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MIDWEST FLOODS of 2008 IN IOWA & WISCONSIN

1 Introduction

In August and September, 2008, the Mitigation Directorate of the Federal Emergency Management Agency (FEMA) within the Department of Homeland Security (DHS) formed and deployed a Mitigation Assessment Team (MAT) to the States of Iowa and Wisconsin to assess damage caused by riverine flooding from the 2008 Midwest floods. This report presents the MAT's observations, conclusions, and recommendations resulting from field investigations.

This chapter provides an introduction, a discussion of the event, and historical information and background on the MAT process. Chapter 2 presents a discussion of the codes, standards, and regulations that apply to construction in the floodplains of Iowa and Wisconsin. Chapters 3 and 4 provide a basic assessment and characterization of damages to noncritical and critical facilities. Mitigation programs including mitigation planning, grant programs, and flood insurance, and their application in Iowa and Wisconsin are detailed in Chapter 5. Chapter 6 presents the MAT's conclusions and discusses past mitigation successes, and Chapter 7 provides the MAT's recommendations. Appendices include acknowledgments, references, and acronyms/glossary of terms as well as recovery advisories detailing specific technical issues related to this event.

1.1 Midwest Floods – The Event

The Midwest has a long history of flooding, with major floods occurring several times over the last century including 1927, 1961, 1993, and 2007. Minor flooding is a regular occurrence. In June 2008, much of the Midwestern portion of the United States received over 12 inches of rainfall as several storm systems sequentially impacted the region. This rainfall exacerbated the existing saturation level of the soil from the wet conditions throughout the 2007–2008 winter and spring. The Midwest had experienced the wettest January–June period on record for 106 locations and from the second to fifth wettest for another 180 locations, causing the soil to be so saturated that additional rainfall quickly became runoff as the season progressed.[1] The National Oceanic and Atmospheric Administration (NOAA) issued a Spring Flood Outlook in March 2008 (Figure 1-1) noting evidence of ground saturation and above-normal flood potential across much of the Midwest including parts of Iowa as well as a potential for moderate to major flooding across parts of Wisconsin as a result of heavy winter snow combined with rain.[2]

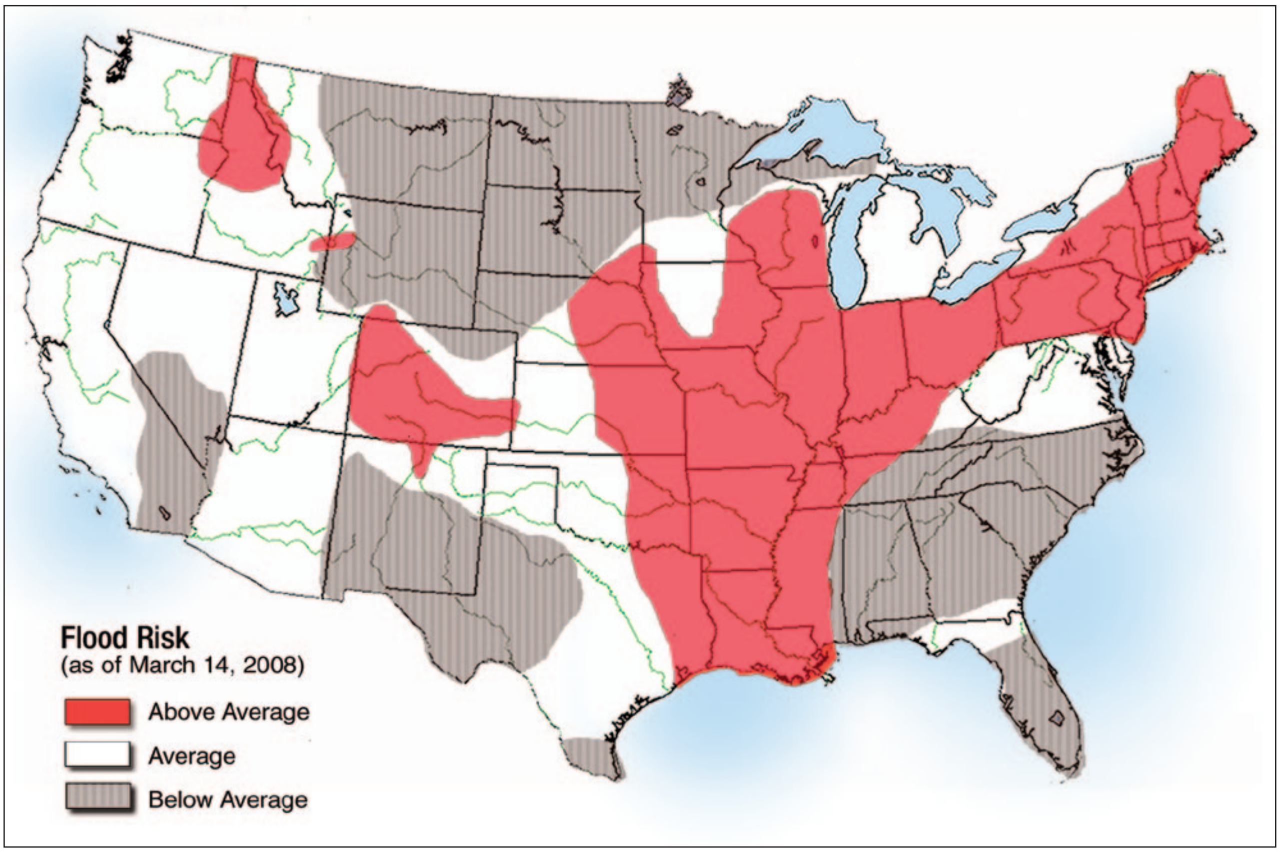

Figure 1-1. NOAA Spring Flood Outlook – March 2008
SOURCE: NOAA

1 National Climatic Data Center, Climate of 2008 Midwestern U.S. Flood Overview. July 9, 2008. http://www.ncdc.noaa.gov/oa/climate/research/2008/flood08.html

2 National Oceanic and Atmospheric Administration "*Current Major Flooding in U.S. a Sign of Things to Come.*" March 20, 2008. http://www.noaanews.noaa.gov/stories2008/20080320_springoutlook.html

When the rain fell in June, the vast majority of precipitation across the region was channeled directly into the lakes, rivers, and streams as runoff. Resulting streamflows reached historic highs across the Midwest, particularly in many areas of Iowa, southern Wisconsin, and northern Illinois. According to NOAA's Midwestern Regional Climate Center, precipitation across much of Missouri, Iowa, southern Wisconsin, central Illinois, southern Indiana, central Ohio, and northern Lower Michigan was more than 200 percent above normal for the month of June, exceeding 12 inches in much of the region (Figure 1-2).[3] Flooding began in early June, lingered for weeks in many areas, and broke historic records for flood levels. According to National Climatic Data Center estimates, the flooding across seven states in the Midwest killed 24 people[4] and many of these deaths resulted when people attempted to drive across flooded roads and bridges.

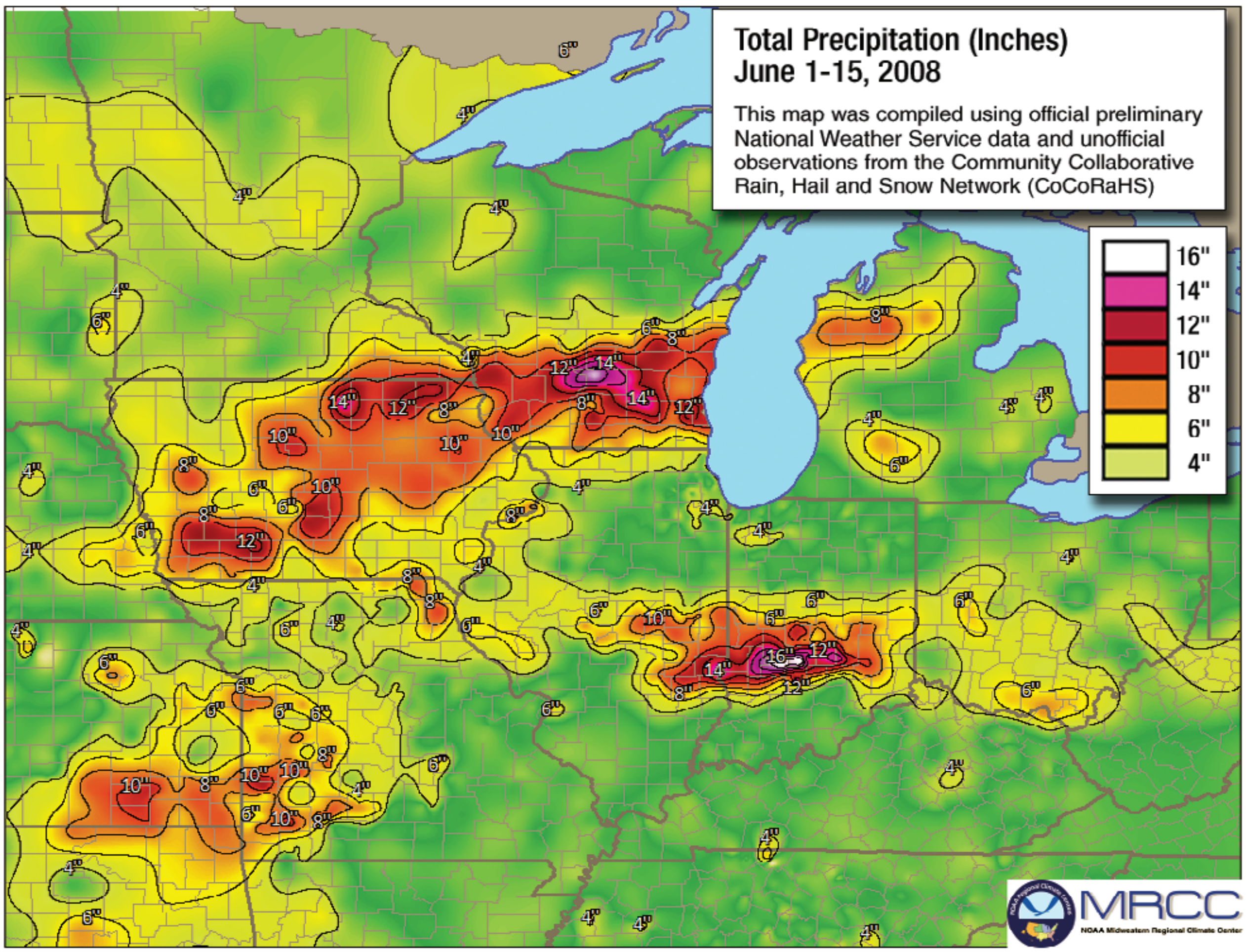

Figure 1-2. Total precipitation in the Midwest, June 1-15, 2008
SOURCE: NOAA MIDWESTERN REGIONAL CLIMATE CENTER

