Appendix A.
Statistical Methodology

THE SURVEY POPULATION

Sample Design

The target population for the 2018 Irrigation and Water Management Survey was composed of all farms irrigating in the reference year of 2018. From the 2017 Census of Agriculture, 198,368 records were identified as belonging to the general U.S. irrigation population on the basis of having irrigation activity on their farm or ranch. The target population was expanded to include any operations that had irrigated land in the past five years. Institutional, research, and experimental farms were excluded from the total number of irrigators that reported in the 2017 census.

The sample was drawn at a State level for all 50 States. This sample design targeted a U.S. level sample size of 35,000. A certainty stratum, with farms selected with probability one, was included for each State to ensure that the major irrigators in each State were sampled. The remaining strata were sampled systematically by irrigated acreage. The stratification boundaries varied among the States and were dependent on the distribution of total acres irrigated within the State. The stratified design ensured that the sample was reflective of the survey population and achieved the appropriate coefficients of variation (CV) levels at both the U.S. and State levels.

The final national sample size was 34,783 farms; 1,340 of these farms were selected from the certainty strata and the remaining 33,443 farms were systematically selected from the noncertainty strata. Table A provides the State sample counts for the survey, including acres associated with those counts, final reports processed and tabulated both unexpanded and expanded, and 2017 census counts.

DATA COLLECTION

Method of Enumeration

The 2018 Irrigation and Water Management Survey was conducted using multiple data collection strategies. Data were collected by mail, Computer-Assisted Web Interviewing (CAWI) via the Internet, telephone enumeration, and personal enumeration. Enumeration methods used in the 2018 survey were similar to those used in the 2013 survey.

Report Form

A single 20-page report form was used for the survey, similar to the 2013 report form. The report form was mailed to all the producers in the sample that reported irrigation in the 2017 Census of Agriculture. See Appendix B for copies of the report form and instruction booklet and information regarding changes between the 2013 and 2018 report forms.

Report Form Mailings and Respondent Follow-up

The initial mailout took place in February 2019. Mail packets were mailed to 34,783 irrigators. The initial mail packets included a labeled report form, an instruction booklet, an instruction letter, and a return envelope. Mailout packet preparation, initial mailout, and one follow-up mailing to nonrespondents were handled by the U.S. Census Bureau's National Processing Center (NPC) in Jeffersonville, IN. Telephone follow-up from a NASS Data Collection Center began April 2019 to nonrespondents who were mailed a report form from NPC.

Data were collected for a select group of operations by the NASS regional field offices. To minimize the number of agency contacts, operations were included in this group if they were scheduled for contact by

NASS for other agricultural surveys. Report forms were labeled at NPC and sent to the regional field offices in November 2018. Regional field office staff collected data by personal enumeration or by phone from February 2019 through May 2019. For a description of the adjustment for nonresponse, see Estimation.

REPORT FORM PROCESSING

Data Capture

All report forms returned to NPC were immediately checked in, using bar codes printed on the mailing label, and removed from follow-up mailings. All report forms were reviewed prior to data keying to identify inconsistencies and to ensure that the data could be keyed. Major inconsistencies, respondent remarks, blank report forms, and large irrigation cases were reviewed by analysts and adjusted prior to data keying as needed. All forms with any data were scanned and an image was created for each page of a report form.

Data Editing and Analysis

Data from each report form were processed through a computer edit which flagged missing or inconsistent entries. Each report with a flagged entry was reviewed by regional field office and/or headquarters statisticians. Action was required for any record with reported data that were clearly incorrect, for example, in some cases, respondents may have failed to provide all of the information requested, only indicating the presence of an item but not the amount. These items were tagged for machine imputation. After the initial edit, an imputation program supplied missing data and made adjustments based on responses of similarly sized farms within the same geographic area. Data entries by the computer edit process were reviewed and verified by analysts. Instances where imputed data failed edit checks were referred to statisticians for corrective action. The computer edit ensured the data on a report form were internally consistent.

