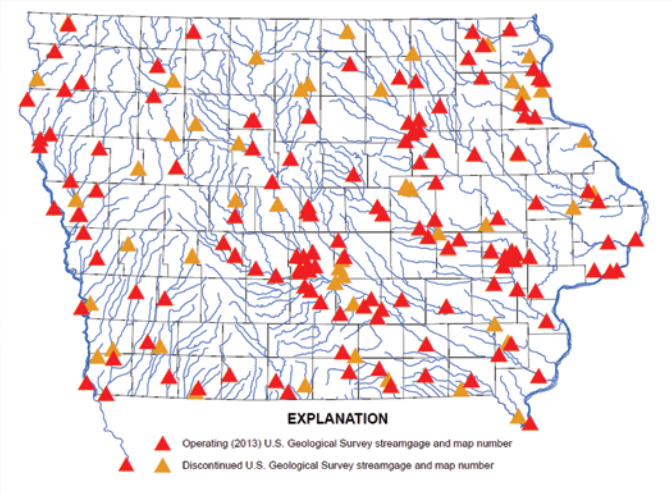
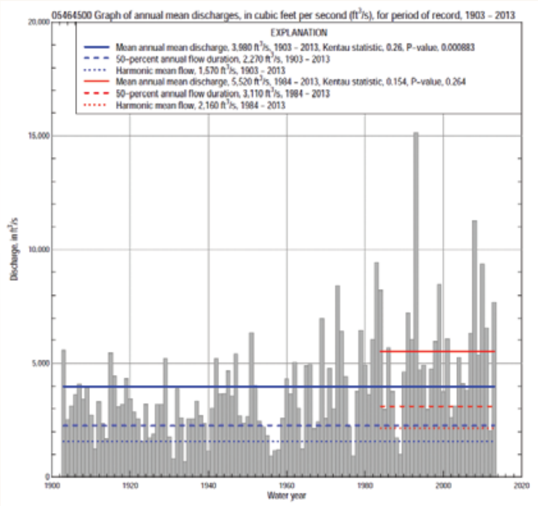
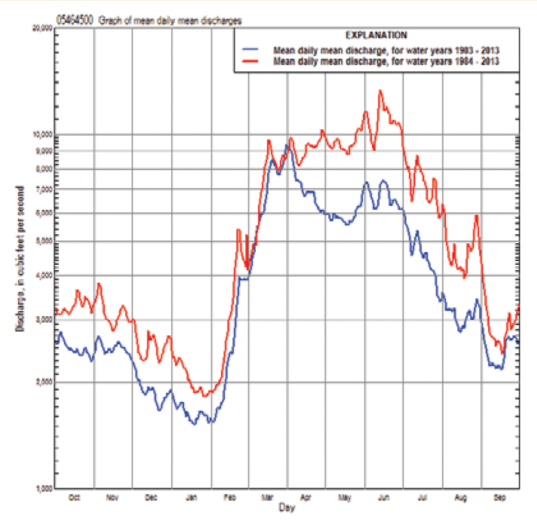
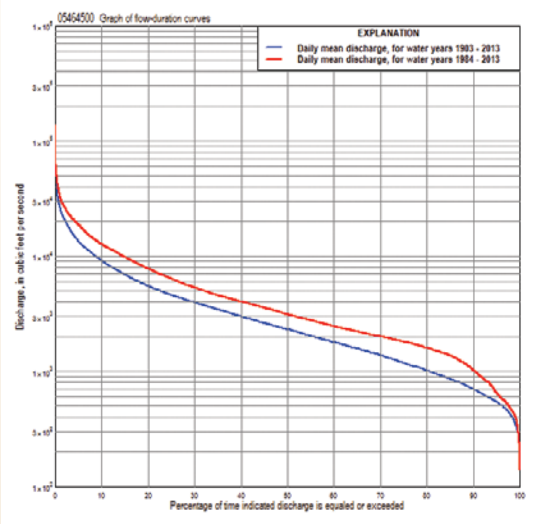
Prepared in cooperation with the Iowa Department of Transportation, the Iowa Highway Research Board (Iowa DOT Research Project TR-669), and the U.S. Army Corps of Engineers

Statistical Summaries of Selected Iowa Streamflow Data Through September 2013









Open-File Report 2015–1214

U.S. Department of the Interior
U.S. Geological Survey

Cover. Clockwise from upper left: Map of Iowa streamgages, graph of annual mean discharges, graph of flow-duration curves, and graph of mean daily mean discharges.

Statistical Summaries of Selected Iowa Streamflow Data Through September 2013

By David A. Eash, Padraic S. O'Shea, Jared R. Weber, Kevin T. Nguyen, Nicholas L. Montgomery, and Adrian J. Simonson

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Open-File Report 2015–1214

U.S. Department of the Interior
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U.S. Department of the Interior
SALLY JEWELL, Secretary

U.S. Geological Survey
Suzette M. Kimball, Acting Director

U.S. Geological Survey, Reston, Virginia: 2015

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Contents

Figures

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Conversion Factors

[Inch/Pound to International System of Units]

Multiply	By	To obtain
	Length	
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)

Datums

Elevation or vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29) or mean sea level. The NGVD 29 can be converted to the North American Vertical Datum of 1988 by using the National Geodetic Survey conversion utility (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, and National Climatic Data Center, 2013).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83) or North American Datum of 1927 (NAD 27).

Supplemental Information

A water year is the 12-month period from October 1 through September 30. The water year is designated by the calendar year in which the water year ends and includes 9 of the 12 months of that year. Thus, the water year ending September 30, 2013, is the “2013 water year.”

A climatic year is the 12-month period from April 1 through March 31. The climatic year is designated by the calendar year in which the climatic year ends and includes 3 of the 12 months of that year. Thus, the climatic year ending March 31, 2013, is the “2013 climatic year.”

Abbreviations

AEP	annual exceedance probability
ANNIE	U.S. Geological Survey interactive hydrologic analyses and data management computer program
ANP	annual nonexceedance probability
BASINS	Better Assessment Science Integrating Point and Nonpoint Sources
DVstats	U.S. Geological Survey R-package functions to manipulate daily-values data
EMA	expected moments algorithm AEP analysis
EPA	U.S. Environmental Protection Agency

IA	Iowa
Kentau statistic	Kendall's tau statistic, a measure of the correlation between the streamflow data series (discharges) and time (water years or climatic years)
lat	latitude
long	longitude
MGB	multiple Grubbs-Beck low-outlier test
N-day	number of consecutive days
NE	northeast
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NW	northwest
NWISWeb	National Water Information System Web interface
P-value	represents a 95-percent confidence-level probability that a true null hypothesis of no trend is erroneously rejected, *P*-values less than or equal to 5 percent (α=0.05) indicate statistically significant trends (positive or negative)
PeakFQ	U.S. Geological Survey computer program that implements both Bulletin 17B and EMA procedures for flood-frequency analysis
R	range
RI	recurrence interval
RRE	regional regression equation
SE	southeast
sec.	section
SW	southwest
smwrBase	U.S. Geological Survey R-package functions to import and manipulate hydrologic data
smwrGraphs	U.S. Geological Survey R-package graphing functions
smwrStats	U.S. Geological Survey R-package general tools for hydrologic data and trend analysis
SWSTAT	U.S. Geological Survey Surface-Water Statistics computer program
T	township
USGS	U.S. Geological Survey
USGS SW Toolbox	U.S. Geological Survey surface-water analysis program that includes the U.S. Geological Survey Surface-Water Statistics (SWSTAT) computer program
WaterWatch	A U.S. Geological Survey Web site that displays maps, graphs, and tables describing real-time, recent, and past streamflow conditions for streamgages in the United States.
WIE	Weighted Independent Estimates

