2018 FloodWarn Training

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

Flooding Importance
Flooding Types and Causes
Flood Products
River Flooding
Partners
Flood Safety
Reporting Flooding
Flood Risk
Flooding Importance
Flooding is Deadly!

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

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

Texas Flood Fatalities by Shelter from 2013-2016

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

Data from NWS National Hazard Statistics
Houston Floods: April 18, 2016
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.

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**Example only**

Counties in Flash Flood Watch

**Example only**

Flash Flood Warning (green polygon)
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 rapid and extreme flow of high water typically beginning within 6 hours of the causative event (heavy/excessive rainfall, dam failure, etc). Flash floods are characterized by:

- ≥ 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)
Don’t underestimate the power of water!

- 6 inches of fast-moving water can knock over and carry away an adult.
- 12 inches of fast-moving water can carry away a small car.
- 18-24 inches of fast-moving water can carry away most large SUVs, vans and trucks.
# Understanding Flooding

<table>
<thead>
<tr>
<th>Urban / Small Stream Advisory</th>
<th>Flood Watch</th>
<th>Flash Flood Watch</th>
<th>Flood Warning</th>
<th>Flash Flood Warning</th>
<th>Flash Flood Emergency</th>
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<tbody>
<tr>
<td><strong>WHAT IS IT?</strong></td>
<td>Flooding is possible – typically within a 6 to 48 hours before rain is expected to reach the area.</td>
<td>Flooding impacts are occurring or imminent.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WHAT TO DO?</strong></td>
<td>Need to exercise caution. Stay away from areas that are prone to flooding and stay clear of rapidly moving water</td>
<td>Stay tuned to local river forecasts; prepare for areas near rivers to spread towards nearby roads and buildings</td>
<td>Have a way to receive local warnings, expect hazardous travel conditions and have alternate routes available</td>
<td>Conditions will rapidly become hazardous, life threatening! Do not cross flooded roadways or approach inundated areas as water may still be rising</td>
<td>Immediately reach higher ground by any means possible</td>
</tr>
</tbody>
</table>
You make the call...
What type of flooding is this?

This image depicts what conditions may look like during a Flash Flood Warning.
What type of flooding is this?
What type of flooding is this?

This image depicts what impacts may result from a Flash Flood Emergency. A rapidly moving flood wave resulted in this roadway being completely washed out.
What type of flooding is this?

This image depicts what conditions may look like during an Areal Flood Warning.
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/](https://www.weather.gov/hgx/)

Be sure to have multiple ways to receive warnings.
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.
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 leads to unique challenges.
Diverse Watershed Characteristics in Texas

- Snowpack - Water Supply
- Hill Country Hydrology
  - Flash Flood threats
  - Rapid River responses
  - Cycles of Flood/Drought
- Complex Reservoir Operations
- Forest Hydrology
  - Slower River responses
- International Border Water Allocation
- Coastal Hydrology
  - Hurricanes
  - Tropical Cyclones
  - Storm surge
  - Coastal flooding

Prolonged River Flooding
Watershed

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- Madison County deals with 2 primary watersheds: Trinity River and Navasota River.
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- NWS issues river forecasts for 2 sites in Madison County.
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
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.
Hydrograph Basics

What is the current stage in MSL?

Latest observed value: 3.18 ft at 10:45 AM CST 26-Nov-2018. Flood Stage is 19 ft.
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

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

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

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</tr>
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<td>Name:</td>
<td>W FK San Jacinto Rv nr Humble, TX</td>
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<tr>
<td>Agency:</td>
<td>USGS</td>
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</tr>
<tr>
<td>My email address</td>
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</table>

<table>
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<tr>
<th>Notification Frequency:</th>
<th>about this...</th>
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<tbody>
<tr>
<td>Hourly</td>
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<tr>
<td>Daily</td>
<td></td>
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<table>
<thead>
<tr>
<th>Streamflow Parameter(s):</th>
<th>Recent value:</th>
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</thead>
<tbody>
<tr>
<td>Discharge, in ft³/s</td>
<td>7260 [peak chart]</td>
</tr>
<tr>
<td>Gage height, in ft</td>
<td>42.78 [peak chart]</td>
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</tbody>
</table>

<table>
<thead>
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<th>Alert Threshold Condition:</th>
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<tbody>
<tr>
<td>Greater than (&gt;)</td>
<td></td>
</tr>
<tr>
<td>Less than (&lt;)</td>
<td></td>
</tr>
<tr>
<td>Outside a range (&lt;&gt;&lt;&gt;&gt;)</td>
<td></td>
</tr>
<tr>
<td>Inside a range (&gt;= and &lt;=)</td>
<td>Real-time value is greater than: ft³/s</td>
</tr>
</tbody>
</table>