3 NOAA Midwestern Regional Climate Center, Midwest Overview – June 2008. http://mrcc.sws.uiuc.edu/cliwatch/0806/climwatch.0806.htm

4 National Climatic Data Center, Climate of 2008 Midwestern U.S. Flood Overview. July 9, 2008. http://www.ncdc.noaa.gov/oa/climate/research/2008/flood08.html

In Iowa, a presidential disaster declaration made on May 27, 2008, for severe storms and tornadoes was amended as a result of the June flooding. The presidential disaster declaration was increased from 4 counties to include a total of 85 counties as shown in Figure 1-3. A state disaster declaration by Iowa Governor Chet Culver included 86 counties. As a result of the flooding in Wisconsin, Governor Jim Doyle requested a joint federal/state preliminary damage assessment on June 10, and, as a result, 31 counties were declared as federal disaster areas as shown in Figure 1-4.

Flooding occurred even outside of mapped Special Flood Hazard Areas (SFHAs) (i.e., areas that have a 1-percent or greater chance of being flooded in any given year, also known as 100-year floodplains). Though the SFHA is used as the minimum regulatory area for National Flood Insurance Program (NFIP) purposes and floodplain development standards, the natural floodplain extends beyond this regulatory area and can be flooded in more infrequent events.[5] The emphasis placed on the SFHA often creates a misperception that flooding cannot occur outside of this designated area, which leads to a lack of awareness and preparedness for properties located outside of the SFHA on FEMA's Flood Insurance Rate Maps (FIRMs)[6] (refer to Section 1.2 and Table 1-1 for flood crest observation information).

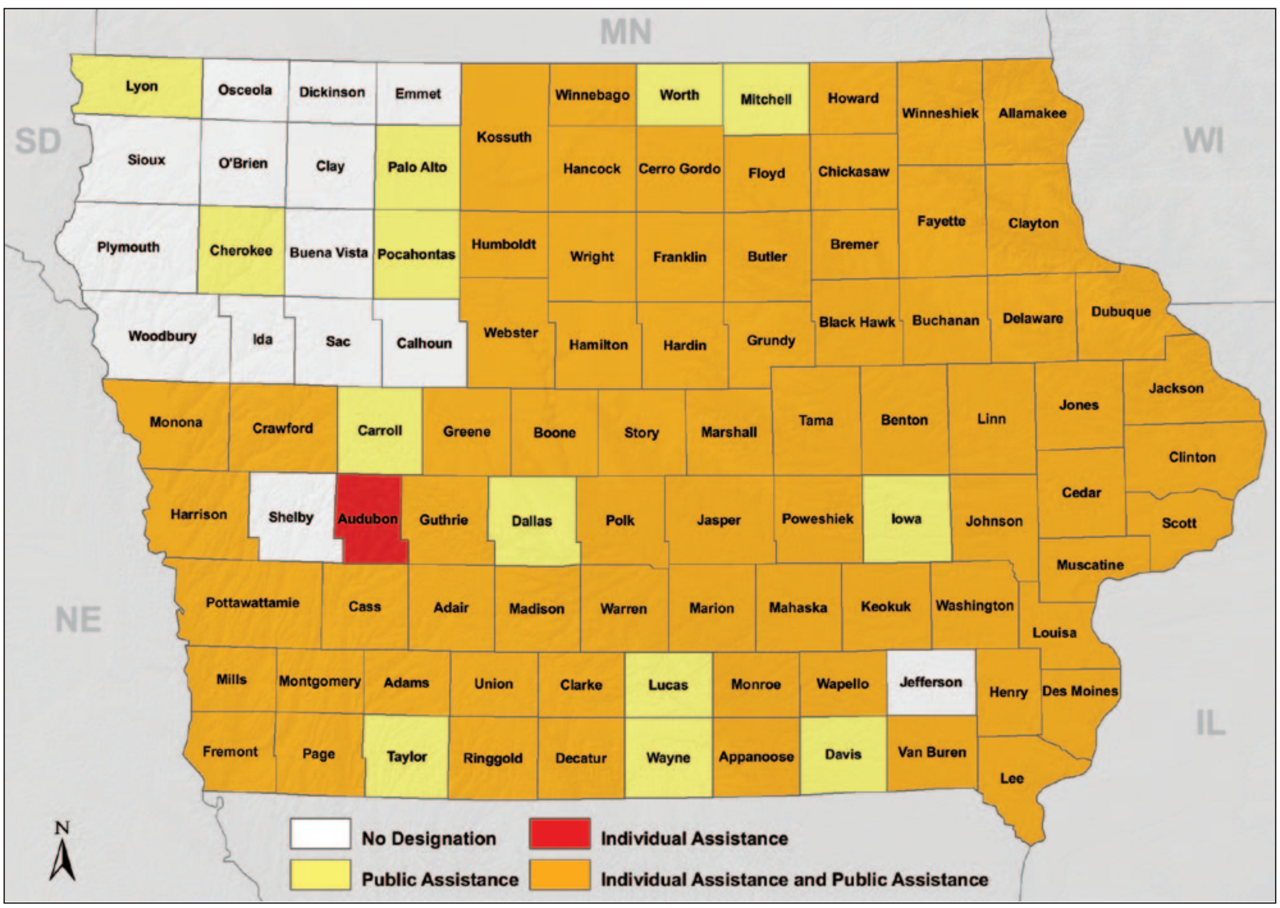

Figure 1-3. Iowa federal disaster declaration areas

5 FEMA 309, *Addressing Your Community's Flood Problems*. June 1996.

6 Montgomery, Malcolm K. and Lively, Francis P. *The Rising Tide – Flood Insurance in an Active Hurricane Era.* Winter 2006.

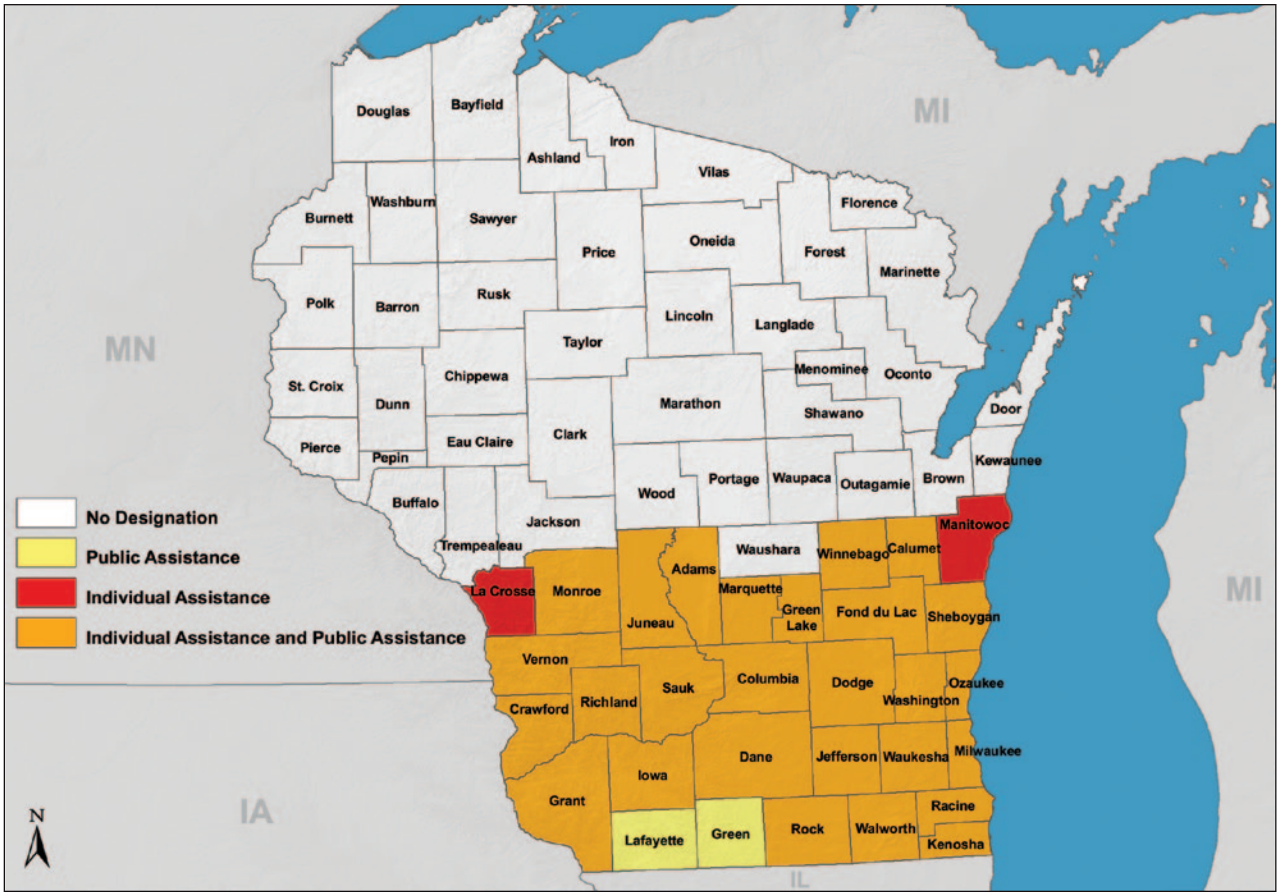

Figure 1-4. Wisconsin federal disaster declaration areas

Many homeowners, businesses, other building owners, and volunteers attempted to avoid flood damages in several ways. Most of the flood preparation efforts were ineffective in protecting against the flood; however, some techniques helped to significantly reduce flood damage including:

- Moving contents to higher floors
- Sandbagging around entrances of critical facilities, over manhole covers, and to build temporary dikes
- Pumping water out of buildings and critical facility sites before, during, and after rivers crested
- Using elevator pits for sumps at several locations
- Drilling drainage holes in floors and walls to relieve hydrostatic pressure by allowing water to pass through

In general, these techniques could not entirely protect against flood damage. Water that was higher than expected or coming in from unanticipated sources undermined remediation efforts, rendering them mostly futile. Surcharge of sanitary sewage systems can occur from a number of causes (as outlined in Section 1.1.1) and could have been anticipated from the conditions described above. However, as noted in the summary of damages, both frequent and costly damages occurred from sewer back-up that could have been prevented with appropriate preparation.

1.1.1 Summary of Iowa Flooding and Damages

The flooding experienced in Iowa during early June was record breaking in terms of water depths and discharges, with floodwaters reaching 0.2-percent-annual-chance levels in many locations (refer to Section 1.2 and Table 1-1 for flood crest observation information). Approximately 1.2 million acres of corn and soybeans were lost, nearly 10 percent of the tillable land in Iowa was under water, and estimated crop losses surpassed $3 billion.[7] Iowa highways were also impacted as 24 state roads, 20 highways including Interstates 80 and 380, and more than 1,000 secondary roads were closed at some point during the course of the flooding.[8] Iowa City was impacted as floodwater affected 304 residences across the city and caused significant damage to 19 buildings and some infrastructure elements at the University of Iowa campus. Wastewater treatment facilities in several cities were compromised. In addition, surcharge (i.e., more sewage and stormwater coming in than can be handled) resulted in sewer back-ups into toilets, sinks, and drains in schools, police stations, hospitals, and homes. This situation can occur from a number of causes. Even when sewage systems are entirely separate from stormwater systems, they are still not water tight and surface water can infiltrate the sanitary sewer system through cracks and small holes in pipes and manhole lids. Systems are most frequently surcharged when stormwater and sewage are combined. Discharges of stormwater into sanitary sewers (from rain leaders or other sources) is a common practice in some areas (however current design practices no longer permit this technique), but when this occurs it can also result in excessive flow into a sanitary sewer.

A timeline of the Iowa flood is presented in Figure 1-5.

7 *Agriculture and Environment Task Force Report To the Rebuild Iowa Advisory Commission,* Rebuild Iowa Office, August 2008. http://www.rio.iowa.gov/task_forces/ag-enviro/ag-enviro_report_08-2008.pdf.

8 *Flood Recovery and Reinvestment Plan*, City of Cedar Rapids, Iowa, March 3, 2009. http://www.corridorrecovery.org/city/plan.

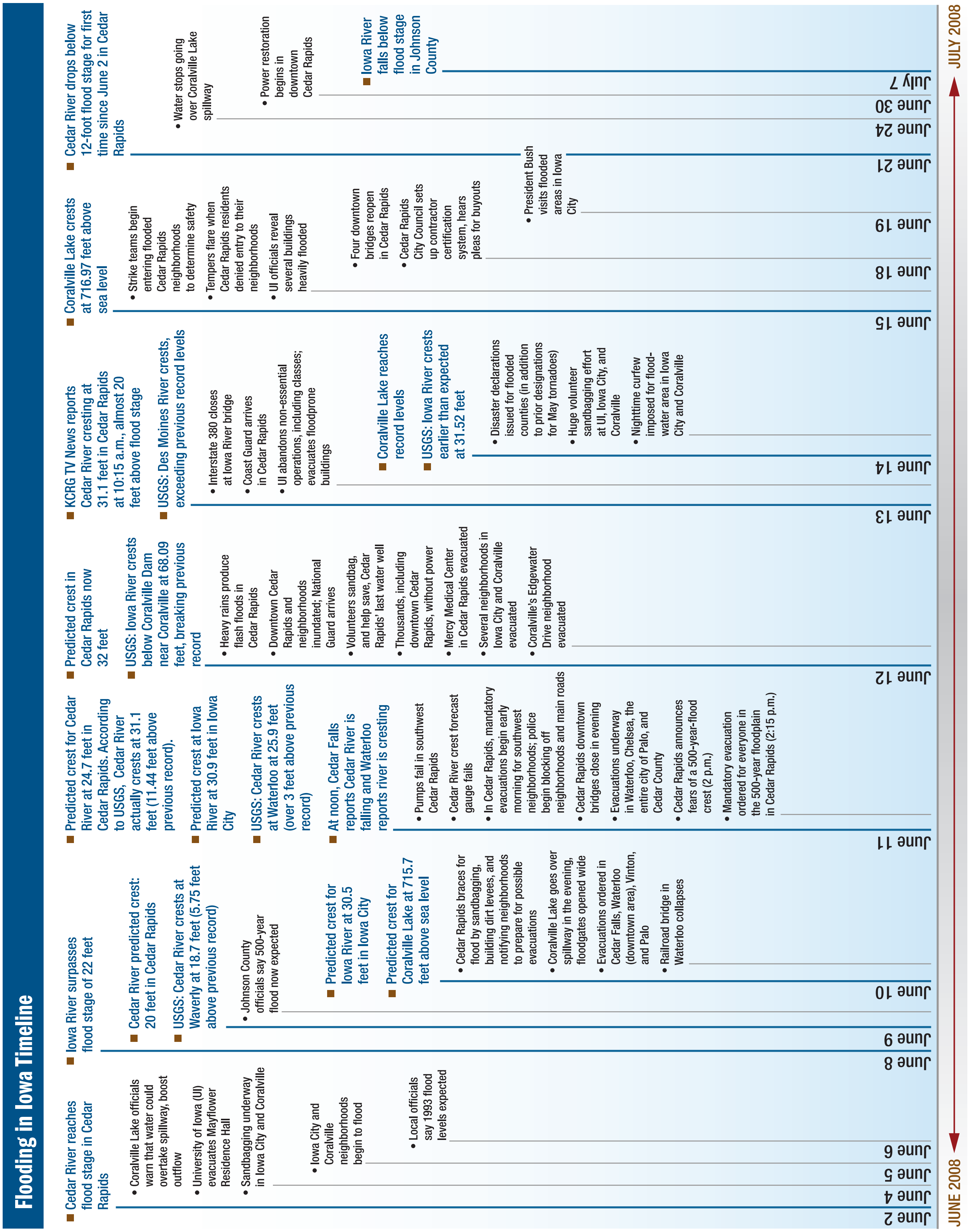

Figure 1-5. Iowa flood timeline

SOURCES: KCRG TV NEWS, USGS

In Cedar Rapids, a flood crest more than 12 feet above the previous record of 19.66 feet set in 1961 flooded areas well outside of the designated floodplain (Figure 1-6). A portion of the downtown area with several government facilities including City Hall is located on Mays Island in the Cedar River, which flooded (Figure 1-7). Levees were overtopped, flooding neighborhoods that were thought to be adequately protected. Three food manufacturing plants in Cedar Rapids (Quaker, Swiss Valley Farms, and Penford Products) were closed because of flood inundation to facilities as well as access roads. By June 23, floodwater was moving swiftly across overtopped banks and levees along the Cedar River. The City of Cedar Rapids reported over $5.4 billion in flood losses with inundation affecting 9.2 square miles, 1,300 city blocks, 3,894 single family residences, and 818 commercial properties and government buildings in this jurisdiction alone.[9] Structures such as the Linn County Sheriff's Office and Mercy Medical Center were subject to riverine flooding even though they were located outside of the 0.2-percent-annual-chance floodplain (also known as the 500-year floodplain) on the FIRM.

