United States in 2015. Hydroelectric-power generation is not included in this report, but accounts for about 6 percent of the United States total energy needs and is an important energy source in the Western United States (U.S. Department of Energy, 2016b). In 2015, 58 percent of the total 248,000 gWh from hydroelectric powerplants was produced by utilities in Washington, California, Oregon, and New York (U.S. Department of Energy, 2016b).

The geographic distribution of total water use and total consumptive use is shown in figure 14*A* for once-through cooling systems and figure 14*B* for recirculating cooling systems. Powerplants equipped with once-through cooling systems accounted for 96 percent of total thermoelectric-power withdrawals and 37 percent of net power generated (table 13*A*), whereas plants with recirculating cooling systems withdrew much less water (4 percent of total withdrawals) and produced most (63 percent) of the power (table 13*B*). Plants with recirculating cooling systems accounted for 67 percent of total consumptive use. Consumptive use for recirculating cooling systems was 57 percent of total recirculating withdrawals, whereas consumptive use for once-through systems was just 1 percent of total once-through withdrawals (tables 13*A* and 13*B*). Powerplants with recirculating cooling systems are found in every State except the District of Columbia and the U.S. Virgin Islands. Powerplants with once-through cooling systems are found in every State except Arizona, Colorado, District of Columbia, Idaho, Nevada, New Mexico, Oklahoma, Oregon, South Dakota, Utah, Vermont, Washington, and Wyoming.

Reporting of public-supply deliveries and the use of reclaimed wastewater for cooling purposes was not required for 2015, although values were estimated for some States (table 12; fig. 14*A* and *B*). Public-supply deliveries were reported for 32 States and totaled 220 Mgal/d, less than 1 percent of total thermoelectric withdrawals. Texas (48.3 Mgal/d), Massachusetts (47.0 Mgal/d), and California (38.9 Mgal/d) accounted for 61 percent of total public-supply deliveries to thermoelectric plants. Reclaimed wastewater was reported for 25 States and totaled 203 Mgal/d. Arizona reported the largest use of reclaimed wastewater at 67.7 Mgal/d, almost all of which was used at the Palo Verde nuclear powerplant in Maricopa County, Arizona. Texas (38.2 Mgal/d) and Florida (34.5 Mgal/d) reported substantial amounts of reclaimed wastewater use as well. Plants with recirculating cooling systems accounted for 77 percent of public-supply deliveries and 95 percent of reclaimed wastewater uses (fig. 14*B*). Note that the reported public-supply deliveries and reclaimed wastewater data, because the reporting of data was not a requirement for this compilation, may not include all instances of these types of water use and, therefore, may be underestimated.

Thermoelectric powerplant in Montana. Photograph by Rodney Caldwell, USGS.

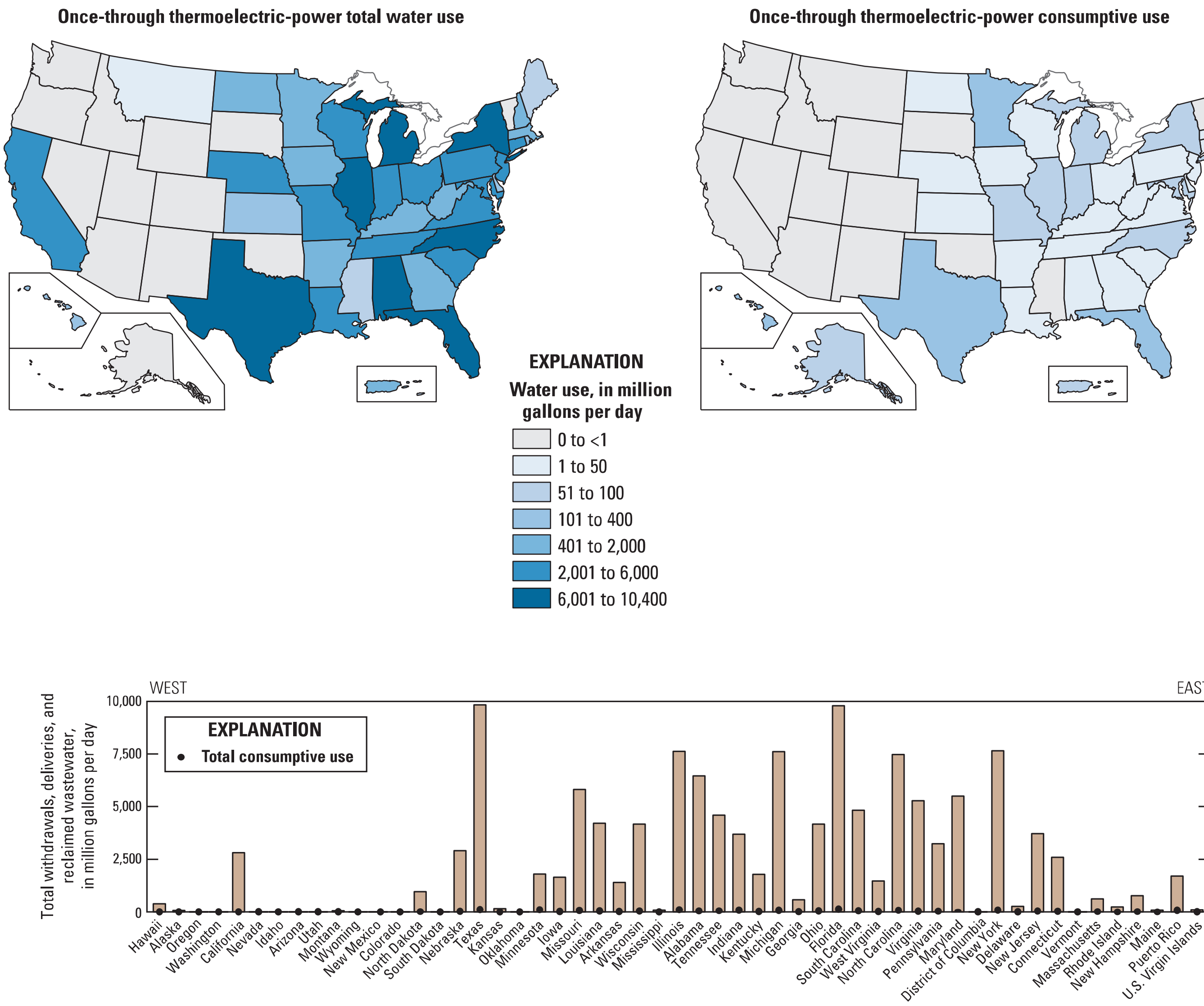

Figure 14*A*. Thermoelectric-power water use and consumptive use by State for once-through cooling types, 2015.

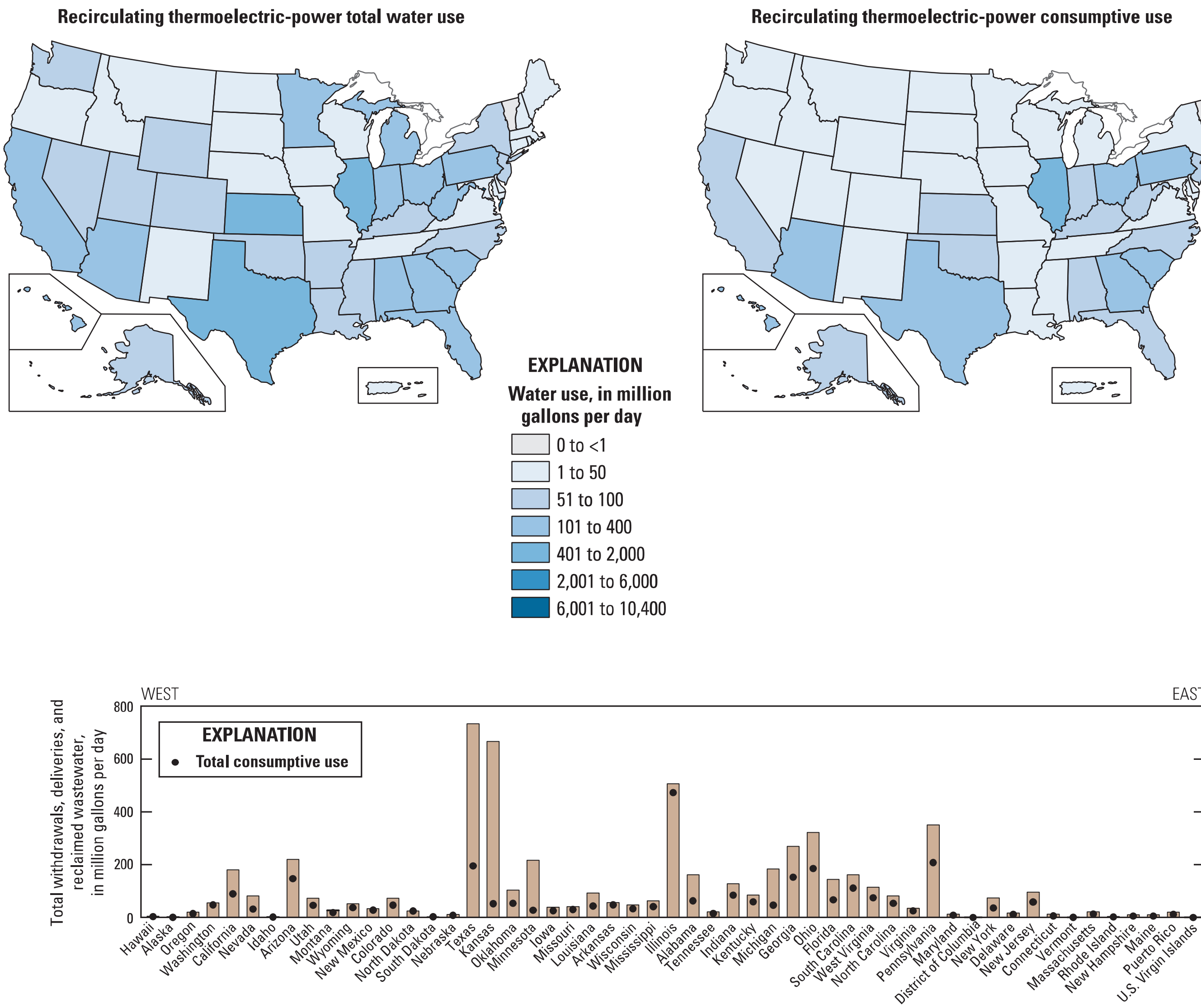

Figure 14*B*. Thermoelectric-power water use and consumptive use by State for recirculating cooling types, 2015.

Table 13*A*. Once-through cooling 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 for once-through cooling							Reclaimed wastewater	Public-supply deliveries to once-through cooling thermoelectric-power generation use	Total use				Net power generated (gigawatt-hours)
	By source and type				Total					Water use (withdrawals, deliveries, and reclaimed wastewater)	Consumptive use			
	Groundwater		Surface water											
	Fresh	Saline	Fresh	Saline	Fresh	Saline	Total		Fresh	Total	Fresh	Saline	Total	
Alabama	0	0	6,460	0	6,460	0	6,460	—	—	6,460	44.1	0	44.1	44,900
Alaska	0	0	66.1	0	66.1	0	66.1	—	—	66.1	0.50	0	0.50	446
Arizona	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arkansas	0	0	1,390	0	1,390	0	1,390	—	—	1,390	13.3	0	13.3	9,910
California	0	0	0	2,800	0	2,800	2,800	0	0	2,800	0	0.19	0.19	30,300
Colorado	0	0	0	0	0	0	0	—	—	0	0	0	0	0
Connecticut	0	0	123	2,470	123	2,470	2,590	—	—	2,590	1.16	23.2	24.4	21,900
Delaware	0	0	0	254	0	254	254	—	—	254	0	2.54	2.54	586
District of Columbia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	2.17	27.5	354	9,400	356	9,420	9,780	7.10	3.81	9,790	5.26	121	127	93,900
Georgia	0.91	0	471	102	472	102	574	—	—	574	8.16	0.02	8.18	2,540
Hawaii	0.78	15.9	0	357	0.78	373	374	—	—	374	0.01	0	0.01	4,120
Idaho	0	0	0	0	0	0	0	—	—	0	0	0	0	0
Illinois	1.98	0	7,630	0	7,630	0	7,630	—	—	7,630	99.3	0	99.3	79,900
Indiana	13.9	0	3,680	0	3,690	0	3,690	—	—	3,690	76.3	0	76.3	30,000
Iowa	5.49	0	1,640	0	1,650	0	1,650	—	—	1,650	14.2	0	14.2	20,000
Kansas	0.06	0	150	0	151	0	151	—	—	151	1.69	0	1.69	1,520
Kentucky	0	0	1,780	0	1,780	0	1,780	—	—	1,780	17.7	0	17.7	28,900
Louisiana	24.6	0	3,920	261	3,940	261	4,200	—	—	4,200	38.9	2.61	41.5	39,700
Maine	0	0	0	80.4	0	80.4	80.4	—	—	80.4	0	0.81	0.81	573
Maryland	2.21	0	218	5,280	220	5,280	5,500	—	—	5,500	2.19	52.8	55.0	22,800
Massachusetts	0	0	46.9	473	46.9	473	520	0	45.7	566	0.94	4.74	5.68	9,060
Michigan	1.33	0	7,620	0	7,620	0	7,620	—	—	7,620	70.2	0	70.2	72,600
Minnesota	0.43	0	1,800	0	1,800	0	1,800	0	—	1,800	103	0	103	42,200
Mississippi	0	0	73.7	0	73.7	0	73.7	0	0	73.7	0.87	0	0.87	601
Missouri	0	0	5,820	0	5,820	0	5,820	—	—	5,820	60.5	0	60.5	62,900
Montana	0	0	49.2	0	49.2	0	49.2	—	—	49.2	0.49	0	0.49	375
Nebraska	11.1	0	2,900	0	2,910	0	2,910	—	—	2,910	22.7	0	22.7	27,000
Nevada	0	0	0	0	0	0	0	—	—	0	0	0	0	0
New Hampshire	0.20	0	72.0	692	72.2	692	764	0.14	0.18	764	0.54	6.92	7.46	10,900
New Jersey	0	0	348	3,370	348	3,370	3,710	0	0	3,710	3.54	34.2	37.8	24,700
New Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New York	0	0	2,180	5,470	2,180	5,470	7,650	0	0	7,650	30.7	54.8	85.5	58,800
North Carolina	0	0	6,120	1,360	6,120	1,360	7,470	0	0	7,470	59.6	13.6	73.1	66,600
North Dakota	0	0	959	0	959	0	959	1.00	0.05	960	4.10	0	4.10	15,300
Ohio	4.36	0	4,160	0	4,170	0	4,170	—	0.75	4,170	43.9	0	43.9	32,400
Oklahoma	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oregon	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pennsylvania	0.60	0	3,230	0	3,230	0	3,230	1.12	—	3,230	32.5	0	32.5	35,000
Rhode Island	0	0	0	222	0	222	222	—	—	222	0	2.22	2.22	1,910
South Carolina	0	0	4,830	0	4,830	0	4,830	0	0	4,830	48.0	0	48.0	43,400
South Dakota	0	0	0	0	0	0	0	—	—	0	0	0	0	0
Tennessee	0	0	4,600	0	4,600	0	4,600	—	—	4,600	47.3	0	47.3	46,200
Texas	9.82	0	9,450	379	9,460	379	9,840	—	0.04	9,840	104	0	104	111,000
Utah	0	0	0	0	0	0	0	—	—	0	0	0	0	0
Vermont	0	0	0	0	0	0	0	—	—	0	0	0	0	0
Virginia	0.35	0	2,890	2,400	2,890	2,400	5,280	—	—	5,280	14.4	11.2	25.6	38,900
Washington	0	0	0	0	0	0	0	—	0	0	0	0	0	0
West Virginia	0.03	0	1,460	0	1,460	0	1,460	—	0.03	1,460	14.9	0	14.9	11,700
Wisconsin	0.49	0	4,160	0	4,160	0	4,160	0	0	4,160	41.6	0	41.6	36,600
Wyoming	0	0	0	0	0	0	0	—	—	0	0	0	0	0
Puerto Rico	1.63	0	0.24	1,690	1.87	1,690	1,690	0	0.97	1,690	0.11	67.6	67.7	8,100
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	82.4	43.4	90,600	37,200	90,700	37,200	128,000	9.36	51.5	128,000	1,030	403	1,430	1,190,000