Statistical Summaries of Selected Iowa Streamflow Data Through September 2013

By David A. Eash, Padraic S. O’Shea, Jared R. Weber, Kevin T. Nguyen, Nicholas L. Montgomery, and Adrian J. Simonson

Abstract

Statistical summaries of streamflow data collected at 184 streamgages in Iowa are presented in this report. All streamgages included for analysis have at least 10 years of continuous record collected before or through September 2013. This report is an update to two previously published reports that presented statistical summaries of selected Iowa streamflow data through September 1988 and September 1996. The statistical summaries include (1) monthly and annual flow durations, (2) annual exceedance probabilities of instantaneous peak discharges (flood frequencies), (3) annual exceedance probabilities of high discharges, and (4) annual nonexceedance probabilities of low discharges and seasonal low discharges. Also presented for each streamgage are graphs of the annual mean discharges, mean annual mean discharges, 50-percent annual flow-duration discharges (median flows), harmonic mean flows, mean daily mean discharges, and flow-duration curves. Two sets of statistical summaries are presented for each streamgage, which include (1) long-term statistics for the entire period of streamflow record and (2) recent-term statistics for or during the 30-year period of record from 1984 to 2013. The recent-term statistics are only calculated for streamgages with streamflow records pre-dating the 1984 water year and with at least 10 years of record during 1984–2013. The streamflow statistics in this report are not adjusted for the effects of water use; although some of this water is used consumptively, most of it is returned to the streams.

Introduction

Information concerning streamflow characteristics is essential for the development and management of surface-water resources. Statistical analyses of streamflow data provide information about the spatial and temporal characteristics of streamflow. Project designers, water- and land-use managers, and hydrologists need information on all aspects of streamflow to evaluate various hydraulic and hydrologic designs or land-use alternatives. To address this need, the U.S. Geological Survey (USGS), in cooperation with the Iowa Department of Transportation, the Iowa Highway Research Board (Iowa DOT Research Project TR-669), and the U.S. Army Corps of Engineers, prepared statistical summaries based on streamflow data available through September 2013 for operating and discontinued streamgages in and near Iowa.

This report presents statistical summaries of streamflow data for 184 streamgages that have at least 10 years of continuous record collected before or through September 2013. A link to the statistical summaries calculated for each streamgage is listed in table 1. The streamgages are located in Iowa except for three Missouri River streamgages that are located in Nebraska. The previous Iowa streamflow statistics reports presented summaries for 144 streamgages that had data collected before or through September 1988 (Fischer and others, 1990) and summaries for 156 streamgages that had data collected before or through September 1996 (Fischer and Eash, 1998); thus, the present report reflects the addition of 28 streamgages and the collection of 17 more years of record at operating streamgages.

The statistical summaries presented for each streamgage are (1) monthly and annual flow durations; (2) annual exceedance probabilities (AEP) of instantaneous peak discharges (flood frequencies); (3) AEPs of high discharges; and (4) annual nonexceedance probabilities (ANP) of low discharges and seasonal low discharges. Also presented for each streamgage is a description of the streamgage; links to all available data for the streamgage through the USGS National Water Information System Web interface (NWISWeb) (U.S. Geological Survey, 2015a) and through the USGS WaterWatch Toolkit (U.S. Geological Survey, 2015b); and graphs of the annual mean discharges, mean annual mean discharges, 50-percent annual flow-duration discharges (median flows), harmonic mean flows, mean daily mean discharges, and flow-duration curves. WaterWatch is a Web site that displays maps, graphs, and tables describing real-time, recent, and past streamflow conditions for streamgages in the United States; the real-time information generally is updated on an hourly basis. Two sets of statistical summaries are presented for each streamgage, which include (1) long-term statistics for the entire period of streamflow record and (2) recent-term statistics for or during the 30-year period of record from 1984 to 2013. The recent-term statistics are only calculated for streamgages with streamflow records pre-dating the 1984 water year and with at least 10 years of record during 1984–2013. A water year is the 12-month period from October 1 through September 30. The water year is designated by the calendar year in which the water year ends and includes 9 of the 12 months of that year. Thus, the water year ending September 30, 2013, is the "2013 water year." A 30-year period of record (1984–2013) was selected for the recent-term statistics because this record length is used by the National Oceanic and Atmospheric Administration (NOAA), the World Meteorological Organization, and the Natural Resources Conservation Service (NRCS) for calculating 30-year climatic and hydrologic normals (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, 2015; World Meteorological Organization, 2015; Natural Resources Conservation Service, 2015), and this record length is essential for assessing trends (U.S. Geological Survey, 2005; Dixon and others, 2006).

Users of this report are responsible for assessing the suitability and applicability of the statistics for their requirements.

Table 1. Streamgages in Iowa included in this study. Streamflow statistics for the streamgages are available at http://dx.doi.org/10.3133/ofr20151214.

[no., number]

Map number (fig. 1)	Streamgage number	Streamgage name
1	05387440	Upper Iowa River at Bluffton, Iowa.
2	05387500	Upper Iowa River at Decorah, Iowa.
3	05388000	Upper Iowa River near Decorah, Iowa.
4	05388250	Upper Iowa River near Dorchester, Iowa.
5	05388500	Paint Creek at Waterville, Iowa.
6	05389000	Yellow River near Ion, Iowa.
7	05389400	Bloody Run Creek near Marquette, Iowa.
8	05389500	Mississippi River at McGregor, Iowa.
9	05411400	Sny Magill Creek near Clayton, Iowa.
10	05411600	Turkey River at Spillville, Iowa.
11	05411850	Turkey River near Eldorado, Iowa.
12	05412000	Turkey River at Elkader, Iowa
13	05412020	Turkey River above French Hollow Creek at Elkader, Iowa.
14	05412060	Silver Creek near Luana, Iowa.
15	05412100	Roberts Creek above Saint Olaf, Iowa.
16	05412400	Volga River at Littleport, Iowa.
17	05412500	Turkey River at Garber, Iowa.
18	05414500	Little Maquoketa River near Durango, Iowa.
19	05416900	Maquoketa River at Manchester, Iowa.
20	05417000	Maquoketa River near Manchester, Iowa.
21	05417700	Bear Creek near Monmouth, Iowa.
22	05418400	North Fork Maquoketa River near Fulton, Iowa.
23	05418450	North Fork Maquoketa River at Fulton, Iowa.
24	05418500	Maquoketa River near Maquoketa, Iowa.
25	05420500	Mississippi River at Clinton, Iowa.
26	05420560	Wapsipinicon River near Elma, Iowa.
27	05420680	Wapsipinicon River near Tripoli, Iowa.
28	05421000	Wapsipinicon River at Independence, Iowa.
29	05421740	Wapsipinicon River near Anamosa, Iowa.
30	05422000	Wapsipinicon River near De Witt, Iowa.
31	05422470	Crow Creek at Bettendorf, Iowa.

Table 1. Streamgages in Iowa included in this study.—Continued. Streamflow statistics for the streamgages are available at http://dx.doi.org/10.3133/ofr20151214.

