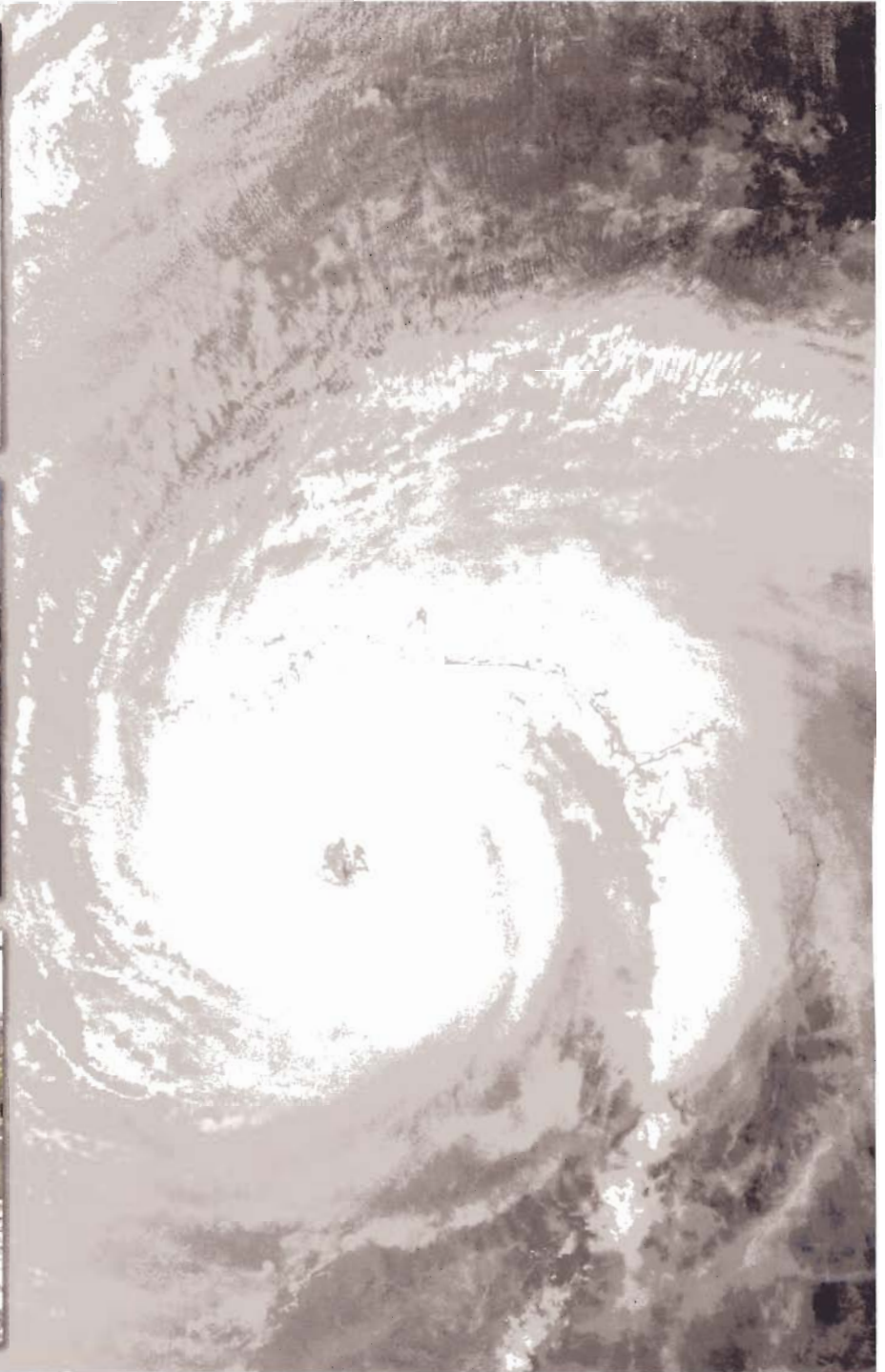


Tropical Cyclone Flooding A Deadly Inland Danger



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service
March 2005



**American
Red Cross**



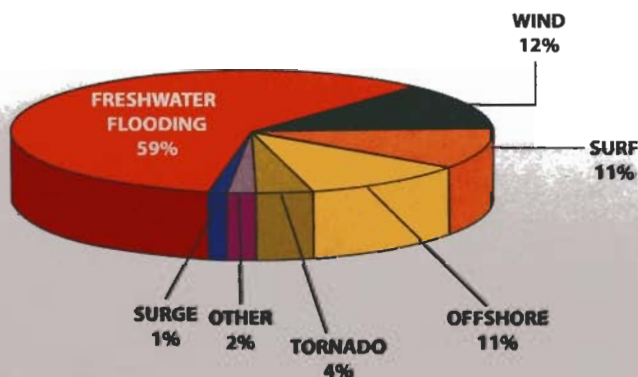
FEMA

What You Need to Know about Inland Flooding

When it comes to tropical cyclones (a generic term for a hurricane, typhoon, or tropical storm), wind speeds do not tell the whole story. Intense rainfall, not directly related to the wind speed of a tropical cyclone, often causes more damage. Just ask the citizens of Richmond, Virginia.

In late August 2004, decaying Tropical Storm Gaston traversed through the Carolinas and into southern Virginia. Although its circulation had lost much of its strength, Gaston remained a dangerous storm as more than a foot of rain fell over Richmond in a few hours, causing major flooding. Five people died, many houses and businesses were destroyed, power was lost, and Interstate 95 was flooded for more than 24 hours, prohibiting ground transportation on a major East Coast highway. The event was declared a natural disaster by

Deaths caused by the effects of tropical cyclones in the U.S. since 1970



Since the 1970s inland flooding has been responsible for more than half of all deaths associated with tropical cyclones in the United States.

“During the 20th century, floods were the number-one natural disaster in the United States in terms of the number of lives lost and property damage.”
March 2000, U.S. Geological Survey



Storm surge from Hurricane Isabel at Rock Hall, Md, Sept. 2003

