



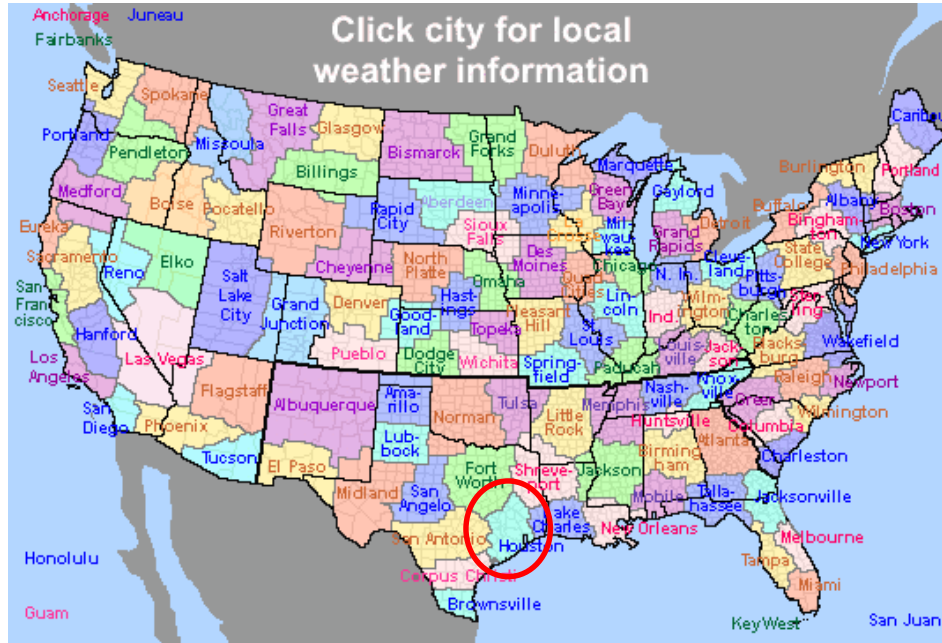
2019 FloodAware Training

Nikki Hathaway
Meteorologist
National Weather Service- Houston/Galveston, TX

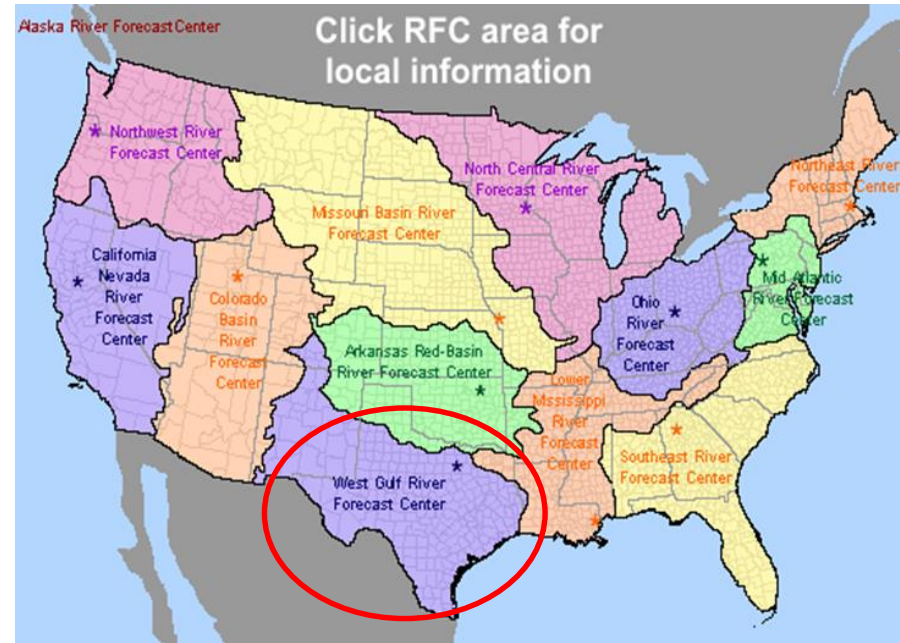
Katie Landry-Guyton
Senior Service Hydrologist/Meteorologist
National Weather Service- Houston/Galveston, TX

National Weather Service

Weather Forecast Offices



River Forecast Centers



Outline

Flooding Importance

Flooding Types and Causes

Flood Products

Coastal and River Flooding

Partners

Flood Safety

Reporting Flooding

Flood Risk

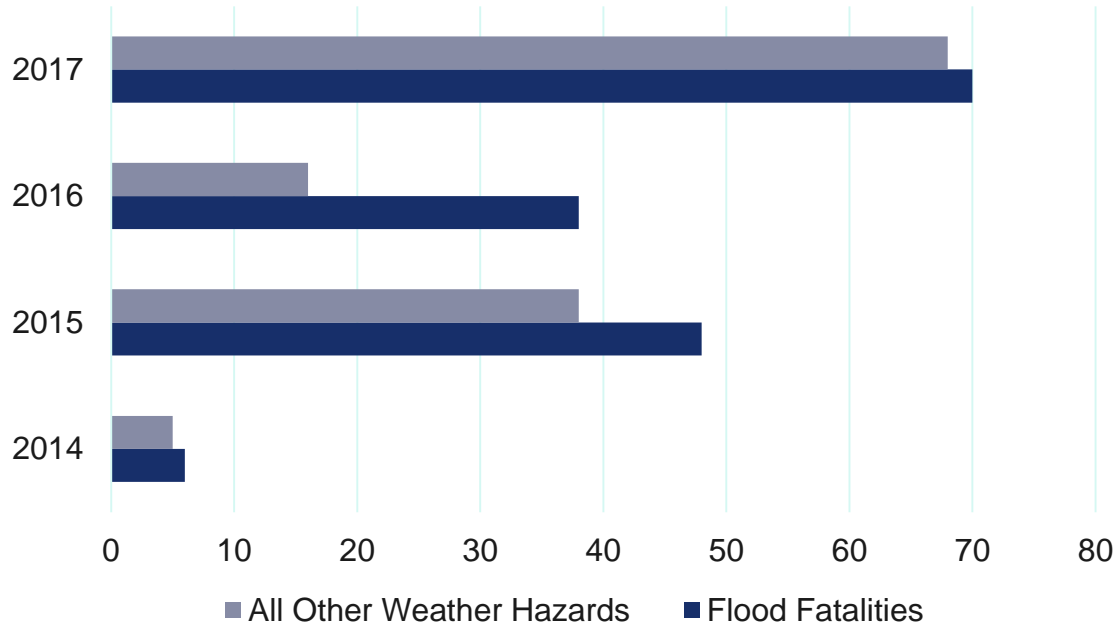




Flooding Importance

Flooding is Deadly!

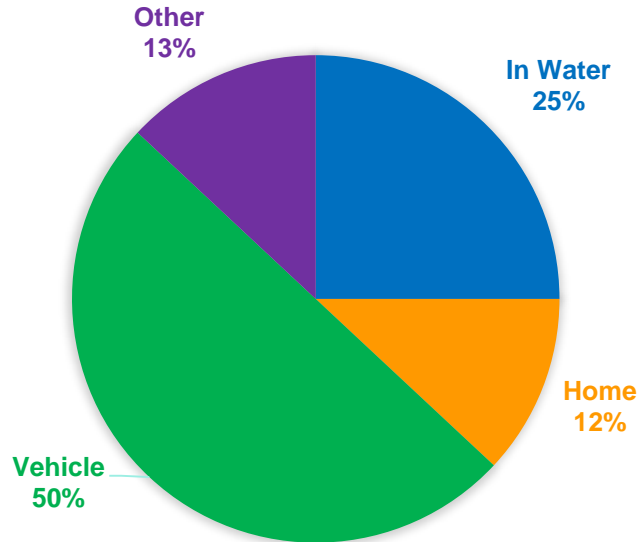
Weather-Related Deaths in Texas



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

Flood Fatalities

TEXAS FLOOD FATALITIES BY SHELTER FROM 2014-2016



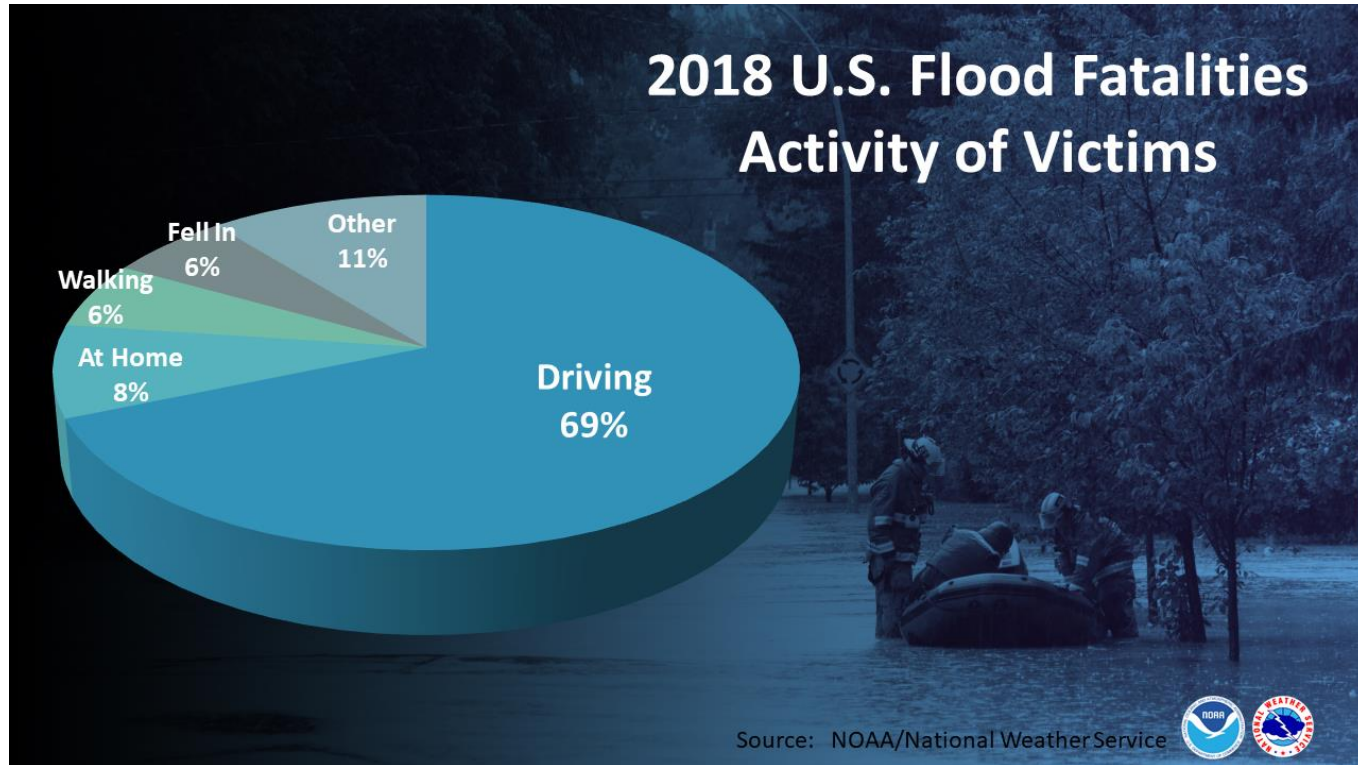
Half of the flood fatalities in Texas occurred while people were in their car.

2017 was skewed due to Hurricane Harvey. In 2017, there were 33 flood fatalities in the water and 19 in vehicles.

Houston Floods: April 18, 2016



Flood Fatalities



Recent Big Floods...

Memorial Day 2015

Tax Day 2016

Brenham 2016

Harvey 2017



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



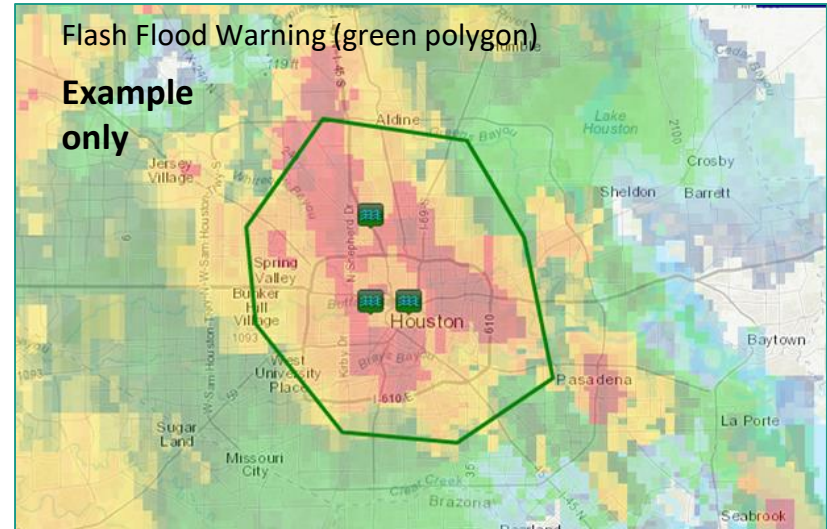
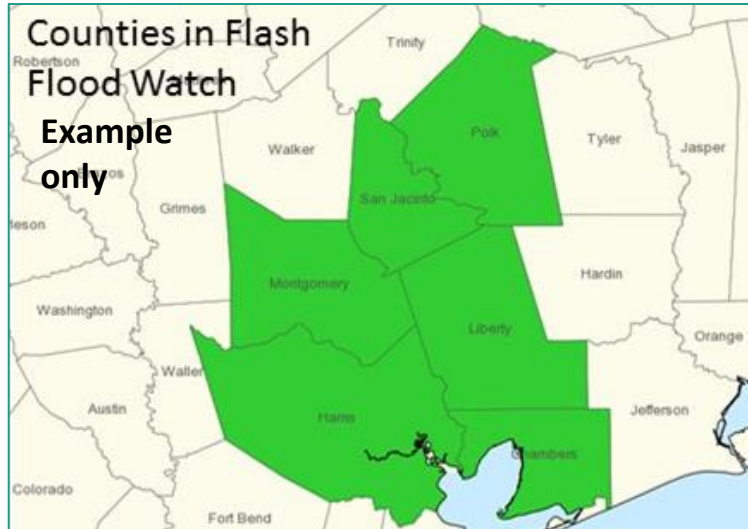


Flood Products

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.



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

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?