[no., number]

Map number (fig. 1)	Streamgage number	Streamgage name
32	05422560	Duck Creek at 110th Avenue at Davenport, Iowa.
33	05422600	Duck Creek at Duck Creek Golf Course at Davenport, Iowa.
34	05448500	West Branch Iowa River near Klemme, Iowa.
35	05449000	East Branch Iowa River near Klemme, Iowa.
36	05449500	Iowa River near Rowan, Iowa.
37	05451210	South Fork Iowa River northeast of New Providence, Iowa.
38	05451500	Iowa River at Marshalltown, Iowa.
39	05451700	Timber Creek near Marshalltown, Iowa.
40	05451900	Richland Creek near Haven, Iowa.
41	05452000	Salt Creek near Elberon, Iowa.
42	05452200	Walnut Creek near Hartwick, Iowa.
43	05452500	Iowa River near Belle Plaine, Iowa.
44	05453000	Big Bear Creek at Ladora, Iowa.
45	05453100	Iowa River at Marengo, Iowa.
46	05453520	Iowa River below Coralville Dam near Coralville, Iowa.
47	05454000	Rapid Creek near Iowa City, Iowa.
48	05454220	Clear Creek near Oxford, Iowa.
49	05454300	Clear Creek near Coralville, Iowa.
50	05454500	Iowa River at Iowa City, Iowa.
51	05455000	Ralston Creek at Iowa City, Iowa.
52	05455010	South Branch Ralston Creek at Iowa City, Iowa.
53	05455100	Old Mans Creek near Iowa City, Iowa.
54	05455500	English River at Kalona, Iowa.
55	05455700	Iowa River near Lone Tree, Iowa.
56	05457700	Cedar River at Charles City, Iowa.
57	05458000	Little Cedar River near Ionia, Iowa.
58	05458300	Cedar River at Waverly, Iowa.
59	05458500	Cedar River at Janesville, Iowa.
60	05458900	West Fork Cedar River at Finchford, Iowa.
61	05459000	Shell Rock River near Northwood, Iowa.
62	05459500	Winnebago River at Mason City, Iowa.
63	05460500	Shell Rock River at Marble Rock, Iowa.
64	05462000	Shell Rock River at Shell Rock, Iowa.
65	05463000	Beaver Creek at New Hartford, Iowa.
66	05463500	Black Hawk Creek at Hudson, Iowa.
67	05464000	Cedar River at Waterloo, Iowa.
68	05464130	Fourmile Creek near Lincoln, Iowa.
69	05464133	Halfmile Creek near Gladbrook, Iowa.
70	05464137	Fourmile Creek near Traer, Iowa.
71	05464220	Wolf Creek near Dysart, Iowa.
72	05464500	Cedar River at Cedar Rapids, Iowa.

Table 1. Streamgages in Iowa included in this study.—Continued. Streamflow statistics for the streamgages are available at http://dx.doi.org/10.3133/ofr20151214.

[no., number]

Map number (fig. 1)	Streamgage number	Streamgage name
73	05464640	Prairie Creek at Fairfax, Iowa.
74	05464942	Hoover Creek at Hoover National Historic Site at West Branch, Iowa.
75	05465000	Cedar River near Conesville, Iowa.
76	05465500	Iowa River at Wapello, Iowa.
77	05470000	South Skunk River near Ames, Iowa.
78	05470500	Squaw Creek at Ames, Iowa.
79	05471000	South Skunk River below Squaw Creek near Ames, Iowa.
80	05471040	Squaw Creek near Colfax, Iowa.
81	05471050	South Skunk River at Colfax, Iowa.
82	05471200	Indian Creek near Mingo, Iowa.
83	05471500	South Skunk River near Oskaloosa, Iowa.
84	05472500	North Skunk River near Sigourney, Iowa.
85	05473000	Skunk River at Coppock, Iowa.
86	05473400	Cedar Creek near Oakland Mills, Iowa.
87	05473450	Big Creek North of Mount Pleasant, Iowa.
88	05473500	Big Creek near Mount Pleasant, Iowa.
89	05474000	Skunk River at Augusta, Iowa.
90	05474500	Mississippi River at Keokuk, Iowa.
91	05476500	Des Moines River at Estherville, Iowa.
92	05476750	Des Moines River at Humboldt, Iowa.
93	05478000	East Fork Des Moines River near Burt, Iowa.
94	05479000	East Fork Des Moines River at Dakota City, Iowa.
95	05480000	Lizard Creek near Clare, Iowa.
96	05480500	Des Moines River at Fort Dodge, Iowa.
97	05481000	Boone River near Webster City, Iowa.
98	05481300	Des Moines River near Stratford, Iowa.
99	05481500	Des Moines River near Boone, Iowa.
100	05481650	Des Moines River near Saylorville, Iowa.
101	05481950	Beaver Creek near Grimes, Iowa.
102	05482000	Des Moines River at 2nd Avenue at Des Moines, Iowa.
103	05482135	North Raccoon River near Newell, Iowa.
104	05482170	Big Cedar Creek near Varina, Iowa.
105	05482300	North Raccoon River near Sac City, Iowa.
106	05482500	North Raccoon River near Jefferson, Iowa.
107	05483000	East Fork Hardin Creek near Churdan, Iowa.
108	05483450	Middle Raccoon River near Bayard, Iowa.
109	05483600	Middle Raccoon River at Panora, Iowa.
110	05484000	South Raccoon River at Redfield, Iowa.
111	05484500	Raccoon River at Van Meter, Iowa.
112	05484650	Raccoon River at 63rd Street at Des Moines, Iowa.
113	05484800	Walnut Creek at Des Moines, Iowa.

Table 1. Streamgages in Iowa included in this study.—Continued. Streamflow statistics for the streamgages are available at http://dx.doi.org/10.3133/ofr20151214.

[no., number]

Map number (fig. 1)	Streamgage number	Streamgage name
114	05484900	Raccoon River at Fleur Drive at Des Moines, Iowa.
115	05485500	Des Moines River below Raccoon River at Des Moines, Iowa.
116	05485605	Fourmile Creek near Ankeny, Iowa.
117	05485640	Fourmile Creek at Des Moines, Iowa.
118	05486000	North River near Norwalk, Iowa.
119	05486490	Middle River near Indianola, Iowa.
120	05487470	South River near Ackworth, Iowa.
121	05487500	Des Moines River near Runnells, Iowa.
122	05487540	Walnut Creek near Prairie City, Iowa.
123	05487550	Walnut Creek near Vandalia, Iowa.
124	05487980	White Breast Creek near Dallas, Iowa.
125	05488000	White Breast Creek near Knoxville, Iowa.
126	05488110	Des Moines River near Pella, Iowa.
127	05488200	English Creek near Knoxville, Iowa.
128	05488500	Des Moines River near Tracy, Iowa.
129	05489000	Cedar Creek near Bussey, Iowa.
130	05489500	Des Moines River at Ottumwa, Iowa.
131	05490500	Des Moines River at Keosauqua, Iowa.
132	05491000	Sugar Creek near Keokuk, Iowa.
133	05494300	Fox River at Bloomfield, Iowa.
134	05494500	Fox River at Cantril, Iowa.
135	06483270	Rock River at Rock Rapids, Iowa.
136	06483290	Rock River below Tom Creek at Rock Rapids, Iowa.
137	06483500	Rock River near Rock Valley, Iowa.
138	06484000	Dry Creek at Hawarden, Iowa.
139	06485500	Big Sioux River at Akron, Iowa.
140	06486000	Missouri River at Sioux City, Iowa.
141	06600000	Perry Creek at 38th Street at Sioux City, Iowa.
142	06600100	Floyd River at Alton, Iowa.
143	06600300	West Branch Floyd River near Struble, Iowa.
144	06600500	Floyd River at James, Iowa.
145	06601200	Missouri River at Decatur, Iowa.
146	06602020	West Fork Ditch at Hornick, Iowa.
147	06602400	Monona-Harrison Ditch near Turin, Iowa.
148	06605000	Ocheyedan River near Spencer, Iowa.
149	06605600	Little Sioux River at Gillett Grove, Iowa.
150	06605850	Little Sioux River at Linn Grove, Iowa.
151	06606600	Little Sioux River at Correctionville, Iowa.
152	06606700	Little Sioux River near Kennebec, Iowa.
153	06607000	Odebolt Creek near Arthur, Iowa.
154	06607200	Maple River at Mapleton, Iowa.

