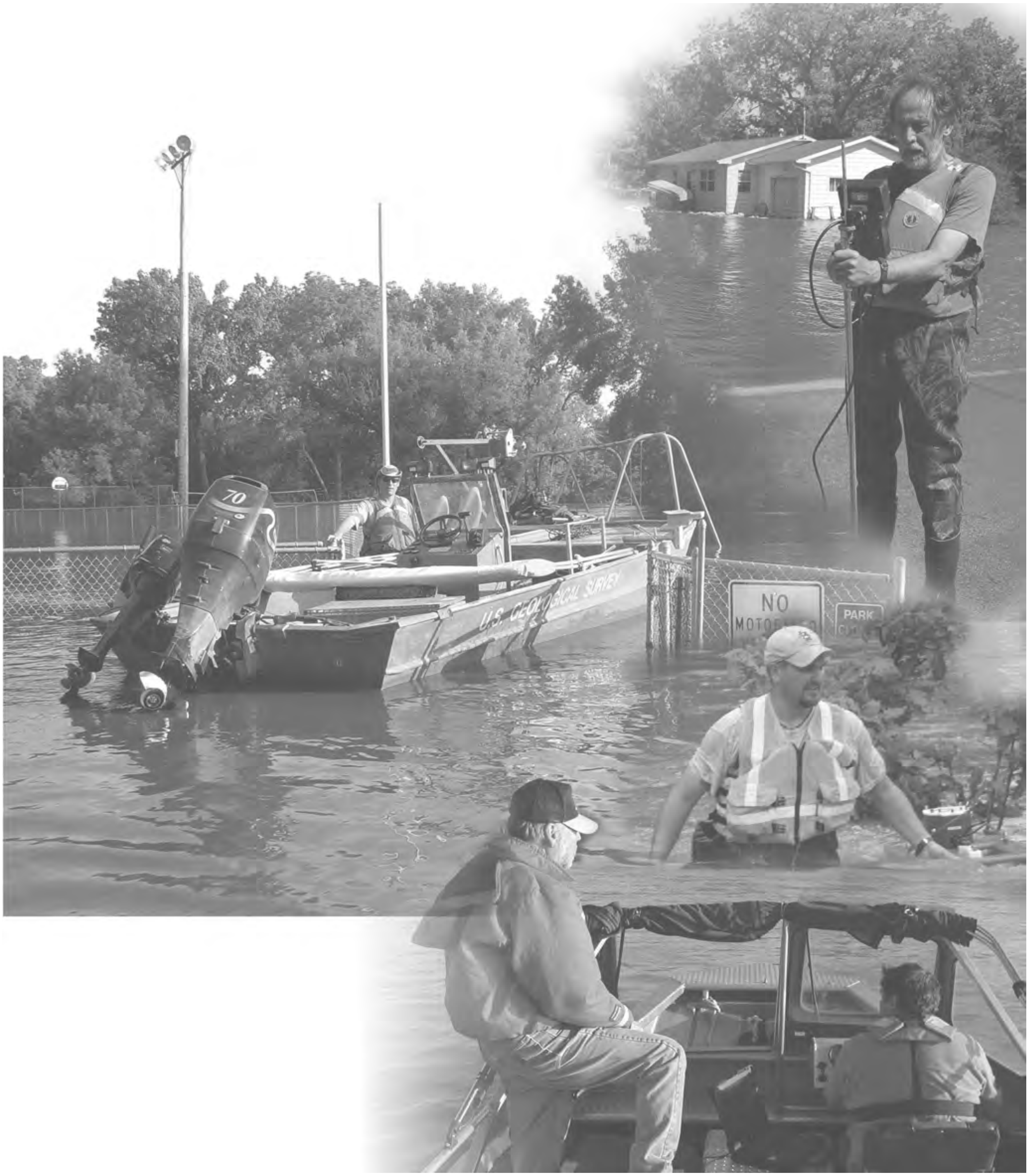
Flooding in the United States Midwest, 2008

Professional Paper 1775

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



Front cover.
Left center: USGS personnel launching boat in Janesville, Iowa park. Boat was used to access the streamgage on the Cedar River at Janesville, Iowa (USGS streamgage 05458500). Photograph by Scott Strader, USGS.
Upper right: USGS hydrographer analyzing stream velocity data collected in the road overflow caused by West Fork Cedar Creek in Finchford, Iowa (USGS streamgage 05458900). Photograph by Don Becker, USGS.
Center right: USGS hydrographer retrieving streamflow measurement instrument temporarily lodged in overbank trees on Long Branch Creek at Atlanta, Missouri (USGS streamgage 06906150). Photograph by C. Shane Barks, USGS.
Lower right: USGS hydrographers making a measurement of streamflow on the Gasconade River at Jerome, Missouri (USGS streamgage 06933500). Photograph by Richard Huizinga, USGS.

Flooding in the United States Midwest, 2008

By Robert R. Holmes, Jr., Todd A. Koenig, and Krista A. Karstensen

Professional Paper 1775

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

U.S. Department of the Interior
KEN SALAZAR, Secretary

U.S. Geological Survey
Marcia K. McNutt, Director

U.S. Geological Survey, Reston, Virginia: 2010

For more information on the USGS—the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment, visit http://www.usgs.gov or call 1-888-ASK-USGS

For an overview of USGS information products, including maps, imagery, and publications, visit http://www.usgs.gov/pubprod

To order this and other USGS information products, visit http://store.usgs.gov

Suggested citation:
Holmes, R.R., Jr., Koenig, T.A., and Karstensen, K.A., 2010, Flooding in the United States Midwest, 2008: U.S. Geological Survey Professional Paper 1775, 64 p.

Library of Congress Cataloging-in-Publication Data

Holmes, Robert R., 1965-
Flooding in the United States Midwest, 2008 / by Robert R. Holmes, Jr., Todd A. Koenig, and Krista A. Karstensen.
p. cm. -- (Professional paper ; 1775)
ISBN 978-1-4113-2841-9
1. Floods--Middle West. 2. Flood damage--Middle West. I. Koenig, Todd A. II. Karstensen, Krista A. III. Geological Survey (U.S.) IV. Title. V. Series: U.S. Geological Survey professional paper ; no. 1775.
GB1399.4.M6H65 2010
551.48'90978'090511--dc22

2010020227

Contents

Figures

USGS hydrographer inspecting the gage house on the Current River near Doniphan, Missouri (USGS streamgage 07068000). Photograph by Paul Rydlund, USGS.

USGS hydrographer measuring streamflow on the Meramec River near Eureka, Missouri (USGS streamgage 07068000). Photograph by Paul Rydlund, USGS

Tables

Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
	Length	
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	259.0	hectare (ha)
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
	Flow rate	
foot per second (ft/s)	0.3048	meter per second (m/s)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)

Glossary

Note: Glossary definitions are taken from Langbein and Iseri (1960) whenever possible

Annual exceedance probability (AEP) The probability, or chance, of a flood of a given streamflow magnitude being equaled or exceeded in any given year. The probability can be expressed as a fraction, decimal, or percentage.

Annual exceedance probability flood quantile (AEP flood quantile) The value of the peak streamflow that corresponds to a particular annual exceedance probability (for example, 1-percent AEP flood quantile)

Bulletin 17B Report by the Interagency Advisory Committee on Water Data, published in 1982, that delineates the recommended method for flood-probability analysis in the United States.

Confidence Limits To gauge the accuracy of an approximation based on a probability distribution, upper and lower confidence limits can be estimated based on the properties of the probability distribution. This report includes the 95-percent confidence limits of the estimate of the flood quantiles as computed by the methods outlined in Bulletin 17B.

Discharge In its simplest concept discharge means outflow; therefore, the use of this term is not restricted as to course or location, and it can be applied to describe the flow of water from a pipe or from a drainage basin.

Flood An overflow or inundation that comes from a river or other body of water, and causes or threatens damage.

Flood Peak The highest value of the stage or streamflow attained by a flood; often designated as peak stage or peak streamflow respectively.

Flood Quantile See “Annual Exceedance Probability Flood Quantile”

Flood Stage The stage at which overflow of the natural banks of a stream begins to cause damage in the reach in which the water surface elevation is measured.

Hydrograph A graph showing stage, streamflow, velocity, or other property of water with respect to time.

Log-Pearson Type III Probability Distribution (LPIII) One of the family of probability distributions developed by Karl Pearson that is used in the United States as a best-fit for the distribution of annual peak flood streamflows in the Bulletin 17B analysis procedures developed by the Interagency Advisory Committee on Water Data (1982).

Peak-of-Record Streamflow The largest instantaneous streamflow value for the period that data have been collected.

Peak Stage See “Flood Peak.”

Peak Streamflow See “Flood Peak.”

Precipitation As used in hydrology, precipitation is the discharge of water, in liquid or solid state, out of the atmosphere, generally upon a land or water surface. It is the common process by which atmospheric water becomes surface or subsurface water. The term “precipitation” is also commonly used to designate the quantity of water that is precipitated.

Probability A means to express the likelihood of something occurring, also known as chance. The probability can be expressed as a fraction, decimal, or percentage.

Probability Distribution Describes the range of possible values that a random variable can attain and the probability that the value of the random variable is within any subset of that range.

Rating Curve A graph showing the relation between the stage (gage height), usually plotted as the ordinate, and amount of water flowing in the channel (streamflow) expressed as volume per unit time, plotted as abscissa.

Recurrence Interval The average interval of time within which the given flood is expected to be equaled or exceeded once.

Regional Regression Equation Equation developed through use of regression techniques that relate the flood-probability data at many streamgages in a region to the basin characteristics of the streams monitored by the streamgages. For any location along a stream, a user can enter the basin characteristics (drainage area, basin slope, etc.) as independent variables into the equations and compute various flow characteristics (for example, 1-percent AEP flood quantile, 2-percent AEP flood quantile, and annual mean streamflow).

Stage Height of a water surface above an established datum, also known as gage height.

Streamflow The discharge that occurs in a natural channel. Although the term discharge can be applied to flow in a canal, the word streamflow uniquely describes the discharge in a surface stream course. The units of measurement often are reported in cubic feet per second (ft^3/s).

Streamgage A particular site on a stream where a record of streamflow is obtained.

Trend The change of a particular variable with either time or spatial location as computed by statistical analysis.

Trend Magnitude The value of the trend as computed by a statistical analysis.

USGS streamgage on the Meramec River near Eureka, Missouri (USGS streamgage 07019000). Photograph by Robert Holmes, USGS.

Flooding at Burlington Street Bridge over the Iowa River at Iowa City, Iowa, July 2008. Photograph by James Caldwell, USGS.

Flooding in the United States Midwest, 2008

By Robert R. Holmes, Jr., Todd A. Koenig, and Krista A. Karstensen

Abstract

During 2008, record precipitation amounts, coupled with already saturated soils, resulted in flooding along many rivers in the United States Midwest. Separate flooding events occurred in January, February, March, April, May, June, July, and September of 2008. The June floods were by far the most severe and widespread with substantial (and in places record) flooding and damage occurring in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Oklahoma, South Dakota, and Wisconsin. Indiana had the most recurrent flooding during 2008, with peak-of-record streamflows occurring during January, February, March, June, and September. During 2008, peak-of-record streamflows were recorded at more than 147 U.S. Geological Survey (USGS) streamgages. The annual exceedance probability of the peak streamflows at 26 streamgages was less than 0.2 percent and between 0.2 and 1 percent at 67 streamgages. Trends in flood magnitudes were computed for USGS Midwest streamgages that had no regulation. No Midwest-wide systematic trends upward or downward were evident, although clusters of consistent trends (both upward and downward) were detected in parts of the Midwest.

Introduction

Flooding occurred on numerous rivers throughout the Midwestern United States (hereafter referred to as the Midwest) at various times during 2008 (fig. 1). The Midwest, and in particular the southern Midwest, has been identified as an area of the conterminous United States where the largest flood streamflows are likely to occur because of the close proximity of subtropical moisture from the Gulf of Mexico (O’Connor and Costa, 2003). This tendency toward large floods was dramatically displayed in 2008 as flooding dominated the media for weeks, with reports of property destruction, evacuations, and loss of life. At various times during 2008, flooding in the Midwest occurred in parts of Arkansas, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Oklahoma, South Dakota, and Wisconsin. Examples of the severity of the flooding include the Cedar River, which inundated 14 percent of Cedar Rapids, Iowa, displaced more than 24,000 people, and damaged or destroyed an estimated 5,400 houses and 700 businesses (National Weather Service, 2009). In southwestern Wisconsin, an earthen embankment between Lake Delton and the Wisconsin

USGS hydrographer making a streamflow measurement on the Salt Fork near Sidney, Illinois (USGS streamgage 03337848). Photograph by Robert Holmes, USGS.

Figure 1. The United States Midwest and general areas of flooding streams, January to September, 2008.

River failed, causing a rapid emptying of Lake Delton and more than $5 million in property destruction (Adams, 2008). In Columbus, Indiana, the Columbus Regional Hospital had more than $125 million in damages (Indiana News Center, 2008), and at least 70 businesses were inundated and suffered damages (Indianapolis Star, 2008). The June 2008 flooding resulted in the loss of 11 lives and damages in excess of $5 billion (National Weather Service, 2009).

The 2008 Midwest floods stand out not only with respect to their cost in human lives, property damage, and environmental effects, but also with respect to their persistence. Separate incidences of flooding occurred over several months in parts of the Midwest; for example, Indiana had severe flooding during January, February, March, June, and September. Because of the severity and unusual repetitiveness of the flooding in parts of the Midwest, documenting the 2008 floods is essential.

Previously published U.S. Geological Survey (USGS) reports provide detailed documentation and analysis of the 2008 flooding in particular geographic areas of the Midwest (Fitzpatrick and others, 2008; Funkhouser and Eng, 2008; Morlock and others, 2008), and two of these reports contain flood-inundation maps for selected rivers in Indiana and Wisconsin. This report consolidates the flooding information and documents the flood peaks (stage and streamflow) for all States in the Midwest that were affected by the 2008 floods. Flood peak data are reported for USGS streamgages in the Midwest that had peak streamflows with an annual exceedance probability (AEP) of less than 10 percent. AEP is the probability, or chance, of a flood of a given streamflow magnitude being equaled or exceeded in any given year. In addition, flood peak data for selected streamgages, which had AEPs greater than 10 percent, also are included to aid in comparing the 2008 floods with previous floods. Documenting the flood peaks, along with the antecedent conditions, flood chronology, AEP, and flood trends, will help put the 2008 floods in historic context and facilitate public and private consideration of flood-control, land-use, and flood-insurance regulations by local and regional citizens and elected officials.

Wabash River at Riverton, Indiana (USGS streamgage 03342000). Photograph by Paul Baker, USGS.

The Role of the U.S. Geological Survey in Flood Response

The USGS was established in 1879 by Congress to classify the public lands and "examine the geological structure, mineral resources, and products of the national domain" (Rabbitt, 1989). As part of this mission, the USGS provides practical, unbiased information about the Nation's rivers and streams that is crucial in mitigating hazards associated with floods. Some of the scientific investigations conducted by the USGS that include data collection and scientific interpretation to address flood issues include the following:

- Operating a nationwide network of long-term streamgages;
- Determining and documenting high water-mark elevations;
- Constructing inundation maps;
- Determining peak streamflow at miscellaneous locations by using indirect methods;
- Collecting remotely-sensed geospatial information;
- Analyzing trends, geographic distribution, and flood probabilities;
- Determining paleoflood occurrence, timing, and magnitude; and
- Modeling flood processes, including rainfall-runoff, flood wave movement, multidimensional hydraulics of floods, and sediment transport.

The operation of more than 7,500 active streamgages nationwide enables the USGS to provide data for a variety of needs, with one of the most important needs being flood prediction and characterization. USGS streamgages provide critical real-time streamflow and stage data during flooding events to support the operational programs of the National Weather Service (NWS; flood forecasting), U.S. Army Corps of Engineers (USACE; water-control, flood-fighting, and mitigation activities), Federal Emergency Management Agency (FEMA; emergency management and mitigation), and numerous State and local agencies. The USGS expends extra effort to keep streamgages operational during floods, when damage to the streamgages increases. USGS streamgages operate autonomously for collecting stage data; however, on-site direct streamflow measurements are required and consist of USGS personnel making on-site physical observations of stream velocity and stream depth to determine streamflow. These direct streamflow measurements are required periodically to calibrate the stage-streamflow rating curve (rating curve). The rating curve is used to determine the streamflow from the stage data when USGS personnel are not physically present at the streamgage to make a streamflow measurement.

The need for direct streamflow measurement (fig. 2) to calibrate the rating curve increases during floods, because the rating curve can change as a result of river-channel changes. An example of the changes that can occur in the rating curve that would be detected only by actual field measurements is shown in figure 3. In this figure, two direct streamflow measurements made during flooding in 2008 (numbers 353 and 354, fig. 3) on the Platte River near Kearney, Nebraska, resulted in a more than 1-foot (ft) correction of the rating curve at the upper end (above a stage of 5.9 ft) of the rating. At a streamflow of 15,000 cubic feet per second (ft^3/s), the stage on the rating curve changed by 1.2 feet, from approximately 7.0 to 8.2.

The importance of accurate rating curves is demonstrated by examination of the potential impact of an incorrect rating curve on the flood-forecasting operations of the NWS. The NWS uses USGS rating curves as part of their forecasting process to estimate the forecasted stream stage from their computer-model prediction of forecasted streamflow. Based on the example in figure 3, if the original rating curve had been used, a NWS computer-model prediction of 15,000 ft^3/s would have resulted in the NWS predicting a corresponding stage of 7.0 ft. In actuality, as the new rating indicates, the stage would have been approximately 8.2 ft. In the absence of the USGS rating curve calibration efforts, an under-prediction of approximately 1.2 ft would have occurred, with potentially serious implications for life and property.

To meet critical needs for real-time streamflow data, the USGS mobilizes all available field personnel in areas of flooding to make direct streamflow measurements and maintain streamgages in operational readiness. The rapid response of USGS field personnel provides reliable and accurate stage and streamflow data in near real time to the many entities that rely on these data while minimizing interruptions in the dissemination of data that would hamper flood-response operations. During the June 2008 flooding, the USGS made 449 direct streamflow measurements throughout the Midwest to ensure the accuracy of the rating curves.

USGS hydrographer determining the outside stage for the Skillet Fork near Wayne City, Illinois (USGS streamgage 03380500). Photograph by Robert Holmes, USGS.

Figure 2. U.S. Geological Survey hydrographer measuring streamflow on the Platte River near Sharps Station, Missouri (USGS streamgage 06821190), with an acoustic Doppler current profiler (ADCP) mounted to a tethered boat to collect velocity and depth readings that are sent by radio link to a laptop computer inside the field vehicle. The gage house for this site can be seen in the background. Photograph by Chris Rowden, USGS.

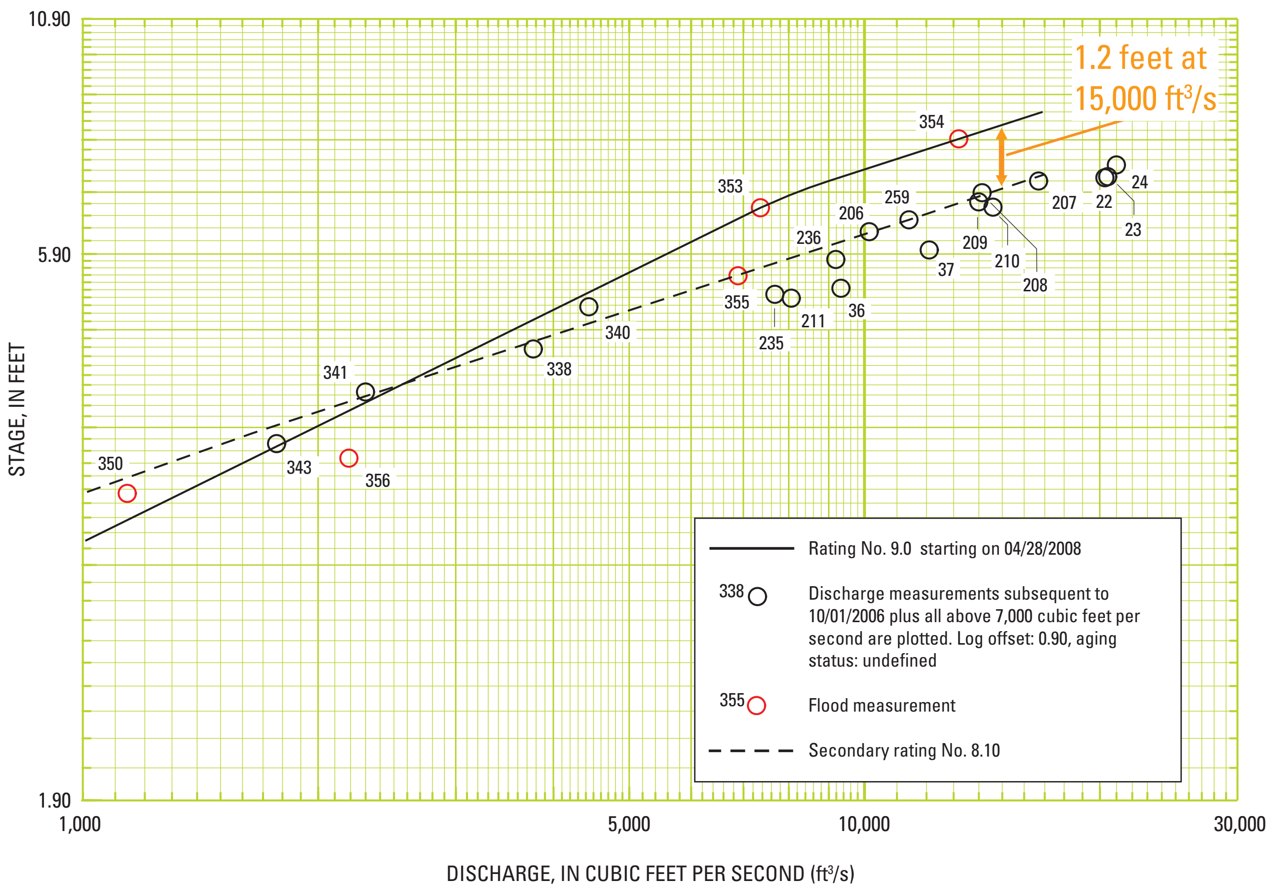


Figure 3. Changes in the rating curve for the Platte River near Kearney, Nebraska (USGS streamgage 06770200), as a result of on-site direct streamflow measurements made in May 2008.

2008 Flooding: Causes, Chronology, and Magnitude

An understanding of the causes of flooding requires some knowledge of hydrology and the hydrologic cycle. The hydrologic cycle is described by Hjelmfelt and Cassidy (1975) as follows:

> "Water occurs in many places and in many phases on, in, and over the earth. The transformation from one phase to another and the motion from one location to another constitutes the hydrologic cycle, which is a closed system having no beginning nor end."

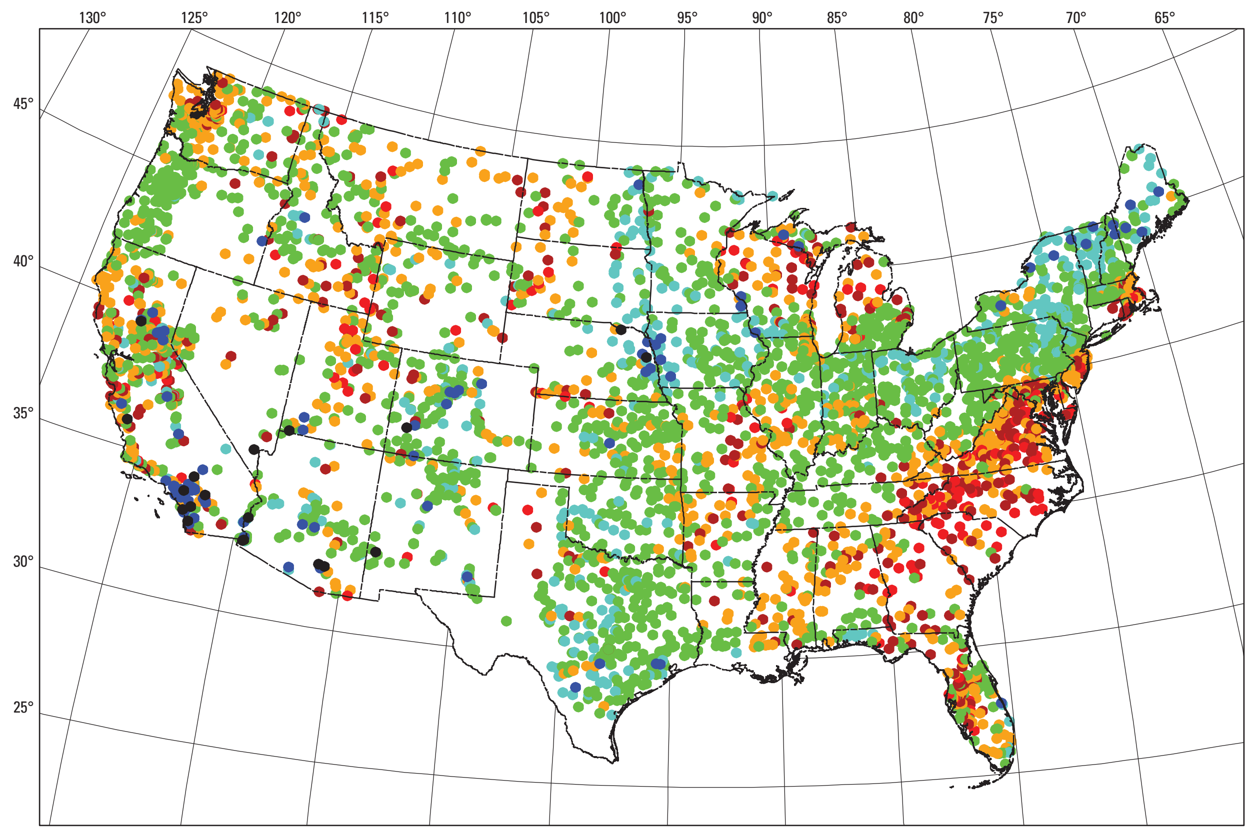
The hydrology of a region as large as the Midwest is complex because of the heterogeneity of the variables controlling the movement of water in the hydrologic cycle: precipitation (source, type, rate, and amount), vegetation, temperature, soil, geology, topography, stream gradient, and man-made structures. In addition, the flood hydrology of small basins is different than that of large basins, with different characteristic causes of flooding. Flooding in small basins often is caused by localized intense precipitation of short duration (minutes to hours). Flooding in large basins often is caused by large amounts of sustained precipitation over a long duration (days to weeks) and broad geographic area.

The 2008 flooding in the Midwest occurred on small and large streams. The area of flooding was widespread and, at various times, included parts of Arkansas, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Oklahoma, South Dakota, and Wisconsin. Separate flooding events occurred in January, February, March, April, May, June, July, and September of 2008.

Antecedent Conditions for the 2008 Midwest Flooding

The genesis of most major widespread flooding is not one particular storm or precipitation event. Most flooding is the result of frequent and consistently abundant precipitation occurring over the same geographic area for an extended period. As the soil becomes increasingly saturated and the receiving streams reach bankfull stage, additional precipitation results in flooding. Much of the area in the Midwest that was affected by flooding in 2008 began in the early winter of 2007 with streamflows in the normal to above-normal ranges (fig. 4). Above-average snowfalls occurred in the northern one-half of the Midwest during the winter of 2007-2008, and the snow accumulated into large snowpacks. In some parts of central Wisconsin, the snowpacks contained the equivalent of 10 to 12 inches (in.) of water (National Weather Service, 2009). Although the melting of the snowpacks was not a direct cause of catastrophic flooding, the melting contributed to the flooding by saturating the soils and filling the streams to near bankfull conditions in numerous locations.

The first flood-inducing precipitation event began on January 7, 2008 (fig. 5). This was the first of many rainfall events that occurred during the next several months across areas of the Midwest, and this event caused major flooding in parts of east-central Illinois and northern, western, and southwestern Indiana. Although this event did not result in severe



Base from U.S. Geological Survey digital data, 1:2,000,000, 2006
Universal Transverse Mercator projection, zone 15

From U.S. Geological Survey WaterWatch, accessed February 3, 2010 (http://water.weather.gov)

EXPLANATION

Streamflow conditions, in percentile classes

- High
- Greater than 90, much above normal
- 76 – 90, above normal
- 25 – 75, normal
- 10 – 24, below normal
- Less than 10, much below normal
- Low

Figure 4. Streamflow conditions at U.S. Geological Survey streamgages across the United States on November 30, 2007 (U.S. Geological Survey, 2007).

Flooding on the West Fork Cedar River at Finchford, Iowa. Photograph by Don Becker, USGS.

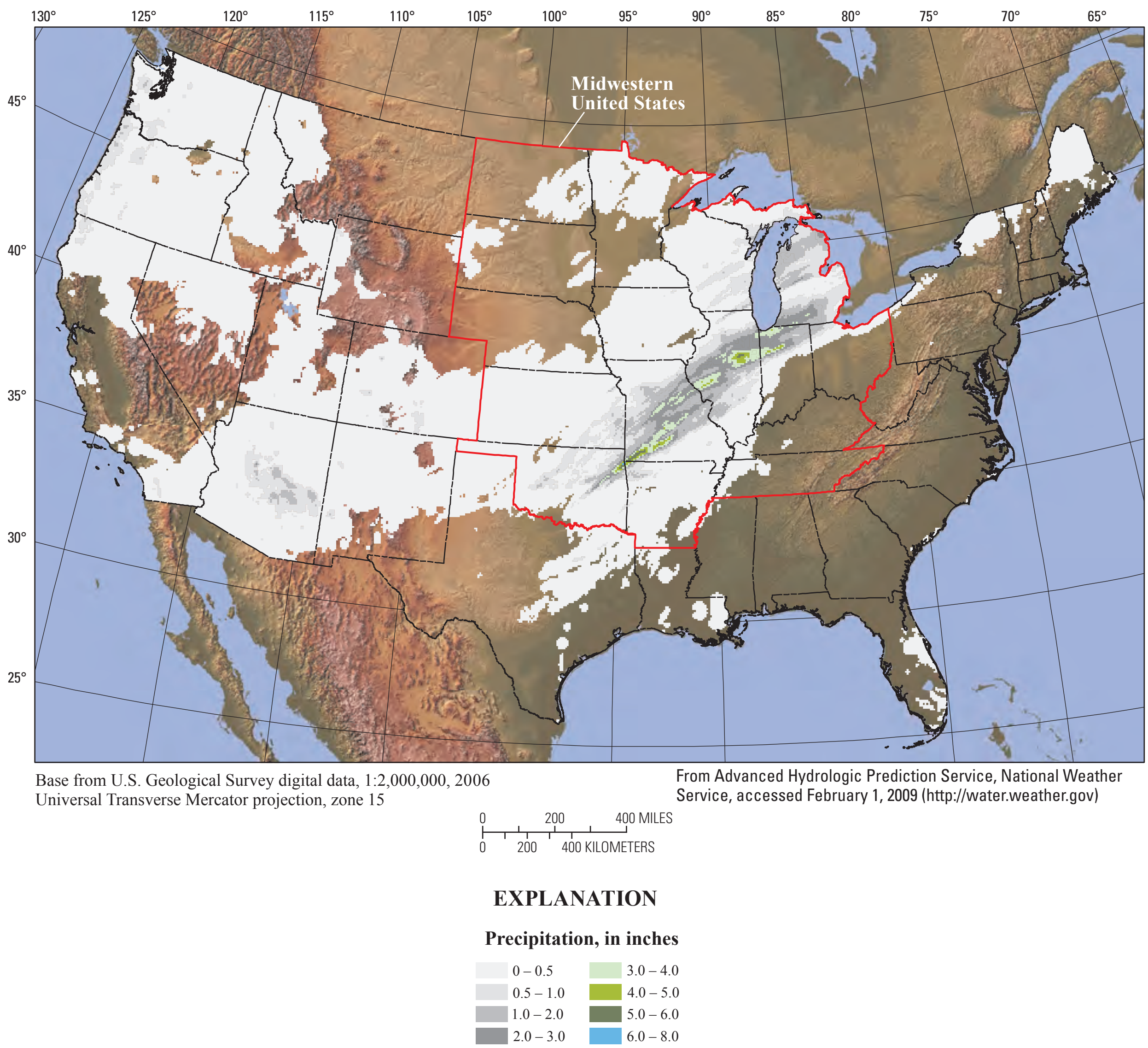


Figure 5. Observed precipitation across the United States for the previous 24 hours at 7:00 a.m. Central Standard Time on January 8, 2008. (National Weather Service, 2008a).

USGS hydrographer measuring the streamflow flowing across U.S. Highway 30 near Cedar Rapids, Iowa. Photograph by Scott Strader, USGS.

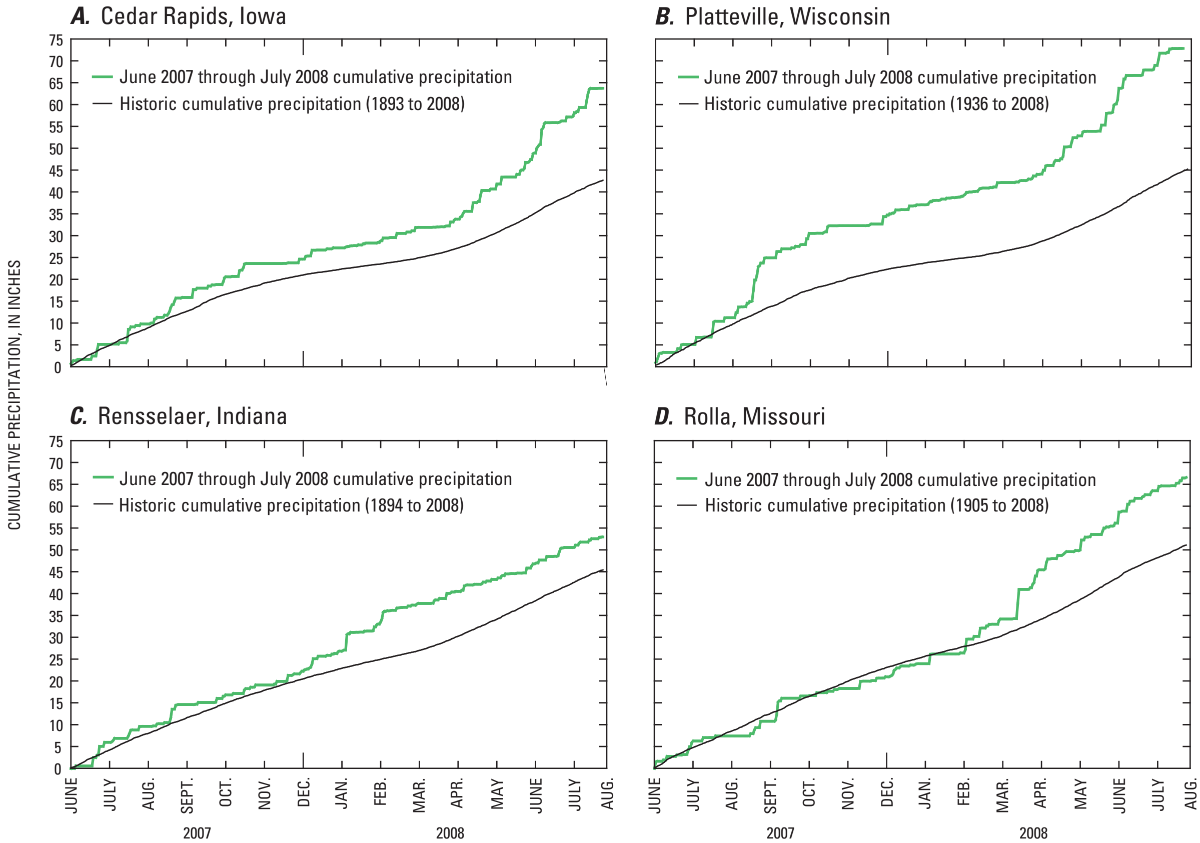


Figure 6. Cumulative precipitation totals from June 1, 2007, to July 31, 2008, in relation to historic average cumulative precipitation for selected sites in the Midwest. (National Climatic Data Center, 2008).

flooding outside of Indiana, the widespread rainfall contributed to increased soil-moisture levels and streamflows in other areas of the Midwest. Consistent above-normal precipitation during 2007-2008 occurred in much of the Midwest, as evidenced when comparing the June 2007 to July 2008 cumulative precipitation with historic average cumulative precipitation for four selected precipitation gages in the Midwest (figs. 6*A-D*).

Chronology and Magnitude of Flooding: January through September 2008

The 2008 Midwest floods were caused by persistent and excessive precipitation amounts on saturated soils. Record 6-month precipitation totals were set at 106 Midwest locations during January through June 2008 (Midwest Regional Climate Center, 2008). The 6-month total precipitation was composed of numerous discrete storm sequences that induced multiple flooding events in different geographic locations. Peak-of-record streamflows were set at 147 USGS Midwestern streamgages during 2008. The USGS streamgages that had peak streamflows with an AEP of less than 10 percent are listed in tables 1–7 (at the back of this report), with each table representing a unique flooding period during 2008. Selected streamgages that reported peak streamflow with AEPs greater than 10 percent also appear in the tables for comparison with other record flood periods [for example, Mississippi River at St. Louis, Missouri, and Wabash River at Terre Haute, Indiana (table 5)]. Each USGS streamgage listed in these tables contains a map "site number" that allows cross reference from the table to the respective map figure for that flood period. To minimize figure clutter, only the major rivers (for example, Illinois, Mississippi, Missouri, Ohio, and Wabash Rivers) and selected small rivers mentioned in the report text for that particular flood period are shown on the figures. The tables include 2008 peak-stage and streamflow data, previous peak-of-record flood data, the estimated AEP for the 2008 peak streamflow, and estimates of the magnitude of the streamflow corresponding to the 4-percent, 2-percent, 1-percent, and 0.2-percent AEP. For each figure corresponding to a particular flood period, the size of the symbol for each streamgage represents the estimated AEP that corresponds to the magnitude of the observed peak streamflow – the less probable (less frequent) the peak streamflow, the larger the symbol.

