Appendix A.
Statistical Methodology

THE SURVEY POPULATION

Sample Design

The target population for the 2008 Farm and Ranch Irrigation Survey (FRIS) was composed of all farms irrigating in the reference year 2008. From the 2007 Census of Agriculture, 217,604 records were identified for the U.S. level FRIS population on the basis of having irrigation activity on their farm or ranch. This excluded 1,063 institutional, research, or experimental farms from the total number of irrigators that reported in the 2007 census.

The population was divided into two groups. The first group consisted of all 32,568 operations that reported any sales of irrigated horticultural commodities. The remaining 185,036 operations comprised the general FRIS group. Each record in both sub-groups was assigned to a specific strata based on acres or area irrigated.

For the general FRIS sample, a State level sample was drawn for all 50 States. This sample design targeted a U.S. level sample size of 25,000. A certainty stratum, with farms selected with probability one, was included in each State to ensure that the major irrigators in each State were sampled. The remaining strata were sampled systematically by acreage. The stratification boundaries varied among the States and were dependent on the distribution of total acres irrigated within the State. A final sample of 23,089 operations was selected. The stratified design ensured that the sample was reflective of the general FRIS sub-population and achieved the appropriate coefficients of variation (CV) levels at both the U.S. and State levels. The stratified design also incorporated an allowance for the expected national response rate of 70 percent.

The horticulture sample was also drawn from a stratified design in all 50 States. The stratified design targeted a U.S. level sample size of 10,000. There were two certainty strata, with farms selected with probability one, included in each State to ensure that the major irrigators with horticultural activity in each State were sampled. The remaining strata were sampled systematically by acreage. The stratification boundaries were consistent across all States and were dependent on the distribution of horticulture irrigated within the State. A final sample of 9,996 operations was selected. The design ensured that the horticulture sample was reflective of the general horticulture population.

The final national sample size was 33,085 farms; 2,738 of these farms were selected from the certainty strata and the remaining 30,347 farms were systematically selected from the noncertainty strata. Table A provides the State sample counts for the general FRIS, including acres associated with those counts, final reports processed and tabulated both unexpanded and expanded, and 2007 census counts.

DATA COLLECTION

Method of Enumeration

The 2008 Farm and Ranch Irrigation Survey was conducted primarily by mail. It was supplemented with Electronic Data Reporting (EDR) via the Internet, telephone calls, and personal enumeration. With the exception of EDR, enumeration methods used in the 2008 survey were similar to those used in the 2003 survey.

Report Forms

Two report forms were developed. A 16-page 2008 Farm and Ranch Irrigation Survey report form was designed to collect data from irrigated farm and ranch operations. Its design was similar to the form used in the 2003 survey with the addition of one new

section. See Appendix B for changes. The 8-page 2008 Horticultural Irrigation Survey report form is new. It was designed to collect data from operations with horticulture that irrigated. This report form can be found in Appendix B.

Report Form Mailings and Respondent Follow-up

The initial mailout took place in January 2009. Mail packets were mailed to approximately 23,100 farm and ranch operations and 10,000 horticultural operations. The initial mail packets included a labeled report form, an instruction sheet, a letter requesting a prompt response, and a return envelope. Mailout packet preparation, initial mailout, and one follow-up mailing to nonrespondents were handled by the Census Bureau's National Processing Center (NPC) in Jeffersonville, IN. Telephone follow-up from a NASS Data Collection Center began April 2009 to nonrespondents who were mailed a report form from NPC.

Data were collected for a select group of operations by the NASS 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 field offices in January. Field office staff collected data by personal enumeration or by phone from January 2009 through May 2009. 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 this check-in process removed it from follow-up mailings. All forms were reviewed prior to data keying to identify inconsistencies and 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 inconsistent entries. Each flagged entry was reviewed by staff. Reported data that were obviously incorrect due to misinterpretation of a question were either corrected or deleted prior to the computer edit. 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. For those data that would not be machine imputed they were estimated by the analyst based on other responses in the geographic area and by similarly sized farms. 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 of large magnitude and data items that were changed significantly in the computer edit process were reviewed and verified by analysts.

