2019 FloodAware Training

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National Weather Service

Weather Forecast Offices

River Forecast Centers

Click city for local weather information

Click RFC area for local information

West Gulf River Forecast Center
Outline

Flooding Importance

Flooding Types and Causes

Flood Products

River Flooding

Partners

Flood Safety

Reporting Flooding

Flood Risk

(REUTERS/Richard Carson)
Flooding Importance
Flooding is Deadly!

In the 4 year period from 2014 to 2017, more people have died in Texas from flooding than all other weather hazards combined.

Data from NWS National Hazard Statistics
Flood Fatalities

TEXAS FLOOD FATALITIES BY SHELTER FROM 2014-2016

Half of the flood fatalities in Texas occurred while people were in their car. 2017 was skewed due to Hurricane Harvey. In 2017, there were 33 flood fatalities in the water and 19 in vehicles.

Data from NWS National Hazard Statistics
Flood Fatalities

2018 U.S. Flood Fatalities
Activity of Victims

- Driving: 69%
- At Home: 8%
- Walking: 6%
- Fell In: 6%
- Other: 11%

Source: NOAA/National Weather Service
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
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.

Example only

Counts 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, poor drainage, or high tides/surge. 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

<table>
<thead>
<tr>
<th><strong>Urban / Small Stream Advisory</strong></th>
<th><strong>Flood Watch</strong></th>
<th><strong>Flash Flood Watch</strong></th>
<th><strong>Flood Warning</strong></th>
<th><strong>Flash Flood Warning</strong></th>
<th><strong>Flash Flood Emergency</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WHAT IS IT?</strong> Flooding of small streams, streets and low-lying areas.</td>
<td><strong>WHAT IS IT?</strong> Flooding is possible – typically within a 6 to 48 hours before rain is expected to reach the area.</td>
<td><strong>WHAT IS IT?</strong> Flash flooding is possible – typically 6 to 48 hours before rain is expected to reach the area.</td>
<td><strong>WHAT IS IT?</strong> Flooding impacts are occurring or imminent.</td>
<td><strong>WHAT IS IT?</strong> Flash flooding impacts are occurring or imminent.</td>
<td><strong>WHAT IS IT?</strong> Flash flood situation that presents a clear threat to human life due to extremely dangerous flooding conditions</td>
</tr>
<tr>
<td><strong>WHAT TO DO?</strong> Stay away from areas that are prone to flooding and stay clear of rapidly moving water</td>
<td><strong>WHAT TO DO?</strong> Stay tuned to local river forecasts; prepare for areas near rivers to spread towards nearby roads and buildings</td>
<td><strong>WHAT TO DO?</strong> Have a way to receive local warnings, expect hazardous travel conditions and have alternate routes available</td>
<td><strong>WHAT TO DO?</strong> Stay alert for inundated roadways and follow all local signage! Additional impacts include homes and structures could become flooded and need to be evacuated</td>
<td><strong>WHAT TO DO?</strong> Conditions will rapidly become hazardous! Do not cross flooded roadways or approach inundated areas as water may still be rising</td>
<td><strong>WHAT TO DO?</strong> Immediately reach higher ground by any means possible</td>
</tr>
</tbody>
</table>
You make the call...
Urban / Small Stream Flood Advisory

This image depicts what conditions may look like during a flood advisory.
Flash Flood Warning

This image depicts what conditions may look like during a Flash Flood Warning.
Flash Flood Emergency

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.
Flood Warning (Areal/River/Bayou)
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
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.
- A watershed can flow into another watershed.
- Watersheds vary in shape and size which ultimately lead to unique challenges.
- Topography plays a big role in how watershed boundaries are defined.
- Liberty County deals with 3 primary watersheds: Trinity, San Jacinto, and Neches basins.
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
- Prolonged River Flooding
- Coastal Hydrology
  - Hurricanes
  - Tropical Cyclones
  - Storm surge
  - Coastal flooding
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.

A watershed can flow into another watershed.

Watersheds vary in shape and size which ultimately lead to unique challenges.

Topography plays a big role in how watershed boundaries are defined.

Liberty County deals with 3 primary watersheds: Trinity, San Jacinto, and Neches basins.

NWS issues forecasts for 5 gauges in Liberty County.
**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**
- River Forecast Process

**Warning**
- Flood Warning

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

**DATUM:**
Adjustment to mean sea level

[Graph of Trinity River at Liberty showing past river stages and adjustments to mean sea level.]
Hydrograph Basics

**FORECAST:**
Forecast River Stages

**CREST:**
Peak Stage

```
Latest observed value: 29.62 ft at 12:15 AM CDT 29-Aug-2017. Flood Stage is 26 ft
```

```
Major: 29.0'
Moderate: 27.0'
Minor: 26.0'
Action: 21.0'
Record: 31.0'
```

```
Flow (cfs)
```

```
Site Time (CDT)
```

```
Graph Created (12:50AM Aug 29, 2017)  Observed

Forecast (issued 7:57PM Aug 28)
```

Observations courtesy of US Geological Survey
**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.
<table>
<thead>
<tr>
<th>Impact Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BELOW CRITERIA</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>ACTION</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>MINOR</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>MODERATE</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>MAJOR</strong></td>
<td>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.</td>
</tr>
</tbody>
</table>
Advanced Hydrologic Prediction System

Forecasting the Trinity River

- 9 Forecast Points
  - 6 on Trinity River:
    - Crockett
    - Riverside
    - Goodrich
    - Romayor
    - Liberty
    - Moss Bluff
  - 1 on Bedias Creek
  - 1 on Long King Creek
  - 1 on Menard Creek
- 1 Reservoir
  - Lake Livingston
USGS Water Alerts

