.1	94.1	0	94.1
New Mexico.....	3.40	0	3.40	0	0	0	3.40	0	3.40
New York	29.4	0	29.4	283	8.43	291	312	8.43	320
North Carolina	15.0	0	15.0	178	0	178	193	0	193
North Dakota.....	6.18	0	6.18	13.5	0	13.5	19.6	0	19.6
Ohio.....	138	0	138	210	0	210	348	0	348
Oklahoma.....	7.27	0	7.27	44.7	0	44.7	52.0	0	52.0
Oregon.....	3.45	0	3.45	101	0	101	105	0	105
Pennsylvania.....	45.9	0	45.9	599	0	599	645	0	645
Rhode Island	0.54	0	0.54	1.51	0.03	1.54	2.05	0.03	2.08
South Carolina	26.3	0	26.3	260	0	260	286	0	286
South Dakota.....	18.4	0	18.4	6.04	0	6.04	24.4	0	24.4
Tennessee.....	51.6	0	51.6	682	0	682	734	0	734
Texas	99.8	3.28	103	223	598	821	323	601	924
Utah.....	37.4	36.6	74.0	16.8	42.4	59.2	54.2	79.0	133
Vermont.....	1.51	0	1.51	9.46	0	9.46	11.0	0	11.0
Virginia.....	66.0	0	66.0	304	5.15	309	370	5.15	375
Washington.....	83.5	0	83.5	329	0	329	412	0	412
West Virginia.....	25.7	3.05	28.7	399	0	399	424	3.05	427
Wisconsin.....	46.8	0	46.8	336	0	336	382	0	382
Wyoming.....	5.83	0	5.83	2.21	0	2.21	8.04	0	8.04
Puerto Rico.....	3.67	0	3.67	0	0	0	3.67	0	3.67
U.S. Virgin Islands	0.52	0	0.52	0	0	0	0.52	0	0.52
TOTAL	2,670	42.9	2,710	11,300	743	12,100	14,000	786	14,800

Mining

4,000 million gallons per day

Mining water use is water used for the extraction of minerals and rocks that may be in the form of solids, such as coal, iron, sand, and gravel; liquids, such as crude petroleum; and gases, such as natural gas. The category includes quarrying, milling of mined materials, injection of water for secondary oil recovery or for unconventional oil and gas recovery (such as hydraulic fracturing), and other operations associated with mining activities. All mining withdrawals were considered to be self-supplied. Water withdrawals were reported as freshwater or saline water. Dewatering was not reported as a mining withdrawal unless the water was used beneficially, such as dampening roads for dust control.

Sources of data used to estimate water use for mining include surveys of mining operations and State and Federal agencies that collect water withdrawal, discharge, or mineral production data for mining operations. Many of the 2015 withdrawals for mining were estimated according to methods described by Lovelace (2009c), using mineral production data and water-use coefficients, in gallons per weight or volume of minerals produced. Production data for nonfuel minerals, including metals and nonmetallic minerals, were provided by the USGS National Minerals Information Center. Production or water-injection data for fuel minerals, including coal, petroleum, and natural gas, were obtained from the USDOE EIA, the FracFocus Chemical Disclosure Registry (FracFocus, 2016), and various State agencies.

Mining withdrawals during 2015 are listed by State in table 11. During 2015, an estimated 4,000 Mgal/d, or 4,480 thousand acre-ft/yr (table 2B), were withdrawn. Mining withdrawals were about 1 percent of total withdrawals and about 2 percent of total withdrawals for all categories, excluding thermoelectric power. Groundwater was the source for 72 percent of total withdrawals for mining (table 11).



Wash pond. Photograph by Wendy McPherson, USGS

Sixty-five percent of the groundwater withdrawn for mining was saline. Seventy-seven percent of the surface-water withdrawn was freshwater. Saline groundwater withdrawals and fresh surface-water withdrawals together represented 68 percent of the total withdrawals for mining (table 11). Total mining withdrawals in 2015 were about 1 percent more than in 2010. Groundwater withdrawals were 1 percent more, and surface-water withdrawals were less than 1 percent less. Freshwater withdrawals in 2015 were 4 percent less than in 2010, and saline-water withdrawals were 5 percent more than in 2010.