The first major flooding occurred just after the new year began as the result of precipitation during January 7–9, 2008. Examination of daily NWS Next Generation Weather Radar (NEXRAD) observations indicated as much as 6.7 in. of precipitation occurred during these 3 days (fig. 7) on

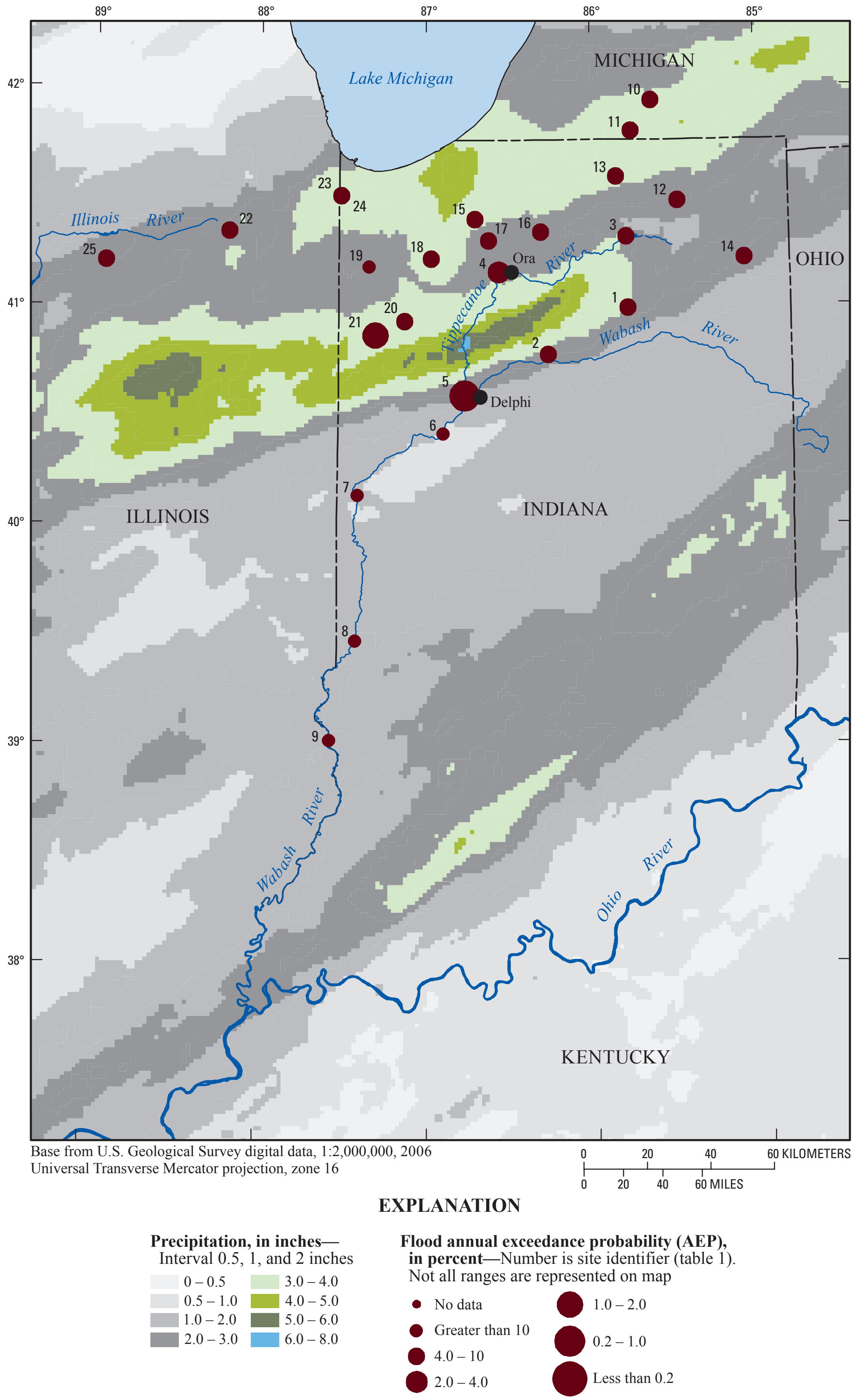


Figure 7. Cumulative precipitation totals for January 7–9, 2008, and locations of U.S. Geological Survey streamgages in Illinois, Indiana, and Michigan with peak streamflows that had an annual exceedance probability less than 10 percent.

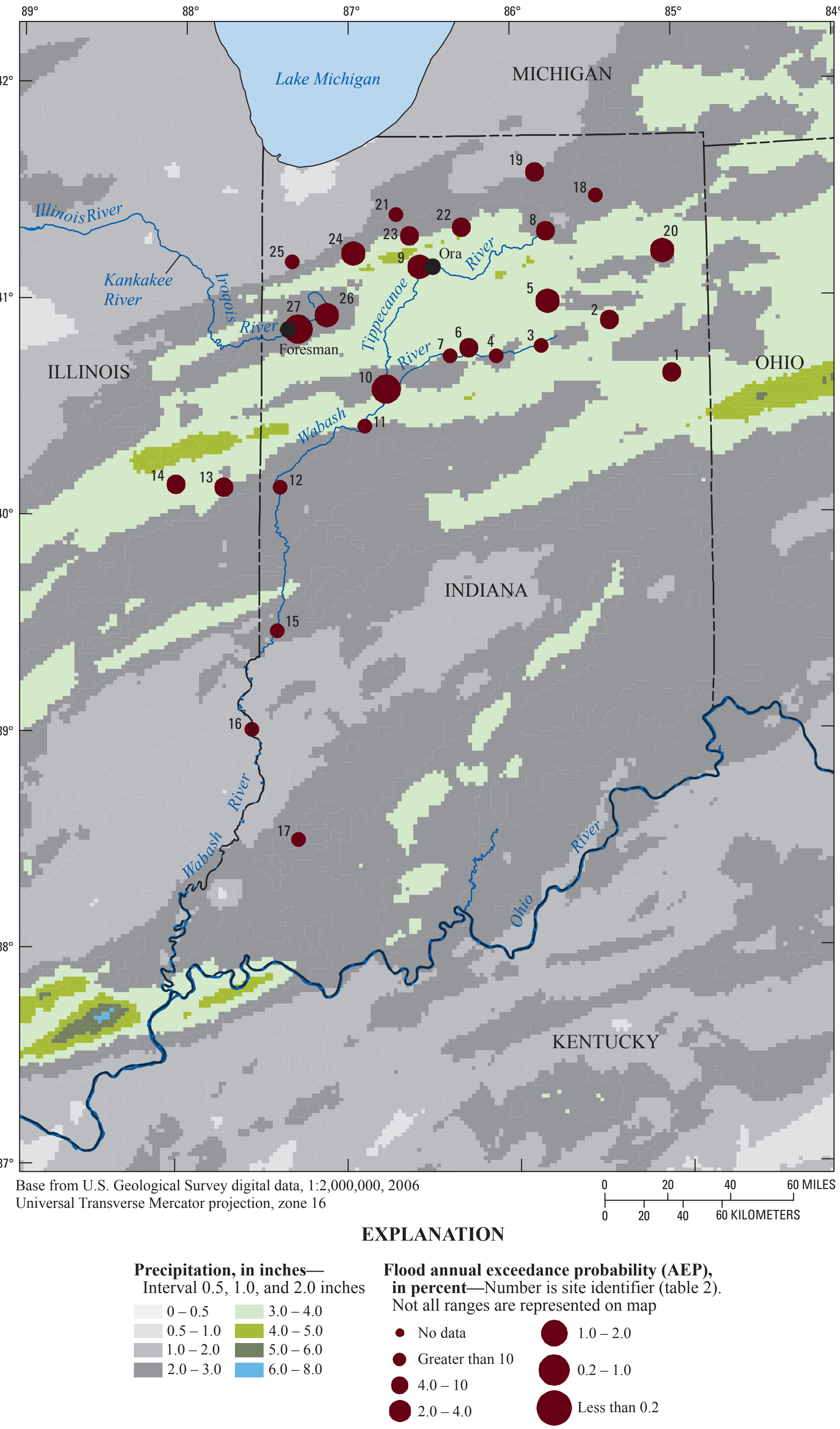
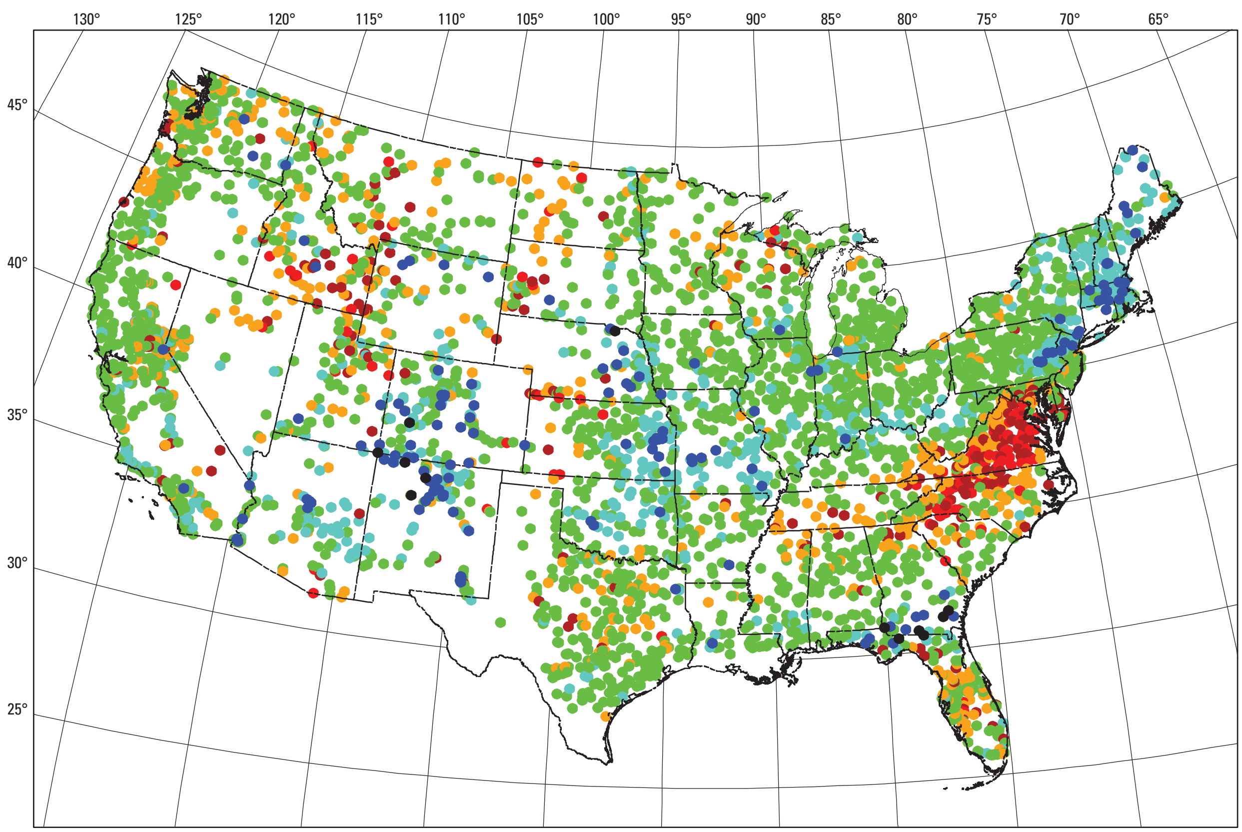


Figure 8. Cumulative precipitation totals for February 3–7, 2008, and locations of U.S. Geological Survey streamgages in Illinois and Indiana with peak streamflows that had an annual exceedance probability less than 10 percent.

frozen, often bare, ground, which resulted in major flooding in Illinois, Indiana, and Michigan. Peak-of-record streamflow occurred at USGS streamgages on the Tippecanoe River at Ora and Delphi, Indiana (USGS streamgages 03331500 and 03333050, respectively, table 1).

Precipitation that began on February 3, 2008, and continued through much of February 7 (fig. 8) resulted in an accumulation of up to 6.3 in. and flooding in Illinois and Indiana. The Iroquois River had a peak-of-record streamflow at the Foresman, Indiana, streamgage (USGS streamgage 05524500) that surpassed the 1958 record (table 2). The February flooding occurred in many of the same areas that had flooding during the previous month, with the Tippecanoe River being a prime example of recurrent flooding. The USGS streamgage near Ora, Indiana (USGS streamgage 03331500), had a peak streamflow of 9,200 ft^3/s on February 8 (table 2), which was within 90 ft^3/s of the January 10 peak streamflow of 9,290 ft^3/s (table 1). Although the severe flooding during February was limited to Illinois and Indiana, by the end of February 2008, the additional precipitation across the Midwest resulted in streamflows that were above normal at numerous USGS streamgages in Arkansas, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Oklahoma, South Dakota, and Wisconsin (fig. 9).

Substantial rainfall that contributed amounts as much as 12.8 in. occurred during March 16-20, 2008, in a band through Arkansas, Illinois, Indiana, Missouri, and Oklahoma (fig. 10). Most of the rivers in the five-State flood area peaked by March 19, although some of the large basins peaked as late as March 24 (for example, White River near Georgetown,



Base from U.S. Geological Survey digital data, 1:2,000,000, 2006
Universal Transverse Mercator projection, zone 15

From U.S. Geological Survey WaterWatch, accessed February 3, 2010 (http://water.weather.gov)

0 200 400 600 MILES
0 200 400 600 KILOMETERS

EXPLANATION

Streamflow conditions, in percentile classes

- High
- Greater than 90, much above normal
- 76 – 90, above normal
- 25 – 75, normal
- 10 – 24, below normal
- Less than 10, much below normal
- Low

Figure 9. Streamflow conditions at U.S. Geological Survey streamgages on February 28, 2008 (U.S. Geological Survey, 2007).

Arkansas (USGS streamgage 07076750), table 3). Peak-of-record streamflows occurred on the Spring, White, and Black Rivers in Arkansas; the Castor and James Rivers in Missouri; the South Fork Saline River and Crab Orchard Creek in southern Illinois; and the Blue River and Big Creek in southern Indiana (table 3). Streamflow peaks on the Gasconade River in Missouri were near the flood of record (for example, Gasconade River near Rich Fountain, Missouri (USGS streamgage 06934000), table 3). The town of Harrisburg, Illinois, which is surrounded by a levee to protect it from backwater from the Ohio River approximately 30 miles (mi) away, was inundated by flooding from more than 11.5 in. of rain in less than 48 hours on March 18 and 19, 2008. Local drainage, interior to the levee system, proved to be too much for the pumping system and resulted in more than 44 businesses and 30 homes being flooded. The flooding resulted in an estimated $16.8 million in damages (Fodor, 2009). In Arkansas, one remarkable scene of destruction was captured on video by USGS hydrologic technician Steven B. Franks, (U.S. Geological Survey, 2010) as he witnessed a house that had been washed into the White River floating downstream and colliding with a bridge at the White River at Calico Rock, Arkansas (USGS streamgage 07060500).

Additional flooding occurred in early April 2008 in many of the same areas of Arkansas, Missouri, and Oklahoma as in March. As much as 9.6 in. of rain fell during April 7–11, 2008,

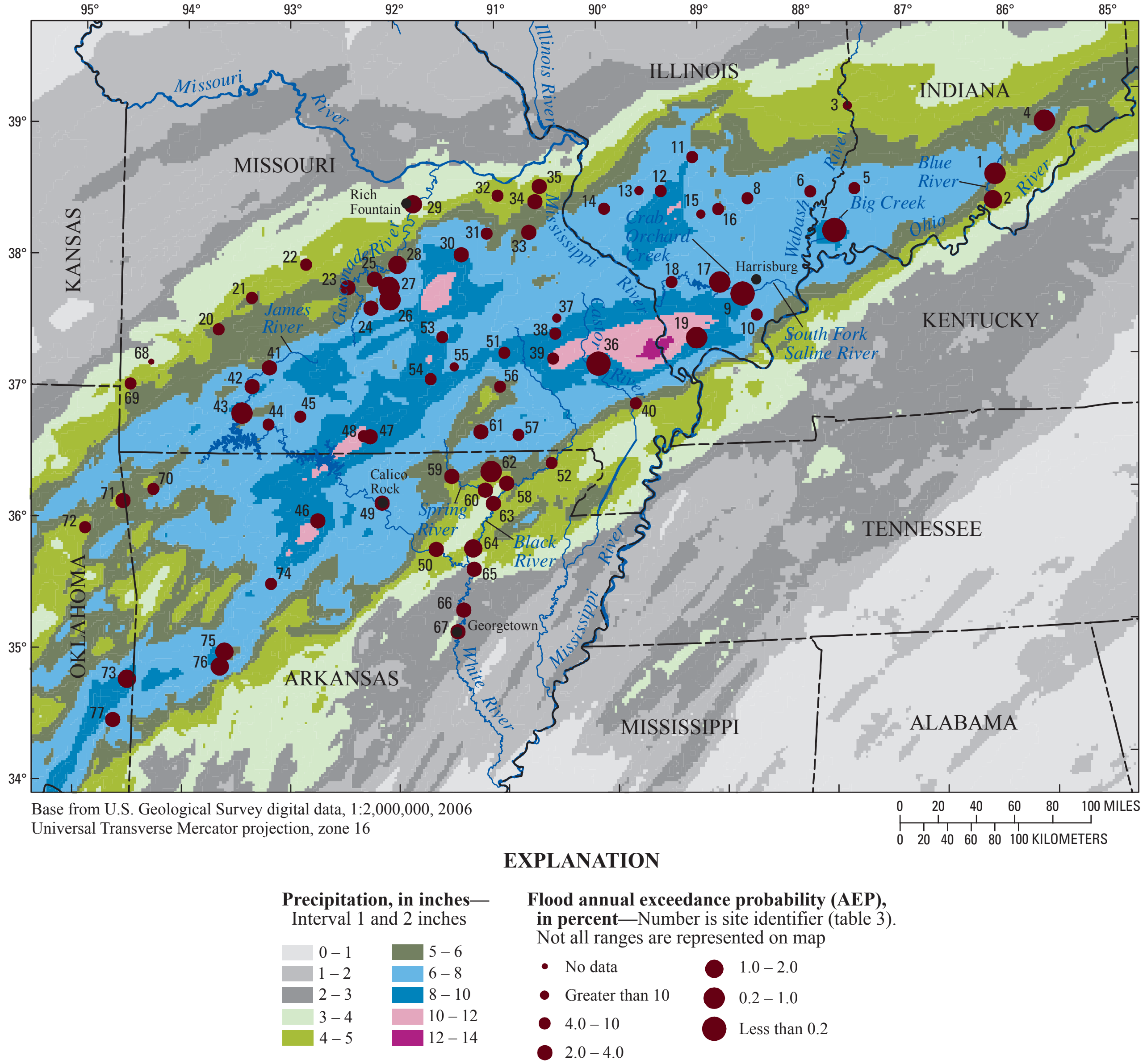


Figure 10. Cumulative precipitation totals for March 16–20, 2008, and locations of U.S. Geological Survey streamgages in Arkansas, Illinois, Indiana, Missouri, and Oklahoma with peak streamflows that had an annual exceedance probability less than 10 percent.

which produced flooding along numerous rivers (fig. 11*A*) and peak-of-record streamflow on North Sylamore Creek in Arkansas that exceeded the 1982 record peak streamflow (USGS streamgage 07060710, table 4).

An isolated system in late April produced flooding from up to 6.3 in. of precipitation that fell in eastern Iowa during April 22–26, 2008 (fig. 11*B*). Substantial flooding was limited mostly to streams with drainage areas less than 400 square miles (mi^2), such as Black Hawk Creek at Hudson, Iowa (USGS streamgage 05463500), where a peak-of-record streamflow occurred on April 25, 2008 (table 4). Although the late-April precipitation produced only isolated flooding on smaller drainages, it provided additional moisture for continued soil saturation in Iowa.

Substantial rainfalls occurred during May and June throughout much of the Midwest, resulting in some of the worst flooding during 2008. Examination of daily NEXRAD rainfall observations for the Midwest area that included Illinois, Indiana, Iowa, Michigan, Missouri, and Wisconsin indicated that from May 21 to June 14, 2008, precipitation amounts greater than 0.5 in. occurred daily somewhere within the six-State area (National Weather Service, 2008a). Total

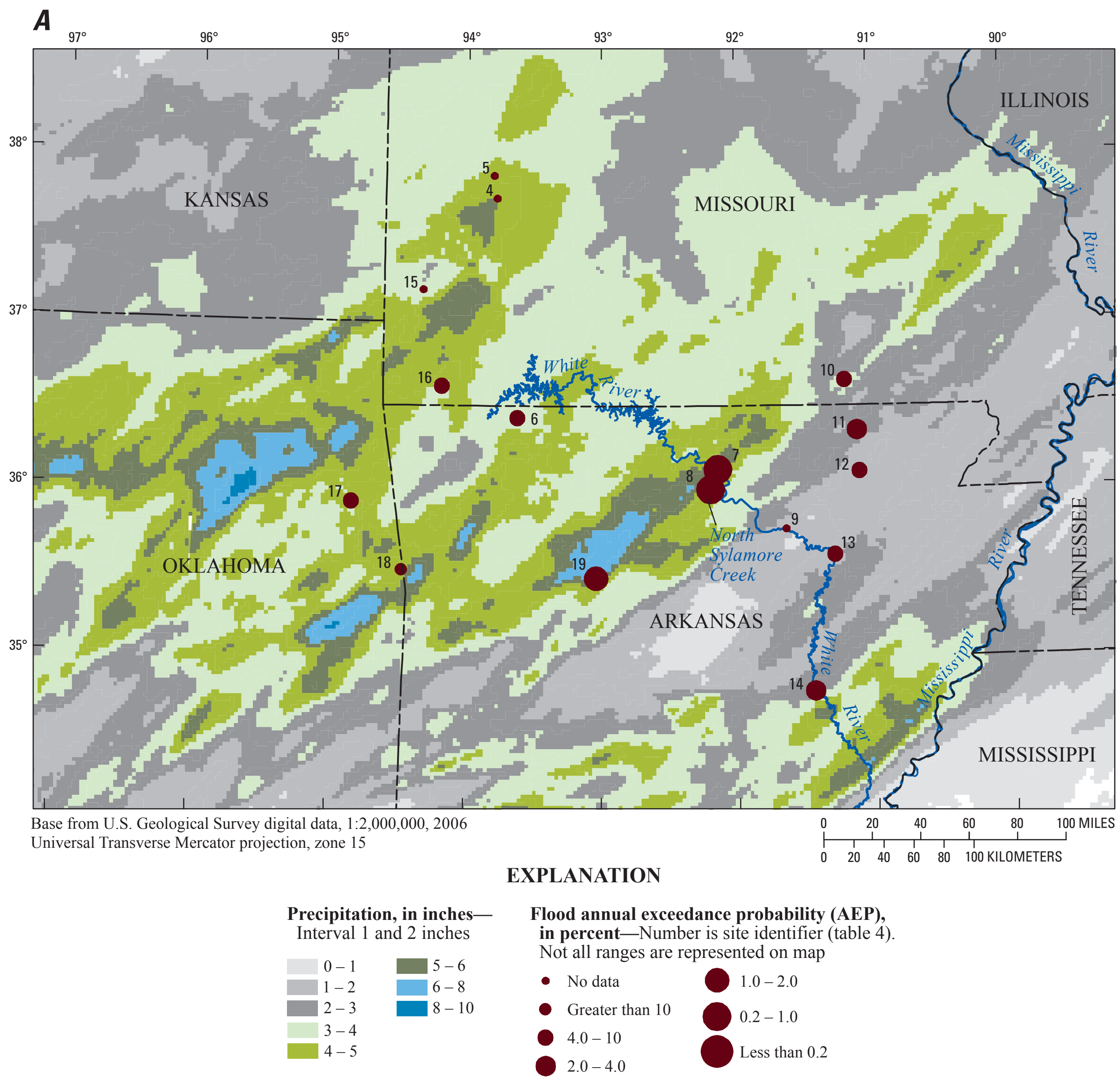


Figure 11. Cumulative precipitation totals for *A*, April 7–11, 2008, and locations of U.S. Geological Survey streamgages in Arkansas, Missouri, and Oklahoma with peak streamflows that had an annual exceedance probability less than 10 percent; and *B*, cumulative precipitation totals for April 21–25, 2008, and locations of U.S. Geological Survey streamgages in Iowa with peak streamflows that had an annual exceedance probability less than 10 percent.

precipitation for this 25-day period was more than 20 in. in several locations (fig. 12). The rainfall amounts for this period are considered extreme by the NWS, which determined the annual exceedance probabilities to be between 0.1 to 0.2 percent for the observed rainfall in parts of Iowa, east-central Illinois, and south-central Indiana and less than 0.1 percent for isolated areas in Iowa (fig. 13) (Geoffrey M. Bonnin, National Oceanic and Atmospheric Administration, National Weather Service, Office of Hydrologic Development, written commun., 2008). New June total precipitation records were set at 66 sites in the Midwest (Midwestern Regional Climate Center, 2008). The record precipitation produced 77 peak-of-record streamflows at USGS streamgages during June, particularly in Iowa (39 peak-of-record streamflows) and Wisconsin (19 peak-of-record streamflows). The USGS streamgage at Cedar Rapids, Iowa (USGS streamgage 05464500), recorded a peak streamflow of 140,000 ft^3/s on June 13 that was 92 percent greater than the previous peak-of-record streamflow (73,000 ft^3/s) set in 1961, and the peak stage of 31.12 ft was 11 ft above the previous peak-of-record stage of 20.00 ft set in 1929 (table 5). Other peak-of-record streamflows were observed at USGS streamgages in Illinois,

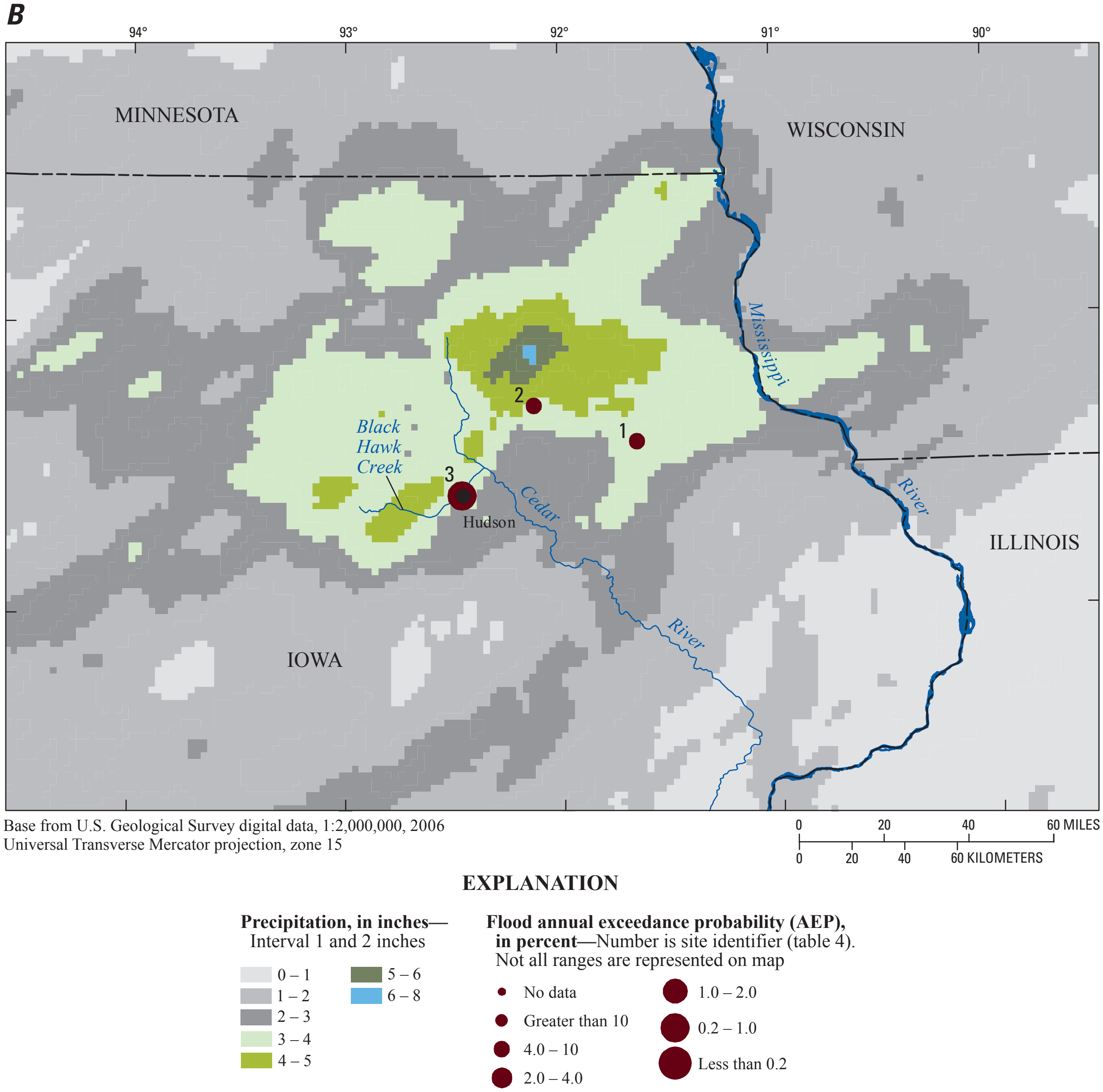


Figure 11. Cumulative precipitation totals for *A*, April 7–11, 2008, and locations of U.S. Geological Survey streamgages in Arkansas, Missouri, and Oklahoma with peak streamflows that had an annual exceedance probability less than 10 percent; and *B*, cumulative precipitation totals for April 21–25, 2008, and locations of U.S. Geological Survey streamgages in Iowa with peak streamflows that had an annual exceedance probability less than 10 percent.—Continued

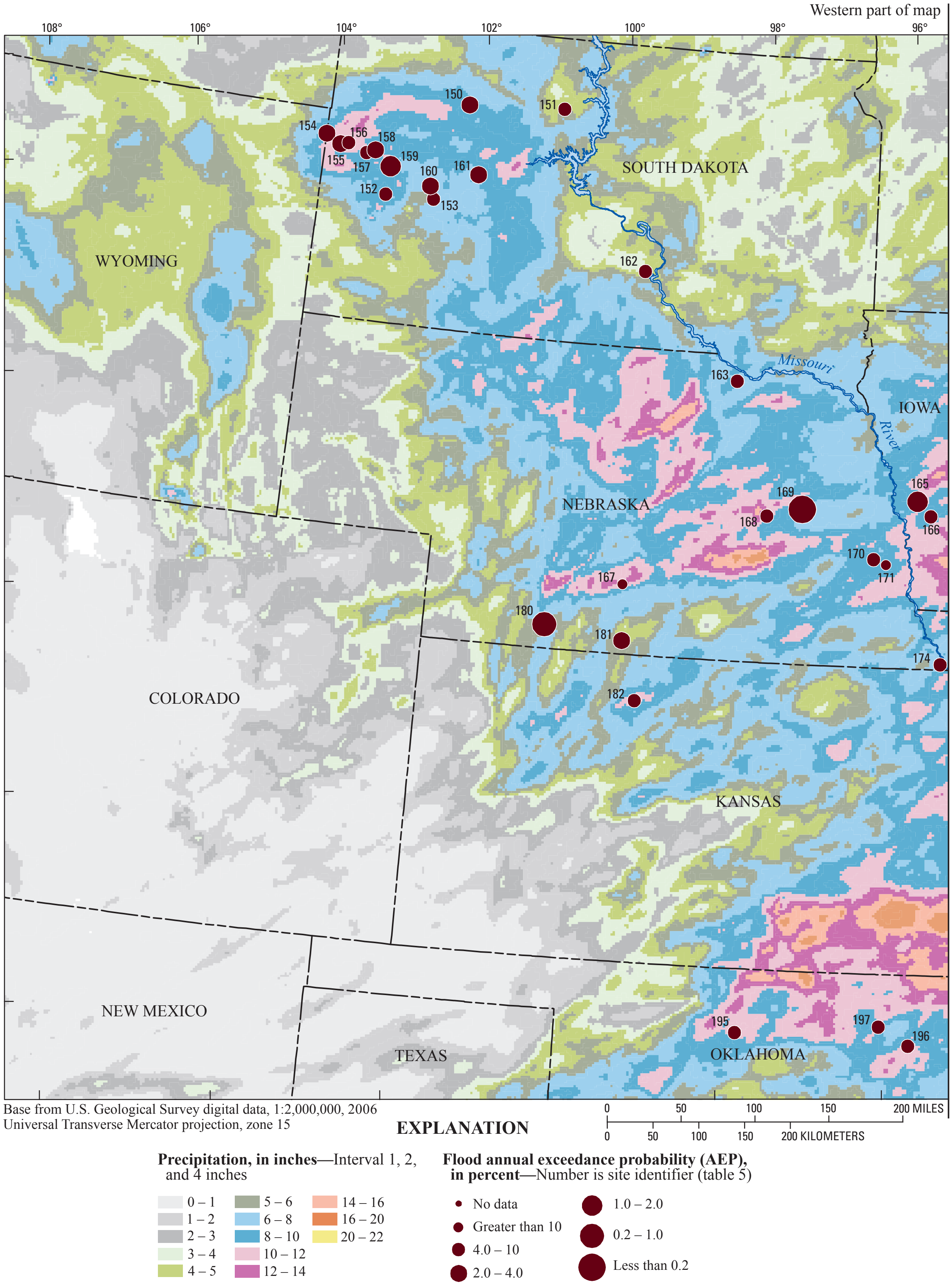
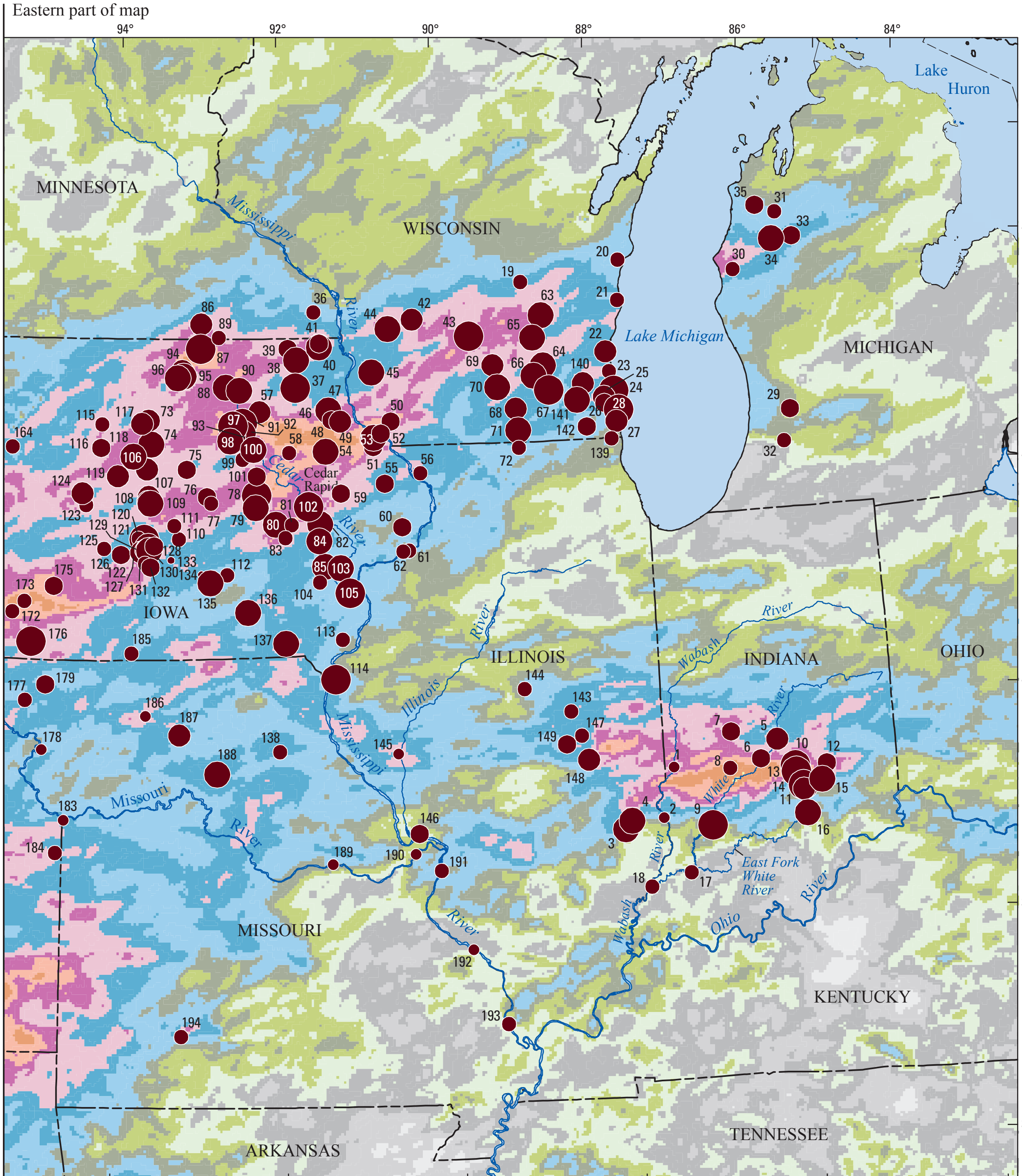


Figure 12. Cumulative precipitation totals for May 21 through June 14, 2008, and locations of U.S. Geological Survey streamgages in several Midwestern States with peak streamflows that had an annual exceedance probability less than 10 percent.



Base from U.S. Geological Survey digital data, 1:2,000,000, 2006
Universal Transverse Mercator projection, zone 15

0 50 100 150 200 MILES
0 50 100 150 200 KILOMETERS

EXPLANATION

Precipitation, in inches—Interval 1, 2, and 4 inches

0 – 1
1 – 2
2 – 3
3 – 4
4 – 5
5 – 6
6 – 8
8 – 10
10 – 12
12 – 14
14 – 16
16 – 20
20 – 22

Flood annual exceedance probability (AEP), in percent—Number is site identifier (table 5)

No data
Greater than 10
4.0 – 10
2.0 – 4.0
1.0 – 2.0
0.2 – 1.0
Less than 0.2

Figure 12. Cumulative precipitation totals for May 21 through June 14, 2008, and locations of U.S. Geological Survey streamgages in several Midwestern States with peak streamflows that had an annual exceedance probability less than 10 percent.—Continued

Indiana, Michigan, Nebraska, Oklahoma, and South Dakota. Some locations in Indiana received a third or fourth round of flooding (fig. 14).