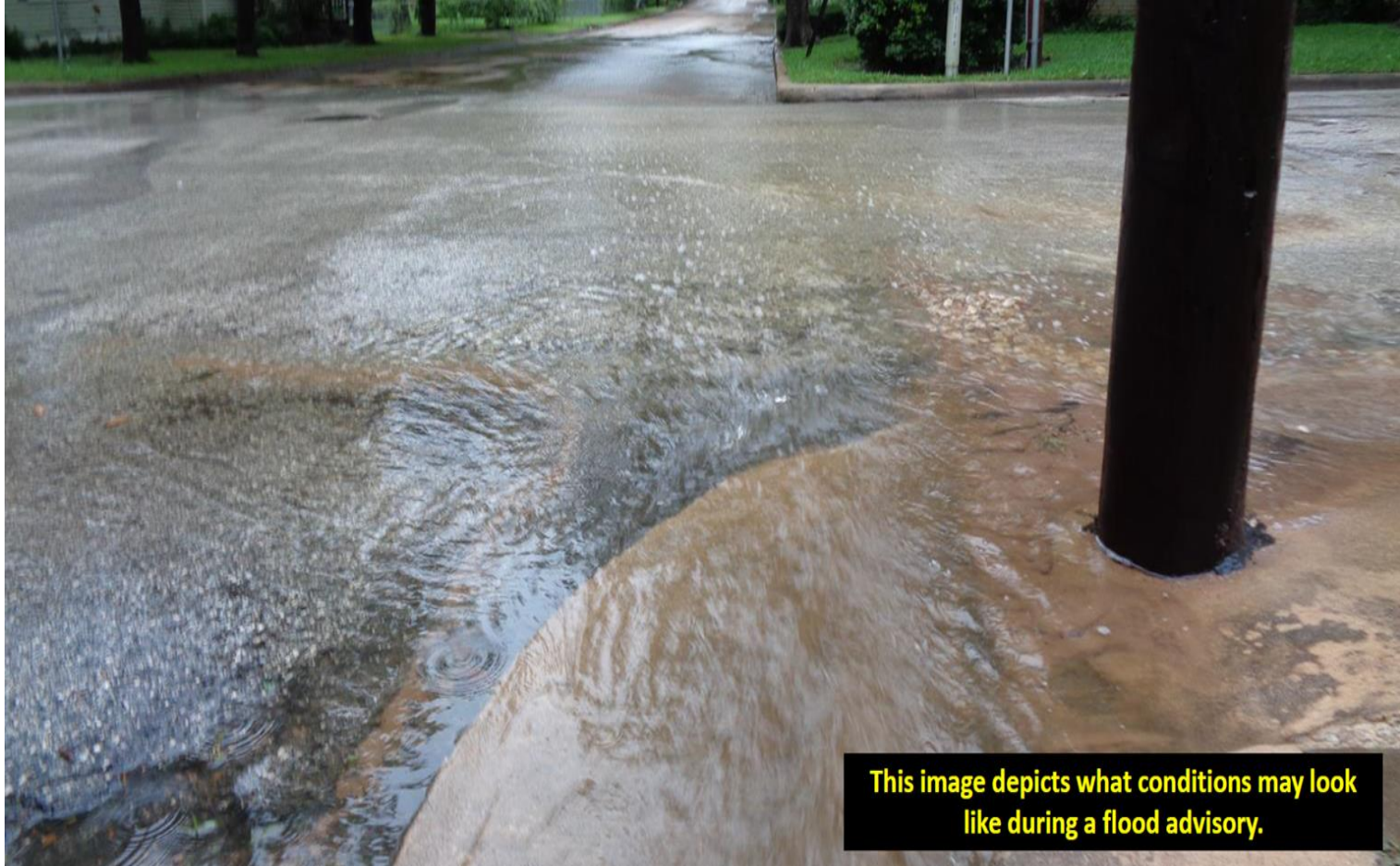
Immediately reach higher ground by any means possible



You make the call...



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



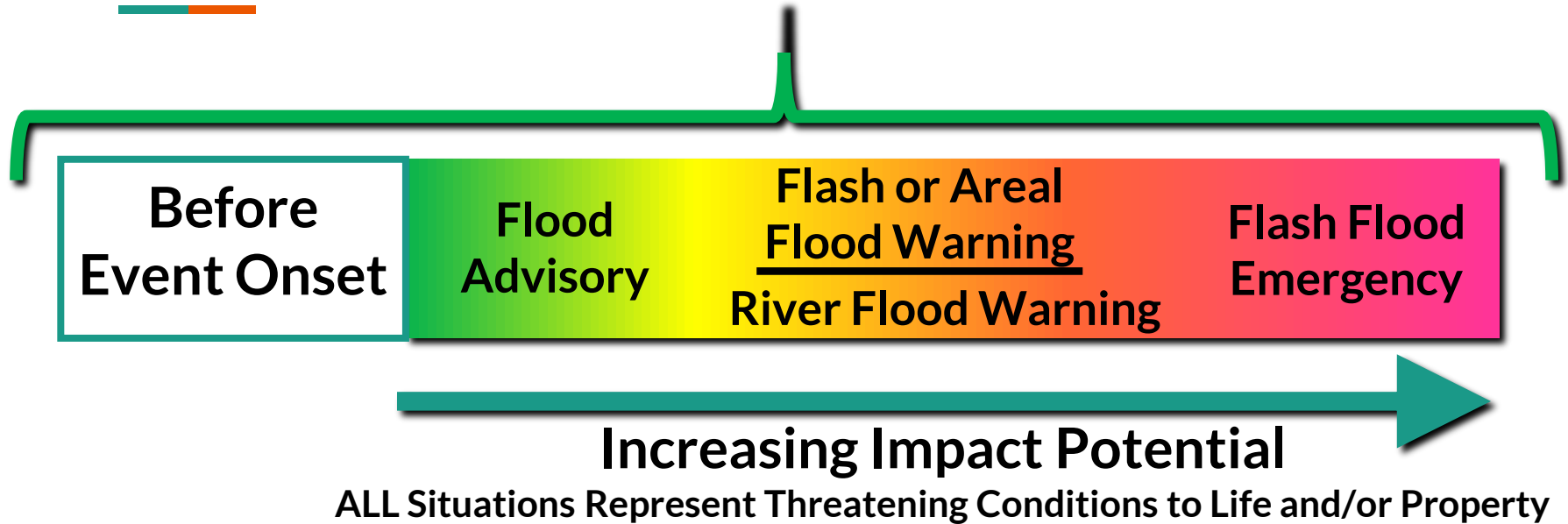
This image depicts what impacts may result from a Flash Flood Emergency. A rapidly moving flood wave resulted in this roadway being completely washed out.

Flood Warning (Areal/ River/ Bayou)



This image depicts what conditions may look like during an Areal Flood Warning.

Flood Timeline



Note: Flooding can (and does) occur without a Flash Flood Watch!

Be sure to have multiple ways to receive warnings.

Ways to Receive a Warning

NOAA Weather Radio



NWS Website: <https://www.weather.gov/hgx/>

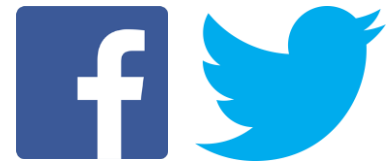
Wireless Emergency Alerts and Weather Apps



TV and Radio



Social Media

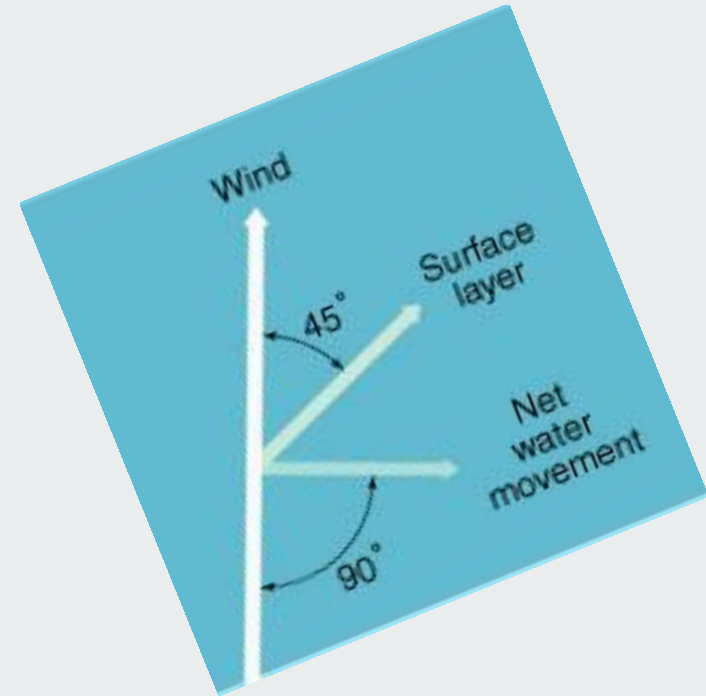


Coastal and Storm Surge Flooding



Ekman Transport

- ❑ In general, winds generate motion upon ocean waters. Water is deflected/transported 45° (at the surface) to 90° (330-500 feet) to the right of the wind.
- ❑ Easy way to remember: Turn your back to the wind. Water is transported toward your right.
- ❑ Depending on wind conditions, water can “pile up” along the coastline causing levels to run much above normal -- even without a storm system in the area. Coastal flooding can even result!
- ❑ The opposite can be true as well, with wind “pushing” water away from shore and causing below normal water levels -- increasing the risk of vessel groundings.



Ekman Transport



What impacts water levels locally?

- ☐ **Wind direction.** An easterly wind component will typically produce higher water levels. Opposite is true about northwesterly directions.
- ☐ **Wind speed.** Higher speeds have a more significant impact than lower speeds.
- ☐ **Duration.** The longer elevated winds persist, the more significant the impacts.
- ☐ **Fetch.** The longer the distance the elevated winds, the more significant the impacts.
- ☐ **Misc.** Astronomical tides, seas, shelf slope, shape of the coast, etc.



You make the call...

Which scenario is more likely to produce higher water levels?

#1

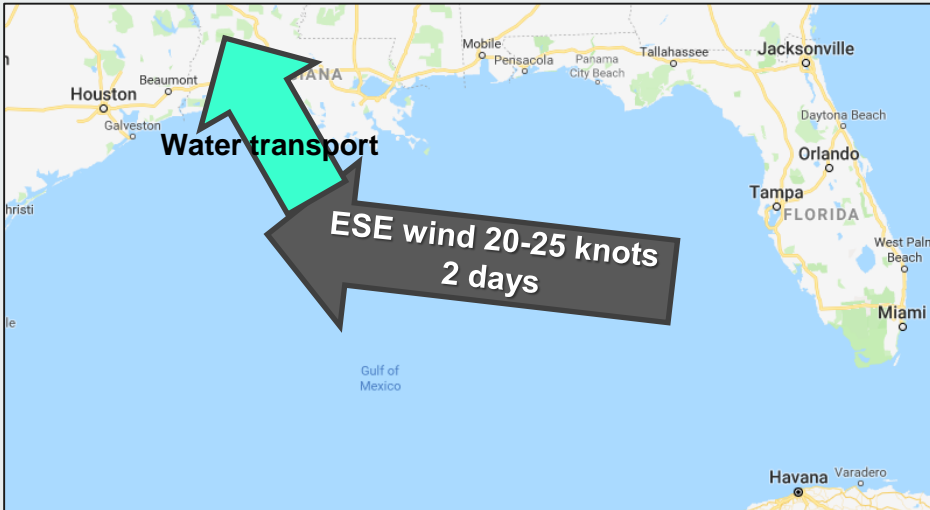


#2



Which scenario is more likely to produce higher water levels?

#1

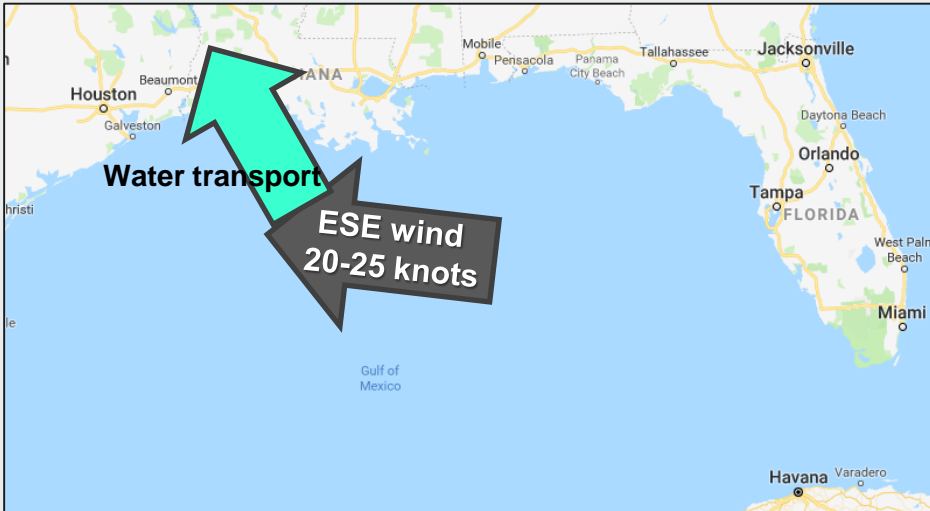


#2

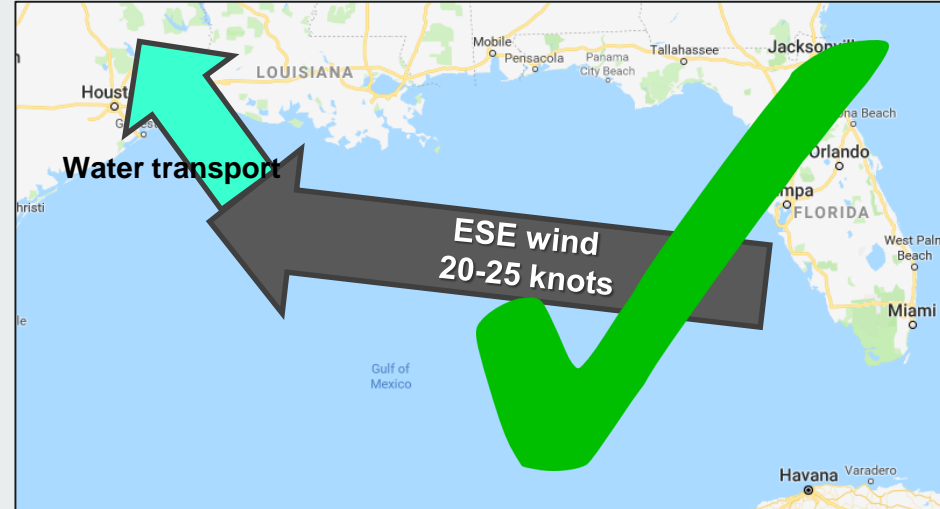


Which scenario is more likely to produce higher water levels?

