2018 FloodWarn Training

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Senior Service Hydrologist/Meteorologist
National Weather Service- Houston/Galveston, TX
National Weather Service

Weather Forecast Offices

Click city for local weather information

River Forecast Centers

Click RFC area for local information
Outline

Flooding Importance

Flooding Types and Causes

Flood Products

River Flooding

Partners

Flood Safety

Reporting Flooding

Flood Risk
Flooding Importance
Flooding is Deadly!

Weather-Related Deaths in Texas

<table>
<thead>
<tr>
<th>Year</th>
<th>Flooding</th>
<th>All Other Weather Hazards</th>
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<tbody>
<tr>
<td>2016</td>
<td>30</td>
<td>15</td>
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<tr>
<td>2015</td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>2014</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>2013</td>
<td>10</td>
<td>10</td>
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</table>

In the 5 year period from 2013 to 2017*, more people have died in Texas from flooding than all other weather hazards combined.

*2017 Data: 70 Flood Related Deaths in TX out of 138 Total Weather-Related Fatalities

Data from NWS National Hazard Statistics
Flood Fatalities

Texas Flood Fatalities by Shelter from 2013-2016

- Vehicle: 51.0%
- Permanent Home: 10.6%
- In Water: 26.0%
- Other: 12.5%

Over half of the flood fatalities in Texas occurred while people were in their car.

Data from NWS National Hazard Statistics
Recent Big Floods...

Memorial Day 2015
Tax Day 2016
Brenham 2016
Harvey 2017

And other historic floods...
Tropical Storm Allison
1994 Flood
Tropical Storm Claudette
Flooding Types and Causes
What Causes Flooding?

- Intense rainfall
- Rain over several days
- Dam/levee failures
- High tides or storm surge
- Snowmelt
- Ice or debris jams
Types of Flooding

**Ponding & Sheet Flow Flooding**
Flooding that occurs gradually over time, usually 6 hours after the rain begins or longer (longer duration).

**Flash Flooding**
Flooding that develops quickly (typically 6 hours or less) either from heavy rainfall or dam/levee failure (shorter duration).

**River Flooding**
Flooding that occurs from water escaping river banks.

**Coastal Flooding**
Flooding along a coastline either from high tides or storm surge during a tropical storm or hurricane.
Flood Products
Watch vs Warning

A **Watch** is issued when conditions are favorable to occur.

A **Warning** is issued when the threat is *occurring or imminent*, threatening life or property.

![Counties in Flash Flood Watch Example only](image1)

![Flash Flood Warning (green polygon), Example only](image2)
Flood vs. Flash Flood

A **Flood** is an overflow of water onto normally dry land likely caused by rising water in a river/bayou or poor drainage. Flooding is a longer term event than flash flooding. It may last days or weeks.

A **Flash Flood** is a flood caused by heavy or excessive rainfall in a short period of time, typically 6 hours or less. Flash floods are defined as:

- ≥ 3 feet of standing water (less if threatening life or property), and/or
- ≥ 6 inches of fast flowing water across a road or bridge, or
- Water in a stream or bayou flowing rapidly out of its banks, or
- A dam break (even on a sunny day)
# Understanding Flooding

## Urban / Small Stream Advisory

**WHAT IS IT?**
Flooding of small streams, streets and low-lying areas.

**WHAT TO DO?**
Stay away from areas that are prone to flooding and stay clear of rapidly moving water.

## Flood Watch

**WHAT IS IT?**
Flooding is possible – typically within a 6 to 48 hours before rain is expected to reach the area.

**WHAT TO DO?**
Stay tuned to local river forecasts; prepare for areas near rivers to spread towards nearby roads and buildings.

## Flash Flood Watch

**WHAT IS IT?**
Flash flooding is possible – typically 6 to 48 hours before rain is expected to reach the area.

**WHAT TO DO?**
Have a way to receive local warnings, expect hazardous travel conditions and have alternate routes available.

## Flood Warning

**WHAT IS IT?**
Flooding impacts are occurring or imminent.

**WHAT TO DO?**
Stay alert for inundated roadways and follow all local signage! Additional impacts include homes and structures could become flooded and need to be evacuated.