The geographic distribution of total, total freshwater, and total saline-water withdrawals is shown in figure 12. Total mining withdrawals in Texas, including 1,000 Mgal/d of saline groundwater, were 1,140 Mgal/d and accounted for 28 percent of the total withdrawals for mining (table 11). The next largest users, California, Utah, and Nevada each used greater than 200 Mgal/d of water for mining and accounted for another 20 percent of total withdrawals (fig. 12; table 11). Nevada, Texas, Ohio, Florida, and Arizona each used more than 50 Mgal/d of fresh groundwater for mining and together accounted for 55 percent of total fresh groundwater withdrawals for this use. Indiana, Iowa, Michigan, and New Jersey each used more than 50 Mgal/d of fresh surface water for mining

and together accounted for 37 percent of total fresh surface-water withdrawals for this use (table 11). Saline groundwater withdrawals were greater than 150 Mgal/d in Texas, California, and Oklahoma and together accounted for 77 percent of total saline groundwater withdrawals for mining. Saline surface-water withdrawals were greater than 40 Mgal/d for Utah and Alaska and together accounted for almost 100 percent of total saline surface-water withdrawals for mining (table 11).

Table 11. Mining water withdrawals, 2015.

[Values may not sum to totals because of independent rounding]

State	Withdrawals (million gallons per day)								
	By source and type						Total		
	Groundwater			Surface water			Fresh	Saline	Total
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Alabama.....	21.8	0	21.8	8.45	0	8.45	30.2	0	30.2
Alaska.....	0	89.2	89.2	36.4	41.4	77.8	36.4	131	167
Arizona.....	68.3	0	68.3	0	0	0	68.3	0	68.3
Arkansas.....	0.14	0	0.14	2.93	0	2.93	3.07	0	3.07
California.....	30.2	272	302	15.6	0.01	15.6	45.8	272	318
Colorado.....	5.24	24.2	29.4	2.46	0	2.46	7.70	24.2	31.9
Connecticut.....	0.82	0	0.82	3.43	0	3.43	4.25	0	4.25
Delaware.....	0.34	0	0.34	0.31	0	0.31	0.65	0	0.65
District of Columbia ...	0	0	0	0	0	0	0	0	0
Florida.....	89.1	0	89.1	40.7	0	40.7	130	0	130
Georgia.....	15.9	0	15.9	3.89	0	3.89	19.8	0	19.8
Hawaii.....	0.89	0	0.89	0.03	0	0.03	0.92	0	0.92
Idaho.....	1.35	0	1.35	21.8	0	21.8	23.1	0	23.1
Illinois.....	14.6	21.0	35.6	40.4	0	40.4	55.0	21.0	76.0
Indiana.....	5.52	0	5.52	121	0	121	126	0	126
Iowa.....	1.08	0	1.08	74.4	0	74.4	75.5	0	75.5
Kansas.....	5.44	0	5.44	0.55	0	0.55	5.99	0	5.99
Kentucky.....	17.6	0	17.6	22.9	0	22.9	40.6	0	40.6
Louisiana.....	1.65	0	1.65	4.59	0	4.59	6.24	0	6.24
Maine.....	1.45	0	1.45	4.88	0	4.88	6.33	0	6.33
Maryland.....	13.7	0	13.7	3.09	0	3.09	16.8	0	16.8
Massachusetts.....	5.51	0	5.51	4.09	0	4.09	9.60	0	9.60
Michigan.....	16.0	0.58	16.6	69.7	0	69.7	85.7	0.58	86.2
Minnesota.....	3.63	0	3.63	5.57	0	5.57	9.20	0	9.20
Mississippi.....	8.21	6.58	14.8	1.24	0	1.24	9.45	6.58	16.0
Missouri.....	21.1	0	21.1	8.47	0	8.47	29.6	0	29.6
Montana.....	1.06	16.3	17.4	20.5	0	20.5	21.6	16.3	37.9
Nebraska.....	0.06	6.41	6.47	9.54	0	9.54	9.60	6.41	16.0
Nevada.....	187	11.3	199	8.13	0	8.13	195	11.3	207
New Hampshire.....	1.76	0	1.76	4.37	0	4.37	6.13	0	6.13
New Jersey.....	1.48	0	1.48	56.8	0	56.8	58.3	0	58.3
New Mexico.....	39.4	89.4	129	17.4	0	17.4	56.8	89.4	146
New York.....	5.64	0.95	6.59	34.6	0	34.6	40.2	0.95	41.2
North Carolina.....	30.0	0	30.0	8.26	0	8.26	38.3	0	38.3
North Dakota.....	26.2	15.1	41.3	4.50	0	4.50	30.7	15.1	45.8
Ohio.....	91.3	0	91.3	37.6	0	37.6	129	0	129
Oklahoma.....	4.22	155	159	33.2	0	33.2	37.4	155	192
Oregon.....	8.45	0	8.45	2.85	0	2.85	11.3	0	11.3
Pennsylvania.....	32.9	5.60	38.5	5.21	0	5.21	38.1	5.60	43.7
Rhode Island.....	1.18	0	1.18	1.74	0	1.74	2.92	0	2.92
South Carolina.....	8.28	0	8.28	1.79	0	1.79	10.1	0	10.1
South Dakota.....	3.59	0	3.59	5.06	0	5.06	8.65	0	8.65
Tennessee.....	17.1	0	17.1	14.2	0	14.2	31.4	0	31.4
Texas.....	116	1,000	1,120	15.9	0.01	15.9	131	1,000	1,140
Utah.....	1.67	43.7	45.4	1.80	214	216	3.47	258	262
Vermont.....	0.23	0	0.23	4.33	0	4.33	4.56	0	4.56
Virginia.....	6.20	0	6.20	18.7	0	18.7	24.9	0	24.9
Washington.....	13.4	0	13.4	3.61	0	3.61	17.0	0	17.0
West Virginia.....	23.8	1.52	25.3	29.5	0	29.5	53.3	1.52	54.9
Wisconsin.....	0.42	0	0.42	28.8	0	28.8	29.3	0	29.3
Wyoming.....	33.1	96.8	130	11.4	0	11.4	44.5	96.8	141
Puerto Rico.....	1.84	0	1.84	0.18	0	0.18	2.02	0	2.02
U.S. Virgin Islands.....	0	0	0	0	0.02	0.02	0	0.02	0.02
TOTAL	1,010	1,860	2,870	877	256	1,130	1,880	2,120	4,000