Prior to publication, tabulated totals were reviewed to identify and resolve remaining irregularities. Comparisons were made with 2017 census data, 2013 Farm and Ranch Irrigation Survey data, and other available check data. The data were processed through a disclosure program to prevent data from being published that could be sourced back to an individual operation.

Imputation

Many data items in the 2018 Irrigation and Water Management Survey used nearest neighbor hot-deck imputation. Records were sorted by State and strata to increase likelihood that the nearest neighbor donor record was within the same State and stratum as the recipient record. Some exceptions are described below.

- Imputation for items related to ground water from wells used a combination of techniques to maintain relationships between other items in the record. Based on available data, imputation techniques were prioritized as listed directly below:
  - Other data in the record that referenced the same well.
  - Other wells on the same farm.
  - Nearest neighbor hot-deck imputation (accounts for missing information from similar records in the same data set).

- Imputation for items related to acres harvested in the open and pastureland was based on ratios created at the State by stratum level, State level, and U.S. level using good donor records.
  - Priority was given to the ratio based on the most similar contributors when there was a sufficient number of donors (i.e., first same State by stratum).

- Imputation for sections that required categorical or yes/no responses was based on the distributions of farms that responded to the item.

Items that were imputed:

- Quantity of water applied;
- Well and pump characteristics;
- Energy costs of well pumps;
- Individual crop yields and quantity of water used;
- Horticulture water sources and methods; and
- Acres associated with expenditures, maintenance, and repair costs.

ESTIMATION

Data were summarized for the Nation as a whole, for

each of the 50 States, and for the geographic domains known as Water Resources Regions (WRR) (see Appendix B for a detailed description). The estimation methodology consisted of two weighting components that made up the total survey weight. The first component was the fully adjusted weight pulled in from the 2017 Census of Agriculture. This weight accounted for any list incompleteness and undercoverage from the 2017 census. The second component was the sampling rate used for the 2018 Irrigation and Water Management Survey. This expansion factor was the inverse of the selection probability for the sample farms in a stratum. This expansion factor was reweighted at the stratum level to account for whole-farm nonresponse. The nonresponse adjustment factor used to reweight the expansion factor was the ratio of the number of sample farms in a stratum to the number of sample farms that responded to the survey in that stratum. The assumption underlying this weighting approach to survey nonresponse was that survey respondents and nonrespondents within a stratum constitute a homogeneous population, thus allowing respondents to represent nonrespondents. An expanded data value for a sample record was obtained by multiplying the data value by the total 2018 Irrigation and Water Management Survey weight. State totals for a characteristic were estimated by summing the expanded data values from all responding sample records across all strata within the State. National estimates were obtained by summing across all States. The WRR estimates were obtained by summing the expanded data values for the portion of the sample falling into the WRR.

RESPONDENT CONFIDENTIALITY

In keeping with the provisions of Title 7 of the United States Code, no data are published that would disclose information about the operations of an individual farm or ranch. All tabulated data are subjected to an extensive disclosure review prior to publication. Any tabulated item that identifies data reported by a respondent or allows a respondent's data to be accurately estimated or derived, was suppressed and coded with a 'D'. However, the number of farms reporting an item is not considered confidential information and is provided even though other information is withheld.

DATA COMPARABILITY

The report form for the 2018 Irrigation and Water Management Survey was very similar to the report form for the 2013 Farm and Ranch Irrigation Survey. Only a small number of questions were either split, dropped, or reworded. The data are mostly comparable between 2013 and 2018. There are slight differences due to the target population now including those who irrigated in the past five years instead of just those who had irrigated the prior year. However, the population they represent is still the same, which is all active irrigators in 2018 in the U.S.

The differences between the 2018 Irrigation and Water Management Survey and the 2013 Farm and Ranch Irrigation Survey are as follows:

- Number of hours pumps were operational during the survey year was removed from 2018.
- Horticulture in the open was recorded under Other cropland during 2013 while it was recorded as its own commodity during 2018. Therefore, Other cropland is not comparable between 2018 and 2013.

