

Major Damages in Northern Illinois from a Record-Setting Rainstorm in 2010

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ABSTRACT

A record-setting July rainstorm fell in 24 hours in northern Illinois. Amounts exceeded 10 inches in northwest Illinois (rural) and northeastern Illinois (urban). Many rain amounts that fell in 3-, 6-, and 24-hour periods exceeded totals expected to occur only once in 100 years. Regional rivers quickly reached levels 3 to 10 feet above flood stages. Regional flooding affected 30,000 homes in the Chicago area, damaged crops and dairy farming, and damaged railroads and halted movement of trucks and trains in both areas. Property damages totaled \$184 million, much higher than the state's average flood loss of \$79 million. FEMA ultimately awarded \$320 million in aid, the largest amount ever awarded Illinois for any past storm disasters. The July storm losses and costs totaled \$620 million.

INTRODUCTION

Heavy rains fell in northern Illinois on July 23-24, 2010, creating severe flooding in many locales and major damages. The total rain was above 10 inches in extreme northwestern Illinois (Jo Daviess and Stephenson Counties) and in northeastern Illinois (Cook County), as shown in Figure 1. Rainfall exceeded 4 inches across northern Illinois from Carroll County eastward to Du Page and Cook Counties. Most locales received the heavy rainfall in 24 hours or less, and some places had amounts expected to occur only once in a 100-year period.

Most of the rain fell from the afternoon of July 23 until noon on July 24. The total storm rainfall pattern (fig. 1) shows two small areas where amounts exceeded 10 inches. These both occurred in 24 hours or less and the 100-year value for 24 hours is 8 inches (Huff and Angel, 1989), revealing the record-setting level of these amounts.

The heavy rains were the result of strong frontal activity. Northern Illinois, southern Wisconsin, and eastern Iowa were in and near frontal zones from midnight on July 22 until late on July 24. The resulting atmospheric instability created many storms and several mesoscale storm complexes across the 3-state area. A sizable convective system moved from Iowa into northern Illinois and southern Wisconsin producing rains exceeding 2 inches (fig. 1).

Rains began in northwestern Illinois early on July 23 and ended in the afternoon of the 23rd. Then, storms began again late on the 23rd and lasted until the morning of the 24th. In northeastern Illinois rains began on the afternoon of July 23 and ended by mid-day on July 24, largely a result of a strong south-moving cold front that pushed to the south, leaving stable atmospheric conditions in the Illinois storm areas.

The paper illustrates the rainfall patterns for various periods of time ranging from when the heaviest rainfall fell in 3 hours up to the storm totals. An evaluation of the rain amounts in a historic-statistical context is presented, followed by descriptions of the physical and economic impacts the heavy rains caused.

RAINFALL

The storm rainfall pattern across northern Illinois and parts of Iowa and Wisconsin is presented in figure 1. This shows two major heavy rain areas: one in northeastern Illinois, and one in northwestern Illinois. Rainfall exceeded 12 inches in an area west of Freeport, and an area of more than 10 inches fell in Chicago. The July 2010 storm's rain totals in Chicago and Rockford both rated as the third highest 24-hour amounts since records began in 1890.

Rainfall exceeding 10 inches fell over much of a 3-county area in northwestern Illinois, and a small area in Jo Daviess and Carroll Counties had more than 12 inches. The heaviest rain fell from midnight on July 22 until noon on July 23. This storm period produced amounts from 2 inches up to 6 inches in northwestern Illinois. A secondary heavy rain period began late in the evening on July 23 and continued until 7 AM on July 24. This second storm system produced 1 to 4 inches of rain in northwestern Illinois and also eastward across northern Illinois. Rain at Rockford in the first period was 5.1 inches and then 3.2 inches in the second rain period. The heavy rains also extended into extreme southern Wisconsin and eastern Iowa (fig. 1).

At most locations in Cook County the rainstorm began at 10 PM on July 23 and ended by 10 AM on July 24. Most of the rainfall fell in 14- or 15-hour periods. The heaviest rain fell along a narrow west-east path (fig. 1) with less than 6 inches in northern Cook county and less than 4 inches in the southern end of Cook County. As shown in figure 1, amounts in the suburbs west of Chicago ranged from 4 to 6 inches. The small area of heavy rain likely resulted from local urban effects on the atmosphere that enhanced the rainfall.