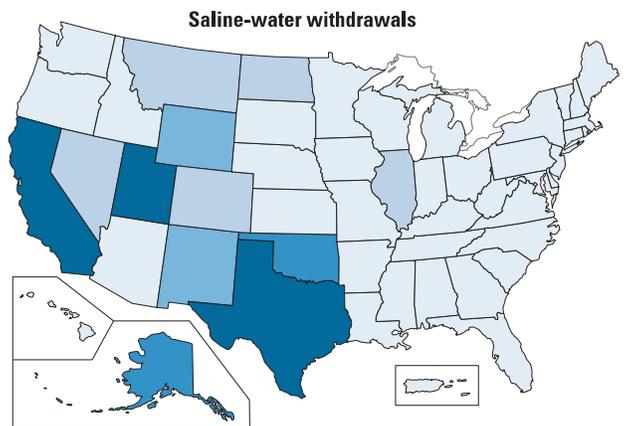
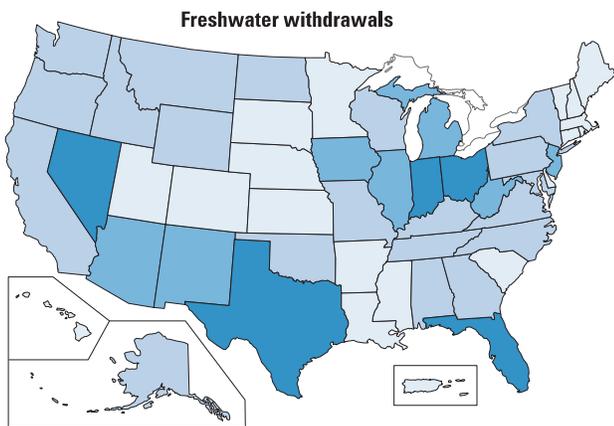