Differences exist between the expanded results of the 2018 Irrigation and Water Management Survey and the published data from the 2017 Census of Agriculture. Some of these are as follows:

1. The survey includes data only for operations that irrigated sometime between 2013 and 2017 and 2018. Operations in some areas, especially the eastern States, may irrigate only when moisture is needed. Operations with irrigation capabilities may not irrigate depending on the amount of rainfall for a particular year or geographic area. The number of operations that irrigated in 2017 but discontinued irrigation in 2018 is tabulated in Table 27 for all farms and in Table 44 for horticultural operations by reason of discontinuance.

2. Some producers reported that they had been misclassified as irrigators and did not irrigate in either 2017 or 2018. Operations which indicated they had not irrigated in 2017 but had in the past five years were not counted as misclassified. In addition to errors in processing census data, some producers misreported or misinterpreted the questions. Most of the producers misreporting irrigation in the 2017 census reported irrigation of

small acreages of vegetables, fruits and nuts, tobacco, field crops, or berries.

3. Some respondents indicated they had retired, moved, sold or rented the land, etc., since 2017. These operations were dropped from processing because they were no longer farming. Special care was taken with large operations to ensure that they were not erroneously dropped due to reorganization or name change rather than discontinuing agricultural operations.

4. New irrigators in 2018 (not included in the 2017 census) did not have a chance for selection in the sample and, therefore, were excluded from the survey. It is believed that the impact of new irrigators is probably minimal. This conclusion is supported by comparisons between the 2012 and 2017 Censuses of Agriculture irrigation data which show little change in irrigated acres.

Table B shows acres irrigated in the 2018 survey (expanded) compared with U.S. totals from the 2017 Census of Agriculture. The expanded survey accounts for 96.4 percent of all land reported as irrigated in the 2017 census and all irrigation characteristics associated with that land.

MEASURES OF SURVEY QUALITY

The statistics in this report are estimates derived from a sample survey. There are two types of errors possible in an estimate-based sample survey: sampling and nonsampling. Sampling errors are caused by observing only a piece of the population instead of the entire population. These errors are subject to sample-to-sample variation. Nonsampling errors include all other errors and can arise from many different sources. These sources may include respondent error, enumerator error, or incorrect data keying, editing, or imputing for missing data. Nonsampling error due to mail list incompleteness and duplication, as well as misclassification of records on the mail list, is referred to as coverage error.

Undercoverage existed in the frame population to the extent that there were irrigated farms that either erroneously reported they were not irrigating on the 2017 census, started irrigating in 2018, or had succeeding irrigators in 2018 (i.e., a producer who, since 2017, took control of an existing irrigating farm through sale, rental, or other arrangement).

Overcoverage also existed in the frame because some operations were misclassified as irrigators and did not irrigate in 2017 or had either stopped farming or irrigating in 2018. Farms in the sample that fell into these groups were identified during the survey and estimates are provided covering their number and acres irrigated in the Data Comparability section, items 2 and 3.

Survey Response Rate

The response rate is an indicator of the quality of data collection. It is generally assumed that if a response rate was close to 100 percent, the potential for nonresponse bias is small. Because this survey contains both farm and nonfarm records, the response rate is an indicator of replying to the survey data collection effort, but does not reflect whether those responding met the farm definition or had the items of interest for the survey. The response rate for the 2018 Irrigation and Water Management Survey is 64.4 percent. This compares to 69.8 percent for the 2013 Farm and Ranch Irrigation Survey.

MEASURES OF PRECISION

Under the guidance of the Statistical Policy Office of the Office of Management and Budget (OMB), the U.S. Department of Agriculture's National Agricultural Statistics Service (NASS) provides data users with quality metrics for its published data series. The accuracy of data products may be evaluated through sampling and nonsampling error. The measurement of error due to sampling in the current period is evaluated by the coefficient of variation (CV) for each estimated item. Nonsampling error is evaluated by response rates and the percent of the estimate from respondents.