Prior to publication, tabulated totals were reviewed to identify and resolve remaining inconsistencies and potential coverage problems. Comparisons were made to 2007 census data, 2003 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

After the initial edit, imputations were made for missing data on individual crop yields and quantity of water used, maintenance and repair costs, expenditures, cost of water received from off-farm water suppliers, well and pump characteristics, energy cost of well pumps, area of horticulture crops, horticulture water sources, and value of sales.

ESTIMATION

Estimates were produced 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 detailed description). The estimation methodology consisted of two weighting components that made up the total FRIS weight. The first component was the fully adjusted weight

pulled in from the 2007 Census of Agriculture. This weight accounted for any list incompleteness and undercoverage from the 2007 census. The second component was the sampling rate used for the FRIS. 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 FRIS 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 2008 Farm and Ranch Irrigation Survey data were weighted for incompleteness of the mail list. The State level general FRIS data are not comparable between the 2008 and 2003 surveys. In the 2003 survey, the data included operations that reported horticultural production with sales less than $10,000 during the previous census year. In 2008 data for these operations are included in a separate set of horticultural data tables. To provide a measure of comparability, published 2003 U.S. level data were adjusted by removing operations that reported horticultural production with sales less than $10,000.

Differences exist between the expanded results of the 2008 Farm and Ranch Irrigation Survey and published data from the 2007 Census of Agriculture. Some of these are as follows:

1. The survey includes data only for operations that irrigated in both 2007 and 2008. Operations in some areas, especially the eastern States, irrigate intermittently according to moisture needs. 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 2007 but discontinued irrigation in 2008 is tabulated in Table 43 by reason of discontinuance.

2. Some operators reported that they had been misclassified as irrigators and did not irrigate in either 2007 or 2008. An estimated 10,058 operations with 749,291 acres irrigated were misclassified as irrigated in the 2007 Census of Agriculture. This is estimated by expanding reports in the farm and ranch irrigation survey where the respondents reported that they did not irrigate in 2008 or in 2007. In addition to errors in processing census data, some operators misreported or misinterpreted the questions. Most of the operators misreporting irrigation in the 2007 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 2007. After analytical review of the 2008 receipts, an estimated 12,322 operations accounting for 1,976,622 acres irrigated in 2007, after expansion, 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 2008 (not included in the 2007 census) did not have a chance of being selected 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 2002 and 2007 Census of Agriculture irrigation data which show little change in acres of irrigated cropland harvested.

Table B shows acres irrigated in the 2008 general FRIS (expanded) compared with U.S. totals from the 2007 Census of Agriculture. The expanded survey accounts for 97.1 percent of all land reported as irrigated in the 2007 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 error is the error caused by observing only a sample instead of the entire population. The sampling error is subject to sample-to-sample variation. Nonsampling errors include all other errors and can arise from many different sources. These sources may include respondent or 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 farms that either erroneously reported not irrigating in the 2007 census, started irrigating in 2008, or had succeeding irrigators in 2008 (i.e., an operator who, since 2007, took over control of an irrigating farm through sales, rental, or other arrangements). Overcoverage existed in the frame because some operations were misclassified as irrigated and did not irrigate in 2007 or had either stopped farming or irrigating in 2008. Farms in these groups that were selected into the sample were identified during the survey and estimates of their number and acres irrigated are provided above under Data Comparability, items 2 and 3.

MEASURES OF PRECISION

The survey sample was one of a large number of possible samples of the same size that could have been selected using the same sample design. Survey estimates derived from the different samples will differ from each other.

The relative standard error 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. The relative standard error expresses the standard error of an estimate as a percent of the estimated value. The standard error of a survey estimate is a measure of the variation among the estimates from all possible samples. It is a measure of the precision with which an estimate from a particular sample approximates the average result of all possible samples.

The relative standard errors given in Table C and Table D can be used to construct confidence intervals for the major survey items. Confidence intervals are another way to express the precision of an estimate by calculating the upper and lower bounds for a level of confidence. This confidence interval is designed to contain the true value being estimated. If all possible samples were selected, each of the samples were surveyed under essentially the same conditions, and an estimate and its standard error were calculated from each sample, then:

1. Approximately 67 percent of the intervals from one standard error below the estimate to one standard error above the estimate would include the average value of all possible samples.

2. Approximately 90 percent of the intervals from 1.65 standard errors below the estimate to 1.65 standard errors above the estimate would include the average value of all possible samples.