July proved to be no drier in southern Iowa and northern Missouri, which had two periods of substantial precipitation and subsequent flooding. Slightly more than 8 in. of precipitation occurred in south-central Iowa during July 5–8, 2008 (fig. 15A), causing peak streamflows on some small and mid-size streams on the order of 2-percent AEP, including the Chariton River near Moulton, Iowa (USGS streamgage 06904010, table 6). More abundant precipitation, as much as 17 in., over a much wider area between July 17 and July 28, 2008 (fig. 15*B*) fell on Iowa and Missouri. The later July precipitation produced new peak-of-record streamflows at USGS streamgages on the Salt and Chariton Rivers in Missouri (table 6).

Hurricanes Gustav and Ike initiated substantial precipitation events in September. The remnants of Hurricane Gustav passed over the Midwest during September 1–5, 2008, by tracking through Arkansas, Missouri, Illinois, and Michigan. Arkansas received the brunt of the precipitation as more than 12 in. of rainfall occurred during this period (fig. 16*A*).

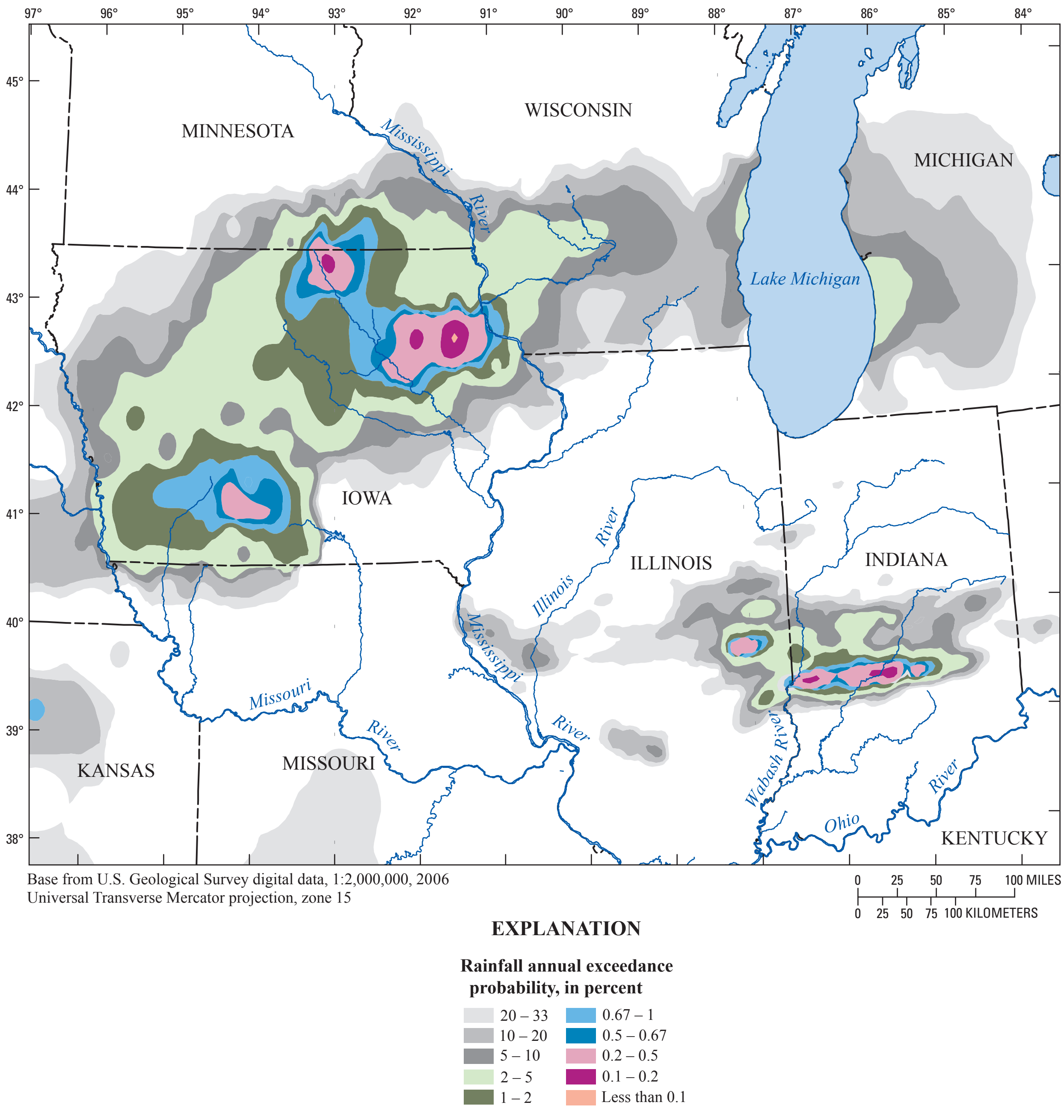


Figure 13. Annual exceedance probability for the rainfall total from May 23, 2008, to June 12, 2008 (revised from Geoffrey M. Bonnin, NOAA, National Weather Service, Office of Hydrologic Development, written commun., 2008)

Although no peak-of-record streamflows occurred at USGS streamgages, the peak streamflow at Dutch Creek at Waltreak, Arkansas, and Saline River at Benton, Arkansas (USGS streamgages 07260000 and 07363000, table 7), were near the 1-percent AEP.

During September 13–15, 2008, the remnants of Hurricane Ike passed through Oklahoma, Arkansas, Missouri, Illinois, Indiana, and Michigan along a similar track as Hurricane Gustav earlier in the month. The passage of the remnants of Hurricane Ike was preceded by a continental-type storm event during September 11–13, 2008, that produced more than 12 in. of rainfall in parts of Kansas, which received little of the Hurricane Ike-induced rainfall that followed. Substantial precipitation from a combination of the continental-type storm and the remnants of Hurricane Ike occurred in Arkansas, Illinois, Indiana, Iowa, Michigan, Missouri, and Oklahoma (fig. 16*B*). Numerous peak-of-record streamflows occurred, particularly in the urban areas of St. Louis, Missouri, and Chicago, Illinois (table 7). The River Des Peres in St. Louis flooded, with the loss of two lives and the City of St. Louis temporarily condemning 275 properties in the aftermath of the flood (Gillerman, 2008). One resident reported that this was the sixth time their home had been flooded since 1988 (Gillerman, 2008).

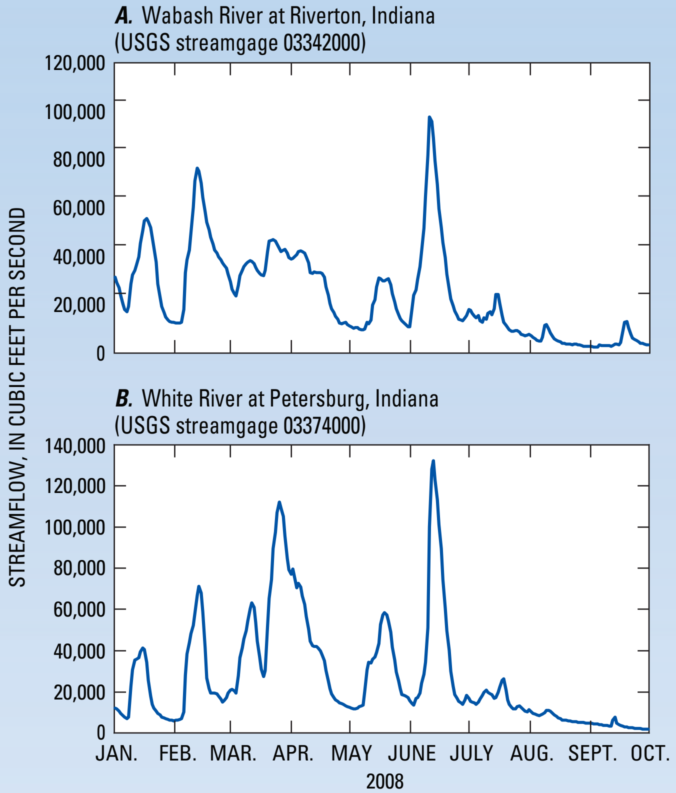


Figure 14. Streamflow for Wabash River at Riverton, Indiana and White River at Petersburg, Indiana.

Flooding in Waterloo, Iowa. Photograph by Don Becker, USGS.

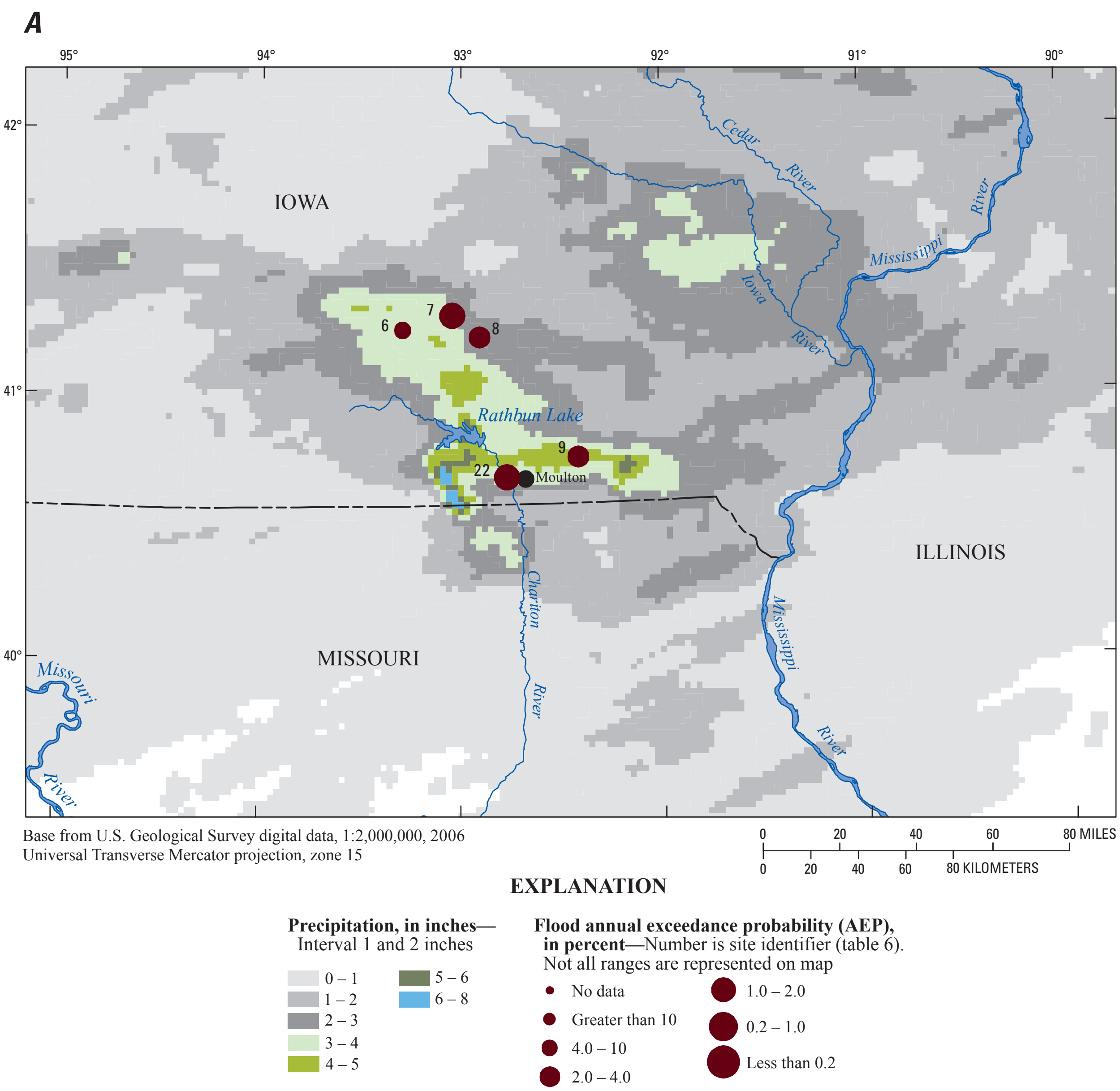


Figure 15. Cumulative precipitation totals for *A*, July 5–8, 2008, and locations of U.S. Geological Survey streamgages in Iowa with peak streamflows that had an annual exceedance probability less than 10 percent; and *B*, cumulative precipitation totals for July 17–28, 2008,and locations of U.S. Geological Survey streamgages in Iowa and Missouri with peak streamflows that had an annual exceedance probability less than 10 percent.

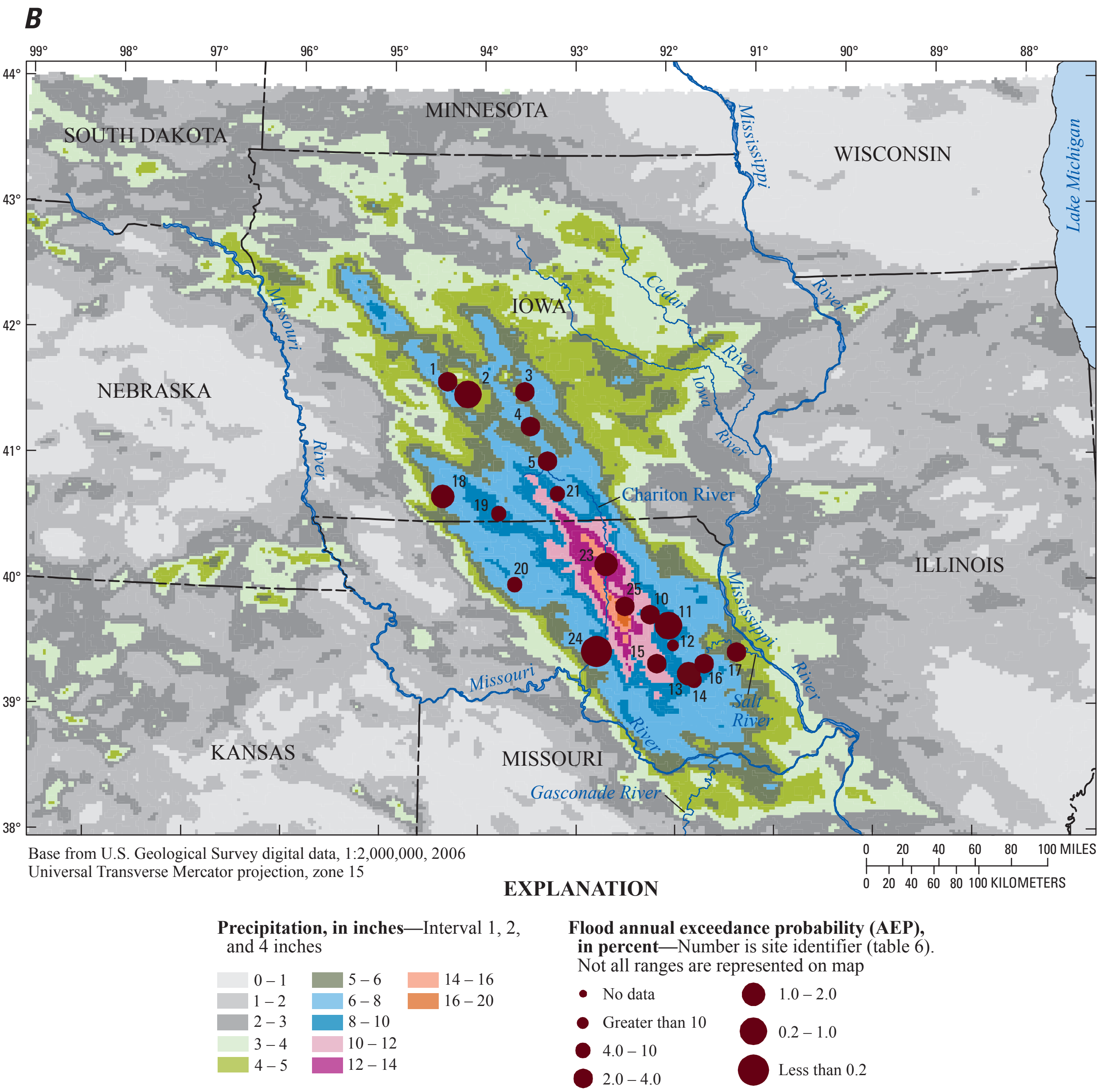


Figure 15. Cumulative precipitation totals for *A*, July 5–8, 2008, and locations of U.S. Geological Survey streamgages in Iowa with peak streamflows that had an annual exceedance probability less than 10 percent; and *B*, cumulative precipitation totals for July 17–28, 2008,and locations of U.S. Geological Survey streamgages in Iowa and Missouri with peak streamflows that had an annual exceedance probability less than 10 percent.—Continued

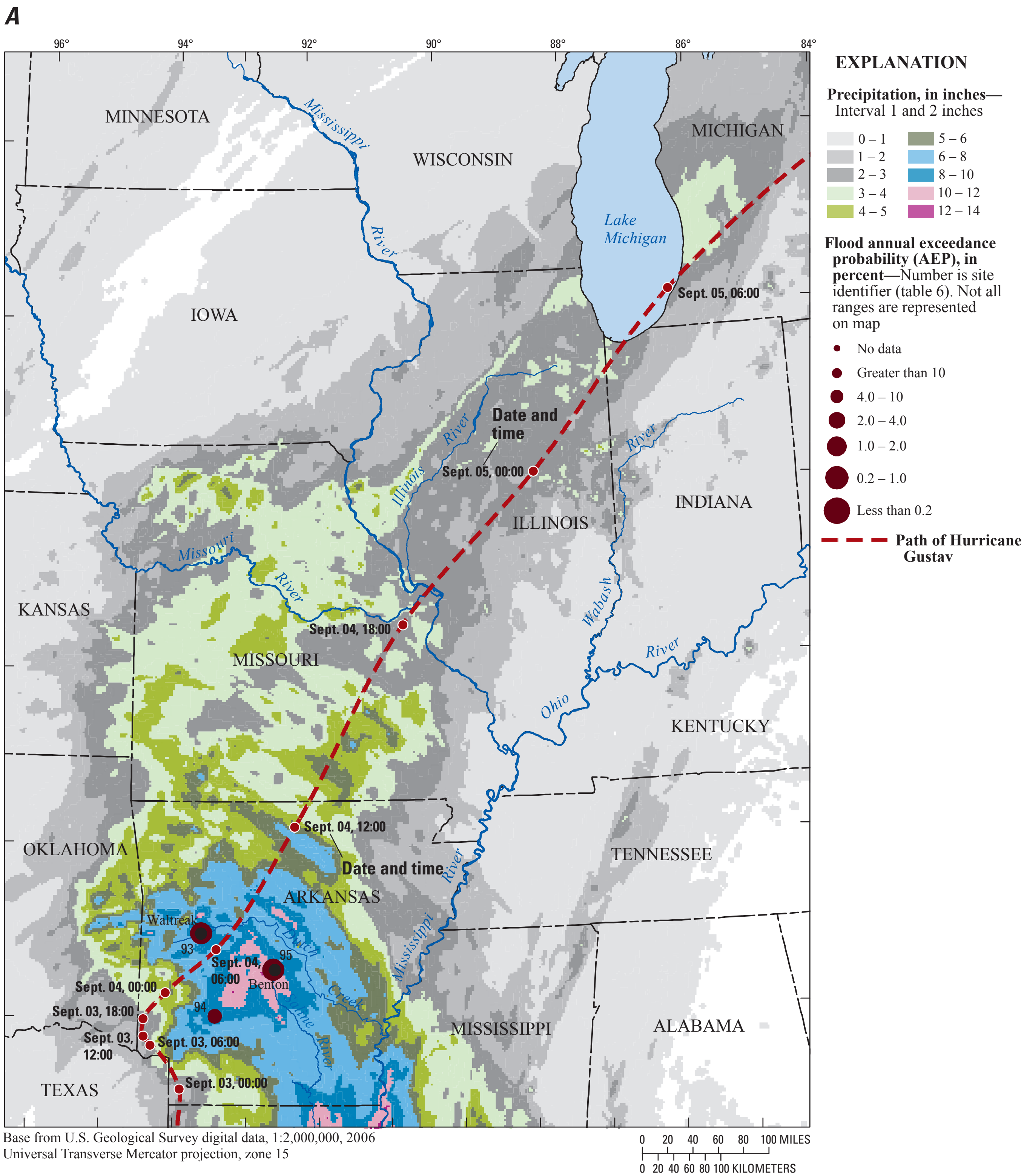


Figure 16. Cumulative precipitation totals for *A*, September 1–5, 2008, the path of the remnants of Hurricane Gustav, and locations of U.S. Geological Survey streamgages in Arkansas with peak streamflow that had an annual exceedance probability less than 10 percent; and *B*, cumulative precipitation totals for September 11–15, 2008, the path of the remnants of Hurricane Ike, and locations of U.S. Geological Survey streamgages in Illinois, Indiana, Iowa, Kansas, Michigan, Missouri, and Oklahoma with peak streamflows that had an annual exceedance probability less than 10 percent.

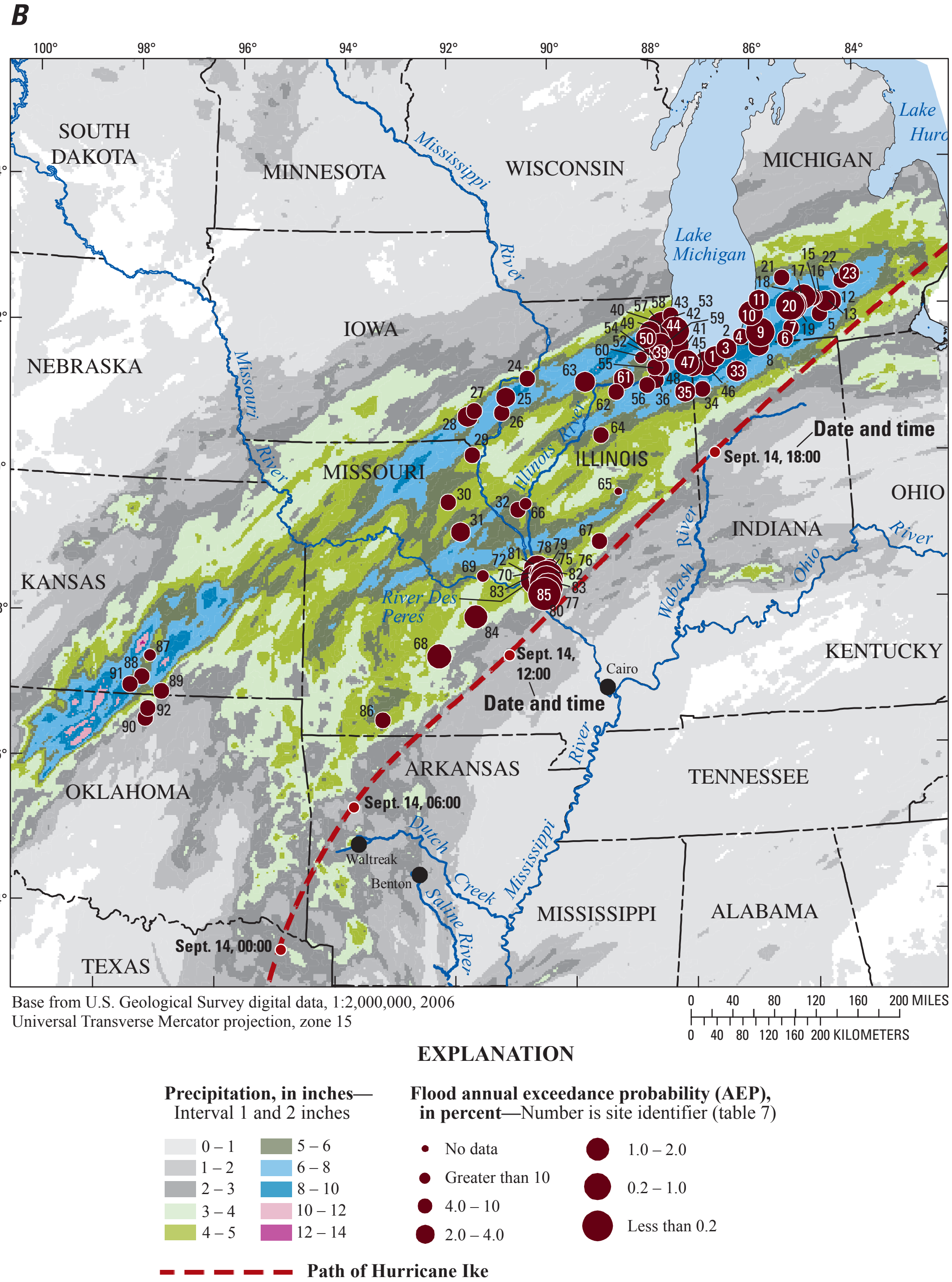


Figure 16. Cumulative precipitation totals for *A*, September 1–5, 2008, the path of the remnants of Hurricane Gustav, and locations of U.S. Geological Survey streamgages in Arkansas with peak streamflow that had an annual exceedance probability less than 10 percent; and *B*, cumulative precipitation totals for September 11–15, 2008, the path of the remnants of Hurricane Ike, and locations of U.S. Geological Survey streamgages in Illinois, Indiana, Iowa, Kansas, Michigan, Missouri, and Oklahoma with peak streamflows that had an annual exceedance probability less than 10 percent.—Continued

2008 Flooding: Comparison with Historic Floods

Placing the magnitude of a flood into context is desirable for comparison with previous floods. Ranking the observed 2008 peak streamflows at USGS streamgages against previous streamflow peaks of record indicates the relative magnitude of the 2008 floods (tables 1–7). In many locations, the 2008 streamflow peaks were the largest to occur in many decades. For example, the June 2008 flood on the Cedar River at Cedar Rapids, Iowa, (USGS streamgage 05464500, table 5) is the largest streamflow ever recorded at this site and exceeds the previous peak-of-record stage by more than 11 ft. During 2008, 147 USGS streamgages recorded new peak-of-record streamflows, with 77 peak-of-record streamflows set during the June floods alone.

To gain perspective of the magnitude of 2008 peak streamflows compared with previous annual peak streamflows, the annual streamflow peaks through time were plotted from data recorded at six USGS streamgages across the Midwest (fig. 17). Also included in these plots is the estimated value of the 1-percent AEP flood quantile at these six sites. The benchmark for major flooding on many of the major tributaries and much of the main stem of the upper Mississippi River (above Cairo, Illinois) is the 1993 flood; however, for some of the tributaries, and certainly for the rivers in Arkansas, Indiana, Illinois, Michigan, Nebraska, Oklahoma, and South Dakota, floods other than 1993 flood serve as the benchmarks for record flooding as evidenced in figure 17. The 2008 flood hydrographs for selected USGS streamgages in the Midwest are presented in figure 18 with previous record flood hydrographs to enable comparisons. Although the June 2008 floods were record setting on some of the Mississippi River tributaries in Iowa, Wisconsin, Illinois, and Missouri, [for example, Cedar River at Cedar Rapids, Iowa (fig. 18*A*) and Iowa River at Iowa City, Iowa (fig. 18*B*)], the Mississippi River main stem did not have record-setting streamflows at the USGS streamgages. The Mississippi River at Keokuk, Iowa (fig. 18*C*) peak streamflow in June 2008 ranked second in 131 years of systematic streamflow records, just 8,000 ft^3/s shy of the 1993 record peak streamflow of 446,000 ft^3/s. Contrast the near peak-of-record streamflow at Keokuk, Iowa (ranked 2nd in 131 years of record), with the 2008 peak streamflow 184 mi downstream on the Mississippi River at St. Louis, Missouri. The 2008 peak streamflow ranked only 25th in the 147 years of systematic streamflow records, well below the 1993 record peak streamflow (fig. 18*D*). The 2008 streamflow on the Mississippi River at St. Louis was lower primarily because of the smaller streamflow contribution from the Missouri River in 2008, which contributed streamflow of as much as 750,000 ft^3/s in 1993 (Parrett and others, 1993) compared with a maximum streamflow during June 2008 of 302,000 ft^3/s at the USGS streamgage at St. Charles, Missouri (table 5).

2008 Flooding: Annual Exceedance Probability

Although ranking floods helps to illustrate the relative magnitude of the floods, it has limited use for evaluating the future risk of flooding. Determining the AEP requires flood-probability analysis, which involves determining the parameters needed to estimate a probability distribution from a set of observed peak streamflow data. The probability distribution relates probability to the magnitude of a certain size flood being equaled or exceeded.

Selection of the probability distribution and the process for fitting the parameters of the distribution may vary depending on the underlying characteristics of the data. For consistency, Federal agencies that estimate flood frequencies follow standard guidelines, known as Bulletin 17*B* (Interagency Advisory Committee on Water Data, 1982), which recommend the use of the log-Pearson type III (LPIII) distribution and the “method of moments” for estimating the distribution parameters (mean, standard deviation, and skewness of the data). The analysis is based on annual peak streamflow data. For USGS streamgages, the data are available from the USGS National Water Information System database (U.S. Geological Survey, 2008).

In previous flood reports (for example, Chin and others, 1975; Parrett and others, 1993; Holmes and Kupka, 1997), flood probabilities were expressed as flood frequencies by listing the T-year recurrence interval for a particular flood quantile (for example, the “100-year flood”). Use of the T-year recurrence interval to describe flood probability is now discouraged by the USGS because it tends to confuse the general public. A T-year recurrence interval is sometimes interpreted to imply that there is a set time interval between floods of a specific magnitude when, in fact, floods are random processes that are best understood using probabilistic terms. The use of an AEP percentage for a flood is now recommended because of the clear communication, by the terminology, that the peak streamflow is being characterized by its probability or chance of occurrence. The reader can easily convert from the AEP to the T-year recurrence interval by simply taking the reciprocal of the AEP. For example, a 1-percent AEP flood corresponds to the streamflow magnitude that is equaled or exceeded by a probability (expressed as a decimal) of 0.01 in any given year. The reciprocal of 0.01 is 100, thus the T-year recurrence interval for the 1-percent AEP flood is the 100-year flood. Equivalence of selected AEP and recurrence intervals are as follows:

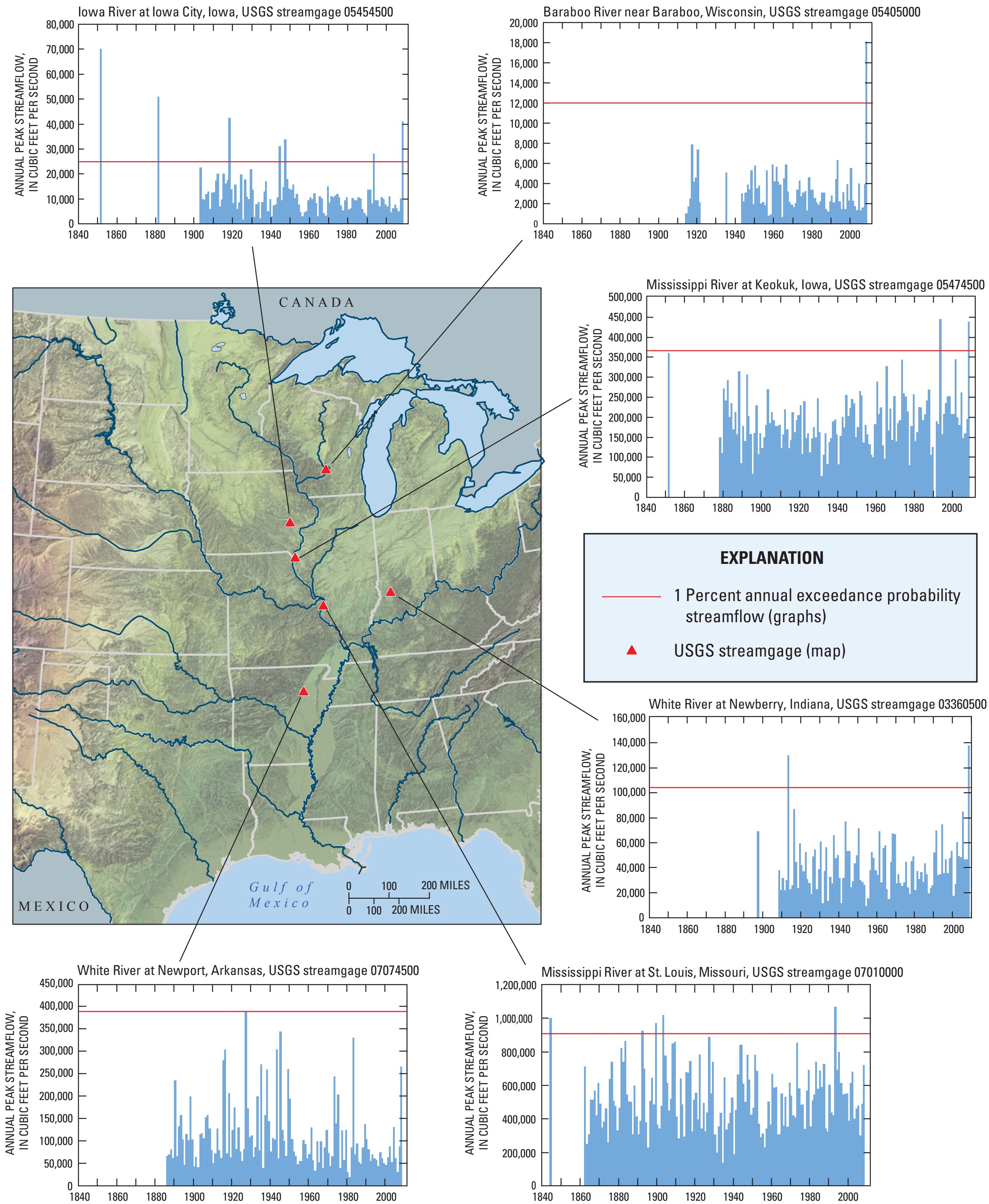


Figure 17. Annual peak streamflows for the period of record up to 2008 and the 1-percent annual exceedance probability at selected U.S. Geological Survey streamgages in the Midwest.

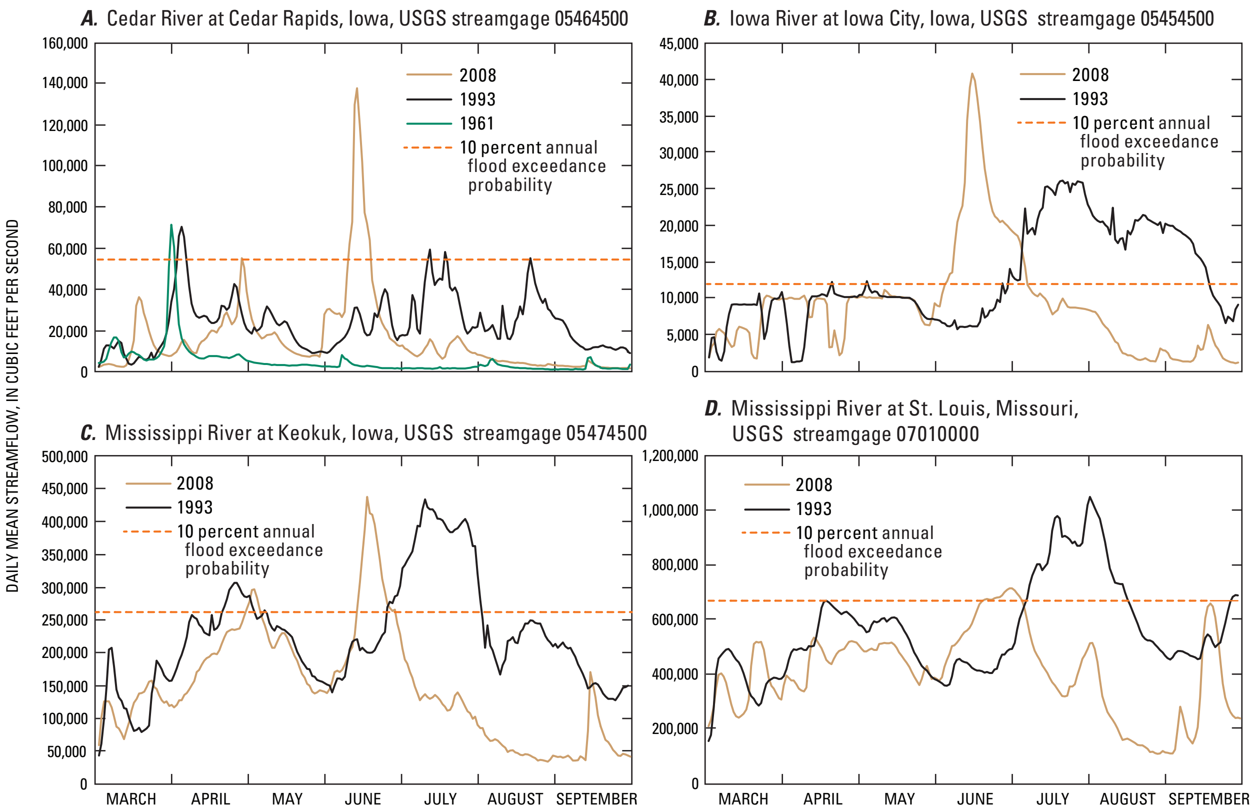


Figure 18. Streamflow for selected U.S. Geological Survey streamgages for the 2008 flood period and previous major floods, and the 10-percent annual exceedance probability for each site.

AEP (percent)	Recurrence interval (years)
50	2
20	5
10	10
4	25
2	50
1	100
0.2	500

The reliability of an AEP flood quantile from Bulletin 17B methods may be expressed as a “variance of prediction” and is computed by using the asymptotic formula given by Cohn and others (2001), with the addition of the mean-squared error of generalized skew (Griffis and others, 2004). The variance of prediction varies as a function of the length of record, the fitted flood-probability distribution parameters (mean, standard deviation, and weighted skew), and the accuracy of the method used to determine the regional skew component of the weighted skew. The variance of prediction generally decreases with length of record and the fit of the LPIII distribution.

Besides estimating AEP flood quantiles by Bulletin 17B methods, another way to obtain an AEP flood quantile estimate is by using regional regression equations (RRE). RRE are developed by using regression techniques that relate the flood-probability data at many streamgages in a particular region to the basin characteristics of the streams being monitored by the streamgages (Jennings and others, 1994). For any location along a stream (gaged or ungaged), a user can enter the basin characteristics (drainage area, basin slope, and so on) as independent variables into the equations and compute various streamflow characteristics, such as the 1-percent AEP flood quantile. The variance of prediction from the regional regression is a function of the RRE and the values of the independent variables used to develop the streamflow estimate from the RRE. The variance generally increases with departure of the actual values from the mean values of the independent variables. The USGS uses software programs, such as GLSNET (Generalized Least Squares NETwork analysis; Tasker and Stedinger, 1989), to compute the model error variance.