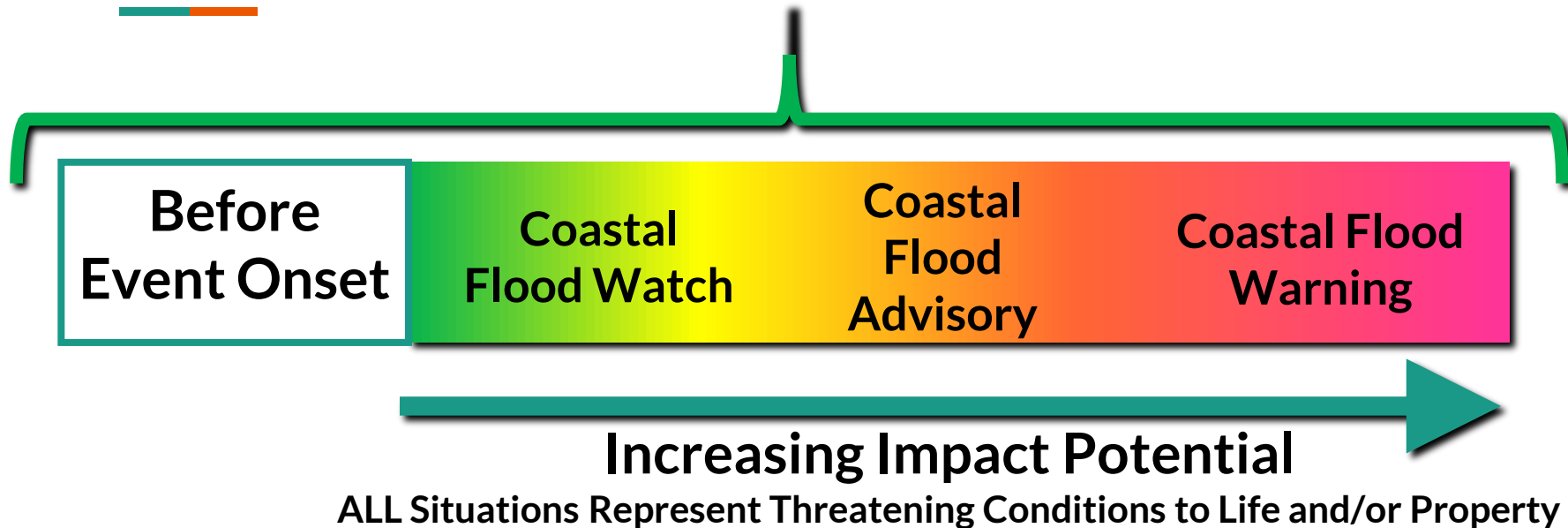
#1



#2

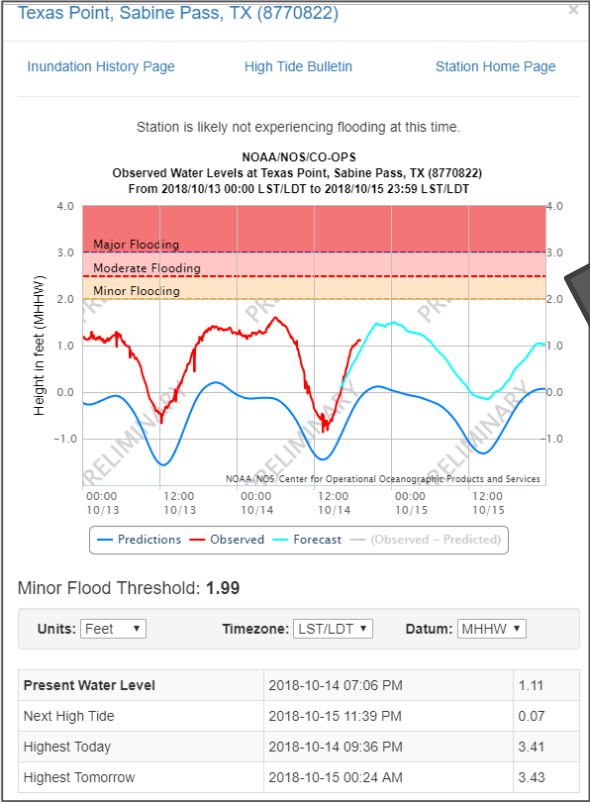
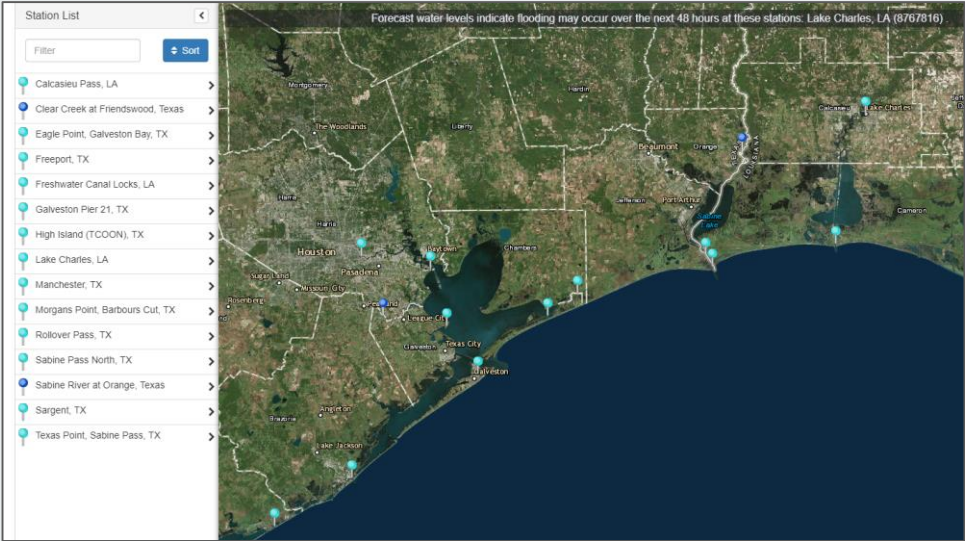


Coastal Flood Timeline



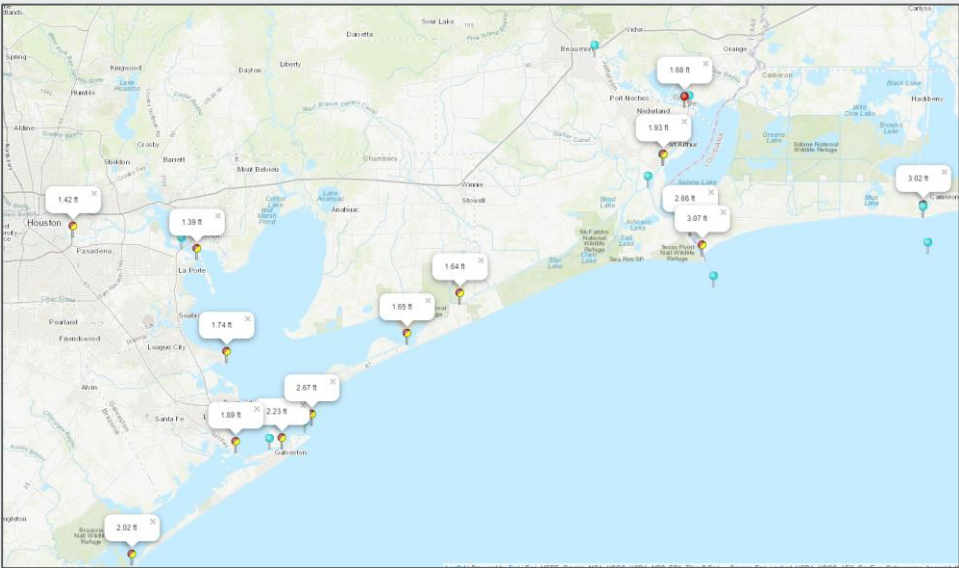
Real Time Water Level Observations & Forecasts

<https://tidesandcurrents.noaa.gov/inundationdb/>

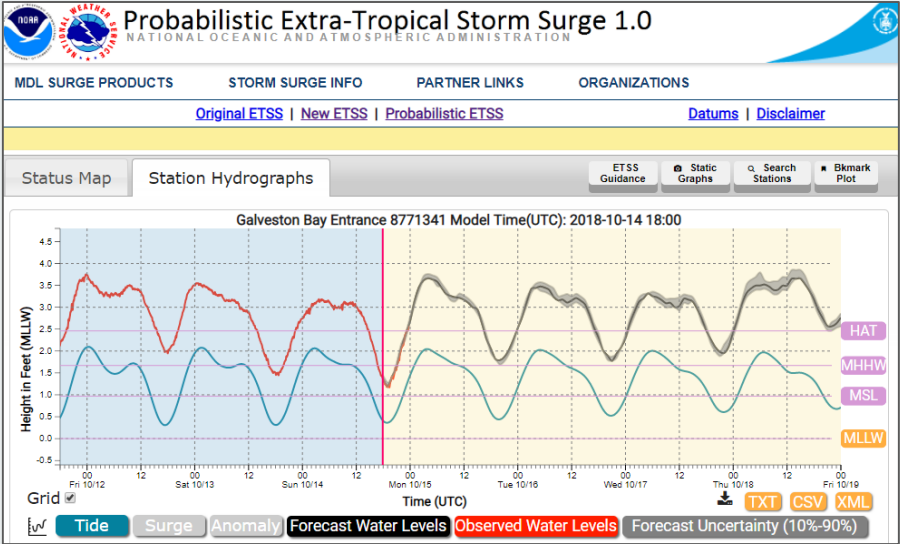


Real Time Water Level Observations & Forecasts

<https://tidesandcurrents.noaa.gov/map/index.html?region=Texas>



<https://slosh.nws.noaa.gov/etsurge2.0>



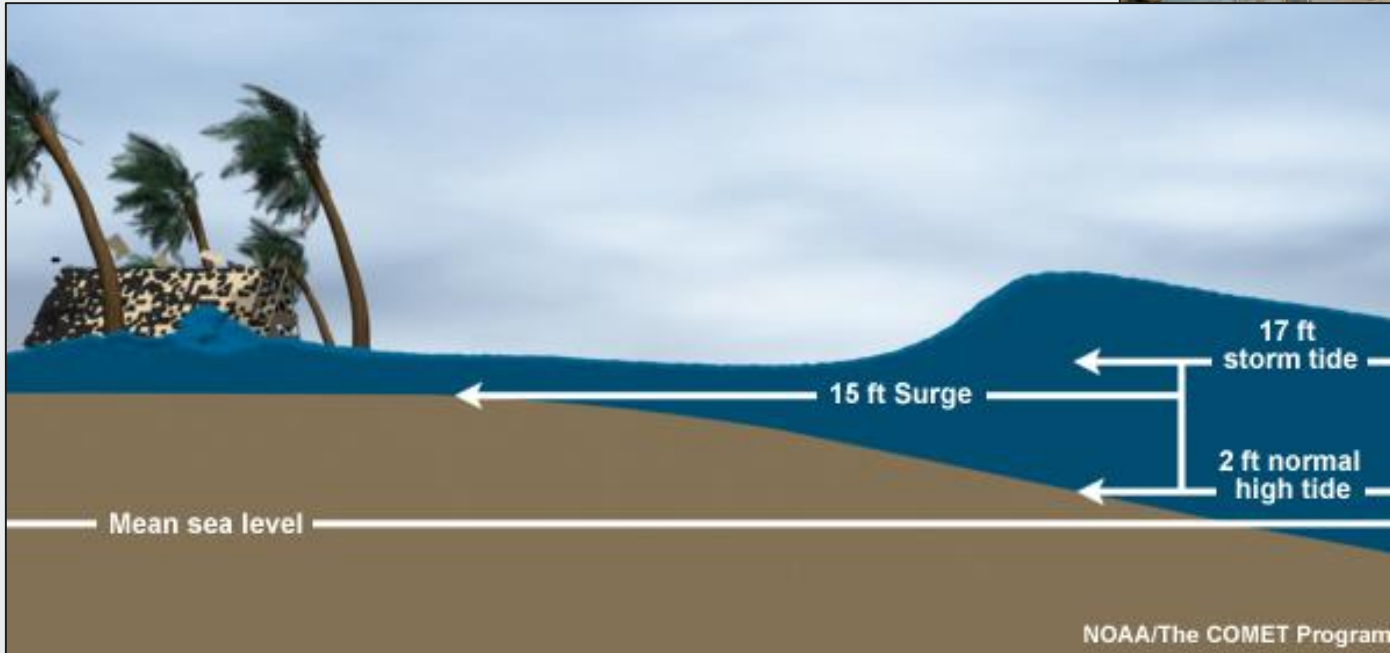
Storm surge



- ❑ Storm surge is an abnormal rise of water generated by a storm, over and above the predicted astronomical tides.
- ❑ Storm surge is produced by water being pushed toward the shore by the force of the winds moving counter-clockwise around the storm.
- ❑ Storm surge is often the greatest threat to life and property from a hurricane.

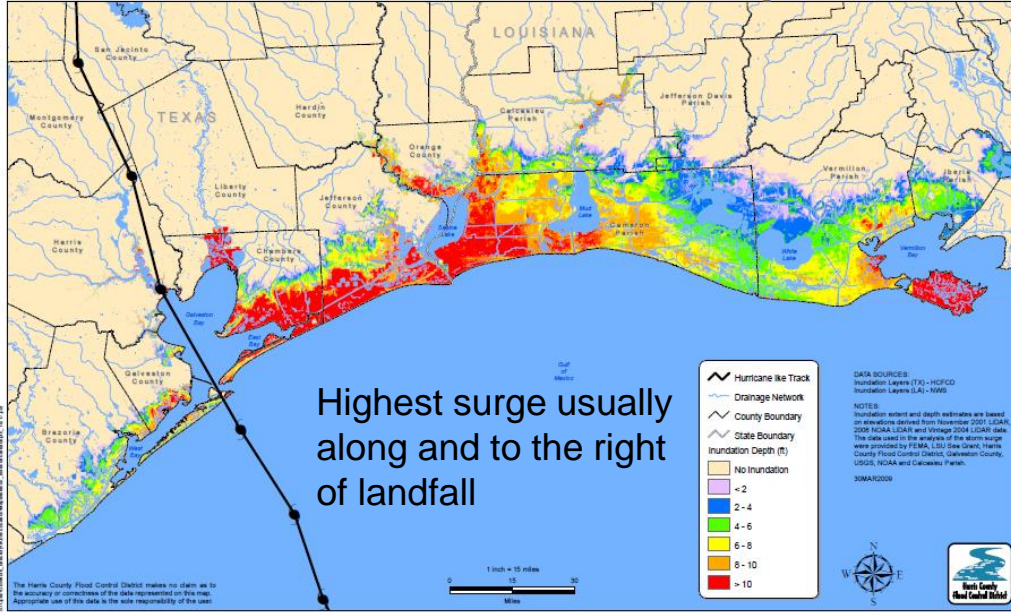
Storm Surge

Waves on top of surge are highly destructive.
Water weighs approximately 1,700 pounds per cubic yard.



Storm Surge

Hurricane Ike Inundation Depth



Sensitive to the slightest changes in:

- ❑ Storm track.
- ❑ Storm intensity.
- ❑ Forward speed.
- ❑ Size (radius of maximum winds).
- ❑ Angle of approach to the coast.
- ❑ Shape and characteristics of coastal features such as bays and estuaries.
- ❑ Width and slope of the continental shelf. A shallow slope will potentially produce a greater storm surge than a steep shelf.

Storm surge values many times do not correspond well to the hurricane wind categories (on the Saffir-Simpson Hurricane Wind Scale) that range from 1 to 5. These categories are based only on winds and do not account for storm surge. Ike was a category 2 storm that produced a 15-20 foot storm surge.

Storm Surge

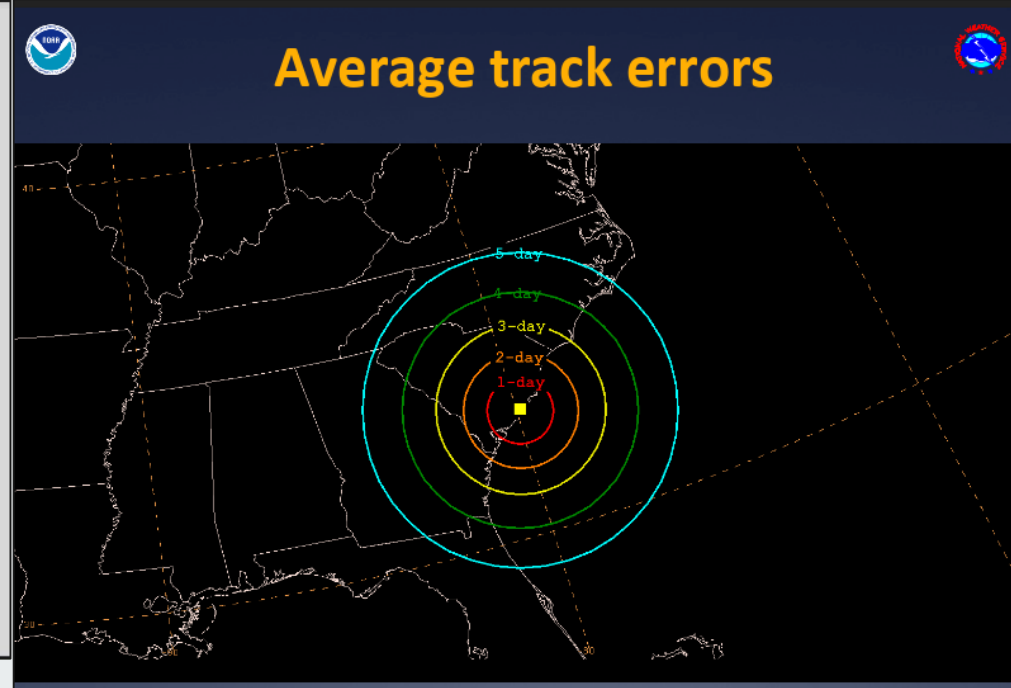
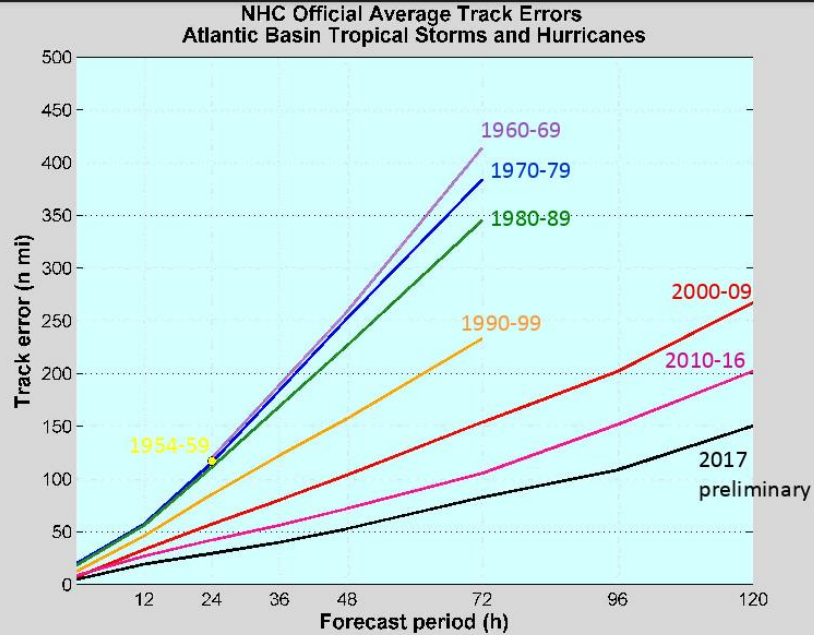
Sometimes high water levels cut off communities well before (sometimes days) the bad weather arrives. First responders need to be prepared for this and also ensure your personal family members have a plan in place.