Coefficient of variation is a measure of the relative amount of error associated with a sample estimate. Specifically, it is the standard error of a point estimate divided by that estimate, generally multiplied times 100 so that it can be reported as a percentage. This relative measure allows the reliability of a range of estimates to be compared. For example, the standard error is often larger for large population estimates than for small population estimates, but the large

population estimates may have a smaller CV, indicating a more reliable estimate. Every estimate for the 2018 Irrigation and Water Management Survey has a corresponding CV published with it. NASS has identified the following index to use when evaluating coefficient of variation for the 2018 Irrigation and Water Management Survey. The coefficient of variation is used as an indicator of the precision in the survey estimates and is reported for major survey items in Table C and Table D.

- **Low Reliability Estimate.** Coefficient of Variation (CV) 30 percent or higher. Caution should be used when using this estimate in any form. Please consult NASS for more information or guidance.

- **Medium Reliability Estimate.** Coefficient of Variation (CV) between 15 percent and 29.9 percent

- **High Reliability Estimate.** Coefficient of Variation (CV) less than 15 percent.

Table A. **Irrigated Farms: 2018 Irrigation and Water Management Survey and the 2017 Census of Agriculture**

Geographic area	2018 Irrigation and Water Management Survey						2017 Census of Agriculture			
	Sample count		Final reports processed and tabulated				Published totals		Sample universe [1]	
			Unexpanded		Expanded					
	Farms	2017 census irrigated acres	Farms	Acres irrigated	Farms	Acres irrigated	Farms	Acres irrigated	Farms	Acres irrigated
United States	34,783	21,955,328	17,177	13,126,383	231,474	55,938,795	294,235	58,013,907	198,368	43,988,618
Alabama	254	65,832	119	54,611	1,069	163,338	1,891	142,001	1,372	121,835
Alaska	155	1,676	86	1,285	308	1,721	377	2,400	417	1,923
Arizona	560	435,419	262	324,665	3,054	945,570	4,808	910,883	2,517	758,535
Arkansas	1,838	2,665,768	777	1,483,354	3,173	4,246,491	4,475	4,855,143	3,500	3,858,092
California	4,661	3,400,265	2,583	1,986,818	42,093	8,408,282	52,362	7,833,593	31,307	6,199,928
Colorado	1,587	771,802	858	420,440	14,529	2,458,742	17,162	2,761,173	10,969	1,986,872
Connecticut	137	4,503	54	2,916	669	6,104	998	7,376	656	6,144
Delaware	129	76,545	74	53,139	521	201,305	612	163,255	432	125,185
Florida	954	958,264	433	719,122	7,615	1,331,739	11,228	1,519,379	7,240	1,385,135
Georgia	691	361,308	273	223,742	3,861	1,163,038	6,191	1,287,541	4,608	928,480
Hawaii	298	35,783	152	14,753	1,863	26,700	2,250	45,452	1,482	46,616
Idaho	1,821	1,594,524	1,077	924,795	14,867	3,393,063	15,597	3,398,266	9,353	2,609,651
Illinois	329	176,359	177	138,682	1,807	566,024	2,541	612,459	2,156	518,603
Indiana	359	128,509	210	106,079	2,039	582,661	2,836	555,443	2,268	449,277
Iowa	207	59,199	106	41,334	1,061	166,193	1,707	221,986	1,409	173,060
Kansas	781	781,207	393	500,357	4,249	2,386,816	5,141	2,503,386	3,904	1,887,854
Kentucky	355	55,601	150	34,914	1,188	58,234	2,030	83,859	1,834	78,189
Louisiana	542	350,475	185	188,810	1,862	1,072,033	3,102	1,235,752	2,371	899,045
Maine	254	27,174	138	23,136	990	35,695	1,420	32,312	877	30,154
Maryland	208	52,377	117	43,011	959	125,024	1,318	124,831	1,108	103,414
Massachusetts	183	9,311	85	6,747	1,335	19,311	1,696	23,928	1,193	18,705
Michigan	541	270,615	286	207,528	3,886	827,010	5,153	670,212	4,007	567,014
Minnesota	412	191,907	219	118,184	2,367	554,605	3,220	611,621	2,364	475,393
Mississippi	825	933,666	305	506,650	1,621	1,667,023	2,561	1,814,548	1,776	1,477,133
Missouri	805	596,492	375	272,957	2,705	1,429,074	3,523	1,529,155	2,922	1,178,685
Montana	1,020	617,118	570	329,705	8,887	2,140,162	9,941	2,061,236	6,564	1,434,050
Nebraska	2,391	2,312,733	1,064	1,087,187	13,013	7,666,152	16,112	8,588,389	10,871	5,711,548
Nevada	294	336,827	184	218,825	1,857	693,520	2,217	790,425	1,293	597,082
New Hampshire	110	953	61	923	731	3,218	618	2,207	407	1,573
New Jersey	273	51,621	142	36,452	1,585	89,941	1,980	86,819	1,619	78,259
New Mexico	682	220,119	374	175,993	10,093	675,330	10,745	626,034	5,652	483,785
New York	351	22,509	153	17,213	2,148	47,974	3,285	53,257	2,548	43,213
North Carolina	461	44,220	181	24,784	2,451	132,870	3,708	143,444	3,085	121,274
North Dakota	119	81,205	57	57,552	720	297,001	764	263,885	581	196,328
Ohio	382	29,036	168	17,361	1,601	39,258	2,935	50,665	2,412	44,666
Oklahoma	370	219,387	163	169,011	1,835	601,492	2,668	573,776	2,144	432,749
Oregon	1,667	654,725	875	371,957	13,794	1,579,108	16,291	1,664,921	11,417	1,378,226
Pennsylvania	469	11,612	216	9,087	2,766	40,596	3,904	32,139	3,026	24,177
Rhode Island	107	2,215	48	1,945	227	3,231	234	2,956	169	2,618
South Carolina	274	74,563	129	73,298	1,489	252,720	2,167	210,437	1,597	161,606
South Dakota	191	109,871	95	63,391	1,219	378,413	1,798	492,452	1,221	314,483
Tennessee	279	82,970	125	57,030	1,452	190,746	2,011	184,899	1,930	156,912
Texas	2,334	1,347,636	917	804,535	11,997	4,085,754	17,932	4,363,345	13,366	3,068,226
Utah	924	212,392	562	136,503	12,575	1,181,700	13,159	1,097,219	7,787	780,765
Vermont	153	1,950	87	1,041	573	3,022	672	3,017	439	2,412
Virginia	251	28,050	101	16,090	1,377	48,248	2,053	63,433	1,751	54,113
Washington	1,646	761,415	798	600,521	11,259	1,866,110	14,887	1,689,377	9,314	1,423,352
West Virginia	106	529	43	1,326	482	6,525	581	1,660	541	1,140
Wisconsin	403	186,494	205	190,679	2,127	518,312	3,284	454,362	2,686	418,657
Wyoming	640	540,597	365	265,945	5,525	1,561,596	6,090	1,567,599	3,906	1,172,482