Table 1. Streamgages in Iowa included in this study.—Continued. Streamflow statistics for the streamgages are available at http://dx.doi.org/10.3133/ofr20151214.

[no., number]

Map number (fig. 1)	Streamgage number	Streamgage name
155	06607500	Little Sioux River near Turin, Iowa.
156	06608500	Soldier River at Pisgah, Iowa.
157	06609500	Boyer River at Logan, Iowa.
158	06610000	Missouri River at Omaha, Nebraska.
159	06610500	Indian Creek at Council Bluffs, Iowa.
160	06610520	Mosquito Creek near Earling, Iowa.
161	06806000	Waubonsie Creek near Bartlett, Iowa.
162	06807000	Missouri River at Nebraska City, Nebraska.
163	06807410	West Nishnabotna River at Hancock, Iowa.
164	06808000	Mule Creek near Malvern, Iowa.
165	06808500	West Nishnabotna River at Randolph, Iowa.
166	06809000	Davids Creek near Hamlin, Iowa.
167	06809210	East Nishnabotna River near Atlantic, Iowa.
168	06809500	East Nishnabotna River at Red Oak, Iowa.
169	06810000	Nishnabotna River above Hamburg, Iowa.
170	06811840	Tarkio River at Stanton, Iowa.
171	06813500	Missouri River at Rulo, Nebraska
172	06817000	Nodaway River at Clarinda, Iowa.
173	06818750	Platte River near Diagonal, Iowa.
174	06819185	East Fork One Hundred and Two River at Bedford, Iowa.
175	06819190	East Fork One Hundred and Two River near Bedford, Iowa.
176	06897950	Elk Creek near Decatur City, Iowa.
177	06898000	Thompson River at Davis City, Iowa.
178	06898400	Weldon River near Leon, Iowa.
179	06903400	Chariton River near Chariton, Iowa.
180	06903500	Honey Creek near Russell, Iowa.
181	06903700	South Fork Chariton River near Promise City, Iowa.
182	06903900	Chariton River near Rathbun, Iowa.
183	06904000	Chariton River near Centerville, Iowa.
184	06904010	Chariton River near Moulton, Iowa.

U.S. Geological Survey Streamgage Network in Iowa

The USGS is the primary Federal agency responsible for the collection of the Nation's streamflow data. In 2013, the USGS streamgage network consisted of nearly 8,000 streamgages nationwide, most collecting real-time data (Jian and others, 2014). In Iowa, the network consisted of 153 continuous-record or daily-discharge streamgages in 2013 (Rantz and others, 1982); all were real-time streamgages except for one. Real-time data are recorded at 15-minute intervals, stored onsite, and then transmitted to USGS offices every hour. Recording and transmission times may be more frequent during critical events. Data from real-time sites are relayed to USGS offices by way of satellite, telephone, and (or) radio and are available for viewing within minutes of arrival; data for Iowa are available at http://waterdata.usgs.gov/ia/nwis/current/?type=flow.

The first systematic collection of streamflow data in Iowa was made in 1873 when the USGS began collecting data at Mississippi River at Clinton (streamgage 05420500, fig. 1, map number 25; formerly published as Mississippi River at Le Claire, Iowa, until 1939). Additional streamgages were installed in 1878 at Mississippi River at Keokuk (streamgage 05474500, fig. 1, map number 90) and in 1897 at Missouri River at Sioux City (streamgage 06486000, fig. 1, map number 140; monthly discharges only until 1928 when daily discharges became available). The streamgages at Clinton, Keokuk, and Sioux City are still in operation in the Iowa streamgage network.

The USGS established five streamgages on interior streams in Iowa between 1903 and 1905, some of which were discontinued after a short period of operation. Daily-discharge records are continuous since 1903 for Iowa River at Iowa City (streamgage 05454500, fig. 1, map number 50) and Cedar River at Cedar Rapids (streamgage 05464500, fig. 1, map number 72) (Burmeister, 1970). Since that time, the Iowa USGS streamgage network has grown to include over 150 streamgages in operation around the State. A chart of the number of Iowa streamgages operated each water year since the first streamgage was installed is shown in figure 2; note that the number of streamgages shown in figure 2 does not exactly correlate with previously published numbers (Fischer and Eash, 1998; Fischer and others, 1990).

The Federal-State cooperative program for the collection of streamflow records in Iowa was established in 1914. The streamgage network increased from 14 streamgages in 1914 to 28 streamgages in 1922. The cooperative program was dissolved in 1928 and the number of streamgages decreased to 17. The cooperative program was resumed in 1932 (Burmeister, 1970), and by 1935 the number of streamgages increased to 37.

By 1940, the number of streamgages increased to 63, primarily because of the U.S. Army Corps of Engineer's flood-control program during the late 1930s (Burmeister, 1970). Since 1940, the streamgage network increased steadily from 61 streamgages in 1945 to 126 streamgages in 1968. The size of the network has fluctuated annually since 1968 from a minimum of 111 streamgages in 1984 to a maximum of 153 streamgages in 2013.

The streamgage network is not a network in the purest sense. Data collected at one streamgage or group of streamgages may be intended to answer different questions than data collected at other streamgages. Rather, the network is a mixture of many individual networks with different purposes and sources of funding. Fortunately, many USGS streamgages provide data that are useful for purposes other than that for which the streamgage was originally installed (Wahl and Crippen, 1984). In 1995, the USGS conducted a survey of users of the USGS streamgage network in Iowa to determine more definitively who uses streamflow data and for what purposes the data are used. The survey responses indicated that streamflow data collected at many streamgages in Iowa often are used by other agencies for purposes other than originally planned (Fischer, 1996). Additional information on the importance of streamgages and the use of streamflow information is provided at http://water.usgs.gov/nsip/uses9.html.