Table 13*B*. Recirculating cooling 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 for recirculating cooling							Reclaimed wastewater	Public-supply deliveries to recirculating cooling thermoelectric-power generation use	Total use				Net power generated (gigawatt-hours)
	By source and type				Total					Water use (withdrawals, deliveries, and reclaimed wastewater)	Consumptive use			
	Groundwater		Surface water											
	Fresh	Saline	Fresh	Saline	Fresh	Saline	Total		Fresh	Total	Fresh	Saline	Total	
Alabama	0	0	162	0	162	0	162	—	—	162	63.1	0	63.1	82,700
Alaska	0.63	0	0	0	0.63	0	0.63	—	0.60	1.23	0.88	0	0.88	1,430
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	53.2	0	56.3	0	56.3	—	—	56.3	47.9	0	47.9	39,600
California	19.6	35.1	16.7	0.05	36.4	35.2	71.5	15.6	38.9	126	64.4	25.1	89.5	80,600
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	2.96	0	2.96	0	2.96	—	4.65	7.61	5.89	0	5.89	9,040
Delaware	0.13	0	14.3	2.12	14.4	2.12	16.5	—	—	16.5	10.3	1.48	11.8	5,080
District of Columbia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	25.7	1.06	52.2	0	77.8	1.06	78.9	27.4	5.07	111	66.3	0.74	67.0	137,000
Georgia	2.52	0	267	0	270	0	270	—	—	270	153	0	153	108,000
Hawaii	0.70	4.34	0	0	0.70	4.34	5.04	—	—	5.04	0.50	3.10	3.60	3,700
Idaho	1.79	0	0	0	1.79	0	1.79	—	—	1.79	1.79	0	1.79	2,210
Illinois	2.23	0	504	0	506	0	506	—	—	506	473	0	473	97,100
Indiana	6.93	0	121	0	128	0	128	—	—	128	84.7	0	84.7	57,000
Iowa	21.5	0	16.4	0	37.8	0	37.8	0.42	0.16	38.4	25.8	0	25.8	15,600
Kansas	7.75	0	658	0	666	0	666	—	0.25	666	52.4	0	52.4	32,200
Kentucky	4.96	0	80.5	0	85.5	0	85.5	—	—	85.5	59.4	0	59.4	45,800
Louisiana	12.4	0	79.8	0	92.3	0	92.3	—	—	92.3	43.4	0	43.4	30,000
Maine	0.92	0	4.38	0.27	5.30	0.27	5.57	—	2.05	7.62	4.94	0.19	5.13	4,390
Maryland	0.09	0	0.14	11.9	0.23	11.9	12.1	—	—	12.1	0.10	8.31	8.41	7,940
Massachusetts	1.10	0	2.13	13.5	3.23	13.5	16.7	1.07	1.30	19.1	3.92	9.46	13.4	7,760
Michigan	4.28	0	179	0	183	0	183	—	—	183	46.9	0	46.9	29,500
Minnesota	1.34	0	215	0	216	0	216	0.35	—	216	27.6	0	27.6	8,420
Mississippi	33.7	6.35	10.3	2.07	44.0	8.42	52.5	5.41	0.01	57.9	35.2	6.01	41.2	56,900
Missouri	13.8	0	23.7	0	37.4	0	37.4	—	1.64	39.1	30.1	0	30.1	16,900
Montana	0.80	0	25.7	0	26.5	0	26.5	—	—	26.5	18.6	0	18.6	16,100
Nebraska	5.71	0	5.16	0	10.9	0	10.9	0.04	—	10.9	7.99	0	7.99	7,320
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	0.90	0	1.67	1.83	2.57	1.83	4.40	2.68	0.35	7.43	4.02	1.35	5.37	7,330
New Jersey	2.08	0	10.8	59.8	12.9	59.8	72.6	10.7	0.71	84.1	16.9	41.8	58.7	39,000
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	27.2	0	34.6	0	34.6	2.76	17.1	54.4	36.3	0	36.3	30,600
North Carolina	0.18	0	65.2	0	65.4	0	65.4	—	8.33	73.8	53.5	0	53.5	46,000
North Dakota	0.42	0	24.3	0	24.7	0	24.7	0.13	0	24.8	24.5	0	24.5	19,000
Ohio	6.63	0	308	0	315	0	315	—	3.44	319	186	0	186	84,600
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	4.78	0	345	0	349	0	349	1.06	—	351	208	0	208	154,000
Rhode Island	0	0	1.33	0	1.33	0	1.33	0	1.44	2.77	1.98	0	1.98	3,330
South Carolina	4.52	0	150	0	155	0	155	0	3.93	158	111	0	111	45,800
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	19.4	0	21.6	0	21.6	—	—	21.6	15.4	0	15.4	16,400
Texas	27.9	0	155	378	182	378	561	38.2	48.2	647	191	4.71	195	239,000
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	0.73	2.72	27.5	0.80	28.3	3.52	31.8	1.24	0.29	33.3	22.4	2.70	25.1	22,300
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	1.16	0	112	0	113	0	113	—	0.59	114	75.0	0	75.0	56,100
Wisconsin	2.72	0	39.3	0	42.0	0	42.0	2.27	0.23	44.5	33.1	0	33.1	21,500
Wyoming	1.31	0	50.5	0	51.8	0	51.8	—	—	51.8	37.0	0	37.0	35,600
Puerto Rico	0.19	0	2.59	12.0	2.78	12.0	14.8	2.69	—	17.4	2.23	9.58	11.8	6,200
U.S. Virgin Islands	0	0	0	0	0	0	0	—	—	0	0	0	0	0
TOTAL	343	129	4,090	482	4,430	611	5,040	194	169	5,400	2,730	144	2,880	2,050,000

Trends in Water Use, 1950–2015

The USGS has conducted water-use compilations every 5 years since 1950 (https://water.usgs.gov/watuse/50years.html). A summary of population growth and withdrawal estimates by category of use and source of water is discussed in this section and shown in table 14 for each 5-year period from 1950 through 2015. These trends are shown graphically for freshwater uses in figure 15 and total uses in figure 16.

Some categories have been compiled and presented differently since compilations were begun. For example, self-supplied domestic and livestock withdrawals are shown separately in table 14; however, they were combined as "rural" in the 1950 and 1955 reports. Prior to 1985, the industrial water-use category included withdrawals for commercial, mining, and aquaculture; after 1985 these categories were estimated separately. Water use at fish hatcheries was reported as commercial use in 1990 and 1995 but has been included in the aquaculture category since 2000. Estimates of commercial withdrawals have not been compiled nationally since 2000. Totals in table 14 represent the most current data and incorporate revisions to previously published data; therefore, percentage differences and national totals may be slightly different from those in previous reports (Solley and others, 1988, 1993, 1998; Hutson and others, 2004; Kenny and others, 2009; Maupin and others, 2014).

Some revisions at the county or State levels have been made to previously published data since Maupin and others (2014) was published. The revisions have resulted in changes in total withdrawals by category as noted in table 14. For example, mining withdrawals published in Maupin and others (2014; table 14) were 5.32 Bgal/d, which is 1.35 Bgal/d more than the revised estimate of 3.97 Bgal/d shown in table 14 of this report. The 1.35 Bgal/d decrease in the 2010 estimate for total withdrawals for mining was almost entirely accounted for in Oklahoma (86 percent) from revisions to estimates that resulted in reduced saline groundwater withdrawals. An increase of 1 Bgal/d for thermoelectric-power withdrawals

Table 14. Trends in estimated water use in the United States, 1950–2015.

[Data for 1980 and earlier are from Kenny and others (2009). Water-use data are in billion gallons per day (thousand million gallons per day) and are rounded to two significant figures for 1950–80, and to three significant figures for 1985–2015; percent change is calculated from unrounded numbers. Values may not sum to totals because of independent rounding. Geographic extent: 1950, 48 States, District of Columbia, and Hawaii; 1955, 48 States and District of Columbia; 1960 and 1975–2015, 50 States, District of Columbia, Puerto Rico, and U.S. Virgin Islands; 1965–70, 50 States, District of Columbia, and Puerto Rico]

	Year														Percent change, 2010–15
	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015	
Population, in millions	150.7	164.0	179.3	193.8	205.9	216.4	229.6	242.4	252.3	267.1	285.3	300.7	312.6	325.0	4
Total withdrawals	180	240	270	310	370	420	430	397	404	398	413	410[a]	354[a]	322	–9
Public supply	14	17	21	24	27	29	33	36.6	38.7	40.2	43.3	44.4[a]	42.0	39.0	–7
Rural domestic and livestock															
Self-supplied domestic	2.1	2.1	2.0	2.3	2.6	2.8	3.4	3.32	3.39	3.39	3.58	3.73[a]	3.53[a]	3.26	–8
Livestock	1.5	1.5	1.6	1.7	1.9	2.1	2.2	2.23	2.25	2.28	2.37[a]	2.15	2.00	2.00	0
Irrigation	89	110	110	120	130	140	150	135	134	130	139	127	116[a]	118	2
Thermoelectric power	40	72	100	130	170	200	210	187	194	190	195	201	162[a]	133	–18
Other															
Self-supplied industrial	37	39	38	46	47	45	45	25.8	22.4[a]	21.6	19.5[a]	18.1	16.2[a]	14.8	–9
Mining	(b)	(b)	(b)	(b)	(b)	(b)	(b)	3.44	4.93	3.59	4.13[a]	3.83	3.97[a]	4.00	1
Commercial	(b)	(b)	(b)	(b)	(b)	(b)	(b)	1.23	2.39	2.89	(c)	(c)	(c)	(c)	
Aquaculture	(b)	(b)	(b)	(b)	(b)	(b)	(b)	2.24	2.24	3.27[a]	5.79[a]	8.83[a]	8.96[a]	7.55	–16
Source of water															
Groundwater															
Fresh	34	47	50	60	68	82	83	73.4	79.4	76.4[a]	84.3[a]	78.9	75.9[a]	82.3	8
Saline	(c)	0.6	0.4	0.5	1.0	1.0	0.93	0.66	1.30[a]	1.11	2.47[a]	1.51	2.22[a]	2.34	5
Surface water															
Fresh	140	180	190	210	250	260	280	263	255[a]	261	265	270	231[a]	198	–14
Saline	10	18	31	43	53	69	71	59.6	68.7[a]	59.7	61.0	59.8[a]	45.0	38.6	–14

[a]Data revised from Maupin and others (2014) because of revisions to individual State data during interim years.

[b]Included in self-supplied industrial.

[c]Data not available.

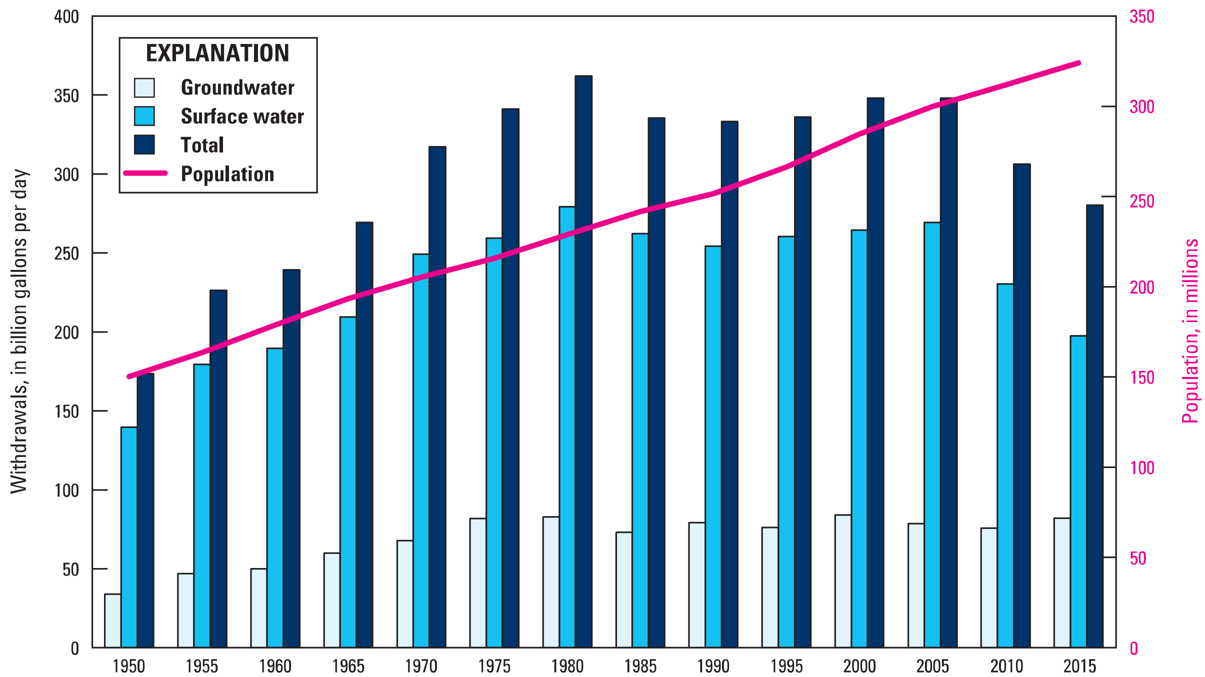

Figure 15. Trends in population and freshwater withdrawals by source, 1950–2015.