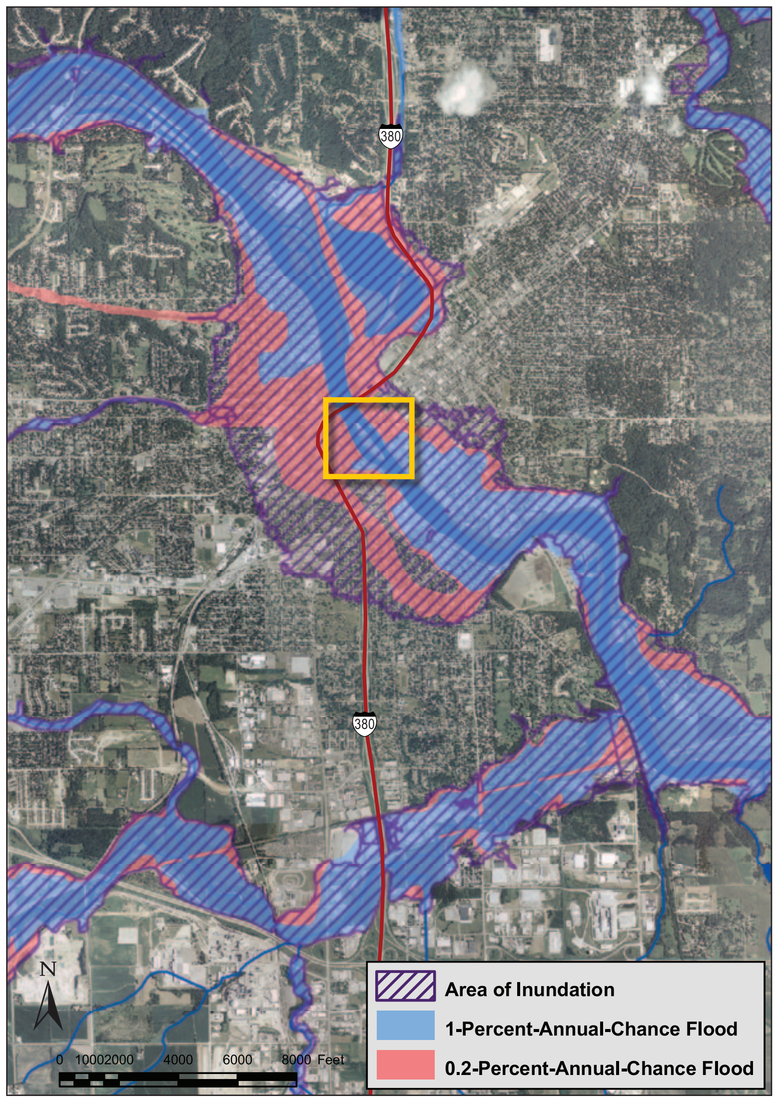

Figure 1-6.
Cedar Rapids, Iowa, areas of flood inundation. The downtown area, including Mays Island, is highlighted by the yellow box.

9 *Flood Recovery and Reinvestment Plan*, City of Cedar Rapids, Iowa, March 3, 2009. http://www.corridorrecovery.org/city/plan

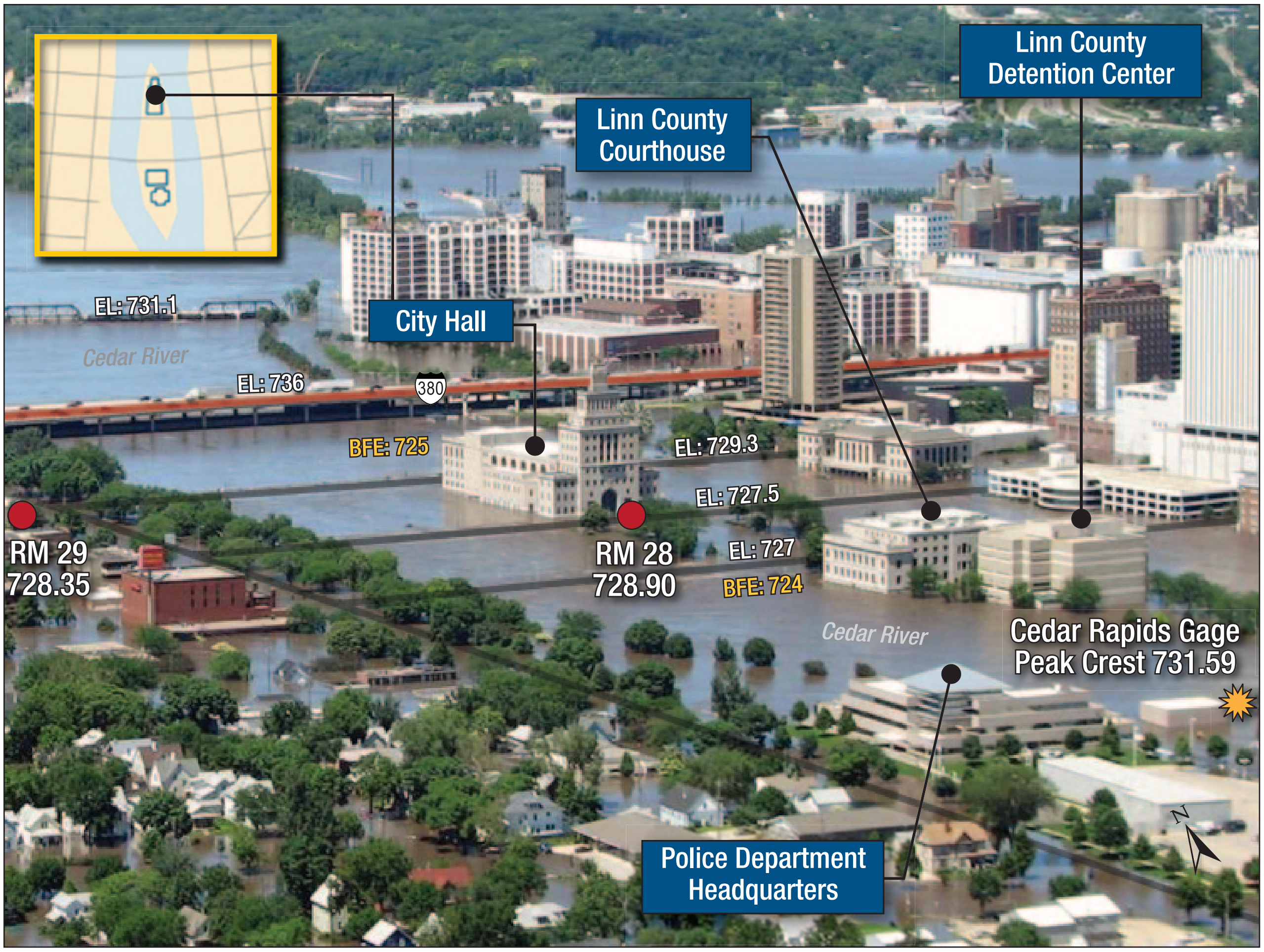

Figure 1-7. Inundation in Cedar Rapids, Iowa, exceeded 1- and 0.2-percent-annual-chance flood elevations.

1.1.2 Summary of Wisconsin Flooding and Damages

As a result of flooding across southern Wisconsin, hundreds of people were forced from their homes as several highways were closed and homes became inundated. The Rock, Kickapoo, and Baraboo Rivers were greatly impacted by the rainfall and experienced significant flooding, with floodwaters reaching 0.2-percent-annual-chance levels and breaking flood records in some locations (refer to Section 1.2 and Table 1-1 for flood crest observation information). Low-lying farm fields were inundated, and millions of dollars in crops were lost. Several manufacturing facilities impacted by the flood, including Tyson and Avalanche Organics, laid off workers. A timeline of the flooding in Wisconsin is presented in Figure 1-8.

DEFINITIONS

EL = Elevation Above Sea Level (Top of Deck for Bridges Shown)

RM = Reference Mark (FIRM Elevation Benchmark)

BFE = Base Flood Elevation. The BFE is the elevation of the 1-percent-annual-chance flood.