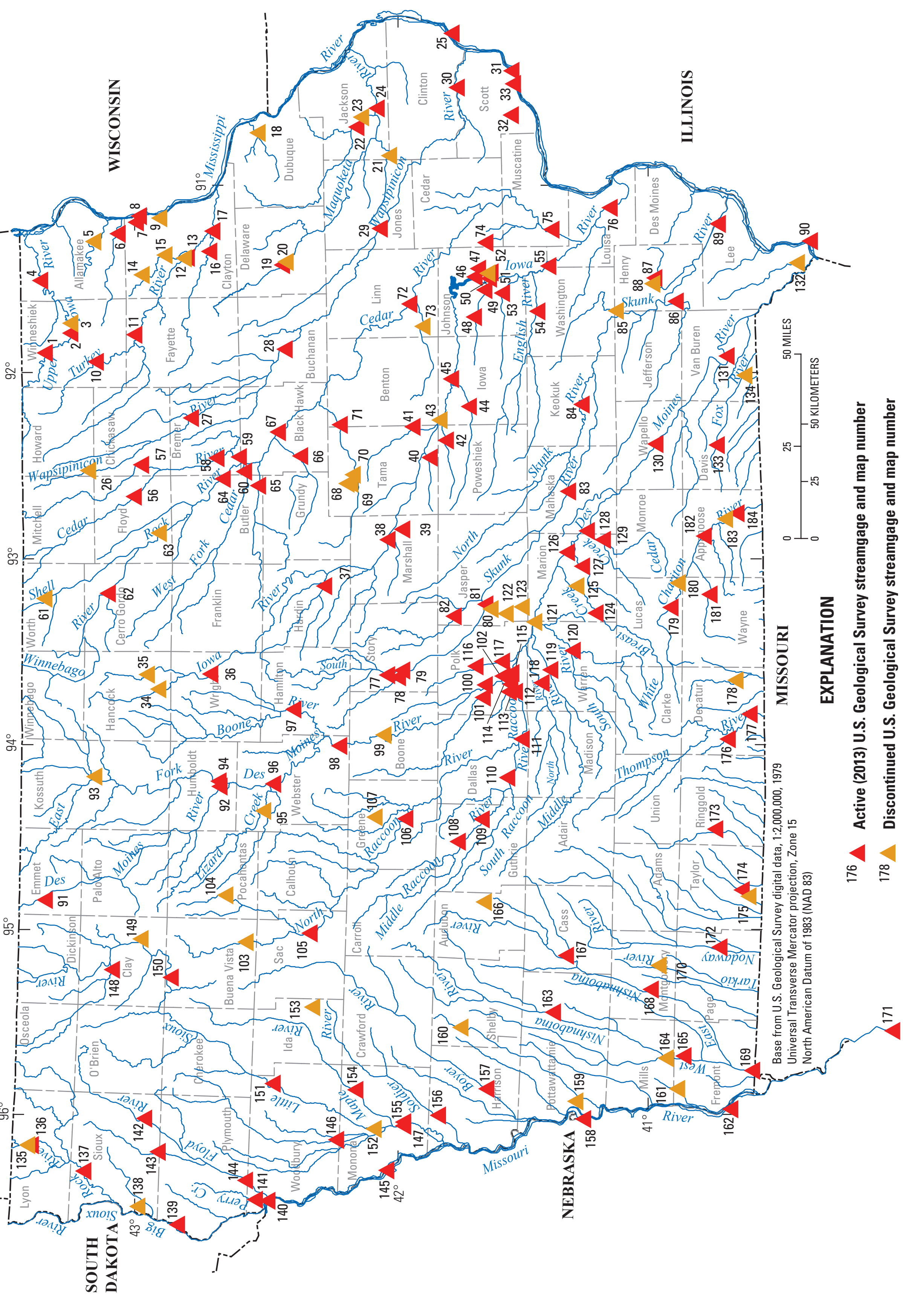

Figure 1. Location of U.S. Geological Survey streamgages for which statistical summaries are calculated in this report.

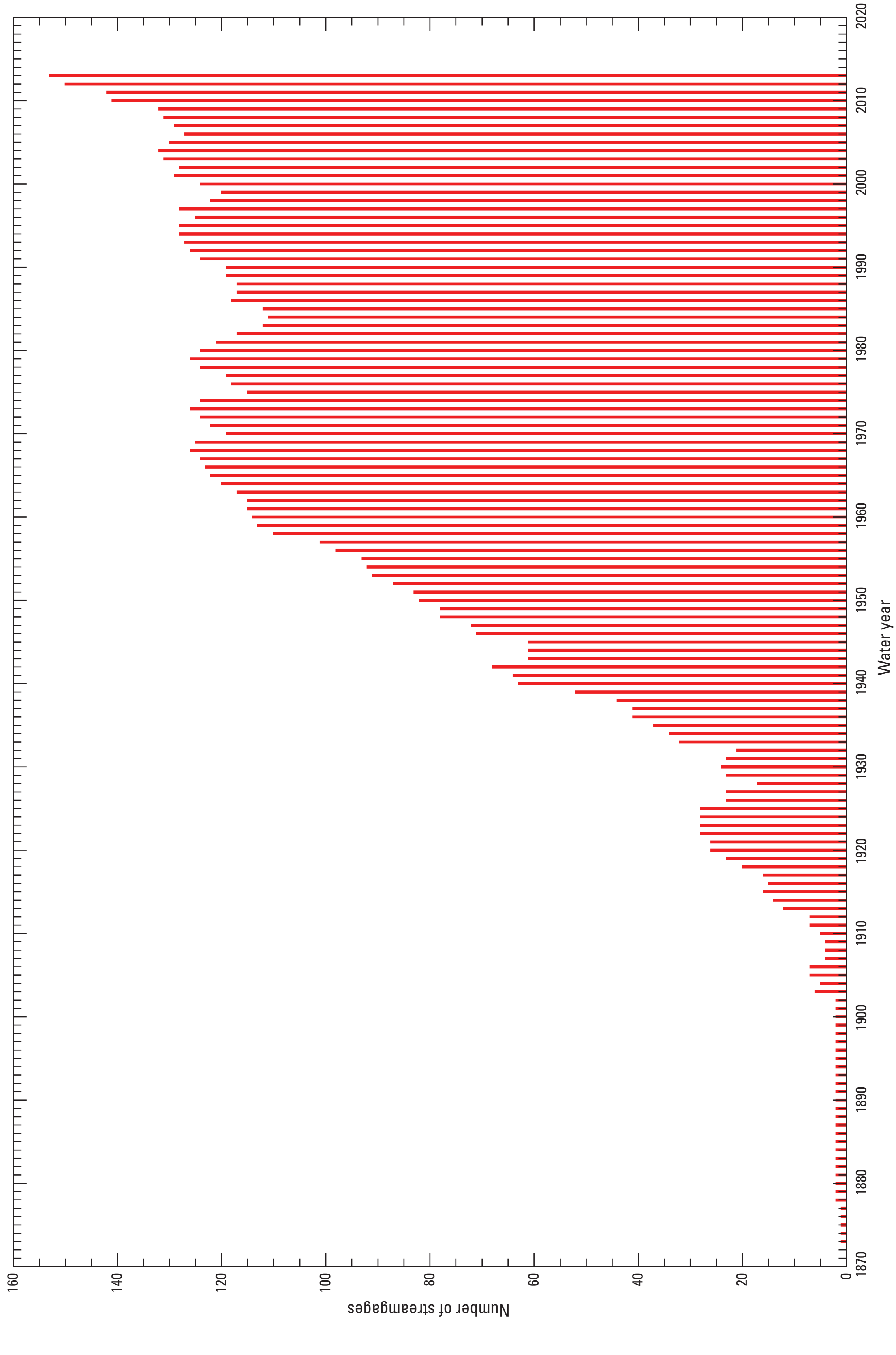

Figure 2. Number of daily-discharge streamgages operated in Iowa each water year, 1873–2013.

Explanation of Streamgage Summaries and Streamflow Statistics

Two sets of statistical summaries are presented for each streamgage (refer to link in table 1), which include (1) long-term statistics for the entire period of streamflow record and (2) recent-term statistics for or during the 30-year period of record from 1984 to 2013; however, for the AEPs of instantaneous peak discharges (flood frequencies), statistics are only calculated for the entire period of record. The recent-term statistics are only calculated for streamgages with streamflow records pre-dating the 1984 water year and with at least 10 years of streamflow data available during 1984–2013. The streamgage summaries and statistics consist of nine elements, which are presented in the following order for each streamgage:

- Streamgage description and links to all available data for a streamgage provided through the USGS NWISWeb interface (U.S. Geological Survey, 2015a) and through the USGS WaterWatch Toolkit (U.S. Geological Survey, 2015b).
- Graph of annual mean discharges, mean annual mean discharges, Kentau (Kendall's tau) statistics, *P*-values for the time series of annual mean discharges, 50-percent annual flow-duration discharges (median flows), and harmonic mean flows. Typically, a trend is considered to be significant if the probability (*P*) value (probability that a true null hypothesis of no trend is erroneously rejected) is less than or equal to 0.05 (Rasmussen and Perry, 2001; Eash and Barnes, 2012; Linhart and others, 2012; Eash and others, 2013), which represents a 95-percent confidence level. Thus, *P*-values less than or equal to 5 percent (α=0.05) indicate statistically significant trends (positive or negative).
- Graph of mean daily mean discharges.
- Graph of flow-duration curves.
- Monthly and annual flow durations, and Kentau statistics and *P*-values for the times series of annual flow durations.
- AEPs of instantaneous peak discharges, and Kentau statistics and *P*-value for the time series of annual peak discharges.
- AEPs of high discharges, and Kentau statistics and *P*-values for the annual time series of selected numbers of consecutive days for high discharges.
- ANPs of low discharges, and Kentau statistics and *P*-values for the annual time series of selected numbers of consecutive days for low discharges.
- ANPs of seasonal low discharges, and Kentau statistics and *P*-values for the annual time series of selected numbers of consecutive days for seasonal low discharges.