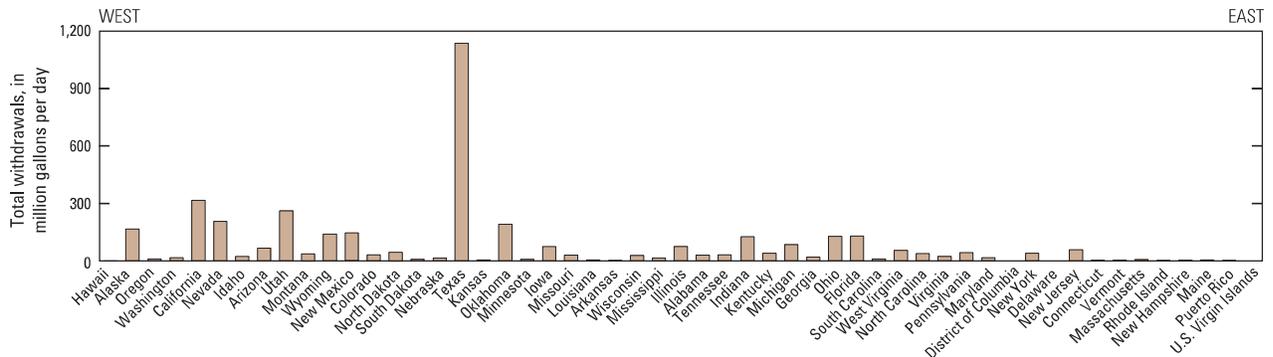
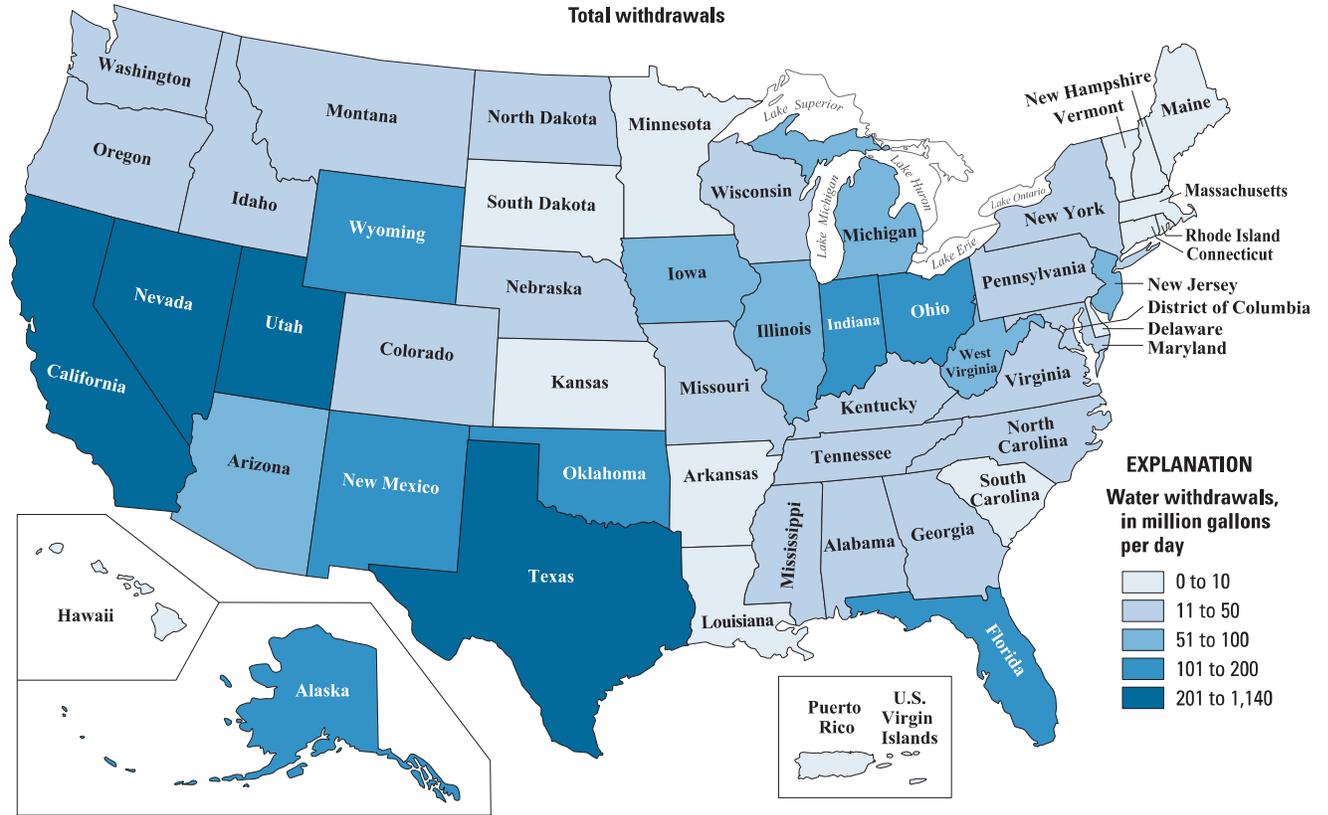