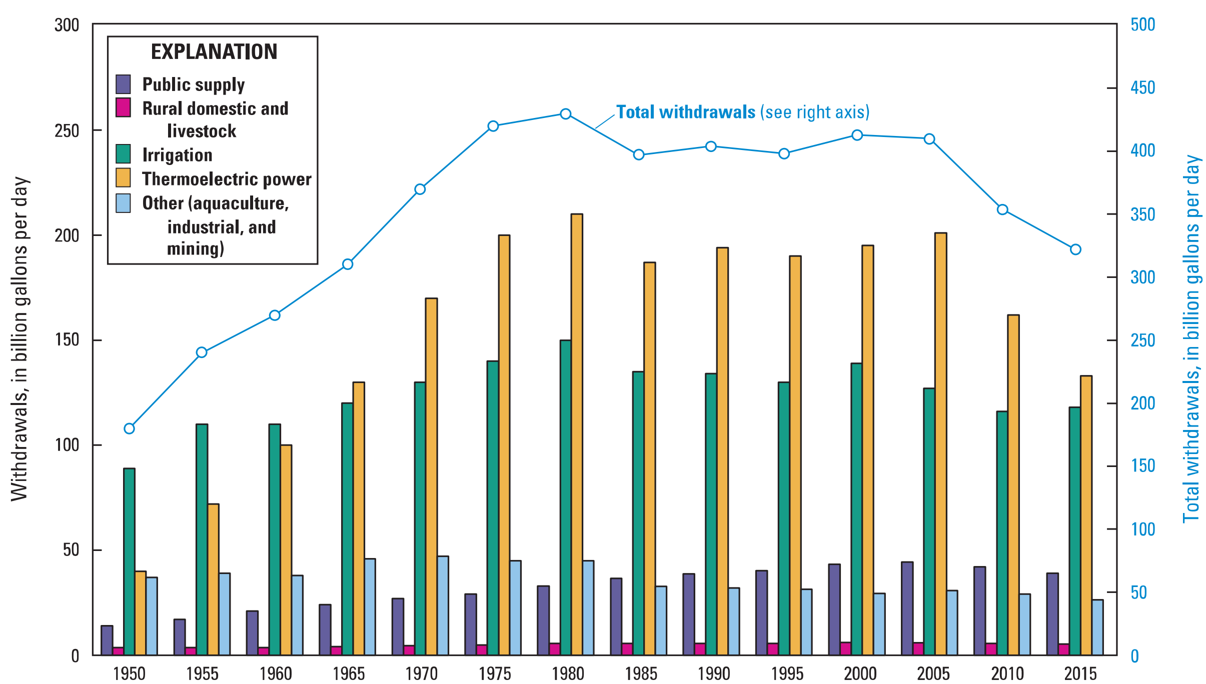

Figure 16. Trends in total water withdrawals by water-use category, 1950–2015.

for 2010 published in Maupin and others (2014; table 14) versus the value in table 14 (this report) was entirely related to revisions in estimates for South Carolina. A small decrease (0.46 Bgal/d) for aquaculture withdrawals published in Maupin and others (2014; table 14) versus the value in table 14 (this report) was mostly accounted for by revisions to estimates, resulting in a decrease in Idaho and an increase in Colorado. The increase of 1 Bgal/d between published values for irrigation in Maupin and others (2014, table 14) versus the value in table 14 (this report) is caused by rounding; the actual difference amounted to only 0.182 Bgal/d, mostly resulting from revisions to withdrawals in Montana. Table 14 notes additional total withdrawals by category for the United States from 1990 to 2015 that have changed since values were last published in Maupin and others (2014). These fluctuations in total withdrawals by category over time represent the level of flux that is inherent in maintaining large national datasets over time; datasets are constantly updated by USGS work or are based on new information from State, Federal, and local entities that are contributors to this national water-use compilation effort.

Comparisons between years stated hereafter are based on updated historical data and current 2015 data (table 14). Total withdrawals for all categories of use in 2015 were estimated to be 322 Bgal/d, a level not reported since before 1970 and 9 percent less than in 2010, continuing a sharp but steady downward trend since 2005. The drop in total withdrawals in 2015 was primarily caused by significant decreases in withdrawals for thermoelectric power (28.8 Bgal/d), which accounted for 89 percent of the decrease in total withdrawals. The decrease in public-supply withdrawals accounted for another 9 percent of the decline in total withdrawals. Categories of use with larger withdrawals in 2015 than in 2010 were irrigation and mining. The increase in irrigation withdrawals was only about 2 percent greater than 2010 levels, partly resulting from updated 2010 data, and mining withdrawals were corrected downward for 2010.

States with the largest decreases in total withdrawals for all categories between 2010 and 2015 were California, Texas, Ohio, Illinois, Pennsylvania, and North Carolina, and cumulatively these six States accounted for more than two-thirds of the total decrease in withdrawals for all categories. States that showed the largest increases between 2010 and 2015 withdrawals were Wyoming, Arkansas, Montana, Nebraska and Idaho. Total groundwater withdrawals (mostly freshwater) increased about 6.52 Bgal/d between 2010 and 2015. States with the largest increases in groundwater withdrawals were California, Arkansas, Idaho, and Nebraska, mostly for irrigation uses. Total surface-water withdrawals decreased about 38.9 Bgal/d, and the States that contributed to most of those decreased withdrawals were California, Texas, Ohio, Illinois, Pennsylvania, and North Carolina. These States, cumulatively, accounted for more than two-thirds of the total surface-water withdrawal decrease between 2010 and 2015, either through larger reductions in irrigation or thermoelectric-power withdrawals. California and Texas were experiencing record-setting droughts during 2015, which also likely contributed to lower surface-water withdrawals because of the decrease in available water.

The total population in the United States increased 4 percent between 2010 and 2015, or 12.4 million people, almost exactly mirroring the increase between 2005 and 2010 (table 14; fig. 16). This continues the steady upward trend in total population growth exhibited since 1950. Texas, California, and Florida all had population increases ranging from about 1.5 million (Florida) to 2.3 million (Texas). These three States accounted for 46 percent of the total population increase in the Nation.

Public-supply withdrawals in 2015 were 7 percent less than in 2010, decreasing from 42.0 Bgal/d to 39.0 Bgal/d and continuing the decline in public-supply withdrawals that was first observed in 2010 (table 14), which marked the first decline since being initially reported in 1950 (fig. 17*A*). Public-supply withdrawals increased between 2010 and 2015 in 17 States, with Florida showing the largest increase of about 0.12 Bgal/d. States with the largest decreases in public-supply withdrawals were California and Texas (1.15 Bgal/d and 1.11 Bgal/d, respectively), and they accounted for 76 percent of the national decrease of 2.99 Bgal/d between 2010 and 2015. The percentage of the population that is served from public-supply withdrawals has increased from 62 percent in 1950 to 87 percent in 2015. Texas, California, and Florida had the largest increases in the population that is served from public-supply withdrawals, accounting for 55 percent of the total national increase. Although California and Texas reported increased population served by public supply, withdrawals decreased. In 2015, California experienced a severe drought, and Governor Jerry Brown ordered a 25-percent statewide reduction in urban water use (which included water for landscaping) from water withdrawals in 2013 (Boxall and Xia, 2015). Selected water districts were ordered to reduce water usage by 36 percent, including water districts in the Sacramento region (Reese and Kasler, 2015). Reports from California water districts recorded a statewide reduction in water use of 27 and 31 percent in the summer months of June and July 2015, respectively, from the same months in 2013 (Boxall and Xia, 2015), exceeding the Governor's ordered limit. Although Texas was experiencing a drought in 2015 that had officially started in 2010 (National Oceanic and Atmospheric Administration, 2018), no mandatory water restrictions from the Governor were ordered in the State; however, municipal utilities in cities in Texas have been working with the populations they serve to promote water conservation. The San Antonio Water System that serves 1.6 million people, for example, reduced per capita water usage by 42 percent, simply by focusing on education, outreach, and regulations, through tools promoting water-smart landscaping, seminars on maintaining soils, and year-round time restrictions on the use of irrigation and sprinkler systems (U.S. Environmental Protection Agency, 2016).

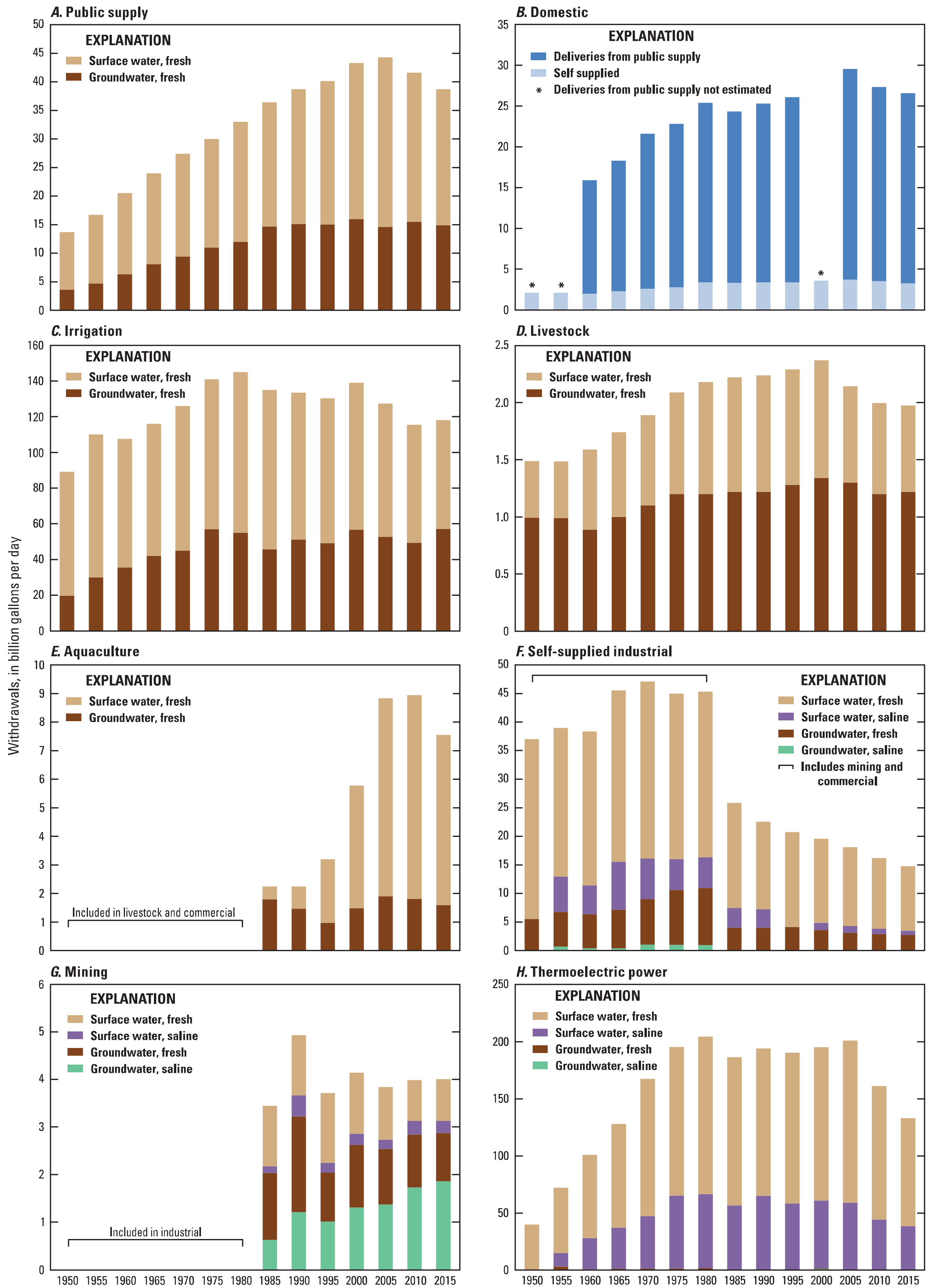

Figure 17. Trends in water withdrawals, 1950–2015.

The self-supplied domestic withdrawals decreased by 8 percent from 3.53 Bgal/d in 2010 to 3.26 Bgal/d in 2015. This represents a continued decline since 2005 and marks the lowest levels since prior to 1980 (table 14; fig. 17*B*). Between 1985 and 2015, the percentage of total population that was self-supplied has continuously declined, from about 18 percent to 13 percent.

The national average per capita use rate for self-supplied domestic withdrawals decreased from 81 GPCD in 2010 to 77 GPCD in 2015. This represents the rate of use for people with their own water supply. The rate of use for water that is delivered to people from public-supply systems (public-supply delivery GPCD) also decreased from 88 GPCD in 2010 to 82 GPCD in 2015.

Total domestic use is the combined water from public-supply deliveries to domestic users and self-supplied domestic withdrawals. Nationally, these withdrawals decreased about 0.75 Bgal/d between 2010 and 2015, from 27.3 Bgal/d in 2010 to 26.6 Bgal/d in 2015. Total domestic use in California alone decreased 0.68 Bgal/d between 2010 and 2015, accounting for 91 percent of the total national decrease and representing a 17-percent decrease in California's total domestic use between 2010 and 2015. In 2015, California endured one of the worst drought years on record (Khokha, 2014; Richtel, 2015; Stephens, 2015; California Department of Water Resources, 2016), with wide-scale water-use reductions and curtailments in effect statewide. Similarly, Texas was in a drought year in 2015 and reported about 0.05 Bgal/d, or 2 percent, less total domestic use between 2010 and 2015.

Reductions from 2005 to 2015 in water withdrawals for public supply and self-supplied domestic can be attributed to Federal, State, and local policies that have allowed for water and energy efficiency improvements. One policy is the National Energy Policy Act of 1992 (Donnelly and Cooley, 2015; Osann, 2017). This act established efficiency standards for all toilets, faucets, and showerheads. Additional and amendment legislation improved the efficiency of washing machines, dishwashers, and other water using appliances (Donnelly and Cooley, 2015; Osann, 2017). Another program to encourage water efficiency is the EPA WaterSense launched in 2006; it is a voluntary program that uses an easily identifiable label on consumer products. Many of these products are the water and energy efficient fixtures and appliances mandated through the National Energy Act of 1992 (U.S. Environmental Protection Agency, 2018a); however, the WaterSense label also currently (2018) extends to irrigation and landscaping, buildings, and certification of irrigation professionals. WaterSense-labeled products are certified to use at least 20 percent less water and save energy.

Total irrigation withdrawals were somewhat similar between 2010 and 2015 with about a 2-percent increase from 116 Bgal/d to 118 Bgal/d. Irrigation withdrawals for 2015 are at the fifth lowest level since 1950 and are 21 percent less than 1980, when withdrawals peaked at 150 Bgal/d (table 14; fig. 17*C*). However, 2015 marks the first 5-year period of increase in irrigation withdrawals since 2000, although it is possible that the increase is within the error of the estimated total withdrawal and that the withdrawals in 2015 are essentially the same as in 2010. California and Texas experienced the largest declines in irrigation withdrawals between 2010 and 2015, with a combined total reduction of 5.42 Bgal/d. However, States with increased irrigation withdrawals between 2010 and 2015 include Wyoming, Arkansas, Montana, and Idaho. These States had a combined total increase of 9.59 Bgal/d. Irrigation remains the second-largest category of use after thermoelectric, but the difference between irrigation withdrawals and thermoelectric is narrowing. Irrigation withdrawals in 2015 accounted for 64 percent of total freshwater withdrawals, excluding thermoelectric, the same percentage as in 1950. Surface water continues to be the primary source of irrigation water in the United States, but the relative proportion appears to be changing. Between 1985 and 2010, most of the irrigation water was supplied by surface-water sources, ranging from 66 percent in 1985 to 57 percent in 2010. Surface water accounted for only 52 percent of the total irrigation withdrawals in 2015. Although reclaimed wastewater is a minor overall source of irrigation water in the Nation, accounting for less than 1 percent of the total irrigation water, its use increased from 0.47 Bgal/d in 2010 to about 0.67 Bgal/d in 2015.

The use of more water-efficient irrigation systems continued to increase with 10 percent more irrigated acres using sprinkler systems in 2015 than in 2010. About 11 percent fewer irrigated acres were reported using surface (flood) irrigation systems in 2015 than in 2010. About 19 percent more irrigated acres were reported using microirrigation systems between 2010 and 2015. Total irrigated acres were about 2 percent more in 2015 than in 2010.

The compilation of irrigation water-use data conducted every 5 years since 1950 not only makes it possible to observe long-term changes in irrigation practices, including changing irrigation system types (for example, conversion of surface irrigation to sprinkler irrigation) and changes in total irrigated acres, but also allows for observations of shorter-term dynamic changes in irrigation practices and water use. For example, the 2015 dataset revealed the dynamic change in the Nation's largest user of water for irrigation, California. Estimated 2015 California irrigation withdrawals declined 4.07 Bgal/d (18 percent), and irrigated acres decreased by 10 percent in comparison to 2010, likely as a result of the intense drought conditions in 2015. 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. In California in 2015, groundwater withdrawals for irrigation increased 60 percent from 2010, and surface-water withdrawals for irrigation decreased 64 percent.