the President.

Factors Affecting Inland Flooding

Forward Speed – Slower moving tropical cyclones allow heavy rain to persist over a location.

Orography – When warm, moist tropical air is forced up hills and mountains, the rain is intensified.

Intersection with other weather features – The remains of hurricane Agnes (1972) merged with another mid-latitude storm, producing major floods in the northeast U.S.

Antecedent conditions – The wetter the soil and the higher the water level in streams, rivers, ponds, lakes, and reservoirs, the greater the severity of flooding.

Tropical cyclones usually cause both flash and river flooding.

Flash Flooding occurs in creeks, streams, and urban areas within a few minutes or hours of excessive rainfall. Rapidly rising water can reach heights of 30 feet or more. Streets can become swift moving rivers and underpasses can become death traps.

River Flooding occurs from torrential rains associated with decaying hurricanes or tropical storms. River floods can last a week or more.

Inland fresh water flooding disasters due to tropical cyclones are all too common.

2002 Tropical Storm Fay produced heavy rainfall and inland flooding across the upper Texas coastal area. Rainfall totals of nearly 2 feet destroyed homes, businesses, and public facilities.

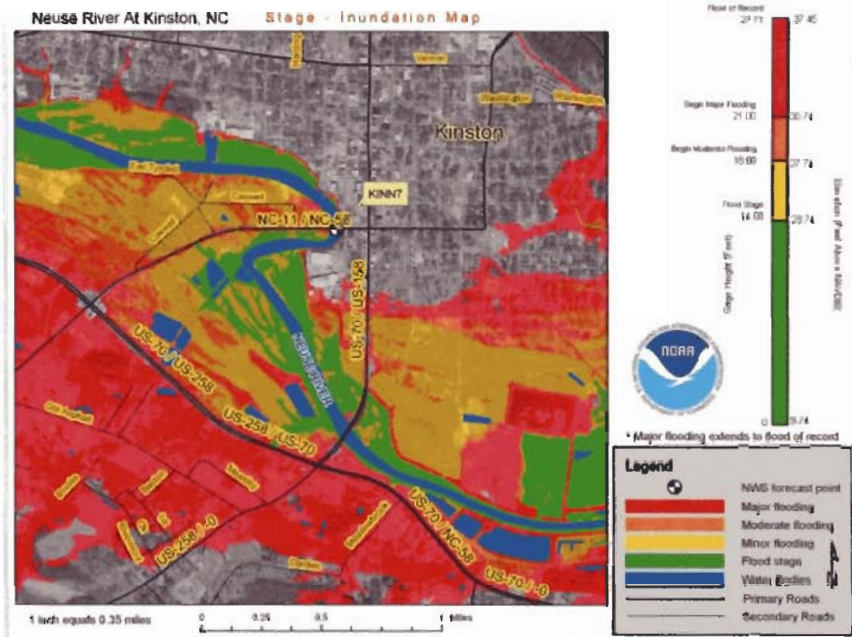
2001 Tropical Storm Allison caused more damage than any tropical storm in U.S. history with estimates in excess of \$5B. Three feet of rain was reported in Texas. Of the 23 deaths in Texas, 20 were from drowning.