## Flash Flood Warning

**WHAT IS IT?**
Flash flooding impacts are occurring or imminent.

**WHAT TO DO?**
Conditions will rapidly become hazardous! Do not cross flooded roadways or approach inundated areas as water may still be rising.

## Flash Flood Emergency

**WHAT IS IT?**
Flash flood situation that presents a clear threat to human life due to extremely dangerous flooding conditions.

**WHAT TO DO?**
Immediately reach higher ground by any means possible.
You make the call...
What type of flooding is this?
What type of flooding is this?
What type of flooding is this?
What type of flooding is this?
Flood Advisory
Increasing Impact Potential
ALL Situations Represent Threatening Conditions to Life and/or Property

Note: Flooding can (and does) occur without a Flash Flood Watch!
Ways to Receive a Warning

NOAA Weather Radio

Wireless Emergency Alerts and Weather Apps

TV and Radio

Social Media

NWS Website: https://www.weather.gov/hgx/
River Flooding
Llano River Flooding
River flooding occurs when water escapes the river banks. There are different thresholds for river flooding: action, minor, moderate, major and record flooding. This image depicts what a river flooding looks like.
A watershed, or basin, is an area of land that drains runoff from rainfall (stormwater) to a body of water, either a river, bayou, creek, or lake. Topography plays a big role in how watershed boundaries are defined. A watershed can flow into another watershed. Watersheds vary in shape and size which ultimately lead to unique challenges.
Diverse Watershed Characteristics in Texas

- Snowpack - Water Supply
- Complex Reservoir Operations
- Hill Country Hydrology
  - Flash Flood threats
  - Rapid River responses
  - Cycles of Flood/Drought
- Forest Hydrology
  - Slower River responses
- International Border Water Allocation
- Prolonged River Flooding

Coastal Hydrology
- Hurricanes
  - Tropical Cyclones
  - Storm surge
  - Coastal flooding
River Forecast Process

Rainfall Analysis

Rainfall estimates and forecasts merged into continuous dataset

Hydrologic Modeling

Rainfall ingested into hydrologic model. Forecasters adjust model parameters in real time

Forecast

Warning
Hydrograph Basics

LOCATION:
Of the gage the forecast is made, AT means the gage is in the limits of the town/city, NEAR or NR means that town/city has the closest post office.
Hydrograph Basics

OBSERVATIONS: Past river stages
Hydrograph Basics

**FORECAST:**
Forecast River Stages

**CREST:**
Peak Stage

*Latest observed value: 53.13 ft at 5:15 AM CDT 30-Aug-2017. Flood Stage is 45 ft*
STAGE VS FLOW:
Hydrologists, models, reservoirs work in flow. Emergency managers, media, general public work in stage.

What is flow or a cubic foot per second?
Hydrograph Basics

A basketball is roughly a cubic foot, so 20,000 cfs is 20,000 basketballs of water passing the gage every second.
Understanding River Criteria Levels

**BELOW CRITERIA**

**Impact:** Water is within the banks of the river with no impacts to the surrounding area. Flow speeds may still be high during rainfall or releases which could impact recreational activities.

**ACTION**

**Impact:** Water is over the banks and into the flood plain, but not a threat to structures or roadways. Some action may be required such as moving farm equipment or increasing awareness.

**MINOR**

**Impact:** Typically water is impacting areas inside of floodplain which can vary by location. Some low water crossings covered by water, agricultural flooding, water approaching public areas (parks, sidewalks etc.). Areas frequently flooded can expect to be impacted.

**MODERATE**

**Impact:** Water now reaching areas only impacted by significant rain events. Structures can be inundated, several roads covered with water, water may cut off certain areas, widespread agricultural flooding.

**MAJOR**

**Impact:** Water is near the highest it’s ever been representing rare flooding and significant widespread impacts. Most roads will be covered by water in the area cutting off if not completely flooding subdivisions, rivers can be several miles wide in areas. Homes and structures underwater, bridges inundated and in danger of being hit by debris. Impacts may be greater than ever experienced.
Advanced Hydrologic Prediction System

USGS Water Alerts

- Set alerts when a gauge reaches certain water surface elevations.
- Identify the gauge nearest you
- Click on the gauge and select “Subscribe to WaterAlert”
- Define how you want to receive the information:
  - Email or phone
  - Frequency
  - Stage or Discharge
  - Stream Elevation(s)
- Note: Use Internet Explorer

USGS Water Alerts: https://maps.waterdata.usgs.gov/mapper/wateralert/

Subscription Form

The U.S. Geological Survey WaterAlert service sends e-mail or text (SMS) messages when certain parameters, as measured by a USGS real-time data-collection station, exceed user-definable thresholds. The development and maintenance of the WaterAlert system is supported by the USGS and its partners, including numerous federal, state, and local agencies.