BREAKING NEWS
TROPICAL STORM HARVEY
COAST GUARD AVIATORS ASSISTING
NATIONAL HARVEY CAUSES DEVASTATING FLOODS IN HOUSTON

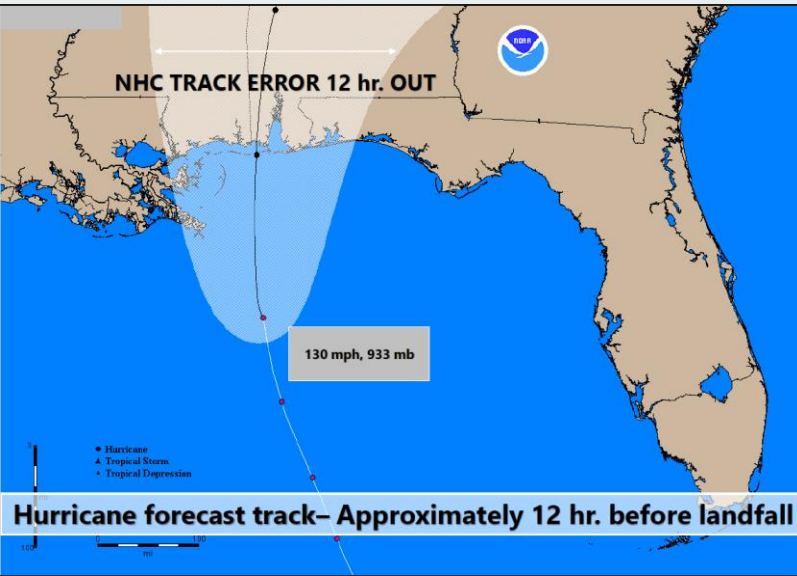
FOX 10
NEWS

Track Errors

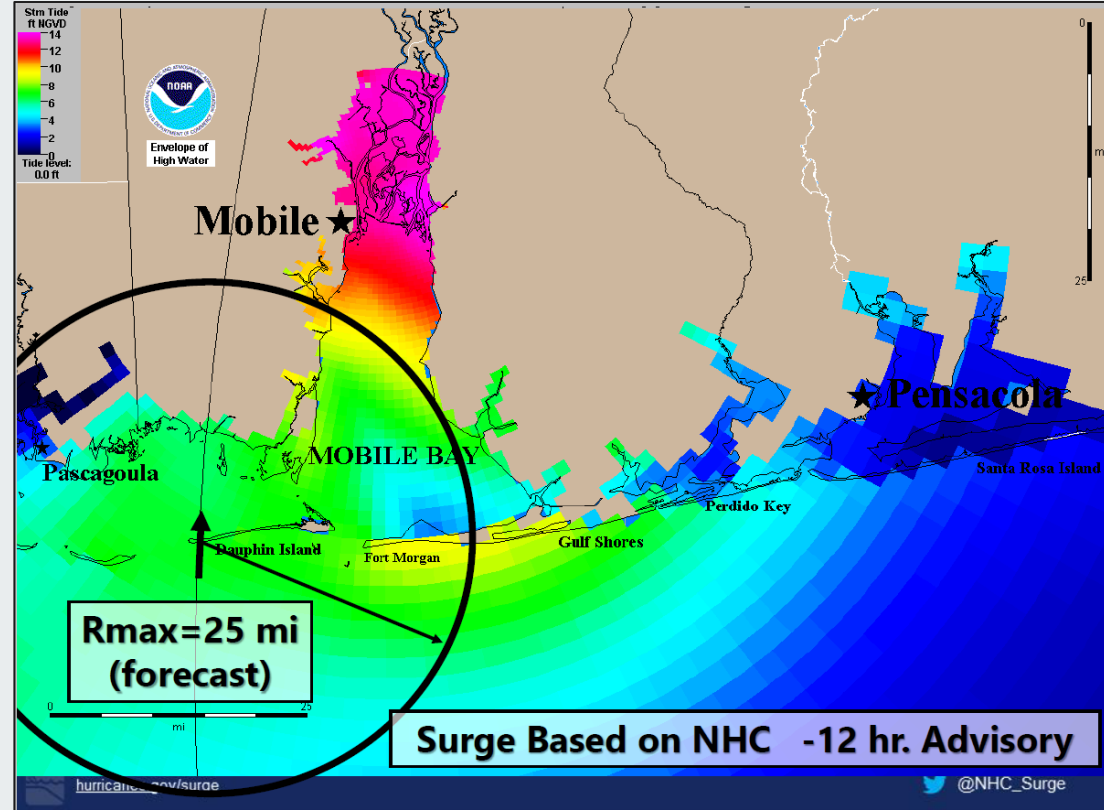


Storm Surge

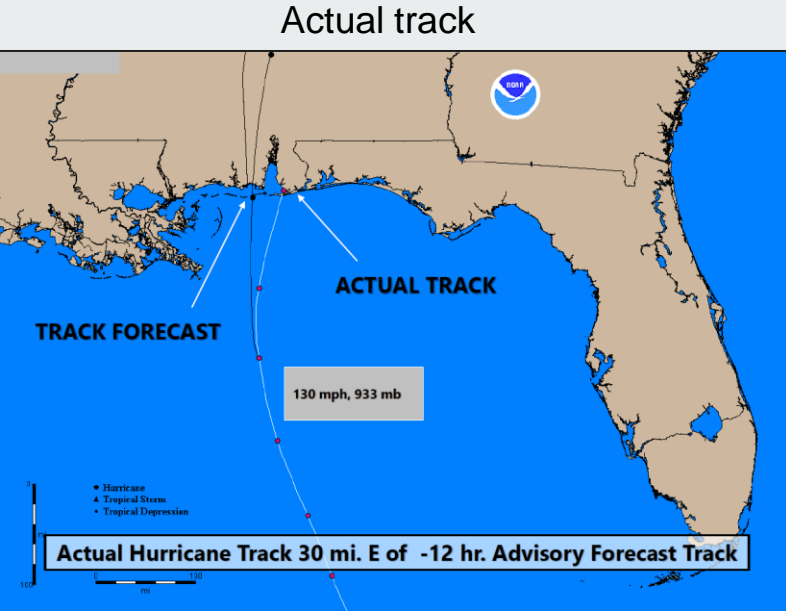
Real scenario...NHC forecast track



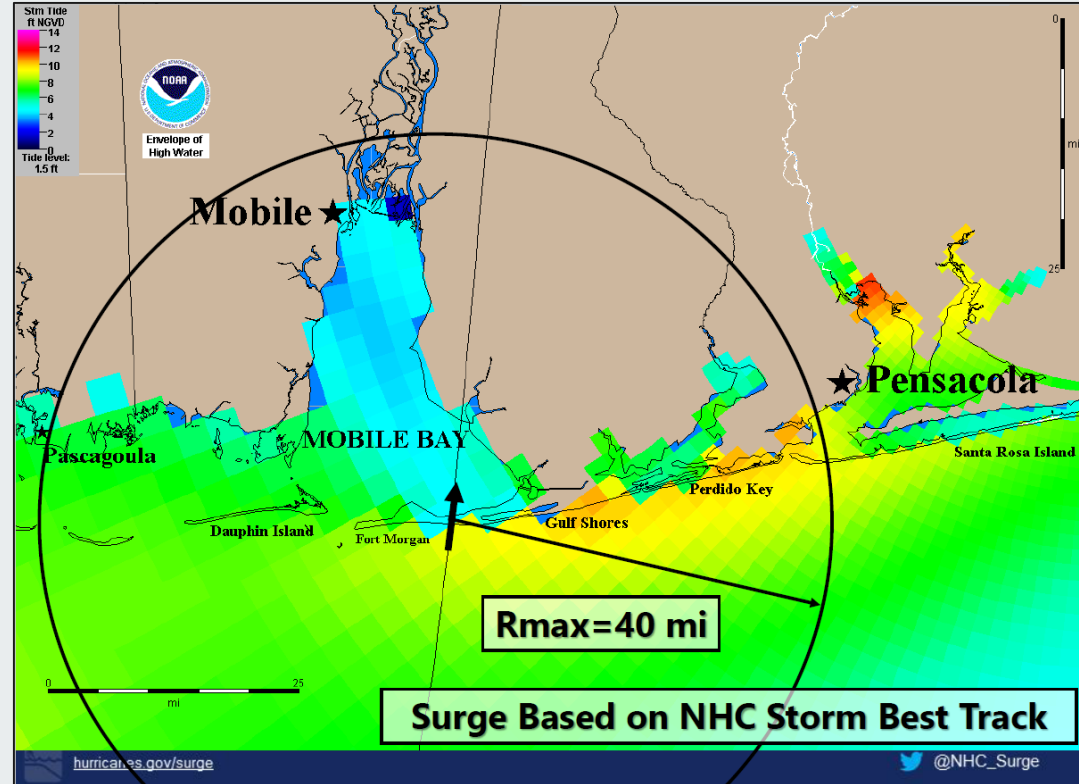
Forecast surge



Storm Surge

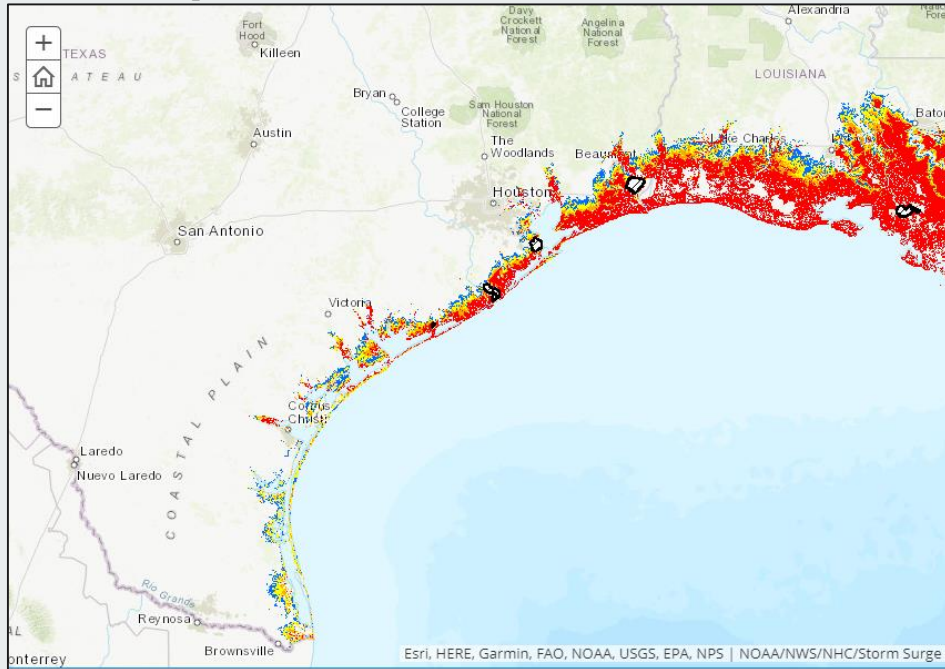


Observed surge



Storm Surge – Readiness, Planning & Mitigation

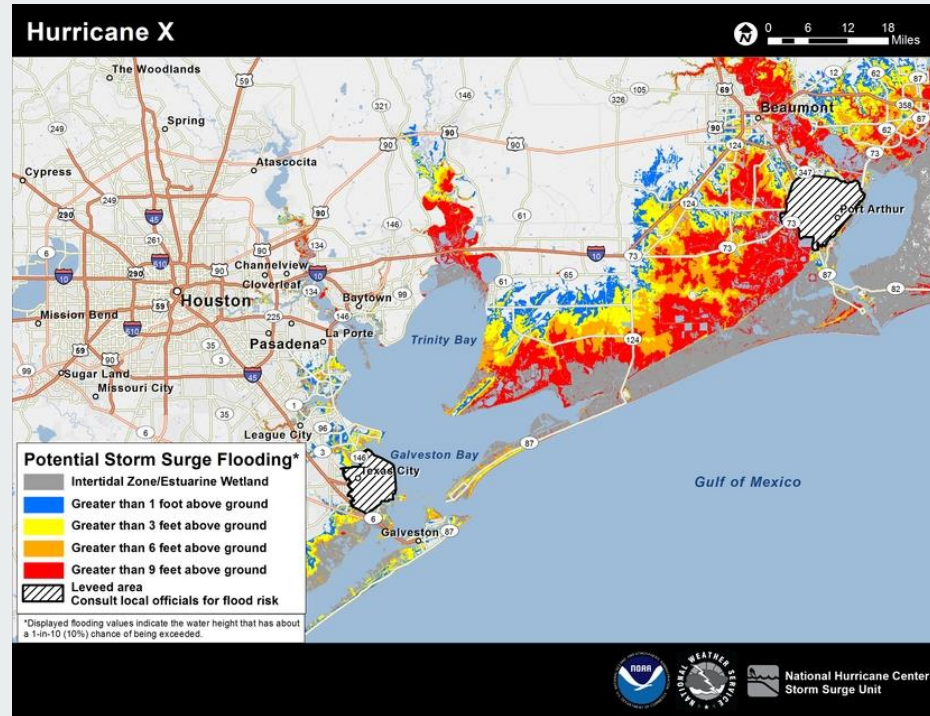
Landfall 48+ hours out: pre-computed *risk* maps (SLOSH MOMs and MEOWs).



- ❑ Maps made by using up to 100,000 hypothetical storms to compute the maximum storm surge at an individual point.
- ❑ Varying forward speed, radius of maximum wind, intensity, landfall location, tide level, and storm direction.
- ❑ Ask your local NWS where to find these maps and how to read them.
- ❑ To access SLOSH MOMs:
<https://noaa.maps.arcgis.com/apps/MapSeries/index.html?appid=d9ed7904dbec441a9c4dd7b277935fad&entry=1>

Storm Surge - Response

<48 hours before landfall: NHC Potential Storm Surge



- ❑ Shows geographical areas where inundation from storm surge could occur and how high above ground the water could reach in those areas.
- ❑ Based on the latest forecast track and intensity of the tropical cyclone.
- ❑ Takes into account likely forecast errors.
- ❑ The shading represents inundation levels that have a 10 percent chance of being exceeded, which can therefore be thought of as representing a reasonable worst-case scenario for any individual location.
- ❑ Updated every six hours or so.