Figure 12. Mining withdrawals by water quality and State, 2015.

Thermoelectric Power

133,000 million gallons per day

Water withdrawn for thermoelectric-power generation is primarily used to condense, or cool, the steam used to drive thermoelectric generators. In general, there are two types of cooling systems used for thermoelectric power: once-through and recirculating. Once-through (also known as open-loop) cooling systems withdraw relatively large volumes of water, route the water through condensers to cool the steam used to generate electricity, and then return the water at a higher temperature. The heated discharge results in evaporative losses of the water, which for a once-through cooling system is the consumptive use of water. Consumptive use is relatively small compared to the total amount of water withdrawn for a once-through cooling system. Recirculating (also known as closed-loop or recirculation) cooling systems withdraw relatively smaller volumes of water (compared to once-through cooling systems) and circulate the water between the condensers and the cooling system, either recirculating towers or cooling ponds. Subsequent water withdrawals are used to replace, or make up, water lost to evaporation, blowdown, drift, and leakage. Consumptive use for a recirculating cooling system is the water lost to evaporation in cooling towers or from the surface of recirculating ponds and is relatively large (compared to the total amount of water withdrawn).

Sources of information used to compile the thermoelectric-power category data include State water agencies, powerplant facilities, USDOE EIA, USGS thermoelectric water-use project, and coefficients derived from previous USGS compilations. The USGS thermoelectric water-use project estimated monthly and annual water withdrawals, and consumptive use for 2015, on the basis of linked heat-and-water budget models that are constrained by power-generation technologies, cooling-system technologies, and environmental variables, such as air and water temperatures, wind speeds, and elevation (Diehl and others, 2013; Diehl and Harris, 2014). The USGS estimates include minimum to maximum ranges of withdrawals and consumptive use, as well as plant-level “best” estimates. These plausible, thermodynamically based model estimates provided a quality-assurance check for reported data. The monthly and annual model estimates were provided to NWUSP compilers as supplemental and supportive datasets for the compilation and included cooling-system-type categories and water sources. USDOE EIA-reported water-use data and net power generation data also were provided (U.S. Department of Energy, 2016a, b). These data were used either in whole or in part for this compilation. Compilers in some States obtained data reported directly from thermoelectric powerplants.

Thermoelectric-power withdrawals and consumptive-use data were compiled according to once-through and recirculating cooling-system types, and reported as freshwater or saline water from surface water or groundwater sources. Net power generation was compiled by cooling-system type. Consumptive use for thermoelectric water use was reported for the first

time since 1995. Public-supply deliveries to thermoelectric powerplants and the use of reclaimed wastewater for cooling purposes were not required to be reported, although some States did report these data.

Thermoelectric-power withdrawals, consumptive use, and net power generation are listed by State in table 12. Total withdrawals for thermoelectric power for 2015 were 133,000 Mgal/d, or 149,000 thousand acre-ft/yr (table 2B). Surface water was the source for nearly 100 percent of total thermoelectric-power withdrawals, and 72 percent of those surface-water withdrawals were from freshwater sources. Saline surface-water withdrawals for thermoelectric power accounted for 97 percent of total saline surface-water withdrawals for all uses. Total withdrawals for thermoelectric power accounted for 41 percent of total water withdrawals, 34 percent of total freshwater withdrawals, and 48 percent of fresh surface-water withdrawals for all uses. Total thermoelectric-power consumptive use for 2015 was 4,310 Mgal/d, about 3 percent of total thermoelectric-power withdrawals. Freshwater accounted for 87 percent of total consumptive use. Net power generation associated with thermoelectric-power water use was 3,230,000 gigawatt-hours (gWh), or 83 percent of the total reported utility power (public utilities and independent power producers) in the United States for 2015 (U.S. Department of Energy, 2016b). On average, 15 gallons (gal) of water was used to produce 1 kilowatt-hour (kWh) of electricity in 2015, compared to almost 19 gallons per kilowatt-hour in 2010.

The geographic distribution of total, total freshwater, and total saline-water withdrawals for thermoelectric power is shown in figure 13. The largest total withdrawals for thermoelectric power were in Texas, where 93 percent of the withdrawals were from freshwater sources. Texas, Illinois, Michigan, Alabama, and North Carolina each withdrew more than 6,000 Mgal/d of freshwater for electricity generation, which combined accounted for more than 40 percent of freshwater withdrawals for thermoelectric power. Florida, New York, and Maryland accounted for about 53 percent of total saline withdrawals for thermoelectric power, nearly all from surface water. Nevada, California, Florida, and Hawaii accounted for 90 percent of the total saline groundwater withdrawals.