[1] Excludes institutional, research, and experimental farms.

Table B. **Farms with Irrigation by Acres Irrigated: 2018 Irrigation and Water Management Survey compared with 2017 Census of Agriculture**

Item	2017 Census of Agriculture United States totals	2018 Irrigation and Water Management Survey		Item	2017 Census of Agriculture United States totals	2018 Irrigation and Water Management Survey	
		United States totals (expanded)	Percent of 2017 Census of Agriculture totals			United States totals (expanded)	Percent of 2017 Census of Agriculture totals
Farms ..... number	294,235	231,474	78.7	200 to 499 acres .....farms	26,787	24,749	92.4
acres	58,013,907	55,938,795	96.4	acres	8,390,366	7,669,292	91.4
1 to 49 acres .....farms	191,649	136,429	71.2	500 to 999 acres .....farms	15,172	13,790	90.9
acres	1,777,418	1,535,201	86.4	acres	10,507,125	9,503,359	90.4
50 to 99 acres .....farms	22,629	19,825	87.6	1,000 to 1,999 acres .....farms	9,285	9,170	98.8
acres	1,568,582	1,383,478	88.2	acres	12,575,750	12,245,392	97.4
100 to 199 acres .....farms	23,452	22,259	94.9	2,000 acres or more .....farms	5,261	5,252	99.8
acres	3,208,908	3,026,351	94.3	acres	19,985,758	20,575,722	103.0

Table C. **Coefficient of Variation (percent) for Selected General Irrigation Data: 2018**

[Excludes institutional, research, and experimental farms and farms with horticulture. For meaning of abbreviations and symbols, see introductory text.]