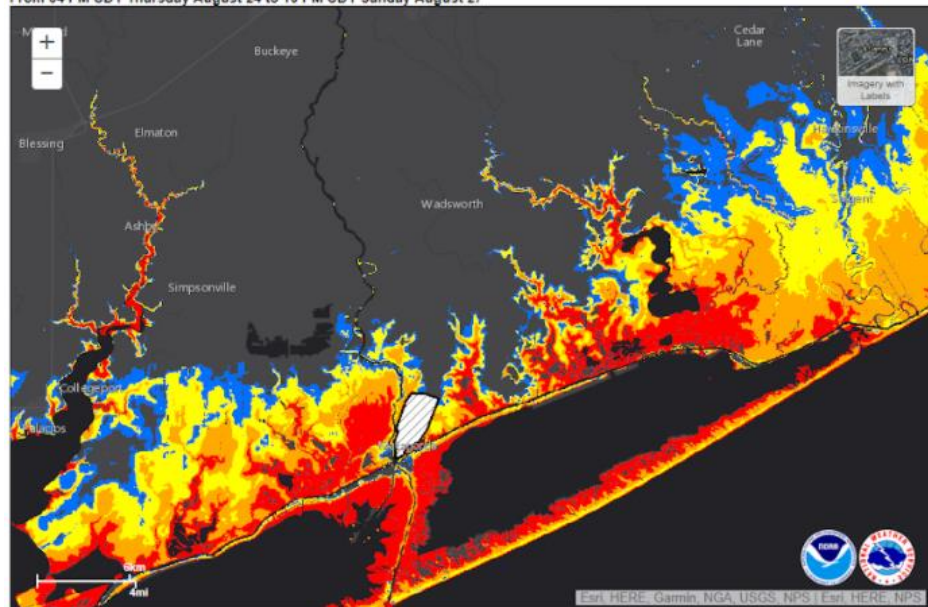
Where to Find the Potential Storm Surge Flooding Map?

NWS Houston/Galveston

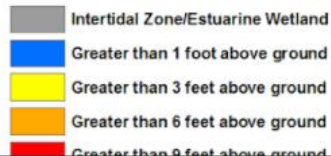
f NWSHouston

@NWSHouston

NHC Potential Storm Surge Flooding Map
Hurricane HARVEY (2017) Advisory 18
From 04 PM CDT Thursday August 24 to 10 PM CDT Sunday August 27



Potential Storm Surge Flooding*



Map Layer Options:

Map Layer Options:

☒ Inundation Layer Only ☐ Inundation with Intertidal Layer

- To access map: <https://www.nhc.noaa.gov/> and select "Storm Surge Inundation under the respective tropical storm/hurricane.

Atlantic - Caribbean Sea - Gulf of Mexico

Tropical Weather Outlook (en Español)

200 PM EDT Wed Aug 23 2017

Tropical Weather Discussion

205 PM EDT Tue Aug 23 2017

Tropical Depression Harvey

Satellite | Buoys | Grids | Storm Archive

...HARVEY MOVING LITTLE BUT EXPECTED TO RESUME A NORTHWESTWARD COURSE SOON...

1:00 PM CDT Wed Aug 23

Location: 21.5°N 92.5°W

Moving: Stationary

Min pressure: 1005 mb

Max sustained: 35 mph

Public Advisory

#12A

100 PM CDT

Aviso Publico*

#12A

100 PM CDT

Forecast Advisory

#12

1500 UTC

Forecast Discussion

#12

1000 AM CDT

Pronóstico Discusión*

#12

1000 AM CDT

Wind Speed Probabilities

#12

1500 UTC



Wind Speed Probabilities



Experimental Arrival Time of Winds



Wind History



Warnings/Cone Interactive Map



Warnings/Cone Static Images



Warnings and Surface Wind



Storm Surge Inundation

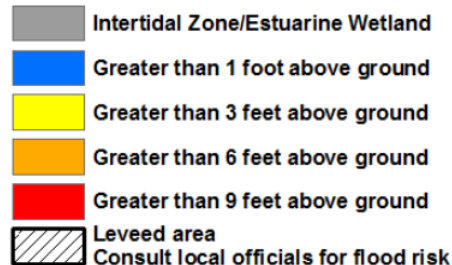


Storm Surge Watch/Warning

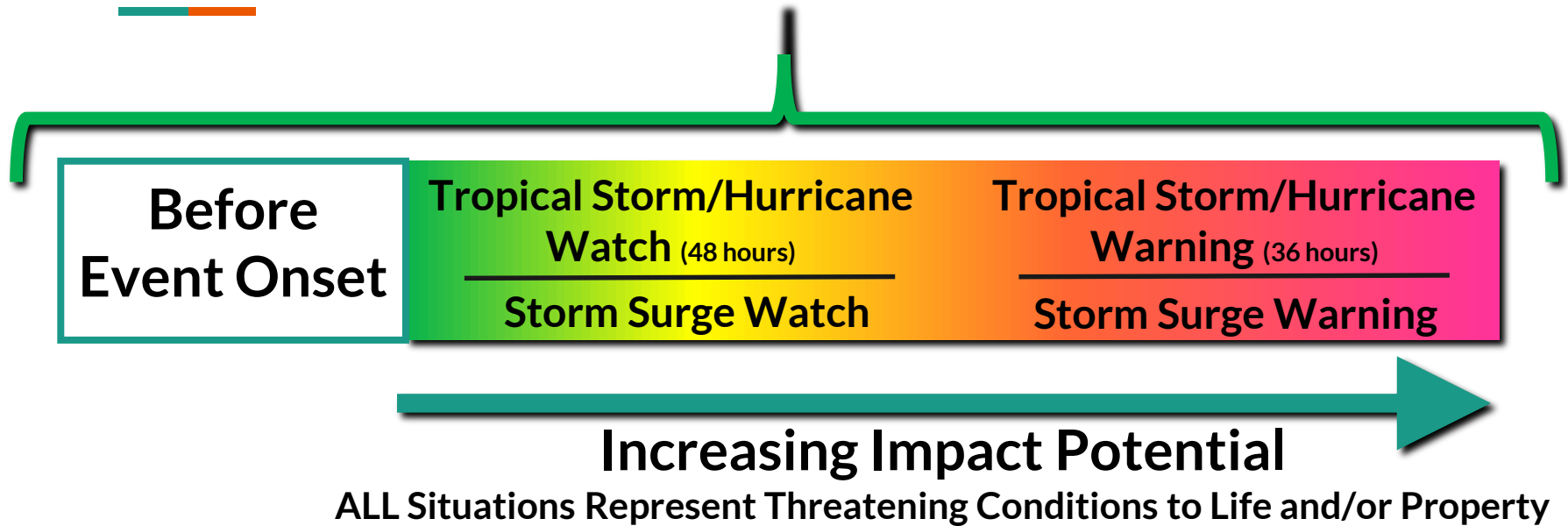


U.S. Rainfall Potential

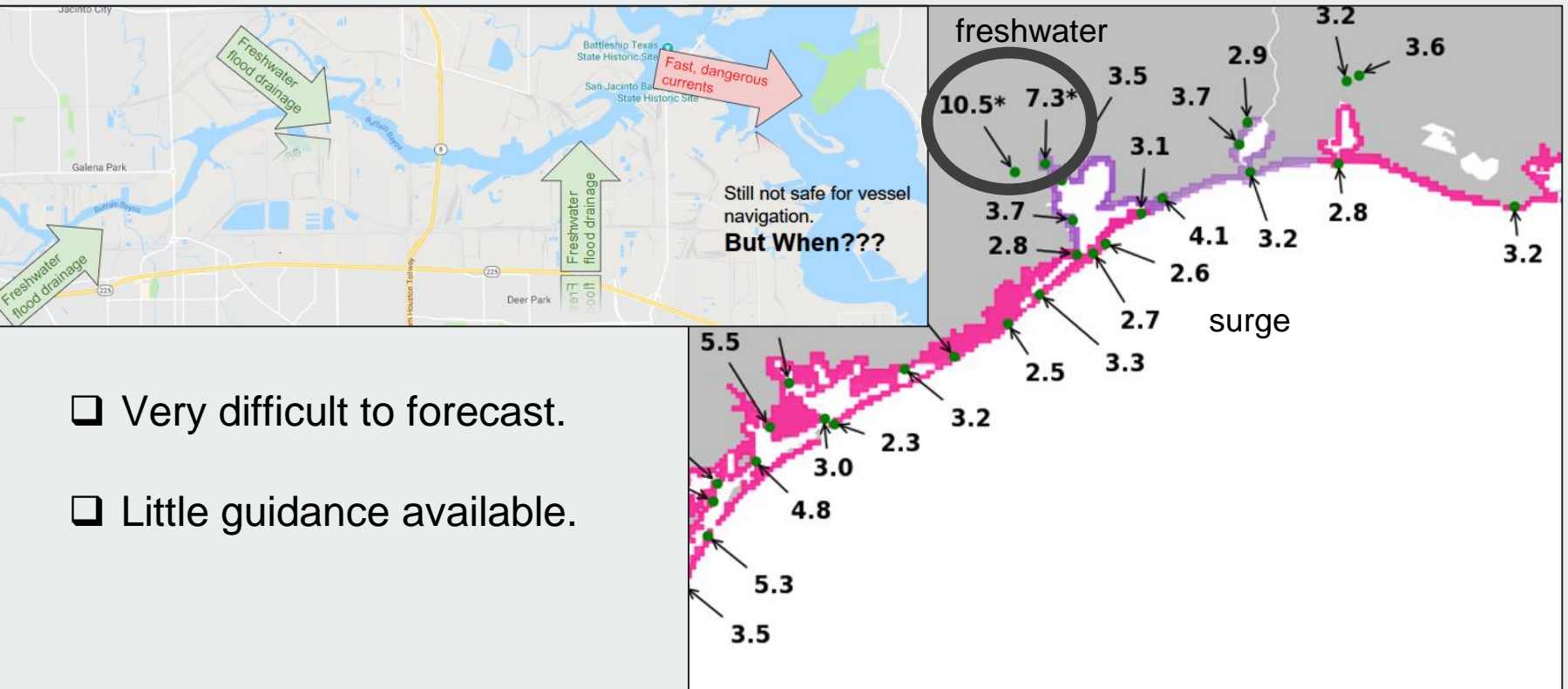
Potential Storm Surge Flooding*



Tropical Cyclone Timeline



Storm Surge + Freshwater Flooding (Harvey)





River Flooding

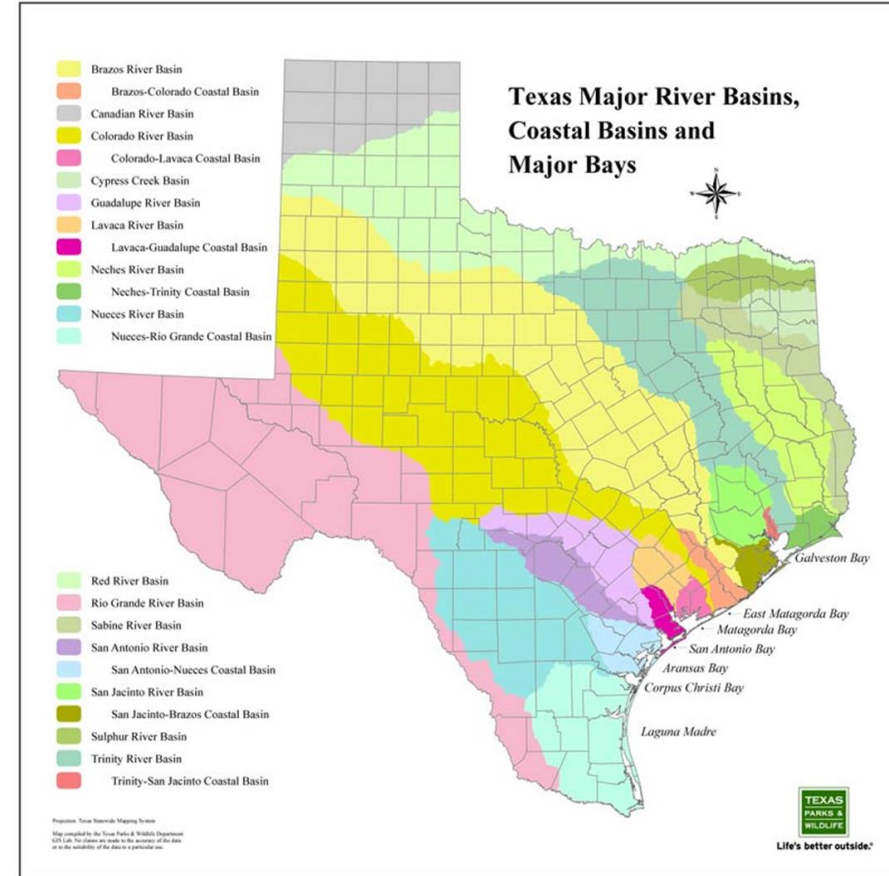
River Flooding



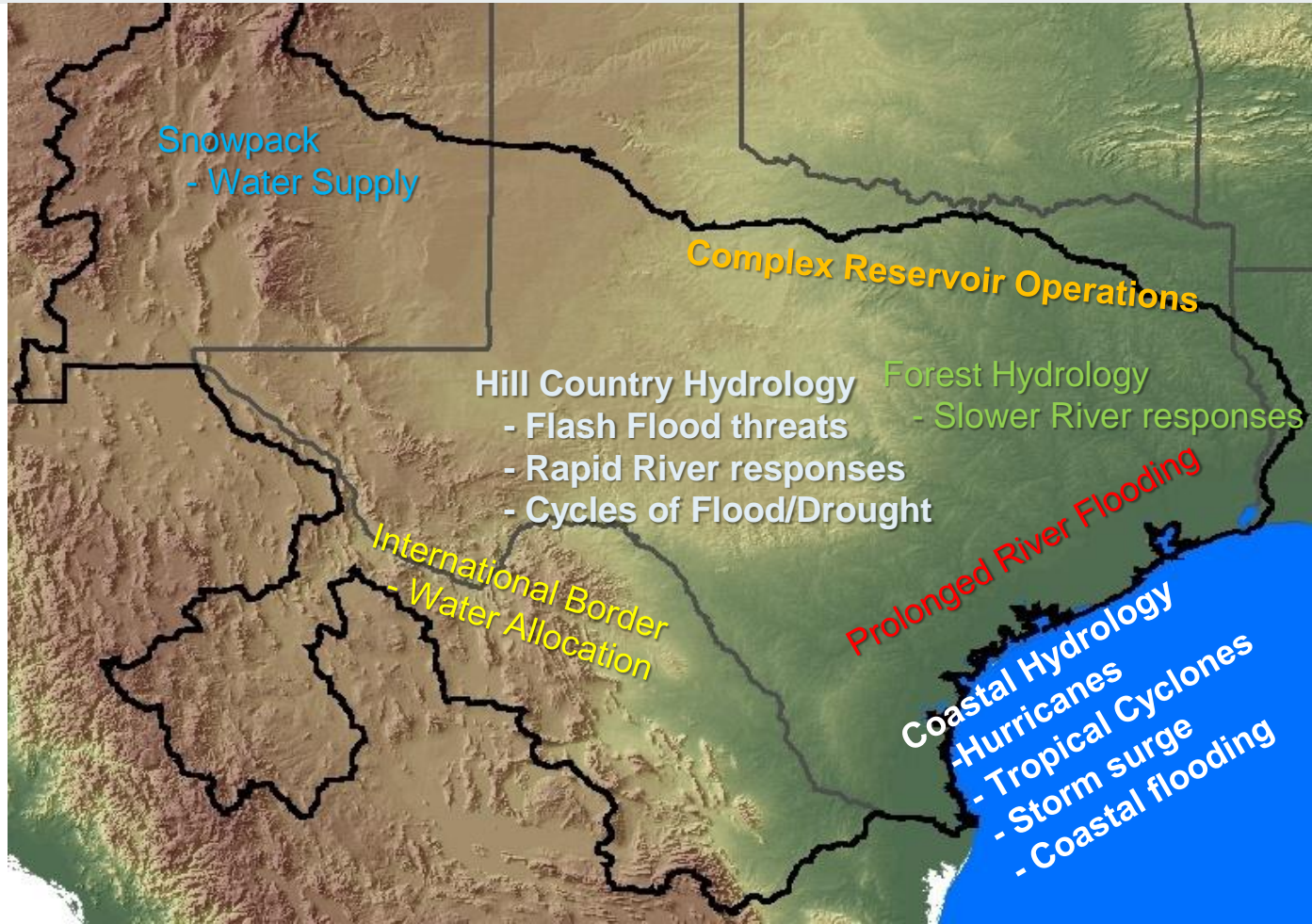
River flooding occurs when water escapes the river banks. There are different thresholds for river flooding: action, minor, moderate, major and record flooding. This image depicts what a river flooding looks like.