The computations necessary to construct the confidence intervals associated with these statements are illustrated in the following example: Assume that

the estimated number of irrigated acres of a certain item is 669,813 and the relative standard error of the estimate is 1.6 percent (0.016). Multiplying 669,813 by 0.016 yields 10,717, the standard error. Therefore, a 67-percent confidence interval is 659,096 to 680,530 (i.e., 669,813 + 10,717). If corresponding confidence intervals were constructed for all possible samples of the same size and design, approximately 2 out of 3 (67 percent) of these intervals would contain the figure obtained from a complete enumeration. Similarly, a 90-percent confidence interval is 652,130 to 687,496 (i.e., 669,813 + 1.65 x 10,717).

Table A. **Irrigated Farms: 2008 General FRIS and the 2007 Census of Agriculture**

Geographic area	2008 general FRIS						2007 census			
	Sample counts		Final reports processed and tabulated				Published totals		Sample universe [1]	
			Unexpanded		Expanded					
	Farms	2007 census acres	Farms	Acres irrigated	Farms	Acres irrigated	Farms	Acres irrigated	Farms	Acres irrigated
United States	23,089	21,337,704	14,503	16,277,815	206,834	54,929,915	301,028	56,599,305	185,036	47,620,963
Alabama	552	72,030	238	51,013	665	75,023	2,035	112,819	1,022	77,498
Alaska	33	3,042	15	1,553	23	1,589	184	3,730	52	3,078
Arizona	487	663,067	313	511,070	2,997	861,496	5,094	876,158	3,601	798,293
Arkansas	737	1,382,195	516	1,112,272	4,119	4,493,435	5,393	4,460,682	4,026	3,769,187
California	1,144	2,566,099	699	1,701,225	45,136	7,329,245	53,400	8,016,159	34,078	7,183,651
Colorado	615	742,044	458	587,130	12,778	2,865,840	15,774	2,867,957	11,249	2,427,969
Connecticut	67	3,004	33	1,693	147	2,337	789	9,901	161	3,408
Delaware	212	87,505	149	72,383	309	104,620	560	104,562	294	91,706
Florida	557	965,954	348	788,084	5,250	1,222,797	12,868	1,552,118	6,145	1,202,604
Georgia	746	513,765	368	297,409	3,584	1,007,763	5,716	1,017,773	3,144	763,304
Hawaii	280	46,627	164	59,090	1,077	99,577	2,810	58,635	863	48,167
Idaho	694	1,261,457	531	1,053,363	13,834	3,319,827	16,124	3,299,889	10,938	2,938,063
Illinois	599	325,731	407	264,834	1,091	457,078	2,388	474,454	1,172	385,192
Indiana	585	258,318	393	217,501	1,089	404,399	2,391	397,113	1,298	323,764
Iowa	469	145,653	285	115,433	527	162,838	1,287	189,518	687	152,330
Kansas	534	807,073	356	598,583	4,508	2,570,003	5,957	2,762,748	4,543	2,384,538
Kentucky	441	38,716	170	15,986	822	32,380	2,980	58,730	1,407	47,871
Louisiana	794	656,972	486	503,837	1,692	932,712	3,218	954,353	1,979	763,539
Maine	68	17,262	36	15,028	196	18,151	901	20,994	222	17,780
Maryland	307	68,180	206	56,446	597	85,552	1,326	92,805	569	71,729
Massachusetts	103	9,133	73	7,357	677	17,421	1,630	23,133	610	14,914
Michigan	613	347,839	427	334,642	2,121	531,927	5,078	500,428	2,419	426,711
Minnesota	685	342,620	430	262,654	1,546	504,330	2,918	506,357	1,702	413,128
Mississippi	826	1,221,050	558	979,767	1,277	1,451,652	2,284	1,368,661	1,539	1,288,152
Missouri	847	856,070	515	655,503	1,877	1,232,354	3,613	1,199,981	2,198	1,006,991
Montana	598	571,890	437	449,698	8,507	1,947,159	10,457	2,013,167	7,911	1,665,858
Nebraska	588	940,783	421	769,917	14,812	8,365,545	17,128	8,558,559	13,062	6,748,579
Nevada	407	514,178	287	381,871	1,734	685,261	2,054	691,030	1,490	626,057
New Hampshire	66	585	32	357	86	720	505	2,482	104	681
New Jersey	298	48,326	202	40,899	608	59,412	2,055	95,277	631	51,461
New Mexico	518	448,839	348	368,581	8,878	835,639	10,167	830,048	5,869	669,075
New York	256	29,514	105	9,978	596	20,158	3,036	68,010	915	39,907
North Carolina	336	91,968	150	47,620	1,975	148,999	5,788	232,075	2,784	177,458
North Dakota	393	190,598	238	145,626	601	248,070	795	236,138	585	207,308
Ohio	241	18,916	106	12,928	379	18,548	2,402	37,959	629	20,390
Oklahoma	555	371,197	296	252,171	1,454	461,235	3,026	534,768	1,877	449,164
Oregon	680	742,108	485	564,447	12,156	1,758,602	16,792	1,845,194	10,216	1,457,086
Pennsylvania	321	15,314	180	8,415	1,090	17,359	3,958	37,786	1,190	20,221
Rhode Island	37	604	20	424	61	681	313	4,306	61	657
South Carolina	305	86,682	168	72,501	712	104,091	2,030	132,439	1,034	95,227
South Dakota	384	198,109	261	150,218	1,165	360,071	1,627	373,842	1,199	306,570
Tennessee	493	52,375	215	60,491	582	72,862	2,453	81,405	1,043	54,275
Texas	1,010	1,451,163	602	1,025,548	12,673	5,356,876	19,713	5,010,416	13,440	4,348,699
Utah	549	347,138	419	252,674	10,876	1,068,929	12,492	1,134,144	8,649	879,863
Vermont	47	634	19	234	66	488	523	2,295	79	714
Virginia	228	38,743	102	24,377	657	44,818	2,347	82,187	1,127	56,332
Washington	733	841,821	503	665,657	12,712	1,675,898	15,492	1,735,917	9,545	1,490,232
West Virginia	63	1,041	28	592	90	906	457	2,189	122	1,172
Wisconsin	513	308,994	355	284,732	1,261	396,123	2,907	377,291	1,307	344,974
Wyoming	475	624,778	350	424,003	5,164	1,497,119	5,793	1,550,723	4,249	1,305,436

