

United States Flood Loss Report - Water Year 2010

Executive Summary:

Flood damages during Water Year 2010 (October 1st 2009-September 30th 2010) totaled \$5.04 billion. This was 67% of the thirty year average (1980 - 2009) of \$7.56 billion (adjusted to 2010 inflation). There were 112 flood-related deaths (119% of the 30 *year average of 93*). The fatalities this year include 43 vehicle related incidents and 71 can be attributed to flash flooding events.

The first major flood event of Water Year 2010 impacted the Northeastern United States in March. A series of slow moving spring storms dropped heavy rains over areas saturated by a heavy winter snowpack in New Jersey, Connecticut, Massachusetts and Rhode Island, causing approximately \$330 million in damage. In early May, the most catastrophic and deadly flood of the year hit the Nashville, Tennessee area killing 26 in Tennessee and Kentucky, and causing \$2.3 billion in damages. In early June, a flash flood awoke campers in the middle of the night in the Albert Pike Campground in Central Arkansas, killing 20 people and injuring 26. Meanwhile, persistent heavy rains battered the northern plains in Iowa and Wisconsin for much of June and July, resulting in widespread crop loss and property damage totaling over \$1 billion.

The hurricane season of 2010 mostly spared the U.S. coastlines from direct impacts; yet three systems still produced significant flood losses. In early July, torrential rains from Hurricane Alex and Tropical Depression #2, dropped 10-20 inches of rain over parts of South Texas, as 30 or more inches fell across the border in Mexico. Three lives were lost and \$110 million in damages occurred in the US. In September, Tropical Storm Hermine hit Texas resulting in another 6 fatalities and \$29 million in damages in Texas and Oklahoma. The last major event of Water Year 2010 came from the remnants of Tropical Storm Nicole along the Eastern Seaboard from North Carolina to New York, where flooding caused 7 fatalities, produced nearly \$20 million in property damage and \$70 million of crop loss.

See below for detailed summaries and associated flood losses for the most significant events during Water Year 2010. Additionally, a table of all flood losses by state is provided.

NWS Role in Flood Loss Statistics

There is no one agency in the United States with specific responsibility for collecting and evaluating detailed flood loss information. The National Weather Service (NWS), through its many field offices, provides loss estimates for significant flooding events. However, this task is ancillary to the primary mission of the NWS: *The National Weather*

Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. The NWS's primary focus is on predicting the events that lead to death and damage, therefore, the estimates provided here should only be considered approximations¹.

This report concerns itself with fresh water flooding, and does not account for coastal flooding related to cyclone related storm surge. An example of this distinction is Hurricane Katrina in 2005 where the majority of flood deaths were caused by storm surge, thus impacts were categorized separately from freshwater flooding (caused by rain and/or snow melt, dam or levee failures, and ice jams). Storm surge death and damages are not included in this report.

Detailed Major Event Summaries

Northeastern US Floods: March 2010

During March 2010, widespread river and areal flooding occurred over a large portion of the Northeastern US. The winter of 2009-2010 brought a moisture laden snowpack to portions of New Jersey, Western Connecticut and Western Massachusetts. An early spring thaw in mid-March melted snowpack and left soils saturated before a slow moving low pressure system, laden with Atlantic moisture, dropped an average of 3 to 6 inches of rain over parts of New Jersey during March 13-15. In Rhode Island and Eastern Massachusetts, two-day storm totals of 6 to 10 inches resulted in record, widespread flooding.

Two weeks later, with rivers still running high across much of Massachusetts and Rhode Island, warming temperatures upstream in northern Vermont and New Hampshire brought snow melt waters down the main stem of the Connecticut and Merrimack Rivers. Over a subsequent two day period, heavy rainfall of up to 10 inches compounded flooding along the Pawtuxet River in Rhode Island and the Sudbury River in Massachusetts, setting more flow records.

The flooding which ensued along the Passaic River Basin in Northern New Jersey, a densely populated region west of New York City, was described as the basin's worst flooding since April of 1984. Approximately 5800 homes and businesses were impacted.