The Kendall's tau hypothesis test was used to analyze for trends to determine if there may be any statistically significant trends in the annual times series of streamflow data for mean discharges; flow durations; peak discharges; and selected numbers of consecutive days for high discharges, low discharges, and seasonal low discharges. The Kendall's tau test for annual mean discharges was calculated using the "kensen.test" within the USGS R package smwrStats (Lorenz, 2014c). Kendall's tau tests for annual flow durations were calculated using the USGS Surface Water Statistics (SWSTAT) program within the USGS ANNIE program (Flynn and others, 1995). The Kendall's tau test for annual peak discharges was calculated using the PeakFQ program (Veilleux and others 2014). Kendall's tau tests for the annual time series of selected numbers of consecutive days for high discharges, low discharges, and seasonal low discharges were calculated using the "Trend" preprocessing step of the "Integrated Frequency Analysis" procedure within the USGS surface water (SW) Toolbox program. The Kendall's tau test was used to calculate the monotonic relation between streamflow data (discharges) and time (water years or climatic years) (Helsel and Hirsch, 2002), and is a nonparametric test that can be used to indicate the likelihood of a positive or negative trend with time (Rasmussen and Perry, 2001). Using the Kendall's tau test, the rank of each discharge value in the annual time series is compared to the rank of the values following it in the series. If the second value is consistently greater than the first, the Kentau statistic is positive. If the second value is consistently lower, the Kentau statistic is negative. An equal number of positive and negative values would indicate that a trend does not exist. Thus, the Kentau statistic is a measure of the correlation between the series and time.

Wahl (1998) describes how Kendall's tau test results may be sensitive to multiyear sequences of larger or smaller discharges if the sequences happen near the beginning or end of the period of record used in the test. Although trend results are relatively insensitive to individual outliers, multiyear sequences of extremes near either end of the record can have a significant effect on the test results but may imply no systematic change. Annual time series of streamflow data indicated to have statistically significant trends in this study were not retested to determine if a statistically significant trend may not be indicated with the removal of annual discharges from either the beginning or the end of the record, or from both the beginning and the end of the record (Eash and others, 2013; Eash, 2014).

The streamgage summaries and statistics are presented in downstream order. Streamgages are assigned unique, 8-digit numbers for identification. The first two digits are a part number and refer to major drainage basins. Part 05 refers to the upper Mississippi River Basin and part 06 refers to the Missouri River Basin. The six remaining digits are assigned to the streamgage on the basis of downstream order (numbers increase from headwaters to mouth).

Three sets of statistics are presented for streamgages located downstream from flow-regulation dams: the first for the pre-regulated streamflow period, the second for the regulated streamflow period, and the third for the 1984–2013 regulated streamflow period, if at least 10 years of streamflow data are available for the 1984–2013 period. (Refer to the “Effects of Regulation and Water Use” section.)

Annual mean discharges, mean annual mean discharges, annual flow durations, AEPs of instantaneous peak discharges, and AEPs of high discharges were calculated for complete water years of streamflow data. The ANPs of low discharges were calculated for the climatic year. A climatic year is the 12-month period from April 1 through March 31.The climatic year is designated by the calendar year in which the climatic year ends and includes 3 of the 12 months of that year. Thus, the climatic year ending March 31, 2013, is the “2013 climatic year.” The climatic year is used for analyses of ANPs of low discharges because low-flow events in Iowa typically occur during the late summer through winter months. The ANPs of seasonal low discharges were calculated for complete 3-month periods of seasonal record.

More than 5,000 separate statistical analyses were calculated for this study to produce the more than 230,000 unique statistics presented in this report. Most of the statistics in this report were calculated using the USGS SW Toolbox computer program (Kate Flynn, U.S. Geological Survey, written commun., 2014), which implements the USGS SWSTAT program functionality (Lumb and others, 1990) within a modern Windows™ interface. Unless otherwise noted, all references to the SW Toolbox program are to SWSTAT functionality within SW Toolbox. Specifically, the monthly and annual flow durations were calculated using the “Duration/Compare” procedure within the SW Toolbox program; the AEP of high discharges and the ANP of low discharges and seasonal low discharges were calculated using the “Integrated Frequency Analysis” procedure within the SW Toolbox program. These two SW Toolbox procedures for statistical analyses of time-series data were obtained from the U.S. Environmental Protection Agency (EPA) Better Assessment Science Integrating point and Nonpoint Sources (BASINS) program (U.S. Environmental Protection Agency, 2013). BASINS is a multipurpose environmental analysis system designed to perform watershed- and water-quality-based studies. The AEPs of instantaneous peak discharges (flood frequencies) were calculated using the USGS PeakFQ program (version 7.1) (Flynn and others, 2006; Veilleux and others 2014). Annual mean discharges, mean annual mean discharges, 50-percent annual flow-duration discharges (median flows), harmonic mean flows, mean daily mean discharges, and flow-duration curves shown in the three graphs were calculated using three R scripts and four USGS R packages named DVstats, smwrBase, smwrGraphs, and smwrStats (Lorenz, 2013, 2014a, 2014b, 2014c). The streamflow daily values data used in the SW Toolbox and R-script calculations and the annual instantaneous peak-discharge data used in the PeakFQ calculations were retrieved from the USGS NWISWeb database (U.S. Geological Survey, 2015a).

Streamgage Description

The streamgage description provides, under various headings, information such as streamgage location, period of record, historical extremes outside the period of record, and other remarks pertinent to streamgage operation and regulation; additional information on streamgage description is provided at http://wdr.water.usgs.gov/current/documentation.html. The USGS Water-Supply Papers (WSPs) were the original medium for publishing streamflow data (for example Wells, 1959). The following information, as appropriate, is provided for each streamgage. Comments follow that clarify information presented under the various headings of the streamgage description.

LOCATION.—Location information is obtained from the most accurate maps available. The location of the streamgage with respect to the cultural and physical features in the vicinity and with respect to the reference place mentioned in the streamgage name is given. In the case of discontinued streamgages, the location is furnished using features present at the time the streamgage was in operation. In many instances, the identifying features have changed since the streamgage was discontinued. Public Land Survey System coordinates (township, range, section) are referenced to the fifth principal meridian unless noted otherwise. River mileages, given for only a few streamgages, were determined by methods given in “River Mileage Measurement,” Bulletin 14, revision of October 1968, prepared by the U.S. Water Resources Council (1968) or were provided by the U.S. Army Corps of Engineers (Fischer and Eash, 1998).

DRAINAGE AREA.—Drainage areas are measured using the most accurate maps available. Because the type of maps available varies from one drainage basin to another, the accuracy of drainage areas likewise varies. Drainage areas are updated as more accurate maps become available. Drainage areas of discontinued streamgages were determined at the time the streamgage was in operation.

PERIOD OF RECORD.—This term indicates the time period for which daily mean streamflow data are available for computation of the statistical summaries. For some streamgages, WSPs 1308, 1310, 1728, 1730, and 1914 are shown under this heading and they refer to Water-Supply Papers 1308 (Wells, 1959), 1310 (Wells, 1958), 1728 (Hendricks, 1964a), 1730 (Hendricks, 1964b), and 1914 (U.S. Geological Survey, 1971).

GAGE.—The type of streamgage that was used to collect the streamflow data. The datum of the streamgage is referenced to the National Geodetic Vertical Datum of 1929, except at some streamgages the datum is mean sea level when the records have been furnished to the USGS by other agencies. A condensed history of the types, locations, and datums of previous streamgages are also given under this heading.