Estimated 2015 thermoelectric withdrawals were 18 percent less than estimates for 2010. Reasons for this large difference include plant closures (U.S. Department of Energy, 2016a), decrease of coal use and increase of natural gas use (U.S. Department of Energy, 2016c), and new powerplants using more water-efficient power generation and cooling-system technologies (U.S. Department of Energy, 2016a, b).

The conterminous Eastern States (fig. 13) accounted for 84 percent of total thermoelectric-power withdrawals and 70 percent of the related net power generation in the

Table 12. Thermoelectric-power water use, 2015.

[Values may not sum to totals because of independent rounding. All withdrawal, reclaimed wastewater, delivery, and use data are in million gallons per day. Abbreviation: —, not estimated]

State	Withdrawals							Re-claimed waste-water	Public-supply deliveries to thermoelectric-power generation use	Total use					Net power generated (gigawatt-hours)
	By source and type				Total					Consumptive use			Water use (with-drawals, deliveries, and reclaimed waste-water)		
	Groundwater		Surface water		Fresh	Saline	Total			Fresh	Saline	Total			
	Fresh	Saline	Fresh	Saline	Fresh	Saline	Total			Fresh	Saline	Total			
Alabama.....	0	0	6,630	0	6,630	0	6,630	—	—	6,630	107	0	107	128,000	
Alaska.....	0.63	0	66.1	0	66.7	0	66.7	—	0.60	67.3	1.38	0	1.38	1,870	
Arizona.....	57.7	0	25.8	0	83.5	0	83.5	67.7	0.50	152	147	0	147	102,000	
Arkansas.....	3.13	0	1,440	0	1,440	0	1,440	—	—	1,440	61.3	0	61.3	49,500	
California.....	19.6	35.1	16.7	2,800	36.4	2,840	2,880	15.6	38.9	2,930	64.4	25.3	89.7	111,000	
Colorado.....	3.03	0	34.1	0	37.2	0	37.2	4.11	13.7	55.0	46.7	0	46.7	42,300	
Connecticut.....	0	0	126	2,470	126	2,470	2,590	—	4.65	2,600	7.05	23.2	30.2	31,000	
Delaware.....	0.13	0	14.3	256	14.4	256	271	—	—	271	10.3	4.02	14.3	5,660	
District of Columbia ...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Florida.....	27.8	28.5	406	9,400	434	9,420	9,860	34.5	8.88	9,900	71.6	122	194	231,000	
Georgia.....	3.43	0	738	102	741	102	843	—	—	843	161	0.02	161	110,000	
Hawaii.....	1.48	20.2	0	357	1.48	377	379	—	—	379	0.51	3.10	3.61	7,820	
Idaho.....	1.79	0	0	0	1.79	0	1.79	—	—	1.79	1.79	0	1.79	2,210	
Illinois.....	4.21	0	8,130	0	8,140	0	8,140	—	—	8,140	572	0	572	177,000	
Indiana.....	20.8	0	3,800	0	3,820	0	3,820	—	—	3,820	161	0	161	87,000	
Iowa.....	27.0	0	1,660	0	1,680	0	1,680	0.42	0.16	1,680	40.0	0	40.0	35,500	
Kansas.....	7.81	0	809	0	817	0	817	—	0.25	817	54.1	0	54.1	33,800	
Kentucky.....	4.96	0	1,860	0	1,860	0	1,860	—	—	1,860	77.1	0	77.1	74,700	
Louisiana.....	37.0	0	4,000	261	4,040	261	4,300	—	—	4,300	82.3	2.61	84.9	69,700	
Maine.....	0.92	0	4.38	80.7	5.30	80.7	86.0	—	2.05	88.0	4.94	1.00	5.94	4,960	