In total, the March 2010 floods in the Northeastern US caused approximately \$330 million of damage across densely populated portions of New Jersey, Rhode Island,

¹ Pielke, Jr., R.A., M.W. Downton, and J.Z. Barnard Miller, 2002: *Flood Damage in the United States, 1926-2000: A Reanalysis of National Weather Service Estimates*. Boulder, CO: UCAR.

Massachusetts, and Connecticut. No fatalities were reported.

Tennessee and Kentucky Floods May 1-2, 2010

May began with two days of historic rainfall over much of middle Tennessee, and Kentucky. The heaviest rainfall stretched along the Interstate 40 corridor from Benton County to Davidson County in Tennessee, running through metropolitan Nashville. Some areas received nearly 20 inches of rain in this two-day period. Numerous rainfall records were broken at the Nashville International Airport, including the most rain received in a 6-hour period, highest calendar day rainfall, and wettest month, along with several others. Fifteen observation sites had rainfall measurements exceeding the maximum observed rainfall associated with Hurricane Katrina landfall. A two day total of 13.57 inches was recorded at Nashville International Airport shattering the *monthly* rainfall record for May which was 11.04 inches. NWS radar-based estimates also showed a large area of 16-20 inch totals stretching from Nashville towards Memphis.

Many area rivers exceeded their record crest levels, including the Harpeth River near Kingston Springs which rose to 13.8 feet above the previous record. The Cumberland River in Nashville hit a post flood control era crest of 51.86 feet, its highest level since flood control was implemented in the late 1960s, flooding parts of downtown Nashville.

A total of 26 fatalities and \$2.3 billion in damage occurred across Tennessee, Kentucky and Mississippi. Eleven of the fatalities and the majority of the economic impact occurred in the Nashville area, where 11,000 structures incurred major flood damage. \$220 million in damages were reported in the Opryland Resort alone, where 7 feet of water flooded 1.2 million square feet of the Opry Mills Mall. The Grand Ole Opry was closed for several months.

Albert Pike Campground, Arkansas: June 11, 2010

June 10th, a storm system moved from northeast Texas into southwest Arkansas. Before arriving, the system was responsible for significant flash flooding about 20 miles northeast of San Antonio Texas, where more than 10 inches of rain fell on June 9th. Several people were rescued from rooftops and evacuations were ordered. On the 10th, similar precipitation amounts closed roads in Tyler (northeast Texas) and resulted in numerous rescues across neighboring towns.

By the evening of June 10th, the storm system had brought two rounds of showers and thunderstorms to southwestern and central Arkansas. The highest intensity of rainfall occurred in the vicinity of a campground (Albert Pike Recreation Area) about 100 miles southwest of Little Rock where reports showed 6 to 7 inches of rain fell over a 24 hour period. Most of this rain fell in a few hours, in the evening and overnight into June 11th,

over steep topography which rapidly funneled flood waters down the Little Missouri River, directly through the campground. The river climbed almost 20 feet in just a few hours overnight, awakening 200 to 300 campers to a rapidly unfolding flash flood. Twenty fatalities, 26 injuries and \$9 million in damage resulted in a matter of minutes.

Oklahoma City: June 14, 2010

Up to 10 inches of rain fell across the Oklahoma City metro area on June 14th as rainfall rates averaged 1 to 2 inches per hour, with some thunderstorms producing rates near 3 inches per hour. The heavy rain accumulated quickly before and during the morning rush hour, stranding numerous cars in the rapidly rising waters. Will Rogers World Airport reported its largest daily precipitation since records began in 1891, with 7.62 inches. Even higher totals were reported over the north-central portion of Oklahoma City, where 9 to 12 inches were measured. Widespread urban and flash flooding ensued, resulting in 1 death, over 130 minor injuries, \$6 million in property damage and several interstate highway closures.