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

Table B. **Farms with Irrigation by Acres Irrigated – 2008 General FRIS Compared with 2007 Census of Agriculture**

Item	2007 census	2008 general FRIS		Item	2007 census	2008 general FRIS	
	United States totals	United States totals (expanded)	Percent of 2007 census totals		United States totals	United States totals (expanded)	Percent of 2007 census totals
Farms ..... number	301,028	206,834	68.7	200 to 499 acres ..... farms	29,207	26,699	91.4
acres	56,599,305	54,929,915	97.1	acres	9,143,515	8,370,607	91.5
1 to 49 acres ..... farms	190,382	111,103	58.4	500 to 999 acres ..... farms	16,569	15,778	95.2
acres	2,018,479	1,455,383	72.1	acres	11,498,297	11,077,737	96.3
50 to 99 acres ..... farms	25,467	17,735	69.6	1,000 acres or			
acres	1,761,170	1,217,958	69.2	more ..... farms	13,588	14,175	104.3
100 to 199 acres ..... farms	25,815	21,344	82.7	acres	28,632,206	29,800,427	104.1
acres	3,545,638	3,007,803	84.8				

Table C. **Relative Standard Error (percent) for Selected Irrigation Data – General FRIS: 2008**

[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 of water applied, all sources	Wells used in 2008	Pumps, all types	Expenses for irrigation		
			Total	Cropland harvested	By sprinkler systems	By gravity flow				Energy used for pumping	For wells, pumps, equipment, and facilities	Maintenance and repair
United States	1.1	3.8	0.9	0.9	1.5	1.5	1.1	2.5	2.0	1.6	3.0	2.8
Alabama	4.7	5.0	3.2	3.2	3.3	16.4	3.7	8.0	4.7	4.8	12.2	8.3
Alaska	17.7	4.1	1.7	(D)	1.6	(D)	2.5	15.4	14.1	8.2	7.6	16.9
Arizona	9.9	44.1	2.0	2.1	7.7	2.8	2.8	11.4	9.3	5.6	10.9	6.4
Arkansas	3.6	4.9	2.6	2.6	8.0	3.0	3.5	3.1	3.2	4.8	8.6	7.9
California	3.0	16.0	2.3	2.4	9.1	4.4	3.1	7.0	4.5	4.4	8.4	6.4
Colorado	4.3	7.7	3.3	3.4	5.8	5.7	4.4	6.7	17.8	6.7	12.4	12.2
Connecticut	15.1	14.0	7.4	7.4	10.6	-	8.2	30.9	14.3	13.0	24.2	31.2
Delaware	4.5	4.3	2.3	2.3	2.4	-	4.2	3.9	3.7	3.8	15.9	6.0
Florida	9.8	5.8	2.2	2.2	10.3	3.4	3.4	9.2	8.0	4.8	15.5	8.1
Georgia	5.0	5.5	3.5	3.6	4.0	21.8	4.9	7.0	5.8	4.5	17.0	8.4