REMARKS.—Additional information about the streamgage, such as conditions that affect natural streamflow or notes on the accuracy of the records at the site, is provided here.

EXTREMES OUTSIDE PERIOD OF RECORD.—Information here documents major floods or unusually low flows that occurred outside the stated period of record. The information may or may not have been obtained by the USGS.

Graph of Annual Mean Discharges

The annual mean discharges for the entire period of streamflow record are plotted on a graph. Also shown on the graph are lines depicting the mean of the annual mean discharges, the 50-percent annual flow-duration discharge (median flow), and the harmonic mean flow for the entire streamflow period of record and for the 1984–2013 streamflow period of record, if the streamflow record pre-dates the 1984 water year and at least 10 years of streamflow data are available for the 1984–2013 period. The time series of annual mean discharges are used for the Kendall’s tau hypothesis test to analyze for trends. The results of the Kendall’s tau tests are listed in the explanation following the mean annual mean discharge value and period of record. The harmonic-mean-flow statistic can serve as a design flow for human health criteria that are based on lifetime exposures because it can be used to calculate the average exposure concentration of a contaminant for an average contaminant loading rate (Rossman, 1990; Koltun and Whitehead, 2002); see Eash and Barnes (2012) for more information on the harmonic-mean-flow statistic. All statistics are calculated using only complete water years of record. The period of record listed on the graph does not account for water years of missing streamflow data; see the monthly and annual flow-duration table for a listing of complete water years.

Graph of Mean Daily Mean Discharges

The mean of the daily mean discharges is plotted on a graph for each day of the water year. The mean of the daily mean discharges is calculated using only complete water years of record for the entire streamflow period of record and for the 1984–2013 streamflow period of record, if the streamflow record pre-dates the 1984 water year and at least 10 years of streamflow data are available for the 1984–2013 period. For example, if the entire period of record for a streamgage includes 100 complete water years of record for the period 1914–2013, the mean of the daily mean discharges for October 1 was calculated from 100 daily mean discharge values collected for October 1 during 1914–2013; likewise, the mean of the daily mean discharges is calculated for each other day of the water year. Water years listed on the graph do not account for missing years of streamflow data; see the monthly and annual flow-duration table for a listing of complete water years.

Graph of Flow-Duration Curves

The flow-duration curves are plotted on a graph for the entire streamflow period of record and for the 1984–2013 streamflow period of record, if the streamflow record pre-dates the 1984 water year and at least 10 years of streamflow data are available for the 1984–2013 period. The flow-duration curve is a cumulative frequency curve that shows the percent of time specified discharges were equaled or exceeded during a given period (Searcy, 1959); the flow-duration curve combines in one curve the flow characteristics of a stream throughout the range of discharge, without regard to the sequence of the occurrence. The flow-duration curves are calculated using only complete water years. Water years listed on the graph do not account for missing years of streamflow data; see the monthly and annual flow-duration table for a listing of complete water years.

Monthly and Annual Flow Durations

The monthly and annual flow-duration table is a frequency analysis of the daily-discharge values. The daily values are sorted by value and the percentiles calculated. Because the flow durations are calculated on daily values, the percentiles are the same as “percentage of days discharge equaled or exceeded.” For example, if the 90-percent flow-duration value for October is 300 cubic feet per second (ft^3/s), then 90 percent of the October daily discharge values in the period of record were greater than or equal to 300 ft^3/s. The preceding graphs of flow-duration curves are plots of the annual flow-duration values listed in the table. Results of Kendall’s tau tests are only presented for the annual flow-duration time series. The results of the Kendall’s tau tests are not independent of each other and should be considered in aggregate to evaluate for trends. Flow durations are calculated using only complete water years of record.

Annual Exceedance Probability of Instantaneous Peak Discharges

The AEP of instantaneous peak discharges, also called flood-frequency discharges, are calculated using procedures recommended by the Interagency Advisory Committee on Water Data (1982). An AEP curve is developed by fitting a Pearson Type-III distribution to the logarithms (base 10) of the annual instantaneous peak discharges collected at a streamgage. In addition to the annual peak discharges measured during the period of systematic record collection (also called the “systematic record”), historic peak-flood information (called the “historical record”) often is included in the analyses to effectively extend the length of the flood record.

The systematic record length is listed as the "Number of peaks" at the bottom of the table and the "historical period length" is listed in the middle of the table. If the AEP curve is historically adjusted, the historic period length is greater than the systematic record length, otherwise it is equal to the systematic record length.

An AEP peak-discharge analysis named the expected moment algorithm (EMA), along with a test for detecting low outliers named the multiple Grubbs-Beck (MGB) test, collectively referred to as the EMA/MGB analysis method (Cohn and others, 1997, 2001, 2013; Eash and others, 2013; Veilleux and others, 2014), was used to calculate the AEP of instantaneous peak discharges for this study. The EMA/MGB analysis method is an optional analysis method within the USGS PeakFQ program (Veilleux and others, 2014). Results of a statewide regional skew study (Veilleux and others, 2012; Eash and others, 2013) were used with the EMA/MGB analysis method to calculate the AEP of instantaneous peak discharges for this study.

The Interagency Advisory Committee on Water Data (1982) recommends that improved estimates of the AEP of peak discharges at streamgages can be obtained by weighting the AEP log-Pearson Type III estimate (EMA/MGB estimate) with a regional regression equation (RRE) estimate using the variance of prediction for each of these two estimates. The variance of prediction can be thought of as a measure of the uncertainty in either the EMA/MGB estimate or the RRE estimate. If the two estimates are assumed to be independent and are weighted inversely proportional to their associated variances, the variance of the weighted estimate will be less than the variance of either of the independent estimates. Optimal weighted estimates of the AEP of instantaneous peak discharges were calculated for this study using the Weighted Independent Estimates (WIE) computer program (Cohn and others, 2012; Eash and others, 2013). The RRE estimates that were used to calculate the WIE estimates for streamgages in this study were obtained from RREs developed for three flood regions defined for Iowa (Eash and others, 2013). The AEP of instantaneous peak discharges tables present WIE estimates and EMA/MGB estimates for a streamgage if the RREs are applicable for calculating WIE estimates (Eash and others, 2013). The WIE estimates are considered to provide better estimates of the AEP of instantaneous peak discharges and are the recommended estimates to use for streamgages, following guidance provided by the USGS Office of Surface Water Technical Memorandum 2010.05 (U.S. Geological Survey, 2010). The EMA/MGB estimates are presented for comparison purposes. Tables of the AEP of instantaneous peak discharges are only presented for the entire streamflow period of record, and not for the 1984–2013 period of record, because of the estimation improvement obtained from historically adjusting the AEP curves for streamgages when historic peak-flood information is available (Interagency Advisory Committee on Water Data, 1982; Cohn and others, 1997; Stedinger and Cohn, 1987; Hosking and Wallis, 1986; Tasker and Thomas, 1978). Also, the AEP of peak discharges becomes more statistically reliable with longer record lengths (Feaster, 2010; Soong and others, 2004). The time series of annual instantaneous peak discharges are used for the Kendall's tau hypothesis test to analyze for trends.

Flood-frequency tabulations list the magnitudes of theoretical instantaneous peak discharges for selected AEPs and corresponding recurrence intervals (RI). An AEP is an estimate of the likelihood of a flood of a specified magnitude happening in any 1 year. For example, a flood magnitude that has a 1-percent chance (AEP=0.01) of being exceeded during any particular year is expected to be exceeded on average once during any 100-year period (RI=100) (Holmes and Dinicola, 2010). Percent probability is the inverse of the RI multiplied by 100. Although the annual probability is an estimate of the likelihood of a flood discharge of a specific magnitude happening in any 1 year, more than one flood discharge with a specific magnitude and AEP or RI could happen in the same year.