Geographic area	Irrigated farms	Land in farms	Acres irrigated		Acre-feet applied	Energy expense for pumps	Expenditure expenses	Pumps, all types	Well pumps
			Total	Cropland harvested in the open					
United States	0.7	3.4	1.7	1.5	2.4	2.6	5.6	1.6	2.0
Alabama	7.3	14.5	16.0	16.1	24.0	28.2	43.3	13.0	(D)
Alaska	8.5	24.6	40.0	45.6	60.9	29.1	39.9	15.2	19.3
Arizona	3.3	21.7	11.4	11.9	13.8	24.9	27.2	16.9	20.2
Arkansas	2.3	3.2	3.6	3.7	4.7	6.5	28.9	4.6	4.5
California	1.2	10.9	5.2	4.1	5.6	4.0	10.3	3.2	3.2
Colorado	1.9	15.0	5.6	5.6	6.0	8.9	21.4	7.5	7.0
Connecticut	13.8	25.1	19.8	26.6	27.8	40.5	28.1	19.3	19.0
Delaware	7.4	19.3	13.7	13.8	19.8	61.1	43.4	13.0	12.7
Florida	3.7	23.3	12.3	13.1	13.0	9.7	22.7	6.9	7.5
Georgia	4.9	10.6	6.5	6.5	11.9	10.7	27.5	8.0	6.9
Hawaii	6.6	50.6	23.6	28.5	31.4	26.4	21.4	29.5	(D)
Idaho	1.9	9.6	5.7	5.1	6.6	6.1	23.2	3.6	6.5
Illinois	6.4	17.5	7.4	7.4	8.3	12.1	28.2	5.5	4.8
Indiana	5.7	9.7	7.0	7.0	11.8	12.2	49.2	9.4	10.7
Iowa	9.7	18.3	13.8	13.8	14.3	25.2	33.5	9.2	13.7
Kansas	3.3	6.7	4.0	4.1	5.6	6.4	16.9	4.7	4.8
Kentucky	10.9	17.3	14.2	14.4	11.5	18.2	34.5	17.6	15.4
Louisiana	5.7	8.9	7.7	7.9	12.5	15.2	32.0	9.3	9.2
Maine	12.1	30.1	24.0	20.4	28.2	26.0	35.8	5.7	10.3
Maryland	8.5	14.0	11.0	11.1	18.5	17.7	31.6	12.0	14.5
Massachusetts	7.3	23.4	15.6	17.6	28.6	30.9	42.2	11.5	20.3
Michigan	4.1	10.2	8.4	8.7	8.4	9.0	25.0	7.5	(D)
Minnesota	6.7	7.6	7.0	7.0	8.9	10.3	26.9	7.1	7.5
Mississippi	5.0	7.0	6.6	6.6	6.7	10.7	19.3	7.4	7.1
Missouri	3.3	5.6	5.7	6.1	8.0	10.3	18.7	7.5	7.3
Montana	3.7	13.4	5.1	4.9	8.4	6.4	28.4	9.4	15.4
Nebraska	2.1	5.3	2.4	2.3	3.3	3.4	12.3	1.9	2.3
Nevada	5.8	30.4	4.9	5.7	5.3	14.9	20.3	8.4	8.9
New Hampshire	8.5	21.5	25.0	25.7	35.4	34.1	44.6	19.8	24.6
New Jersey	6.2	14.6	6.7	6.7	10.3	14.3	46.5	6.9	(D)
New Mexico	2.9	38.7	10.5	14.1	14.7	16.1	23.4	6.6	7.1
New York	8.7	16.0	15.6	15.5	27.1	20.0	35.3	9.8	14.0
North Carolina	10.3	37.2	37.8	39.9	25.9	36.8	43.3	15.3	13.0
North Dakota	10.9	20.6	14.8	14.8	20.2	24.7	43.2	19.1	20.4
Ohio	9.6	17.8	10.7	11.6	13.1	12.8	42.4	11.6	14.8
Oklahoma	7.8	19.5	12.9	11.8	11.4	15.6	38.1	13.7	14.7