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.

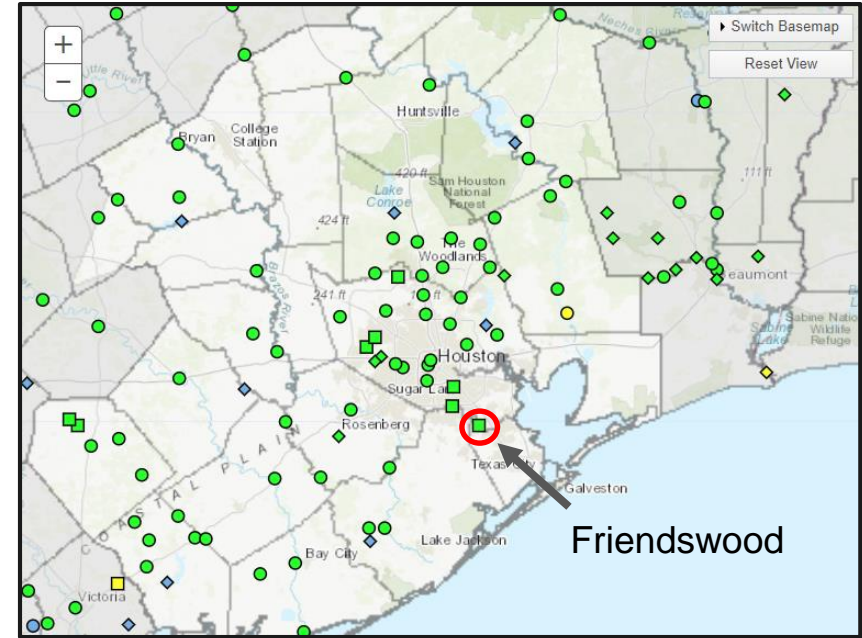


Diverse Watershed Characteristics in Texas



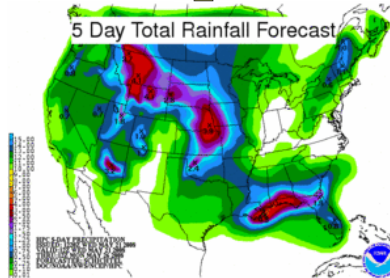
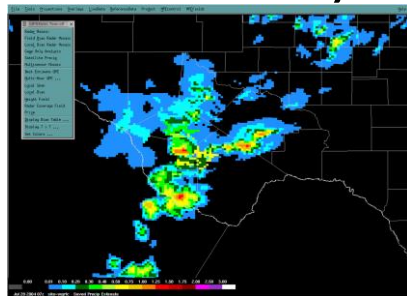
Watershed

- 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.
- Galveston County has 1 site specific forecast point.



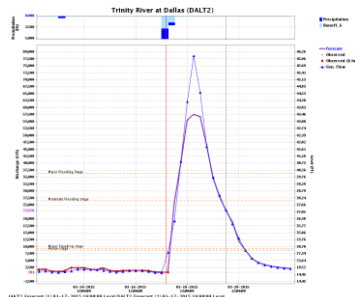
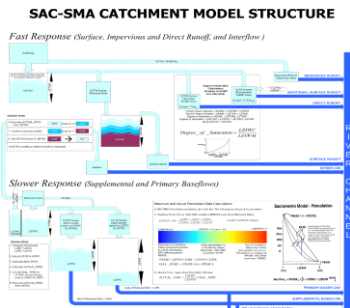
River Forecast Process

Rainfall Analysis



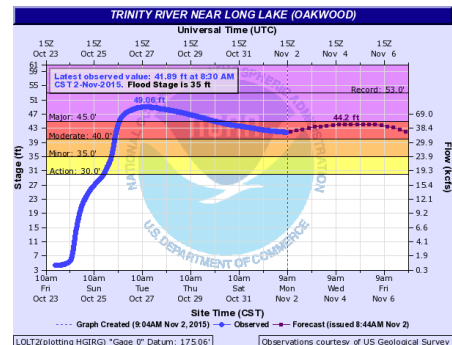
Rainfall estimates and forecasts merged into continuous dataset

Hydrologic Modeling



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

Forecast



Warning

FLOOD WARNING
NATIONAL WEATHER SERVICE HOUSTON/GALVESTON, TX
926 PM CDT THU MAY 26 2016

...The National Weather Service in Houston/Galveston has issued a flood warning for the following rivers...

Brazos River in Richmond affecting the following counties in Texas...Austin and Fort Bend

/XC015-039-157-473-271425-
/O.NEW.KHGX.FL.W.0149.160529T0730Z-000000T0000Z/
/R/NOT2.1.ER.160529T0730Z.160531T0600Z.000000T0000Z.NO/
126 PM CDT THU MAY 26 2016

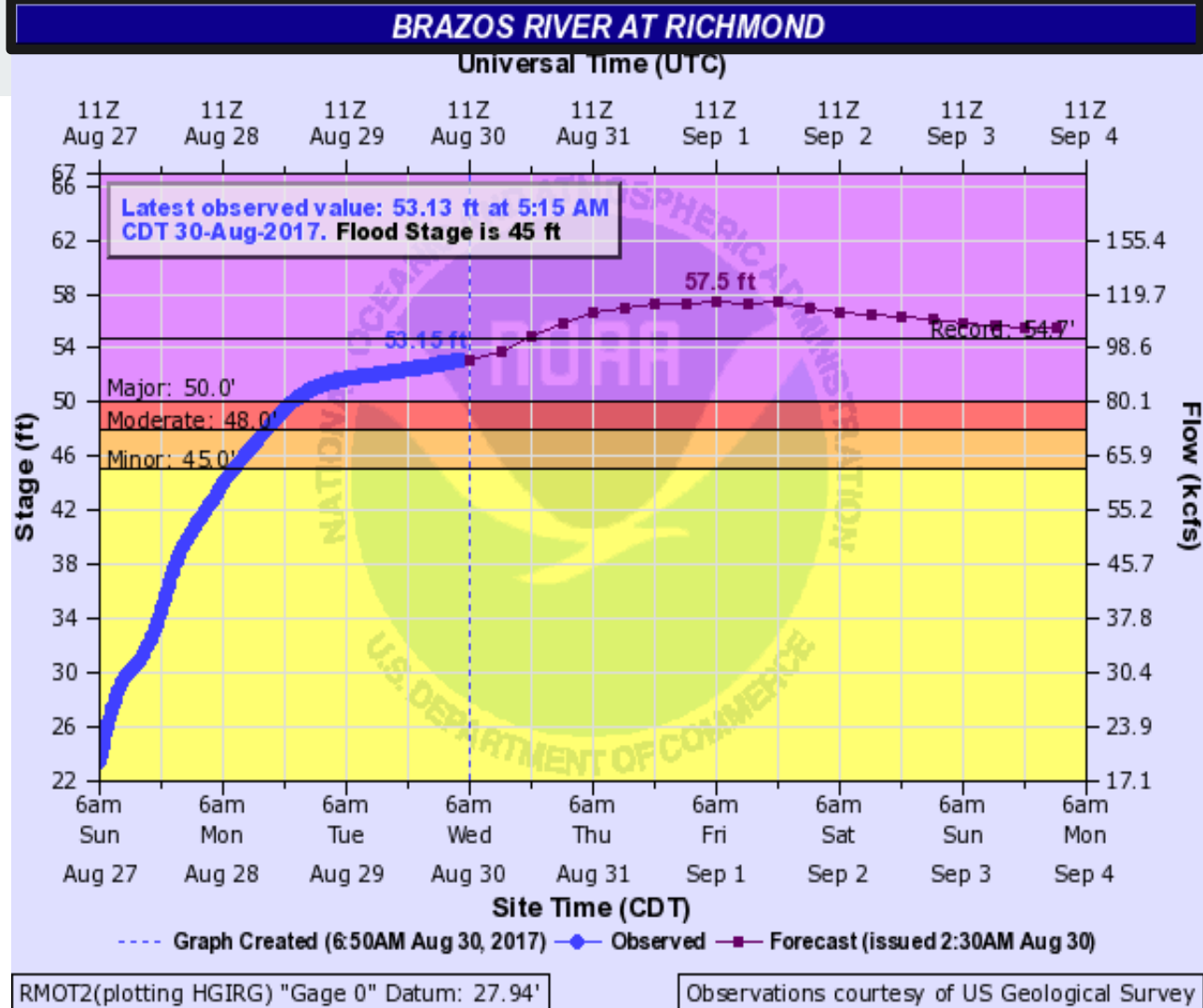
The National Weather Service in Houston/Galveston has issued a

Flood Warning for
The Brazos River in Richmond.
from late Saturday night until further notice...or until the warning is canceled.