Hawaii	5.0	16.7	25.6	21.7	18.0	30.0	31.7	21.5	17.0	15.8	55.4	15.9
Idaho	4.5	7.7	2.9	2.7	3.5	7.8	3.3	10.6	6.2	3.9	9.1	11.7
Illinois	3.6	2.9	2.6	2.7	2.8	43.8	4.2	2.9	2.9	6.3	9.4	6.3
Indiana	4.3	3.1	2.9	2.9	3.0	34.5	3.7	4.2	3.7	4.3	10.7	6.6
Iowa	3.5	3.8	2.3	2.3	2.5	25.5	3.5	2.8	2.7	3.8	9.7	10.8
Kansas	3.7	8.4	3.0	3.0	3.4	12.6	3.6	3.5	3.3	4.4	11.8	7.6
Kentucky	6.1	9.1	6.0	6.0	6.4	27.9	7.8	12.3	7.7	12.8	19.6	21.5
Louisiana	7.1	3.7	2.7	2.8	7.0	3.1	3.6	3.7	3.2	3.9	8.9	6.7
Maine	21.4	9.9	6.6	(D)	4.4	-	2.3	34.6	21.7	9.2	11.9	23.1
Maryland	7.0	3.9	2.7	2.8	2.8	58.3	4.0	5.1	5.2	3.4	7.7	7.2
Massachusetts	10.4	8.6	6.4	(D)	6.8	47.7	15.2	32.1	7.3	9.0	17.3	24.9
Michigan	5.4	5.1	2.3	2.3	2.2	76.1	2.9	5.1	4.0	3.6	7.7	6.1
Minnesota	4.0	4.6	3.5	3.5	3.7	17.0	3.8	3.4	3.2	4.1	14.0	6.2
Mississippi	8.1	4.1	1.7	1.7	3.5	1.9	2.0	1.8	1.8	2.0	3.9	3.7
Missouri	5.8	4.4	5.6	5.6	4.8	7.5	6.5	5.1	4.8	5.7	8.4	5.0
Montana	4.4	10.3	2.8	3.1	5.3	5.1	4.3	21.4	8.6	8.8	22.1	7.2
Nebraska	3.1	18.5	2.8	2.8	3.4	8.3	4.2	3.8	3.7	4.4	11.1	7.9
Nevada	5.4	9.0	3.0	3.1	5.7	4.5	4.0	7.4	7.9	6.4	12.7	14.6
New Hampshire	11.2	18.1	21.9	21.9	31.6	52.4	18.4	21.9	14.1	16.3	37.8	35.9
New Jersey	6.0	5.2	2.5	2.5	3.5	20.4	4.5	5.9	4.6	3.4	16.9	8.8
New Mexico	5.2	28.7	4.4	4.6	7.0	6.6	8.4	8.8	9.5	4.8	15.0	10.4
New York	13.4	9.5	7.3	7.4	13.5	37.6	11.8	18.6	14.5	12.8	17.0	12.7
North Carolina	10.0	12.0	6.0	6.1	6.3	52.3	10.6	25.7	9.6	9.4	23.4	14.2
North Dakota	3.3	5.9	2.7	2.7	3.6	9.6	4.3	5.2	4.1	4.8	11.4	6.9
Ohio	9.5	9.5	8.2	8.3	9.5	24.7	8.6	15.1	8.9	7.9	10.5	9.2
Oklahoma	8.0	7.5	3.4	2.9	3.8	10.7	3.6	5.7	5.3	7.4	10.7	7.2
Oregon	4.7	7.0	5.0	6.2	6.8	5.7	4.7	12.8	6.1	7.5	9.9	20.1
Pennsylvania	7.8	7.6	5.7	5.8	8.8	33.9	11.6	14.6	8.7	8.6	17.8	10.6
Rhode Island	14.3	10.9	10.7	10.8	11.7	87.9	7.5	25.3	21.5	11.5	32.8	29.7
South Carolina	13.6	5.8	3.4	3.4	3.7	14.8	4.0	16.8	11.9	5.5	10.7	8.4
South Dakota	4.9	14.2	5.4	5.4	6.5	10.5	4.5	9.3	6.9	9.0	15.6	12.5
Tennessee	6.9	3.1	2.9	(D)	3.3	7.4	3.0	7.4	5.7	5.7	7.4	6.9