Flood-frequency tabulations for regulated periods of record for regulated streamgages downstream from Federal dams on the Chariton, Des Moines, Iowa, Mississippi, and Missouri Rivers were obtained from the U.S. Army Corps of Engineers (2003, 2004a, 2004b, 2009, 2010), except for Des Moines River near Runnells (streamgage 05487500, fig. 1, map number 121) and Chariton River near Moulton (streamgage 06904010, fig. 1, map number 184).

Annual Exceedance Probability of High Discharges and Annual Nonexceedance Probability of Low Discharges

The AEP of high discharges and the ANP of low discharges and seasonal low discharges also are based on fitting the Pearson Type-III distribution to the logarithms of the respective discharges. The USGS has established standard methods for estimating high-flow and low-flow frequency statistics for streamgages (Riggs, 1968, 1972; Lumb and others, 1990; Eash and Barnes, 2012). Unlike flood-frequency analyses, however, no historical data or regional skew data are used. For high-flow discharges, the AEP is the likelihood that the largest discharge will be greater than or equal to the stated magnitude in any 1 year. For annual and seasonal low-flow discharges, the ANP is the likelihood that the smallest discharge will be less than or equal to the stated magnitude in any 1 year.

The AEPs of high discharges are calculated using the maximum mean discharges for any specific number of consecutive days (*N*-day high flows) during an annual period (water year) for a selected period of record. The ANPs of low discharges are calculated using the minimum mean discharges for any specific number of consecutive days (*N*-day low flows) during an annual period (climatic year) for a selected period of record. For example, the statistic for the 7-day low-flow value at the 0.10 nonexceedance probability is calculated from the annual series of minimum 7-day mean flows for a streamgage. From the daily mean discharge record, the mean flow for each consecutive 7-day period is determined and the lowest mean value for each year is assigned to that year in the annual series. The series of annual minimum 7-day values are then fit to a log-Pearson Type III distribution to develop an ANP curve (Riggs, 1972). Selected ANP discharge values, such as the 7-day low-flow value at the 0.10 nonexceedance probability, are then interpolated from the curve. More specific information about the log-Pearson Type III distribution can be found in Interagency Advisory Committee on Water Data (1982). Low-flow, or high-flow, frequency statistics also can be calculated on a seasonal or monthly basis by limiting the daily mean discharge data used for the annual series to just the season or month of interest. The time series of annual maximum *N*-day values used to calculate AEPs for high discharges and the time series of annual and seasonal minimum *N*-day values used to calculate ANPs for low discharges are the time series used for the Kendall's tau hypothesis test to analyze for trends. The results of these Kendall's tau tests are not independent of each other and should be considered in aggregate to evaluate for trends. Annual and seasonal *N*-day, low-flow discharge values for some streamgages included in this study were equal to zero. A conditional probability adjustment for zero flow values (appendix 5 in Interagency Advisory Committee on Water Data, 1982) was used for low-flow frequency analyses for streamgages with one or more annual or seasonal *N*-day discharge values of zero.

The AEPs for high discharges and the ANPs for low discharges (especially for low discharges) are prone to inconsistencies. For example, a 3-day low-flow value at the 0.01 nonexceedance probability might be calculated to be less than the 1-day low-flow value calculated for the same nonexceedance probability. When this situation occurred, the frequency curves were modified graphically from the log-Pearson Type-Ill distribution as recommended by the USGS Office of Surface Water Technical Memorandum 89.11 (U.S. Geological Survey, 1989). The AEP values of high discharges, especially for 1- and 3-day high-flow values, occasionally exceeded the AEP values of instantaneous peak discharges when historical records are included in the AEP analyses of peak discharges. When these inconsistencies occurred, the AEP of high discharges for the affected *N*-day analyses were presented as not determined.

The AEPs of high discharges were not calculated for regulated periods of record for regulated streamgages downstream from Federal dams on the Chariton, Des Moines, Iowa, and Missouri Rivers because of the effects of regulation. Users requiring the AEP of high discharges for these streamgages should contact the U.S. Army Corps of Engineers.

Data Considerations

Period of Record

The reliability of statistical streamflow data is related to the length of streamflow record. The Interagency Advisory Committee on Water Data (1982) recommends that at least 10 years of record be used for calculating estimates of the AEP of peak discharges; therefore, the length-of-record criterion for including a streamgage in this report was set at 10 years. Even with this criterion, statistical computations based on short periods of record (for example, 10 to 15 years) still are less reliable than computations based on long periods of record (for example, 50 or more years).

The lengths of streamflow records at streamgages included in this report vary greatly. Extreme high or low flows that are part of the streamflow record of one streamgage might not be part of the record of another streamgage, resulting in apparent inconsistencies in the streamflow statistics when comparing data from two streamgages.

Data Rounding

The number of significant figures used to report discharges is based on the magnitude of the discharge. Flow duration and probability discharges are rounded according to the criteria listed in table 2.

Table 2. Significant figures used for reporting flow duration and probability discharges.

Range of discharge (cubic feet per second)	Significant figures
less than 0.010	1
0.10 to 0.99	2
1.0 to 9.9	2
10 to 99	2
greater than or equal to 100	3

Effects of Regulation and Water Use

Streamflows measured at several Iowa streamgages located downstream from Federal dams on the Chariton, Des Moines, Iowa, and Missouri Rivers are affected by reservoir regulation. Reservoir regulation has the effect of decreasing high flows and augmenting low flows downstream from the dam. Because regulation affects streamflow characteristics, three sets of statistics are calculated for streamgages located downstream from reservoirs. The first set is calculated for the period of record before reservoir operation began (pre-regulated streamflow period), the second set is calculated for the period after reservoir operation began (regulated streamflow period), and the third set is calculated for the 1984–2013 regulated streamflow period. Only one set of statistics is calculated for the three Mississippi River streamgages, however, because the Mississippi River locks and dams were built for river navigation and have only a minimal regulatory effect on streamflows. For Missouri River streamflow statistics included in this report, significant streamflow regulation is considered to have begun in water year 1953 when storage behind Fort Randall Dam, South Dakota, began in late 1952.

The streamflow statistics in this report are not adjusted for the effects of water use. Total water withdrawals in Iowa are approximately 79 percent from surface water and 21 percent from groundwater (Maupin and others, 2014). The primary uses of surface water in Iowa are thermoelectric power generation, public-water supply, mining, and livestock watering (Maupin and others, 2014). Other surface-water uses include aquaculture, self-supplied industrial, and irrigation. Although some of this water is used consumptively, most of it is returned to the streams.

Summary

Statistical summaries of streamflow data collected at 184 streamgages in Iowa are presented in this report. All streamgages included for analysis have at least 10 years of continuous record collected before or through September 2013. This report is an update to two previously published reports that presented statistical summaries of selected Iowa streamflow data through September 1988 and September 1996. The statistical summaries include (1) monthly and annual flow durations, (2) annual exceedance probabilities of instantaneous peak discharges (flood frequencies), (3) annual exceedance probabilities of high discharges, and (4) annual nonexceedance probabilities of low discharges and seasonal low discharges. Also presented for each streamgage are graphs of the annual mean discharges, mean annual mean discharges, 50-percent annual flow-duration discharges (median flows), harmonic mean flows, mean daily mean discharges, and flow-duration curves. Two sets of statistical summaries are presented for each streamgage, which include (1) long-term statistics for the entire period of streamflow record and (2) recent-term statistics for or during the 30-year period of record from 1984 to 2013. The recent-term statistics are only calculated for streamgages with streamflow records pre-dating the 1984 water year and with at least 10 years of record during 1984–2013. The streamflow statistics in this report are not adjusted for the effects of water use; although some of this water is used consumptively, most of it is returned to the streams.

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