The optimal estimate of the AEP flood quantile for a gaged site is determined by weighting the AEP flood quantile estimate determined from the Bulletin 17B methods with the AEP flood quantile estimate determined from the RRE. The weights are inversely proportional to the variances of prediction, yielding the weighted estimator:

$$LogQ_{P,OPT} = \frac{\left(Var\left[RRE\right]*LogQ_{P,LPIII} + Var\left[LPIII\right]*LogQ_{P,RRE}\right)}{\left(Var\left[RRE\right]+Var\left[LPIII\right]\right)} \quad (1)$$

where

- $Q_{P,OPT}$ is the optimal estimate of AEP flood quantile for a particular probability of flooding (p) (Interagency Advisory Committee on Water Data, 1982, Appendix 8);
- $Var[RRE]$ is the variance of the RRE estimate of the AEP flood quantile for a particular probability of flooding (p);
- $Q_{P,LPIII}$ is the Bulletin 17B method estimate of the AEP flood quantile for a particular probability of flooding (*p*);
- $Var[LPIII]$ is the variance of the Bulletin 17B estimate of the AEP flood quantile for a particular probability of flooding (p); and
- $Q_{P,RRE}$ is the RRE estimate of the AEP flood quantile for a particular probability of flooding (*p*).

Previous USGS reports have expressed the accuracy of RREs in terms of equivalent years of record and used these estimates with the length of record at the streamgage to combine RRE and LPIII AEP flood quantile estimates (for example, Hodge and Tasker, 1995; Soong and others, 2004; Ries and Dillow, 2006). The length of record, however, can fail to account for the true variance of LPIII flood-probability estimates. For example, the length of record fails to account for any improvement in the information provided by the regional skew. Furthermore, flood-probability distributions computed from two different streamgaging records of the same length may not be of equal reliability because of differences in underlying variances of the streamflow records for each site. For example, a small drainage basin may have dynamic, more highly varied records and may be more difficult to accurately measure the streamflow than a large drainage basin; hence, the LPIII distributions in a small drainage basin could be expected to have larger variances than in a large drainage basin. More importantly, the equivalent years-of-record concept, although relatively easy to grasp, misconstrues the relation between the AEP flood quantile estimates and the variances. Using estimated variances provides a more natural characterization of the underlying uncertainty of the various streamflow estimates.

The optimal (weighted) estimates of the AEP flood quantiles corresponding to the 4-percent, 2-percent, 1-percent, and 0.2-percent AEP, along with their respective 95-percent confidence limits, for most of the streams in the Midwest that were flooded during the January to September 2008 time frame, are given in tables 1–7. Presenting this information for the streams in this report allows the reader to better assess the uncertainty of the AEP for each stream in the tables. During January through September 2008, peak streamflows at 26 USGS streamgages had a less than 0.2-percent AEP, and peak streamflows at 67 USGS streamgages had an AEP in the range of 0.2 to 1 percent.

Effects of the 2008 Flooding on Annual Exceedance Probability Estimates

The calculation of AEP flood quantiles by the guidelines published in Bulletin 17B is dependent on annual peak streamflow data from USGS streamgages. As more data become available, the AEP flood quantile estimates are affected. As a result, the AEP flood quantiles for the various AEP values (for example, 50-percent, 2-percent, and 1-percent AEP) change through time at each site. The effects of changing the length of the annual peak streamflow record on AEP flood quantiles are shown for selected sites in figure 19, which has the moving unweighted (not weighted with RRE estimate) AEP flood quantile plotted through time. A minimum of 10 years of annual peak streamflow data was needed for these sites before the first unweighted AEP flood quantile was computed by Bulletin 17B methods. Thereafter, the moving unweighted AEP flood quantiles for the 50-percent, 2-percent, and 1-percent AEP were computed using the Bulletin 17B guidelines for each successive year, keeping all previous annual peak streamflow data in the analysis. By examining the time series for each graph, it is apparent that increases in the 1-percent and 2-percent unweighted AEP flood quantile occur with each new major flood, followed by slight decreases in the years following each major flood. The 50-percent unweighted AEP flood quantile estimate is mostly insensitive to major floods.

Inclusion of the 2008 flood-peak streamflow in the analysis increases the 2-percent and 1-percent unweighted AEP flood quantile estimate for each of the six selected USGS streamgages (fig. 19). The unregulated streams in the Midwest with more than 10 years of record and that had peak streamflows during 2008 with an estimated AEP less than 1 percent are presented in figure 20. Including the 2008 peak streamflow in the flood-probability analysis increased the estimate of the 1-percent unweighted AEP flood quantile anywhere from 20 percent to more than 100 percent for streamgages with less than 25 years of record (fig. 20). In contrast, streamgages with more than 80 years of record had a less than 10 percent increase in the 1-percent unweighted AEP flood quantile, inferring that the longer the period of record used for the flood-probability analysis, the less pronounced the effect of including the 2008 flood data. A similar observation can be made for the confidence limits. All other factors being equal, one can reasonably conclude that as the length of record increases, the instability in the AEP flood quantile estimate decreases and the confidence limits narrow, resulting in a decrease in the level of uncertainty in the AEP flood quantile estimate. For this report, the 2008 peak streamflows were included in all flood-probability analyses to determine the AEP flood quantile estimates provided in tables 1–7.

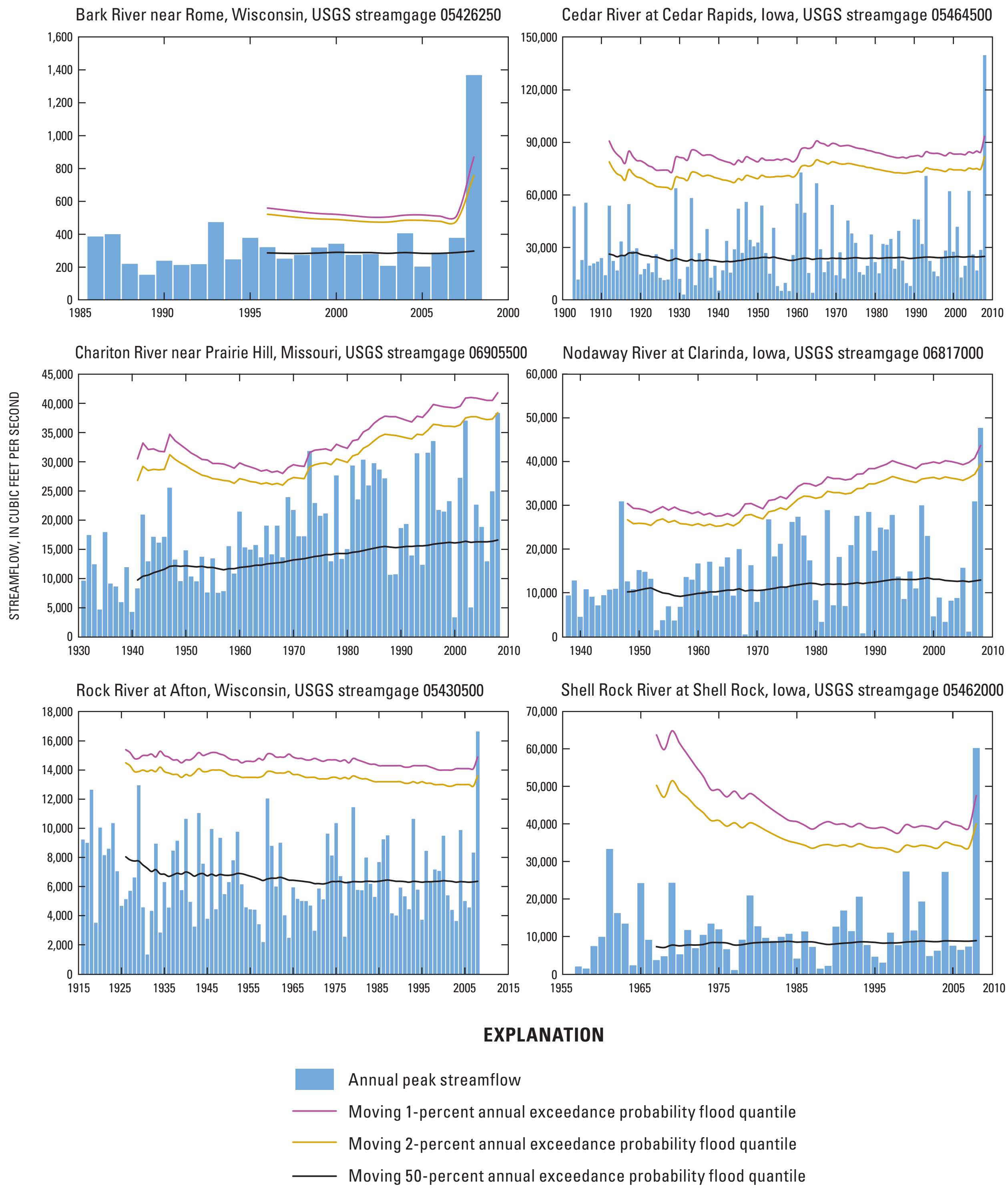


Figure 19. Effects of annual peak streamflows on moving 50-percent, 2-percent, and 1-percent unweighted annual exceedance probability flood quantiles through time at selected U.S. Geological Survey streamgages.

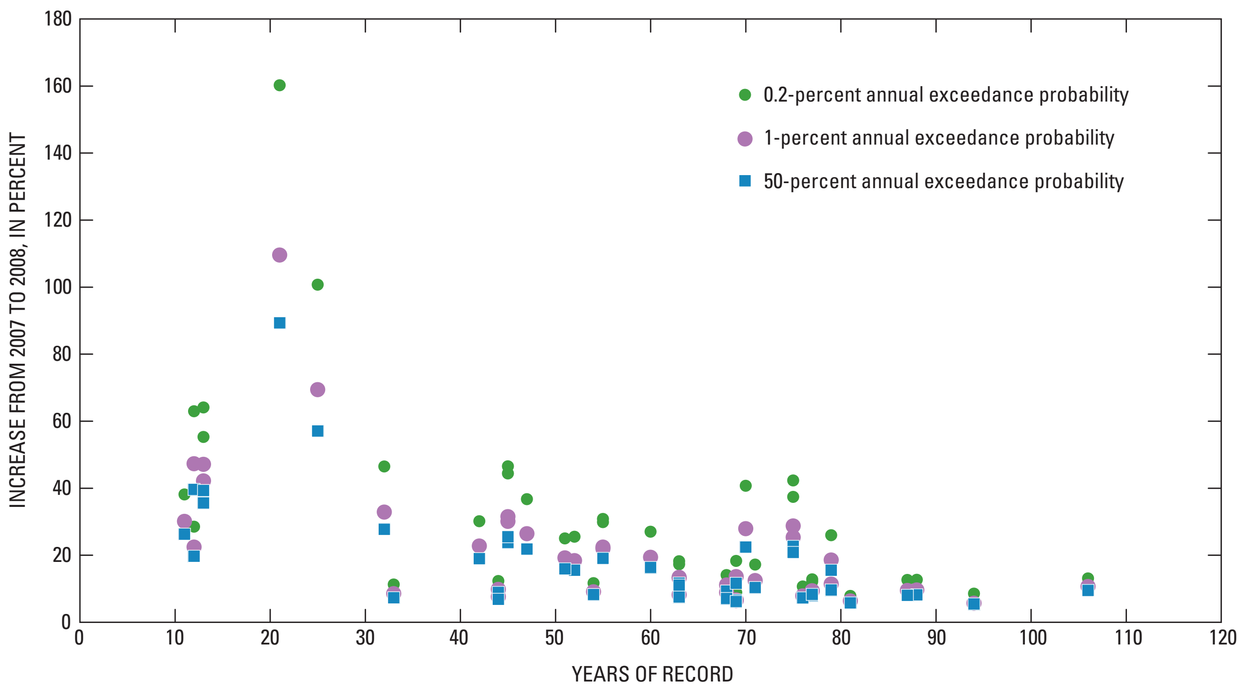


Figure 20. Increase in the 0.2-percent, 1-percent, and 50-percent unweighted annual exceedence probability flood quantiles for unregulated streams in the Midwest with more than 10 years of record when 2008 peak streamflow data were included in the flood-probability analysis.

Trends in Flood Maxima

Trends in peak streamflows are important to investigate, as a trend may indicate to emergency and infrastructure managers changes in levels of risk to public safety. The annual peak-streamflow time-series data were analyzed for selected USGS streamgages in the Midwest to determine the presence and subsequent magnitude of trends through time at each site. Only trend magnitudes were computed with no effort to conduct null hypothesis significance testing (NHST), as much discussion in recent literature has focused on problems with NHST (Nichols, 2001) and the issue of long-term persistence (Cohn and Lins, 2005).

The trend magnitudes were computed based on the Sen slope estimator (Sen, 1968) using the MAKESENS application from the Finnish Meteorological Institute (Salmi and others, 2002). The Sen slope, also known as the Kendall-Theil robust line, is a nonparametric estimate of trend magnitude slope for a univariate time series when the time interval is constant (equally spaced).

$$f(t) = M_q t + B \qquad (2)$$

where

$f(t)$ is the increasing or decreasing function of time for the trend magnitudes of the peak streamflows used in the investigation,

M_q is the Sen slope (trend magnitude),

t is time, and

B is a constant.

The Sen slope is the median slope of all pairwise comparisons with each pairwise difference divided by the number of years separating the records. To determine the Sen slope estimate in equation 2, the slopes of all data pairs are calculated:

$$M_{j,k} = \frac{(x_k - x_j)}{\Delta t_{j,k}} \quad \text{for } j = 1, \ldots, n\text{-}1;\ j < k \le n \qquad (3)$$

where

$M_{j,k}$ is the slope between data points x_j and x_k;

x_j is the data measurement at time *j*;

x_k is the data measurement at time *k;* and

$\Delta t_{j,k}$ is the change in time between observations.

The Sen slope, M_q, is equal to the median value of all the $M_{j,k}$.

The streamgages selected for trend analysis were selected from the streamgages that had peak streamflows less than 10-percent AEP in 2008 and met the criteria outlined in Hodgkins and others (2007). The criteria stipulate that the streamgage must have at least 50 years of data with no more than 5 percent missing and that the stream must not be

regulated by the presence of a substantial dam or other water-diversion and control structure. The minimum timeframe of 50 years of record is arbitrary. The USGS streamgages that did not meet these criteria were eliminated from the analyses. In the Midwestern States included in this investigation, 147 streamgages on unregulated streams met the criteria and were included in the computation of trend magnitudes of annual peak streamflows.

For comparison of streamgages with varying basin sizes, the Sen slope for each streamgage was divided by the median annual peak streamflow value to determine the percentage of

◀ *Streamgage 05462000, Shell Rock River at Shell Rock, Iowa. Photograph by Don Becker, USGS.*

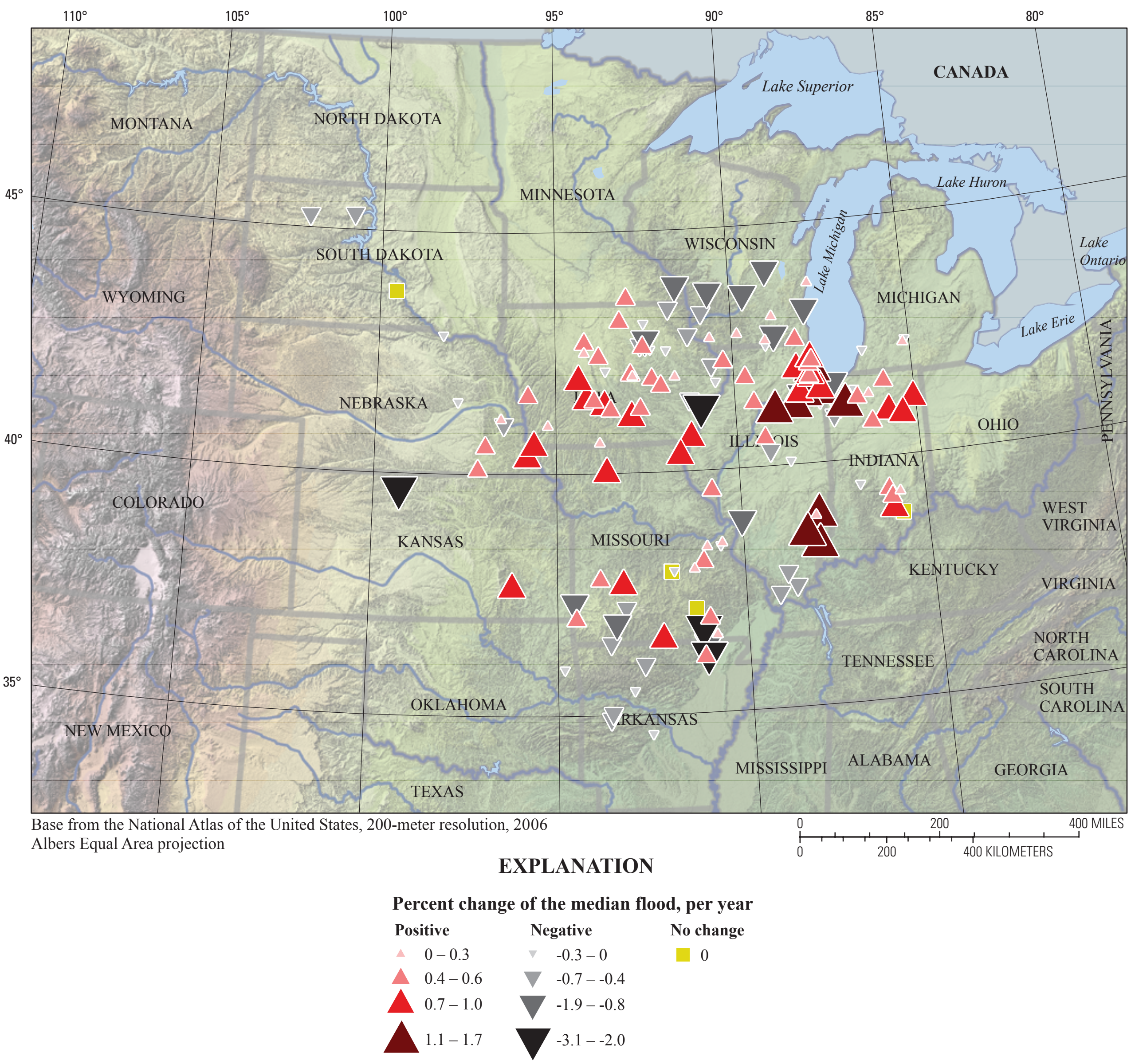


Figure 21. Percentage changes in the median annual peak streamflow values for selected U.S. Geological Survey streamgages on unregulated streams with data from 1958 to 2007.

change with respect to the median annual peak streamflow at each streamgage. Examination of the trend magnitude (scaled by median annual peak flood streamflow) from1958 to 2007 does not indicate a systematic trend for the Midwest in either direction. Of the 147 streamgages, 83 had an upward trend, 60 had a downward trend, and 4 had no trend (fig. 21). The clustering of upward trends in magnitude (positive percentages) in northeastern Illinois and northwestern Indiana (fig. 21) likely is explained partially by increased urbanization in the Chicago metropolitan area between 1958 and 2007. A clustering of downward trends in magnitude (negative percentages) occurred in areas of eastern Iowa, southern Wisconsin, and southern Illinois. An additional analysis was conducted on 14 streamgages on unregulated streams with annual peak streamflow data from 1918 to 2007; of these 14 sites, 10 streamgages had an upward trend (fig. 22).

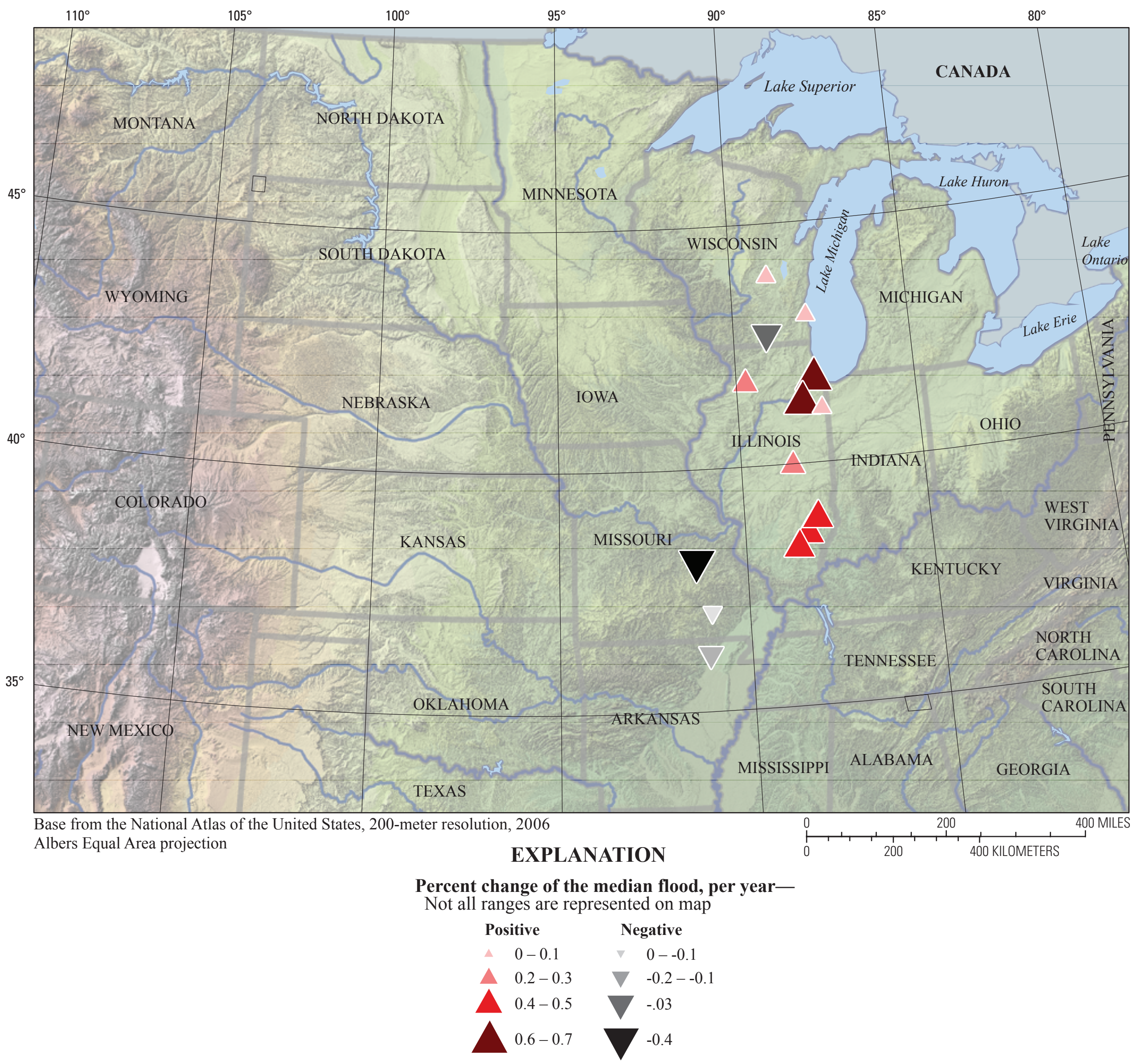


Figure 22. Percentage changes in the median annual peak streamflow values for selected U.S. Geological Survey streamgages on unregulated streams with data from 1918 to 2007.

Summary

Above-average precipitation occurred throughout much of the United States Midwest during late 2007, which left soils extremely wet or saturated as the 2007–2008 winter months approached. Melting of the above-average snow accumulations in the upper Midwest provided a perfect setting for enhanced runoff by keeping the soil saturated and streams flowing well above baseflow throughout spring 2008. Heavy precipitation occurred in January in parts of Illinois and Indiana and initiated the first of many rounds of flooding in the Midwest. Discrete episodes of extreme or heavy precipitation resulted in flooding in parts of the Midwest during the months of January–April, June, July, and September, 2008. New total precipitation records were set at 106 National Weather Service rain gages during January through June 2008. During June 2008, new monthly total precipitation records were set at 66 rain gages, with precipitation totals in the range of 0.2-percent to 0.1-percent annual exceedance probability in parts of Illinois, Indiana, and Iowa.

In 2008, more than 147 USGS Midwestern streamgages had peak-of-record streamflows. Of these 147 peak-of-record streamflows, 77 were set in June alone, and 39 of the 77 were in Iowa.

Rare floods (less than 0.2-percent chance of exceedance) were recorded at USGS streamgages at 26 sites, and 67 streamgages recorded peak streamflows having an annual exceedance probability between 0.2 percent and 1 percent. Recurrent flooding in Indiana set new records at several streamgages during the months of January, February, March, June, and September 2008. The June flooding was by far the most severe and widespread, causing damage in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, Oklahoma, South Dakota, and Wisconsin.

Trend magnitudes were computed at 147 unregulated Midwest streamgages. The computed trend magnitudes and percentages of change in the median annual peak streamflow values indicated that although clustering of increasing and decreasing trends occurred, no consistent trend was evident across the Midwest.

References Cited

Adams, Barry, 2008, Hope returns to Lake Delton: Madison, Wisconsin, Wisconsin State Journal, December 5, 2008.

Benson, M.A., and Dalrymple, Tate, 1967, General field and office procedures for indirect measurements: U.S. Geological Survey Techniques of Water-Resources Investigations, book 3, chap. A1, 30 p.

Chin, E.H., Skelton, John, and Guy, H.P., 1975, The 1973 Mississippi River basin flood: compilation and analysis of meteorologic, streamflow, and sediment data: U.S. Geological Survey Professional Paper 937, 137 p.

Cohn, T.A., Lane, W.L., and Stedinger, J.R., 2001, Confidence intervals for expected moments algorithm flood quantile estimates: Water Resources Research, v. 37, no. 6, p. 1,695-1,706.

Cohn, T.A., and Lins, H.F., 2005, Nature's style: Naturally trendy: Geophysical Research Letters, v. 32, L23402, 5 p.

Eash, D.A., 2001, Techniques for estimating flood-frequency discharges for streams in Iowa: U.S. Geological Survey Water-Resources Investigations Report 00–4233, 88 p.

Fitzpatrick, F.A., Peppler, M.C., Walker, J.F., Rose, W.J., Waschbusch, R.J., and Kennedy, J.L., 2008, Flood of June 2008 in southern Wisconsin: U.S. Geological Survey Scientific Investigations Report 2008-5235, 24 p.

Fodor, Eric, 2009, Flooding is a continual problem: Harrisburg, IL, Harrisburg Daily Register, March 17, 2009.

Funkhouser, J.E., and Eng, Ken, 2008, Floods of selected streams in Arkansas, spring 2008: U.S. Geological Survey Fact Sheet 2008–3103, 4 p.

Gillerman, Margaret, 2008, University City flood victims plead for help: St. Louis, Missouri, St. Louis Post Dispatch, September 23, 2008.

Griffis, V.A., Stedinger, J.R., and Cohn, T.A., 2004, Log Pearson type 3 quantile estimators with regional skew information and low outlier adjustments: Water Resources Research, v. 40, W07503, 17 p.

Hjelmfelt, A.T., Jr., and Cassidy, J.J., 1975, Hydrology for engineers and planners: Ames, Iowa, Iowa State University Press, 210 p.

Hodge, S.A., and Tasker, G.D., 1995, Magnitude and frequency of floods in Arkansas: U.S. Geological Survey Water-Resources Investigations Report 95–4224, 52 p.

Hodgkins, G.A., Dudley, R.W., and Aichele, S.S., 2007, Historical changes in precipitation and streamflow in the U.S. Great Lakes Basin, 1915-2004: U.S. Geological Survey Scientific Investigations Report 2007–5118, 31 p.

Holmes, R.R., Jr., and Kupka, A.L., 1997, Floods of July 18–20, 1996, in northern Illinois: U.S. Geological Survey Open-File Report 97–425, 29 p.

Indiana NewsCenter, 2008, 125-million flood damage at Columbus Hospital, accessed August 31, 2008, at *http://www.indianasnewscenter.com/news/local/20601219.html*.

Indianapolis Star, 2008, Assessing the damage, accessed August 31, 2008, at *http://www.indystar.com/apps/pbcs.dll/article?AID=/20080615/LOCAL/806150400/1001/NEWS.*

Interagency Advisory Committee on Water Data, 1982, Guidelines for determining flood flow frequency: Reston, Virginia., U.S. Geological Survey, Bulletin 17B of the Hydrology Subcommittee, Office of Water Data Coordination, 183 p., available online at *http://water.usgs.gov/osw/bulletin17b/dl_flow.pdf*.

Jennings, M.E., Thomas, T.O., Jr., and Riggs, H.C., 1994, Nationwide summary of U.S. Geological Survey regional regression equations estimating magnitude and frequency of floods for ungaged sites: U.S. Geological Survey Water-Resources Investigations Report 94-4002, 196 p.

Langbein, W.B., and Iseri, K.T., 1960, General introduction and hydrologic definitions: U.S. Geological Survey Water-Supply Paper 1541-A, 29 p.

Midwestern Regional Climate Center, 2008, Record-setting precipitation totals in the Midwest: accessed on December 15, 2008, at *http://mcc.sws.uiuc.edu/news/releases/2008/20080702_Precipitation%20Records.pdf.*

Morlock, S.E., Menke, C.D., Arvin, D.V., and Kiim, M.H., 2008, Flood of June 7-9, 2008, in central and southern Indiana: U.S. Geological Survey Open-File Report 2008–1322, 15 p.

National Climatic Data Center, 2008, Climate-radar data inventories: accessed on September 15, 2009, at *http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?WWDI~getstate~USA.*

National Weather Service, 2009, Central United States flooding of June 2008: Service assessment: Silver Spring, MD, National Oceanic and Atmospheric Administration, National Weather Service, 50 p

National Weather Service, 2008a, Advanced Hydrologic Prediction Service, current 1-day observed precipitation, January 8, 2008: National Oceanic and Atmospheric Administration, National Weather Service, accessed January 8, 2008, at *http://water.weather.gov/*.

National Weather Service, 2008b, NOAA's source for snow information: National Oceanic and Atmospheric Administration, National Weather Service, National Operational Hydrologic Remote Sensing Center, accessed on February 18, 2008, at *http://www.nohrsc.nws.gov/*.

Nichols, Neville, 2001, The insignificance of significance testing: Bulletin of American Meteorology Society, v. 81, no. 5, p. 981–986.

O'Connor, J.E., and Costa, J.E., 2003, Large floods in the United States: where they happen and why: U.S. Geological Survey Circular 1245, 13 p.

Parrett, Charles, Melcher, N.B., and James, R.W., Jr., 1993, Flood streamflows in the upper Mississippi River basin, 1993: U.S. Geological Survey Circular 1120-A, 14 p.

Rabbitt, M.C., 1989. The United States Geological Survey, 1879–1989: U.S. Geological Survey Circular 1050, 52 p., available online at *http://pubs.usgs.gov/circ/c1050/index.htm.*

Rantz, S.E., Measurement and computation of streamflow: volumes 1 and 2: U.S. Geological Survey Water-Supply Paper 2175, 632 p.

Ries, K.G., III, and Dillow, J.J.A., 2006, Magnitude and frequency of floods on nontidal streams in Delaware: U.S. Geological Survey Scientific Investigations Report 2006–5146, 59 p.

Salmi, T., Määttä, A., Anttila, P., Ruoho-Airola, T., and Amnell, T., 2002, Detecting trends of annual values of atmospheric pollutants by the Mann-Kendall test and Sen's slope estimates—The excel template application MAKESENS: Helsinki, Finland, Finnish Meteorological Institute Report 31, 35 p.

Sando, S.K., Driscoll, D.G., and Parrett, Charles, 2008, Peak-flow Frequency Estimates Based on Data through Water Year 2001 for Selected Streamflow-Gaging Stations in South Dakota: U.S. Geological Survey Scientific Investigations Report 2008–5104, 367 p. available online at *http://pubs.usgs.gov/sir/2008/5104*.

Sen, P.K., 1968, Estimates of the regression coefficient based on Kendall's tau: Journal of American Statistical Association, vl. 63, p. 1,379-1,389.

Soong, D.T., Ishii, A.L., Sharpe, J.B., and Avery, C.F., 2004, Estimating flood-peak streamflow magnitudes and frequencies for rural streams in Illinois: U.S. Geological Survey Scientific Investigations Report 2004–5103, 147 p.

Tasker, G.D., and Stedinger, J.R., 1989, An operational GLS model for hydrologic regression: Journal of Hydrology, v. 111, p. 361–375.

U.S. Army Corps of Engineers , 2009, Iowa River regulated flow frequency study. U.S. Army Corps of Engineers, Rock Island, Illinois, October 2009, 65 p.

U.S. Army Corps of Engineers , 2004, Upper Mississippi River System flow frequency study. U.S. Army Corps of Engineers, Rock Island, Illinois, available online at *http://www.mvr.usace.army.mil/pdw/pdf/flowfrequency/Documents/FinalReport/default.asp.*

U.S. Army Corps of Engineers, 2002, Regulated Frequency Curve and Pool Elevation Frequency Estimates for the Des Moines and Iowa River Basins, Iowa, Prepared for the Rock Island District Corps of Engineers by the Hydrologic Engineering Center, Davis, California, January 2002.

U.S. Geological Survey, 2010, Flood Photo and Video Archive, White River at Calico Rock, Arkansas Video: U.S. Geological Survey, accessed on January 1, 2010 at *http://water.usgs.gov/osw/floods/photo_vid_archive/2008_March/calicovideo.wmv.*

U.S. Geological Survey, 2008, National Water Information System, peak streamflow for the Nation: U.S. Geological Survey Web interface, accessed on October 31, 2008, at *http://nwis.waterdata.usgs.gov/usa/nwis/peak*.

U.S. Geological Survey, 2007, WaterWatch—Current water resources conditions, map of real-time streamflow compared to historical streamflow for the day of the year (United States): U.S. Geological Survey, accessed on November 30, 2007, and February 28, 2008, at *http://waterwatch.usgs.gov/*.

Flooding on the West Fork Cedar River near Finchford, Iowa. Photograph by Don Becker, USGS.

Tables 1–7

USGS hydrographers preparing to make a boat measurement of the streamflow coming across the road on the Cedar River near Conesville, Iowa (USGS streamgage 05465000). Photograph by Scott Strader, USGS.

Table 1. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during January 2008.