Texas	6.6	8.2	5.9	5.6	7.5	9.1	4.2	10.9	10.3	5.0	11.0	11.9
Utah	3.1	12.9	3.2	3.7	5.8	5.9	4.1	20.2	11.5	8.6	17.9	10.3
Vermont	15.8	22.3	15.9	15.9	33.7	87.3	24.0	30.0	21.1	28.8	29.1	31.1
Virginia	14.3	11.3	4.9	5.0	5.4	39.3	5.7	28.4	13.7	7.1	12.9	14.9
Washington	3.3	18.9	2.8	2.8	3.5	10.5	3.0	12.9	5.1	3.9	7.3	5.8
West Virginia	14.1	25.9	10.8	10.6	9.6	(D)	40.1	25.6	15.3	13.9	36.5	37.7
Wisconsin	4.3	3.8	1.6	1.6	1.8	22.8	3.9	2.6	3.7	4.1	12.1	8.0
Wyoming	3.1	13.4	4.5	4.4	8.0	5.6	5.5	24.5	19.8	11.1	23.3	11.7
Water Resources Regions												
Region 01 New England	7.3	6.4	4.2	(D)	3.6	43.9	10.2	17.0	6.1	7.7	10.9	20.6
Region 02 Mid-Atlantic	4.6	2.7	1.5	1.5	1.7	15.1	2.3	4.0	3.7	2.0	7.5	4.2
Region 03 South Atlantic-Gulf	4.8	3.6	1.8	1.8	3.0	3.7	2.6	5.7	4.2	2.9	10.2	5.3
Region 04 Great Lakes	4.6	4.0	2.2	2.2	2.2	30.4	2.8	4.1	3.3	3.2	6.7	4.8
Region 05 Ohio	4.9	3.9	4.0	4.0	4.1	30.0	4.0	5.5	4.5	5.8	10.2	7.8
Region 06 Tennessee	9.2	7.6	6.3	(D)	6.7	(D)	6.8	15.8	11.7	10.0	16.3	10.1
Region 07 Upper Mississippi	2.8	2.6	1.9	1.9	2.0	13.4	2.4	2.0	2.2	2.9	7.6	4.4
Region 08 Lower Mississippi	3.0	2.0	2.0	2.0	4.1	2.3	2.9	2.3	2.4	3.0	5.1	5.2
Region 09 Souris-Red-Rainy	9.3	6.5	5.6	5.5	5.9	20.7	8.2	6.9	6.3	6.1	12.8	10.0
Region 10 Missouri	2.8	7.6	2.0	2.0	2.6	4.2	2.7	3.3	4.0	3.5	7.4	5.6
Region 11 Arkansas-White-Red	7.0	14.5	3.5	3.4	4.0	7.1	4.1	4.5	4.5	4.3	10.5	5.5
Region 12 Texas-Gulf	8.4	8.0	8.7	8.3	11.4	10.4	5.7	13.9	13.0	7.8	13.9	16.0
Region 13 Rio Grande	8.9	23.5	7.0	7.2	8.8	9.8	8.7	9.5	10.2	10.2	16.5	14.7
Region 14 Upper Colorado	8.3	9.3	6.2	6.9	10.5	7.3	6.8	47.9	17.8	15.1	23.3	11.8
Region 15 Lower Colorado	9.8	41.5	2.5	2.5	7.4	3.2	3.0	10.8	8.8	5.7	10.4	6.2
Region 16 Great Basin	6.5	8.7	4.0	4.4	7.0	4.9	4.3	11.3	9.0	6.4	11.2	23.1
Region 17 Pacific Northwest	2.8	7.4	2.1	2.2	2.5	4.5	2.2	7.1	3.5	2.7	5.1	5.9
Region 18 California	3.0	15.6	2.3	2.4	8.6	4.4	3.1	6.9	4.5	4.4	8.4	6.4
Region 19 Alaska	17.7	4.1	1.7	(D)	1.6	(D)	2.5	15.4	14.1	8.2	7.6	16.9
Region 20 Hawaii	5.0	16.7	25.6	21.7	18.0	30.0	31.7	21.5	17.0	15.8	55.4	15.9