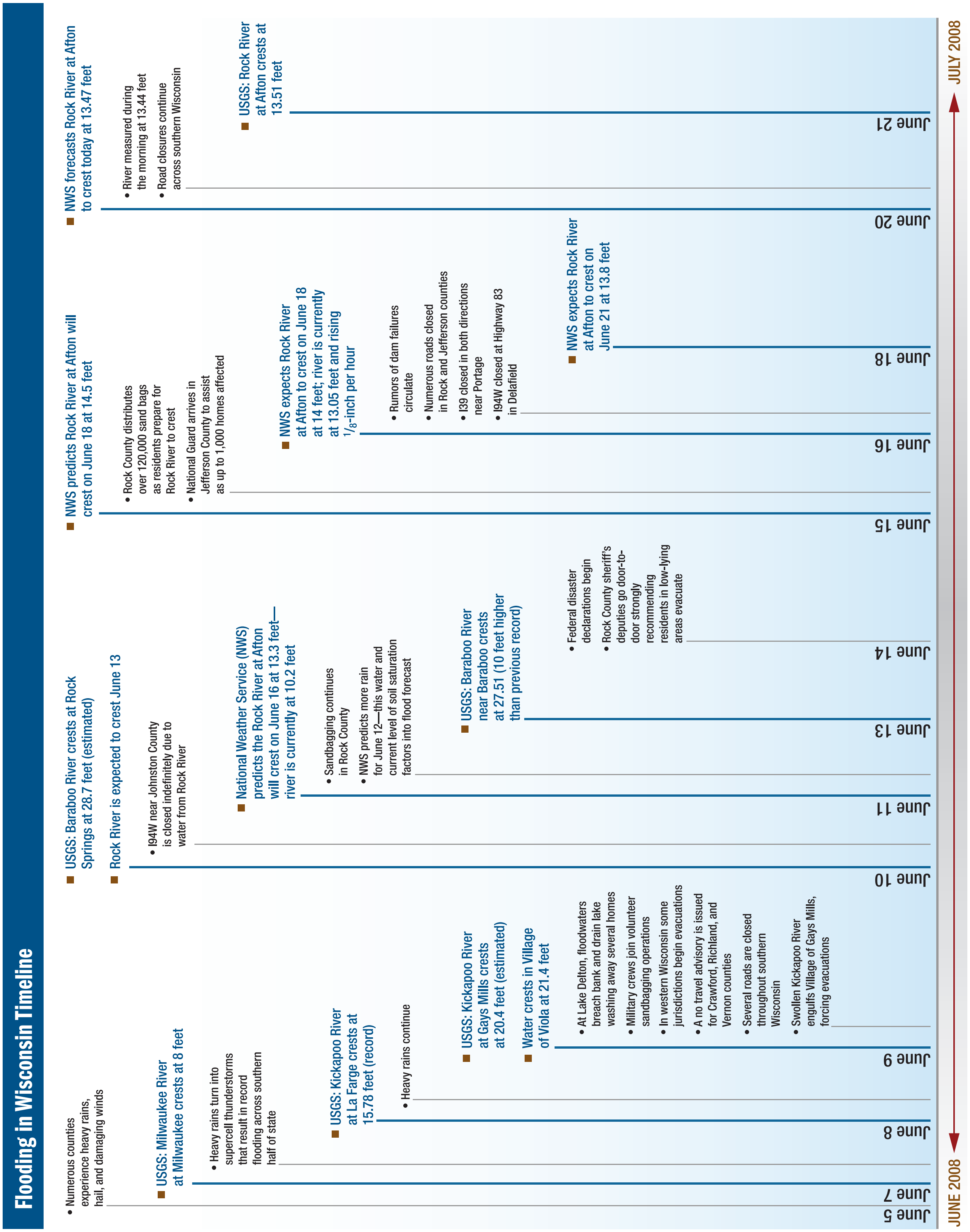

Figure 1-8. Wisconsin flood timeline

SOURCES: WCLO NEWS, USGS, WISCONSIN RECOVERY TASK FORCE REPORT TO THE GOVERNOR

Many areas in Wisconsin experienced record snowfall in early 2008 and with the spring rains, ground saturation was higher than average. With soil infiltration rates lowered, the volume of stormwater runoff increased. Older structures and developments were not designed to manage stormwater as well as they are today. Some structures experienced inches and others several feet of standing water. Sanitary sewer systems experienced high inflow and infiltration through cracks in the system, and sewer backups were reported in many critical facilities. Wastewater treatment facilities dealt with multiple complications: high inflow from stormwater infiltration exceeding plant operational treatment capacities, plant inundation from surface flows and riverine flooding resulting in a complete plant shutdown, and limited fuel and power capabilities needed to keep generators running and pumps operating at full capacity.

Most of the downtown area of Gays Mills was flooded in June 2008.[10] In August 2007, just 10 months before the June 2008 flood, the Kickapoo River had inundated the western portion of Gays Mills with record flooding. Several homes were awaiting pending buyouts and some businesses had not yet reopened when the new flooding occurred. Rock Springs was inundated by 7 feet of water throughout the downtown area. Figures 1-9 and 1-10 illustrate the scale of inundation across Gays Mills and Rock Springs in June 2008.

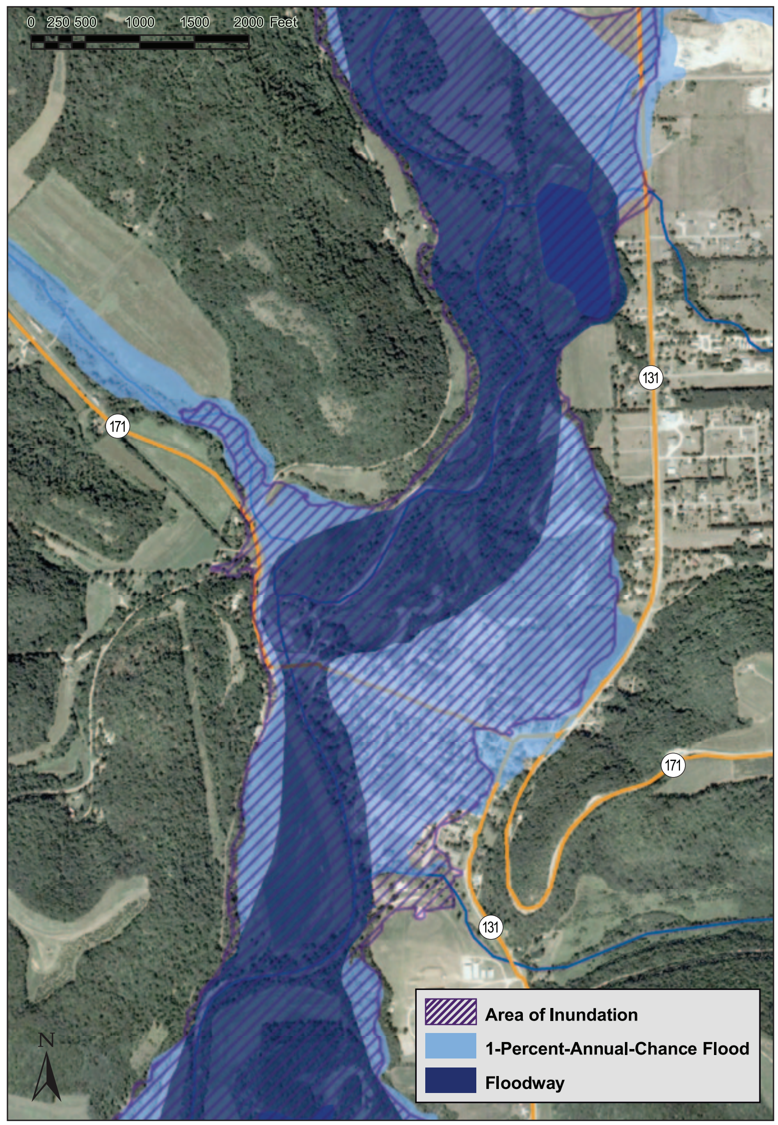

Figure 1-9.
Gays Mills, Wisconsin, areas of flood inundation

10 Wisconsin Recovery Task Force, Report to the Governor, November 2008.

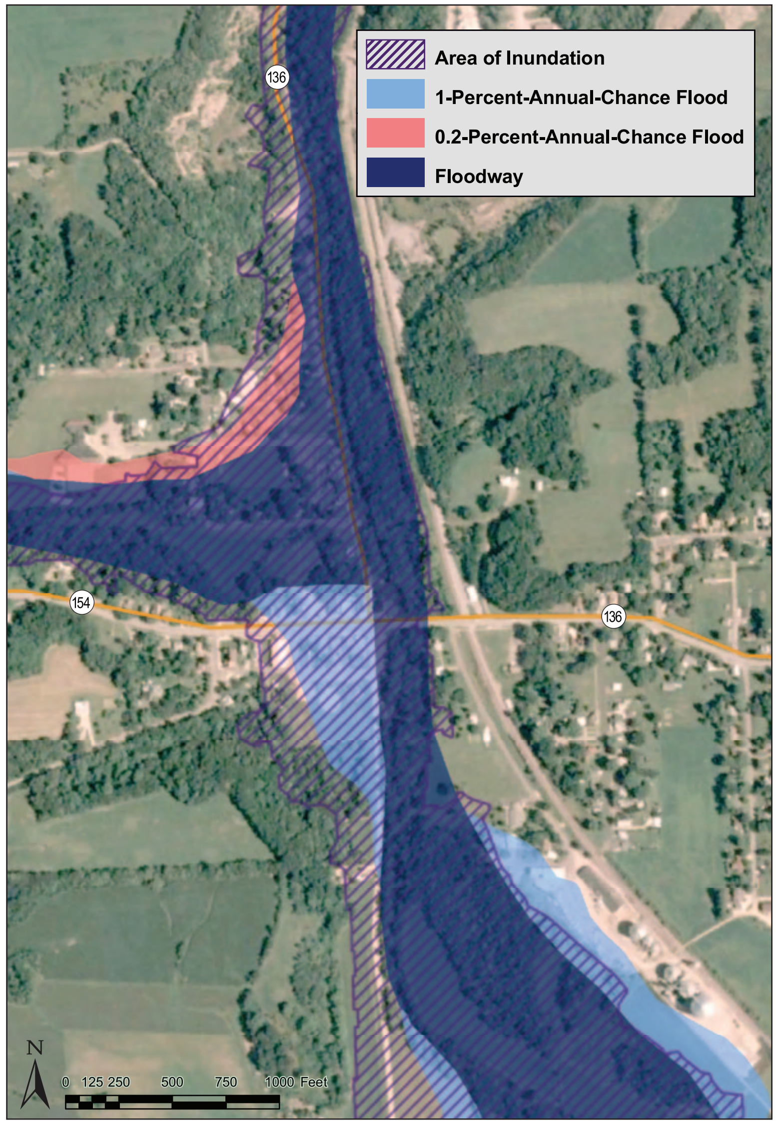

Figure 1-10.
Rock Springs, Wisconsin, areas of flood inundation

1.2 Flood Crest Predictions and Observations

As the Midwest braced for flooding in June, citizens monitored crest predictions as they made decisions on how to prepare. Although warnings and preparation activities took place, many residents found themselves confused by changing crest predictions as well as actual flood crest levels several feet higher than predictions.

Flood gauges located along streams and rivers monitored water levels periodically to gather data regarding rising floodwaters to be used by the National Weather Service (NWS) to predict crest levels. However, the preliminary crest estimates provided by the NWS were exceeded in several areas. As the flood grew larger, flood heights exceeded predicted levels, and many historical records were broken (Table 1-1). Figure 1-11 shows an example of a location where the observed recurrence interval is supported by the corresponding flood elevation provided in the Flood Insurance Study.