Figure 2 shows the heaviest 3-, 6-, and 12-hour rainfalls in Cook County. The data are from a dense network of 25 recording raingages in Cook County, and these data allowed a detailed time and space analysis of the heaviest rains in that area. All had their highest amounts in the center of Chicago. The heaviest rainfall at most raingages occurred in a 3-hour period. For example, gage 10, which had a storm total of 10.1 inches, had a peak of 4.6 inches in three hours, from 11 PM to 2 AM. This rates as a once in 100-year amount for 3 hours (Huff and Angel, 1989). A secondary peak at gages 8, 9, and 10 was 2.8 inches from 4 to 6 AM.

The storm totals in northwestern Illinois, where 8 inches or more fell in 24 hours, represented values expected at least once in 100 years. The areas of 10 to 12 inches were exceptionally high, setting local records and well beyond the 100-year frequency.

The frequencies of the heaviest rain amounts in 3-, 6- and 12-hour periods in Cook County (fig. 2) reveal that all rainfall in central Chicago had 100-year frequencies at all three durations, with lesser frequencies to the north and south. Amounts at gages 1 and 2 (north) and gages 24 and 25 (south) were only once in 2-year events.

IMPACTS

The major physical impact of the rainstorm was flooding of several streams and rivers in northern Illinois and areas alongside these rivers. The Illinois River reached well above flood stage by 8 to 11 feet all the way from Morris to Hardin where it joins the Mississippi. The Mississippi River became 2 to 5 feet above flood stage from Keokuk south to Cairo, Illinois. Localized rivers that flooded include the Rock River, which crested at 12.4 feet (2.4 feet above flood stage). Tributaries of the Rock also flooded including the Kishwaukee (crested 4 feet above flood stage), and Pecatonica (peaked 3 feet above flood stage). The Plum and Apple Rivers, which flow directly into the Mississippi, were also much above flood stage. In the Chicago area, flooding occurred along the north branch of the Chicago River, the Des Plaines River, Du Page River, and Fox River.

Damaging impacts occurred in four sectors. This included property losses, transportation damages, agricultural losses, and reduced retail sales.

Property losses occurred to homes, businesses, and vehicles in Chicago. Several suburbs southwest and west of the city had extreme flooding in over 30,000 homes. This included parts of Joliet, Orland Park, Romeoville, Hillside, Riverside, Cicero, Westchester, and Lemont (Chicago Tribune, August 4). Insured property losses totaled \$105 million. The insurance industry defines losses greater than \$25 million as a catastrophe; hence, the damages on July 23-24 were a catastrophe, creating major costs for several insurance firms. Property losses in the northeast area occurred along the four Chicago area rivers listed above. River flooding plus slow drainage in Chicago brought excessive house and building flooding, and the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) faced this major flooding with sewage stained waters and could not store it in its new tunnel and reservoir system. They estimated that 60 billion gallons of water had fallen over the city (Chicago Tribune, July 26). The MWRDGC chose to release 6.5 billion gallons of polluted flood waters into Lake Michigan to reduce the urban flooding, and the releases were through the Wilmette Channel and Chicago River Locks (Chicago Tribune, August 26). These polluted waters also led to beach closures for many days. Cicero sued the city over its flood losses, claiming the MWRDGC had failed to store and remove flood waters when needed (Chicago Tribune, August 4).

Property losses in northwestern Illinois occurred at farms and at communities along the Plum and Rock Rivers. Over 1,000 homes in this area were flooded (MRCC, July 20).

Surface transportation was damaged in both heavy rain areas. In Chicago and its suburbs more than 100 viaducts were flooded along with many roads and several highways,

collectively halting traffic for 2 to 3 days (Chicago Tribune, July 26). Several Metra commuter trains had to be cancelled on routes in the southwest and west of Chicago (Chicago Tribune, August 4). Hundreds of vehicles were flooded and badly damaged. Flooding in northwestern Illinois caused many state highways and rural roads to be overcome with water and most were closed for 2 to 3 days (MWRC, July 20). A highway bridge was washed out at Elizabeth (FarmWeek, August 2010).