Maryland.....	2.30	0	218	5,300	220	5,300	5,520	—	—	5,520	2.29	61.2	63.4	30,700	
Massachusetts.....	1.10	0	49.0	487	50.1	487	537	1.07	47.0	585	4.86	14.2	19.1	16,800	
Michigan.....	5.61	0	7,800	0	7,800	0	7,800	—	—	7,800	117	0	117	102,000	
Minnesota.....	1.77	0	2,010	0	2,010	0	2,010	0.35	—	2,010	130	0	130	50,600	
Mississippi.....	33.7	6.35	84.0	2.07	118	8.42	126	5.41	0.01	132	36.1	6.01	42.1	57,500	
Missouri.....	13.8	0	5,840	0	5,860	0	5,860	—	1.64	5,860	90.6	0	90.6	79,700	
Montana.....	0.80	0	74.9	0	75.7	0	75.7	—	—	75.7	19.1	0	19.1	16,500	
Nebraska.....	16.8	0	2,900	0	2,920	0	2,920	0.04	—	2,920	30.7	0	30.7	34,300	
Nevada.....	7.04	70.9	1.69	0	8.73	70.9	79.7	0.56	0.49	80.7	4.63	27.5	32.1	11,400	
New Hampshire.....	1.10	0	73.7	693	74.8	693	768	2.82	0.53	772	4.56	8.27	12.8	18,200	
New Jersey.....	2.08	0	358	3,430	361	3,430	3,790	10.7	0.71	3,800	20.5	76.0	96.5	63,700	
New Mexico.....	6.13	0	27.3	0	33.5	0	33.5	0	0.26	33.7	27.7	0	27.7	25,000	
New York.....	7.30	0	2,200	5,470	2,210	5,470	7,680	2.76	17.1	7,700	67.0	54.8	122	89,400	
North Carolina.....	0.18	0	6,180	1,360	6,180	1,360	7,540	—	8.33	7,550	113	13.6	127	113,000	
North Dakota.....	0.42	0	983	0	983	0	983	1.13	0.05	984	28.6	0	28.6	34,300	
Ohio.....	11.0	0	4,470	0	4,480	0	4,480	—	4.19	4,490	230	0	230	117,000	
Oklahoma.....	1.59	0	70.2	0	71.7	0	71.7	8.94	6.96	87.6	53.5	0	53.5	60,600	
Oregon.....	1.57	0	9.79	0	11.4	0	11.4	0	4.53	15.9	14.4	0	14.4	7,080	
Pennsylvania.....	5.38	0	3,570	0	3,580	0	3,580	2.18	—	3,580	240	0	240	189,000	
Rhode Island.....	0	0	1.33	222	1.33	222	223	—	1.44	224	1.98	2.22	4.20	5,240	
South Carolina.....	4.52	0	4,980	0	4,980	0	4,980	0	3.93	4,990	159	0	159	89,200	
South Dakota.....	0	0	2.39	0	2.39	0	2.39	—	—	2.39	2.39	0	2.39	1,470	
Tennessee.....	2.18	0	4,620	0	4,620	0	4,620	—	—	4,620	62.8	0	62.8	62,600	
Texas.....	37.7	0	9,600	757	9,640	757	10,400	38.2	48.3	10,500	294	4.71	299	351,000	
Utah.....	22.7	8.46	38.3	0	61.0	8.46	69.5	0.45	1.33	71.2	43.6	2.46	46.0	40,500	
Vermont.....	0.54	0	0.26	0	0.80	0	0.80	—	—	0.80	0.63	0	0.63	445	
Virginia.....	1.08	2.72	2,910	2,400	2,910	2,400	5,320	1.24	0.29	5,320	36.8	13.8	50.6	61,100	
Washington.....	7.77	0	44.4	0	52.2	0	52.2	—	1.63	53.8	47.7	0	47.7	25,900	
West Virginia.....	1.19	0	1,570	0	1,570	0	1,570	—	0.62	1,570	89.9	0	89.9	67,700	
Wisconsin.....	3.21	0	4,200	0	4,210	0	4,210	2.27	0.23	4,210	74.7	0	74.7	58,100	
Wyoming.....	1.31	0	50.5	0	51.8	0	51.8	—	—	51.8	37.0	0	37.0	35,600	
Puerto Rico.....	1.82	0	2.83	1,700	4.65	1,700	1,710	2.69	0.97	1,710	2.34	77.1	79.5	14,300	
U.S. Virgin Islands.....	0	0	0.14	96.5	0.14	96.5	96.7	—	—	96.7	0	3.88	3.88	693	
TOTAL	425	172	94,700	37,600	95,100	37,800	133,000	203	220	133,000	3,760	547	4,310	3,230,000	