Eastern Alaska July 10-11th, 2010

Three to 4 inches of rain fell over the Fortymile River Basin in Eastern Alaska, near the town of Tok (300 miles northeast of Anchorage on the Alaska Highway) on July 10th and 11th. Flooding of the Fortymile River caused many washouts and mudslides on the Taylor Highway from Tok to Eagle Alaska. The river rose rapidly (nearly 20 feet in 24 hours) at the Taylor Highway Bridge, setting a record stage of 94.3 feet. This magnitude of rainfall over a relatively short period of time produced flash flooding, which is a rare phenomenon in Alaska. One fatality was associated with a vehicle found submerged along the Taylor Highway.

Iowa Floods, June and July 2010

Persistent heavy rains impacted Iowa and surrounding areas during the early summer, breaking several monthly precipitation records. Twelve to 16 inches were recorded at some locations, exceeding the most rainfall records for any calendar month. By late July, soils were primed for flooding as another round of heavy rains pounded Northeastern Iowa July 22-24th with an additional 8 to 12 inches. Record flooding resulted on the Maquoketa River and caused the failure of an earthen berm on the south side of the Lake Delhi Dam, about 40 miles west of Dubuque on July 24th.

In Iowa alone, approximately \$1 billion of damage to the corn and soybean crop was attributed to the rains. Estimates from the state and county extension offices indicated that about 10% of the crop was lost across the state. Agricultural losses continued to mount as the flooding this late in the planting season prohibited replanting waterlogged

fields.

At least half a dozen homes were swept away in the dam break flood near the town of Delhi, and much of the town of Hopkinton (a town of 700 about 10 miles downstream from Delhi) was evacuated. Flood damages from the event were estimated at \$50 million. Numerous properties were damaged along the river, including about 500 homes bordering Lake Delhi. No fatalities or serious injuries were reported.

Milwaukee Floods July 22-24, 2010

Further north in Wisconsin, the same pattern produced nearly 18 inches of rain breaking the record for the wettest two months (June and July) in the Milwaukee area. On July 22nd, the Milwaukee area was hit with thunderstorms which produced 5 to 8 inches of rain, with some locations reporting over 7 inches in just 2 hours. Widespread flooding resulted, with highways closed and cars stranded. One flood-fatality in Milwaukee County was reported and total flood losses for south-central and southeast Wisconsin totaled about \$27.7 million. The runways at Milwaukee Mitchell Field Airport were flooded and the airport was closed the evening of July 22nd.

Hurricane Alex, Tropical Depression #2 and the Rio Grande Floods July, 2010

The remnants of Hurricane Alex brought a large area of 10 to 20 inches of rain to the upper Rio Grande basin and mountains from July 1st through July 5th, 2010. On July 8th and 9th, 2010 Tropical Depression Number Two, brought additional significant rainfall to South Texas and the Rio Grande Basin.

Conditions across the border were also playing an important role. An estimated 30 inches of rain caused severe flooding in the city of Monterrey, in the Nuevo Leon province in México from June 30th through July 2nd. These flood waters drained into the Rio Grande, requiring a series of planned flood control actions to mitigate the impacts of river flooding downstream in the middle and lower Rio Grande Valley. Major river flooding began in early July and lasted for over a month.

On August 3rd, President Obama declared most counties in the Rio Grande Valley a Major Disaster, eligible for federal funding to assist with the longer term recovery. After nearly a month and a half of flood impacts, 3 lives were lost and damages totaled over \$110 million, of which \$70 million were directly attributed to the Rio Grande.

Tropical Storm Hermine, Texas and Oklahoma September 6-9, 2010

Tropical storm Hermine made landfall near the Texas-Mexico border on the night of

September 6th, and moved north where it affected populated portions of Texas including the Austin and Dallas areas. Flooding began in South Central Texas on September 7th where widespread rains of eight to 12 inches over two days which affected much of the Interstate-35 corridor from Austin to San Antonio. Northern portions of the Austin area sustained the heaviest rains, especially the town of Georgetown, 30 miles north of Austin, where 16.37 inches fell during the two day event. Further north, on the morning of September 9th, the flooding hit portions of Oklahoma. Rainfall rates of over 2 inches per hour and one day rainfall totals of 8 to 14 inches across East Central Oklahoma led to widespread flash flooding.