Livestock initially was included with rural domestic but since 1960 has been estimated as a separate category and has consistently accounted for about 1–2 percent of total withdrawals, excluding thermoelectric. Total withdrawals for livestock were 2.00 Bgal/d in 2015, the same as in 2010 (table 14; fig. 17*D*). Livestock withdrawals in 2015 were 16 percent less than the peak year of 2000, when 2.37 Bgal/d was reported. This may, in part, be a reflection of the decreasing number of cattle and calves raised in the United States; the USDA NASS reported that the number of cattle and calves in the United States decreased 23 percent from 1,188,659 in 1997 to 913,246 in 2012 (U.S. Department of Agriculture, 2014a). Withdrawals for livestock are heavily influenced by numbers of cattle, especially milk cows, which generally use much more water than other livestock because of their size and the sanitation needs of milking facilities.

Aquaculture withdrawals were 7.55 Bgal/d in 2015, or a 16 percent decrease from 2010 (8.95 Bgal/d). From 1985 to 2010, aquaculture quadrupled from 2.24 Bgal/d in 1985 to 8.96 Bgal/d in 2010. Much of the increase occurred between 1995 and 2005 and is attributed to increased accounting of aquaculture withdrawals. The decrease in aquaculture withdrawals after 2010 (table 14; fig. 17*E*) marks the first period of decline since 1985, but the reason for the decline is unclear. The decrease could be a reflection of a sharp decrease in the reported number of aquaculture farms in the United States from 4,309 to 3,093 and in freshwater acreage used for aquaculture from 365,566 to 249,274 between 2005 and 2013 (U.S. Department of Agriculture, 2014b). The reported number of flow-through raceways, however, increased by 77 percent from 9,160 to 16,253 during the same period (U.S. Department of Agriculture, 2014b). However, the decrease could simply be due to differences in changes in methodologies that were used to estimate withdrawals for many of the States. The 2005 and 2015 water withdrawals for many States were estimated on the basis of data from the USDA NASS 2005 and 2013 censuses of aquaculture. The USDA NASS did not conduct a comparable census for 2010; therefore, the 2010 withdrawal estimates for many States were based on changes in the numbers of aquaculture operations from the USDA NASS 2002 and 2007 censuses of agriculture.

Self-supplied industrial withdrawals in the Nation can be directly compared from 1985 through 2015. Since 1985, self-supplied industrial withdrawals have consistently declined and are about 43 percent less than 1985 (table 14; fig. 17*F*). Between 2010 and 2015, self-supplied industrial withdrawals decreased 1.4 Bgal/d. Texas (–0.37 Bgal/d), West Virginia (–0.34 Bgal/d), Pennsylvania (–0.22 Bgal/d), Maryland (–0.15 Bgal/d), Ohio (–0.14 Bgal/d), Arkansas (–0.12 Bgal/d), and Michigan (–0.10 Bgal/d) had the largest decreases. Delaware (0.21 Bgal/d) and Connecticut (0.12 Bgal/d) showed the largest increases from 2010 to 2015.

Declines in self-supplied industrial water withdrawals between 1985 and 2015 can likely be linked to a number of changes in factors in the United States economy, including technology, trade with foreign markets, operating costs, and a decline in manufacturing output (Bailey and Bosworth, 2014), as well as increases in the efficient use of water in industrial processes. One partial explanation for the decline in industry in the United States is a shift to a more service-based economy, where financial and health-care services have grown while the higher standard of living and higher labor costs in the United States have sent industries to countries with lower-paid labor (Amadeo, 2017). A decline in manufacturing (and a loss of jobs in this sector) in the decade 2000 to 2009 (this would impact the 2005 and 2010 water-use data) is linked to a decline in manufacturing's share of gross domestic product; the products from the United States could not compete globally (Atkinson, 2013; Bailey and Bosworth, 2014). Finally, it has been suggested that higher taxes for manufactured goods in the United States, as well as decreased prices for overseas supplies better negotiated by other nations through trade agreements, make industrial products from the United States more expensive and less able to compete in the global market (Amadeo, 2017), resulting in less need for these manufactured goods.

In addition to changes in the United States economy, declines in self-supplied industrial withdrawals reflect greater efficiencies in industrial processes and an emphasis on water reuse and recycling within industrial facilities, both driven by environmental regulations and limited availability of freshwater resources in some areas. The EPA EnergyStar program, begun in 1992, provides information and suggestions on reducing water and energy use to industries (U.S. Environmental Protection Agency, 2018b).

Mining withdrawals were 4.00 Bgal/d in 2015, about a 1-percent increase from 2010 (3.97 Bgal/d). Prior to 1985, mining was included in other industrial withdrawals but since 1985 has represented from about 2 to 3 percent of total withdrawals, excluding thermoelectric. Trends in mining withdrawals fluctuated between 1985 and 2015, ranging from an increase of 43 percent between 1985 and 1990 to a 27-percent decrease between 1990 and 1995 (table 14; fig. 17*G*). Since 2000, mining withdrawals have fluctuated only slightly, averaging about 4 Bgal/d over the period.

Thermoelectric-power withdrawals continued to account for the largest portion of total withdrawals for all categories of use, at 133 Bgal/d, or 41 percent of the total withdrawals. However, total thermoelectric-power withdrawals in 2015 were about 18 percent less than in 2010. On average, 15 gallons of water were used to produce 1 kWh of electricity in 2015, compared to almost 19 gallons in 2010. The decline in withdrawals between 2010 and 2015 continues the trend of declining withdrawals for thermoelectric power; withdrawals in 2010 were about 20 percent less than in 2005 (table 14; fig. 17*H*). Total withdrawals for thermoelectric power in 1985 were 11 percent less than in 1980, and fluctuations in total withdrawals during the 5-year intervals between 1985 and 2005 were never more than 5 percent. States with the largest increases in thermoelectric-power withdrawals between 2010 and 2015 were Nebraska (1.12 Bgal/d), Florida (0.67 Bgal/d), and North Dakota (0.15 Bgal/d). Many States (California, Ohio, Illinois, Pennsylvania, Alabama, Indiana, Massachusetts, Kentucky, North Carolina, Tennessee, and Georgia) had large decreases in withdrawals, ranging from 3.73 Bgal/d (California) to 1.17 Bgal/d (Georgia).

Several factors may have contributed to the 18 percent decline in total thermoelectric withdrawals between 2010 and 2015 (table 14). Since the 1970s, an increasing number of powerplants were built with or converted to recirculating cooling systems or dry cooling systems, which withdraw less water than powerplants with once-through cooling systems. Since 2010, 77 percent of the new cooling systems are recirculating cooling systems, and 18 percent are dry cooling systems (U.S. Department of Energy, 2016a). The increased use of natural gas to power energy- and water-efficient combined-cycle plants, almost all of which have recirculating or dry-cooling towers, has contributed to the decline in withdrawals (U.S. Department of Energy, 2016a, c). The decreased use of coal has also helped to reduce withdrawals because many coal-fired powerplants with once-through cooling systems have been retired. Of the 49 plants with once-through cooling systems that were generating electricity in 2010 and have since been decommissioned, 31 of them were conventional coal-fired powerplants (U.S. Department of Energy, 2016a). Withdrawals have declined in some States as a result of the implementation of new rules designed to minimize adverse effects to aquatic life from heated discharges and from entrainment/impingement at pump intakes at powerplants with once-through cooling systems (California Environmental Protection Agency, 2010).

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Glossary

The following terms are referenced in the text or are part of the water-use Circular series.

animal-specialties water use Water use associated with the production of fish in captivity, except for fish hatcheries, and the raising of horses and such fur-bearing animals as rabbits and pets. Animal-specialties water-use estimates were included in the 1990 and 1995 water-use Circulars but were combined with the livestock categories or aquaculture categories beginning in 2000. *See also* aquaculture water use, fish-farm water use, livestock water use, and rural water use.

aquaculture water use Water use associated with the farming of organisms that live in water (such as finfish and shellfish) and offstream water use associated with fish hatcheries. *See also* fish-farm water use, fish-hatchery water use, animal-specialties water use, and livestock water use.

closed-loop cooling system *See* recirculating cooling system.

commercial water use Water for motels, hotels, restaurants, office buildings, other commercial facilities, military and nonmilitary institutions, and (for 1990 and 1995) offstream fish hatcheries. Water may be obtained from a public-supply system or may be self-supplied. Commercial water-use estimates were included in some previous water-use Circulars but were omitted beginning in 2000. *See also* fish-hatchery water use, public-supply water use, public-supply deliveries, and self-supplied water use.

consumptive use The part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment. Also referred to as water consumed.

conveyance loss Water that is lost in transit from a pipe, canal, conduit, or ditch by leakage or evaporation. Generally, the water is not available for further use; however, leakage from an irrigation ditch, for example, may percolate to a groundwater source and be available for further use. Conveyance-loss estimates were included in some previous water-use Circulars but were omitted beginning in 2000. *See also* irrigation water use.

cooling system An equipment system that provides water for cooling purposes, such as to condensers at powerplants or at factories. May include water intakes, outlets, cooling towers, ponds, canals, pumps, and pipes. *See also* cooling-system type, industrial water use, and thermoelectric-power water use.

cooling-system type Defined as either once-through or recirculating cooling system. *See also* industrial water use, once-through cooling system, recirculating cooling system, and thermoelectric-power water use.

domestic water use Water used for indoor household purposes such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and outdoor purposes such as watering lawns and gardens. Domestic water use includes water provided to households by a public water supply (domestic deliveries from public suppliers) and self-supplied water. *See also* public-supply deliveries, public-supply water use, rural water use, and self-supplied water use.

fish-farm water use Water used for the production of finfish and shellfish under controlled feeding, sanitation, and harvesting procedures for commercial purposes. Water use by fish farms is classified in the aquaculture category. *See also* animal-specialties water use, aquaculture water use, and fish-hatchery water use.

fish-hatchery water use Water used for raising fish for later release and in association with the operation of fish hatcheries or fishing preserves. Fish-hatchery water use has been included in the aquaculture category since 2000. *See also* aquaculture water use, commercial water use, and fish-farm water use.

freshwater Water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids. Generally, water with more than 500 mg/L of dissolved solids is undesirable for drinking and many industrial uses. *See also* saline water.

industrial water use Water used for fabrication, processing, washing, and cooling. Includes industries such as chemical and allied products, food, mining, paper and allied products, petroleum refining, and steel. Term used in previous water-use Circulars to describe the combined public-supply deliveries to industrial users and self-supplied industrial withdrawals. Since 2000, industrial water use refers only to self-supplied industrial withdrawals. *See also* mining water use, public-supply deliveries, public-supply water use, and self-supplied water use.

instream use Water that is used, but not withdrawn, from a surface-water source for such purposes as hydroelectric-power generation, navigation, water-quality improvement, fish propagation, and recreation. Instream water-use estimates for hydroelectric power were included in some previous water-use Circulars but were omitted since 2000. *See also* offstream use.

irrigation district A cooperative, self-governing public corporation set up as a subdivision of the State government, with definite geographic boundaries, organized, and having taxing power to obtain and distribute water for irrigation of lands within the district. Created under the authority of a State legislature with the consent of a designated fraction of the landowners or citizens. *See also* irrigation water use.

irrigation water use Water that is applied by an irrigation system to assist crop and pasture growth, or to maintain vegetation on recreational lands such as parks and golf courses. Irrigation includes water that is applied for pre-irrigation, frost protection, chemical application, weed control, field preparation, crop cooling, harvesting, dust suppression, leaching of salts from the root zone, and conveyance losses. Irrigation water use includes self-supplied water and reclaimed wastewater. *See also* conveyance loss, microirrigation system, sprinkler irrigation system, and surface irrigation system.

livestock water use Water used for livestock watering, feedlots, dairy operations, and other on-farm needs. Types of livestock include dairy cows and heifers, beef cattle and calves, sheep and lambs, goats, hogs and pigs, horses, and poultry. *See also* animal-specialties water use, aquaculture water use, and rural water use.

microirrigation system An irrigation system that wets only a discrete portion of the soil surface in the vicinity of the plant by means of applicators (such as orifices, emitters, porous tubing, or perforated pipe) and operated under low pressure. The applicators may be placed on or below the surface of the ground or suspended from supports. *See also* irrigation water use, sprinkler irrigation system, and surface irrigation system.

mining water use Water used for the extraction of naturally occurring minerals including solids (such as coal, sand, gravel, and other ores), liquids (such as crude petroleum), and gases (such as natural gas). Also includes uses associated with 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 activity. Does not include water associated with dewatering of the aquifer that is not put to beneficial use. Also does not include water used in processing, such as smelting, refining petroleum, or slurry pipeline operations. These processing uses are included in industrial water use. *See also* industrial water use and self-supplied water use.

offstream use Water withdrawn or diverted from a groundwater or surface-water source for aquaculture, commercial, self-supplied domestic, industrial, irrigation, livestock, mining, public supply, thermoelectric power, and other uses. *See also* entries for each of these categories of use, and instream use.

once-through cooling system Also known as open-loop cooling system. Cooling system in which the water is withdrawn from a source, circulated through the heat exchangers, and then returned to a body of water at a higher temperature. *See also* cooling system, cooling-system type, and thermoelectric-power water use.

public-supply deliveries Amount of water delivered from a public supplier to users for domestic, commercial, industrial, thermoelectric-power, or public-use purposes. Estimates of deliveries for each purpose were provided for 1995 and earlier years, but not for 2000. For 2005–2015, only domestic deliveries were estimated nationally. *See also* commercial water use, domestic water use, industrial water use, public-supply water use, public water use, and thermoelectric-power use.

public-supply water use Water withdrawn by public and private water suppliers that furnish water to at least 25 people or have a minimum of 15 connections. Public suppliers provide water for a variety of uses, such as domestic, commercial, industrial, thermoelectric-power, and public water use. *See also* commercial water use, domestic water use, industrial water use, public-supply deliveries, public water use, and thermoelectric-power water use.

public water use Water supplied from a public supplier and used for such purposes as firefighting, street washing, flushing of water lines, and maintaining municipal parks and swimming pools. Generally, public-use water is not billed by the public supplier. *See also* public-supply deliveries and public-supply water use.

recirculating cooling system Also known as closed-loop cooling system or recirculation cooling system. Water is withdrawn from a source, circulated through heat exchangers, cooled, and then re-used in the same process. Recirculating cooling systems may use induced draft cooling towers, forced draft cooling towers, cooling ponds, or canals. *See also* cooling system, cooling-system type, and thermoelectric-power water use.

reclaimed wastewater Wastewater-treatment plant effluent that has been diverted for beneficial uses such as irrigation, industrial use, or thermoelectric-power cooling instead of being released to a natural waterway or aquifer. *See also* water use.

return flow Water that reaches a groundwater or surface-water source after release from the point of use and thus becomes available for further use. *See also* water use.

rural water use Water used in suburban or farm areas for domestic and livestock needs. The water generally is self-supplied, and includes domestic use, drinking water for livestock, and other uses such as dairy sanitation, cleaning, and waste disposal. Term used in 1950 and 1955 water-use Circulars. *See also* animal-specialties water use, domestic water use, livestock water use, and self-supplied water use.

saline water Water that contains 1,000 mg/L or more of dissolved solids. *See also* freshwater.

self-supplied water use Water withdrawn from a groundwater or surface-water source by a user rather than being obtained from a public-supply source.

sprinkler irrigation system An irrigation system in which water is applied by means of perforated pipes or nozzles operated under pressure so as to form a spray pattern. *See also* irrigation water use, microirrigation system, and surface irrigation system.

surface irrigation system Irrigation by means of flood, furrow, or gravity methods. Flood irrigation is the application of irrigation water in which the entire soil surface is covered by ponded water. Furrow is a partial surface-flooding method of irrigation normally used with clean-tilled crops in which water is applied in furrows or rows of sufficient capacity to contain the design irrigation stream. Gravity is an irrigation method in which water is not pumped, but flows in ditches or pipes and is distributed by gravity. *See also* irrigation water use, microirrigation system, and sprinkler irrigation system.

thermoelectric-power water use Water used in the process of generating electricity with steam-driven turbine generators. Thermoelectric-power water use includes water provided by a public water supply (deliveries from public suppliers), self-supplied water, and reclaimed wastewater. *See also* cooling system, cooling-system type, public-supply water use, reclaimed wastewater, and self-supplied water use.

wastewater-treatment return flow Term used in previous water-use Circulars to describe water returned to the hydrologic system by wastewater-treatment facilities. *See also* water use.

water use In a restrictive sense, the term refers to water that is withdrawn for a specific purpose, such as for public supply, domestic use, irrigation, thermoelectric-power cooling, or industrial processing. In some previous water-use Circulars, water use for the domestic, commercial, industrial, and thermoelectric categories included both self-supplied withdrawals and deliveries from public supply, and some categories included reclaimed wastewater use. More broadly, water use pertains to the interaction of humans with and influence on the hydrologic cycle, and includes elements such as water withdrawal, delivery, consumptive use, wastewater release, reclaimed wastewater, return flow, and instream use. *See also* offstream use and instream use.

water withdrawal Water removed from a groundwater or surface-water source for use. *See also* offstream use and self-supplied water use.

watt-hour (Wh) An electrical energy unit of measure equal to 1 watt of power supplied to, or taken from, an electric circuit steadily for 1 hour.