Railroads in the northwest area suffered serious damages (Railroads Illustrated, October). In the northwest area the Canadian National mainline experienced a 200-foot long landslide that covered the tracks, and this line also had two track washouts. These damages stopped all trains for three days. A rush of flood waters on the Plum River washed out a railroad line and rail yards at Savanna (fig. 1), and many rail cars were knocked off the tracks. These fast waters also eroded a bridge support on Route 84 in Savannah, leading to a physical separation of the community. The flooding closed the mainline of the BNSF for two days halting 27 trains. The flooding also had detrimental effects on Amtrak passenger trains in the Chicago metropolitan area. Twelve trains scheduled to depart Chicago on July 24 were canceled, greatly altering passenger movements and creating a major loss of business. Thirty-two passenger trains heading into Chicago were delayed several hours. Many freight trains in northern Illinois carrying perishable foods to Chicago were halted by flooded right-of-ways. These train delays led to the loss of many perishable foods, creating sizable costly losses.

Agricultural losses resulted from the heavy rains and subsequent flooding in northwestern Illinois. Several dairy farms were closed for 4 to 5 days with no milk produced, and cows at two farms had to be moved to farms with high grounds to escape the deep waters in the fields and barns (FarmWeek, August). Many areas of farm land were flooded, damaging the corn and soybean crops in some areas and totally ruining the crops in 12 square miles (FarmWeek, September).

Flooded streets, highways, and viaducts in northeastern Illinois reduced efforts to shop. Hence, retail sales were reported down 45 percent for 3 days (Chicago Tribune, September 2).

Responses to the flood damages began when Illinois Governor Quinn declared 12 counties as disaster areas. Ten were in northwestern Illinois and two in the Northeast (Cook and DuPage). The Federal Emergency Management Agency (FEMA) assessed damages throughout the region. On August 19 President Obama declared seven counties to be disaster areas, making them eligible for funds to repair homes and businesses (Chicago Tribune, September 2). Persons with damages had to apply to FEMA for aid. These seven counties included Cook and DuPage (northeast), and Carroll, Jo Daviess, Ogle, Stephenson, and Winnebago in the northwest storm area. By August 25, FEMA had received requests for aid from 17,653 households. By August 25, FEMA had assessed losses totaling \$9.4 million and had awarded \$8 million. Several persons requesting assistance were refused with FEMA stating the residences were "livable" (Chicago Tribune, August 20).

By September 1 FEMA reported it had approved \$60.9 million in aid and had already distributed \$33 million (Chicago Tribune, September 7). After many loss uncertainty investigations, FEMA made delayed awards to complaining individuals (Chicago Tribune,

August 13). Also many persons sought state aid, and delivery of food stamps was delayed in most counties (Chicago Tribune, September 2). Massive lines of people were at several offices of the Illinois Department of Human Services in Cook County. The agency approved \$2.4 million in disaster food aid for 5,690 Illinois households.

FEMA had distributed \$75 million in disaster aid by September 3 (Chicago Tribune, September 3). More than 45,000 persons had applied for aid and the average package awarded was \$3,000. Another battle between damaged areas and FEMA developed in October when FEMA refused to provide aid to public institutions (cities and county agencies) in Cook and DuPage counties (Chicago Tribune, October 22) to repair damaged streets and public infrastructure. FEMA claimed the total losses in the two counties (average loss per resident) were not high enough to meet the \$3.23 per resident level set by FEMA. Although estimated losses were high in both counties (Cook=\$14.6 million and DuPage=\$935,000) their high populations kept the resident averages below the FEMA threshold. Governor Quinn appealed for a change but it was not made. The five other counties in the disaster declaration were given FEMA funding to repair damaged public institutions. Although these counties had less damage than Cook County, they had much lower populations and had an average above the FEMA limit of \$3.23 per resident. FEMA had provided \$278.7 million to private interests (households and businesses) in Illinois by October 22. Cook County got \$266 million in responses to 125,000 requests for aid.

The U.S. Department of Agriculture identified seven counties in northwestern Illinois as disaster counties. Low interest loans were made available for farmers experiencing physical damages and production losses (FarmWeek, September 20).