Table D. **Relative Standard Error (percent) for Selected Horticultural Irrigation Data: 2008**

Geographic area	Horticultural operations	Irrigated area	
		Square feet under protection	Acres in the open
United States	0.8	4.6	1.3
Alabama	6.7	20.8	6.7
Alaska	12.1	30.4	39.8
Arizona	11.0	38.3	6.5
Arkansas	9.6	66.9	4.3
California	2.6	9.5	5.0
Colorado	7.0	30.5	10.2
Connecticut	6.0	19.8	11.0
Delaware	17.8	39.5	52.8
Florida	2.6	11.1	2.5
Georgia	5.2	27.1	5.1
Hawaii	5.6	22.6	17.4
Idaho	8.7	51.9	11.3
Illinois	5.0	46.7	5.9
Indiana	5.3	15.3	31.3
Iowa	7.6	25.4	16.2
Kansas	8.9	33.6	13.8
Kentucky	5.2	23.7	17.1
Louisiana	6.4	29.9	19.6
Maine	6.6	39.5	9.1
Maryland	6.1	21.9	11.4
Massachusetts	6.1	20.8	16.3
Michigan	3.1	10.1	5.2
Minnesota	5.4	28.7	6.0
Mississippi	10.0	42.3	23.2
Missouri	6.7	52.0	11.9
Montana	6.7	22.5	5.6
Nebraska	6.7	25.5	11.8
Nevada	27.7	49.4	18.8
New Hampshire	5.9	30.2	40.0
New Jersey	4.5	13.6	10.5
New Mexico	13.9	82.6	31.2
New York	3.8	15.5	6.6
North Carolina	4.1	23.8	6.0
North Dakota	39.9	58.8	70.7
Ohio	4.7	18.2	10.7
Oklahoma	10.0	28.2	6.3
Oregon	3.3	10.5	2.5
Pennsylvania	3.2	27.6	13.4
Rhode Island	9.0	22.2	12.8
South Carolina	8.2	29.0	5.2
South Dakota	12.4	35.8	27.6
Tennessee	4.6	15.3	6.0
Texas	4.4	24.9	3.7
Utah	8.6	45.4	4.6
Vermont	7.2	31.5	26.2
Virginia	6.1	22.1	10.7
Washington	5.4	19.0	5.9
West Virginia	9.3	18.7	42.0
Wisconsin	3.9	13.7	25.8
Wyoming	15.0	26.9	22.8
Water Resources Regions			
Region 01 New England	3.0	12.6	6.7
Region 02 Mid-Atlantic	2.4	9.6	5.7
Region 03 South Atlantic-Gulf	2.0	9.3	2.1
Region 04 Great Lakes	3.1	9.1	5.3
Region 05 Ohio	3.6	28.2	13.8
Region 06 Tennessee	6.9	21.2	7.7
Region 07 Upper Mississippi	3.4	27.1	8.5
Region 08 Lower Mississippi	7.9	16.0	10.9
Region 09 Souris-Red-Rainy	31.9	59.0	71.1
Region 10 Missouri	4.7	28.7	7.2
Region 11 Arkansas-White-Red	6.6	29.8	5.0
Region 12 Texas-Gulf	4.7	25.1	3.9
Region 13 Rio Grande	18.2	38.8	29.7
Region 14 Upper Colorado	16.6	76.1	24.2
Region 15 Lower Colorado	10.9	35.1	9.5
Region 16 Great Basin	10.2	47.7	5.5
Region 17 Pacific Northwest	2.7	9.1	2.5
Region 18 California	2.6	9.5	4.9
Region 19 Alaska	12.1	30.4	39.8
Region 20 Hawaii	5.6	22.6	17.4