Table 1-1. USGS River Gauge Data for MAT Observation Locations in Iowa and Wisconsin

Stream and Place of Determination	MAT Observation Locations within 10 miles of Gauge	Maximum prior to June 2008 Flood			Maximum during June 2008 Flood				New record stage/ discharge set in 2008?
		Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge (cfs)	Estimated recurrence interval* (percent)	
IOWA									
Beaver Creek at New Hartford	New Hartford, Waterloo	06/13/1947	13.50	18,000	06/08/2008	15.71	25,900	0.2-1	Yes
Cedar River at Cedar Rapids	Cedar Rapids, Palo	03/31/1961	19.66	73,000	06/11/2008	31.1	150,000	<0.2	Yes
Cedar River at Janesville	Cedar Falls, New Hartford	07/22/1999	17.15	42,200	06/10/2008	19.45	53,400	0.2-1	Yes
Cedar River at Waterloo	Waterloo	03/29/1961	21.86	76,700	06/11/2008	25.39	105,000	0.2-0.5	Yes
Cedar River at Waverly	Waverly	04/14/2001	12.95	25,600	06/09/2008	18.7	49,200	<0.2	Yes
Des Moines River at 2nd Avenue, Des Moines	Des Moines	06/24/1954	30.16	60,200	06/13/2008	31.57	47,300	0.2-1	Yes
Des Moines River below Racoon River at Des Moines	Des Moines	07/11/1993	34.29	116,000	06/13/2008	35	117,000	0.2-1	Yes
Fourmile Creek at Des Moines	Des Moines	06/18/1998	15	5,600	06/09/2008	17.34	11,800	>2-4	Yes
Iowa River at Iowa City	Coralville, Iowa City	06/01/1851	24.1	70,000	06/14/2008	31.52	41,900	<0.2	Yes
Iowa River at Lone Tree	Columbus Junction	07/07/1993	22.94	57,100	06/15/2008	23.10	53,700	0.2-1	Yes
Iowa River at Wapello	Oakville	07/08/1993	28.1	111,000	6/14/2008	32.15	188,000	<0.2	Yes
Iowa River below Coralville Dam near Coralville	Coralville, Iowa City	07/19/1993	63.95	25,800	06/12/2008	68.09	40,800	<0.2	Yes
Shell Rock River at Shell Rock	Clarksville, New Hartford, Shell Rock	03/28/1961	16.26	33,500	06/10/2008	20.36	60,400	<0.2	Yes
Wapsipinicon River at Independence	Independence	05/18/1999	22.35	31,100	06/11/2008	18.86	23,700	>4	No

Note: Figures 1-13 and 1-14 show gauge locations with return intervals in relation to MAT observation locations

* By definition, the recurrence interval corresponding to a particular flood probability is equal to one divided by the flood probability. For example, the flood probability of 0.2 percent corresponds to the 500-year flood.

Table 1-1. USGS River Gauge Data for MAT Observation Locations in Iowa and Wisconsin (continued)

Stream and Place of Determination	MAT Observation Locations within 10 miles of Gauge	Maximum prior to June 2008 Flood			Maximum during June 2008 Flood				New record stage/ discharge set in 2008?
		Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge (cfs)	Estimated recurrence interval* (percent)	
WISCONSIN									
Baraboo River near Baraboo	Baraboo	03/26/1917	17.5	7,900	06/13/2008	27.51	18,000	<0.2	Yes
Kickapoo River at Gays Mills	Gays Mills	02/10/1966	16	10,600	06/09/2008	20.4	19,200-22,000	>1	Yes
Kickapoo River at La Farge	La Farge, Viola	07/01/1978	14.92	14,300	06/08/2008	15.78	22,100	0.2-0.5	Yes
Kickapoo River at Steuben	Gays Mills	07/03/1978	14.81	16,500	06/10/2008	19.16	28,700	0.2-0.5	Yes
Milwaukee River at Milwaukee	Milwaukee	06/21/1997	10	16,500	06/07/2008	8.07	10,400	4-10	No
Oak Creek at South Milwaukee	Milwaukee	08/06/1986	9.88	1,140	06/07/2008	11.56	2,370	<0.2	Yes
Rock River at Afton	Janesville	03/23/1929	11.81	13,000	06/21/2008	13.51	16,700	0.2-0.5	Yes
Rock River at Indianford	Janesville, Milton, Newville	04/05/1979	16.23	11,900	06/21/2008	18.33	14,900	1-2	Yes

Note: Figures 1-13 and 1-14 show gauge locations with return intervals in relation to MAT observation locations

* By definition, the recurrence interval corresponding to a particular flood probability is equal to one divided by the flood probability. For example, the flood probability of 0.2 percent corresponds to the 500-year flood.

Flood predictions varied widely in the days leading up to the floods, resulting in some confusion among residents and local officials. In Iowa City, river flow predictions jumped by as much as 10,000 cubic feet per second (cfs), or 33 percent, when an estimate calculation error was corrected in the final days before the flood. Significant preparation was required to protect the University of Iowa campus from flooding, and an entire day of preparation was lost as a result of the estimation error. The Johnson County, Iowa, Emergency Operations Center (EOC) worked with the University of Iowa to use HAZUS-MH (FEMA's loss estimation software) to develop estimates of potential impacts based on predicted crest levels to aid with planning and decision making, including the estimation of road closures, government building vulnerability, and displaced households. At the wastewater treatment facility in Reedsburg, Wisconsin, real-time flood level predictions were not available due to the absence of flood gauges. As a result, officials had to rely on information relayed to them by neighboring towns.

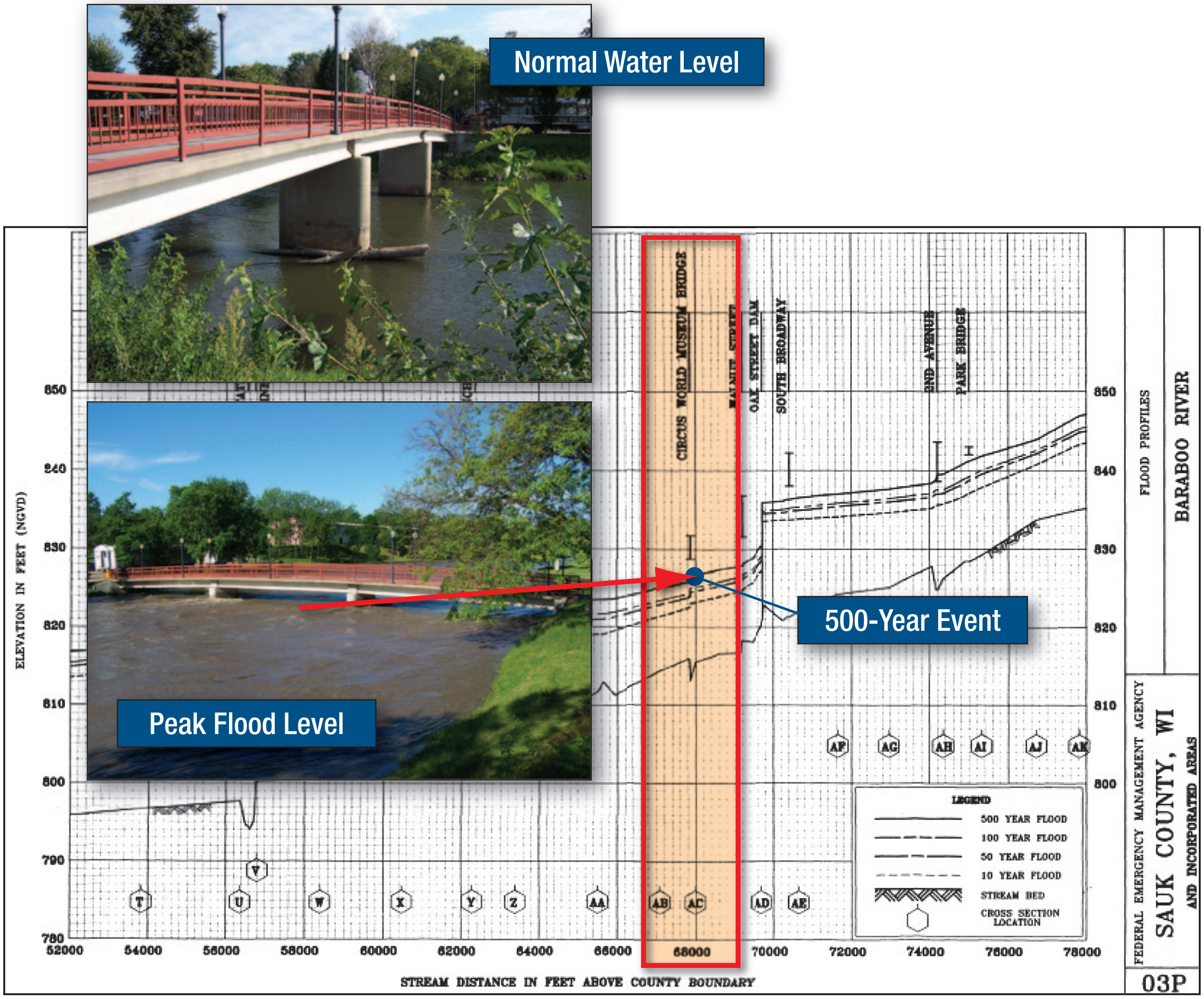

Figure 1-11.
Observed flood levels at the Circus World Museum Bridge along the Baraboo River, which were just below the estimated 0.2-percent-annual-chance flood elevation, validate the estimated recurrence intervals (Baraboo, Wisconsin).

According to the U.S. Geological Survey (USGS), the Cedar River at Cedar Rapids, Iowa, crested on June 11, 2008, at 31.10 feet (after increasing nearly 10 feet during the previous 24 hours), over 11 feet higher than the previous record of 19.66 feet set on March 21, 1961.[11] Only 48 hours before this record crest, the river had been projected to crest at 20 feet, and even on the morning of June 11, the crest was predicted to be only 24.7 feet, which is 7.7 feet lower than the actual flood crest level. At this location, the Cedar River was above flood stage for nearly two weeks. Several riverside neighborhoods, including some protected by a levee, experienced flooding of 10–12 feet, covering homes up to the rooflines. The Linn County Detention Center in Cedar Rapids was forced to implement an immediate evacuation of over 350 inmates as water began to enter the building and cover access bridge routes.