- Set alerts when a gauge reaches certain water surface elevations.
- Identify the gauge nearest you

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/
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

US Army Corps of Engineers

USGS

National Weather Service

Shared Data and Resources

- 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
Trinity River Basin Overview
Basin Facts

- Nearly 18,000 square miles
- More water storage than any other river system in Texas
Basin Facts

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.
## COE Release Schedule

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Benbrook</td>
<td>520.0 - 590.0</td>
<td>0.16</td>
<td>650</td>
<td>6000</td>
<td>6000</td>
<td>1200</td>
<td>1600</td>
<td>1600</td>
<td>2000</td>
<td>3000</td>
<td>4000</td>
<td>4000</td>
<td>2000</td>
<td>4000</td>
<td>2400</td>
<td></td>
</tr>
</tbody>
</table>
Water Conservation 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>
</tr>
</thead>
<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>5</td>
<td>1990</td>
<td>139.08</td>
</tr>
</tbody>
</table>

1968: Gates at Dam Closed
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?
- Link: http://lakedata.traweb.net/home.php
- Twitter Releases: @LivingstonDam
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 place.
• 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 Flood

- Monitor warnings and be prepared to take action.
- Have multiple ways to receive weather information.
- Turn around, don’t drown!
- Stay away or be swept away. Flood waters will be moving swiftly and river banks/culverts can become unstable.
- Barricades are for your protection; do not drive around them!
- Do not sightsee!
- If evacuations are ongoing, don’t get in the way of first responders.
- Stay out of the flood waters!
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!
Flooded roads may have hidden dangers, such as washed out road beds or underwater obstructions.
Be especially cautious when traveling at night.
If your vehicle is caught in rising water, leave it immediately and seek higher ground.

Turn Around, Don’t Drown!

Minnesota road damaged by flood waters, courtesy of FEMA.
Safety After a Flood

• Stay away from damaged areas unless your assistance has been specifically requested by police, fire, or a relief organization.

• Return home only when authorities indicate it is safe.

• Use extreme caution when entering buildings; there may be hidden damage, particularly in foundations.

• Cut power to flooded areas of your home

• Only use generators in well-ventilated areas—never in a closed garage!

weather.gov/flood
Reporting/Wrap Up
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

Any Coastal 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.

*Everyone is at a risk for flooding.*
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.
### Cost of Flood Damage?

A 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>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
<td>$23,635</td>
<td>$3,172</td>
<td>$26,807</td>
</tr>
<tr>
<td>2&quot;</td>
<td>$23,720</td>
<td>$3,172</td>
<td>$26,892</td>
</tr>
<tr>
<td>3&quot;</td>
<td>$24,370</td>
<td>$4,917</td>
<td>$29,287</td>
</tr>
<tr>
<td>4&quot;</td>
<td>$31,345</td>
<td>$7,207</td>
<td>$38,552</td>
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<tr>
<td>5&quot;</td>
<td>$31,425</td>
<td>$13,914</td>
<td>$45,339</td>
</tr>
<tr>
<td>6&quot;</td>
<td>$37,260</td>
<td>$14,777</td>
<td>$52,037</td>
</tr>
<tr>
<td>7&quot;</td>
<td>$37,691</td>
<td>$17,700</td>
<td>$55,391</td>
</tr>
<tr>
<td>8&quot;</td>
<td>$38,122</td>
<td>$20,624</td>
<td>$58,746</td>
</tr>
<tr>
<td>9&quot;</td>
<td>$38,553</td>
<td>$23,547</td>
<td>$62,100</td>
</tr>
<tr>
<td>10&quot;</td>
<td>$38,983</td>
<td>$26,470</td>
<td>$65,453</td>
</tr>
<tr>
<td>11&quot;</td>
<td>$39,414</td>
<td>$29,394</td>
<td>$68,808</td>
</tr>
<tr>
<td>12&quot;</td>
<td>$39,845</td>
<td>$32,317</td>
<td>$72,162</td>
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<tr>
<td>24&quot;</td>
<td>$44,325</td>
<td>$43,001</td>
<td>$87,326</td>
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<tr>
<td>36&quot;</td>
<td>$47,905</td>
<td>$46,633</td>
<td>$94,538</td>
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<tr>
<td>48&quot;</td>
<td>$53,355</td>
<td>$50,000</td>
<td>$103,355</td>
</tr>
</tbody>
</table>
Flood Insurance Basics

- Brief definition of flooding – Any form of rising water in which 2 properties are affected.
- It doesn’t have to be presidential declared event for a flood claim to be filed on a flood policy.

**Individual Flood Insurance**

- **Structure Coverage**
  - Max coverage $250,000
  - Higher limits for commercial risk
- **Contents coverage**
  - Contents is an optional addition (except for Preferred Risk Policy)
  - Max coverage $100,000 coverage.
  - Renters can purchase flood insurance for contents.
- **Wait Period**
  - Typically - 30-days from purchase until effective.

**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
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 only show Costal and Riverine flood risk

Find your zone at https://msc.fema.gov/portal/home
Structure Elevation Impact Insurance Rates

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

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

EVERY Structure has a risk…

generally the higher the structure the less the risk.
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

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Lauren Schmied, PE, Floodplain Management
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Gilbert Giron, ANFI, CFM, ACA
Senior Regional Insurance Specialist, FEMA Region 6
Phone: 940-898-5412 | Gilberty.giron@fema.dhs.gov

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

National Weather Service
Trinity River Authority