Oregon	2.4	14.2	6.3	7.2	7.0	7.2	9.2	3.8	6.7
Pennsylvania	5.1	8.3	37.0	40.2	76.1	23.1	67.6	8.4	8.4
Rhode Island	17.1	29.8	29.7	31.0	28.2	25.2	42.3	20.4	23.3
South Carolina	7.7	19.6	18.7	19.0	15.1	22.8	38.0	13.3	15.2
South Dakota	11.2	23.1	11.8	11.1	17.9	10.3	37.0	13.0	20.1
Tennessee	12.5	17.6	16.6	16.7	18.8	10.2	48.1	10.3	13.5
Texas	3.4	7.8	4.9	4.8	5.9	7.9	10.8	8.6	8.7
Utah	2.6	18.1	7.1	8.0	6.1	13.7	25.0	7.9	17.6
Vermont	16.4	28.0	16.2	20.8	33.6	29.4	33.8	20.9	22.3
Virginia	9.0	15.6	14.3	14.5	13.8	14.5	47.1	8.7	11.4
Washington	3.0	20.1	7.4	7.1	7.4	8.8	19.2	7.9	6.8
West Virginia	17.2	40.7	87.1	91.6	79.3	44.1	69.1	26.9	27.1
Wisconsin	4.1	11.0	9.4	9.4	16.5	13.4	26.3	9.3	10.6
Wyoming	3.6	11.2	6.4	5.8	7.8	15.1	28.2	9.1	17.6
Water Resources Regions									
Region 01 New England	5.5	12.5	9.6	8.5	12.6	16.9	17.8	7.6	10.4
Region 02 Mid-Atlantic	3.3	9.2	6.7	6.9	14.8	25.8	26.0	4.9	5.7
Region 03 South Atlantic-Gulf	2.1	10.4	4.8	5.1	7.6	6.5	16.4	4.4	4.4
Region 04 Great Lakes	3.2	6.6	8.3	8.5	7.3	8.0	20.2	4.7	6.6
Region 05 Ohio	7.5	12.5	14.4	14.2	21.1	18.2	25.0	10.7	15.2
Region 06 Tennessee	13.7	22.2	25.4	25.6	31.6	22.9	43.8	11.9	13.3
Region 07 Upper Mississippi	3.5	6.4	6.1	6.1	8.6	6.9	17.7	5.5	5.5
Region 08 Lower Mississippi	3.8	3.8	3.9	3.9	3.9	5.7	11.5	3.4	3.1
Region 09 Souris-Red-Rainy	12.2	22.5	20.3	20.4	19.9	20.6	49.1	18.9	(D)
Region 10 Missouri	2.1	6.0	2.3	2.4	2.8	3.4	11.2	2.7	2.9
Region 11 Arkansas-White-Red	4.9	9.0	3.6	3.3	4.5	5.3	19.8	2.5	2.8
Region 12 Texas-Gulf	2.9	9.9	4.1	4.7	7.0	8.1	12.6	11.2	11.4
Region 13 Rio Grande	3.8	33.6	10.9	11.3	9.3	9.1	17.1	9.8	11.5
Region 14 Upper Colorado	3.3	14.5	8.5	6.7	9.1	30.2	26.1	12.2	(D)
Region 15 Lower Colorado	5.4	26.1	10.8	11.3	13.7	23.3	22.0	15.1	17.8
Region 16 Great Basin	3.6	14.8	5.6	6.0	5.2	9.2	26.1	9.3	10.2
Region 17 Pacific Northwest	1.9	7.8	3.3	2.7	3.4	3.9	10.7	2.1	3.4
Region 18 California	1.3	10.8	5.4	4.4	5.9	4.1	10.4	3.2	3.2
Region 19 Alaska	8.5	24.6	40.0	45.6	60.9	29.1	39.9	15.2	19.3
Region 20 Hawaii	6.6	50.6	23.6	28.5	31.4	26.4	21.4	29.5	(D)