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

SubmitResetCancel
Partners
Partners

Roles of Primary River Forecast Partners

- Operate Flood Control Reservoirs
- Manage Other WR Projects

- U.S. Stream Gage Network
- Water Science Studies

- Issue Weather & Water Forecasts, Watches, Warnings & Data

- Assist w/Gage Maintenance
- Assist w/Stream Measurements
- Assist w/Funding Data Networks

- Gage Maintenance
- Stream Measurements
- Focus Stream Gage Network

- Cooperative Data Network
- NOAA/NWS Satellite Transmission
- Forecasts/Data for Operations

Shared Data and Resources
Trinity River Basin Overview
• Nearly 18,000 square miles
• More water storage than any other river system in Texas
20 reservoirs ranging from 1,000 to 83,000 acres
- 12 Water Conservation
- 8 Flood Control
Basic Components of a Dam
Flood Control Reservoir
Flood Control Reservoir

- Built to regulate flood waters
- Examples:
  1. Lake Grapevine
     - Storage-535 MSL
     - Flood Pool-560 MSL
     - Surcharge-582 MSL
  2. Lake Lewisville
     - Storage-522 MSL
     - Flood Pool-532 MSL
     - Surcharge-552 MSL

Figure 7.5 Classification of principle storage zones in a cross section of a multipurpose reservoir.
Water Supply Reservoir

- Designed to stay near full
- Have very limited capacity to capture storm inflows
- Designed to pass inflows from storms (with some reduction in peak flow)
- Structurally, the gates must open gradually as lake rises
- Still reduces flooding downstream
Lake Livingston

**WATER CONSERVATION RESERVOIR** is responsible for the safe storage of water and providing drinking water to more than two million southeast Texans.

- 83,000 surface acres
- 1,750,000 acre feet
- More than 350,000 CFS spillway discharge capacity
- Conservation Pool – 131 MSL
- Flowage Easement – 135 to 140 MSL
Gate Operations

• Manage outflow in order to mimic river flows
• Calculate releases adequate to keep pace with increasing inflows without causing sudden surges and without exceeding computed inflows until the peak inflow has been reached.
• Once reservoir elevation has peaked, excess inflow will be released from surcharge storage in an orderly fashion to reduce pool to conservation pool of 131 MSL.
Lake Livingston Emergency Action Plan

• Implemented at discharge of 20,000 cubic feet/second (CFS)

• Who do we contact?
  ✓ Emergency Management Coordinator for Walker, Polk, San Jacinto, Trinity, Liberty and Chambers counties
  ✓ NWS and WGRFC
  ✓ DPS-Lufkin
  ✓ Liberty radio

• Methods of notification
  ✓ Phone
  ✓ Email
  ✓ Twitter
Hydrology and History of the Trinity River
Trinity River Travel Times

- Travel times are to/from Lake Livingston
## Historic Flood Stages at Riverside

<table>
<thead>
<tr>
<th>RANK</th>
<th>YEAR</th>
<th>STAGE</th>
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<tbody>
<tr>
<td>1</td>
<td>1942</td>
<td>142.61</td>
</tr>
<tr>
<td>2</td>
<td>1945</td>
<td>141.69</td>
</tr>
<tr>
<td>3</td>
<td>1957</td>
<td>139.61</td>
</tr>
<tr>
<td>4</td>
<td>1908</td>
<td>139.56</td>
</tr>
<tr>
<td></td>
<td>1968</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1990</td>
<td>139.08</td>
</tr>
</tbody>
</table>

1968 Gates at Dam Closed
Riverside 1942
No Two Floods Are The Same

- What part of the watershed is the flood event originating?
  - Rain event in Dallas
  - Local Rain
- How much of the watershed was covered by precipitation?
- What are the current conditions?
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.

Minnesota 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.
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
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
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.”
Flood Insurance/Group Flood Insurance

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 pay out for Harvey for NFIP 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 and Flood Zone?

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 Coastal and Riverine flood risk

Find your zone at https://msc.fema.gov/portal/home
What is a Flood Zone?
# Cost of Flood Damage?

2,500 sqft, one-story home with possessions worth $50,000

<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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<tbody>
<tr>
<td>1&quot;</td>
<td>$23,635</td>
<td>$3,172</td>
<td>$26,807</td>
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<td>48&quot;</td>
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Structure Elevation Impact Insurance Rates

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) – 55,570 claims**

Harris County Numbers**

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

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
Questions

National Weather Service
FEMA