[mi^2, square mile; ft, foot; ft^3/s, cubic foot per second; AEP, annual exceedance probability; <, less than; --, no data; >, greater than]

Site number (fig. 7)	Station number	Station name	Contributing drainage area (mi^2)	Flood data: Previous maximum streamflow: Date	Stage (ft)	Streamflow (ft^3/s)	Flood of January 2008: Rank[a]/ annual peaks	Date	Peak stage (ft)	Peak streamflow (ft^3/s)
1	03328000	Eel River at North Manchester, Ind.	417	12/1990	20.16	8,740	([c])	1/9/2008	13.88	7,950
2	03328500	Eel River near Logansport, Ind.	789	02/1985	12.68	17,700	([c])	1/10/2008	11.26	13,300
3	03330500	Tippecanoe River at Oswego, Ind.	113	03/1982	9.25	[d]950	([c])	1/13/2008	8.51	[d]650
4	03331500	Tippecanoe River near Ora, Ind.	856	06/1981	15.08	8,660	1/64	1/10/2008	15.63	9,290
5	03333050	Tippecanoe River near Delphi, Ind.	1,869	12/1990	12.87	22,100	1/20	1/8/2008	17.83	[e]37,600
6	03335500	Wabash River at Lafayette, Ind.	7,267	03/1913	32.90	190,000	([c])	1/10/2008	21.95	[d]59,800
7	03336000	Wabash River at Covington, Ind.	8,218	03/1913	35.10	200,000	([c])	1/11/2008	25.99	[d]56,700
8	03341500	Wabash River at Terre Haute, Ind.	12,263	03/1913	31.20	245,000	([c])	1/13/2008	21.56	[d]58,500
9	03342000	Wabash River at Riverton, Ind.	13,161	03/1913	26.40	250,000	([c])	1/17/2008	21.21	[d]55,800
10	04097500	St. Joseph River at Three Rivers, Mich.	1,350	04/1950	10.60	8,260	3/49	1/12/2008	9.44	6,330
11	04099000	St. Joseph River at Mottville, Mich.	1,866	06/1989	10.41	[d]11,400	8/86	1/12/2008	8.59	[d]8,110
12	04100222	North Branch Elkhart River at Cosperville, Ind.	142	03/1982	8.12	[d]919	4/37	1/12/2008	[h]7.28	[d]742
13	04100500	Elkhart River at Goshen, Ind.	594	02/1985	11.87	6,360	([c])	1/9/2008	10.07	4,860
14	04180000	Cedar Creek near Cedarville, Ind.	270	12/1990	13.38	5,580	([c])	1/9/2008	12.03	4,870
15	05515500	Kankakee River at Davis, Ind.	537	01/2005	13.05	1,930	([c])	1/8/2008	13.61	1,760
16	05516500	Yellow River at Plymouth, Ind.	294	10/1954	17.13	5,390	3/60	1/10/2008	15.13	4,010
17	05517000	Yellow River at Knox, Ind.	435	10/1954	13.75	5,660	([c])	1/12/2008	12.14	4,290
18	05517500	Kankakee River at Dunns Bridge, Ind.	1,160	03/1982	13.38	5,870	([c])	1/13/2008	12.69	5,230
19	05518000	Kankakee River at Shelby, Ind.	1,779	03/1982	12.98	7,650	([c])	1/12/2008	12.43	5,660
20	05522500	Iroquois River at Rensselaer, Ind.	203	07/2003	16.59	2,620	([c])	1/10/2008	15.06	2,290
21	05524500	Iroquois River near Foresman, Ind.	449	06/1958	24.42	5,930	([c])	1/9/2008	24.16	6,420
22	05527500	Kankakee River near Wilmington, Ill.	5,150	07/1957	11.40	75,900	7/96	1/9/2008	8.77	49,500
23	05536179	Hart Ditch at Dyer, Ind.	37.6	11/1990	15.33	3,010	([c])	1/8/2008	12.31	1,660
24	05536195	Little Calumet River at Munster, Ind.	90.0	04/1959	13.67	1,510	6/50	1/9/2008	14.58	1,050
25	05555300	Vermilion River near Leonore, Ill.	1,251	07/1958	15.30	33,500	3/78	1/9/2008	25.22	26,900

Site number	Estimated AEP for observed peak streamflow (percent)	Expected peak streamflows for selected AEP with 95-percent confidence limits (ft^3/s)[b]: 4-percent AEP (25-year recurrence): Estimate	Confidence limit: Low	High	2-percent AEP (50-year recurrence): Estimate	Confidence limit: Low	High	1-percent AEP (100-year recurrence): Estimate	Confidence limit: Low	High	0.2-percent AEP (500-year recurrence): Estimate	Confidence limit: Low	High
1	4–10	8,220	7,210	9,370	9,170	7,840	10,700	10,100	8,440	12,200	12,400	9,670	15,900
2	4–10	15,500	13,500	17,700	17,400	14,800	20,500	19,400	16,000	23,500	24,200	18,600	31,300
3	4–10	782	662	925	895	733	1,090	1,010	804	1,280	1,310	970	1,770
4	2–4	8,920	7,660	10,400	9,990	8,370	11,900	11,000	8,990	13,500	13,300	10,200	17,200
5	< 1	[f]22,200	--	--	[f]24,600	--	--	[f]27,100	--	--	--	--	--
6	> 10	96,100	86,500	107,000	110,000	96,500	125,000	124,000	106,000	144,000	158,000	128,000	195,000
7	> 10	105,000	94,800	117,000	119,000	105,000	135,000	133,000	115,000	154,000	165,000	135,000	202,000
8	> 10	139,000	125,000	154,000	156,000	138,000	177,000	174,000	150,000	201,000	213,000	174,000	260,000
9	> 10	134,000	121,000	149,000	152,000	134,000	172,000	169,000	146,000	196,000	208,000	171,000	254,000
10	4–10	[g]6,360	5,720	7,310	[g]6,970	6,200	8,140	[g]7,560	6,660	8,950	[g]8,900	7,680	10,900
11	4–10	[g]8,780	8,080	9,730	[g]9,800	8,930	11,000	[g]10,800	9,780	12,300	[g]13,400	11,800	15,700
12	4–10	873	725	1,050	984	793	1,220	1,100	859	1,410	1,390	1,020	1,900
13	4–10	5,600	4,910	6,380	6,180	5,290	7,230	6,740	5,610	8,090	7,950	6,240	10,100
14	4–10	5,280	4,740	5,880	5,630	4,950	6,410	5,950	5,100	6,920	6,580	5,360	8,090
15	4–10	1,830	1,710	1,960	1,940	1,790	2,100	2,050	1,860	2,250	2,300	2,010	2,620
16	4–10	4,100	3,530	4,750	4,600	3,860	5,480	5,100	4,170	6,240	6,290	4,870	8,120
17	4–10	4,510	3,950	5,140	5,020	4,300	5,860	5,530	4,630	6,600	6,750	5,360	8,490
18	4–10	5,390	4,940	5,870	5,730	5,170	6,350	6,060	5,370	6,840	6,800	5,760	8,040
19	> 10	6,370	5,940	6,830	6,730	6,180	7,320	7,060	6,390	7,810	7,760	6,740	8,930
20	4–10	2,360	2,160	2,580	2,570	2,310	2,860	2,770	2,450	3,140	3,250	2,740	3,860
21	1–2	5,690	4,930	6,550	6,300	5,340	7,430	6,880	5,690	8,320	8,210	6,430	10,500
22	4–10	54,700	47,300	63,300	61,300	51,600	72,900	67,500	55,200	82,600	80,800	61,300	106,000
23	> 10	[g]3,100	2,380	4,690	[g]3,730	2,780	5,990	[g]4,420	3,200	7,540	[g]6,340	4,290	12,300
24	4–10	1,210	1,050	1,510	1,320	1,130	1,720	1,440	1,210	1,940	1,730	1,410	2,490
25	4–10	30,700	25,600	36,900	35,000	28,300	43,400	39,100	30,500	50,200	48,200	34,400	67,500

[a] Rank of the maximum instantaneous peak streamflow measured during January 2008 compared to all systematic and historic annual peaks. A rank of 1 indicates that the January 2008 peak streamflow was higher than all other recorded annual peaks.

[b] Unless otherwise noted, expected peak streamflows are based on Water Resources Council Bulletin 17B weighting by variance method.

[c] The peak streamflow for January 2008 was exceeded by another peak streamflow during 2008.

[d] Streamflow affected to unknown degree by regulation or diversion.

[e] Streamflow affected by regulation or diversion.

[f] Expected peak streamflows are Indiana Coordinated Discharges, which do not include confidence limits (*http://www.state.in.us/dnr/water/4898.htm*).

[g] Expected peak streamflows based on Bulletin 17B systematic frequency-curve estimate only.

[h] A higher stage exists that corresponds to a streamflow that is less than the peak streamflow.

Flooding in Spencer, Indiana from the White River (left) and USGS personnel launching boat (right) to make a streamflow measurement on the White River near Newberry, Indiana (USGS streamgage 03360500). Photographs by Paul Baker, USGS.

Table 2. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during February 2008.

[mi², square mile; ft, foot; ft³/s, cubic foot per second; AEP, annual exceedance probability; >, greater than; --, no data]

Site number (fig. 8)	Station number	Station name	Contributing drainage area (mi²)	Flood data: Previous maximum streamflow: Date	Previous maximum streamflow: Stage (ft)	Previous maximum streamflow: Streamflow (ft³/s)	Flood of February 2008: Rank[a]/annual peaks	Flood of February 2008: Date	Flood of February 2008: Peak stage (ft)	Flood of February 2008: Peak streamflow (ft³/s)
1	03322900	Wabash River at Linn Grove, Ind.	453	07/2003	14.76	[c]14,500	2/45	2/7/2008	13.52	[c]9,890
2	03324000	Little River near Huntington, Ind.	263	01/1950	16.90	5,990	5/65	2/7/2008	18.91	5,180
3	03325000	Wabash River at Wabash, Ind.	1,768	03/1913	28.70	90,000	44/86	2/6/2008	16.37	[d]14,400
4	03327500	Wabash River at Peru, Ind.	2,686	03/1913	28.10	115,000	39/67	2/6/2008	12.39	[d]15,800
5	03328000	Eel River at North Manchester, Ind.	417	12/1990	20.16	8,740	3/87	2/6/2008	14.09	8,230
6	03328500	Eel River near Logansport, Ind.	789	02/1985	12.68	17,700	6/66	2/7/2008	11.31	13,500
7	03329000	Wabash River at Logansport, Ind.	3,779	03/1913	25.30	140,000	41/94	2/6/2008	12.70	[c]32,400
8	03330500	Tippecanoe River at Oswego, Ind.	113	03/1982	9.25	[c]950	6/60	2/10/2008	8.54	[c]661
9	03331500	Tippecanoe River near Ora, Ind.	856	06/1981	15.08	8,660	([f])	2/8/2008	15.60	9,200
10	03333050	Tippecanoe River near Delphi, Ind.	1,869	12/1990	12.87	22,100	([f])	2/6/2008	14.89	[d]24,600
11	03335500	Wabash River at Lafayette, Ind.	7,267	03/1913	32.90	190,000	15/105	2/7/2008	23.94	[c]72,400
12	03336000	Wabash River at Covington, Ind.	8,218	03/1913	35.10	200,000	15/82	2/8/2008	27.67	[c]74,000
13	03336645	Middle Fork Vermilion River, Oakwood, Ill.	432	04/1994	20.46	15,500	4/32	2/6/2008	16.16	12,600
14	03336900	Salt Fork near St. Joseph, Ill.	134	05/1968	18.26	6,860	4/38	2/6/2008	19.06	5,660
15	03341500	Wabash River at Terre Haute, Ind.	12,263	03/1913	31.20	245,000	([f])	2/10/2008	25.00	[c]92,200
16	03342000	Wabash River at Riverton, Ind.	13,161	03/1913	26.40	250,000	([f])	2/12/2008	24.16	[c]77,300
17	03374000	White River at Petersburg, Ind.	11,125	03/1913	29.50	235,000	([f])	2/13/2008	23.58	[c]70,600
18	04100222	North Branch Elkhart River at Cosperville, Ind.	142	03/1982	8.12	[c]919	([f])	2/11/2008	7.58	[c]718
19	04100500	Elkhart River at Goshen, Ind.	594	02/1985	11.87	6,360	8/81	2/6/2008	10.39	5,080
20	04180000	Cedar Creek near Cedarville, Ind.	270	12/1990	13.38	5,580	3/62	2/7/2008	12.83	5,290
21	05515500	Kankakee River at Davis, Ind.	537	01/2005	13.05	1,930	([f])	2/6/2008	[g]13.17	1,580
22	05516500	Yellow River at Plymouth, Ind.	294	10/1954	17.13	5,390	([f])	2/7/2008	14.94	3,590
23	05517000	Yellow River at Knox, Ind.	435	10/1954	13.75	5,660	3/65	2/9/2008	12.16	4,310
24	05517500	Kankakee River at Dunns Bridge, Ind.	1,160	03/1982	13.38	5,870	2/60	2/12/2008	[g]12.72	5,420
25	05518000	Kankakee River at Shelby, Ind.	1,779	03/1982	12.98	7,650	([f])	2/13/2008	12.27	5,710
26	05522500	Iroquois River at Rensselaer, Ind.	203	07/2003	16.59	2,620	4/61	2/7/2008	15.64	2,490
27	05524500	Iroquois River near Foresman, Ind.	449	06/1958	24.42	5,930	1/60	2/7/2008	[g]22.70	6,480

Site number (fig. 8)	Estimated AEP for observed peak streamflow (percent)	Expected peak streamflows for selected AEP with 95-percent confidence limits (ft³/s)[b]: 4-percent AEP (25-year recurrence): Estimate	4-percent AEP: Confidence limit: Low	4-percent AEP: Confidence limit: High	2-percent AEP (50-year recurrence): Estimate	2-percent AEP: Confidence limit: Low	2-percent AEP: Confidence limit: High	1-percent AEP (100-year recurrence): Estimate	1-percent AEP: Confidence limit: Low	1-percent AEP: Confidence limit: High	0.2-percent AEP (500-year recurrence): Estimate	0.2-percent AEP: Confidence limit: Low	0.2-percent AEP: Confidence limit: High
1	4–10	10,100	8,610	12,000	11,000	9,100	13,400	11,800	9,440	14,700	13,200	9,940	17,500
2	4–10	5,530	5,010	6,090	5,940	5,290	6,670	6,340	5,540	7,260	7,250	6,040	8,700
3	> 10	[e]22,500	--	--	[e]25,500	--	--	[e]29,500	--	--	--	--	--
4	> 10	[e]23,900	--	--	[e]26,900	--	--	[e]30,900	--	--	--	--	--
5	2–4	8,220	7,210	9,370	9,170	7,840	10,700	10,100	8,440	12,200	12,400	9,670	15,900
6	4–10	15,500	13,500	17,700	17,400	14,800	20,500	19,400	16,000	23,500	24,200	18,600	31,300
7	> 10	68,400	59,600	78,500	80,300	67,700	95,300	92,800	75,700	114,000	125,000	94,100	166,000
8	4–10	782	662	925	895	733	1,090	1,010	804	1,280	1,310	970	1,770
9	2–4	8,920	7,660	10,400	9,990	8,370	11,900	11,000	8,990	13,500	13,300	10,200	17,200
10	1–2	[e]22,200	--	--	[e]24,600	--	--	[e]27,100	--	--	--	--	--
11	> 10	96,100	86,500	107,000	110,000	96,500	125,000	124,000	106,000	144,000	158,000	128,000	195,000
12	> 10	105,000	94,800	117,000	119,000	105,000	135,000	133,000	115,000	154,000	165,000	135,000	202,000
13	4–10	14,800	12,200	18,000	17,300	13,700	21,800	19,900	15,200	26,100	26,500	18,500	37,900
14	4–10	6,280	4,830	8,150	7,390	5,460	10,000	8,580	6,070	12,100	11,600	7,430	18,200
15	> 10	139,000	125,000	154,000	156,000	138,000	177,000	174,000	150,000	201,000	213,000	174,000	260,000
16	> 10	134,000	121,000	149,000	152,000	134,000	172,000	169,000	146,000	196,000	208,000	171,000	254,000
17	> 10	153,000	139,000	170,000	173,000	153,000	195,000	191,000	166,000	221,000	235,000	192,000	286,000
18	> 10	873	725	1,050	984	793	1,220	1,100	859	1,410	1,390	1,020	1,900
19	4–10	5,600	4,910	6,380	6,180	5,290	7,230	6,740	5,610	8,090	7,950	6,240	10,100
20	2–4	5,280	4,740	5,880	5,630	4,950	6,410	5,950	5,100	6,920	6,580	5,360	8,090
21	> 10	1,830	1,710	1,960	1,940	1,790	2,100	2,050	1,860	2,250	2,300	2,010	2,620
22	4–10	4,100	3,530	4,750	4,600	3,860	5,480	5,100	4,170	6,240	6,290	4,870	8,120
23	4–10	4,510	3,950	5,140	5,020	4,300	5,860	5,530	4,630	6,600	6,750	5,360	8,490
24	2–4	5,390	4,940	5,870	5,730	5,170	6,350	6,060	5,370	6,840	6,800	5,760	8,040
25	> 10	6,370	5,940	6,830	6,730	6,180	7,320	7,060	6,390	7,810	7,760	6,740	8,930
26	2–4	2,360	2,160	2,580	2,570	2,310	2,860	2,770	2,450	3,140	3,250	2,740	3,860
27	1–2	5,690	4,930	6,550	6,300	5,340	7,430	6,880	5,690	8,320	8,210	6,430	10,500

[a] Rank of the maximum instantaneous peak streamflow measured during February 2008 compared to all systematic and historic annual peaks. A rank of 1 indicates that the February 2008 peak streamflow was higher than all other recorded annual peaks.

[b] Unless otherwise noted, expected peak streamflows are based on Water Resources Council Bulletin 17B weighting by variance method.

[c] Streamflow affected to unknown degree by regulation or diversion.

[d] Streamflow affected by regulation or diversion.

[e] Expected peak streamflows are Indiana Coordinated Discharges, which do not include confidence limits (*http://www.state.in.us/dnr/water/4898.htm*).

[f] The peak streamflow for February 2008 was exceeded by another peak streamflow during 2008.

[g] A higher stage exists that corresponds to a streamflow that is less than the peak streamflow.

Flooding in Harrisburg, Illinois. Flooding was because of local drainage interior to the levee (foreground) that could not be evacuated quick enough by the pumping station located in the brick structure atop the levee. Photograph by Robert Holmes, USGS.

Flooding in Harrisburg, Illinois. Photograph by Robert Holmes, USGS.

Table 3. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during March 2008.

[mi², square mile; ft, foot; ft³/s, cubic foot per second; AEP, annual exceedance probability; >, greater than; <, less than; --, no data]

Site number (fig. 10)	Station number	Station name	Contributing drainage area (mi²)	Flood data: Previous maximum streamflow: Date	Previous maximum streamflow: Stage (ft)	Previous maximum streamflow: Streamflow (ft³/s)	Flood of March 2008: Rank[a]/annual peaks	Flood of March 2008: Date	Flood of March 2008: Peak stage (ft)	Flood of March 2008: Peak streamflow (ft³/s)
1	03302800	Blue River at Fredricksburg, Ind.	206	04/1996	27.15	39,000	1/40	3/19/2008	27.37	41,700
2	03303000	Blue River near White Cloud, Ind.	284	04/1996	23.30	29,400	1/83	3/20/2008	24.15	31,000
3	03342000	Wabash River at Riverton, Ind.	13,161	03/1913	26.40	250,000	([c])	3/22/2008	19.99	[d]47,100
4	03366500	Muscatatuck River near Deputy, Ind.	293	01/1959	34.27	52,200	2/61	3/19/2008	30.51	36,600
5	03376500	Patoka River near Princeton, Ind.	822	01/1937	26.80	18,700	6/74	3/24/2008	[e]24.11	[f]12,600
6	03378000	Bonpas Creek at Browns, Ill.	228	05/1961	24.04	7,500	6/68	3/20/2008	23.27	5,530
7	03378550	Big Creek at Wadesville, Ind.	104	04/1996	20.35	10,400	1/43	3/19/2008	20.55	14,300
8	03380500	Skillet Fork at Wayne City, Ill.	464	05/1990	25.75	59,400	6/91	3/20/2008	23.29	22,900
9	03382100	South Fork Saline River near Carrier Mills, Ill.	147	01/1982	16.32	5,160	1/43	3/19/2008	18.41	24,300
10	03384450	Lusk Creek near Eddyville, Ill.	42.9	08/1985	27.78	16,100	5/42	3/18/2008	22.05	9,740
11	05592900	East Fork Kaskaskia River near Sandoval, Ill.	113	05/1990	20.03	[h]17,000	4/29	3/19/2008	20.06	9,300
12	05593575	Crooked Creek near New Minden, Ill.	84.3	05/1995	21.76	11,900	5/41	3/19/2008	21.22	9,950
13	05594100	Kaskaskia River near Venedy Station, Ill.	4,393	05/1995	25.79	[f]50,300	8/39	3/21/2008	24.01	[f]38,000
14	05595200	Richland Creek near Hecker, Ill.	129	04/1996	44.40	23,400	4/39	3/19/2008	42.90	13,200
15	05595730	Rayse Creek near Waltonville, Ill.	88.0	11/1993	17.73	21,200	7/29	3/19/2008	16.09	13,700
16	05595820	Casey Fork at Mount Vernon, Ill.	76.9	05/1990	17.03	16,100	4/23	3/19/2008	16.09	10,300
17	05597500	Crab Orchard Creek near Marion, Ill.	31.7	12/2001	13.63	9,430	1/57	3/19/2008	13.74	10,000
18	05599490	Big Muddy River at Murphysboro, Ill.	2,159	05/1996	[i]37.65	33,800	4/80	3/22/2008	37.24	31,500
19	05600000	Big Creek near Wetaug, Ill.	32.2	03/1943	15.90	7,200	1/67	3/19/2008	15.74	[h]7,200
20	06918440	Sac River near Dadeville, Mo.	257	09/1993	27.56	36,100	3/44	3/19/2008	21.32	14,600
21	06921070	Pomme de Terre River near Polk, Mo.	276	09/1993	27.10	34,300	3/40	3/19/2008	22.81	22,800
22	06923950	Niangua River, Tunnel Dam, Macks Creek, Mo.	598	01/2005	16.33	28,800	1/13	3/19/2008	17.06	32,600
23	06928000	Gasconade River near Hazelgreen, Mo.	1,250	12/1982	34.46	90,000	3/64	3/19/2008	34.92	89,500
24	06928300	Roubidoux Creek above Fort Wood, Mo.	165	05/2002	14.86	12,900	([c])	3/19/2008	19.92	24,500
25	06928430	Roubidoux Creek below Fort Wood, Mo.	287	05/2002	14.13	14,000	1/8	3/19/2008	18.45	28,900
26	06930000	Big Piney River near Big Piney, Mo.	560	12/1982	24.50	81,200	2/79	3/19/2008	23.58	64,000
27	06930060	Big Piney below Fort Wood, Mo.	593	05/2002	18.89	43,400	3/8	3/19/2008	23.45	66,000
28	06933500	Gasconade River at Jerome, Mo.	2,840	12/1982	31.34	136,000	3/90	3/20/2008	30.43	118,000
29	06934000	Gasconade River near Rich Fountain, Mo.	3,180	12/1982	33.27	134,000	2/69	3/21/2008	32.64	119,000
30	07013000	Meramec River near Steelville, Mo.	781	08/1915	26.50	60,000	4/93	3/19/2008	26.84	52,700
31	07014500	Meramec River near Sullivan, Mo.	1,475	08/1915	33.50	90,000	4/78	3/20/2008	31.69	66,900
32	07016500	Bourbeuse River at Union, Mo.	808	12/1982	33.80	73,300	5 /95	3/21/2008	25.89	36,900
33	07018100	Big River near Richwoods, Mo.	735	09/1993	30.33	59,800	2/25	3/19/2008	28.70	52,800
34	07018500	Big River at Byrnesville, Mo.	917	08/1915	30.20	80,000	4/87	3/20/2008	27.57	47,300
35	07019000	Meramec River near Eureka, Mo.	3,788	08/1915	40.20	175,000	4/91	3/21/2008	40.06	123,000
36	07021000	Castor River at Zalma, Mo.	423	12/1982	29.92	[d]97,100	1/80	3/19/2008	30.47	[d]114,000
37	07035800	St. Francis River near Mill Creek, Mo.	505	11/1993	33.10	130,000	3/20	3/19/2008	23.61	50,500
38	07036100	St. Francis River near Saco, Mo.	664	11/1993	36.10	161,000	2/17	3/19/2008	28.93	69,000
39	07037500	St. Francis River near Patterson, Mo.	956	12/1982	35.77	155,000	3/87	3/19/2008	30.82	79,300
40	07043500	Little River Ditch No.1 near Morehouse, Mo.	450	02/1989	19.30	12,000	6/60	3/19/2008	18.66	10,100
41	07050700	James River near Springfield, Mo.	246	07/1909	22.00	62,000	3/54	3/18/2008	19.32	34,200
42	07052250	James River near Boaz, Mo.	462	07/1973	20.56	31,400	1/15	3/19/2008	23.55	41,900
43	07052500	James River at Galena, Mo.	987	09/1993	33.46	73,200	1/87	3/19/2008	35.96	85,100
44	07053810	Bull Creek near Walnut Shade, Mo.	191	05/2002	14.41	32,200	([c])	3/18/2008	16.00	24,700
45	07054080	Beaver Creek at Bradleyville, Mo.	298	05/2002	17.92	20,800	1/14	3/19/2008	19.03	33,200
46	07056000	Buffalo River near St. Joe, Ark.	829	12/1982	53.75	158,000	3/81	3/19/2008	49.41	134,000

Site number (fig. 10)	Estimated AEP for observed peak streamflow (percent)	4-percent AEP (25-year recurrence): Estimate	4-percent AEP: Confidence limit Low	4-percent AEP: Confidence limit High	2-percent AEP (50-year recurrence): Estimate	2-percent AEP: Confidence limit Low	2-percent AEP: Confidence limit High	1-percent AEP (100-year recurrence): Estimate	1-percent AEP: Confidence limit Low	1-percent AEP: Confidence limit High	0.2-percent AEP (500-year recurrence): Estimate	0.2-percent AEP: Confidence limit Low	0.2-percent AEP: Confidence limit High
		Expected peak streamflows for selected AEP with 95-percent confidence limits (ft³/s)[b]											
1	0.2–1	24,100	19,200	30,200	28,300	22,100	36,300	32,700	25,000	42,900	44,400	31,600	62,200
2	1–2	27,300	23,700	31,500	31,000	26,300	36,600	34,900	28,800	42,200	44,700	34,700	57,500
3	> 10	134,000	121,000	149,000	152,000	134,000	172,000	169,000	146,000	196,000	208,000	171,000	254,000
4	.2–1	29,600	26,600	33,000	32,800	28,900	37,200	35,700	30,900	41,300	42,300	35,000	51,100
5	4–10	[g]13,800	11,200	18,400	[g]15,800	12,700	21,800	[g]17,900	14,100	25,300	[g]22,800	17,300	34,200
6	4–10	6,600	5,640	7,740	7,480	6,210	9,010	8,370	6,750	10,400	10,500	7,880	14,100
7	< .2	8,940	7,330	10,900	9,730	7,730	12,200	10,500	8,070	13,600	12,100	8,650	16,900
8	4–10	29,800	23,200	38,300	36,700	27,300	49,200	43,900	31,200	61,800	62,300	39,600	98,000
9	< .2	7,780	5,780	10,500	9,450	6,660	13,400	11,300	7,550	16,800	16,200	9,610	27,300
10	4–10	11,900	9,370	15,100	13,600	10,400	17,900	15,400	11,300	21,100	19,700	13,100	29,500
11	4–10	11,500	8,170	16,300	13,700	9,290	20,300	16,000	10,300	24,900	21,600	12,500	37,500
12	4–10	11,600	8,720	15,500	13,700	9,850	19,100	15,800	10,900	23,000	20,800	12,800	33,600
13	> 10	[g]54,800	44,600	72,300	[g]62,600	50,100	84,700	[g]70,200	55,400	97,100	[g]87,200	66,900	126,000
14	4–10	14,600	11,100	19,200	17,100	12,400	23,500	19,700	13,700	28,200	25,900	16,300	41,200
15	> 10	19,500	12,600	30,300	23,600	14,400	38,700	27,700	16,000	48,000	37,300	19,100	73,100
16	4–10	13,600	8,990	20,500	16,200	10,200	25,700	18,800	11,200	31,400	25,100	13,300	47,200
17	.2–1	6,480	4,690	8,940	8,050	5,530	11,700	9,740	6,350	14,900	14,100	8,110	24,400
18	4–10	[g]32,600	27,200	41,500	[g]37,200	30,600	48,700	[g]41,900	34,000	56,200	[g]53,000	41,600	74,600
19	.2–1	4,240	3,530	5,090	4,920	3,950	6,140	5,660	4,360	7,350	7,650	5,360	10,900
20	4–10	20,100	14,300	28,300	25,700	17,600	37,700	31,900	21,000	48,400	46,900	28,900	76,200
21	4–10	26,300	22,100	31,300	29,100	23,700	35,700	31,900	25,200	40,300	38,700	28,500	52,600
22	4–10	40,100	--	--	47,300	--	--	55,100	--	--	73,500	--	--
23	2–4	79,700	64,000	99,300	94,900	73,400	123,000	110,000	81,800	147,000	144,000	98,900	209,000
24	2–4	[j]21,200	--	--	[j]25,300	--	--	[j]29,700	--	--	[j]40,300	--	--
25	2–4	[j]26,900	--	--	[j]31,900	--	--	[j]37,200	--	--	[j]50,000	--	--
26	.2–1	41,400	33,200	51,800	50,200	38,700	65,000	59,400	44,200	79,800	82,000	56,500	119,000
27	.2–1	[j]42,000	--	--	[j]49,700	--	--	[j]58,000	--	--	[j]77,700	--	--
28	1–2	97,900	81,900	117,000	116,000	93,800	143,000	135,000	105,000	173,000	181,000	131,000	251,000
29	1–2	94,900	77,700	116,000	114,000	89,800	144,000	134,000	102,000	175,000	184,000	130,000	260,000
30	2–4	49,900	40,700	61,300	58,700	45,800	75,100	67,700	50,700	90,300	89,500	61,600	130,000
31	4–10	74,900	56,600	99,300	89,000	63,500	125,000	104,000	70,800	152,000	138,000	87,500	218,000
32	4–10	38,400	32,200	45,700	45,600	37,000	56,100	53,200	41,900	67,700	72,700	53,000	99,500
33	2–4	52,300	37,900	72,000	60,800	42,600	86,700	69,400	47,100	102,000	89,800	57,000	142,000
34	2–4	46,600	38,700	56,000	54,800	44,100	68,100	63,300	49,200	81,300	84,000	60,500	116,000
35	2–4	114,000	95,400	136,000	136,000	110,000	167,000	159,000	125,000	202,000	219,000	160,000	300,000
36	< .2	50,900	37,600	68,700	63,900	45,300	90,100	77,100	52,600	113,000	107,000	67,900	170,000
37	> 10	67,000	45,800	98,100	78,100	51,600	118,000	89,300	57,400	139,000	116,000	70,300	191,000
38	4–10	86,100	61,400	121,000	98,500	67,800	143,000	111,000	73,900	166,000	140,000	87,500	224,000
39	4–10	84,700	70,600	102,000	98,300	79,400	122,000	112,000	87,700	144,000	146,000	106,000	202,000
40	4–10	10,900	9,510	12,400	11,900	10,200	14,000	13,000	10,800	15,600	15,300	11,800	19,700
41	2–4	33,200	27,600	39,900	38,200	30,700	47,500	42,900	33,300	55,300	53,400	38,300	74,500
42	2–4	38,300	30,000	49,100	44,100	32,800	59,100	50,200	35,700	70,600	65,900	42,900	101,000
43	.2–1	55,800	46,200	67,400	65,600	52,500	81,900	75,800	58,600	97,900	101,000	72,200	141,000
44	4–10	33,000	21,100	51,600	39,600	24,700	63,300	46,400	28,500	75,700	62,900	36,900	107,000
45	4–10	34,200	22,600	51,800	40,800	26,200	63,500	47,600	29,900	75,800	64,200	38,300	107,000
46	2–4	122,000	99,800	157,000	146,000	118,000	193,000	171,000	136,000	231,000	233,000	178,000	327,000

Table 3. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during March 2008.—Continued

[mi², square mile; ft, foot; ft³/s, cubic foot per second; AEP, annual exceedance probability; >, greater than; <, less than; --, no data]

Site number (fig. 10)	Station number	Station name	Contributing drainage area (mi²)	Flood data: Previous maximum streamflow			Flood data: Flood of March 2008			
				Date	Stage (ft)	Streamflow (ft³/s)	Rank[a]/ annual peaks	Date	Peak stage (ft)	Peak streamflow (ft³/s)
47	07057500	North Fork River near Tecumseh, Mo.	561	11/1985	28.10	133,000	4/64	3/19/2008	22.79	60,600
48	07058000	Bryant Creek near Tecumseh, Mo.	570	12/1982	26.74	71,100	3/53	3/19/2008	22.12	42,800
49	07060500	White River at Calico Rock, Ark.	9,980	01/1916	52.90	350,000	([c])	3/19/2008	39.64	[f]197,000
50	07061000	White River at Batesville, Ark.	11,100	02/1916	31.90	382,000	17/93	3/20/2008	26.96	[f]208,000
51	07061900	Logan Creek at Ellington, Mo.	139	05/2002	13.22	16,300	1/15	3/18/2008	13.20	16,600
52	07064000	Black River at Corning, Ark.	1,749	03/1964	15.23	[f]32,500	4/102	3/22/2008	15.92	[f]27,100
53	07064533	Current River above Akers, Mo.	295	11/2003	7.07	5,540	1/7	3/19/2008	18.52	29,500
54	07065200	Jacks Fork near Mountain View, Mo.	185	04/2004	17.68	17,400	1/6	3/18/2008	20.39	23,600
55	07065495	Jacks Fork at Alley Spring, Mo.	298	11/1993	21.97	48,700	3/15	3/19/2008	15.23	30,000
56	07067000	Current River at Van Buren, Mo.	1,667	03/1904	29.00	153,100	10/96	3/20/2008	25.71	82,600
57	07068000	Current River at Doniphan, Mo.	2,038	03/1904	24.90	130,000	4/92	3/19/2008	24.11	95,200
58	07069000	Black River at Pocahontas, Ark.	4,840	04/1927	25.90	80,000	2/73	3/22/2008	26.56	[d]72,200
59	07069305	Spring River at Town Branch Bridge, Hardy, Ark.	867	09/2006	16.75	44,500	1/7	3/19/2008	22.29	80,700
60	07069500	Spring River at Imboden, Ark.	1,180	12/1982	38.12	244,000	2/73	3/19/2008	29.15	97,300
61	07071500	Eleven Point River near Bardley, Mo.	793	12/1982	21.64	49,800	2/88	3/19/2008	21.33	49,400
62	07072000	Eleven Point River near Ravenden Springs, Ark.	1,130	12/1982	29.06	162,000	2/77	3/19/2008	23.81	69,700
63	07072500	Black River at Black Rock, Ark.	7,370	12/1982	31.51	190,000	3/104	3/20/2008	29.74	135,000
64	07074420	Black River near Elgin Ferry, Ark.	8,420	03/2002	26.33	59,500	1/17	3/21/2008	[e]32.57	[h]127,000
65	07074500	White River at Newport, Ark.	19,900	04/1927	35.60	387,000	8/123	3/21/2008	33.87	[f]266,000
66	07074850	White River near Augusta, Ark.	20,500	02/1989	35.54	[f]140,000	1/16	3/22/2008	38.41	[f]252,000
67	07076750	White River near Georgetown, Ark.	22,400	12/1982	28.87	[f]179,000	2/30	3/24/2008	30.18	[f]175,000
68	07185765	Spring River at Carthage, Mo.	425	11/1972	17.15	24,800	1/20	3/19/2008	18.38	--
69	07187000	Shoal Creek above Joplin, Mo.	427	05/1943	16.80	62,100	6/85	3/19/2008	18.28	24,100
70	07195000	Osage Creek near Elm Springs, Ark.	130	05/1950	16.70	22,500	5/43	3/18/2008	15.55	15,800
71	07195500	Illinois River near Watts, Okla.	635	07/1960	25.96	68,000	3/53	3/19/2008	24.73	[d]53,000
72	07196500	Illinois River near Tahlequah, Okla.	959	05/1950	27.94	150,000	6/76	3/20/2008	22.29	[d]61,800
73	07247250	Black Fork below Big Creek near Page, Okla.	74.4	04/2002	20.94	23,300	1/16	3/18/2008	23.36	34,600
74	07257006	Big Piney at Highway 164 near Dover, Ark.	306	12/1982	[i]33.87	110,000	6/16	3/18/2008	21.76	73,700
75	07260000	Dutch Creek at Waltreak, Ark.	81.4	07/1969	22.38	24,500	2/73	3/19/2008	20.00	22,400
76	07261500	Fourche LaFave River near Gravelly, Ark.	410	12/1982	32.45	162,000	2/69	3/19/2008	30.91	81,500
77	07338750	Mountain Fork at Smithville, Okla.	320	10/1998	30.40	46,500	1/15	3/19/2008	30.55	54,900

Site number (fig. 10)	Estimated AEP for observed peak streamflow (percent)	Expected peak streamflows for selected AEP with 95-percent confidence limits (ft³/s)[b]: 4-percent AEP (25-year recurrence)			2-percent AEP (50-year recurrence)			1-percent AEP (100-year recurrence)			0.2-percent AEP (500-year recurrence)		
		Estimate	Confidence limit: Low	High	Estimate	Confidence limit: Low	High	Estimate	Confidence limit: Low	High	Estimate	Confidence limit: Low	High
47	2–4	57,800	40,900	81,800	72,500	49,100	107,000	87,400	57,100	134,000	121,000	74,100	199,000
48	4–10	45,200	34,500	59,200	55,900	41,100	76,100	67,500	47,900	95,300	96,500	63,300	147,000
49	[k]2–4	--	--	--	--	--	--	--	--	--	--	--	--
50	[k]2–4	--	--	--	--	--	--	--	--	--	--	--	--
51	4–10	22,300	13,600	36,600	27,500	16,500	45,900	32,800	19,400	55,500	45,400	25,900	79,400
52	4–10	[g]28,700	24,200	35,500	[g]33,000	27,500	41,600	[g]37,300	30,700	47,900	[g]47,100	37,800	62,700
53	4–10	[j]34,800	--	--	[j]41,700	--	--	[j]49,200	--	--	[j]67,200	--	--
54	4–10	[j]28,400	--	--	[j]34,300	--	--	[j]40,600	--	--	[j]56,000	--	--
55	> 10	39,900	26,200	61,000	47,100	30,000	73,900	54,300	33,900	87,100	71,700	42,500	121,000
56	4–10	99,300	79,800	124,000	122,000	94,200	157,000	145,000	108,000	194,000	202,000	139,000	292,000
57	4–10	95,700	77,600	118,000	117,000	91,300	149,000	139,000	105,000	184,000	194,000	135,000	278,000
58	2–4	66,400	56,000	82,100	80,300	66,500	101,000	95,600	77,700	125,000	137,000	107,000	188,000
59	2–4	[l]79,700	--	--	[l]98,500	--	--	[l]118,100	--	--	--	--	--
60	2–4	94,700	77,000	123,000	120,000	95,400	160,000	149,000	116,000	205,000	232,000	172,000	341,000
61	2–4	46,900	36,100	60,900	60,400	44,700	81,700	75,400	53,600	106,000	114,000	74,700	174,000
62	.2–1	41,300	33,900	52,600	51,600	41,500	67,600	63,000	49,800	85,000	94,900	71,900	136,000
63	2–4	116,000	101,000	137,000	140,000	120,000	169,000	166,000	140,000	203,000	235,000	192,000	300,000
64	[m]1–2	--	--	--	--	--	--	--	--	--	--	--	--
65	[k]2–4	238,000	--	--	306,000	--	--	389,000	--	--	666,000	--	--
66	[k]2–4	--	--	--	--	--	--	--	--	--	--	--	--
67	[k]2–4	--	--	--	--	--	--	--	--	--	--	--	--
68	[n]--	40,600	28,800	57,400	49,700	33,900	72,900	58,800	38,800	89,100	79,700	49,100	129,000
69	4–10	32,800	25,000	43,000	41,900	30,700	57,200	51,900	36,600	73,600	77,100	50,300	118,000
70	4–10	20,100	15,200	29,100	24,500	18,100	36,800	29,200	21,100	45,200	40,800	28,300	67,500
71	2–4	52,900	41,800	67,000	62,200	47,400	81,500	71,700	52,800	97,400	94,700	63,700	141,000
72	4–10	71,800	56,600	91,000	89,400	67,700	118,000	109,000	79,200	150,000	163,000	107,000	249,000
73	1–2	29,500	20,600	42,400	34,600	23,200	51,700	39,800	25,700	61,900	53,200	31,100	91,100
74	4–10	82,100	65,000	111,000	102,000	79,200	142,000	125,000	94,400	179,000	185,000	134,000	283,000
75	1–2	17,800	14,300	22,200	21,200	16,400	27,500	24,600	18,200	33,200	33,400	22,300	50,000
76	1–2	68,800	57,400	86,100	78,900	65,000	101,000	88,500	72,100	115,000	109,000	87,200	146,000
77	2–4	51,900	40,300	66,800	57,800	43,600	76,700	63,800	46,700	87,300	78,000	53,000	115,000

[a] Rank of the maximum instantaneous peak streamflow measured during March 2008 compared to all systematic and historic annual peaks. A rank of 1 indicates that the March 2008 peak streamflow was higher than all other recorded annual peaks.

[b] Unless otherwise noted, expected peak streamflows are based on Water Resources Council Bulletin 17B weighting by variance method.

[c] The peak streamflow for March 2008 was exceeded by another peak streamflow during 2008.

[d] Streamflow affected to unknown degree by regulation or diversion.

[e] Peak stage was because of backwater. Backwater adjustments were made to the streamflow.

[f] Streamflow affected by regulation or diversion.