Table D. **Coefficient of Variation (percent) for Selected Horticultural Irrigation Data: 2018**

Geographic area	Irrigated horticultural operations	Irrigated area	
		Acres in the open	Square feet under protection
United States	1.2	5.8	8.4
Alabama	9.7	24.2	32.7
Alaska	11.1	18.7	29.2
Arizona	26.0	32.7	41.1
Arkansas	13.0	39.2	44.1
California	3.9	27.9	19.3
Colorado	7.0	20.7	29.3
Connecticut	14.2	34.0	38.8
Delaware	11.3	58.2	43.3
Florida	5.3	7.4	27.2
Georgia	11.5	21.0	25.8
Hawaii	14.1	26.0	28.8
Idaho	13.3	29.1	19.8
Illinois	9.8	26.8	61.4
Indiana	7.8	36.8	21.1
Iowa	13.5	40.6	21.3
Kansas	16.6	59.6	41.9
Kentucky	14.1	57.1	23.1
Louisiana	11.4	50.3	38.6
Maine	20.3	68.2	47.9
Maryland	10.9	22.7	26.9
Massachusetts	10.5	21.7	26.0
Michigan	9.0	22.2	39.9
Minnesota	8.0	34.7	22.3
Mississippi	7.8	49.6	18.4
Missouri	7.5	28.7	21.9
Montana	18.2	48.2	29.1
Nebraska	8.7	38.2	31.1
Nevada	24.9	70.8	41.6
New Hampshire	17.7	45.5	31.7
New Jersey	9.2	10.9	36.9
New Mexico	16.6	50.3	37.2
New York	9.0	23.8	32.0
North Carolina	9.0	26.1	28.2
North Dakota	29.7	(D)	44.0
Ohio	10.2	34.9	34.5
Oklahoma	17.0	19.0	35.4
Oregon	7.1	14.0	21.9
Pennsylvania	5.0	23.5	23.5
Rhode Island	21.7	36.0	22.0
South Carolina	15.3	21.2	34.6
South Dakota	12.9	74.8	67.6
Tennessee	15.6	34.9	20.0
Texas	8.5	27.3	44.1
Utah	20.4	40.7	23.0
Vermont	20.8	29.3	33.4
Virginia	9.4	36.7	16.7
Washington	8.1	13.2	30.4
West Virginia	17.7	49.5	39.6
Wisconsin	6.0	35.5	13.3
Wyoming	37.7	(D)	49.9
Water Resources Regions			
Region 01 New England	9.3	23.9	23.4
Region 02 Mid-Atlantic	4.7	12.5	17.1
Region 03 South Atlantic-Gulf	2.6	5.1	22.2
Region 04 Great Lakes	4.5	24.7	24.5
Region 05 Ohio	9.7	28.0	17.3
Region 06 Tennessee	17.7	31.5	36.4
Region 07 Upper Mississippi	6.0	18.0	38.9
Region 08 Lower Mississippi	14.2	28.3	31.2
Region 09 Souris-Red-Rainy	37.2	50.2	46.9
Region 10 Missouri	5.2	13.3	19.2
Region 11 Arkansas-White-Red	13.6	19.1	16.7
Region 12 Texas-Gulf	10.1	27.6	50.5
Region 13 Rio Grande	16.5	42.6	96.8
Region 14 Upper Colorado	18.0	41.1	36.5
Region 15 Lower Colorado	29.7	34.5	40.1
Region 16 Great Basin	13.7	27.3	23.0
Region 17 Pacific Northwest	6.4	8.3	22.4
Region 18 California	3.8	28.2	19.0
Region 19 Alaska	11.1	18.7	29.2
Region 20 Hawaii	14.1	26.0	28.8