Real-time data from USGS gages are transmitted via satellite or other telemetry to USGS offices at various intervals; in most cases, 1 to 4 times per hour. Emergency transmissions, such as during floods, may be more frequent. Notifications will be based on the data received at these site-dependent intervals.

Site Info:
- Number: 08069500
- Name: W Fk San Jacinto Rv nr Humble, TX
- Agency: USGS
- Transaction ID: stscN

Send Notification To:
- My mobile phone
- My email address

Notification Frequency:
- Hourly
- Daily

Streamflow Parameter(s):
- Discharge, in ft³/s: 7260 [peak chart]
- Stage, in ft: 42.78 [peak chart]

Alert Threshold Condition:
- Greater than (>)
- Less than (<)
- Outside a range (<>)
- Inside a range (>= and <=)

Real-time value is greater than: [ ] ft³/s

I have read and acknowledge the Provisional Data Statement and Disclaimer.

Submit Reset Cancel
Watershed

- A watershed, or basin, is an area of land that drains runoff from rainfall (stormwater) to a body of water, either a river, bayou, creek, or lake.
- Topography plays a big role in how watershed boundaries are defined.
- A watershed can flow into another watershed.
- Watersheds vary in shape and size which ultimately lead to unique challenges.
- Harris County deals with 23 watersheds.
- NWS issues river forecasts for 21 sites in Harris County.
Partners
Hydrology in Harris County

Mark Moore
Lead Hydrologic Technician
Harris County Flood Control District
Harris County Open Channel Network

2,500 Miles of Bayous and Creeks

Area = 1,756 Square Miles
± 1,500 Channels
± 2,500 Miles of Channels
Population = 4.1 Million (County)
2.1 Million
(Houston)
Everyone Has a Flood Risk!
Ponding & Sheet Flow Flooding

STREET SEWERS

FLOODING FROM INTENSE LOCAL RAINFALL
(Longer Duration)
Addicks and Barker Watersheds
Flood Warning System
Public Website – Water Level

Stream Elevation
K166_1190 Little Mound Creek @ Mathis Road

- Stream Elevation

Cross Section

Top of Bank (TOB)

BOC

Stream Elevation for sensor 1193 is 205.21'
Reading on 4/19/2016 7:21 AM

<table>
<thead>
<tr>
<th>Flood Frequency</th>
<th>Elevation</th>
</tr>
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<tbody>
<tr>
<td>10% (10-year)</td>
<td>208.80'</td>
</tr>
<tr>
<td>2% (50-year)</td>
<td>209.70'</td>
</tr>
<tr>
<td>1% (100-year)</td>
<td>210.10'</td>
</tr>
<tr>
<td>.2% (500-year)</td>
<td>211.10'</td>
</tr>
</tbody>
</table>

Historical Storm

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/12/2012</td>
<td></td>
<td>207.90'</td>
</tr>
<tr>
<td>4/18/2016</td>
<td></td>
<td>209.30'</td>
</tr>
<tr>
<td>5/27/2016</td>
<td></td>
<td>208.05'</td>
</tr>
<tr>
<td>8/27/2017</td>
<td>Harvey</td>
<td>206.90'</td>
</tr>
</tbody>
</table>

High water mark elevations are approximate.
Future Enhancements

• Near real time inundation mapping

• Public customizable alarms
  Rainfall and stage
  Text or e-mail

• Expansion of FWS gages (Regional)

• Add roadway flooding (TranStar)
Inundation Mapping
Gage Network Expansion

HARRIS COUNTY FLOOD CONTROL DISTRICT
RAIN AND STREAM GAGE LOCATIONS
March 2017
Important Information Sources