[g] Expected peak streamflows based on Bulletin 17B systematic frequency-curve estimate only.

[h] Estimated.

[i] Streamgage previously was at a different location and datum (05599490 replaced 05599500 after 2007 and 07257006 replaced 07257000 after 1992).

[j] Expected peak streamflows based on regional regression equation estimates only.

[k] Estimated AEP based on Bulletin 17B expected probability method.

[l] Expected peak streamflows based on Ries and Dillow method (2006) using 7 years of record.

[m] Estimated AEP based on 2-station analysis using 17 non-consecutive years of record.

[n] Estimated AEP uncharacterized because of regulation or insufficient data.

Flooding on the Current River at Montauk State Park, Montauk, Missouri. Photographs by Paul Rydlund, USGS.

Table 4. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during April 2008.

[mi², square mile; ft, foot; ft³/s, cubic foot per second; AEP, annual exceedance probability; --, no data]

Site number (fig. 11)	Station number	Station name	Contributing drainage area (mi²)	Flood data: Previous maximum streamflow			Flood of April 2008			
				Date	Stage (ft)	Streamflow (ft³/s)	Rank[a]/ annual peaks	Date	Peak stage (ft)	Peak streamflow (ft³/s)
1	05416200	Lamont Creek Tributary near Lamont, Iowa	1.8	06/2000	20.13	[c]635	1/18	4/25/2008	23.18	1,190
2	05420875	Buck Creek near Oran, Iowa	37.9	05/1999	91.02	[c]5,600	2/43	4/25/2008	91.33	2,930
3	05463500	Black Hawk Creek at Hudson, Iowa	303	07/1969	18.23	19,300	1/51	4/25/2008	19.03	22,500
4	06919020	Sac River at Highway J below Stockton, Mo.	1,292	09/1993	23.71	13,300	4/35	4/10/2008	21.26	[d]10,100
5	06919900	Sac River near Caplinger Mills, Mo.	1,810	04/1994	30.95	61,500	6/34	4/11/2008	26.12	[d]23,300
6	07050500	Kings River near Berryville, Ark.	527	11/1985	38.91	66,000	5/80	4/10/2008	35.29	[c]50,100
7	07060500	White River at Calico Rock, Ark.	9,980	01/1916	52.90	350,000	11/116	4/11/2008	40.27	[d]202,000
8	07060710	North Sylamore Creek near Fifty Six, Ark.	58.1	12/1982	20.60	25,200	1/54	4/10/2008	19.16	28,200
9	07061000	White River at Batesville, Ark.	11,100	02/1916	31.90	382,000	([h])	4/11/2008	--	[d]199,000
10	07071500	Eleven Point River near Bardley, Mo.	793	12/1982	21.64	49,800	([h])	4/11/2008	19.72	41,400
11	07072000	Eleven Point River near Ravenden Springs, Ark.	1,130	12/1982	29.06	162,000	([h])	4/11/2008	21.35	43,600
12	07072500	Black River at Black Rock, Ark.	7,370	12/1982	31.51	190,000	([h])	4/11/2008	28.67	108,000
13	07074500	White River at Newport, Ark.	19,900	04/1927	35.60	387,000	([h])	4/13/2008	--	[d]237,000
14	07077000	White River at DeValls Bluff, Ark.	23,400	04/1927	34.60	[d]--	3/73	4/17/2008	31.41	[d]189,000
15	07185765	Spring River at Carthage, Mo.	425	11/1972	17.15	24,800	([h])	4/10/2008	17.74	--
16	07188653	Big Sugar Creek near Powell, Mo.	141	05/2002	15.70	11,000	1/8	4/10/2008	18.11	15,800
17	07197000	Baron Ford at Eldon, Okla.	307	06/2000	26.77	[j]54,700	5/63	4/10/2008	23.50	[j]39,600
18	07249985	Lee Creek near Short, Okla.	420	04/1945	[c]35.00	[c]112,000	10/78	4/10/2008	23.19	55,700
19	07257500	Illinois Bayou near Scottsville, Ark.	241	12/1982	27.49	130,000	2/71	4/10/2008	23.46	77,600

Site number (fig. 11)	Estimated AEP for observed peak streamflow (percent)	Expected peak streamflows for selected AEP with 95-percent confidence limits (ft³/s)[b]: 4-percent AEP (25-year recurrence)			2-percent AEP (50-year recurrence)			1-percent AEP (100-year recurrence)			0.2-percent AEP (500-year recurrence)		
		Estimate	Confidence limit: Low	High	Estimate	Confidence limit: Low	High	Estimate	Confidence limit: Low	High	Estimate	Confidence limit: Low	High
1	4–10	1,380	1,030	1,840	1,770	1,300	2,410	2,200	1,580	3,060	3,380	2,260	5,050
2	4–10	3,630	2,840	4,640	4,650	3,560	6,080	5,720	4,270	7,660	8,440	5,880	12,100
3	.2–1	15,100	11,900	19,000	18,300	14,200	23,600	21,600	16,400	28,400	29,700	21,100	41,600
4	[e]--	--	--	--	--	--	--	--	--	--	--	--	--
5	[e]--	--	--	--	--	--	--	--	--	--	--	--	--
6	4–10	55,800	45,800	71,300	68,200	55,000	89,600	81,600	64,600	110,000	117,000	89,000	166,000
7	[f].2–1	--	--	--	--	--	--	--	--	--	--	--	--
8	.2–1	[g]17,000	12,400	23,300	[g]20,000	14,300	28,000	[g]22,800	15,900	32,500	[g]29,500	19,700	44,300
9	[e]--	--	--	--	--	--	--	--	--	--	--	--	--
10	4–10	46,900	36,100	60,900	60,400	44,700	81,700	75,400	53,600	106,000	114,000	74,700	174,000
11	2–4	41,300	33,900	52,600	51,600	41,500	67,600	63,000	49,800	85,000	94,900	71,900	136,000
12	4–10	116,000	101,000	137,000	140,000	120,000	169,000	166,000	140,000	203,000	235,000	192,000	300,000
13	[f]4–10	238,000	--	--	306,000	--	--	389,000	--	--	666,000	--	--
14	[f]2–4	--	--	--	--	--	--	--	--	--	--	--	--
15	[e]--	40,600	28,800	57,400	49,700	33,900	72,900	58,800	38,800	89,100	79,700	49,100	129,000
16	4–10	[i]21,400	--	--	[i]25,700	--	--	[i]30,400	--	--	[i]41,500	--	--
17	4–10	51,000	39,300	66,200	60,900	45,200	82,000	70,900	50,600	99,500	95,300	61,500	148,000
18	> 10	74,800	59,900	93,200	89,200	69,100	115,000	104,000	77,800	139,000	142,000	96,700	209,000
19	1–2	61,300	49,600	80,400	76,400	60,400	103,000	93,200	72,100	130,000	140,000	104,000	209,000

[a] Rank of the maximum instantaneous peak streamflow measured during April 2008 compared to all systematic and historic annual peaks. A rank of 1 indicates that the April 2008 peak streamflow was higher than all other recorded annual peaks.

[b] Unless otherwise noted, expected peak streamflows are based on Water Resources Council Bulletin 17B weighting by variance method.

[c] Estimated.

[d] Streamflow affected by regulation or diversion.

[e] Estimated AEP uncharacterized because of regulation or insufficient data.

[f] Expected peak streamflows based on Bulletin 17B expected probability method.

[g] Expected peak streamflows based on Bulletin 17B systematic frequency-curve estimate only.

[h] The peak streamflow for April 2008 was exceeded by another peak streamflow during 2008.

[i] Expected peak streamflows based on regional regression equation estimates only.

[j] Streamflow affected to unknown degree by regulation or diversion.

Hydrographer working to repair instrumentation on the Big Muddy River at Murphysboro, Illinois (USGS streamgage 05599490). Photograph by Robert Holmes, USGS.

Hydrographer making a streamflow measurement on the Big Muddy at Murphysboro, Illinois (USGS streamgage 05599490). Photograph by Robert Holmes, USGS.

Table 5. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during May and June 2008.

[mi^2, square mile; ft, foot; ft^3/s, cubic foot per second; AEP, annual exceedance probability; >, greater than; <, less than; --, no data; R., River]

Site number (fig. 12)	Station number	Station name	Contributing drainage area (mi^2)	Flood data: Previous maximum streamflow: Date	Stage (ft)	Streamflow (ft^3/s)	Flood of June 2008: Rank[a]/ annual peaks	Date	Peak stage (ft)	Peak streamflow (ft^3/s)
1	03341500	Wabash River at Terre Haute, Ind.	12,263	03/1913	31.20	245,000	27/118	6/8/2008	25.02	[c]92,400
2	03342000	Wabash River at Riverton, Ind.	13,161	03/1913	[d]26.40	250,000	10/73	6/10/2008	26.56	[c]98,100
3	03345500	Embarras River at Ste. Marie, Ill.	1,516	01/1950	25.95	44,800	1/98	6/7/2008	28.06	60,400
4	03346000	North Fork Embarras River Near Oblong, Ill.	318	01/1950	24.38	27,100	1/68	6/7/2008	26.26	46,200
5	03353637	Little Buck Creek near Indianapolis, Ind.	17.0	12/1990	[d]9.10	2,300	1/19	6/7/2008	13.01	2,850
6	03354000	White River near Centerton, Ind.	2,444	03/1913	21.90	90,000	2/65	6/7/2008	19.85	[c]63,500
7	03357350	Plum Creek near Bainbridge, Ind.	3.0	09/1989	6.50	940	1/39	6/4/2008	7.15	1,000
8	03358000	Mill Creek near Cataract, Ind.	245	12/1990	--	12,200	3/59	6/7/2008	22.61	10,800
9	03360500	White River at Newberry, Ind.	4,688	03/1913	27.50	130,000	1/102	6/9/2008	28.59	[c]138,000
10	03362000	Youngs Creek near Edinburgh, Ind.	107	01/1952	13.40	10,700	1/66	6/7/2008	15.67	20,500
11	03362500	Sugar Creek near Edinburgh, Ind.	474	05/1956	18.38	27,600	1/66	6/7/2008	19.23	39,900
12	03363500	Flatrock River at St. Paul, Ind.	303	01/1949	[d]10.60	18,500	6/78	6/7/2008	12.82	16,400
13	03363900	Flatrock River at Columbus, Ind.	534	01/2005	16.45	22,400	1/41	6/7/2008	19.94	62,500
14	03364000	East Fork White River at Columbus, Ind.	1,707	03/1913	17.90	100,000	2/64	6/8/2008	18.61	68,100
15	03364500	Clifty Creek at Hartsville, Ind.	91.4	03/1913	25.10	20,000	2/62	6/7/2008	17.85	16,200
16	03365500	East Fork White River at Seymour, Ind.	2,341	03/1913	21.00	120,000	2/86	6/8/2008	20.91	96,400
17	03374000	White River at Petersburg, Ind.	11,125	03/1913	29.50	235,000	7/86	6/12/2008	26.96	[c]135,000
18	03377500	Wabash River at Mount Carmel, Ill.	28,635	03/1913	33.00	428,000	11/128	6/14/2008	33.24	[c]255,000
19	04073500	Fox River at Berlin, Wis.	1,340	03/1946	[d]15.50	6,900	5/111	6/22/2008	[e]16.08	6,020
20	04085427	Manitowoc River at Manitowoc, Wis.	526	03/1979	[d]13.24	8,280	2/35	6/13/2008	12.04	6,100
21	04086000	Sheboygan River at Sheboygan, Wis.	418	08/1998	[f]12.02	7,820	3/65	6/9/2008	11.08	6,810
22	04086600	Milwaukee River near Cedarburg, Wis.	607	05/2004	13.11	5,720	1/27	6/13/2008	13.98	6,980
23	04087000	Milwaukee River at Milwaukee, Wis.	696	06/1997	10.00	16,500	6/94	6/7/2008	8.07	10,400
24	04087204	Oak Creek at South Milwaukee, Wis.	25.0	08/1986	9.88	1,140	1/45	6/7/2008	11.56	2,370
25	04087220	Root River near Franklin, Wis.	49.2	03/1960	9.57	5,130	1/46	6/8/2008	11.00	5,350
26	04087233	Root River Canal near Franklin, Wis.	57.0	03/1974	9.88	1,440	1/45	6/9/2008	12.13	1,560
27	04087240	Root River at Racine, Wis.	189	03/1974	8.54	4,500	1/45	6/9/2008	11.29	8,050
28	04087257	Pike River near Racine, Wis.	38.5	08/2007	8.24	1,720	1/37	6/8/2008	8.97	1,960
29	04108600	Rabbit River near Hopkins, Mich.	71.4	06/1997	11.11	[h]3,740	3/44	6/8/2008	9.37	1,770
30	04122500	Pere Marquette River at Scottville, Mich.	681	09/1986	8.07	6,440	2/69	6/13/2008	5.81	3,110
31	04124000	Manistee River near Sherman, Mich.	60.8	03/1913	7.10	3,570	5/89	6/14/2008	16.37	3,200
32	04124200	Manistee River near Mesick, Mich.	1,018	03/2006	6.38	[c]3,150	1/11	6/14/2008	6.87	[c]3,690
33	04124500	East Branch Pine River near Tustin, Mich.	60.0	08/1956	6.23	876	3/53	6/13/2008	6.26	760
34	04125460	Pine River near Hoxeyville, Mich.	245	08/1956	6.82	2,440	1/42	6/14/2008	9.29	2,870
35	04125550	Manistee River near Wellston, Mich.	1,451	03/1998	10.91	[c]6,130	1/12	6/14/2008	11.06	[c]6,500
36	05385500	South Fork Root River near Houston, Minn.	275	06/2000	14.90	13,800	4/56	6/9/2008	14.35	10,900
37	05387440	Upper Iowa River at Bluffton, Iowa	367	08/2007	12.66	8,440	1/6	6/9/2008	15.49	16,600
38	05387490	Dry Run Creek near Decorah, Iowa	21.0	08/1993	20.80	4,620	1/26	6/8/2008	21.53	5,820
39	05387500	Upper Iowa River at Decorah, Iowa	511	08/1993	[h]14.35	[h]20,500	1/57	6/9/2008	17.90	34,100
40	05388250	Upper Iowa River near Dorchester, Iowa	770	05/1941	21.80	30,400	1/33	6/9/2008	22.46	31,200
41	05388310	Waterloo Creek near Dorchester, Iowa	43.6	07/1978	14.80	9,380	2/39	6/8/2008	14.57	8,800
42	05404116	West Branch Baraboo River at Hillsboro, Wis.	39.1	06/1990	15.26	4,010	1/21	6/8/2008	16.12	5,260
43	05405000	Baraboo River near Baraboo, Wis.	609	03/1917	[d]17.50	7,900	1/75	6/13/2008	27.48	18,100
44	05408000	Kickapoo River at La Farge, Wis.	266	07/1978	14.92	14,300	1/70	6/8/2008	15.78	22,100
45	05410490	Kickapoo River at Steuben, Wis.	687	07/1978	14.81	16,500	1/75	6/10/2008	19.16	28,700
46	05411850	Turkey River near Eldorado, Iowa	641	05/2004	19.61	19,700	1/9	6/9/2008	21.46	50,100

Site number (fig. 12)	Estimated AEP for observed peak streamflow (percent)	Expected peak streamflows for selected AEP with 95-percent confidence limits (ft^3/s)[b]: 4-percent AEP (25-year recurrence): Estimate	Confidence limit: Low	High	2-percent AEP (50-year recurrence): Estimate	Confidence limit: Low	High	1-percent AEP (100-year recurrence): Estimate	Confidence limit: Low	High	0.2-percent AEP (500-year recurrence): Estimate	Confidence limit: Low	High
1	> 10	139,000	125,000	154,000	156,000	138,000	177,000	174,000	150,000	201,000	213,000	174,000	260,000
2	> 10	134,000	121,000	149,000	152,000	134,000	172,000	169,000	146,000	196,000	208,000	171,000	254,000
3	.2–1	41,500	34,200	50,300	49,100	39,100	61,700	56,900	43,700	74,200	76,100	53,300	109,000
4	.2–1	26,100	20,500	33,200	31,000	23,400	41,000	35,900	26,000	49,600	47,500	31,000	72,800
5	1–2	2,450	2,220	2,700	2,800	2,490	3,150	3,160	2,750	3,620	4,070	3,380	4,900
6	2–4	55,500	49,800	61,900	63,700	56,000	72,400	71,900	62,000	83,500	91,600	75,400	111,000
7	2–4	909	741	1,120	1,050	839	1,320	1,200	935	1,540	1,550	1,150	2,080
8	4–10	11,300	9,660	13,300	13,000	10,900	15,600	14,700	12,000	18,000	18,700	14,600	23,800
9	< .2	79,700	70,700	89,800	91,700	79,500	106,000	104,000	88,100	123,000	135,000	107,000	170,000
10	< .2	8,670	7,070	10,600	9,820	7,840	12,300	10,800	8,500	13,800	13,000	9,860	17,200
11	< .2	20,600	17,000	25,000	23,700	19,100	29,400	26,500	21,000	33,500	32,800	25,000	43,000
12	2–4	16,300	13,700	19,300	18,600	15,400	22,500	20,800	16,900	25,700	25,700	20,000	33,100
13	< .2	24,200	19,100	30,600	27,900	21,700	35,900	31,100	23,800	40,700	38,500	28,600	51,800
14	1–2	57,000	48,600	66,900	65,600	54,600	78,700	73,500	60,000	90,100	91,300	71,300	117,000
15	.2–1	10,500	8,920	12,300	12,800	10,600	15,400	15,200	12,300	18,800	21,400	16,200	28,100
16	.2–1	74,300	66,300	83,200	83,200	72,700	95,200	91,100	78,000	107,000	108,000	88,300	133,000
17	4–10	153,000	139,000	170,000	173,000	153,000	195,000	191,000	166,000	221,000	235,000	192,000	286,000
18	4–10	281,000	252,000	315,000	311,000	272,000	356,000	339,000	289,000	398,000	397,000	318,000	494,000
19	4–10	6,340	5,650	7,110	7,060	6,150	8,100	7,770	6,610	9,140	9,290	8,250	10,700
20	4–10	6,270	4,990	8,580	7,450	5,800	10,600	8,690	6,630	12,800	11,900	8,650	18,600
21	4–10	7,630	6,350	9,170	8,610	6,950	10,700	9,550	7,450	12,200	11,600	9,460	15,100
22	1–2	6,100	5,080	7,940	6,940	5,680	9,320	7,790	6,270	10,800	9,870	7,640	14,600
23	4–10	11,000	9,250	13,000	12,700	10,400	15,500	14,600	11,600	18,300	19,600	16,500	24,300
24	< .2	1,230	975	1,540	1,400	1,070	1,850	1,590	1,150	2,200	2,310	1,870	3,110
25	1–2	[g]3,430	2,730	4,630	[g]4,340	3,360	6,110	[g]5,390	4,070	7,900	[g]8,510	6,050	13,600
26	2–4	1,470	1,250	1,720	1,610	1,340	1,950	1,760	1,410	2,190	2,020	1,710	2,550
27	< .2	4,130	3,240	5,260	4,760	3,570	6,340	5,400	3,860	7,570	8,030	6,330	11,100
28	1–2	[g]1,740	1,510	2,110	[g]1,900	1,630	2,340	[g]2,040	1,740	2,550	[g]2,330	1,950	2,990
29	2–4	1,550	1,140	2,100	1,830	1,270	2,620	2,120	1,400	3,200	--	--	--
30	4–10	[g]3,540	3,210	4,010	[g]3,930	3,520	4,510	[g]4,310	3,820	5,020	[g]5,190	4,520	6,210
31	4–10	[g]3,240	3,090	3,440	[g]3,420	3,240	3,640	[g]3,580	3,380	3,840	[g]3,920	3,680	4,250
32	4–10	[g]3,740	3,220	4,900	[g]3,970	3,390	5,370	[g]4,190	3,530	5,820	[g]4,640	3,830	6,810
33	2–4	[g]755	645	925	[g]844	712	1,050	[g]927	774	1,170	[g]1,110	905	1,440
34	.2–1	[g]2,150	1,870	2,590	[g]2,440	2,090	3,020	[g]2,750	2,320	3,470	[g]3,500	2,860	4,640
35	2–4	[g]6,220	5,440	7,950	[g]6,680	5,760	8,830	[g]7,130	6,060	9,720	[g]8,150	6,720	11,900
36	4–10	11,900	8,800	16,200	15,400	10,900	21,600	19,100	12,900	28,100	29,100	17,600	48,000
37	2–4	[i]16,300	--	--	[i]19,300	--	--	[i]22,300	--	--	[i]29,600	--	--
38	1–2	4,590	3,750	5,620	5,530	4,420	6,910	6,530	5,100	8,360	9,150	6,700	12,500
39	.2–1	[j]19,200	16,200	22,700	[j]22,800	18,800	27,600	[j]26,400	21,300	32,800	[j]35,300	26,700	46,600
40	.2–1	21,800	18,000	26,500	26,500	21,300	32,900	31,200	24,600	39,700	42,800	31,600	58,100
41	2–4	7,470	5,690	9,800	9,520	7,110	12,800	11,600	8,480	16,000	17,200	11,600	25,300
42	1–2	3,990	2,490	6,380	4,890	2,870	8,340	5,830	3,200	10,600	6,330	3,240	12,400
43	< .2	8,320	6,690	10,300	9,990	7,720	12,900	11,800	8,710	16,000	14,800	11,900	19,700
44	.2–1	8,870	6,460	12,200	11,400	7,790	16,600	14,300	9,160	22,200	23,500	17,400	34,700
45	.2–1	11,500	8,280	16,100	15,200	10,200	22,600	19,400	12,200	30,900	32,700	23,800	49,300
46	< .2	[i]22,400	--	--	[i]26,400	--	--	[i]30,200	--	--	[i]39,700	--	--

Table 5. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during May and June 2008.—Continued

[mi², square mile; ft, foot; ft³/s, cubic foot per second; AEP, annual exceedance probability; >, greater than; <, less than; --, no data; R., River]

Site number (fig. 12)	Station number	Station name	Contributing drainage area (mi²)	Flood data: Previous maximum streamflow			Flood data: Flood of June 2008			
				Date	Stage (ft)	Streamflow (ft³/s)	Rank[a]/ annual peaks	Date	Peak stage (ft)	Peak streamflow (ft³/s)
47	05412020	Turkey River, French Hollow Creek, Elkader, Iowa	903	06/1991	27.32	38,300	1/8	6/10/2008	27.77	40,500
48	05412400	Volga River at Littleport, Iowa	348	05/1999	25.36	[h]30,000	3/12	6/8/2008	20.41	18,900
49	05412500	Turkey River at Garber, Iowa	1,545	05/2004	32.80	66,700	4/90	6/10/2008	29.13	45,500
50	05414000	Platte River near Rockville, Wis.	142	07/1950	17.26	43,500	4/74	6/12/2008	[h]14.17	[h]15,200
51	05414350	Little Maquoketa River near Graf, Iowa	39.6	06/2002	15.93	7,700	1/58	6/8/2008	16.47	8,370
52	05414450	N. Fork Little Maquoketa River, Rickardsville, Iowa	21.6	08/1972	14.02	7,180	1/58	6/8/2008	12.58	8,040
53	05414605	Bloody Run Tributary near Sherrill, Iowa	.6	06/1991	19.27	[h]692	1/18	6/8/2008	22.71	1,110
54	05416900	Maquoketa River at Manchester, Iowa	275	05/2004	21.66	26,000	2/8	5/26/2008	20.80	22,100
55	05418400	North Fork Maquoketa River near Fulton, Iowa	505	06/2002	19.87	22,600	2/10	6/13/2008	18.67	20,700
56	05419000	Apple River near Hanover, Ill.	247	06/2002	27.91	13,700	5/74	6/9/2008	25.20	11,300
57	05420680	Wapsipinicon River near Tripoli, Iowa	346	07/1999	18.50	19,400	3/13	6/9/2008	18.24	18,300
58	05421000	Wapsipinicon River at Independence, Iowa	1,048	05/1999	22.35	31,100	4/75	6/11/2008	18.86	23,700
59	05421740	Wapsipinicon River near Anamosa, Iowa	1,575	05/2004	22.73	[h]22,000	1/7	6/13/2008	26.18	31,800
60	05422000	Wapsipinicon River at DeWitt, Iowa	2,336	05/2004	13.79	31,500	1/74	6/16/2008	[d]14.13	36,400
61	05422470	Crow Creek at Bettendorf, Iowa	17.8	06/1990	11.03	7,700	2/30	6/13/2008	9.56	3,590
62	05422600	Duck Creek, DC Golf Course, Davenport, Iowa	57.3	06/2002	16.34	7,310	1/15	6/13/2008	16.60	7,570
63	05423500	South Branch Rock River at Waupun, Wis.	63.6	04/1959	[d]7.97	1,500	1/42	6/13/2008	10.09	2,350
64	05425500	Rock River at Watertown, Wis.	969	03/1979	[d]6.19	[c]5,080	1/71	6/13/2008	7.81	[c]7,600
65	05425912	Beaver Dam River at Beaver Dam, Wis.	157	06/2004	10.68	[l]1,140	1/23	6/16/2008	[e]845.53	[l]1,700
66	05426000	Crawfish River at Milford, Wis.	762	04/1959	11.15	6,140	1/77	6/16/2008	13.35	7,190
67	05426250	Bark River near Rome, Wis.	122	04/1993	2.56	476	2/25	6/9/2008	4.59	1,370
68	05427570	Rock River at Indianford, Wis.	2,630	04/1979	16.23	[c]11,900	1/33	6/21/2008	18.33	[c]14,900
69	05427718	Yahara River at Windsor, Wis.	37.0	07/1993	6.58	2,050	1/24	6/9/2008	6.97	3,290
70	05429500	Yahara River at McFarland, Wis.	290	04/1959	[d]5.82	[l]867	1/76	6/14/2008	[d]7.17	[l]976
71	05430500	Rock River at Afton, Wis.	3,340	03/1929	[d]11.80	[c]13,000	1/95	6/21/2008	13.51	[c]16,700
72	05437500	Rock River at Rockton, Ill.	6,363	03/1916	13.06	32,500	4/80	6/17/2008	14.72	27,800
73	05449500	Iowa River near Rowan, Iowa	429	06/1954	14.88	8,460	3/67	6/9/2008	15.89	7,890
74	05451080	South Fork Iowa River near Blairsburg, Iowa	12.0	03/2007	11.79	227	1/3	6/8/2008	12.50	762
75	05451210	South Fork Iowa River, New Providence, Iowa	224	06/2007	10.68	3,910	1/13	6/8/2008	13.84	7,390
76	05451500	Iowa River at Marshalltown, Iowa	1,532	06/1918	[d]17.74	42,000	3/92	6/13/2008	21.79	22,400
77	05451700	Timber Creek near Marshalltown, Iowa	118	08/1977	17.69	12,000	5/60	6/8/2008	16.19	7,010
78	05451955	Stein Creek near Clutier, Iowa	23.4	06/1982	77.92	11,400	1/36	5/30/2008	78.02	12,200
79	05452000	Salt Creek near Elberon, Iowa	201	07/1993	20.85	36,600	5/64	5/30/2008	19.75	22,400
80	05453100	Iowa River at Marengo, Iowa	2,794	07/1993	20.31	38,000	1/52	6/12/2008	21.38	51,000
81	05453200	Price Creek at Amana, Iowa	29.1	06/1990	88.78	5,080	9/43	6/12/2008	91.09	3,110
82	05453520	Iowa River below Coralville Dam, Coralville, Iowa	3,115	07/1993	63.95	[l]25,800	1/16	6/15/2008	68.09	[l]39,900
83	05454180	Clear Creek Tributary near Williamsburg, Iowa	.4	06/2007	49.18	328	1/19	6/12/2008	49.37	346
84	05454500	Iowa River at Iowa City, Iowa	3,271	06/1851	24.10	70,000	4/108	6/15/2008	31.53	[l]41,100
85	05455700	Iowa River at Lone Tree, Iowa	4,293	07/1993	22.94	[l]57,100	2/52	6/15/2008	23.10	[l]53,700
86	05457000	Cedar River near Austin, Minn.	399	09/2004	23.26	20,000	3/69	6/12/2008	21.42	15,300
87	05457440	Deer Creek near Carpenter, Iowa	91.6	07/2004	85.75	4,150	1/36	6/8/2008	87.86	11,800
88	05457700	Cedar River at Charles City, Iowa	1,054	07/1999	22.81	31,200	1/54	6/9/2008	25.33	34,600
89	05457778	Little Cedar River near Johnsburg, Minn.	45.8	08/1993	17.58	9,280	4/23	6/12/2008	16.04	3,710
90	05458000	Little Cedar River near Ionia, Iowa	306	08/1993	18.99	14,000	1/55	6/9/2008	21.32	24,700
91	05458300	Cedar River at Waverly, Iowa	1,547	04/2001	12.95	25,600	1/8	6/10/2008	19.33	52,600
92	05458500	Cedar River at Janesville, Iowa	1,661	07/1999	17.15	42,200	1/88	6/10/2008	19.45	53,400

Site number (fig. 12)	Estimated AEP for observed peak streamflow (percent)	Expected peak streamflows for selected AEP with 95-percent confidence limits (ft³/s)[b]: 4-percent AEP (25-year recurrence)			2-percent AEP (50-year recurrence)			1-percent AEP (100-year recurrence)			0.2-percent AEP (500-year recurrence)		
		Estimate	Confidence limit: Low	High	Estimate	Confidence limit: Low	High	Estimate	Confidence limit: Low	High	Estimate	Confidence limit: Low	High
47	0.2–1	[i]26,600	--	--	[i]31,100	--	--	[i]35,600	--	--	[i]46,300	--	--
48	2–4	18,100	14,300	23,000	22,100	17,100	28,600	26,100	19,700	34,500	36,100	25,500	51,200
49	1–2	35,100	30,500	40,400	41,100	35,000	48,300	47,300	39,300	56,900	62,300	48,800	79,600
50	2–4	14,700	10,800	19,900	17,800	12,500	25,500	20,900	13,800	31,800	23,900	14,000	40,800
51	2–4	7,240	5,820	9,010	9,000	7,050	11,500	10,900	8,300	14,300	15,800	11,300	22,300
52	.2–1	5,010	3,920	6,400	6,260	4,800	8,180	7,610	5,680	10,200	11,200	7,820	16,100
53	2–4	[g]1,110	616	2,820	[g]1,620	842	4,680	[g]2,280	1,120	7,460	[g]4,660	1,990	19,800
54	.2–1	[i]15,000	--	--	[i]17,900	--	--	[i]20,700	--	--	[i]27,800	--	--
55	2–4	[j]19,200	15,700	23,500	[j]22,900	18,300	28,600	[j]26,600	20,800	34,000	[j]35,500	26,000	48,400
56	4–10	12,200	10,000	14,800	14,300	11,300	18,000	16,400	12,600	21,500	22,000	15,400	31,500
57	1–2	14,500	11,100	19,000	17,300	13,000	22,900	20,000	14,800	27,100	26,900	18,600	38,900
58	4–10	23,900	20,000	28,400	28,800	23,600	35,000	33,700	27,000	42,000	45,400	34,100	60,300
59	2–4	[k]27,600	--	--	[k]33,100	--	--	[k]38,500	--	--	[k]51,400	--	--
60	2–4	31,700	26,600	37,800	37,700	31,000	45,900	43,700	35,100	54,500	57,800	43,600	76,700
61	4–10	[g]5,040	3,370	8,920	[g]6,690	4,300	12,600	[g]8,600	5,330	17,200	[g]14,200	8,180	32,300
62	4–10	[g]8,420	5,930	15,100	[g]10,100	6,870	19,400	[g]11,800	7,830	24,200	[g]16,300	10,100	38,000
63	.2–1	1,450	1,060	1,980	1,710	1,190	2,450	1,960	1,310	2,940	2,980	2,080	4,910
64	.2–1	4,990	4,150	6,000	5,740	4,600	7,150	6,500	5,020	8,520	8,400	6,950	10,700
65	.2–1	[g]1,200	978	1,630	[g]1,390	1,110	1,970	[g]1,600	1,240	2,350	[g]2,130	1,580	3,420
66	.2–1	4,950	4,220	5,810	5,600	4,620	6,780	6,230	4,970	7,810	7,550	6,370	9,370
67	< .2	652	538	865	757	611	1,050	869	686	1,250	1,160	873	1,810
68	1–2	12,300	9,800	15,500	14,100	10,800	18,600	16,000	11,700	22,000	18,600	14,800	26,000
69	1–2	2,360	1,520	3,670	2,990	1,800	4,960	3,660	2,060	6,510	4,900	2,910	11,200
70	.2–1	735	675	817	811	738	913	887	800	1,010	1,060	942	1,240
71	.2–1	12,500	11,000	14,200	13,900	11,900	16,100	15,200	12,800	18,200	18,000	14,100	22,900
72	4–10	29,400	25,600	33,700	32,700	27,900	38,500	36,100	29,900	43,500	43,600	33,800	56,300
73	1–2	6,390	5,140	7,950	7,560	5,900	9,690	8,750	6,620	11,600	11,600	8,160	16,400
74	.2–1	[i]545	--	--	[i]644	--	--	[i]743	--	--	[i]982	--	--
75	2–4	7,170	5,500	9,350	8,680	6,540	11,500	10,200	7,490	13,800	13,800	9,500	20,000
76	2–4	22,300	19,300	25,800	25,900	21,900	30,600	29,400	24,300	35,600	37,600	29,200	48,400
77	4–10	8,930	7,250	11,000	10,900	8,680	13,700	13,000	10,100	16,700	18,000	13,100	24,700
78	< .2	4,870	3,790	6,250	5,990	4,570	7,850	7,180	5,350	9,630	10,400	7,220	14,900
79	.2–1	15,200	12,000	19,300	18,200	14,100	23,500	21,300	16,100	28,200	29,300	20,700	41,500
80	.2–1	32,000	26,600	38,500	37,200	30,200	45,700	42,300	33,700	53,200	54,300	40,500	72,600
81	> 10	4,320	3,540	5,270	5,090	4,050	6,390	5,900	4,560	7,630	7,960	5,690	11,100
82	.2–1	11,600	--	--	[m]22,200	--	--	[m]28,600	--	--	[m]44,400	--	--
83	4–10	[g]559	269	1,740	[g]852	383	3,040	[g]1,240	523	5,020	[g]2,640	970	13,800
84	.2–1	[m]13,100	--	--	[m]23,800	--	--	[m]30,000	--	--	[m]45,300	--	--
85	.2–1	[m]30,200	--	--	[m]33,100	--	--	[m]53,400	--	--	[m]76,100	--	--
86	1–2	12,200	9,940	15,000	14,300	11,200	18,100	16,300	12,300	21,500	21,000	14,400	30,600
87	< .2	5,570	4,480	6,930	6,840	5,380	8,680	8,140	6,260	10,600	11,400	8,210	15,800
88	.2–1	25,100	21,200	29,800	28,900	23,800	35,000	32,500	26,200	40,400	41,000	31,100	54,200
89	4–10	4,950	3,400	7,200	6,000	4,000	8,980	7,240	4,600	11,400	10,400	5,900	18,500
90	.2–1	14,100	11,200	17,600	17,100	13,400	21,800	20,100	15,400	26,200	27,400	19,700	38,200
91	< .2	[o]30,400	--	--	[o]35,400	--	--	[o]40,300	--	--	[o]51,800	--	--
92	.2–1	31,700	26,800	37,400	36,900	30,600	44,600	42,000	33,900	51,900	53,900	40,800	71,000

Table 5. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during May and June 2008.—Continued

[mi^2, square mile; ft, foot; ft^3/s, cubic foot per second; AEP, annual exceedance probability; >, greater than; <, less than; --, no data; R., River]