11 USGS Iowa Water Science Center. High Flow Statistics – Flood 2008. http://ia.water.usgs.gov/flood08/high_flow_stats.htm

In October 2008, the U.S. Army Corps of Engineers (USACE) convened a Rainfall-River Forecast Summit of representatives of the USACE, NWS, and the USGS. A public meeting was also held as part of the summit to elicit public comment. Summit participants concluded that significantly more rain fell than was predicted, resulting in record river flood stages that were not forecast with sufficient lead time to allow for appropriate emergency response preparations. Although the coordination and data exchange generally went well, it was concluded that discrepancies of reported data created forecasting challenges and raised doubts of forecast reliability. River gauges damaged or swept away by the floodwaters resulted in data gaps during critical periods. As a result, some river forecasts were inaccurate. Better coordination, communication, and collaboration, as well as more and better data measurements, were recommended by the summit participants.[12]

1.3 Economic and Social Impacts of Midwest Floods

Due to the extensive nature of the 2008 Midwest floods, Iowa and Wisconsin reported that impacted areas incurred billions of dollars in economic and agricultural losses, and many residents lost homes and suffered the social and psychological impacts of the disaster. Critical facilities across both states suffered interruptions and experienced significant losses, including water system facilities, city hall, police facilities (including detention cells), fire stations, schools, and libraries.

1.3.1 Loss Estimates

Cedar Rapids, Iowa, estimated that 18,623 persons were in the impacted flood area and approximately 5,390 residential properties were damaged or destroyed. As many as 1,500 properties were slated to be demolished, although only 71 were demolished within the first 6 months after the flood. Approximately 1,360 job losses resulted from the flood. Children and their parents were affected as 45 registered day-care providers were damaged as well as several schools, displacing 3,347 children. Eight cultural assets (e.g., museums, theaters, cultural centers) were displaced and/or destroyed.[13] Over 80,000 tons of residential debris had been collected and removed from impacted areas across the city by the end of 2008 at a cost of $9 million; the city estimates that, when removal is complete, the total volume of removed debris will likely be equivalent to filling four football fields. It is estimated that, at the time of the flood, only 36 percent of the residences in the SFHA that were impacted by the flood were insured through the NFIP, with total coverage at over $107 million.[14]

By April 2009, over 23,200 households in Iowa were approved for federal and state assistance totaling $121.5 million. Over $651 million was approved for public assistance projects to state and local government agencies.[15] By March 2009 in Wisconsin, over $55.6 million in federal and state disaster grants and over $48 million in loan assistance was obligated to individuals and business owners, and over $70 million was obligated for approved public assistance projects to state and local government agencies.[16]

12 Interagency Levee Task Force "U.S. Geological Survey—Rainfall-River Forecast Summit" in Raising the Standard, Oct./Nov. 2008 newsletter, available at http://www.iwr.usace.army.mil/ILTF/docs/ILTF_Newsletter_OctNov_08.pdf.

13 City of Cedar Rapids Corridor Recovery, April 2009. http://www.corridorrecovery.org/stats.asp

14 City of Cedar Rapids Corridor Recovery, April 2009.

15 Rebuild Iowa Office. "Facts and Figures." April 15, 2009. http://www.rio.iowa.gov/resources/facts.html

16 Gray, Roxanne. Wisconsin State Hazard Mitigation Officer.

1.3.2 Economic and Social Impacts

Many areas in Iowa and Wisconsin experienced economic impacts as a result of the floods. Cedar Rapids, Iowa, and the Lake Delton area of Wisconsin are two examples of areas that experienced significant economic losses to commercial businesses. In Cedar Rapids, Iowa, approximately 700 area businesses were damaged, destroyed, or suffered substantial economic loss as a direct result of the flood. Many businesses, especially in the areas directly adjacent to the Cedar River downtown, were forced to close for several months as the significant damage was repaired. In many cases, commercial businesses required significant personal expense to return to normal operations (Figure 1-12). In the tourism-reliant Wisconsin Dells area of south central Wisconsin, Lake Delton was severely impacted by the heavy and persistent rainfall in early June, which caused the land between the lake and the Wisconsin River to quickly erode and the 267-acre manmade lake to quickly empty into the nearby river on June 9. Erosion of the land between the lake and the river created a new channel, and, as a result, several homes were destroyed and many lake-based tourist attractions were inoperable causing significant income losses to the local tourism industry.

Figure 1-12. Downtown Cedar Rapids, Iowa was inundated by several feet of water in June 2008, causing significant business interruption losses and recovery time (Cedar Rapids, Iowa).

Disaster-stricken communities have often shown economic growth in the years following the event, due in part to recovery efforts that stimulate industries including clean-up, construction, and remodeling. However, this growth is not necessarily a good indicator of the actual economic activity that takes place after a disaster. Rick Mattoon of the Federal Reserve Bank of Chicago explains:

> In most cases the rebuilding merely replaces lost capital stock—meaning that, in the long term, the nation's product will not exceed what would have been produced without the disaster. While the immediate burst of economic activity is quite evident, the losses from the foregone output of interrupted and diminished business activity may go largely undetected because the diminished growth takes place in small amounts spread over many years.[17]

17 Assessing the Midwest Floods of 2008 (and 1993), Mattoon, Rick, Federal Reserve Bank of Chicago, July 10, 2008. http://midwest.chicagofedblogs.org/archives/2008/07/mattoon_flood_b.html

Following the 2008 floods, Iowa State University published a preliminary paper titled *Economic Impacts of the 2008 Floods in Iowa*[18] that outlines the expected social and economic impacts of the event. The paper considers four social categories in the Midwest that were affected: households, farmers, businesses, and communities. Families faced the loss of personal items, household goods, vehicles, and homes in addition to the possible loss of wages or even jobs. The floods affected corn and soybean acres so much that anticipated gross sales for Iowa's crop farmers might be as much as $1.5 billion less than it could have been based on preliminary calculations in June 2008. Business owners faced loss of inventory, sales, productivity, and profits. Many communities experienced a disruption in public service delivery including water and wastewater systems, public infrastructure repair, and clean-up activities, and it is expected that local property tax revenues might decline as damaged homes await repair or demolition.

Recovery prospects for any community depend on its relative health before the flood event. By June 2008, some households in the affected areas had already experienced economic stress due to higher fuel and food prices nationwide. Furthermore, people residing in floodprone areas tend to have lower than average incomes and fewer resources to aid recovery.[19] These two factors could result in lower homeownership rates throughout affected areas as post-disaster recovery takes place. Similarly, commercial districts in small communities were experiencing economic stress before the flood due to the profusion of larger regional trade centers. Without a wide economic base, these districts may have difficulty returning to pre-flood operation. Independent and locally owned businesses may also have a hard time resuming operation without the large support network of businesses owned or operated by large chains.[20]

1.4 FEMA Mitigation Assessment Teams

FEMA conducts scientific and engineering studies before and after disasters to better understand natural and manmade events impacting the built environment. These studies are conducted with the intent of reducing the number of lives lost to these events and minimizing the economic, social, and psychological impacts on the communities where these events occur. Additionally, lessons learned are applied to the education of residents and to the rebuilding effort after disasters to enhance the disaster resistance of new building stock and apply mitigation measures to existing buildings.

Since the mid-1980s, FEMA has sent MATs to presidentially declared disaster areas to evaluate building performance, assess damage, and provide recommendations to reduce future damage. Based on estimates from preliminary information about the potential type and severity of damage in the affected area(s) and the magnitude of expected hazards, FEMA determines the potential need to deploy MATs to observe and assess damage to buildings and structures caused by the

18 *Economic Impacts of the 2008 Floods in Iowa*. Iowa State University Extension, June 2008. http://www.econ.iastate.edu/research/webpapers/paper_12954.pdf

19 *Implementing Floodplain Land Acquisition Programs in Urban Localities*, The Center for Urban & Regional Studies, University of North Carolina at Chapel Hill, December 2003. http://people.vanderbilt.edu/~james.c.fraser/publications/Floddplain%20Project%20Report.Final.pdf

20 *Economic Impacts of the 2008 Floods in Iowa*

event. These teams are deployed when FEMA believes the findings and recommendations derived from field observations will provide design and construction guidance that will not only improve the disaster resistance of the built environment in the impacted state or region but will also be of national significance to regions exposed to similar hazards. Most past MATs have focused on coastal flooding and wind in relation to hurricane impacts. Riverine flooding occurs frequently across the United States, but, prior to the Midwest floods, it had never been the focus of a MAT. The Midwest flood disaster provided an opportunity for a MAT to formally evaluate a number of planning and building construction practices related to riverine flooding and to provide insight on the effectiveness of recovery and mitigation efforts that were undertaken after the 1993 flood.

1.4.1 Methodology

In response to requests for technical support from FEMA Joint Field Offices in Urbandale, Iowa, and Madison, Wisconsin, FEMA's Mitigation Directorate formed and deployed a MAT to Iowa and Wisconsin to evaluate both building performance during the flooding and the adequacy of current building codes, other construction requirements, and building practices and materials. Building performance issues including floodproofing, flood resistant materials, basement exceptions, elevations, and critical facilities performance were investigated. Effectiveness of mitigation measures and floodplain management practices were also reviewed. Additionally, the MAT was tasked with reviewing, updating, and developing mitigation educational materials for future use during disaster declaration activities.

The flood levels for this event in most impacted areas of Iowa and Wisconsin far exceeded the current minimum standard design flood event (i.e., the 1-percent-annual-chance flood event), as illustrated on the FEMA FIRMs, and there were occurrences of overtopped levees in some locations. This presented a unique opportunity to investigate long-term impacts of riverine flooding on structural and non-structural elements of buildings, as well as floodplain management issues.

A Pre-MAT was deployed to conduct the first field inspection; further refine FEMA's initial estimates of the types and extent of damage; and determine the value of the information likely to result from deployment of a MAT, and, if deployed, what the composition of the team should be. The Pre-MAT conducted preliminary field investigations to assess building conditions in flood impacted areas across Iowa between August 8 and 15, 2008. Based on damage information collected by the Pre-MAT, including joint FEMA-state Preliminary Damage Assessments (PDAs), the area of focus for the full MAT was more fully defined.