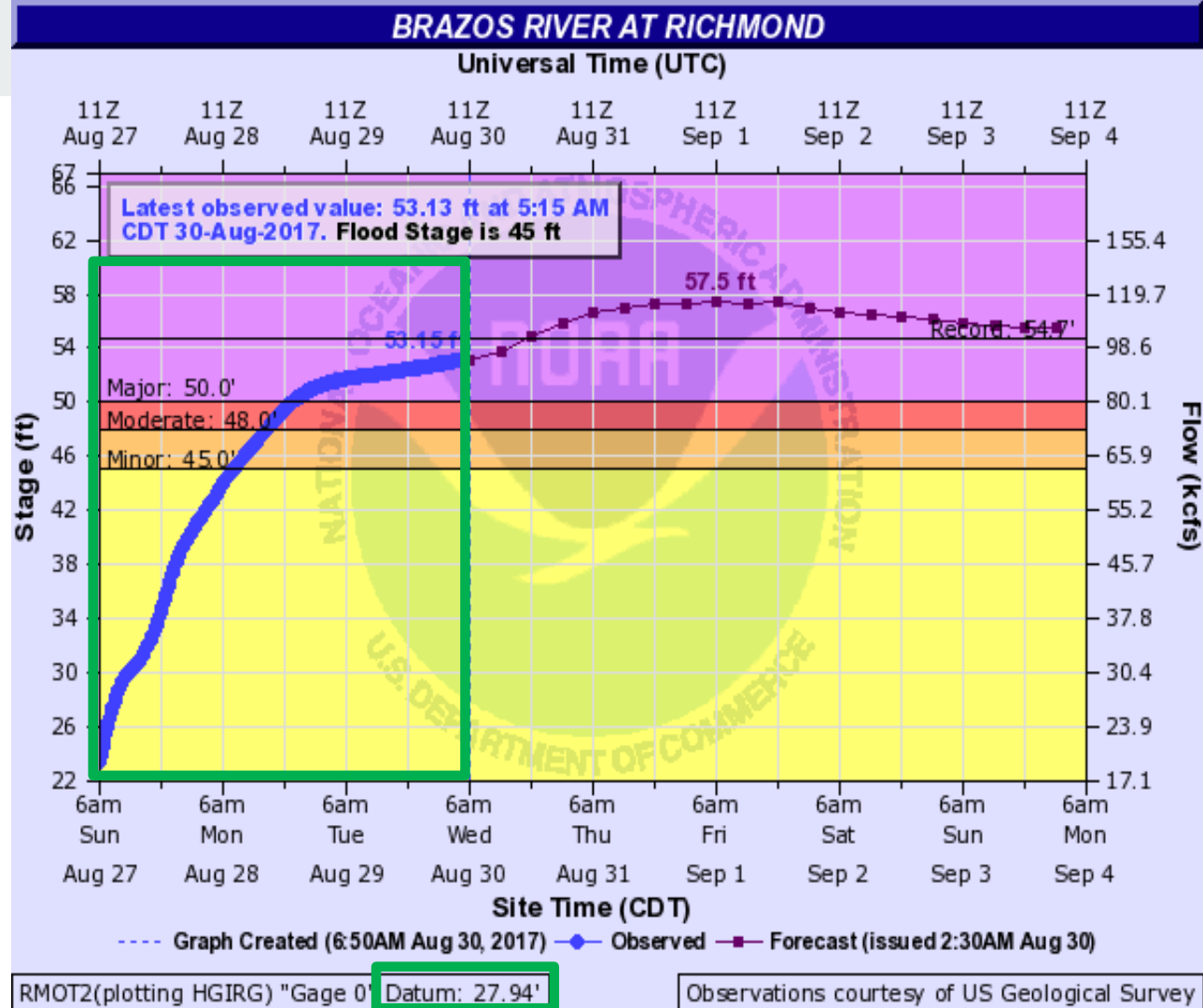
Hydrograph Basics

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



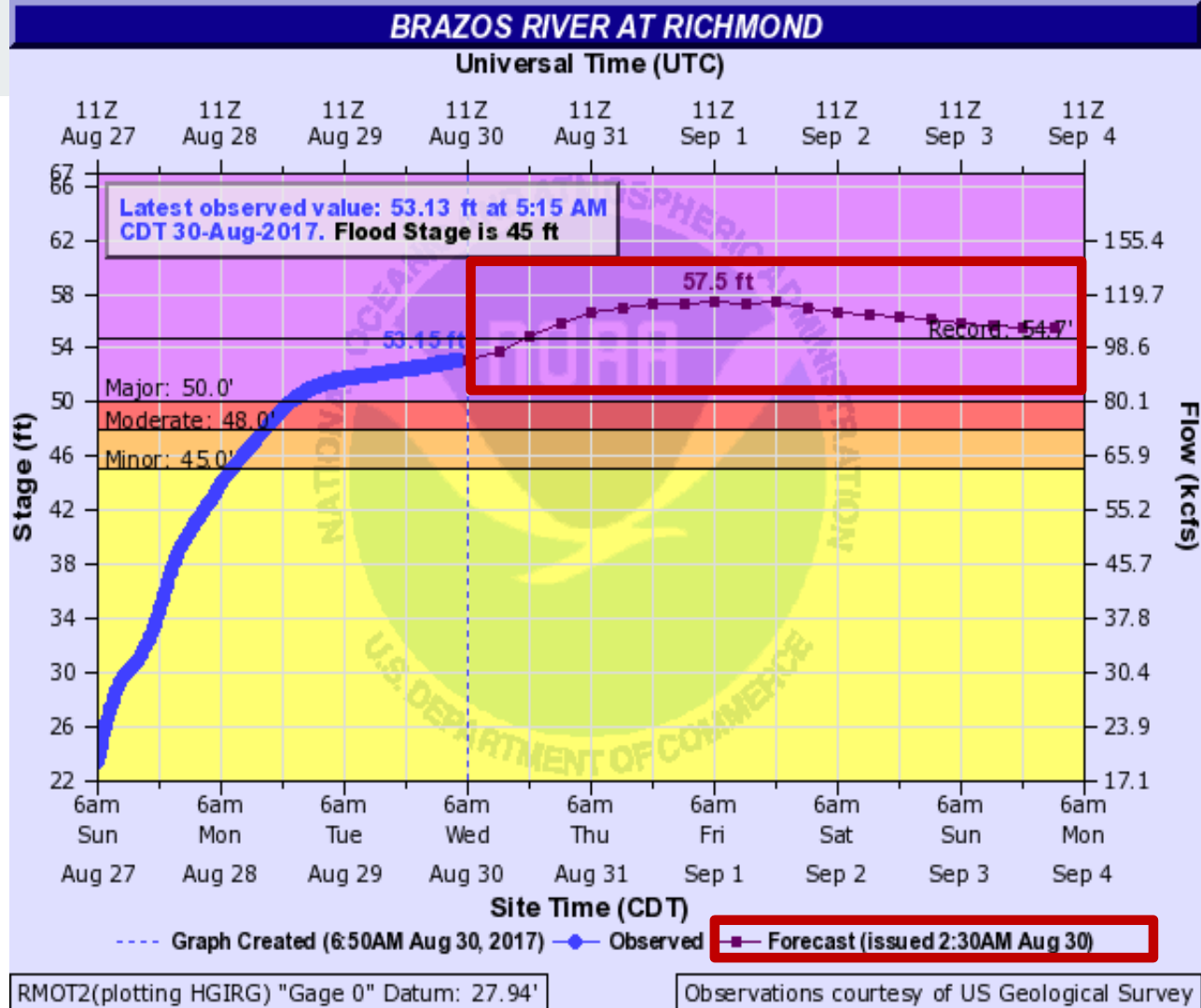
DATUM:
Adjustment to
mean sea level



Hydrograph Basics

FORECAST:
Forecast River
Stages

CREST:
Peak Stage

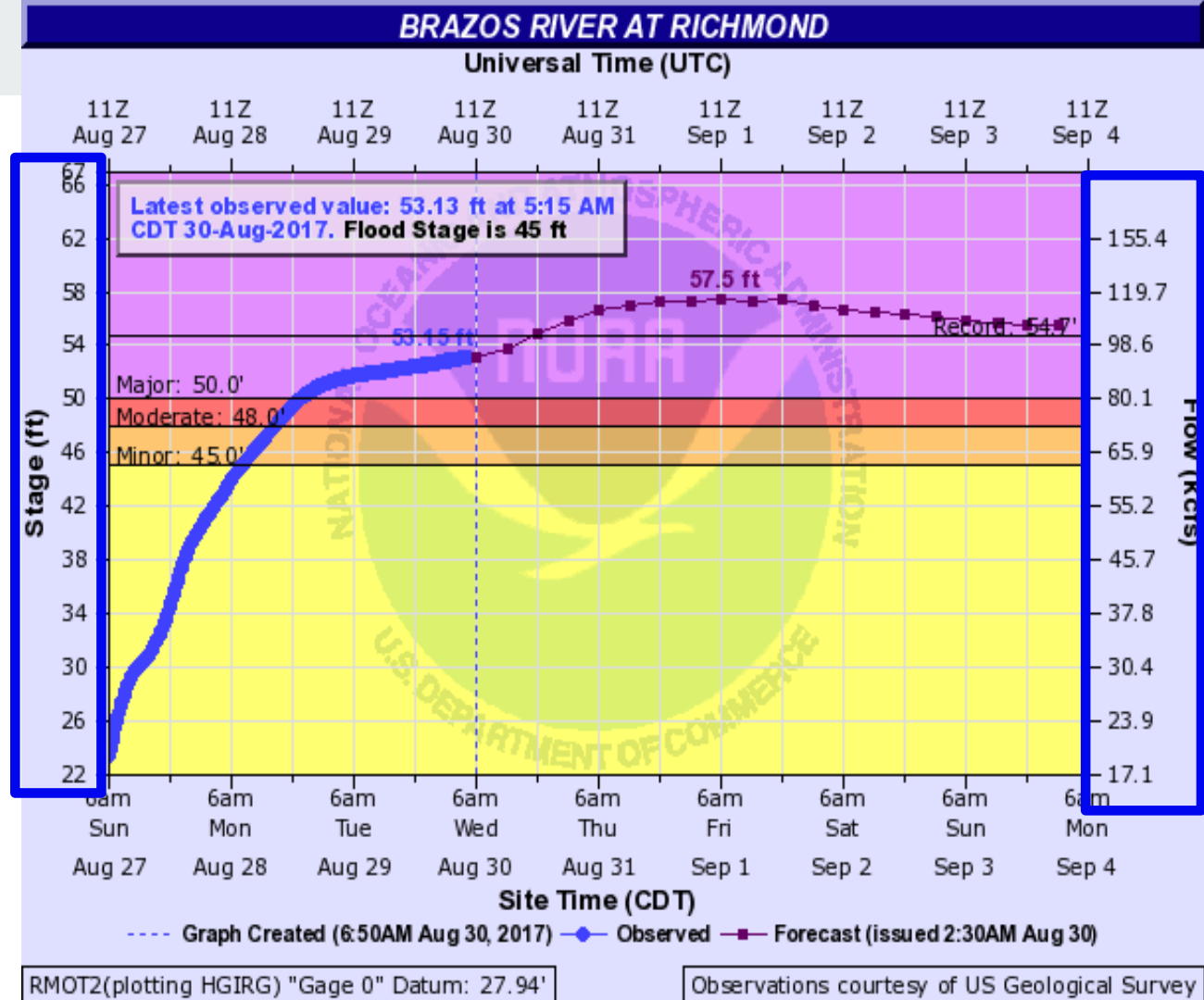


Hydrograph Basics

STAGE VS FLOW:

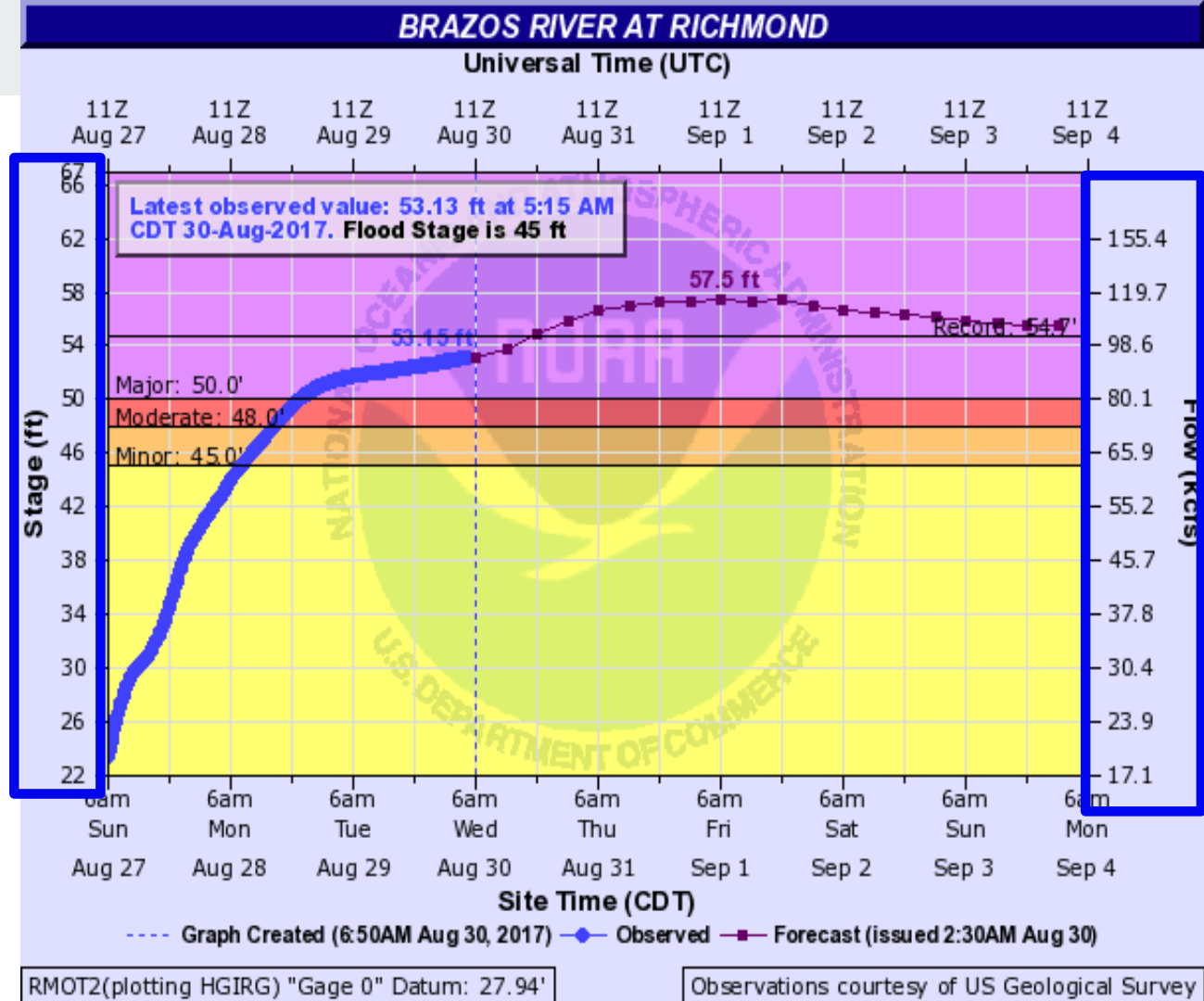
Hydrologists,
models, reservoirs
work in flow.
Emergency
managers, media,
general public work
in stage.

What is flow or a
cubic foot per
second?



Hydrograph Basics

A basketball is roughly a cubic foot, so 20,000cfs 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

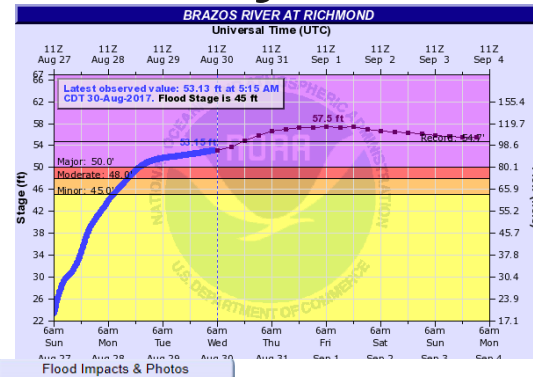
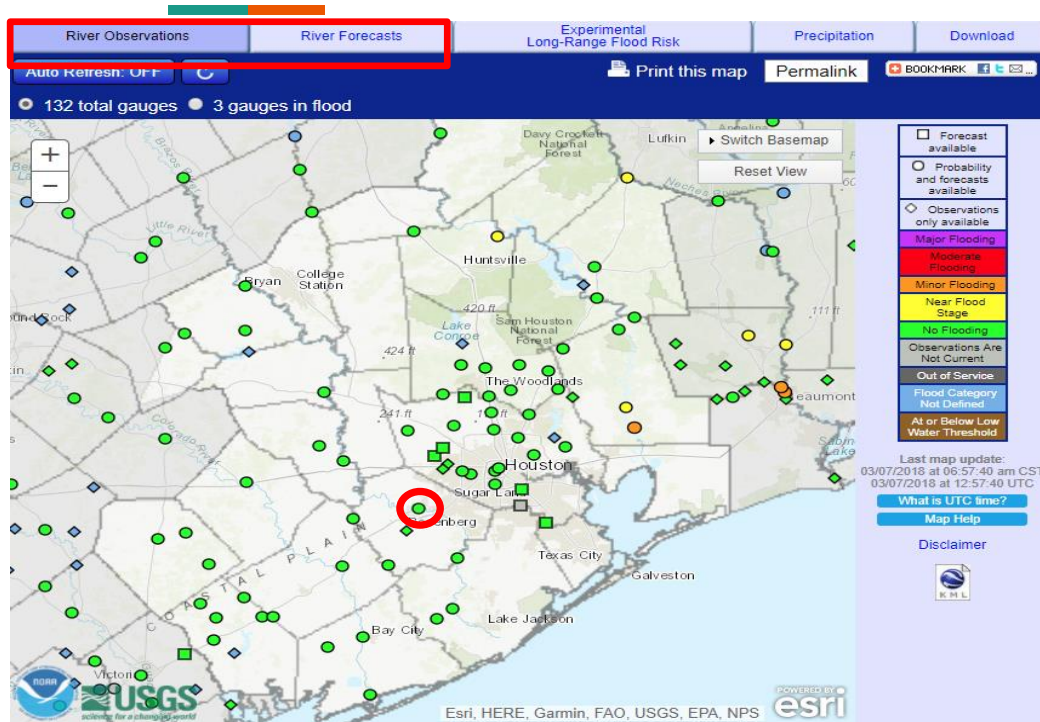
MODERATE

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



Flood Categories (in feet)	
Major Flood Stage:	50
Moderate Flood Stage:	48
Flood Stage:	45
Action Stage:	20
Low Stage (in feet):	0

Historic Crests

- (1) 55.19 ft on 09/01/2017
 - (2) 54.74 ft on 06/02/2016
 - (3) 50.30 ft on 10/21/1994
 - (4) 50.01 ft on 06/03/2015
 - (5) 49.68 ft on 01/01/1992
- [Show More Historic Crests](#)

(P): Preliminary values subject to further review.

Recent Crests

- (1) 55.19 ft on 09/01/2017
- (2) 54.74 ft on 06/02/2016

[Collapse](#)

If you notice any errors in the below information, please contact our Webmaster

- Major flooding continues with significant home flooding in the following areas: Valley Lodge near Simonton, Bar Rd, Baker Rd/Cummings Rd/Rio Brazos area north of Rosenberg, Edgewood/Baudet Rd in Richmond, and FM 2759 near Thompsons. Low lying homes in Grand River, Rivers Edge, Pecan Estates in Thompson, and Pecan Bend flood as well.
- Major flooding continues with US90A eastbound lanes inundated and impassible between Harlem Rd and New Territory. Pitts Rd is impassible between US90A and Savannah Dr.
- Major lowland flooding continues with FM 359 impassible between US90A and the Pecan Grove levee near Southern Place Dr. The intersection of FM 359 and Mason Rd is impassible. FM 2759 is completely inundated east of Agnes Rd. Street flooding occurs along Sienna Parkway between McKeever Rd and Steep Bank Trace. Street flooding occurs along McKeever Rd between Sienna Parkway and SH6. Miller Rd near Arcola is inundated.
- Major lowland flooding continues with homes near intersection of Sixth St. and Avenue B in Rosenberg beginning to take on water. FM 1489 is inundated south of Simonton to Johnson Rd. FM 723 is inundated north of Rosenberg to FM 359, making the Kingdom Heights and Riverside ranch subdivisions inaccessible. FM 359 between US90A and Pecan Grove begins taking on water. Thompson Ferry Rd south of LJ Parkway is inundated outside of the leveed area.
- Major lowland flooding continues with homes flooding along Cummings/Baker Roads and in Rio Brazos north of Rosenberg. FM 1093 is inundated to Stansberry Rd in Simonton. Underpass at intersection of SH36/90A west of Rosenberg is inundated/impassible. Fort Bend County flood fight operations in Simonton are exceeded and cease. Low lying streets on west side of Quail Valley take on water. Feeder roads along SH6 near intersection of FM 521/McKeever Rd are inundated. Low lying areas along Knights Ct take on water.
- Major lowland flooding begins as homes in Richmond begin flooding and many homes in Simonton and Thompsons have water in them. FM 1458 near FM 1093 remains inundated and closed. Homes along Carroll and McKeever Roads near FM 2759 in southeast Fort Bend County are close to taking water. Strange Drive, Greenwood Drive, and Second Street in Richmond and Sixth Street, Avenue B, and River Road in Rosenberg and Pittman Road in Thompsons are inundated with over one foot of water.