Contributing Agencies and Organizations

The following State, regional, and local organizations provided assistance and data as part of the water-use compilation. In addition, State, regional, and national offices of the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, U.S. Census Bureau, U.S. Department of Energy, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Agricultural Statistics Service, National Oceanic and Atmospheric Administration, National Weather Service, Natural Resources Conservation Service, and other Federal agencies provided assistance and data for various States.

Alabama

Alabama Department of Economic and Community Development, Office of Water Resources

Alaska

Alaska Department of Commerce, Community and Economic Development, Community and Regional Affairs
Alaska Department of Environmental Conservation, Division of Water
Alaska Department of Fish and Game
Alaska Department of Natural Resources, Division of Mining, Land and Water

Arizona

Arizona Corporation Commission
Arizona Department of Environmental Quality
Arizona Department of Water Resources
Arizona Public Service
Buckeye Water Conservation and Drainage District
Central Arizona Project
Gila Water Commissioner
Paloma Irrigation and Drainage District
Salt River Project
Wellton-Mohawk Irrigation and Drainage District

Arkansas

Arkansas Association of Conservation Districts
Arkansas Department of Health, Engineering Division
Arkansas Natural Resources Commission

California

California Department of Conservation, Division of Land Resource Protection
California Department of Corrections and Rehabilitation
California Department of Water Resources
California Environmental Protection Agency, State Water Resources Control Board
Golf Course Superintendents Association of America

Colorado

Colorado Division of Reclamation Mining and Safety
Colorado Division of Water Resources
Colorado Oil and Gas Conservation Commission
Colorado Water Conservation Board
Rocky Mountain Golf Course Superintendents Association

Connecticut

State of Connecticut Department of Environmental Protection

Delaware

Delaware Department of Natural Resources and Environmental Control
Delaware State University
University of Delaware

District of Columbia

DC Water

Florida

Florida Department of Agriculture and Consumer Services
Northwest Florida Water Management District
South Florida Water Management District
Southwest Florida Water Management District
St. Johns River Water Management District
Suwannee River Water Management District

Georgia

Georgia Environmental Protection Division, Watershed Protection Branch
Georgia Power Company
Georgia Water Planning and Policy Center

Hawaii

Hawaii Department of Water Supply
Hawaiian Electric Company
Honolulu Board of Water Supply
Kauai Department of Water
Maui Department of Water Supply

Idaho

Idaho Chapter Golf Course Superintendents Association of America
Idaho Department of Commerce
Idaho Department of Environmental Quality
Idaho Department of Fish and Game
Idaho Department of Water Resources

Illinois

Illinois State Water Survey—Illinois Water Inventory Program
Imperial Valley Water Authority

Indiana

Indiana Department of Natural Resources, Division of Water, Water Rights, and Use Section

Iowa

Iowa Department of Natural Resources—Water Allocation and Use Program

Kansas

Kansas Department of Agriculture—Division of Water Resources
Kansas Water Office

Kentucky

Kentucky Energy and Environment Cabinet, Department of Environmental Protection, Division of Water

Louisiana

Capitol Area Ground Water Conservation Committee
Louisiana Cooperative Extension Service
Louisiana Department of Health and Hospitals
Louisiana Department of Natural Resources
Louisiana Department of Transportation and Development
Louisiana State University Agricultural Center

Maine

Maine Department of Agriculture, Conservation and Forestry
Maine Department of Environmental Protection
Maine Department of Health and Human Services
Maine Geological Survey
Maine Public Utilities Commission

Maryland

Maryland Department of the Environment

Massachusetts

Massachusetts Department of Environmental Protection

Michigan

Michigan Department of Environmental Quality, Water Use Program
Michigan Department of Agriculture and Rural Development

Minnesota

Minnesota Department of Natural Resources

Mississippi

Mississippi Department of Environmental Quality, Office of Land and Water Resources
Mississippi State Department of Health
Mississippi State Oil and Gas Board
Mississippi State University Extension Service
Yazoo Mississippi Delta Joint Management District

Missouri

Missouri Department of Natural Resources

Montana

Montana Board of Oil and Gas Conservation
Montana Department of Natural Resources and Conservation

Nebraska

Central Platte Natural Resources District
Lewis and Clark Natural Resources District
Lower Elkhorn Natural Resources District
Lower Loup Natural Resources District
Lower Platte North Natural Resources District
Lower Platte South Natural Resources District
Lower Republican Natural Resources District
Middle Niobrara Natural Resources District
Middle Republican Natural Resources District
Nebraska Department of Natural Resources
North Platte Natural Resources District
South Platte Natural Resources District
Tri-Basin Natural Resources District
Twin Platte Natural Resources District
Upper Big Blue Natural Resources District
Upper Elkhorn Natural Resources District
Upper Loup Natural Resources District
Upper Niobrara–White Natural Resources District
Upper Republican Natural Resources District

Nevada

Colorado River Commission
Federal Water Master
Nevada Department of Business and Industry
Nevada Department of Conservation and Natural Resources, Division of Environmental Protection
Nevada Department of Wildlife
Nevada Division of Water Resources
Southern Nevada Water Authority

New Hampshire

New Hampshire Department of Environmental Services, Water Management Bureau

New Jersey

New Jersey Department of Environmental Protection

New Mexico

New Mexico Office of the State Engineer—Water Conservation Bureau
New Mexico Oil Conservation Division

New York

New York City Department of Environmental Protection
New York State Department of Environmental Conservation
New York State Department of Health

North Carolina

North Carolina Department of Agriculture and Consumer Services, Agribusiness and Aquaculture
North Carolina Department of Environmental Quality, Water Supply Planning Branch

North Dakota

North Dakota Department of Mineral Resources
North Dakota State Department of Commerce
North Dakota State Water Commission

Ohio

Ohio Department of Natural Resources

Oklahoma

Oklahoma Corporation Commission
Oklahoma Water Resources Board

Oregon

Oregon Health Authority Drinking Water Services
Oregon Water Resources Department

Pennsylvania

Delaware River Basin Commission
Pennsylvania Department of Environmental Protection

Puerto Rico

Puerto Rico Aqueduct and Sewer Authority
Puerto Rico Department of Health
Puerto Rico Department of Natural and Environmental Resources
Puerto Rico Electric and Power Authority

Rhode Island

Rhode Island Department of Environmental Management
Rhode Island Department of Health
Rhode Island Water Resources Board

South Carolina

South Carolina Department of Health and Environmental Control

South Dakota

South Dakota Department of Environment and Natural Resources

Tennessee

Tennessee Department of Environment and Conservation, Division of Water Resources

Texas

Texas Commission on Environmental Quality
Texas Railroad Commission
Texas Water Development Board—Water Use and Projections & Planning

U.S. Virgin Islands

U.S. Virgin Islands Department of Planning and Natural Resources

Utah

Golf Course Superintendents Association of America
State of Utah Automated Geographic Reference Center
Utah Department of Agriculture and Food
Utah Department of Natural Resources, Division of Oil, Gas, and Mining
Utah Department of Natural Resources, Division of Water Resources
Utah Department of Natural Resources, Division of Water Rights
Utah Department of Natural Resources, Division of Wildlife Resources
Ute Tribe Fish and Wildlife Department

Vermont

Vermont Agency of Natural Resources, Department of Environmental Conservation, Drinking Water and Groundwater Protection Division
Vermont Fish and Wildlife Department, Agency of Natural Resources

Virginia

Virginia Department of Environmental Quality, Water Supply Planning Program

Washington

Golf Course Superintendents Association of America
Washington State Department of Ecology
Washington State Department of Health

West Virginia

West Virginia Department of Environmental Protection, Water Use Section
West Virginia Public Service Division

Wisconsin

Public Service Commission of Wisconsin—Energy Division
Public Service Commission of Wisconsin—Water Division
Wisconsin Department of Administration (DOA) Demographic Services Center
Wisconsin Department of Natural Resources

Wyoming

Wyoming Oil and Gas Conservation Commission
Wyoming Water Development Commission

For additional information, contact:
U.S. Geological Survey
National Water Use Science Project Team
wu-info@usgs.gov

or visit our website at:
https://water.usgs.gov/watuse/

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SLAUGHTERHOUSE FEASIBILITY REPORT

Prepared for

PRIDE OF VERMONT

Prepared by

SLEEPING LION ASSOCIATES

FINAL - April 2005

SLEEPING LION ASSOCIATES, INC.

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EXECUTIVE SUMMARY

In January 2003, when the owner of Brault's Slaughterhouse in Troy informed his customers that the business was for sale, livestock producers in northern Vermont were concerned that this could impair their ability to slaughter, fabricate and sell their livestock. These producers wanted to evaluate their options for controlling the availability, quality and cost of slaughtering and processing services. In early 2004, Pride of Vermont was able to secure funding on behalf of these producers for a feasibility study of a cooperatively owned slaughterhouse. A Steering Committee was formed to oversee this study.

One of the Steering Committee's major initial findings was the realization that Vermont had more than enough slaughtering capacity but insufficient processing and fabrication capacity. This fabrication capacity is severely limited during the August to January period when small-scale custom producers preempt commercial accounts at many of the State's slaughterhouses. Substantial concerns were also raised about the quality of fabrication and packaging. Livestock producers who raise high-quality lamb, beef, pork and goat meat need attractive cuts and packaging in order to command premium prices for their top-quality cuts. Poorly cut carcasses, unattractive packaging and sloppy labeling all eat into their profits. The demands of this end-market are often unfamiliar to slaughterhouses, which are used to packaging cuts in freezer wrap. Since processing services are in such high demand, commercial livestock producers have been stymied in their ability to encourage greater attention to packaging and presentation.

Early in the process, the Steering Committee identified key criteria for the undertaking. Various options were assessed based on their ability to meet these criteria while minimizing potential risk faced by the producer/ members. An initial financial analysis of Brault's indicated a price and capacity that exceeded the group's requirements. As the process unfolded, it became clear that acquisition and management of a slaughterhouse by this group of producers was not readily feasible. This was due to changes in the market, the volume of livestock represented by this group, the management and financial realities of operating a slaughterhouse or processing facility and clear identification of the group's own criteria.

Changes in the availability of slaughtering and processing services during the study period include:

- significant expansion of Royal Butcher slaughterhouse and meat market in Braintree;
- purchase of Swanton Packing by local consortium including St. Albans Cooperative. (This venture shut down in August of 2004);
- announcement by Farmer's Diner that it is adding a meat processing facility which will have capacity to serve producers who want to market meat products directly to consumers;
- announcement by VQM that it plans to open a processing plant in the near future;
- sale of Moore Beef in St. Johnsbury;
- announcement by Green Mountain Smokehouse that it intends to secure federal licensing; and;
- Vermont Food Venture Center's exploration of the feasibility of expanding their services to include USDA licensed meat processing.

Despite these changes, there was substantial information gleaned through this feasibility study. Information compiled includes:

- Description of the regulatory issues faced by slaughter or processing facility operating in Vermont;
- An assessment of the market for a potential slaughter or processing facility in Vermont;
- Competition analysis of the existing slaughterhouses in Vermont;
- Recommended options for this group including estimated costs;
- Capital Budget;
- Operating Budget.

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  - Agency of Agriculture
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  - Cooperative Development Institute

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Ed Jackson
Phil Leibold
Chet Parsons
Willow Smart
Allen Matthews

Special thanks also to the individuals (many of them listed in Appendix A) within the meat processing industry who generously shared their knowledge and experience with us.

The report is available electronically at:
www.

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BACKGROUND

In January 2003, the owner of Brault's Slaughterhouse in Troy informed his customers that the business was for sale. Livestock producers in northern Vermont who relied on Brault's for slaughtering and processing were concerned that this could impair their ability to slaughter, fabricate and sell their livestock. These producers wanted to evaluate their options for controlling the availability, quality and cost of slaughtering and processing services with a feasibility study for a cooperatively-owned slaughterhouse. Pride of Vermont Farms, LLC, a marketing group for sheep and goat livestock producers sought and received financial assistance to conduct a feasibility study and, if warranted, produce a business plan. Funding for the project was received through a Vermont Community Development Program grant (#0160/03PG(14)) provided to the Town of Troy and administered by Northern Vermont Development Association, and grants from the Vermont Community Loan Fund and Vermont Agency of Agriculture.

In February of 2004, an organizing meeting of interested farmers was held in Westfield A Steering Committee was formed to oversee the development of any new cooperative initiative. In addition, a Coordinator was hired to keep the process on track and keep potential members informed. In March of 2004, Sleeping Lion Associates, Inc. was contracted to conduct a feasibility study for a cooperatively owned slaughterhouse in Northern Vermont. The Steering Committee has met eleven times since February to review information and provide input and guidance for its consultants. The Steering Committee members and/or its consultants visited six slaughterhouses and a commercial processing facility/smokehouse to view and discuss operations with the owners/managers. Two membership meetings were held in May and December to update prospective members. In addition, two meetings were held with the Vermont House Agriculture Committee, at the Legislators' request, to discuss the project. In addition, a presentation on findings from the study was offered as a workshop at the February 2005 NOFA conference.

The original scope of work called for development of 1) a slaughterhouse business plan and 2) a cooperative organization. As the process unfolded, it became clear that ownership of a slaughterhouse was not consistent with the group's criteria or readily feasible given the market and operational realities. The project was therefore revised to assess the feasibility of various alternative approaches. This included contracting as a group for slaughtering and/or processing services as well as potential ownership or contracting with either a mobile unit and/or stand-alone processing/fabrication facility.