• Harris County Flood Control District
• City of Houston
• Harris County Office of Emergency Management
• Fort Bend County Office of Emergency Management
• Fort Bend County Drainage District
• National Weather Service
• U.S. Army Corps of Engineers

Important Twitter Handles

@hcfcd
@readyharris
@houstonOEM
@nwshouston
@jefflindner1
Flood Safety

What to do before, during, and after a flood?
Safety Before a Flood

- Prepare a family disaster plan.
- Check if your insurance covers flood damages. If not, get flood insurance.
- Keep insurance and other important documents, such as copies of driver's licenses and credit cards, and other valuable items, in a safe deposit box.
- Assemble a disaster supplies kit. Be sure to include prescription medications, food, and water.
- Find out where you can go if ordered to evacuate.
- Arrange to keep in contact with relatives and friends.
- Know your resources.

Knowing what to do when a flood occurs will increase your family’s safety and possibly its survival.
Safety During a Flash Flood

- Turn around, don’t drown when encountering flooded roads.
- Be especially cautious at night when it is harder to recognize the dangers of flooding.
- Stay away or be swept away. River banks and culverts can become unstable and unsafe.
- You should monitor the latest forecasts and be prepared to take action should additional Flash Flood Warnings be issued.
- Have multiple ways to receive weather information (cell phone, NOAA weather radio, television, etc.)
Turn Around, Don’t Drown!

- Most flood deaths occur in vehicles.
- It only takes six inches of water for a vehicle to lose contact with the road surface.
- Most vehicles can be swept away in just 18 to 24 inches of water!
- Don’t Rely on Your Big Vehicles
- Flooded roads may have hidden dangers, such as washed out road beds or underwater obstructions.
- If your vehicle is caught in rising water, leave it immediately and seek higher ground.

Minneosta road damaged by flood waters, courtesy of FEMA.
Safety During a Flood

- Do not sightsee!
- Evacuations are ongoing and first responders are working hard to get people to safety. Do not get in their way!
- Flood waters from creeks, bayous and rivers will be swiftly moving. Do not go near the flood waters! They will sweep you away if you go in the water.
- Stay out of the flood waters!
- Roads may still be closed as they could be damaged or still under water. Barricades are for your protection; do not drive around them!
Safety After a Flood

- Don’t put yourself in danger.
- Return home only when authorities indicate it is safe.
- Use extreme caution when entering buildings
- Cut power to flooded areas of your home
- Only use generators in well-ventilated areas – **Not** in a closed garage!
- Do not use power tools while standing in water
- If you smell or hear gas, call the Fire Department.

weather.gov/flood
Report Flooding
What to Report

Flash Flooding

- Underpasses filling with water
- Impassible roadways
- Any fast-moving water greater than 6 inches in depth

Any River or Bayou Flooding

Flooding, Washington County (2016)
Formatting Reports

Reports should include the following information:

- **WHO** is calling
- **WHERE** the flooding is located
- **WHAT** type of flooding is occurring (flash, river, or bayou)
- **WHEN** the flooding occurred (is it ongoing?)
- **HOW** deep is the water (if you can *safely* evaluate this)
The Good

“I’m a storm spotter located in Sealy at the intersection of Meyer and FM 2187. Water is flowing over curbs; it’s at least 6-8 inches deep in some locations on the road.”

The Bad

“Hey, we got some flooding here a few minutes ago!”

The Ugly

“My sister-in-law said the bayou got really closer to her house, did you have a warning out for that?”
How to Report

Call us!
Spotter line: 1-800-846-1828

Report via amateur radio
Call sign WX5HGX

Email
sr-hgx.nws@noaa.gov

Social Media
Twitter: @NWSHouston
Facebook: NWSHouston

Spotter Tip
Set up SKYWARN as a contact in your smartphone
Flood Risk?

Any situation involving exposure to a Flood danger, harm or loss.