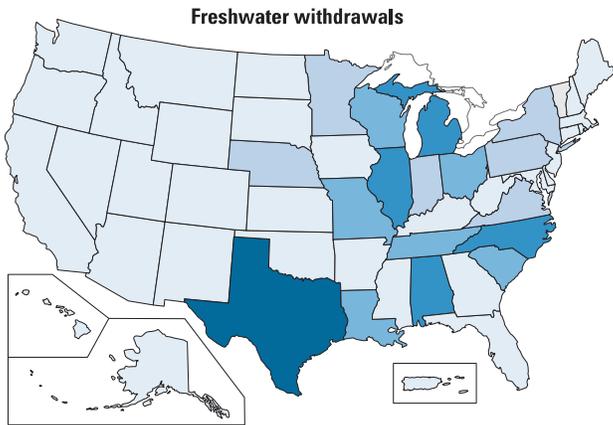
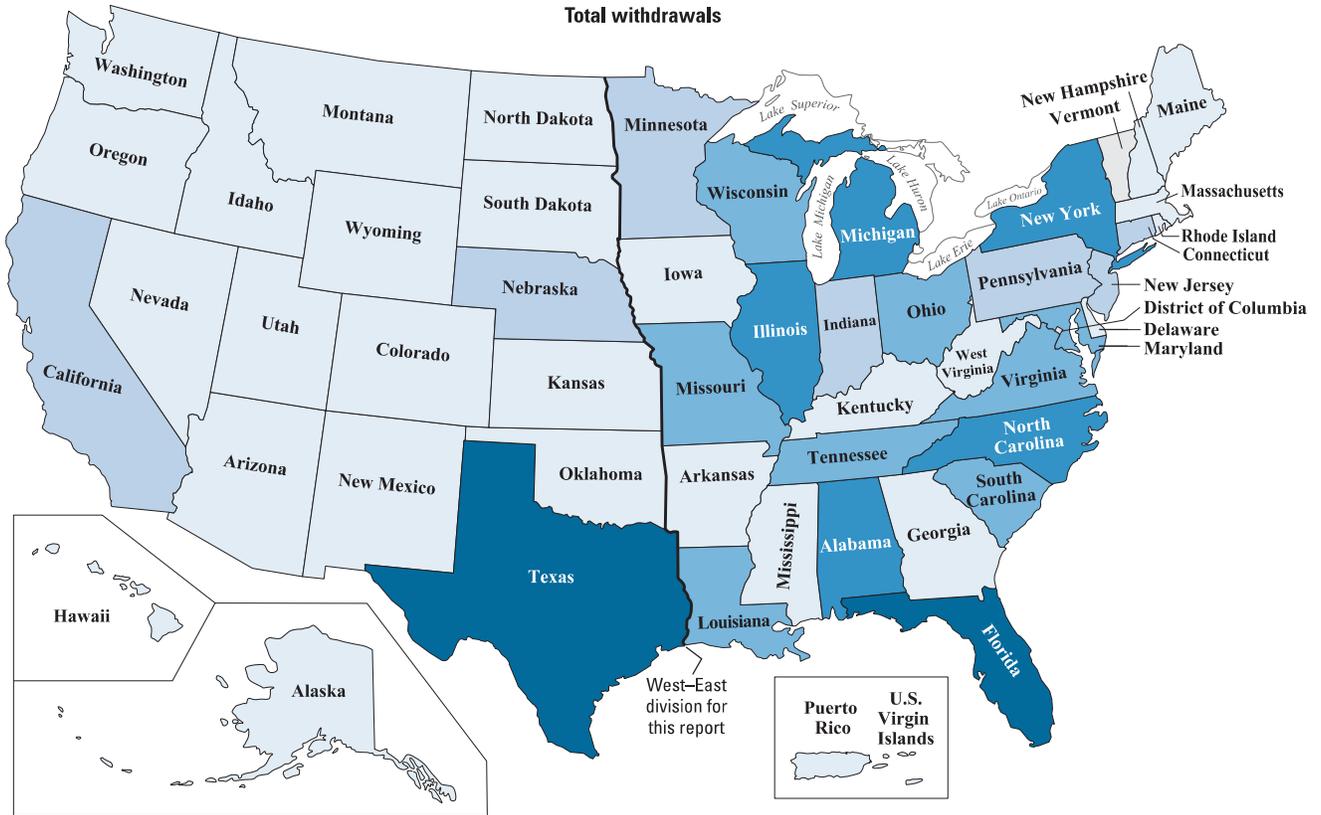


Figure 13. Thermoelectric-power withdrawals by water quality and State, 2015.