Site number (fig. 12)	Station number	Station name	Contributing drainage area (mi^2)	Flood data: Previous maximum streamflow: Date	Previous maximum streamflow: Stage (ft)	Previous maximum streamflow: Streamflow (ft^3/s)	Flood of June 2008: Rank[a]/ annual peaks	Flood of June 2008: Date	Flood of June 2008: Peak stage (ft)	Flood of June 2008: Peak streamflow (ft^3/s)
93	05458900	West Fork Cedar River at Finchford, Iowa	846	06/1951	17.28	31,900	2/64	6/10/2008	20.82	25,900
94	05459490	Spring Creek near Mason City, Iowa	29.3	05/2004	91.15	5,340	2/43	6/6/2008	92.91	4,680
95	05459500	Winnebago River at Mason City, Iowa	526	03/1933	15.70	10,800	1/76	6/8/2008	18.74	13,100
96	05460100	Willow Creek near Mason City, Iowa	78.6	05/2004	92.21	1,270	1/42	6/8/2008	93.28	2,380
97	05462000	Shell Rock River at Shell Rock, Iowa	1,746	1856	17.70	[h]45,000	1/56	6/10/2008	20.36	60,400
98	05463000	Beaver Creek at New Hartford, Iowa	347	06/1947	13.50	18,000	1/63	6/8/2008	15.71	25,900
99	05463500	Black Hawk Creek at Hudson, Iowa	303	07/1969	18.23	19,300	([p])	6/13/2008	17.47	11,800
100	05464000	Cedar River at Waterloo, Iowa	5,146	03/1961	21.86	76,700	1/70	6/11/2008	27.01	112,000
101	05464220	Wolf Creek near Dysart, Iowa	299	05/2004	17.39	14,500	1/10	5/30/2008	18.25	15,700
102	05464500	Cedar River at Cedar Rapids, Iowa	6,510	03/1961	[q]19.66	73,000	1/107	6/13/2008	31.12	140,000
103	05465000	Cedar River near Conesville, Iowa	7,787	04/1993	17.11	74,000	1/69	6/14/2008	[d]23.37	127,000
104	05465150	North Fork Long Creek at Ainsworth, Iowa	30.2	06/1990	90.66	[h]5,800	3/45	6/13/2008	91.19	4,220
105	05465500	Iowa River at Wapello, Iowa	12,500	07/1993	28.10	[l]111,000	1/106	6/14/2008	32.15	[l]188,000
106	05469860	Mud Lake Drainage Ditch 71 at Jewell, Iowa	65.4	07/1993	91.32	3,700	2/43	6/8/2008	91.87	3,120
107	05470000	South Skunk River near Ames, Iowa	315	06/1996	[d]15.89	[h]14,000	3/84	6/9/2008	16.93	11,000
108	05470500	Squaw Creek at Ames, Iowa	204	07/1993	18.54	24,300	3/53	5/30/2008	15.85	12,600
109	05471000	S. Skunk River below Squaw Creek near Ames, Iowa	556	07/1993	[d]25.53	26,500	3/46	5/30/2008	24.70	19,800
110	05471050	South Skunk River at Colfax, Iowa	803	07/1993	21.53	14,200	2/23	6/14/2008	20.25	10,900
111	05471200	Indian Creek near Mingo, Iowa	276	06/1991	19.16	23,500	4/41	5/31/2008	16.33	8,450
112	05471500	South Skunk River near Oskaloosa, Iowa	1,635	05/1944	25.80	37,000	4/64	6/12/2008	24.61	17,300
113	05474000	Skunk River at Augusta, Iowa	4,312	04/1973	27.05	66,800	9/96	6/16/2008	22.85	43,900
114	05474500	Mississippi River at Keokuk, Iowa	119,000	07/1993	27.58	[l]446,000	2/132	6/17/2008	--	[l]438,000
115	05479000	East Fork Des Moines River at Dakota City, Iowa	1,308	09/1938	17.40	[h]22,000	10/72	6/14/2008	19.09	10,400
116	05480500	Des Moines River at Fort Dodge, Iowa	4,190	04/1965	17.79	35,600	3/78	6/8/2008	15.73	34,400
117	05480930	White Fox Creek at Clarion, Iowa	13.3	07/1993	93.59	1,400	1/42	6/8/2008	93.85	1,480
118	05481000	Boone River near Webster City, Iowa	844	06/1918	19.10	21,500	2/70	6/10/2008	17.74	20,500
119	05481300	Des Moines River near Stratford, Iowa	5,452	04/1993	25.68	42,300	1/41	6/9/2008	27.32	50,300
120	05481650	Des Moines River near Saylorville, Iowa	5,841	06/1954	24.50	60,000	2/47	6/13/2008	24.03	[l]50,500
121	05481950	Beaver Creek near Grimes, Iowa	358	07/1993	16.58	14,300	3/49	6/1/2008	14.51	7,800
122	05482000	Des Moines River at 2nd Ave, Des Moines, Iowa	6,245	06/1954	30.16	60,200	2/62	6/13/2008	[d]31.50	[l]47,300
123	05482500	North Raccoon River near Jefferson, Iowa	1,619	06/1947	22.30	29,100	5/69	6/9/2008	18.41	18,300
124	05482900	Hardin Creek near Farlin, Iowa	101	07/1993	13.97	3,010	1/57	6/8/2008	13.40	3,030
125	05484000	South Raccoon River at Redfield, Iowa	994	07/1993	26.98	44,000	([p])	6/12/2008	20.80	26,300
126	05484500	Raccoon River at Van Meter, Iowa	3,441	07/1993	26.34	70,100	3/94	6/12/2008	22.67	43,500
127	05484650	Raccoon River at 63rd Street, Des Moines, Iowa	3,529	07/1993	[d]40.77	66,000	2/15	6/13/2008	41.31	52,000
128	05484900	Raccoon River at Fleur Drive, Des Moines, Iowa	3,625	07/1993	26.80	67,900	2/22	6/13/2008	24.66	56,300
129	05485500	Des Moines R. at Raccoon R., Des Moines, Iowa	9,879	07/1993	[d]34.29	[l]116,000	2/68	6/13/2008	35.55	[l]104,000
130	05485640	Fourmile Creek at Des Moines, Iowa	92.7	06/1998	15.00	5,600	1/36	6/6/2008	[d]15.14	6,810
131	05486000	North River near Norwalk, Iowa	349	06/1947	25.30	32,000	4/69	6/13/2008	23.91	13,500
132	05486490	Middle River near Indianola, Iowa	489	06/1947	26.40	34,000	2/69	6/6/2008	25.55	19,000
133	05487500	Des Moines River near Runnells, Iowa	11,655	07/1993	82.88	[h]134,000	3/23	6/14/2008	79.28	[l]81,200
134	05488110	Des Moines River near Pella, Iowa	12,330	07/1993	109.71	[l]105,000	2/16	6/14/2008	108.96	[l]100,000
135	05488500	Des Moines River near Tracy, Iowa	12,479	06/1947	26.50	155,000	4/90	6/14/2008	23.70	[l]104,000
136	05489500	Des Moines River at Ottumwa, Iowa	13,374	06/1903	[d]19.40	[h]140,000	4/94	6/17/2008	20.60	[l]102,000
137	05490500	Des Moines River at Keosauqua, Iowa	14,038	06/1903	27.85	146,000	5/102	6/16/2008	30.49	[l]106,000
138	05502500	Salt River near Shelbina, Mo.	481	05/2002	28.65	24,600	([p])	6/27/2008	22.93	15,200

Site number (fig. 12)	Estimated AEP for observed peak streamflow (percent)	Expected peak streamflows for selected AEP with 95-percent confidence limits (ft^3/s)[b]: 4-percent AEP (25-year recurrence): Estimate	4-percent AEP: Confidence limit: Low	4-percent AEP: Confidence limit: High	2-percent AEP (50-year recurrence): Estimate	2-percent AEP: Confidence limit: Low	2-percent AEP: Confidence limit: High	1-percent AEP (100-year recurrence): Estimate	1-percent AEP: Confidence limit: Low	1-percent AEP: Confidence limit: High	0.2-percent AEP (500-year recurrence): Estimate	0.2-percent AEP: Confidence limit: Low	0.2-percent AEP: Confidence limit: High
93	2–4	22,300	18,200	27,200	26,400	21,100	32,900	30,400	23,800	38,900	39,800	29,100	54,500
94	1–2	3,300	2,330	4,680	4,040	2,780	5,860	4,750	3,200	7,060	6,500	4,160	10,200
95	.2–1	9,020	7,360	11,000	10,500	8,340	13,300	12,000	9,250	15,600	15,600	11,200	21,700
96	.2–1	1,500	1,230	1,840	1,750	1,390	2,210	2,020	1,560	2,610	2,680	1,940	3,720
97	< .2	29,600	25,400	34,500	34,900	29,200	41,600	40,000	32,700	49,000	51,900	39,800	67,700
98	.2–1	16,400	13,300	20,300	19,600	15,500	24,700	22,800	17,700	29,500	30,500	22,100	42,100
99	4–10	15,100	11,900	19,000	18,300	14,200	23,600	21,600	16,400	28,400	29,700	21,100	41,600
100	.2–1	[g]77,100	62,400	100,000	[g]91,200	72,600	121,000	[g]105,000	82,600	143,000	[g]137,000	105,000	193,000
101	2–4	13,300	10,100	17,600	15,900	11,900	21,300	18,500	13,500	25,200	24,900	17,100	36,300
102	< .2	[g]70,300	60,500	84,000	[g]82,200	69,900	99,800	[g]94,100	79,200	116,000	[g]122,000	100,000	154,000
103	.2–1	[g]76,400	64,000	95,100	[g]88,600	73,200	113,000	[g]101,000	82,200	130,000	[g]128,000	102,000	171,000
104	4–10	4,300	3,360	5,510	5,330	4,080	6,960	6,400	4,780	8,560	9,180	6,410	13,100
105	< .2	[m]86,100	--	--	[m]121,000	--	--	[m]140,000	--	--	[m]185,000	--	--
106	1–2	2,430	1,900	3,110	2,790	2,110	3,680	3,130	2,300	4,270	3,920	2,680	5,730
107	1–2	8,840	7,520	10,400	10,600	8,770	12,700	12,300	9,970	15,200	16,500	12,600	21,800
108	1–2	9,300	7,560	11,400	11,500	9,070	14,500	13,600	10,500	17,700	19,400	13,900	27,100
109	.2–1	14,200	12,100	16,600	16,700	13,900	20,000	19,200	15,600	23,600	25,400	19,400	33,300
110	4–10	14,200	11,500	17,600	16,700	13,200	21,200	19,300	14,900	24,900	25,200	18,300	34,800
111	4–10	11,100	9,030	13,600	13,200	10,500	16,600	15,300	11,900	19,800	20,800	15,000	28,800
112	4–10	20,400	17,600	23,700	23,800	20,100	28,300	27,300	22,500	33,200	35,600	27,600	45,700
113	4–10	44,800	40,300	49,700	50,300	44,500	56,900	55,700	48,200	64,300	67,800	55,700	82,400
114	< .2	[r]298,000	--	--	[r]331,000	--	--	[r]366,000	--	--	[r]429,000	--	--
115	4–10	13,900	11,000	17,600	16,600	12,700	21,600	19,300	14,300	26,000	25,800	17,800	37,400
116	2–4	30,500	25,600	36,300	35,800	29,200	44,000	41,300	32,600	52,300	54,600	40,100	74,500
117	1–2	1,140	738	1,760	1,350	836	2,170	1,530	907	2,590	1,910	1,020	3,580
118	.2–1	15,300	12,900	18,200	17,700	14,400	21,600	19,900	15,800	25,100	25,200	18,600	34,000
119	1–2	[j]41,500	34,900	49,300	[j]48,300	39,500	59,200	[j]55,200	43,700	69,800	[j]71,700	52,700	97,600
120	< .2	--	--	--	[n]27,000	--	--	[n]34,000	--	--	[n]50,000	--	--
121	4–10	9,490	7,610	11,800	11,500	9,000	14,600	13,600	10,400	17,700	18,600	13,200	26,000
122	.2–1	--	--	--	[n]30,000	--	--	[n]37,000	--	--	[n]52,000	--	--
123	4–10	21,500	17,900	25,800	24,700	20,100	30,400	27,900	22,100	35,300	35,100	26,000	47,500
124	1–2	2,520	1,940	3,280	3,030	2,260	4,070	3,540	2,560	4,900	4,740	3,190	7,060
125	4–10	27,400	22,900	32,800	31,600	25,900	38,600	35,800	28,600	44,800	45,900	34,400	61,100
126	2–4	39,200	33,200	46,300	45,300	37,500	54,700	51,500	41,600	63,700	65,900	49,900	87,000
127	1–2	43,500	37,000	51,100	49,700	41,300	59,700	55,500	45,100	68,400	69,400	52,800	91,100
128	1–2	47,300	40,200	55,800	53,600	44,400	64,600	59,400	48,000	73,500	73,200	55,400	96,600
129	.2–1	[r]--	--	--	[n]72,000	--	--	[n]87,000	--	--	[n]132,000	--	--
130	2–4	6,140	4,880	7,730	7,330	5,690	9,440	8,580	6,500	11,300	11,800	8,310	16,600
131	4–10	16,200	13,000	20,200	20,000	15,700	25,400	23,700	18,200	30,900	33,000	23,800	45,900
132	2–4	18,400	15,700	21,600	21,300	17,800	25,500	24,100	19,700	29,600	30,700	23,600	40,100
133	[s]--	--	--	--	--	--	--	--	--	--	--	--	--
134	[s]--	--	--	--	--	--	--	--	--	--	--	--	--
135	.2–1	--	--	--	[n]51,000	--	--	[n]70,000	--	--	[n]135,000	--	--
136	.2–1	--	--	--	[n]61,000	--	--	[n]81,000	--	--	[n]144,000	--	--
137	.2–1	--	--	--	[n]66,000	--	--	[n]86,000	--	--	[n]149,000	--	--
138	4–10	19,300	16,200	23,000	22,600	18,300	27,900	26,000	20,300	33,300	34,100	24,400	47,800

Table 5. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during May and June 2008.—Continued

[mi², square mile; ft, foot; ft³/s, cubic foot per second; AEP, annual exceedance probability; >, greater than; <, less than; --, no data; R., River]

Site number (fig. 12)	Station number	Station name	Contributing drainage area (mi²)	Flood data: Previous maximum streamflow: Date	Stage (ft)	Streamflow (ft³/s)	Flood of June 2008: Rank[a]/ annual peaks	Date	Peak stage (ft)	Peak streamflow (ft³/s)
139	05527800	Des Plaines River at Russell, Ill.	123	05/2004	11.09	3,500	5/49	6/11/2008	9.47	1,910
140	05543830	Fox River at Waukesha, Wis.	126	04/1960	8.00	2,500	2/47	6/9/2008	8.85	2,440
141	05544200	Mukwonago River at Mukwonago, Wis.	74.1	08/2007	3.96	[c]317	1/33	6/13/2008	4.95	[c]364
142	05545750	Fox River near New Munster, Wis.	811	03/1960	9.25	7,520	3/69	6/15/2008	[e]15.18	5,960
143	05572000	Sangamon River at Monticello, Ill.	550	10/1926	18.50	19,000	7/100	6/4/2008	18.79	13,300
144	05580000	Kickapoo Creek at Waynesville, Ill.	227	08/1981	16.91	24,600	8/61	6/4/2008	16.50	11,600
145	05586100	Illinois River at Valley City, Ill.	26,743	05/1943	28.61	[c]123,000	([p])	6/14/2008	17.72	[c]63,000
146	05587450	Mississippi River at Grafton, Ill.	171,300	08/1993	38.17	[l]598,000	2/23	6/28/2008	30.80	[l]440,000
147	05590800	Lake Fork at Atwood, Ill.	149	03/1979	14.03	4,030	1/36	6/7/2008	15.75	3,550
148	05591200	Kaskaskia River at Cooks Mills, Ill.	473	05/2002	17.85	11,000	1/38	6/7/2008	20.41	14,100
149	05591700	West Okaw River near Lovington, Ill.	112	05/1996	16.40	10,300	2/29	6/7/2008	16.17	9,370
150	06359500	Moreau River near Faith, S. Dak.	2,660	04/1944	[f]21.90	26,000	4/65	6/7/2008	21.50	22,900
151	06360500	Moreau River near Whitehorse, S. Dak.	4,880	03/1997	26.93	29,700	4/55	6/8/2008	25.56	25,000
152	06425100	Elk Creek near Rapid City, S. Dak.	190	05/1996	12.77	3,120	3/30	6/6/2008	11.64	[c]2,390
153	06425500	Elk Creek near Elm Springs, S. Dak.	540	03/1952	10.61	8,540	4/59	6/6/2008	14.00	[c]7,000
154	06428500	Belle Fourche R. at Wyo./S. Dak. State Line, S. Dak.	3,280	05/1995	16.33	[l]6,320	2/62	6/6/2008	15.98	[l]5,190
155	06433500	Hay Creek at Belle Fourche, S. Dak.	121	05/1995	10.23	1,280	1/44	6/6/2008	10.50	[h]1,400
156	06436000	Belle Fourche River near Fruitdale, S. Dak.	4,540	05/1982	14.32	[l]12,700	4/63	6/6/2008	12.95	[l]8,700
157	06436198	Whitewood Creek above Vale, S. Dak.	102	05/1995	5.72	4,250	1/26	6/5/2008	7.29	4,500
158	06436760	Horse Creek above Vale, S. Dak.	464	05/1982	24.80	[c]17,700	2/28	6/6/2008	23.42	[c]15,100
159	06437000	Belle Fourche River near Sturgis, S. Dak.	5,870	05/1982	19.10	[l]36,400	2/63	6/6/2008	20.10	[l]36,100
160	06438000	Belle Fourche River near Elm Springs, S. Dak.	7,210	06/1964	15.90	[l]45,100	1/81	6/6/2008	19.73	[l]47,500
161	06438500	Cheyenne River near Plainview, S. Dak.	21,600	05/1996	22.10	[l]69,700	1/47	6/7/2008	22.63	[l]73,200
162	06452000	White River near Oacoma, S. Dak.	9,940	03/1952	19.40	51,900	5/80	6/5/2008	19.39	33,800
163	06465500	Niobrara River near Verdel, Nebr.	11,580	03/1960	[d]10.10	39,000	5/53	6/6/2008	5.56	[l]12,400
164	06606837	(0660683710) Halfway Creek at Schaller, Iowa	1.7	05/2007	94.64	486	1/19	6/8/2008	97.31	1,010
165	06609500	Boyer River at Logan, Iowa	871	06/1990	22.54	30,800	1/80	6/8/2008	[d]24.75	33,600
166	06610581	Mosquito Creek Tributary near Neola, Iowa	3.2	05/2004	87.50	1,960	2/18	6/8/2008	85.24	1,360
167	06768000	Platte River near Overton, Nebr.	51,620	06/1935	[f]6.25	37,600	22/91	5/25/2008	9.05	[l]11,200
168	06794000	Beaver Creek at Genoa, Nebr.	429	07/1950	[d]18.70	21,200	6/68	5/30/2008	18.15	7,270
169	06795500	Shell Creek near Columbus, Nebr.	294	06/1990	22.76	8,000	1/60	5/30/2008	22.06	11,200
170	06801000	Platte River near Ashland, Nebr.	69,300	03/1993	[d]19.23	130,000	5/45	5/31/2008	21.06	[l]85,600
171	06805500	Platte River at Louisville, Nebr.	71,000	07/1993	[d]11.90	160,000	8/56	5/31/2008	10.48	[l]96,600
172	06809500	East Nishnabotna River at Red Oak, Iowa	894	06/1998	29.39	60,500	6/82	6/13/2008	24.09	27,000
173	06811760	Tarkio River near Elliott, Iowa	10.7	06/1998	14.68	5,000	3/57	6/5/2008	13.20	3,010
174	06813500	Missouri River at Rulo, Nebr.	414,900	04/1952	25.60	358,000	8/59	6/14/2008	24.98	[c]167,000
175	06816290	West Nodaway River at Massena, Iowa	23.4	02/1973	82.39	[h]4,700	1/43	6/12/2008	80.54	4,850
176	06817000	Nodaway River at Clarinda, Iowa	762	05/2007	23.82	31,100	1/81	6/5/2008	26.61	47,900
177	06817700	Nodaway River near Graham, Mo.	1,380	09/1993	26.89	90,700	2/26	6/6/2008	25.90	52,300
178	06818000	Missouri River at St. Joseph, Mo.	420,100	04/1952	26.82	[c]397,000	21/89	6/13/2008	25.10	[c]171,000
179	06819500	102 River at Maryville, Mo.	515	10/1973	19.25	28,000	3/67	6/6/2008	26.20	21,800
180	06838000	Red Willow Creek near Red Willow, Nebr.	405	06/1947	18.36	30,000	7/69	5/23/2008	16.02	[l]3,900
181	06844500	Republican River near Orleans, Nebr.	8,880	06/1947	14.00	145,000	6/62	5/26/2008	13.14	[l]9,680
182	06871500	Bow Creek near Stockton, Kans.	341	07/1951	13.60	12,900	5/58	5/24/2008	13.31	6,090
183	06893000	Missouri River at Kansas City, Mo.	484,100	06/1844	48.00	625,000	28/81	6/13/2008	29.02	[c]201,000
184	06893080	Blue River near Stanley, Kans.	46.0	05/1990	20.51	20,200	4/39	6/4/2008	19.68	16,600

Site number	Estimated AEP for observed peak streamflow (percent)	Expected peak streamflows for selected AEP with 95-percent confidence limits (ft³/s)[b]: 4-percent AEP (25-year recurrence): Estimate	Confidence limit: Low	Confidence limit: High	2-percent AEP (50-year recurrence): Estimate	Confidence limit: Low	Confidence limit: High	1-percent AEP (100-year recurrence): Estimate	Confidence limit: Low	Confidence limit: High	0.2-percent AEP (500-year recurrence): Estimate	Confidence limit: Low	Confidence limit: High
139	4–10	2,440	1,830	3,230	2,870	2,070	3,980	3,290	2,270	4,780	4,210	2,600	6,830
140	1–2	2,040	1,650	2,510	2,330	1,820	2,990	2,640	1,970	3,530	3,220	2,200	4,700
141	.2–1	320	292	364	340	308	392	359	322	418	397	352	475
142	2–4	5,940	5,030	7,010	6,760	5,540	8,230	7,580	6,010	9,560	9,120	7,700	11,400
143	4–10	15,000	12,500	18,100	17,800	14,300	22,200	20,600	16,000	26,700	27,700	19,600	39,200
144	4–10	15,500	11,300	21,200	19,400	13,400	27,900	23,600	15,500	35,900	34,500	20,000	59,500
145	> 10	[r]110,000	--	--	[r]121,000	--	--	[r]132,000	--	--	[r]157,000	--	--
146	2–4	[r]408,000	--	--	[r]446,000	--	--	[r]488,000	--	--	[r]585,000	--	--
147	4–10	4,150	3,440	5,010	4,610	3,710	5,720	5,050	3,940	6,470	6,060	4,390	8,360
148	1–2	11,500	9,140	14,400	13,100	10,100	17,000	14,600	10,900	19,700	18,300	12,400	26,900
149	2–4	8,710	6,150	12,300	10,300	6,960	15,400	12,000	7,700	18,700	16,000	9,180	28,000
150	2–4	20,000	15,100	28,800	26,400	19,600	39,900	33,700	24,500	52,900	54,300	28,000	89,500
151	4–10	29,900	22,800	41,500	38,600	28,800	55,300	48,100	35,300	70,900	73,700	51,800	115,000
152	4–10	[t]3,460	--	--	[t]4,490	--	--	[t]5,660	--	--	[t]25,900	--	--
153	4–10	[t]8,600	--	--	[t]11,300	--	--	[t]14,600	--	--	[t]48,600	--	--
154	2–4	5,080	3,950	6,950	6,200	4,740	8,730	7,360	5,530	10,600	10,200	7,390	15,400
155	2–4	[t]968	--	--	[t]1,680	--	--	[t]3,160	--	--	[t]20,900	--	--
156	4–10	11,200	7,220	19,100	14,400	9,120	25,500	17,700	11,000	32,200	25,100	15,100	48,000
157	4–10	[t]6,170	--	--	[t]8,760	--	--	[t]12,100	--	--	[t]27,200	--	--
158	2–4	[t]10,600	--	--	[t]16,100	--	--	[t]24,000	--	--	[t]68,000	--	--
159	1–2	23,400	17,300	34,200	32,100	23,000	49,100	42,700	29,700	68,200	76,300	49,700	134,000
160	2–4	41,600	26,400	72,800	52,800	32,900	95,500	63,700	38,900	118,000	86,600	51,400	168,000
161	2–4	61,200	47,900	83,500	78,400	59,800	111,000	97,800	72,900	143,000	153,000	109,000	240,000
162	4–10	37,200	31,000	46,500	46,500	37,900	59,800	57,000	45,600	75,400	86,900	66,600	122,000
163	4–10	[u]16,000	13,400	20,200	[u]20,000	16,300	26,300	[u]24,700	19,700	33,900	[u]39,700	29,600	59,800
164	4–10	1,280	956	1,710	1,670	1,230	2,280	2,100	1,510	2,930	3,260	2,190	4,880
165	1–2	27,100	23,200	31,600	30,600	25,600	36,500	34,100	27,900	41,600	42,200	32,500	54,900
166	4–10	2,040	1,530	2,730	2,650	1,950	3,610	3,310	2,380	4,610	5,110	3,420	7,630
167	> 10	[u]18,200	15,000	23,300	[u]23,400	18,800	31,100	[u]29,600	23,100	40,700	[u]48,700	36,000	72,100
168	4–10	10,400	7,430	14,500	13,900	9,510	20,400	18,300	11,900	28,000	32,700	19,100	55,800
169	<.2	5,620	4,560	6,930	6,800	5,370	8,600	8,030	6,170	10,400	11,000	7,910	15,300
170	4–10	[u]102,000	83,400	134,000	[u]121,000	96,600	165,000	[u]141,000	110,000	200,000	[u]195,000	146,000	298,000
171	> 10	[u]129,000	107,000	165,000	[u]154,000	125,000	201,000	[u]180,000	144,000	241,000	[u]246,000	189,000	348,000
172	4–10	29,200	24,500	34,900	33,800	27,700	41,200	38,400	30,700	48,000	49,200	36,900	65,600
173	4–10	3,070	2,410	3,920	3,850	2,950	5,010	4,660	3,490	6,220	6,780	4,750	9,690
174	4–10	[h]194,000	--	--	[r]220,000	--	--	[r]250,000	--	--	[r]320,000	--	--
175	2–4	4,010	3,140	5,100	4,970	3,830	6,460	5,970	4,490	7,940	8,510	5,990	12,100
176	< .2	29,800	25,100	35,500	33,500	27,500	40,900	37,100	29,700	46,400	45,800	34,300	61,100
177	4–10	54,500	38,300	77,600	64,700	43,400	96,600	75,000	47,900	118,000	99,300	56,800	174,000
178	> 10	[h]208,000	--	--	[r]234,000	--	--	[r]260,000	--	--	[r]324,000	--	--
179	2–4	21,200	17,800	25,300	24,400	19,800	30,200	27,600	21,500	35,500	35,200	25,000	49,500
180	.2–1	[u]1,700	1,180	2,750	[u]2,520	1,670	4,380	[u]3,640	2,300	6,760	[u]7,920	4,530	17,100
181	2–4	[u]8,440	6,100	12,800	[u]10,400	7,380	16,500	[u]12,500	8,650	20,300	[u]17,400	11,600	30,100
182	4–10	8,770	5,620	13,700	12,700	7,740	20,900	17,400	10,100	30,100	--	--	--
183	> 10	[h]306,000	--	--	[r]351,000	--	--	[r]401,000	--	--	[r]532,000	--	--
184	4–10	18,300	13,400	25,000	22,500	15,700	32,200	26,900	17,900	40,400	--	--	--

Table 5. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during May and June 2008.—Continued

[mi², square mile; ft, foot; ft³/s, cubic foot per second; AEP, annual exceedance probability; >, greater than; <, less than; --, no data; R., River]

Site number (fig. 12)	Station number	Station name	Contributing drainage area (mi²)	Flood data: Previous maximum streamflow			Flood data: Flood of June 2008			
				Date	Stage (ft)	Streamflow (ft³/s)	Rank[a]/ annual peaks	Date	Peak stage (ft)	Peak streamflow (ft³/s)
185	06898000	Thompson River at Davis City, Iowa	701	09/1992	24.29	57,000	([p])	6/7/2008	16.46	20,900
186	06899500	Thompson River at Trenton, Mo.	1,720	06/1947	25.70	95,000	([p])	6/25/2008	31.01	50,400
187	06901500	Locust Creek near Linneus, Mo.	550	06/1947	26.93	38,000	3/59	6/25/2008	25.83	26,900
188	06905500	Chariton River near Prairie Hill, Mo.	1,870	05/2002	23.01	[l]37,100	([p])	6/26/2008	22.84	[l]36,100
189	06934500	Missouri River at Hermann, Mo.	522,500	07/1993	36.97	[c]750,000	([p])	6/17/2008	--	[c]286,000
190	06935965	Missouri River at St. Charles, Mo.	524,000	05/2002	31.69	[c]350,000	([p])	6/18/2008	--	[c]303,000
191	07010000	Mississippi River at St. Louis, Mo.	697,000	08/1993	49.58	[l]1,070,000	25/148	6/30/2008	38.67	[l]720,000
192	07020500	Mississippi River at Chester, Ill.	708,600	04/1927	34.40	1,060,000	21/84	7/1/2008	39.44	[l]696,000
193	07022000	Mississippi River at Thebes, Ill.	713,200	07/1844	--	1,075,000	26/77	7/3/2008	41.10	[l]717,000
194	07050700	James River near Springfield, Mo.	246	07/1909	22.00	62,000	([p])	6/14/2008	18.53	28,400
195	07160350	Skeleton Creek at Enid, Okla.	70.3	11/1998	14.70	[l]8,180	1/13	6/9/2008	15.97	9,860
196	07176000	Verdigris River near Claremore, Okla.	6,534	05/1943	55.05	182,000	14/74	6/16/2008	34.09	[l]50,400
197	07176500	Bird Creek at Avant, Okla.	364	10/1959	31.40	32,400	5/64	6/9/2008	27.58	[c]27,500

[a] Rank of the maximum instantaneous peak streamflow measured during June 2008 compared to all systematic and historic annual peaks. A rank of 1 indicates that the June 2008 peak streamflow was higher than all other recorded annual peaks.

[b] Unless otherwise noted, expected peak streamflows are based on Water Resources Council Bulletin 17B weighting by variance method.

[c] Streamflow affected to unknown degree by regulation or diversion.

[d] A higher stage exists that corresponds to a streamflow that is less than the peak streamflow.

[e] Streamgage datum changes or stage shifts over period of record. Streamgage vertical datum is referenced to the North American Datum of 1927.

[f] Datum change at site.

[g] Expected peak streamflows based on Bulletin 17B systematic frequency-curve estimate only.

[h] Estimated.

[i] Expected peak streamflows are based on regional regression equation estimates only (Eash, 2001).

[j] Expected peak streamflows are based on inclusion of actual, or area-weighted, annual-peak streamflows from an earlier period of record from nearby discontinued downstream streamgage.

[k] Expected peak streamflows are logarithmic interpolations of weighted estimates between upstream and downstream streamgages.

[l] Streamflow affected by regulation or diversion.

[m] U.S. Army Corps of Engineers (2009).

[n] U.S. Army Corps of Engineers (2002).

[o] Expected peak streamflows are based on weighted estimates from nearby downstream streamgage and regional regression estimates for this streamgage.

[p] The peak streamflow for June 2008 was exceeded by another peak streamflow during 2008.

[q] A higher peak stage of 20.00 occurred in 1929 but corresponded to a lesser peak streamflow.

[r] U.S. Army Corps of Engineers (2004).

[s] Estimated AEP uncharacterized because of regulation.

[t] Expected peak streamflows are based on a regional mixed-population analysis (Sando and others, 2008).

[u] Analysis based on station skew for the current (2008) regulated condition.

Estimated AEP for observed peak streamflow (percent)	Expected peak streamflows for selected AEP with 95-percent confidence limits (ft³/s)[b]: 4-percent AEP (25-year recurrence)			2-percent AEP (50-year recurrence)			1-percent AEP (100-year recurrence)			0.2-percent AEP (500-year recurrence)		
	Estimate	Confidence limit: Low	Confidence limit: High	Estimate	Confidence limit: Low	Confidence limit: High	Estimate	Confidence limit: Low	Confidence limit: High	Estimate	Confidence limit: Low	Confidence limit: High
4–10	23,900	19,800	28,700	28,300	23,000	34,700	32,800	26,100	41,100	44,000	33,100	58,700
> 10	63,600	53,500	75,700	72,600	58,800	89,600	81,100	63,100	104,000	99,800	70,500	141,000
1–2	23,000	19,700	27,000	26,400	21,900	31,900	29,900	23,900	37,300	37,800	27,800	51,500
.2–1	25,200	22,200	28,600	28,000	24,000	32,600	30,600	25,500	36,700	36,800	28,600	47,400
> 10	[h]533,000	--	--	[r]604,000	--	--	[r]673,000	--	--	[r]833,000	--	--
> 10	[h]536,000	--	--	[r]606,000	--	--	[r]674,000	--	--	[r]829,000	--	--
4–10	[r]780,000	--	--	[r]850,000	--	--	[r]910,000	--	--	[r]1,120,000	--	--
> 10	[r]805,000	--	--	[r]893,000	--	--	[r]948,000	--	--	[r]1,140,000	--	--
4–10	[r]807,000	--	--	[r]895,000	--	--	[r]950,000	--	--	[r]1,142,000	--	--
4–10	33,200	27,600	39,900	38,200	30,700	47,500	42,900	33,300	55,300	53,400	38,300	74,500
4–10	[g]10,000	6,920	19,400	[g]12,100	8,060	25,700	[g]14,400	9,230	33,200	[g]20,400	12,200	56,300
4–10	[g]52,100	44,800	63,700	[g]59,600	50,400	74,600	[g]67,300	56,100	86,100	[g]86,000	69,500	115,000
4–10	32,100	25,600	40,300	36,300	27,600	47,800	40,800	29,500	56,500	52,300	33,400	81,900

Flooding in Shell Rock, Iowa. Photographs by Don Becker, USGS.

Table 6. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during July 2008.

[mi², square mile; ft, foot; ft³/s, cubic foot per second; AEP, annual exceedance probability; <, less than; --, no data]

Site number (fig. 15)	Station number	Station name	Contributing drainage area (mi²)	Flood data: Previous maximum streamflow: Date	Previous maximum streamflow: Stage (ft)	Previous maximum streamflow: Streamflow (ft³/s)	Flood of July 2008: Rank[a]/ annual peaks	Flood of July 2008: Date	Flood of July 2008: Peak stage (ft)	Flood of July 2008: Peak streamflow (ft³/s)
1	05483600	Middle Raccoon River at Panora, Iowa	440	07/1993	20.04	[c]22,400	3/52	7/28/2008	14.69	[c]14,000
2	05484000	South Raccoon River at Redfield, Iowa	994	07/1993	26.98	44,000	2/69	7/28/2008	24.04	37,100
3	05485640	Fourmile Creek at Des Moines, Iowa	92.7	06/1998	15.00	5,600	([d])	7/28/2008	15.38	6,390
4	05487470	South River near Ackworth, Iowa	460	06/1990	31.25	38,100	2/70	7/29/2008	31.57	35,700
5	05487825	Little White Breast Creek Trib. near Chariton, Iowa	.1	08/1993	18.93	[e]56	1/19	7/28/2008	19.72	78
6	05487980	White Breast Creek near Dallas, Iowa	342	07/1982	33.45	37,300	4/46	7/8/2008	28.44	16,900
7	05488200	English Creek near Knoxville, Iowa	90.1	07/1982	30.28	28,000	3/24	7/8/2008	27.40	14,000
8	05489000	Cedar Creek near Bussey, Iowa	374	07/1982	34.61	96,000	4/62	7/8/2008	28.91	30,800
9	05494300	Fox River at Bloomfield, Iowa	87.7	08/2007	25.05	13,100	2/32	7/8/2008	24.69	11,600
10	05502300	Salt River at Hagers Grove, Mo.	365	05/2002	20.91	42,000	2/35	7/25/2008	20.88	29,300
11	05502500	Salt River near Shelbina, Mo.	481	05/2002	28.65	24,600	1/65	7/26/2008	28.65	28,000
12	05503800	Crooked Creek near Paris, Mo.	80.0	04/1973	15.53	12,100	4/30	7/25/2008	12.35	6,810
13	05504800	South Fork Salt River above Santa Fe, Mo.	233	09/1993	28.66	31,800	([d])	7/26/2008	24.72	15,500
14	05506100	Long Branch near Santal Fe, Mo.	180	07/1998	22.43	16,700	1/14	7/25/2008	24.43	19,500
15	05506800	Elk Fork Salt River near Madison, Mo.	200	04/1973	33.40	42,300	3/41	7/25/2008	30.77	24,300
16	05507600	Lick Creek near Perry, Mo.	104	05/1996	22.25	11,800	2/30	7/25/2008	26.14	15,200
17	05508805	Spencer Creek at Plum Creek, Frankford, Mo.	206	09/1993	18.54	20,300	1/30	7/25/2008	19.60	20,700
18	06818750	Platte River near Diagonal, Iowa	217	09/1989	23.60	8,630	1/36	7/25/2008	25.97	13,400
19	06898000	Thompson River at Davis City, Iowa	701	09/1992	24.29	57,000	5/83	7/24/2008	16.77	21,500
20	06899500	Thompson River at Trenton, Mo.	1,720	06/1947	25.70	95,000	4/84	7/25/2008	31.96	63,400
21	06903700	South Fork Chariton River near Promise City, Iowa	168	09/1992	34.84	70,600	5/42	7/25/2008	25.78	17,700
22	06904010	Chariton River near Moulton, Iowa	740	08/2007	37.94	[c]21,200	3/29	7/9/2008	35.81	[c]10,300
23	06904500	Chariton River at Novinger, Mo.	1,370	06/1917	28.60	27,000	1/86	7/25/2008	28.44	[c]30,200
24	06905500	Chariton River near Prairie Hill, Mo.	1,870	05/2002	23.01	[c]37,100	1/80	7/27/2008	23.27	[c]38,400
25	06906150	Long Banch Creek near Atlanta, Mo.	23.0	05/2002	16.44	3,360	1/13	7/25/2008	16.43	4,870

Site number (fig. 15)	Estimated AEP for observed peak streamflow (percent)	Expected peak streamflows for selected AEP with 95-percent confidence limits (ft³/s)[b]: 4-percent AEP (25-year recurrence): Estimate	4-percent AEP: Confidence limit: Low	4-percent AEP: Confidence limit: High	2-percent AEP (50-year recurrence): Estimate	2-percent AEP: Confidence limit: Low	2-percent AEP: Confidence limit: High	1-percent AEP (100-year recurrence): Estimate	1-percent AEP: Confidence limit: Low	1-percent AEP: Confidence limit: High	0.2-percent AEP (500-year recurrence): Estimate	0.2-percent AEP: Confidence limit: Low	0.2-percent AEP: Confidence limit: High
1	2–4	14,000	11,900	16,400	16,700	13,900	20,000	19,500	15,800	23,900	26,400	20,100	34,600
2	.2–1	27,400	22,900	32,800	31,600	25,900	38,600	35,800	28,600	44,800	45,900	34,400	61,100
3	2–4	6,140	4,880	7,730	7,330	5,690	9,440	8,580	6,500	11,300	11,800	8,310	16,600
4	2–4	31,000	25,500	37,500	36,200	29,100	44,900	41,400	32,400	52,700	53,500	39,200	73,000
5	2–4	[f]74	53	126	[f]90	62	164	[f]108	72	206	[f]152	96	329
6	4–10	[g]19,100	15,700	23,200	[g]22,700	18,400	28,100	[g]26,500	21,000	33,400	[g]36,300	27,200	48,400
7	1–2	9,510	7,270	12,400	11,600	8,720	15,500	14,100	10,300	19,300	20,900	14,200	30,800
8	2–4	28,000	23,400	33,400	33,400	27,400	40,800	39,000	31,200	48,800	53,500	40,200	71,100
9	2–4	11,500	9,080	14,500	14,000	10,900	17,900	16,500	12,700	21,500	23,400	16,900	32,200
10	2–4	27,600	22,100	34,500	32,000	24,600	41,600	36,200	26,700	49,200	46,000	30,500	69,400
11	.2–1	19,300	16,200	23,000	22,600	18,300	27,900	26,000	20,300	33,300	34,100	24,400	47,800
12	> 10	8,900	6,780	11,700	10,300	7,540	14,200	11,800	8,200	16,900	15,200	9,520	24,200
13	4–10	20,000	13,700	29,100	23,600	15,400	36,100	27,300	17,000	43,900	36,200	20,100	65,100
14	1–2	16,200	11,400	23,000	18,600	12,500	27,800	21,200	13,600	33,000	27,400	15,800	47,600
15	2–4	21,700	16,000	29,600	25,700	18,000	36,700	29,700	19,800	44,600	39,400	23,400	66,100
16	2–4	14,500	11,400	18,400	16,600	12,600	22,000	18,800	13,600	25,800	23,900	15,700	36,400
17	2–4	19,400	16,100	23,300	21,200	17,100	26,400	23,000	17,900	29,600	27,100	19,400	37,800
18	1–2	10,800	9,060	12,900	12,500	10,300	15,300	14,300	11,500	17,800	18,200	13,800	24,100
19	4–10	23,900	19,800	28,700	28,300	23,000	34,700	32,800	26,100	41,100	44,000	33,100	58,700
20	4–10	63,600	53,500	75,700	72,600	58,800	89,600	81,100	63,100	104,000	99,800	70,500	141,000
21	4–10	17,900	14,900	21,500	21,000	17,100	25,700	24,400	19,400	30,500	33,600	25,300	44,600
22	< 2	[h]8,130	--	--	[h]8,660	--	--	--	--	--	--	--	--
23	1–2	25,900	21,600	31,200	30,100	24,100	37,700	34,400	26,300	44,900	44,300	30,700	64,000
24	< .2	25,200	22,200	28,600	28,000	24,000	32,600	30,600	25,500	36,700	36,800	28,600	47,400
25	2–4	4,230	2,640	6,780	5,100	3,040	8,560	6,020	3,430	10,600	8,240	4,230	16,000

[a] Rank of the maximum instantaneous peak streamflow measured during July 2008 compared to all systematic and historic annual peaks. A rank of 1 indicates that the July 2008 peak streamflow was higher than all other recorded annual peaks.