PROJECT PARAMETERS

CRITERIA

At the beginning of the feasibility study, the Steering Committee identified key criteria for the undertaking. As a cooperative, farmers would theoretically have three relationships with the business – as users, as owners and in its governance and oversight. Key information about each of these constituencies and the identified criteria are detailed in the table below.

TABLE 1 - Criteria for Slaughterhouse Cooperative

Relationship to Co-op or Company	USERS	OWNERS	OVERSEERS aka Control & Governance
Who are they?	Farmers - both US and Canadian, Hobbyists & Hunters	At least 51% are producers Producer/owners	Primarily Co-op Members
CRITERIA			
- Avoid	Sudden price changes Loss of slaughterhouse services	Loss of investment	Loss of service Changes in service, pricing, etc. without input
- Preserve	Availability of services Quality of services Accurate labeling	Value of investment	Access to slaughtering, processing and packaging services in Northern Vt. (defined as N of Rte 2, S of Canada)
- Achieve	Quality and professional cutting and presentation Consistency in packaging, appearance and sizing Availability re: scheduling Additional capacity and facilities Cost-effective slaughtering for kids Value-added services e.g.. brand for lower quality cuts; non-meat products	Profits Sufficient capitalization Ability to reinvest in the business	Cost Control Input into scheduling Quality management Stable, competent workforce
Key Values	Access to services Commitment to specific amt. of use. No one member responsible for more than 20% of total business. Livestock must be treated humanely and delivered in "clean" condition to the slaughterhouse. Brand will require quality standards.	Limited Return on Equity Capital Profits returned on patronage basis Equity Contribution of $1,000-$2,000/member (exact amount to be determined) Equity Contribution can be paid over time. OK to have non-voting members.	One member – one vote Voting Members - producers who use at least $1500 worth of services per year. Good to have some outside expertise on Board.
Documents that Define this relationship	Use Agreement Marketing Agreement Quality Standards	Articles of Association Share/Stock Certificate Preferred Stock	Articles of Association By-Laws

REGULATORY ISSUES

Food Safety and Labeling

The Federal Meat Inspection[1] and Poultry Products Inspection[2] Acts as well as State laws[3] govern the slaughtering and processing of meat[4]and poultry for human consumption. USDA's Food Safety and Inspection Services (FSIS) is responsible for ensuring that meat and poultry are safe, wholesome, not adulterated and properly marked, labeled, and packaged. These federal acts define the process for pre- and post-mortem inspection as well as specific marking, labelling and packaging requirements.

Generally, federal inspectors oversee facilities that slaughter and process meat and poultry. FSIS has cooperative agreements with many states, including Vermont, that allow state inspectors to enforce requirements "at least equal to" those imposed under the federal acts for state-inspected facilities. Regardless of how a facility chooses to operate, federal and Vermont law require it to be licensed if it is engaged "in the business of buying, selling, preparing, processing, packing, storing, transporting or otherwise handling meat, meat food products or poultry products…" Since the federal acts prohibit product produced under State inspection from being sold outside the State, slaughterhouses processing product for commercial consumption or sale out-of-state must secure a USDA license. This limitation on out-of-state sales, as dictated by federal law, irks many farmers operating in smaller states as well as food safety professionals since the FSIS pays these same state inspectors to enforce the federal regulations.

Exemption from federal inspection requirements (i.e. an inspector does not need to be present when animals are slaughtered or processed) are provided for "custom" slaughtering for "personal, household, guest and employee use." Federal law dictates that these custom facilities be licensed and examined by state inspectors on a periodic basis. Meat packed as "custom" must be marked "not for sale." Operators of commercial slaughtering facilities often do custom work after hours since inspectors require overtime pay for days longer than eight-hour shifts. Since the timing and packaging requirements of custom slaughtering and processing are more flexible and less-labor intensive, many slaughtering facilities charge less for custom processing than commercial processing. Meat customers who purchase live animals prior to slaughter effectively take advantage of this exemption.

In addition, the federal regulations provide exemptions for small-scale poultry producers. Producers slaughtering no more than 1,000 birds annually are exempt from the federal act as long as:

1. All of the poultry was raised, slaughtered and sold on the producer's own farm;
2. The poultry producer is not in the business of buying or selling poultry products other than those produced from their own birds;
3. None of the poultry is distributed or sold outside of the State in which it is produced.

Vermont now allows these producers to sell whole poultry carcasses at farmer's market *if* the producer registers for and meets the requirements for being a Vermont Exempt Poultry Processor. Most of the requirements are similar to those detailed below. No producers have yet taken formal advantage of this exemption.[5]

Poultry producers raising and slaughtering no more than 20,000 birds are exempt from federal inspection if:

1. They meet conditions 2 and 3 detailed above.

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[1] http://www.fsis.usda.gov/regulations_&_policies/Federal_Meat_Inspection_Act/index.asp
[2] http://www.fsis.usda.gov/regulations_&_policies/Poultry_Products_Inspection_Act/index.asp
[3] 6 V.S.A. Part 8 § 3131-3318.
[4] Meat includes the products of cattle, sheep, swine, goats, horses and mules.
[5] Communication with Carl Cushing, Director of Food Safety & Consumer Assurance, Vermont Agency of Agriculture.

2. They do not slaughter or process poultry products at a facility used for slaughtering or processing poultry by any other person.[6]
3. Poultry are sound and healthy before slaughter and "sound, clean and fit for human food when distributed…" Vermont inspectors require initial inspection of the facility and approval of sanitation and HACCP plans.
4. The poultry products have a label that identifies the name and address of the producer and a statement that the product is exempt from Public Law 90-493. Vermont inspectors have interpreted this to mean that the label must state that the poultry "was not slaughtered under inspection and is to be used for home consumption only," even though Vermont regulations only require that the label state "Exempted – 6 V.S.A., Chapter 203(sic)"[7] State inspectors also require the label to name the vendor if a mobile slaughter facility was used.

State inspectors also require the producer to keep records on the number of animals slaughtered and processed. Federal and State regulations clearly allow the farmer to sell these birds on or off the farm. Nonetheless, Vermont inspectors have been reluctant to allow off-farm sales with the exception of registered Exempt Poultry Producer being "allowed" to sell at farmer's markets.

Although federal regulations permit the sale of uninspected poultry meeting these exemptions to "household consumers, restaurants, hotels, and boardinghouses, for use in their own dining rooms, or in the preparation of meals for sales direct to consumers," the Vermont Department of Health regulations preclude sales to restaurants, hotels, and boardinghouses. Vermont Health regulations require all food service establishments to use only inspected poultry.[8]

Water Supply

In order for commercial slaughtering and processing facilities to provide meat or poultry that is clean and fit for human consumption, they must have access to potable hot and cold water including "conveniently located" sanitary facilities (i.e. toilet and washing facilities) for the inspector. Commercial facilities require permits as a "non-public" water system. In Vermont, the sanitary facilities requirement has been interpreted to mean that these facilities need to be accessed on-site. Inspectors in other states have allowed the use of farmhouse facilities for the inspector assigned to mobile slaughtering facilities.

Environmental Considerations

Slaughtering and processing facilities need to meet Vermont environmental regulations. Expansion of an existing facility or building a new facility usually will require permits related to the appropriate disposal of wastewater and solid waste. The project may also be subject to local community regulations and Act 250 (although the facility may qualify for an agricultural exemption if it is located on a farm and engaged in an "on-farm activity.")

Solid waste regulations seek to prevent or mitigate the disposal of materials that emit noxious odors and/or compromise the waters of the State. With a slaughtering facility, solid waste regulators are concerned about the proper disposal of rendered material and other residuals including hides, bones, feathers, blood, and animal fat. Much of this material may be composted on-site if the property has sufficient available land, appropriate soils and good setbacks from waterways and neighbors. When looking at the land availability,

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[6] The Poultry Products Inspection Act allows the USDA Secretary to grant an exemption to this requirement if "granting such exemption will not impair effectuating the purposes of this chapter" See §464(c)(3)(B). The mobile processing unit in Kentucky secured this exemption.

[7] Requirements as interpreted by inspectors are detailed in "Handbook for Exempt Poultry Processors" published by the Agriculture Department. The actual regulations are at Section 181.10 of Vermont State Agriculture Regulations. Reference should be to 6 V.S.A. Chapter 204 not Chapter 203.

[8] Vermont Health Regulations for Food Service Establishment, Section 5-204 X state "All meat and meat products shall have been inspected and approved by the Vermont Agency of Agriculture or the USDA." available at http://www.healthyvermonters.info/rules/03FoodServiceEstablishments.pdf.

regulators want to be certain that the footprint is large enough to accommodate the composting matter as well as any needed stockpiles of carbon materials and bulking agents and the machinery required to manage the piles.

Vermont's Solid Waste Management Rules define when certification is required. New rules that were adopted as of October 15, 2004 provide exemptions from certification[9] for on-site composting of slaughter waste in certain situations. These exemptions include:

- Farms of ten acres or more can compost up to 5 dry tons *per week* of site-generated compostable animal offal and carcasses in addition to any necessary amount of approved high carbon bulking agent up to a limit of 50 dry tons.
- Other sites that compost up to one ton *per year* of site-generated compostable animal offal and carcasses in addition to necessary bulking agents.

Operators disposing larger amounts of slaughtering waste need to file for certification of the facility and comply with the Solid Waste Management Rules.

The disposal of wastewater presents some additional considerations. If the wastewater was to drain into a municipal sewage treatment plant, it is highly probable that the treatment plant would need to request an amendment to its operating permit. Said amendment would detail the conditions or management approach required to accommodate the high nutrient value in blood waste. An alternative approach would be to compost as much blood as possible by designing appropriate drains and collection systems.

If an on-site system were to be used, an indirect discharge permit would be required unless the waste is less than 6500 gallons per day or the wastewater is afforded an agriculture exemption. This agricultural exemption is allowed for wastes generated *solely* from products or processing of materials produced on the same property.

Mobile Facilities

A mobile slaughtering or processing facility raises a number of questions in regards to required safety and environmental permits. If the facility were designed for poultry, it would need to secure an exemption from the federal requirement that the facility not be used for slaughtering or processing poultry raised by more than one person. Vermont inspectors have researched and expressed interest in the development of mobile facilities. They could provide critical guidance and support in designing the facility and securing this waiver. If farmers want the mobile facility to meet state or USDA certification, they should meet with inspectors to get clear guidance regarding the parameters for providing washroom facilities for the inspector.[10] In addition, testing of all water supplies could be required.

From an environmental permitting perspective, the facility could secure agricultural exemptions from wastewater and Act 250 permitting *IF* the facility is limited to slaughtering product produced on the farm where it is parked. As long as the amount of composted waste meets the exemption criteria listed above, the facility would also be exempt from solid waste certification. Discussions with officials at the Vermont Agency of Natural Resources (ANR) make it clear that the processing of livestock from other farms would remove the agricultural exemption. The facility would then probably require Act 250, wastewater and potable water supply permits. Permitting would then dictate the terms under which the facility could operate including waste disposal that would be trucked to an appropriate sewage treatment facility, composted and/or incinerated. If a mobile facility is contemplated, further discussions should be held with ANR in order to determine the optimum operating parameters.

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[9] See section 6-1103 of Solid Waste Management Rules at http://www.anr.state.vt.us/dec/wastediv/solid/pubs/RULESOCT1504.pdf

[10] i.e. does the facility need to incorporate a washroom or can it be provided in barn or farmhouse?

BUSINESS FEASIBILITY

MISSION

After reviewing the criteria, the Steering Committee identified their mission as follows:

> *The goal of this cooperative is to enhance the economic viability and sustainability of member farms by ensuring access to affordable, reliable and high-quality slaughtering and processing services.*

BUSINESS DESCRIPTION

The proposed corporation will be operated as a member cooperative. This means that it is designed to act on behalf of and be controlled by the livestock producers who use its services. The actual corporate organization may be a cooperative or a limited liability company.

The company will contract as a single entity on behalf of all of its customer/members for slaughtering with one or more existing slaughterhouses and either own, co-own or be actively involved in creating a new commercial fabrication facility that meets the criteria outlined by the steering committee.

PRODUCTS AND SERVICES

The Steering Committee identified the following potential products and/or services of the cooperative, in priority order:

1. Slaughterhouse services – i.e. slaughtering, processing and wrapping
2. Marketing Venue/Brand for lower quality cuts of meat - *this will require quality standards*
3. Slaughterhouse Branded Products for non-meat products e.g. smoked pig's ears/bones, blood, compost, organic lard, etc.

MARKET

The size of the market for any slaughtering facility is generally dictated by the distance farmers are willing to have their animals travel prior to slaughtering. This is impacted by the ease, duration and cost of transport as well as how the stress from travel affects the quality of the meat. Most farmers in the group preferred a distance of an hour or less although many already travel further in order to obtain the professional quality services they are seeking from their processing facility. **If the transportation issues can be resolved, the market for a quality processing and fabrication facility might be substantially larger.**

The size of the market was quantified by using 2002 Census of Agriculture data for animals sold by county. Total sales for various livestock in the region are shown in the tables below.

TABLE 2 - Livestock Sold by County

	Hogs & Pigs sold	Sheep & Lamb Sold	Milk Goats Sold	Meat & other Goats sold	Red Deer	Broilers & meat chickens sold	Turkeys sold
Addison	278	1,322	220				
Caledonia	150	405				405	90
Chittenden	873	386					
Essex		27				300	

	Hogs & Pigs sold	Sheep & Lamb Sold	Milk Goats Sold	Meat & other Goats sold	Red Deer	Broilers & meat chickens sold	Turkeys sold
Franklin	88	395				45	316
Grand Isle	16	87					
Lamoille		527					379
Orange	843	901					194
Orleans	68	389				675	137
Washington	472	226					884
Best Guess - total from 'D's'[11]	1,799	-	9	290	283	1,200	750
TOTAL SOLD IN REGION	**4,587**	**4,665**	**229**	**290**	**283**	**2,625**	**2,750**

Sales include animals sold for slaughter and consumption as well as those sold between farmers. Sales data for hogs, ruminants and poultry is likely to correlate relatively well with the number of animals slaughtered. Simple correlations are not as easy with cattle and calves, which take longer to reach maturity and are compounded by the number of dairy cattle sent to slaughter. The Vermont Department of Agriculture reported that approximately 11,000 cattle were slaughtered in inspected facilities in calendar year 2003. We have assumed that 70% of those animals were slaughtered in the 10 counties in the market area. If 25% of the *beef* cattle inventory are slaughtered each year, it becomes quite clear that the vast majority of cattle slaughtered in state are cull cows from dairy herds.

TABLE 3 - Beef Cattle Data by County

County	Beef Cattle Inventory	Est. annual slaughter - beef cattle – 30%	Estimated annual slaughter - cull cows
Addison	1,209	302	
Caledonia	530	133	
Chittenden	663	166	
Essex	169	42	
Franklin	998	250	
Grand Isle	239	60	
Lamoille	424	106	
Orange	1,247	312	
Orleans	634	159	
Washington	786	197	
TOTAL IN REGION	**6,899**	**1,725**	**5,975**

[11] Data marked as "D" in the Census tables is withheld to avoid disclosing data for individual farms. This row is estimated at 40% of the statewide total of undisclosed data.