“While levees can help reduce flood risk...they do not eliminate the risk.”
Everyone is at risk for flooding

- Brief definition of flooding is any forms of rising water in which 2 properties are affected—one being yours
  - **Structure Coverage**
    - Max coverage $250,000
  - **Contents coverage**
    - Contents is an optional addition, except for Preferred Risk Policy.
    - Max coverage $100,000 coverage for Actual Cash Value
  - **Wait Period**
    - Typically - 30-days from purchase until effective.
  - **Average NFIP pay out for Harvey was $112K (March 2018)**

- **Group Flood Insurance**
  - Available during a Presidential Declared event
  - If qualified for a IA grant a GFIP will be purchased in the amount of $600
  - Policy is good for 3 years
  - Must maintain insurance on the property forever
  - Max amount on the policy is 33,500 this includes structure and dwelling
  - Average pay out for Harvey for IA was $6000
Insurance Misconception

**Misconception:**

“I’m already covered—my homeowners policy covers flooding.”

**Fact:**

Most insurance policies do not cover flooding; only flood insurance covers flood damage.

Renters and Business owners should also consider flood insurance for contents.

**Misconception:**

“I don’t live in a flood zone.”

**Facts:**

- Floods are the #1 natural disaster in the United States.
- If it can rain, it can flood.
- FIRMs do not show localized flooding from drainage ditches/sewers/road ponding.
- To some degree overland flooding...but not property to property drainage problems.
What is a FIRM?

Flood Insurance **Rate** Map

- Identifies the flood zones
- **SFHA** (high risk)
  - A, AE, AO, AH, VE, V etc. *(Aqua)*
    - 1% annual chance flood
- **Non-SFHA** (low to moderate risk)
  - B, C and X (Shaded – **orange** or gray color & non-Shaded)
    - **Orange/Gray area** – outlines areas protected by Levees
    - Even the non-shaded is a flood zone – a minimal risk.
- Used for rating flood insurance policies
- Are subdivided by panels to cover jurisdictional boundary.
- Shows what the BFE within the zones
- FIRM’s show Costal and Riverine flood risk

Find your zone at [https://msc.fema.gov/portal/home](https://msc.fema.gov/portal/home)
## Cost of Flood Damage?

A 2,500 sqft, one-story home with possessions worth $50,000 could incur the following costs based on the depth of water:

<table>
<thead>
<tr>
<th>Interior Water Depth (Inches)</th>
<th>Cost to Home</th>
<th>Cost to Personal Property</th>
<th>Combined Loss Potential</th>
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<tr>
<td>1&quot;</td>
<td>$23,635</td>
<td>$3,172</td>
<td>$26,807</td>
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<td>$23,720</td>
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<td>$53,355</td>
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<td>$103,355</td>
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Structure Elevation Impact Insurance Rates

High Risk = $$$
Medium Risk = $$
Lower Risk = $

The elevation is just one factor, others include: when was the structure, has it flooded in the past, etc.

EVERY Structure has a risk...

generally the higher the structure the less the risk.
Harvey Numbers

Insurance claims
- Harris Co (includes cities such as Houston) – all claims 55,570**
- City of Pasadena (unincorporated only) 1467 (Losses over 125K)

Harris County Numbers**
- 154,170 Homes 48,850 in 1% Risk Area (100-yr)
- 34,970 in 0.2% (500-yr) floodplain
- 68% OUTSIDE of the 1% Risk Area.

New GFIP’s Due to Harvey
- City of Pasadena - 61

**Data HCFCD Finale Hurricane Harvey Storm and Flood Information –
Summary

- Living in Texas means we have a flood risk even with heavy rain.
  - Tax Day 2016 and Memorial Day 2015 – not with a tropical system

- Flood Risk is from multiple sources.

- Flood insurance allows individual property owners to manage their risk.
  - **Buy policies that cover the structure AND contents.**
Contact Information

Angela Harrison, Insurance
Cell 470-557-2794 | Angela.Harrison@fema.dhs.gov

Yho-Meka Conway, Insurance
Cell 470-572-0803 | Yho-Meka.Conway@fema.dhs.gov

Lauren Schmied, PE, Floodplain Management
Cell 202-812-6164 | Lauren.Schmied@fema.dhs.gov

Larry Fordham ANFI, CFM, ACA
Acting Senior Regional Insurance Specialist, FEMA Region 6
Phone: 940-383-7253  | Cell: 202-394-4483
Larry.Fordham@fema.dhs.gov

NFIP Hotline
1-800-427-4661
www.fema.gov/nfip
 Fragen

National Weather Service
Harris County Flood Control District
FEMA