1999 Hurricane Floyd brought intense rains and record flooding to the Eastern United States. Of the 53 deaths, 50 were drownings from inland flooding. Damages reached more than \$8B.

Understanding Potential Flood Impacts

Within flood warning products, the NWS conveys the magnitude of observed and forecast flooding using flood severity categories. Each category has a definition based on property damage and public threat.

- ✓ **Minor Flooding** – minimal or no property damage, but possibly some public threat or inconvenience.
- ✓ **Moderate Flooding** – some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- ✓ **Major Flooding** – extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.



Graphical depiction of NWS severity categories

The impacts of floods vary locally. For each NWS river forecast location, flood stage and the stage associated with each of the NWS flood severity categories are established in cooperation with local public officials. Increasing river levels above flood stage constitute minor, moderate, and major flooding. Impacts vary from one river location to another because a certain river stage (height) above flood stage in one location may have an entirely different impact than the same level above flood stage at another location.

What Can You Do?

Determine whether you live in a potential flood zone (For more information: www.floodsmart.gov).

Assemble a disaster supply kit (For more information: www.redcross.org).

Protect your home and family before a flood by purchasing flood insurance (For more information: www.fema.gov/nfip) or call 1-800-427-4661.

Develop a flood emergency action plan with your community leaders (For more information: www.fema.gov).

Learn how you can prepare for flooding and reduce flood loss (For more information: www.fema.gov/library/prepandprev.shtm).

Monitor www.weather.gov for the latest watches, warnings, and current conditions in your area. Monitor NOAA's Weather Radio All Hazards to receive continuous weather information directly from

a nearby NWS Office (For more information: <http://www.nws.noaa.gov/nwr/>).

Keep abreast of road conditions (For more information: www.fhwa.dot.gov/trafficinfo/index.htm).

When you hear hurricane or tropical storm, think inland flooding.

DO NOT attempt to cross flowing water. **TURN AROUND DON'T DROWN.**

As little as 6 inches of water may cause you to lose control of your vehicle, and 2 feet of water will carry most vehicles away (For more information: <http://tadd.weather.gov>).



**FLOODING AHEAD
TURN AROUND
DON'T DROWN**

What to Look and Listen For

Hydrologic Outlook is used to indicate that a hazardous flood event may develop. It is intended to provide information to those who need considerable lead time to prepare for it. **“Get Ready”**

Flood Watch is used when the expectation of a flood event has increased, but its occurrence, location, and/or timing is still uncertain. It is intended to provide enough lead time so those who need to set their mitigation plans in motion can do so. **“Get Set”**

Flash Flood Warning, flood warnings, and various advisories under the flood statement are issued whenever a flood event is occurring, imminent, or has a high probability of occurrence. **“Go, Take Action”**

Current listing of all hydrologic forecasts, watches, and warnings for your local area can be viewed at www.weather.gov

Take Action

When a FLOOD WARNING is issued

- Evacuate **immediately**, if advised to do so!
- Move to a safe area **before** access is cut off by rising water.
- Monitor NOAA Weather Radio All Hazards, television, emergency broadcast stations or go to www.weather.gov.

Get to high ground – Climb to safety!

- Get out of areas subject to flooding, including dips, low spots, canyons, washes, etc.
- Avoid already-flooded areas and do not attempt to cross flowing water.
- Be especially cautious at night, when it is harder to recognize flood dangers.

During the Flood

- Avoid areas subject to sudden flooding.
- NEVER drive through flooded roadways! **STOP! Turn Around Don't Drown.** Do not attempt to drive over a flooded roadbed. Be aware that the roadbed may be washed out.
- NEVER allow children to play around high water, storm drains, creeks, or rivers.

After the Flood

- Throw out fresh water that has come into contact with floodwater.
- Boil drinking water before using it. Wells should be pumped out and tested for quality before drinking. If in doubt, call your local public health authority.
- Seek necessary medical care at the nearest hospital. Food, clothing, shelter, and first aid are available from the American Red Cross.
- Check and dry out electrical equipment before being returned to service.
- Use flashlights, not lanterns, torches, or matches, to examine buildings. Flammables may be inside.
- Report broken utility lines to appropriate authorities.



**This is an Advanced Hydrologic Prediction Service
Safety Message**