We then estimated the percentage of the county that was in the market area if the slaughterhouse were to be locates in either Orleans (e.g. Troy) or Lamoille (e.g. Morrisville) counties. These estimates are as follows:

TABLE 4 – Percent of County in Market Area

County	Orleans County location	Lamoille County location
Addison	5%	15%
Caledonia	50%	50%
Chittenden	50%	50%
Essex	30%	10%
Franklin	70%	70%
Grand Isle	20%	40%
Lamoille	80%	100%
Orange	15%	35%
Orleans	100%	80%
Washington	60%	75%
Best Guess - total from 'D's'	40%	40%

Farmers who had already expressed an interest in the cooperative were then surveyed to ascertain the numbers of livestock they expected to slaughter and process in 2005 and thereafter. These estimates provide a way to quantify the start-up demand for a slaughterhouse in either location. These estimates also provided a way to measure the percentage of the available market that was represented by these self-identified potential members. This "start-up" customer base is shown in the following table:

TABLE 5 – Self-identified Customers for Slaughterhouse Services

Livestock	**Est. #'s for 2005**	**Orleans location**		**Lamoille location**	
		Potential # in Market	**Members as % of total**	**Potential # in Market**	**Members as % of total**
Beef	143	771	19%	887	16%
Cull Cows		2,390		2,390	
Hogs & Pigs	161	1,787	9%	2,044	8%
Sheep & Lamb	1,010	1,845	55%	2,231	45%
Milk Goats	5	15	33%	37	14%
Meat & Other Goats		116		116	
Red Deer/Beefalo	12	113		223	
BEEF Equivalents	**421**	**~1,700** w/o culls		**~2,180** w/o culls	
Chickens	2,310	1,479	156%	1,284	180%
Turkeys	171	1,566	11%	1,786	10%

Table 5 indicates that self-identified customers (i.e. potential co-op members) expect to raise about 400-425 beef equivalents (in terms of annual slaughtering and processing demand) in calendar year 2005.[12] The table also shows that potential members raise a substantial portion of the lamb and poultry that is sold in the

[12] Calculated as follows: 1 beef = 5 lambs = 2.5 hogs

region but only a nominal portion of other animals sold (and slaughtered.) This may indicate relative satisfaction with existing slaughterhouse services among beef and hog farmers or it may indicate the potential for a much larger demand for services *IF* a cooperative venture provides the service, quality and value needed by these farmers. Obviously, potential slaughterhouse revenues from lamb and poultry are substantially lower per animal than the revenues per hog or beef.

Multiplying the total numbers of each type of livestock by typical slaughter and processing fees yields a potential gross sales figure for potential members and the market in either location. Using a typical processing fee of $350 for beef, $130 for hogs (without smoking) and $60 for the small ruminants, the membership represents about $131,000 worth of business.[13] Using the same methodology, the total potential business in the region is in the range of $620,000-720,000 exclusive of cull cows. If the volume of likely cull cows is included, this amount increases by over $835,000.

EXISTING FACILITIES AND COMPETITION

General Environment

Over the time period since the group of farmers first met to consider purchasing Brault's, there have been significant changes in the meat processing industry. Reported incidents of BSE in other parts of the country led the USDA to ban the slaughter of all downer cows and added additional slaughtering protocols for beef animals older than 30 months. As a result of these changes, the market for Swanton Packing, a slaughterhouse with a capacity of about 36 cattle/day changed dramatically. Swanton's primary market had been downers and cull cows from dairy operations. The business was sold in May 2004 to new owners who operated it as Green Mountain Packing. The new owners sought to attract additional customers and identify new markets. In August 2004, the Board of Green Mountain Packing decided to terminate operations. This decision was due to ongoing management challenges including an increasingly monopolized market for cull cows that made it extremely difficult for Green Mountain Packing to source and sell product competitively.

Existing Facilities

Currently, Vermont has eight operating licensed commercial slaughterhouses and two additional licensed facilities that are idle. None provide the complete array of services – slaughter, processing, smoking, sausage links, patties and organic and USDA certification – desired by farmers. The two idle facilities are Green Mountain Packing and Bushway's in Grand Isle. Brault's Market in Troy is for sale; Moore's in St. Johnsbury was sold this past December. Other facilities in the state include Clark's in Vergennes, Fresh Farms in Rutland, Over the Hill in Benson, Royal Butcher in Braintree, Sharon Beef in Sharon and Williston Packing in St. George. All of the operating facilities except Brault's and the Royal Butcher currently have a federal license. Both expect to obtain federal certification by next year. Williston Packing is closed to new commercial accounts in the peak August-January season. Farmers in the group felt that Fresh Farms and Clark's are located too far away. Producers' experiences with some of the other operations have resulted in varied quality in terms of the appearance and presentation of the finished product and the willingness to provide specialty cuts.

Of the eight operating facilities, two are newer, smaller-scale slaughterhouses that have been constructed or significantly expanded over the past two years. Over the Hill Farm, LLC operated by John and Nancy Wing in Benson is a USDA-inspected facility with organic certification. The Wings are experienced at raising and slaughtering beef. Ryan Larocque, a former butcher and chef, operates the Royal Butcher in Braintree. Both facilities were developed with the intent of providing better quality slaughter and processing services for the beef raised by their own families as well as other customers. The auctions following the closure of Green

[13] When one considers these numbers, it is easier to understand why lamb producers are often victims of lower-quality service and rescheduling by slaughterhouse operators.

Mountain Meats and Middlebury Packing provided some of the start-up equipment needed by these new operations.

Vermont has an additional 14 licensed commercial packing plants and 21 custom packing plants. Many of the commercial packing facilities are actually specialty food processors, (e.g. Dakin's, Harrington's, Cottage St. Pasta) smokehouses or jerky makers. The custom cutters are generally butchers who process game and livestock for household use. For example, Randy Locke, a former meat inspector and freelance butcher, recently built a processing facility and smoker in Waterville. Although the facility was built to meet USDA requirements, Locke has found enough demand from non-commercial customers to operate it exclusively as a custom facility. This allows him to operate whenever he wants without worrying about needing to meet an inspector's schedule or overtime pay requirements.

Considerations for potential users include the range of services including animal pick-up and meat delivery, the quality of holding pens, the quality and appearance of the finished product, the cost of services and the distance from the farm. The following two tables detail the services, features, facilities and current costs for slaughtering and processing at each of the existing operations.

TABLE 6 – Existing Slaughterhouse Characteristics

Name	Location	Vt. Lic Commercial SH	USDA inspected	Throughput Capacity	Holding Area	Daily Kill - Beef/Pigs	Coolers	Freezer space	Pick-up animals	Slaughter	Cry-o-vac	Smoker	Retail meat counter	Sausage -making
Braults	Troy	X		40 - 60/wk	30 beef	40-60 /wk	1 hot; 1 cold	24 x 20	X	X	X	X	X	X
Clarks	Ferris-burgh	X	X	8-10 beef +20 pigs/week	30 beef	Slaughter 2 days/ week	1 hot; 1 cold	12 x 30	X	X	X			
Fresh Farms	Rutland	X	X							X				
Moore Beef	St. Johnsbury	X	X	5 beef/ day	10 beef	5 beef/day			X	X	X			
Over the Hill - Wings	Benson	X	X	20 beef/day	40 beef	20 beef or 60-80 hogs or lambs	1-12 x 24 1-24 x 24		X	X	X		X	X
Sharon Beef	Sharon	X	X							X		X		Tubes only
The Royal Butcher[14]	Braintree	X		15-20/wk	15 beef					X			X	Tubes only
Williston Packing[15]	Williston		X							X	X			Tubes only

[14] Royal Butcher is implementing plans to grow their facilities to accommodate up to 40 - 60 beef/week

TABLE 7 – Fall 2004 Slaughterhouse Prices

Name	Beef	Pork	Lamb - slaughter	Lamb - Kill, Process & Freezer Wrap	Custom - Freeze wrap/lb	Commercial/lb.	Cry-o-vac C&W /lb.	Smoking/lb. - commercial	Machine burger patties/lb	Sausage-making
Braults	$40	$35		$63[16]	.35-.45	.47	.50	.75		1.15/lb plus cry-o-vac
Clarks	$30	$25-30		$45 + $5 to bone	.35		.60			
Fresh Farms		NA	$20							
Moore Beef	$40	$30	$30	$55, if < 60#, $65 if larger		.38	.53	1.15		varies
Over the Hill - Wings	$50	$40		$60	.50		.65	.85		
Sharon Beef	$50	$40	$25+	$50	beef .50 pork .35	.55-.60		1.35		3.50/pig
The Royal Butcher	$50	$30		$65		.55				
Williston Packing	$40	$40	$30	$60	.40		.50			3.50/pig

Operational Challenges

All of the slaughterhouses visited by the steering committee experience seasonal variations in the demand for their services. The busiest months are generally from mid-August through January with significant slowdowns in May and June. Having sufficiently skilled staff in the busy months and keeping full-time staff occupied through the slower months can prove challenging for these facilities. As a result, slaughterhouses welcome arrangements that better spread the demand for services over the year.

The operation of the kill floor is highly dependent on the skill and speed of the people staffing and managing the process. In most cases, the owner of the facility is actively managing this process. Finding qualified staff remains a challenge for these operations.

Most of the facilities only slaughter animals one or two days each week. In other words, the factor that limits increased activity and sales is often the hanging and processing capacity NOT the availability of slaughtering facilities.

Although many of the State's slaughterhouses offer a meat counter, few have focused on aggressive marketing or selling their product into niche markets. If this were to change, it could create significant competition for farmers who are direct selling into these markets.

POTENTIAL OPTIONS

The group realized that purchase of an existing slaughterhouse was one of a number of options that could be considered in order to achieve their goals. Other options included building a new state of the art facility,

[15] No new commercial customers during busy season
[16] Plus 60 ¢/pound if lamb is over 60 pounds dressed

building and operating a mobile facility, building and operating a commercial processing facility, contracting as a group for services or joining with Vermont Quality Meats Cooperative (VQM) as it seeks to expand and increase its membership and supply of livestock. Each of these options is further detailed below and compared in Tables 8 and 9 beginning on page 16.

Purchasing Brault's or another slaughterhouse

Brault's is located on along Route 100 in Troy. The sale includes the 6,600 square foot building containing the slaughterhouse, meat market, smoker and all equipment as well as an adjacent 4-bedroom home and a 2-apartment building and storage garage. The asking price is $795,000. Owner Tony Brault was not prepared to release financials without some commitment of purchasing interest. Nonetheless we were able to gauge some sense of the business included a gross annual sales figure. Tony indicated that approximately 60% of his revenues are from custom work, 25% is from retail and roaster pigs and the remaining 15% is from commercial work. If these numbers are accurate, the potential membership of the cooperative represents more than 100% of Brault's commercial business but a substantially smaller percentage of his total sales.

Moore's was sold this past December to Pete and Tara Roy of North Haverhill, NH. The asking price was $235,000, for the building, processing equipment and 4 acres of land just south of downtown St. Johnsbury. Business operations at Moore's were not assessed as part of this feasibility study.

If the group was to purchase a slaughterhouse, it would need to establish a transition plan with the owner, hire new or contract with existing management, secure sufficient customers and develop new products. At Brault's the additional buildings could either be an asset (manager housing and rental income) or a liability (tenant problems.)

A cursory review of the RMA financial ratios for slaughterhouses suggests that sales are generally 2 ½ to 7 times assets. This would indicate that Brault's has the capacity to generate additional sales from its assets. A very cursory review of asking prices indicates that slaughterhouses are priced at 80-150% of gross sales.

Build a new facility

The construction of a new slaughtering and processing facility would require at least $600,000 in capital costs. This cost is based upon estimates included in a recent feasibility study conducted for the Hudson Valley and corroborated by John Wing of Over the Hill, LLC. In addition, the operation would need to secure all environmental and zoning permits and deal with all of the challenges faced by any start-up including the need to identify and secure its market and engage qualified management and staff. We question whether the potential market in the region north of Route 2 is large enough, especially in light of the existing facilities in the region, to support the construction of a new slaughter and processing facility. We would also note that the permitting process could become fairly onerous if neighbors were opposed to the idea.

Build a mobile facility

A mobile facility provides slaughtering and/or processing within the confines of a truck trailer that can be transported between farms. USDA-inspected mobile slaughtering units currently operate in Washington and central California. State-inspected poultry processing facilities are operating in Kentucky and New York. The advantage of these operations are reduced stress on the animals, reduction in transport time or cost for the farmer, the ability to dispose of wastes as part of normal "on-farm activities," and a minimal impact on neighbors.

The operation in Washington State provides slaughtering services to 36 different farms within about a 100-mile radius in four northwestern counties including the San Juan Islands. It is owned by a farmer-cooperative that also operates a stationary fabrication facility. The capital cost of just the mobile unit is approximated $120,000. Prior to the development of this facility, farmers in this region needed to drive over 200 miles through Seattle to a slaughtering plant and then transport the carcasses or primals to another facility for fabrication followed by a return trip with the wrapped product. Fall 2004 prices for slaughter were $70 for beef, $40 for hogs and $30 for lamb. Beef fees are higher than those typically charged in Vermont, while the fee for hogs and lamb compare favorably with local prices. Break-even for the facility is about 500-1,000 beef equivalents per year, depending on the particular circumstances. Designer Bruce Dunlop notes that a mobile facility makes sense if there are no other options available, noting "If there is something that is reasonably priced within two hours drive time, don't even bother with a mobile unit."[17] He also notes that it needs to be allied with a cutting facility and does not work financially as a stand-alone operation. See Appendix B – Washington Mobile Slaughtering Unit Info for more details.

The operation in Kentucky was designed to address the fact that the State had no federally inspected processing facilities that would accept poultry. As a result, farmers were unable to sell their birds commercially. This unit, which cost about $70,000, travels to about six community-docking stations around the state. Each of the stations, which cost about $20,000, provides access to water, electricity and waste disposal. Funding came from Heifer International, who still owns the units and grants. USDA provided a waiver to allow the unit to accept multiple users. The actual slaughtering and processing is handled by each farmer in collaboration with the mobile unit manager who oversees scheduling, transport, training and overall operation. The facility is also designed to accommodate processing of farm-raised shrimp.

In central New York, the Resource Conservation District helped develop a mobile unit for assisting start-up producers with processing poultry. This transportable 25' long unit was created at a cost of $3,000 plus about 70 hours of labor. It is designed to be used in an open air or tarp-covered setting. Two people can process about 20-40 birds per hour with the unit. First-year users are charged $25 for the first 100 birds and .25¢ for each additional bird plus roundtrip mileage. The fees increase by $10 and 10¢ respectively with each year of use. While this type of unit may be of value in helping a small-scale (i.e. less than 1,000 birds/year) producer initiate processing, it does not provide a long-term solution for producers seeking to grow and expand their operations. In addition, Vermont inspectors have indicated their discomfort with the open-air (aka high-fly potential) approach.

Mobile units remain a viable, albeit potentially expensive, option if existing facilities are unable to address the slaughter and processing requirements of commercial customers.

Develop commercial fabrication facility

Some of the biggest concerns facing potential members are the need for firm slaughtering dates and the desire to obtain finished product with the professional and consistent cutting, packaging and presentation that is required in specialty and niche markets. This is particularly challenging during the busy fall and winter months when a facility might bump a lamb producer in favor of a custom customer with four or five head of beef. The consensus opinion is that Vermont needs additional USDA-licensed fabrication capacity. Such a facility would only be able to assure USDA-certification if the slaughtering occurred under federal inspection. Challenges include chilled transport of carcasses, finding slaughterhouses willing to provide slaughtering without processing, finding butchers willing to staff such an operation and making certain than the final pricing is competitive. Ideally, the facility would be managed by someone with experience in food service and meat processing. This experience could potentially help farmers maximize the value of their animals by optimizing the cutting, developing value-added products such as sausages, marinated meats and products that were pre-seasoned and ready for cooking.