[b] Unless otherwise noted, expected peak streamflows are based on Water Resources Council Bulletin 17B weighting by variance method.

[c] Streamflow affected by regulation or diversion.

[d] The peak streamflow for July 2008 was exceeded by another peak streamflow during 2008.

[e] Estimated.

[f] Expected peak streamflows based on Bulletin 17B systematic frequency-curve estimate only.

[g] Expected peak streamflows are based on inclusion of actual, or area-weighted, annual-peak streamflows from an earlier period of record from nearby discontinued downstream streamgage.

[h] Edward Parker, P.E., Hydraulic Engineer, U.S. Army Corps of Engineers, Kansas City District, written commun., January 6, 2010.

Flooding in Spencer, Indiana. Photograph by Paul Baker, USGS.

Flooding in St. Joseph, Illinois. Photograph by Robert Holmes, USGS.

Table 7. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during September 2008.

[mi², square mile; ft, foot; ft³/s, cubic foot per second; AEP, annual exceedance probability; <, less than; --, no data; Br., Branch; >, greater than]

Site number (fig. 16)	Station number	Station name	Contributing drainage area (mi²)	Flood data: Previous maximum streamflow			Flood data: Flood of September 2008			
				Date	Stage (ft)	Streamflow (ft³/s)	Rank[a]/annual peaks	Date	Peak stage (ft)	Peak streamflow (ft³/s)
1	04093000	Deep River at Lake George Outlet, Hobart, Ind.	124	11/1990	17.58	4,230	1/62	9/15/2008	22.18	5,280
2	04094000	Little Calumet River at Porter, Ind.	66.2	11/1990	10.93	3,880	1/64	9/15/2008	12.04	5,320
3	04095300	Trail Creek at Michigan City, Ind.	54.1	06/1993	12.97	4,240	3/26	9/14/2008	13.07	3,310
4	04096015	Galien River near Sawyer, Mich.	80.7	05/1996	14.13	3,440	2/13	9/15/2008	13.26	2,510
5	04096405	St. Joseph River at Burlington, Mich.	206	06/1989	5.82	1,390	4/47	9/16/2008	6.83	1,130
6	04097500	St. Joseph River at Three Rivers, Mich.	1,350	04/1950	10.60	8,260	([d])	9/17/2008	9.29	6,120
7	04099000	St. Joseph River at Mottville, Mich.	1,866	06/1989	10.41	[e]11,400	([d])	9/17/2008	8.25	[e]7,550
8	04101370	Juday Creek near South Bend, Ind.	38.0	06/1993	3.39	226	1/16	9/15/2008	3.65	249
9	04101800	Dowagiac River at Sumnerville, Mich.	255	02/1985	9.26	1,590	1/49	9/15/2008	11.60	2,300
10	04102500	Paw Paw River at Riverside, Mich.	390	10/1986	10.90	3,580	1/57	9/17/2008	11.24	3,870
11	04102700	South Branch Black River near Bangor, Mich.	83.6	02/1997	14.90	2,390	2/43	9/15/2008	13.78	1,950
12	04103010	Kalamazoo River near Marengo, Mich.	267	06/1989	10.18	1,160	2/22	9/14/2008	10.05	1,120
13	04103500	Kalamazoo River at Marshall, Mich.	449	03/1950	8.20	2,130	2/42	9/15/2008	7.89	[e]2,030
14	04105000	Battle Creek at Battle Creek, Mich.	241	04/1947	4.48	3,640	9/77	9/17/2008	3.46	2,410
15	04105500	Kalamazoo River near Battle Creek, Mich.	824	04/1947	--	7,290	3/72	9/17/2008	7.78	5,240
16	04105700	Augusta Creek near Augusta, Mich.	38.9	06/1978	3.41	560	2/44	9/14/2008	3.48	312
17	04106000	Kalamazoo River at Comstock, Mich.	1,010	04/1947	7.94	6,910	4/72	9/18/2008	10.43	5,670
18	04106300	Portage Creek near Kalamazoo, Mich.	22.4	05/1989	3.09	407	2/44	9/14/2008	3.43	398
19	04106320	West Fork Portage Creek near Oshtemo, Mich.	13.0	12/1992	2.47	36	3/37	9/15/2008	2.17	26
20	04106400	West Fork Portage Creek at Kalamazoo, Mich.	18.7	12/1992	3.23	41	1/49	9/15/2008	3.69	69
21	04108600	Rabbit River near Hopkins, Mich.	71.4	06/1997	11.11	[f]3,740	([d])	9/14/2008	8.90	1,360
22	04111000	Grand River near Eaton Rapids, Mich.	661	04/1950	8.15	3,860	2/47	9/16/2008	8.17	3,590
23	04112700	Sycamore Creek at Harper Rd near Mason, Mich.	39.5	04/1975	12.53	1,080	3/34	9/15/2008	12.08	879
24	05448000	Mill Creek at Milan, Ill.	62.4	04/1973	11.65	9,300	3/67	9/13/2008	[g]11.37	8,790
25	05466500	Edwards River near New Boston, Ill.	445	04/1973	23.33	18,000	2/74	9/14/2008	24.13	10,300
26	05469350	Haight Creek at Kingston, Iowa	2.7	06/2007	18.16	2,450	2/19	9/13/2008	[f]16.02	[f]1,740
27	05473400	Cedar Creek near Oakland Mills, Iowa	530	08/2007	21.28	13,100	1/31	9/14/2008	21.96	14,100
28	05473450	Big Creek north of Mount Pleasant, Iowa	58.0	04/1973	--	9,580	2/12	9/13/2008	16.90	4,520
29	05495000	Fox River at Waylund, Mo.	400	04/1973	21.71	26,400	4/87	9/15/2008	20.61	18,600
30	05502500	Salt River near Shelbina, Mo.	481	05/2002	28.65	24,600	([d])	9/16/2008	24.29	17,800
31	05504800	South Fork Salt River above Santa Fe, Mo.	233	09/1993	28.66	31,800	2/21	9/15/2008	26.60	22,100
32	05512500	Bay Creek at Pittsfield, Ill.	39.4	09/1926	18.40	35,000	3/70	9/14/2008	14.75	12,900
33	05515500	Kankakee River at Davis, Ind.	537	01/2005	13.05	1,930	([d])	9/15/2008	13.74	1,900
34	05518000	Kankakee River at Shelby, Ind.	1,779	03/1982	12.98	7,650	5/86	9/19/2008	[g]12.86	6,230
35	05520500	Kankakee River at Momence, Ill.	2,294	03/1979	10.51	[f]16,000	2/94	9/15/2008	6.98	11,800
36	05527500	Kankakee River near Wilmington, Ill.	5,150	07/1957	11.40	75,900	([d])	9/15/2008	8.68	48,800
37	05530990	Salt Creek at Rolling Meadows, Ill.	30.5	08/1987	14.03	1,650	1/35	9/13/2008	12.99	[h]2,510
38	05531300	Salt Creek at Elmhurst, Ill.	91.5	08/1972	7.27	2,230	2/45	9/14/2008	13.27	[i]1,940
39	05531500	Salt Creek at Western Springs, Ill.	115	08/1987	10.54	3,540	2/63	9/14/2008	9.92	[i]2,890
40	05532000	Addison Creek at Bellwood, Ill.	17.9	08/1987	12.84	1,120	4/58	9/13/2008	10.33	808

Site number (fig. 16)	Estimated AEP for observed peak streamflow (percent)	Expected peak streamflows for selected AEP with 95-percent confidence limits (ft³/s)[b]: 4-percent AEP (25-year recurrence)			2-percent AEP (50-year recurrence)			1-percent AEP (100-year recurrence)			0.2-percent AEP (500-year recurrence)		
		Estimate	Confidence limit: Low	Confidence limit: High	Estimate	Confidence limit: Low	Confidence limit: High	Estimate	Confidence limit: Low	Confidence limit: High	Estimate	Confidence limit: Low	Confidence limit: High
1	1–2	4,440	3,530	6,380	5,220	4,040	7,910	6,070	4,570	9,670	8,320	5,900	14,800
2	2–4	4,490	3,230	7,530	5,660	3,920	10,300	7,010	4,680	13,700	11,000	6,750	25,200
3	2–4	3,190	2,190	4,640	3,770	2,480	5,730	4,350	2,750	6,890	5,820	3,390	9,990
4	4–10	[c]2,880	2,210	4,580	[c]3,370	2,510	5,770	[c]3,910	2,820	7,160	[c]5,330	3,600	11,300
5	4–10	[c]1,250	1,100	1,500	[c]1,400	1,210	1,710	[c]1,550	1,320	1,920	[c]1,890	1,570	2,430
6	4–10	[c]6,360	5,720	7,310	[c]6,970	6,200	8,140	[c]7,560	6,660	8,950	[c]8,900	7,680	10,900
7	4–10	[c]8,780	8,080	9,730	[c]9,800	8,930	11,000	[c]10,800	9,780	12,300	[c]13,400	11,800	15,700
8	2–4	[c]238	173	410	[c]282	199	521	[c]329	225	649	[c]450	288	1,020
9	< 1	1,590	1,360	1,850	1,770	1,470	2,130	1,950	1,570	2,430	--	--	--
10	1–2	2,980	2,430	3,650	3,450	2,700	4,400	3,950	2,960	5,250	--	--	--
11	2–4	1,860	1,460	2,360	2,150	1,620	2,860	2,470	1,780	3,440	--	--	--
12	2–4	[c]1,080	950	1,320	[c]1,180	1,020	1,470	[c]1,280	1,090	1,630	[c]1,500	1,250	2,010
13	2–4	1,910	1,590	2,290	2,150	1,740	2,660	2,410	1,880	3,080	--	--	--
14	4–10	2,800	2,340	3,350	3,210	2,580	3,980	3,620	2,810	4,670	--	--	--
15	4–10	5,340	4,510	6,320	6,110	4,990	7,490	6,930	5,460	8,790	--	--	--
16	1–2	263	206	336	303	226	406	344	244	485	--	--	--
17	2–4	[c]5,640	5,080	6,420	[c]6,300	5,620	7,280	[c]6,960	6,140	8,150	[c]8,510	7,360	10,300
18	< 1	288	234	355	323	252	415	360	269	481	--	--	--
19	4–10	[c]29	25	35	[c]33	28	41	[c]38	32	48	[c]49	40	67
20	.2–1	[c]47	42	55	[c]53	46	63	[c]59	51	72	[c]75	63	95
21	4–10	1,550	1,140	2,100	1,830	1,270	2,620	2,120	1,400	3,200	--	--	--
22	4–10	[c]3,970	3,520	4,640	[c]4,360	3,830	5,190	[c]4,750	4,130	5,730	[c]5,610	4,780	6,980
23	2–4	[c]877	731	1,130	[c]1,040	845	1,390	[c]1,210	966	1,680	[c]1,680	1,280	2,520
24	4–10	9,090	7,110	11,600	10,800	8,110	14,300	12,500	8,980	17,300	16,500	10,700	25,400
25	2–4	10,200	8,490	12,200	11,800	9,500	14,600	13,400	10,400	17,100	17,200	12,300	24,000
26	4–10	2,270	1,710	3,000	2,860	2,110	3,860	3,500	2,530	4,860	5,280	3,540	7,860
27	2–4	13,600	11,400	16,200	15,700	12,900	19,000	17,800	14,300	22,100	22,700	17,300	29,900
28	4–10	5,300	3,990	7,050	6,490	4,810	8,770	7,710	5,590	10,600	10,800	7,330	16,000
29	4–10	18,900	15,600	22,900	22,300	17,700	28,000	25,900	19,800	33,800	34,600	24,100	49,600
30	4–10	19,300	16,200	23,000	22,600	18,300	27,900	26,000	20,300	33,300	34,100	24,400	47,800
31	2–4	20,000	13,700	29,100	23,600	15,400	36,100	27,300	17,000	43,900	36,200	20,100	65,100
32	4–10	14,300	11,200	18,200	17,000	12,800	22,600	19,600	14,100	27,300	25,500	16,500	39,400
33	2–4	1,830	1,710	1,960	1,940	1,790	2,100	2,050	1,860	2,250	2,300	2,010	2,620
34	4–10	6,370	5,940	6,830	6,730	6,180	7,320	7,060	6,390	7,810	7,760	6,740	8,930
35	2–4	11,700	10,600	12,900	12,600	11,300	14,200	13,500	11,800	15,500	15,300	12,600	18,400
36	4–10	54,700	47,300	63,300	61,300	51,600	72,900	67,500	55,200	82,600	80,800	61,300	106,000
37	< .2	1,520	1,320	1,860	1,690	1,440	2,110	1,850	1,560	2,360	2,220	1,820	2,950
38	[j]--	--	--	--	--	--	--	--	--	--	--	--	--
39	[j]--	--	--	--	--	--	--	--	--	--	--	--	--
40	4–10	[c]858	767	988	[c]944	837	1,100	[c]1,030	902	1,220	[c]1,210	1,050	1,470

Table 7. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during September 2008.—Continued

[mi^2, square mile; ft, foot; ft^3/s, cubic foot per second; AEP, annual exceedance probability; <, less than; --, no data; Br., Branch; >, greater than]

Site number (fig. 16)	Station number	Station name	Contributing drainage area (mi^2)	Flood data: Previous maximum streamflow: Date	Previous maximum streamflow: Stage (ft)	Previous maximum streamflow: Streamflow (ft^3/s)	Flood of September 2008: Rank[a]/ annual peaks	Flood of September 2008: Date	Flood of September 2008: Peak stage (ft)	Flood of September 2008: Peak streamflow (ft^3/s)
41	05532500	Des Plaines River at Riverside, Ill.	630	08/1987	9.90	9,770	2/95	9/14/2008	9.87	9,560
42	05534500	North Branch Chicago River at Deerfield, Ill.	19.7	08/1987	11.52	933	4/56	9/13/2008	11.39	749
43	05535000	Skokie River at Lake Forest, Ill.	13.0	08/2001	7.78	[h]580	5/57	9/13/2008	7.01	464
44	05536000	North Branch Chicago River at Niles, Ill.	100	08/1987	11.35	2,590	1/58	9/13/2008	12.13	3,340
45	05536179	Hart Ditch at Dyer, Ind.	37.6	11/1990	15.33	3,010	1/19	9/14/2008	16.76	3,110
46	05536190	Hart Ditch at Munster, Ind.	70.7	09/2006	--	3,260	1/66	9/14/2008	9.94	[h,f]3,840
47	05536275	Thorn Creek at Thornton, Ill.	104	04/2006	15.10	[h]5,540	1/62	9/14/2008	15.89	5,860
48	05539000	Hickory Creek at Joliet, Ill.	107	06/1981	14.90	17,300	10/67	9/14/2008	18.39	7,150
49	05539900	West Branch DuPage River near West Chicago, Ill.	28.5	08/2007	10.35	[h]1,040	1/48	9/13/2008	12.28	1,840
50	05540060	Kress Creek at West Chicago, Ill.	18.1	07/1996	9.24	1,980	1/43	9/14/2008	9.37	2,100
51	05540095	West Branch DuPage River near Warrenville, Ill.	90.4	07/1996	6.41	[h]3,470	1/40	9/14/2008	8.03	4,930
52	05540130	West Branch DuPage River near Naperville, Ill.	123	07/1996	14.31	[h]6,620	2/20	9/14/2008	11.98	4,160
53	05540160	East Br. DuPage River near Downers Grove, Ill.	26.6	08/1972	16.94	1,720	3/35	9/14/2008	17.26	1,190
54	05540250	East Branch DuPage River at Bolingbrook, Ill.	75.8	07/1996	23.75	[h]3,980	2/20	9/14/2008	24.01	2,410
55	05540500	Du Page River at Shorewood, Ill.	324	07/1996	14.03	[h]17,300	4/68	9/15/2008	9.94	9,440
56	05542000	Mazon River near Coal City, Ill.	455	12/1982	19.51	22,400	4/69	9/15/2008	18.54	18,800
57	05550300	Tyler Creek at Elgin, Ill.	38.9	08/2002	8.26	[h]1,650	3/28	9/13/2008	8.53	1,250
58	05550500	Poplar Creek at Elgin, Ill.	35.2	02/1997	6.78	[h]1,180	1/57	9/13/2008	7.69	1,560
59	05551200	Ferson Creek near St. Charles, Ill.	51.7	02/1997	8.77	2,580	1/48	9/13/2008	8.96	2,980
60	05551700	Blackberry Creek near Yorkville, Ill.	70.2	07/1996	13.16	5,510	2/48	9/15/2008	9.94	2,130
61	05552500	Fox River at Dayton, Ill.	2,642	07/1996	24.47	[k]55,400	3/93	9/14/2008	21.48	[e]44,300
62	05555300	Vermilion River near Leonore, Ill.	1,251	07/1958	15.30	33,500	([d])	9/15/2008	24.51	25,200
63	05556500	Big Bureau Creek at Princeton, Ill.	196	05/1974	16.01	12,500	1/72	9/14/2008	16.62	12,700
64	05567500	Mackinaw River near Congerville, Ill.	767	12/1982	20.21	44,800	5/64	9/15/2008	18.84	25,400
65	05573540	Sangamon River at Route 48 at Decatur, Ill.	938	05/2002	24.33	[i]31,800	2/26	9/14/2008	24.43	[i]21,500
66	05586100	Illinois River at Valley City, Ill.	26,743	05/1943	28.61	[e]123,000	17/88	9/24/2008	[g]21.11	[e]92,200
67	05593900	East Fork Shoal Creek near Coffeen, Ill.	55.5	12/1966	14.45	5,910	5/45	9/14/2008	14.25	5,070
68	06928300	Roubidoux Creek above Fort Wood, Mo.	165	05/2002	14.86	12,900	1/7	9/14/2008	22.45	25,900
69	06934500	Missouri River at Hermann, Mo.	522,500	07/1993	36.97	750,000	24/82	9/15/2008	31.34	[e]350,000
70	06935850	Creve Coeur Creek at Chesterfield, Mo.	5.6	06/2000	15.88	2,050	1/11	9/14/2008	17.56	2,820
71	06935890	Creve Coeur Creek near Creve Coeur, Mo.	22.0	06/2000	16.43	6,560	1/20	9/14/2008	16.22	8,780
72	06935955	Fee Fee Creek near Bridgeton, Mo.	11.7	04/1979	21.62	3,810	1/21	9/14/2008	20.41	4,680
73	06935965	Missouri River at St. Charles, Mo.	524,000	05/2002	31.69	350,000	1/8	9/16/2008	31.82	[e]353,000
74	06935980	Cowmire Creek at Bridgeton, Mo.	3.7	06/2003	16.04	3,490	1/19	9/14/2008	16.20	3,580
75	06936475	Coldwater Creek near Black Jack, Mo.	40.4	04/2001	10.67	10,600	2/12	9/14/2008	15.62	9,690
76	07005000	Maline Creek at Bellefontaine Neighbors, Mo.	24.4	05/2004	14.06	8,210	1/13	9/14/2008	18.08	12,800
77	07010022	River Des Peres near University City, Mo.	8.9	06/2003	16.31	4,430	1/12	9/14/2008	17.40	5,050
78	07010030	River Des Peres Tributary at Pagedale, Mo.	2.0	07/1998	8.84	1,290	1/12	9/14/2008	10.38	2,160
79	07010035	Engelholm Creek near Wellston, Mo.	1.4	07/1998	8.88	1,090	1/11	9/14/2008	10.29	1,570

Expected peak streamflows for selected AEP with 95-percent confidence limits (ft^3/s)[b]

Site number (fig. 16)	Estimated AEP for observed peak streamflow (percent)	4-percent AEP (25-year recurrence): Estimate	4-percent AEP: Confidence limit Low	4-percent AEP: Confidence limit High	2-percent AEP (50-year recurrence): Estimate	2-percent AEP: Confidence limit Low	2-percent AEP: Confidence limit High	1-percent AEP (100-year recurrence): Estimate	1-percent AEP: Confidence limit Low	1-percent AEP: Confidence limit High	0.2-percent AEP (500-year recurrence): Estimate	0.2-percent AEP: Confidence limit Low	0.2-percent AEP: Confidence limit High
41	0.2–1	[c]7,340	6,710	8,160	[c]8,010	7,280	9,000	[c]8,640	7,800	9,800	[c]9,990	8,900	11,500
42	4–10	[c]871	741	1,090	[c]960	806	1,230	[c]1,040	867	1,360	[c]1,230	995	1,660
43	4–10	[c]509	442	607	[c]563	485	682	[c]614	524	753	[c]721	604	908
44	.2–1	[c]2,570	2,170	3,350	[c]2,890	2,400	3,920	[c]3,230	2,620	4,550	[c]4,080	3,170	6,230
45	2–4	[c]3,100	2,380	4,690	[c]3,730	2,780	5,990	[c]4,420	3,200	7,540	[c]6,340	4,290	12,300
46	[j]--	--	--	--	--	--	--	--	--	--	--	--	--
47	1–2	[c]4,730	4,110	5,650	[c]5,430	4,650	6,610	[c]6,140	5,190	7,620	[c]7,860	6,470	10,100
48	4–10	[c]8,480	6,660	12,400	[c]10,100	7,670	15,600	[c]11,800	8,730	19,200	[c]16,400	11,400	30,100
49	.2–1	[c]1,340	1,090	1,860	[c]1,560	1,230	2,260	[c]1,780	1,380	2,710	[c]2,370	1,740	3,990
50	1–2	[c]1,320	893	2,460	[c]1,750	1,130	3,570	[c]2,260	1,390	5,040	[c]3,900	2,160	10,500
51	1–2	[c]3,750	2,940	5,510	[c]4,450	3,390	6,930	[c]5,220	3,860	8,580	[c]7,310	5,070	13,500
52	4–10	[c]4,870	3,900	6,900	[c]5,690	4,440	8,490	[c]6,580	5,000	10,300	[c]8,930	6,410	15,600
53	4–10	[c]1,200	991	1,610	[c]1,360	1,110	1,920	[c]1,540	1,220	2,260	[c]1,990	1,510	3,190
54	4–10	[c]2,980	2,310	4,450	[c]3,570	2,680	5,650	[c]4,210	3,070	7,070	[c]5,980	4,090	11,400
55	4–10	[c]11,400	8,660	17,600	[c]13,800	10,200	22,800	[c]16,600	11,800	29,000	[c]24,200	16,100	48,500
56	4–10	19,900	16,800	23,600	21,900	17,900	26,900	23,700	18,700	30,100	27,200	19,700	37,400
57	> 10	[c]1,860	1,380	3,260	[c]2,190	1,570	4,190	[c]2,560	1,770	5,300	[c]3,530	2,270	8,750
58	2–4	[c]1,420	1,110	2,100	[c]1,690	1,280	2,650	[c]1,990	1,460	3,280	[c]2,790	1,930	5,200
59	1–2	2,540	2,000	3,230	2,930	2,220	3,870	3,310	2,410	4,540	4,140	2,730	6,290
60	> 10	[c]3,650	2,300	7,550	[c]5,050	3,010	11,600	[c]6,820	3,860	17,400	[c]12,900	6,450	41,100
61	2–4	[c]42,100	30,900	68,800	[c]52,000	36,800	91,300	[c]63,100	43,200	119,000	[c]95,200	60,200	208,000
62	4–10	30,700	25,600	36,900	35,000	28,300	43,400	39,100	30,500	50,200	48,200	34,400	67,500
63	2–4	11,500	9,470	14,100	13,100	10,400	16,600	14,600	11,000	19,200	17,700	12,200	25,800
64	4–10	29,600	22,500	38,900	35,800	26,000	49,300	42,200	29,300	60,900	57,800	35,900	93,200
65	[j]--	--	--	--	--	--	--	--	--	--	--	--	--
66	> 10	[l]110,000	--	--	[l]121,000	--	--	[l]132,000	--	--	[l]157,000	--	--
67	4–10	5,460	4,350	6,860	6,340	4,860	8,250	7,240	5,350	9,800	9,450	6,360	14,000
68	1–2	[m]21,200	--	--	[m]25,300	--	--	[m]29,700	--	--	[m]40,300	--	--
69	> 10	[f]533,000	--	--	[l]604,000	--	--	[l]673,000	--	--	[l]833,000	--	--
70	.2–1	2,370	1,800	3,120	2,530	1,900	3,360	2,680	1,990	3,610	2,990	2,190	4,090
71	4–10	9,470	6,900	13,000	12,500	8,760	17,700	16,000	10,900	23,400	26,500	17,200	40,700
72	2–4	4,650	3,800	5,680	5,200	4,160	6,500	5,740	4,500	7,320	6,950	5,260	9,170
73	> 10	[f]536,000	--	--	[l]606,000	--	--	[l]674,000	--	--	[l]829,000	--	--
74	4–10	3,890	3,120	4,840	4,290	3,310	5,550	4,590	3,420	6,170	5,020	3,490	7,230
75	4–10	9,430	7,120	12,500	10,100	7,320	13,900	10,600	7,430	15,100	11,500	7,590	17,300
76	4–10	13,300	9,460	18,600	16,100	11,100	23,400	19,600	13,200	29,200	30,600	19,700	47,600
77	4–10	5,150	4,050	6,560	5,530	4,150	7,380	5,890	4,210	8,240	6,640	4,230	10,400
78	.2–1	1,700	1,120	2,580	1,870	1,160	3,010	2,010	1,180	3,420	2,240	1,160	4,320
79	2–4	1,480	1,100	1,990	1,620	1,200	2,190	1,750	1,280	2,380	1,990	1,450	2,740

Table 7. Summary of peak stages, streamflows, and flood-probability estimates for selected U.S. Geological Survey streamgages during September 2008.—Continued

[mi^2, square mile; ft, foot; ft^3/s, cubic foot per second; AEP, annual exceedance probability; <, less than; --, no data; Br., Branch; >, greater than]

Site number (fig. 16)	Station number	Station name	Contributing drainage area (mi^2)	Flood data: Previous maximum streamflow: Date	Stage (ft)	Streamflow (ft^3/s)	Flood of September 2008: Rank[a]/ annual peaks	Date	Peak stage (ft)	Peak streamflow (ft^3/s)
80	07010086	Deer Creek at Maplewood, Mo.	36.5	07/2004	16.57	5,560	1/13	9/14/2008	21.53	10,300
81	07010090	MacKenzie Creek near Shrewsbury, Mo.	3.5	06/1998	10.80	1,730	1/12	9/14/2008	11.36	1,970
82	07010180	Gravois Creek near Mehlville, Mo.	18.1	09/2003	16.66	4,450	1/12	9/14/2008	19.17	5,870
83	07010208	Martigney Creek near Arnold, Mo.	2.6	07/2006	13.31	1,710	1/10	9/14/2008	14.67	2,120
84	07015720	Bourbeuse River near High Gate, Mo.	135	12/1982	23.65	49,300	3/45	9/14/2008	24.38	38,800
85	07019317	Mattese Creek near Mattese, Mo.	7.9	07/2006	13.93	6,560	1/13	9/14/2008	16.71	10,700
86	07053810	Bull Creek near Walnut Shade, Mo.	191	05/2002	14.41	32,200	3/12	9/14/2008	16.38	25,900
87	07144550	Arkansas River at Derby, Kans.	33,567	11/1998	16.45	58,300	7/40	9/13/2008	15.19	37,100
88	07145700	Slate Creek at Wellington, Kans.	154	06/1975	25.82	28,500	2/49	9/13/2008	24.28	14,100
89	07146500	Arkansas River at Arkansas City, Kans.	36,106	06/1923	28.43	103,000	4/91	9/14/2008	27.53	[i]79,100
90	07151000	Salt Fork Arkansas River at Tonkawa, Okla.	4,520	10/1973	28.98	[e]97,300	4/77	9/15/2008	25.60	[e]47,300
91	07151500	Chikaskia River near Corbin, Kans.	794	06/1923	28.00	60,000	6/50	9/13/2008	20.07	[f]27,100
92	07152000	Chikaskia River near Blackwell, Okla.	1,859	06/1923	37.00	[e]100,000	4/75	9/14/2008	35.36	[e]66,500
93	07260000	Dutch Creek at Waltreak, Ark.	81.4	07/1969	22.38	24,500	d	9/3/2008	19.61	21,000
94	07361500	Antoine River at Antoine, Ark.	178	05/1905	29.70	40,000	6/71	9/3/2008	26.64	25,300
95	07363000	Saline River at Benton, Ark.	550	04/1927	30.50	110,000	3/80	9/3/2008	29.27	[i]94,800

Site number (fig. 16)	Estimated AEP for observed peak streamflow (percent)	Expected peak streamflows for selected AEP with 95-percent confidence limits (ft^3/s)[b]: 4-percent AEP (25-year recurrence): Estimate	Confidence limit: Low	High	2-percent AEP (50-year recurrence): Estimate	Confidence limit: Low	High	1-percent AEP (100-year recurrence): Estimate	Confidence limit: Low	High	0.2-percent AEP (500-year recurrence): Estimate	Confidence limit: Low	High
80	< .2	7,570	5,240	11,000	7,880	5,270	11,800	8,100	5,280	12,400	8,500	5,350	13,500
81	4–10	2,010	1,570	2,580	2,110	1,560	2,840	2,180	1,550	3,060	2,290	1,520	3,430
82	.2–1	5,170	4,040	6,620	5,450	4,180	7,120	5,720	4,310	7,580	6,280	4,630	8,510
83	2–4	2,100	1,590	2,770	2,330	1,750	3,100	2,560	1,900	3,440	3,070	2,250	4,190
84	1–2	33,700	26,800	42,400	37,700	28,900	49,200	41,200	30,400	55,800	48,900	33,400	71,800
85	< .2	7,730	5,760	10,400	8,400	6,220	11,300	9,050	6,660	12,300	10,500	7,660	14,500
86	4–10	33,000	21,100	51,600	39,600	24,700	63,300	46,400	28,500	75,700	62,900	36,900	107,000
87	> 10	[c]55,800	42,600	80,400	[c]70,100	52,000	105,000	[c]86,000	66,200	135,000	[c]130,000	89,100	223,000
88	4–10	15,000	11,200	20,200	18,500	13,100	26,000	22,200	15,000	32,900	--	--	--
89	4–10	[c]81,200	66,200	104,000	[c]99,700	80,000	131,000	[c]119,000	94,100	159,000	[c]168,000	129,000	234,000
90	4–10	[c]50,600	40,000	67,700	[c]61,500	47,800	84,400	[c]72,700	55,600	102,000	[c]100,000	73,900	147,000
91	4–10	35,800	28,000	45,900	43,600	32,600	58,300	51,700	36,900	72,400	--	--	--
92	4–10	72,900	54,900	96,900	90,800	65,600	126,000	110,000	76,100	160,000	163,000	101,000	263,000
93	1–2	17,800	14,300	22,200	21,200	16,400	27,500	24,600	18,200	33,200	33,400	22,300	50,000
94	4–10	26,800	22,400	32,100	30,300	24,400	37,500	33,700	26,300	43,200	41,800	29,900	58,500
95	1–2	79,600	64,800	97,600	93,700	73,600	119,000	108,000	81,700	143,000	144,000	98,600	209,000

[a] Rank of the maximum instantaneous peak streamflow measured during September 2008 compared to all systematic and historic annual peaks. A rank of 1 indicates that the September 2008 peak streamflow was higher than all other recorded annual peaks.

[b] Unless otherwise noted, expected peak streamflows are based on Water Resources Council Bulletin 17B weighting by variance method.

[c] Expected peak streamflows based on Bulletin 17B systematic frequency-curve estimate only.

[d] The peak streamflow for September 2008 was exceeded by another peak streamflow during 2008.

[e] Streamflow affected to unknown degree by regulation or diversion.

[f] Estimated.

[g] A higher stage exists that corresponds to a streamflow that is less than the peak streamflow.

[h] All or part of the record affected by urbanization, mining, agricultural changes, channelization, or other.

[i] Streamflow affected by regulation or diversion.

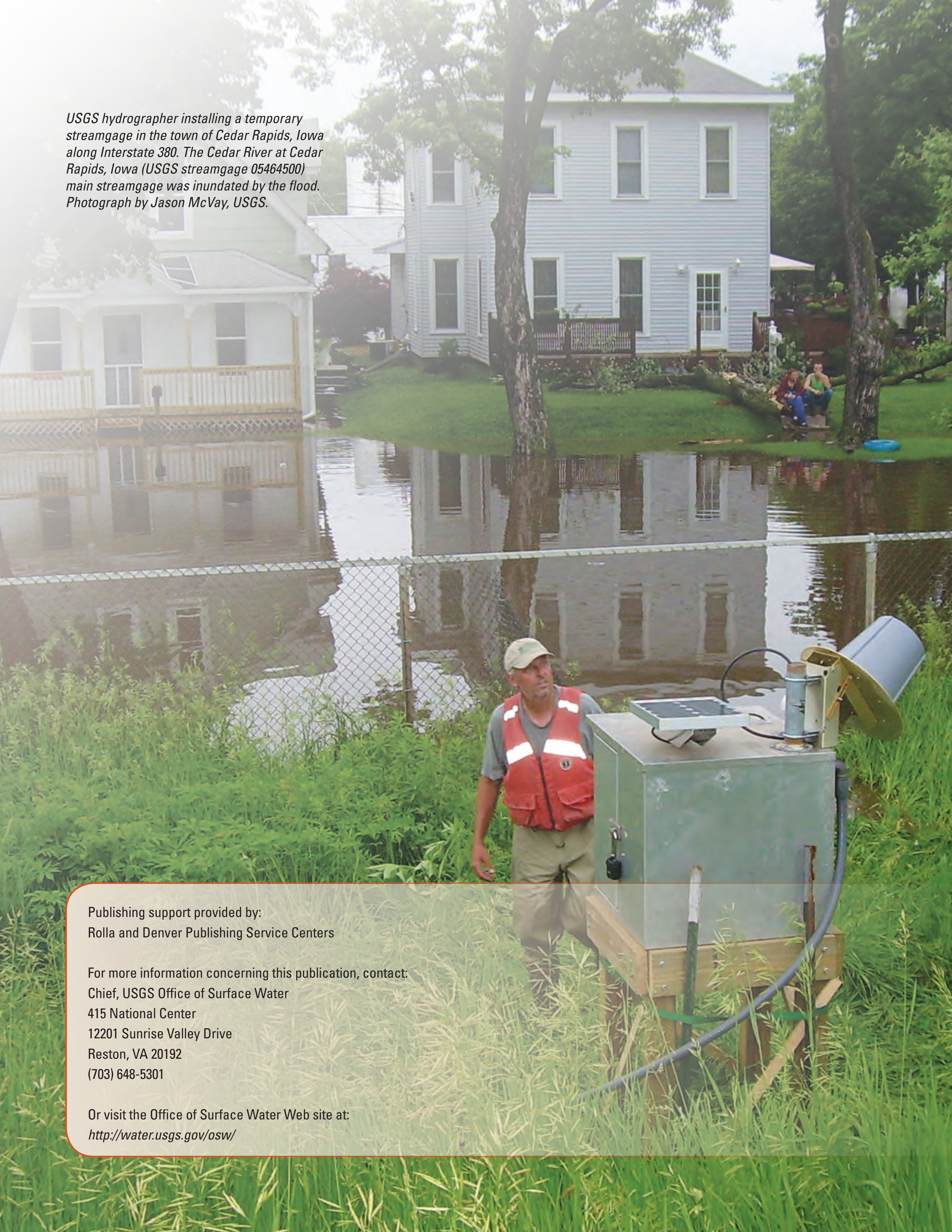
[j] Estimated AEP uncharacterized because of regulation, diversion, or insufficient data.

[k] Streamflow affected by dam failure.

[l] U.S. Army Corps of Engineers (2004).

[m] Expected peak streamflows are based on regional regression equation estimates only.

Flooding in Coralville, Iowa. Photographs by Don Becker, USGS.



USGS hydrographer installing a temporary streamgage in the town of Cedar Rapids, Iowa along Interstate 380. The Cedar River at Cedar Rapids, Iowa (USGS streamgage 05464500) main streamgage was inundated by the flood. Photograph by Jason McVay, USGS.

Publishing support provided by:
Rolla and Denver Publishing Service Centers

For more information concerning this publication, contact:
Chief, USGS Office of Surface Water
415 National Center
12201 Sunrise Valley Drive
Reston, VA 20192
(703) 648-5301

Or visit the Office of Surface Water Web site at:
http://water.usgs.gov/osw/

Back cover.
USGS hydrographers wade through the flooded streets of Cedar Rapids, Iowa to access streamgage on the Cedar River at Cedar Rapids, Iowa (USGS streamgage 05464500). Photograph by Scott Strader, USGS.

USGS

Holmes and others—**Flooding in the United States Midwest, 2008**—Professional Paper 1775

ISBN 978-1-4113-2841-9

9 781411 328419

Printed on recycled paper