The full MAT was deployed to Iowa on August 15, 2008, for one week, conducting ground observations from Ames, Cedar Falls, Cedar Rapids, Clarksville, Coralville, Columbus Junction, Des Moines, Independence, Iowa City, La Porte City, New Hartford, Oakville, Palo, Shell Rock, Vinton, Waterloo, and Waverly, as shown in Figure 1-13. This figure also illustrates the estimated return period of the event for certain locations, where available.

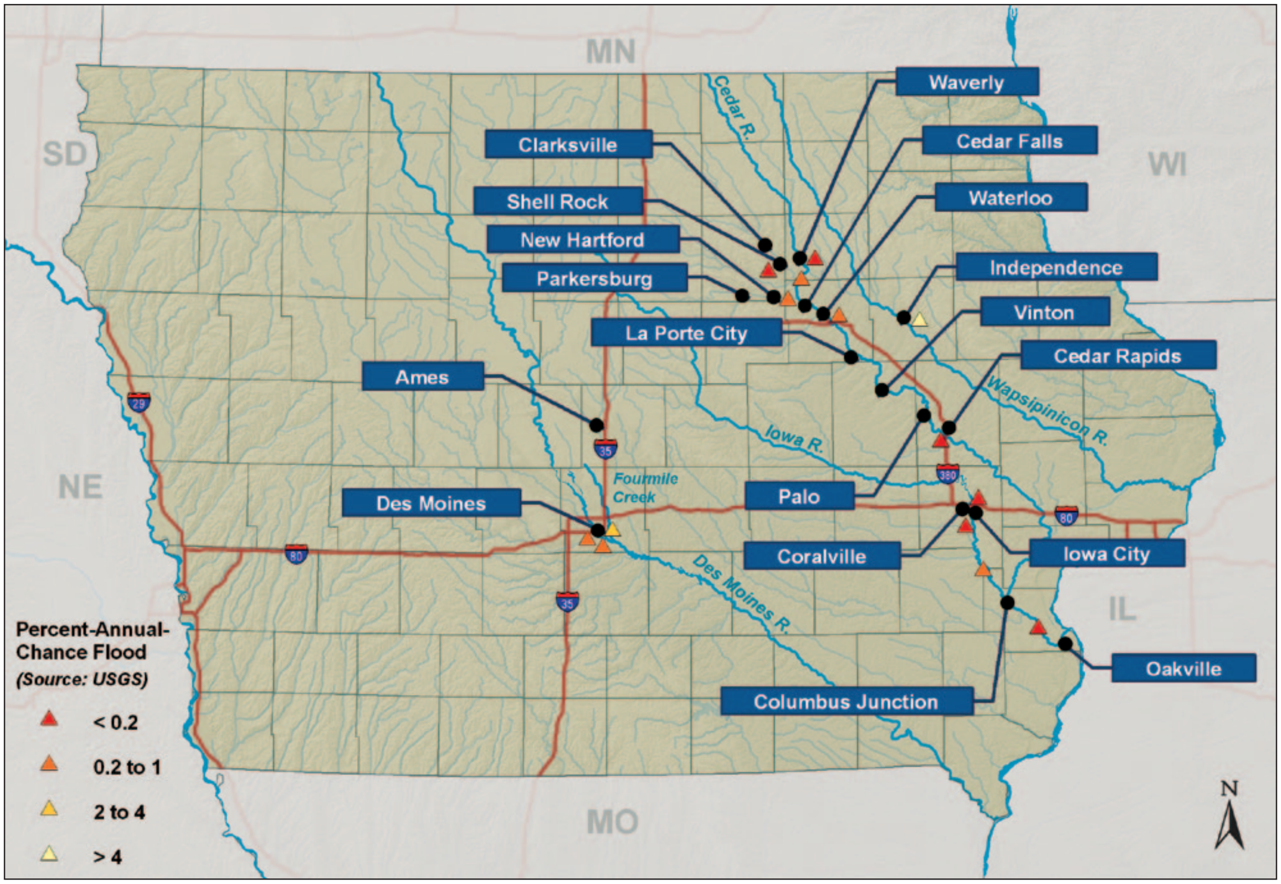

Figure 1-13. Iowa MAT field observation locations

Preliminary field investigations to assess building conditions in Wisconsin were conducted between August 13 and 22, 2008. Based on the data collected through the preliminary field investigations, the area of focus for the full MAT was more fully defined. The full MAT was deployed to Wisconsin on September 7, 2008, for one week, conducting ground observations from Baraboo, Blackhawk Island, Clark Creek, Elm Grove, Fond du Loc, Fort Atkinson, Gays Mills, Janesville, Jefferson, La Farge, La Valle, Lake Delton, Koshkonong, Milwaukee, Milton, Newville, North Freedom, North Shore, Oshkosh, Portage, Reedsburg, Richland Center, Rock Springs, Soldiers Grove, Spring Green, Viola, Wauwatosa, Wisconsin Dells, and Wonewoc, as shown in Figure 1-14. This figure also illustrates the estimated return period of the event for certain locations, where available. The MAT also visited Darlington to document lessons learned and success stories from previous floods.

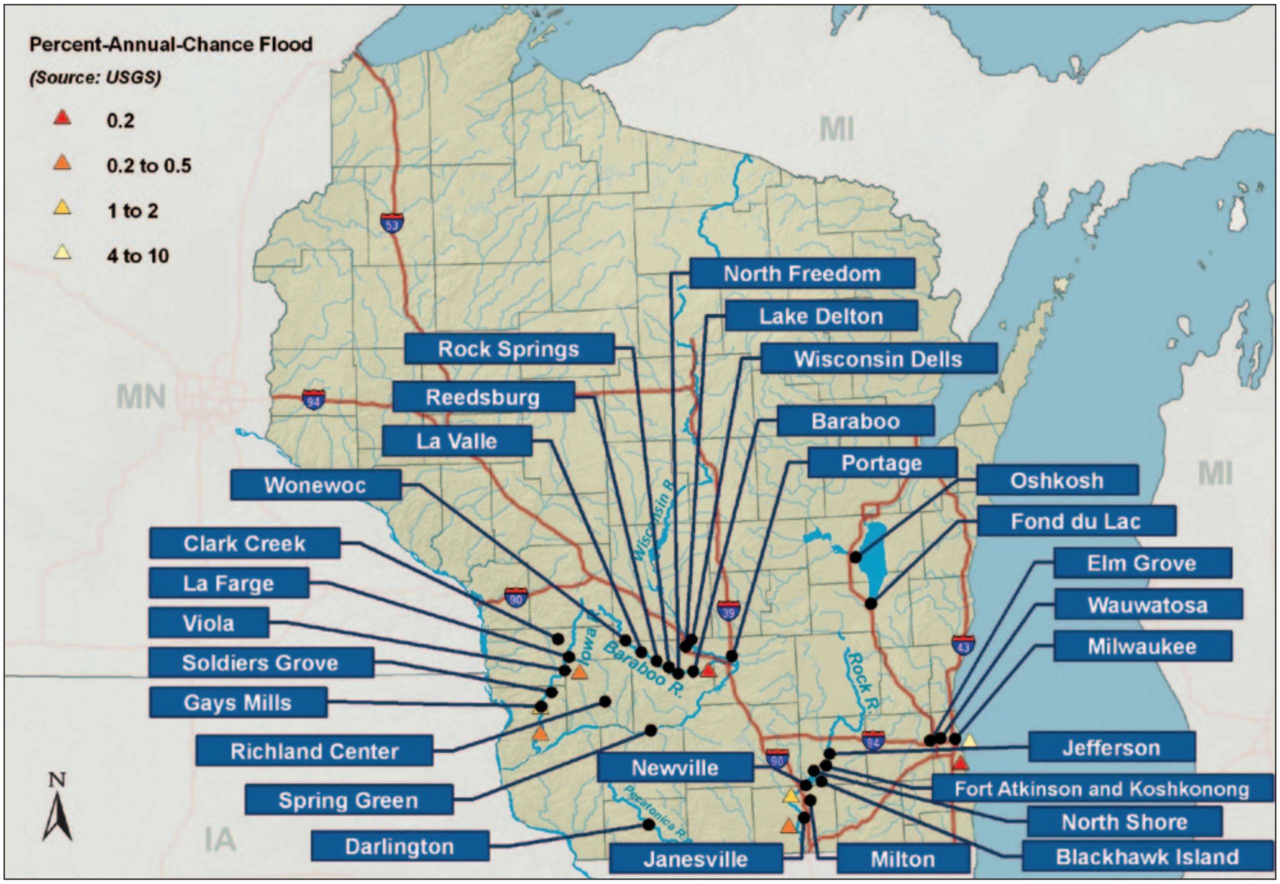

Figure 1-14. Wisconsin MAT field observation locations

Damages were observed to single- and multi-family buildings, manufactured housing, commercial properties, and historic buildings. Additionally, critical and essential facilities such as EOCs, fire and police stations, hospitals, schools, critical infrastructure (i.e., wastewater treatment facilities), and city halls were evaluated in order to document building performance as well as loss of function from flooding. Documentation of observations is presented in this report, including photographs and figures to illustrate successes and failures with expected building performance in the flooded areas.

The MAT's conclusions about observed damages are set forth in Chapter 6, and its specific recommendations for minimizing future damages from flooding are provided in Chapter 7.

1.4.2 Team Composition

The MAT included staff from FEMA Headquarters and FEMA Regions V and VII as well as experts from the design and construction industry. Team members included structural engineers, architects, civil engineers, building code experts, floodplain mapping experts, hazard mitigation planners, GIS specialists, and technical writers. In addition, representatives from the USACE, Colorado State University, the International Code Council (ICC), and the Institute for Business & Home Safety (IBHS) participated.