If space for such a facility could be leased, the major capital costs would include processing equipment and the costs associated with installing the requisite refrigeration, freezer and fabrication space as well as any needed overhead storage rails. Most slaughterhouses have a chill room (aka the "hot cooler") for reducing

[17] Phone conversation, October 5, 2004.

the body heat from freshly-slaughtered animals and a hold or sales cooler for storage of the carcasses. In order to enhance tenderness, most beef is aged at 33º for five to fifteen days, while lamb and goats should be aged for two days. Hogs are generally held for one day.

The space required for this type of facility including refrigeration and office space would be approximately 2,500 to 3,000 square feet. A USDA-prepared sample layout for a small facility is included as Appendix C. The facility would include about 1,000 square feet of chilled space (cooler, cure room and fabrication room) and another 450 square feet of freezer space including a quick freezer. A sample Capital Equipment Budget is included in Appendix D. These figures are roughly estimated – the exact requirements and costs should be recalculated for any specific situation. Total fit-up cost including refrigeration is estimated at $145,000. Total equipment costs are estimated at $75,000. Other start-up expenses are estimated at $15,000. Total estimated capital costs including a 10% contingency are estimated at about $255,000. If the site of the facility is purchased rather than leased, this would add an additional $125,000 to $200,000. Total capital costs would therefore be in the range of $380,000 to $455,000.

Operating costs would depend on staffing needs and the source of financing. A sample operating budget is provided in Appendix E. This budget assumes that the facility would capture the processing needs of all of the self-identified customers in its first year and then grow its annual capacity. The budget assumes the facility would need to borrow $200,000 for 5 years at 9%. Sources of equity are not identified. Given the identified market for its services, the facility is neither profitable nor does it cash flow in its first three years. Increased sales definitely help to improve profitability.

Co-location with a food preparation facility such as the Food Venture Center, the Farmer's Diner planned commissary or a training facility such as UVM or the New England Culinary Institute (NECI) could offer the potential for sharing some of the costs and expertise related to refrigeration, management and market and product development. Initial discussions with NECI, the Food Venture Center and the proponents of a farmer-owned milk processing facility indicated an interest in continued exploration of this idea. NECI is planning to relocate its existing meat fabrication facility on its Montpelier campus within the next year. However, the targeted new location is not large enough to accommodate co-location..

The Farmer's Diner is moving ahead with operating a food commissary/fabrication facility by the fall of 2005. Their plan is to have this facility do all of the food preparation required by their restaurants. The facility will be designed and permitted for slaughtering although they expect to limit their activities to cutting and food preparation. The facility will be modular design so that it can be expanded as needed. The Farmer's Diner is very interesting in processing for private labels and has built the offering of this service into their business plan.

Contract for services

This option meets the Steering Committee's criteria with the least amount of risk. It entails the formation of a cooperative to purchase slaughter and processing services. The underlying assumption is that larger customers get better service and prices than smaller customers. Individual farms represent from $1,500 to $40,000 worth of business per year. Pooled together, the interested farmers supporting this study represents $135,000 worth of business. Discussions with Brault's, Farmer's Diner , Moore's, Over the Hill and The Royal Butcher indicate some interest in this approach but not much concession in terms of price breaks. The slaughterhouses indicated a greater desire to work with the group if:

- It could offer a relatively steady amount of year-round business;
- Services were needed during the less busy times of year i.e. February to August;
- Producers could develop and follow a yearlong schedule;
- The slaughterhouse could deal with one person rather than each farm in terms of scheduling;

- Payment for services was promptly provided. There was a desire to be able to bill only one entity with some willingness to offer a 30-day term once the group had proved its payment ability;
- The group adopted similar labeling protocols and cutting instructions.

The idea of a partnership was generally less appealing than entering into a contract although some of the facilities were willing to look at both. The Royal Butcher was willing to consider either slaughtering or processing services. Moore's, Brault's and Over the Hill were interested in providing both slaughter and processing services. The Farmer's Diner is interested in processing, packaging and possibly, distribution.

If the group is interested in pursuing this option, further negotiations should occur with the preferred provider in order to develop specific terms for a contract.

Join with Vermont Quality Meats

Vermont Quality Meats is a farmer-owned marketing cooperative that sells pork, lamb & goat carcasses as well as sides of veal and game birds at premium prices to restaurants in New York and Boston. VQM has been operating out of the Rutland area since 1999. They currently own two high-quality refrigerated trucks that travel to Clark's slaughterhouse in Vergennes each week and to Brault's occasionally.

Some of the members of the Steering Committee have shipped to VQM and one still does so regularly. The biggest challenge to working with VQM for farmers in the northern part of the State has been transporting live animals to Rutland for slaughter. At the meeting with farmers in December 2004, VQM was present to talk about their need for additional supply. The idea of arranging for animals to be killed at a slaughterhouse in northern Vermont and then transported to Rutland for delivery to VQM's markets became increasingly attractive. Tony Brault indicated a potential interest in working with this type of scenario. Since the meeting, VQM has disclosed their intent to acquire additional storage and processing facilities, which would allow them to better accommodate this type of arrangement. Over time, they expect to develop a line of cuts with the VQM label. They would also be interested in processing for private labels.

The cost of trucking carcasses is estimated to be $10-$25/head for lambs and goats. The exact cost would be based on actual mileage, size of the animal and the number of carcasses/truckload. VQM has negotiated a $15 kill fee with Fresh Farms in Rutland. It remains to be seen if a similarly discounted fee could be negotiated at other slaughterhouses. Even with a higher slaughtering fee, the net to non-member farmers for lamb that meets VQM's quality standards would be in the range of $2.20-$2.40/pound for small lambs (dress out at under 30 pounds) and approximately $1.70-$1.90/pound for large lambs (dress out at 55 pounds or more) Mid-range sized lambs would yield about 15¢ less per pound than these amounts. These prices may be attractive to lamb farmers from northern Vermont without existing labels. This group may wish to join VQM as members or provide product as nonmembers. Regardless, negotiations should be undertaken with Brault's (and others) to make certain they are indeed willing to work with VQM and local farmers.

As part of this study, we reviewed VQM's Business Plan for its proposed expansion. In order to secure the financing that will be needed for this expansion, VQM will need to further elaborate upon its proposed new services, how it will grow its markets and detail the sources and uses of any financing.

TABLE 8 - Options for Farmers

OPTIONS	Buy Braults or other slaughterhouse	Build a state of the art slaughterhouse & processing facility	Build mobile slaughtering unit (MPU)	Build commercial fabrication shop	Contract as a group for slaughtering and processing services	Join with Vt. Quality Meats
Potential variations	buy just the business; buy another slaughterhouse		Combine with fabrication shop	Convince existing custom cut shop; Co-locate with food venture center or NECI		
Certification	Brault's has State – working to USDA, Moore's has USDA	USDA	USDA - may require exemptions	USDA	find USDA-certified	Would access USDA
Services/products offered						
Animal Transport	yes	maybe	NA	maybe	maybe	yes
Slaughter	yes	yes	yes	no	yes	yes
High end cut & wrap	maybe	maybe	maybe	yes	maybe	Promise of…
Sausage making	yes	yes	maybe	yes	yes	Promise of…
Smoking	yes	maybe	no	maybe	maybe	maybe
Delivery of finished product	maybe	maybe	maybe	maybe	maybe	yes
Considerations/Parameters						
Capital Cost	asking $795,000	600K - based on Hudson Valley estimates, confirmed @ Wings	125K - based on conversations w/ KY, WA, Ag Dept, etc.	Roughly estimated at 200-300K if space could be rented	10K to form legal structure	undetermined
Permits Required	assume none unless changes are proposed	local, Act 250, Wastewater, Composting, Labor & Industry, USDA	USDA Possibly water, wastewater, Act 250 & composting	local, wastewater, Act 250 if not in industrial park, Labor & Industry, USDA	none	
Oversight & Control	Need to determine	Need to determine	Need to determine	Need to determine	Need to determine	Members elect Board

OPTIONS	Buy Braults or other slaughterhouse	Build a state of the art slaughterhouse & processing facility	Build mobile slaughtering unit (MPU)	Build commercial fabrication shop	Contract as a group for slaughtering and processing services	Join with Vt. Quality Meats
Potential role of volunteer members or staff	Scheduling, HACCP coordination, Billing	Scheduling, HACCP coordination, Billing	Scheduling, HACCP coordination, Billing	Scheduling. HACCP coordination, Billing	Scheduling. billing	
Management	Establish transition plan, find new management	Starting from scratch - Need to hire manager who can slaughter, manage people, work with Board and build business	Starting from scratch - Need to hire manager who can slaughter, process, schedule and work with farmers, Board & temporary? staff	Starting from scratch - Need to find manager who can process meat, manage people, work with Board and build business	none	Would need to be comfortable with existing management
Personnel	will they stay or go?	Starting from scratch - can Management find the people needed?	Starting from scratch - is it the farmers or hired folks? Can you get what you need?	Starting from scratch - can Management find the people needed?	Do you need to pay someone to coordinate?	Would need to feel comfortable about existing personnel
Market for services	Existing customer base - would they stay?	Owners would probably not be enough of a market. Can you attract others?	Owners may be enough of a market.	Owners would probably not be enough of a market. Can you attract others?	not Co-op's concern	VQM is a market-driven cooperative
Product sales - aka meat counter	Existing customer base - could it be expanded?	Would need to develop the market	none	Would need to develop the market	could be competition for members	maybe
Energy Costs		Ideally, state of the art efficient equipment	Although it could be state of the art, would be hard to determine rates, etc. Would need careful consideration	Ideally, state of the art efficient equipment	not Co-op's concern	Could be an issue

OPTIONS	Buy Braults or other slaughterhouse	Build a state of the art slaughterhouse & processing facility	Build mobile slaughtering unit (MPU)	Build commercial fabrication shop	Contract as a group for slaughtering and processing services	Join with Vt. Quality Meats
Financing	not worth the asking price. If priced properly, then what?	Most expensive option	Who owns it? Grant funding? May take a LONG time to implement	Who owns it? Grant funding?	not Co-op's concern	Could be an issue but farmers will own whatever is purchased
Other benefits	Existing customer base	Creating an asset, but only has value if good management	Innovative approach may entice demo financing	Likely to be most responsive to developing new products	Minimal management required, may fit best with farmer's lives	Owned , managed and operated for and by farmers. Should be responsive to developing new products & services
Other concerns	HACCP, hidden liabilities?, competition from Green Mountain Packing, Developing appropriate incentives to attract the management you need	HACCP, Developing appropriate incentives to attract the management you need	New approach - will take a long time to permit; Wastewater issue is not insignificant, may require legislative change; Will farmers want to work in this operation? Will costs be comparable to existing slaughter/process? Cost of product liability insurance could become prohibitive	Transport of carcasses could be a hassle, HACCP, Developing appropriate incentives to attract the management you need	If selected provider opts out, raises prices or sells, are you left high and dry? If you get a bad reputation as a customer, are you left high and dry?	Transport of carcasses could be a hassle, HACCP, Highly dependent on management and how they interact with farmers and end buyers. Farmer/owners could face additional liability if company goes belly-up

TABLE 9 – Ability to Meet Criteria - measured as High, Medium & Low (high is best)

OPTIONS	Buy Braults or other slaughterhouse	Build a state of the art slaughterhouse & processing facility	Build mobile slaughtering unit (MPU)	Build commercial fabrication shop	Contract as a group for slaughtering and processing services	Join with Vt. Quality Meats
Avoid price changes	to be determined (tbd)	tbd	tbd	tbd	tbd	tbd
Avoid loss of slaughterhouse services	High	High	High	Medium	Medium	Could still lose slaughter-capacity, but gives most options to farmers
Quality professional cutting and presentation?	depends on Management	depends on Management	depends on Management	High	depends on Management	depends on Management
Consistency in packaging, appearance and sizing	High	High	tbd	High	High	High
Availability re: scheduling - Commercial customers have priority over custom customers	High	High	High	na	Medium	High
Additional capacity and facilities	Low				Low	High
Cost-effective slaughtering services for goat kids	tbd	tbd	tbd	na	tbd	Has market for goat kids – likely to consider alternative approaches
Value-added services e.g.. brand for lower quality cuts; non-meat products	High	High	Medium	High	Medium	High

OPTIONS	**Buy Braults or other slaughterhouse**	**Build a state of the art slaughterhouse & processing facility**	**Build mobile slaughtering unit (MPU)**	**Build commercial fabrication shop**	**Contract as a group for slaughtering and processing services**	**Join with Vt. Quality Meats**
Accurate labeling	High	High	High	High	Medium	High
Preserve access to slaughtering, processing and packaging services in Northern Vt. (defined as N of Re 2, S of Canada)	High	High	High	High	Medium	Medium BUT alternative approach…

RECOMMENDATIONS

Based on the information ascertained as of early March 2005, we would suggest that the following options offer the best chance for meeting the group's criteria. The options are listed in priority order. Options are not necessarily mutually exclusive. We firmly believe that additional market volume beyond the members of this group is needed in order to assure the success for any of these options. In addition, the issue of transporting livestock to slaughter and packaged product from the processing facility to customers must be addressed. Finally, some degree of grant funding or other subsidy will undoubtedly be required for these ventures to achieve financial stability.

1) Work with Vermont Quality Meats to transport and market roaster pigs, lamb and goat carcasses as well as beef and pork cuts from northern Vermont to VQM's existing and proposed customers. Achieving this will require the following:
   a) Collaboration among northern Vermont farmers to arrange for delivery of live animals to specified slaughterhouses at pre-determined times.
   b) Negotiating with Brault's and/or other slaughterhouses to make certain that:
      i) They are USDA-certified;
      ii) They are willing to provide slaughtering services without associated processing;
      iii) Pricing is competitive;
      iv) Services will be available at the proscribed times.
   c) Consider using VQM trucks to back-haul processed products from slaughterhouses to northern farmers.

2) Join Vermont Quality Meats and encourage them to develop, contract for and/or manage farmer-owned processing services for their members.

3) Contract for transport, slaughtering and processing as a group – this provides greater purchasing power but does not guarantee access to services or long-term viability. Costs might be reduced if the group can develop online scheduling arrangements and/or consistency in package labeling. The anticipated permanent rise in fuel costs will require more collaborative and creative solutions to address the challenges of transporting livestock and finished product.

4) Contract individually with existing slaughterhouses and/or Farmer's Diner. Continue to support and encourage those facilities that provide high-quality cutting and packaging services.

5) Partner with another entity to develop and operate a commercial fabrication facility. We have assumed that this approach would bring additional market volume and expertise.

6) Once processing services have been addressed, farmers may want to revisit the idea of owning a mobile slaughter facility.

7) Support education, demonstration and technical assistance efforts that help to mitigate the seasonal nature of Vermont's livestock industry. This includes developing niche markets such as spring lambs and summer roaster pigs that make use of excess processing capacity in the slower seasons and the development of feasible business plans for operations that utilize year-round processing and marketing.

8) Continue to monitor emerging developments resulting from the RBEG-funded AAFM program providing technical assistance to Vermont's meat processors, the Organic Meat Company's efforts to process cull cows from organic dairies and the Food Venture Center's activities to address the shortage of USDA-licensed meat processing capacity in northern Vermont.