In the town of Killeen, area residents were evacuated and numerous cars with occupants became submerged resulting in one fatality. Homes near the towns of Elms and Robinette had to be evacuated by boat. In Nolanville, a car was swept away, and a mobile home park was evacuated resulting in the rescue of 35 to 40 people. Seventeen businesses and 26 residences were affected by the flood waters in the city of Belton. Closer to the Dallas metro area, a motorist was swept away and drowned near the town of Alvarado. Emergency officials performed numerous swift water rescues and many roads were closed due to the high water throughout the area. A 19-yr old male drowned on the morning of the 9th as he tried to drive through water over a low water crossing seven miles south of Stilwell in Adair County, Oklahoma. Several small bridges and low water crossings were washed out.

All together, flash flooding from Hermine's intense rainfall killed 6 and caused \$29 million in damages across Texas and Oklahoma.

North Carolina and Eastern Seaboard Remnants of Tropical Storm Nicole, September 29th-October 1st, 2010

A low pressure system formed along a stationary front off the Carolina Coast on September 29th and moved north towards Pennsylvania and New York State over the next two days. This low was able to ingest tropical moisture associated with dissipating Tropical Storm Nicole, pouring large quantities of rain over two days along the Eastern Seaboard.

Soils In North Carolina were already saturated from heavy rain the previous few days before this system dropped a total of 6 to 8 inches over the Outer Banks and 12 to 20 inches over the main-land areas. Further north in Philadelphia's western suburbs two day totals averaged 5 to 10 inches causing major flooding, described in some areas as the worst flooding since Hurricane Floyd in 1999. In the Catskills of New York State, 6 to 8 inches of rain over two days.

In North Carolina, significant flash flooding developed leading to 5 fatalities. \$70 million of local crops were also lost in the floods.

One woman drowned on the morning of October 1st after she drove into flood waters of the Skippack Creek near Evansburg State Park, 30 miles northwest of Philadelphia. In the Catskills of New York State, a motorist was swept away by a flooded creek and found the next morning along the shore of a local reservoir.

All together, flooding from this storm killed 7, produced nearly \$20 million in property damage and \$70 million of crop loss.

FLOOD DEATHS AND DAMAGES BY STATE

Water Year FY 2010

State	Damages (Thousands of Dollars)	Deaths
Alaska	\$6,160	0
Alabama	\$7,241	0
Arkansas	\$108,352	24
Arizona		2
California	\$14,177	2
Colorado	\$26,394	0
Connecticut	\$1,200	0
District of Columbia	\$10,990	0
Delaware	0	0
Florida	\$55	0
Georgia	\$599	0
Hawaii	\$1,663	0
Iowa	0	1
Idaho	\$1,255,496	0
Illinois	\$4,119	2
Indiana	\$304,511	0
Kansas	\$303	0
Kentucky	\$952	7
Louisiana	\$28,309	2
Massachusetts	\$33,204	0
Maryland	\$164,008	0

Maine	\$10	0
Michigan	\$3,499	0
Minnesota	\$5,050	0
Missouri	\$82,333	8
Mississippi	\$4,591	1
Montana	\$19,743	0
North Carolina	\$2,329	6
North Dakota	\$76,425	0
Nebraska	\$5,235	1
New Hampshire	\$22,000	0
New Jersey	\$9,911	0
New Mexico	\$78,600	1
Nevada	\$3,803	0
New York	\$53	0
Ohio	\$5,056	5
Oklahoma	\$13,546	3
Oregon	\$7,105	0
Pennsylvania	\$20	1
Puerto Rico	\$2,130	4
Rhode Island	\$2,925	0
South Carolina	\$87,850	0
South Dakota	\$434	0
Tennessee	\$4,230	22
Texas	\$2,336,531	15
Utah	\$193,341	0
Virginia	\$9,461	1
Virgin Islands	\$7,537	0
Vermont	0	0
Washington	\$232	0

Wisconsin	\$1,033	1
West Virginia	\$53,119	3
Wyoming	\$23,345	0
American Samoa	\$12,017	0
Guam	0	0
TOTAL	\$5,041,227	112