The economic impacts included losses and costs. The losses included those to property (\$105 million), to agriculture (\$34 million), and those to transportation systems (\$42 million). Losses totaled \$181 million. A study of flood losses in the United States during 1949-2007 found the average loss from a flood was \$79 million (Changnon, 2008), revealing that the July 2010 storm greatly exceeded the average.

The costs associated with responses to the July floods included federal relief (\$320 million), state relief (\$95 million), and local and state repairs to damaged infrastructure (\$26 million). The FEMA payment was \$320 million, the largest ever awarded to Illinois after a disaster (Chicago Tribune, November 26). Costs totaled \$441 million. The losses and costs of the July storm totaled \$620 million. The property losses (\$181 million) ranked as the 13th most damaging storm event in Illinois during 1949-2010 after adjusting from inflation over time. (Changnon, 2010).

SUMMARY

A major rainstorm occurred in parts of northern Illinois from late on July 23 to late on July 24, 2010. Near record 24-hour rain amounts came from storms generated in an unstable frontal zone lying across northern Illinois. The heaviest rainfall, >10 inches, fell in Illinois' northwest and northeast corners. Maximum rainfall amounts for 3-, 6-, 12-, and 24-hour periods in Chicago rated as once in 100-year events at several raingages.

The dimensions of this rainstorm in the Chicago area were found to match the location of the heaviest historical rainstorms in northern Illinois (Vogel and Huff, 1977). This outcome is partially due to the urban and lake effects on the atmosphere which act to increase rainfall over Chicago (Changnon, 1980).

The heavy rains resulted in some flash flooding and all the rivers in northern Illinois had levels that were 4 to 7 feet above flood stages. Impacts of the excessive flooding in the northwest were largely to rural areas, whereas those in the northeast were to urban areas. Northeast area rains were heaviest in Chicago where values exceeded 100-year frequencies. The flooding did extensive damages to property (houses, buildings, and vehicles) in the Chicago area. Flooding losses in the northwest were largely to agriculture, and losses to transportation systems occurred in both areas. Trains were halted for 2-3 days and rail lines were washed out and train cars derailed.

The major costly impact was to property in Chicago and several suburbs. Losses totaled \$181 million, and the highest cost was \$320 million in federal aid. This FEMA aid to Illinois was larger than in any previous storm disaster to the state. The total losses and costs from the storm was \$620 million

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Figure 1. Total storm rainfall for July 23-24, 2010.

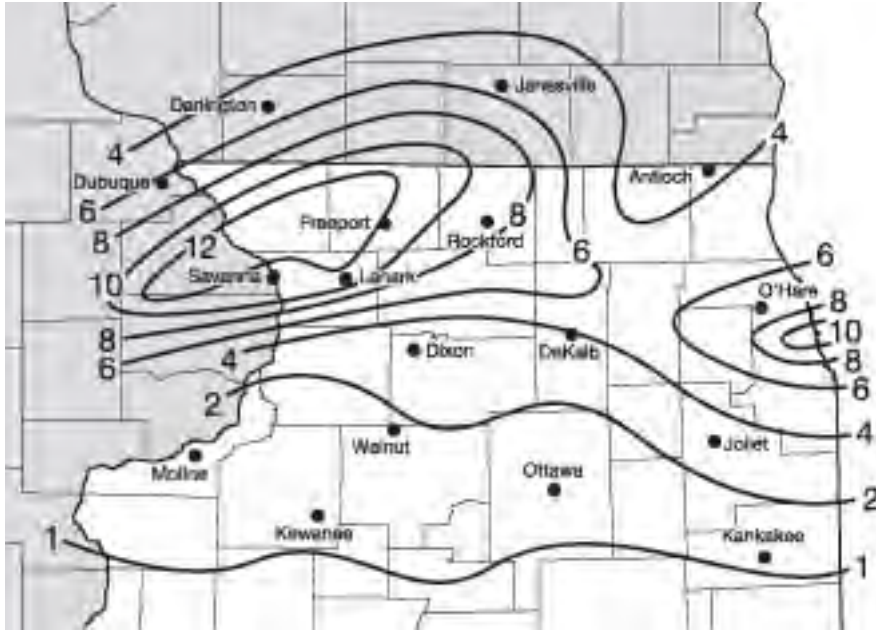


Figure 2. Maximum rainfall amounts for 3-, 6-, and 12-hours in the Cook County rain-gage network.