<http://water.weather.gov/ahps2/index.php?wfo=hgx>

USGS Water Alerts

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

USGS
science for a changing world

WaterAlert

Sites Map

Select Location

News updated September 30, 2013

Search by Street Address:
Enter Street Address

Search by Place Name:
Enter Place Name

Search by Site Number(s):
Enter Site Number(s)

Search by State/Territory:
Select an Area

Search by Watershed Region:
Select a Region

Select Data Type

About WaterAlert

How To Use WaterAlert

Related Information

Sam Houston National Forest

The Woodlands

Houston

Pasadena

Baytown

Sugar Land

Missouri City

Pearland

League City

Reynoldsburg

Angleton

Brazoria Natl Wildlife Refuge

Lake Jackson

0 10 20mi

95.597, 29.141

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

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:

- [about this...](#)
- ☐ My mobile phone
- ☐ My email address

Notification Frequency:

- [about this...](#)
- Hourly ☐
- Daily ☒

Streamflow Parameter(s):

[about this...](#) Recent value:

Discharge, in ft³/s ☒ 7260 [\[peak chart\]](#)

Gage height, in ft ☐ 42.78 [\[peak chart\]](#)

Alert Threshold Condition:

- [about this...](#)
- ☒ Greater than (>)
- ☐ Less than (<)
- ☐ Outside a range (< or >)
- ☐ 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

[Related Information](#)



USGS Water Alerts:

<https://maps.waterdata.usgs.gov/mapper/wateralert/>



Partners

Partners

Roles of Primary River Forecast Partners



**US Army Corps
of Engineers®**

- Operate Flood Control Reservoirs
- Manage Other WR Projects



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



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

Shared Data and Resources



**US Army Corps
of Engineers®**

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



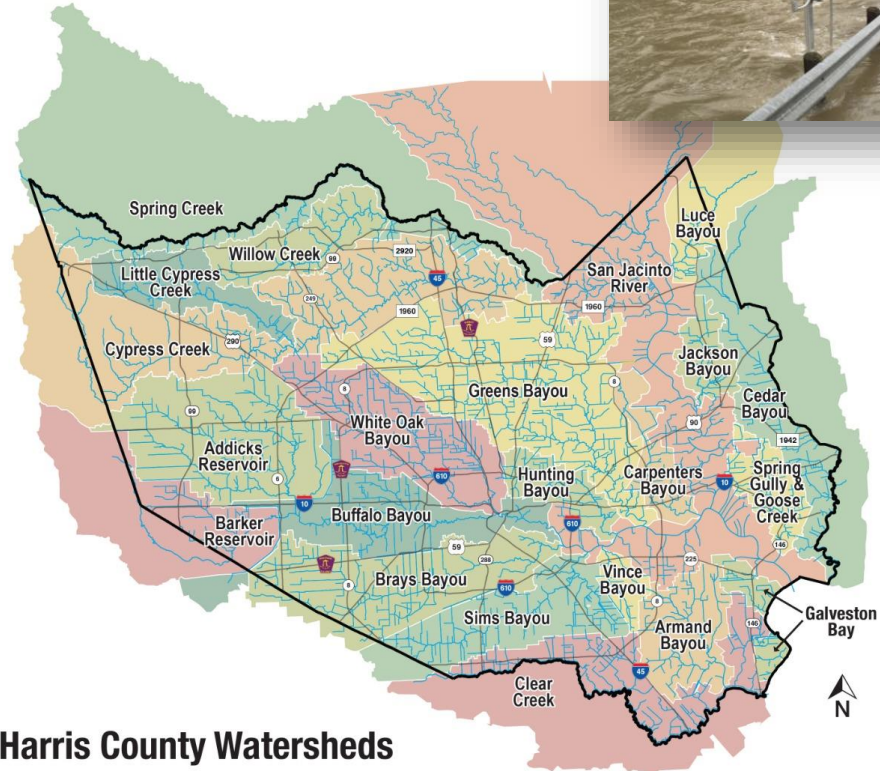
- Gage Maintenance
- Stream Measurements
- Focus Stream Gage Network



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

Harris County Flood Control District

- HCFCFCD's mission is to provide flood damage reduction projects that work, with appropriate regard for community and natural values.
 - Devise flood damage reduction plans
 - Implement the plans
 - Maintain the infrastructure
- Flood Warning System
- Public Website:
www.harriscountyfws.org



Harris County Watersheds



Weather Alert

Beach Hazards Statement issued October 10 at 4:29AM CDT until October 10 at 7:00

CONTACT US



FWS MAP | ALERTS | ABOUT FWS | DOCUMENT LIBRARY | GLOSSARY | FAQs | HELPFUL RESOURCES

HELP

MAP VIEW OPTIONS

- ☐ Watersheds
- ☐ Channels
- ☐ Inundation Map
- ☒ Rainfall
- ☐ Channel Status

Mouse over map label for more information

RAINFALL DATA

Current Historical
Rainfall in the last 24 Hours
[Refresh Data](#)

GAGE SELECTIONS

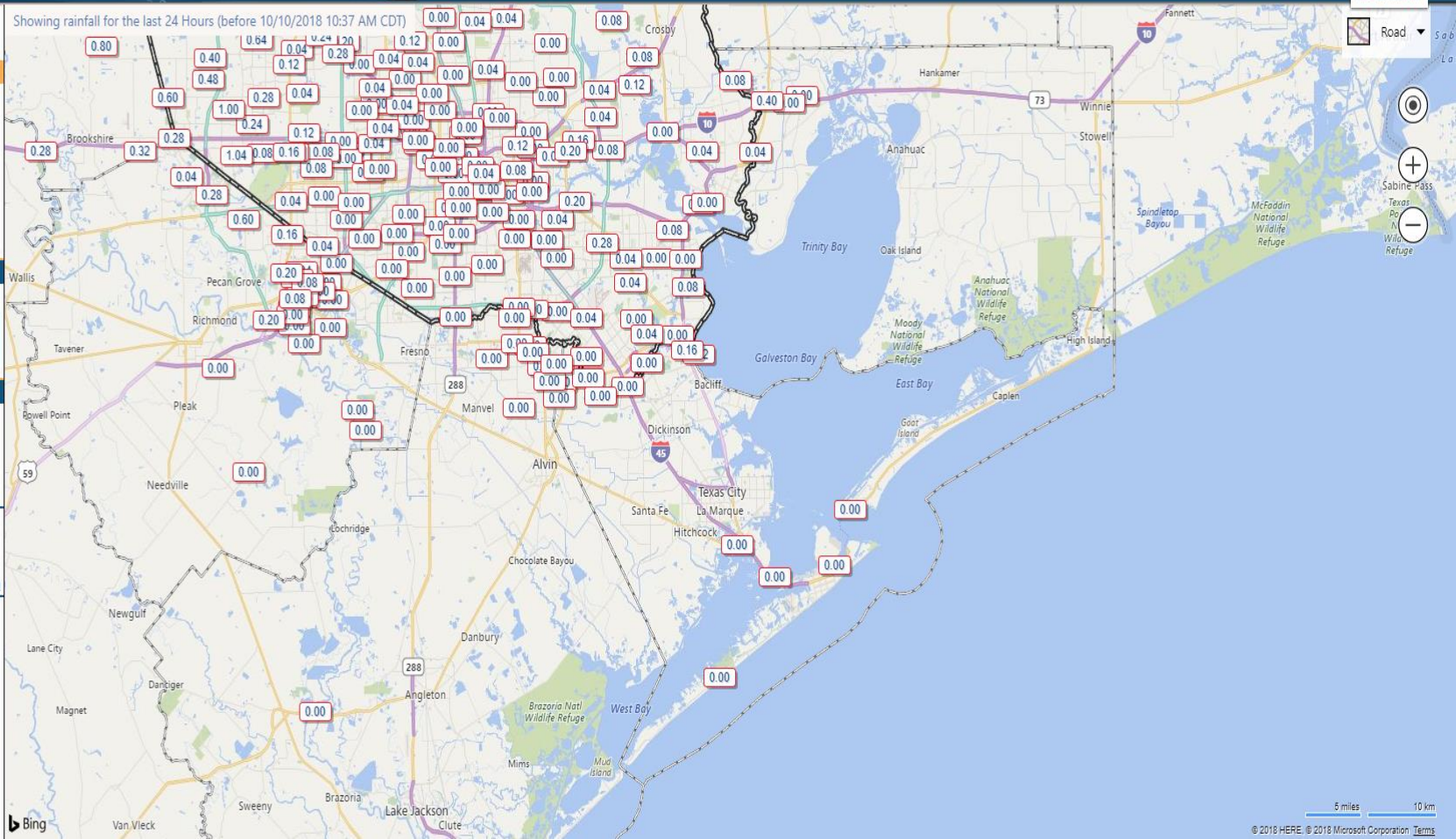
Gages by Agency
ALL
Gage by Location
(Select Gage)

ADDRESS SEARCH

Find
e.g. 5900 Northwest Fwy, Houston 77092
[Clear Search](#)

An interactive map of the
Harris County Flood Control District

[Disclaimer](#)



5 miles 10 km

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Weather Alert

*by NWS in effect for Coastal Brazoria, Coastal Galveston, Coastal Harris, Coastal Jackson

CONTACT US



FWS MAP | ALERTS | ABOUT FWS | DOCUMENT LIBRARY | GLOSSARY | FAQs | HELPFUL RESOURCES

HELP

MAP VIEW OPTIONS

- ☐ Watersheds
- ☐ Channels
- ☐ Inundation Map
- ☐ Rainfall 0.00
- ☐ Channel Status
- ☐ Channel Status not Defined
- ☐ Water in Bank
- ☐ Near Top of Bank
- ☐ Out of Bank

Mouse over map label for more information

SURFACE LEVEL DATA

Current Historical

Showing the latest surface levels

[Refresh Data](#)

GAGE SELECTIONS

Gages by Agency

ALL

Gage by Location

(Select Gage)

ADDRESS SEARCH

Find

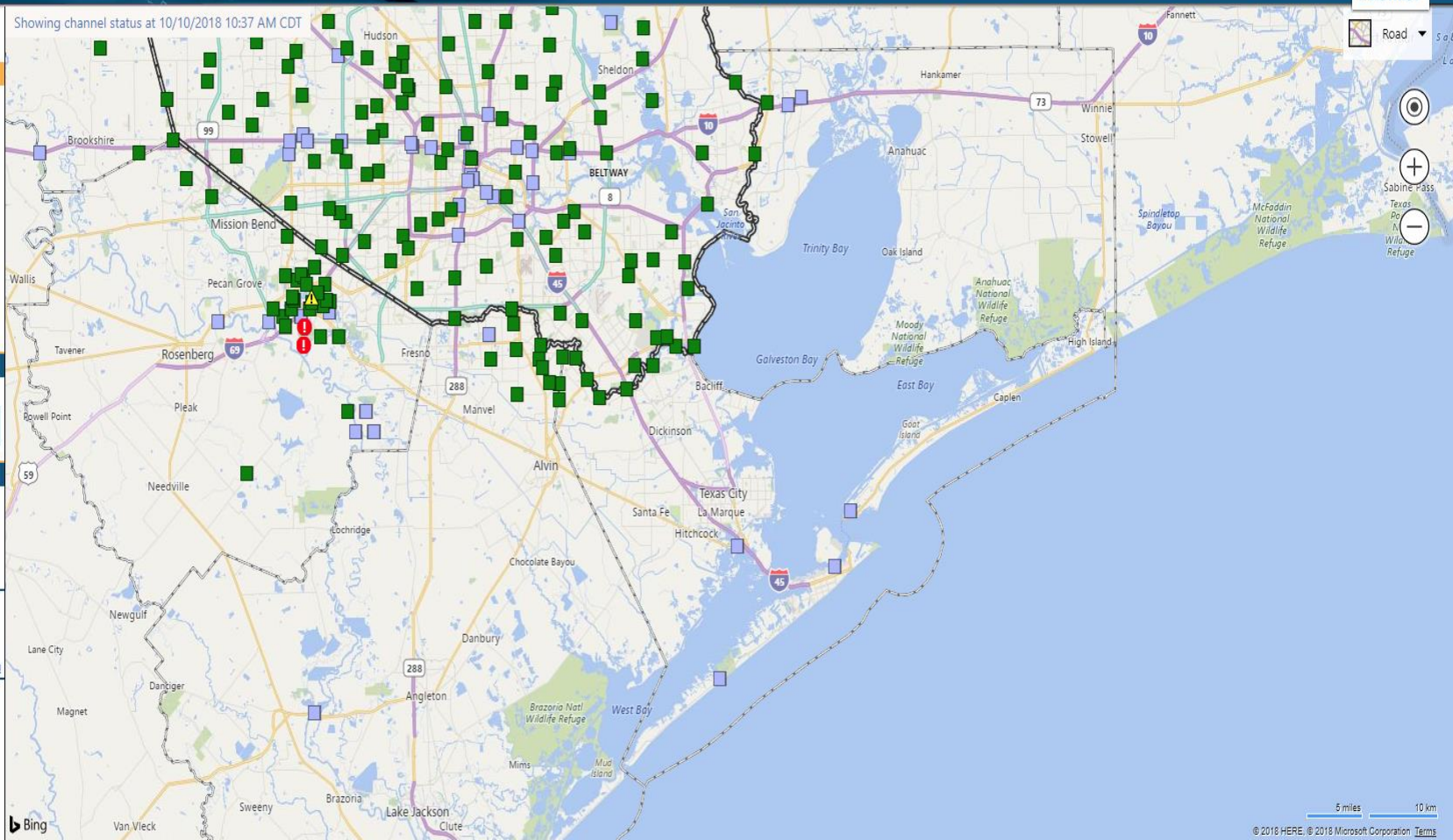
e.g. 9900 Northwest Fwy, Houston 77092

[Clear Search](#)



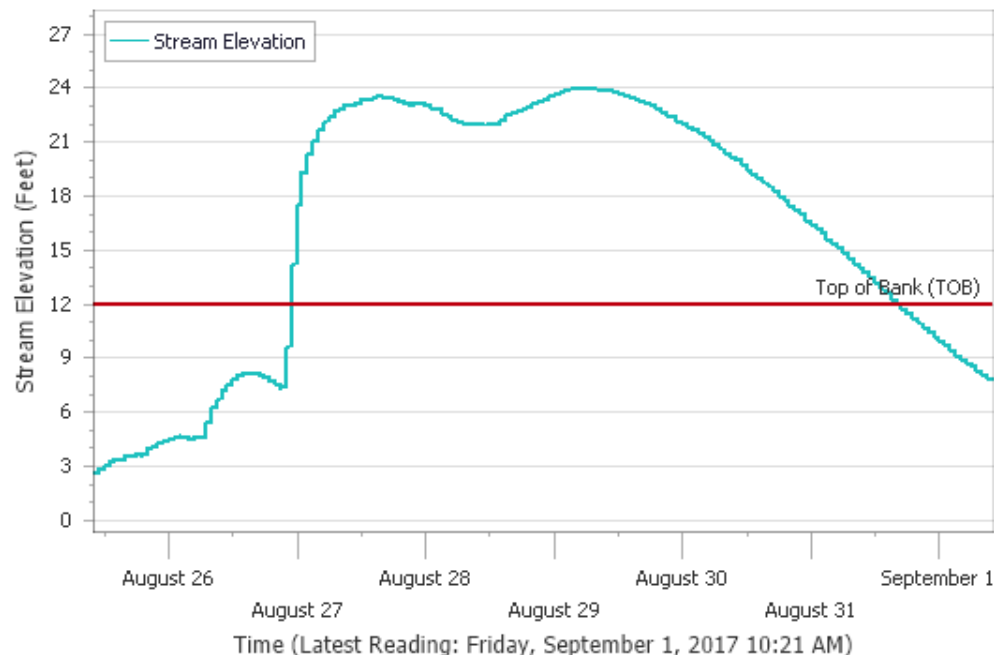
An interactive map of the Harris County Flood Control District

[Disclaimer](#)



Flood Warning System

Stream Elevation
A100_120 Clear Creek @ FM 528



Flood Frequency	Elevation
10% (10-year)	17.50'
2% (50-year)	20.10'
1% (100-year)	21.00'
.2% (500-year)	23.10'

Date	Event	Elevation
6/20/1973		16.88'
9/20/1979		18.48'
5/3/1981		13.78'
8/18/1983	Alicia	14.38'
8/1/1989	Chantal	18.78'
10/18/1994		15.98'
6/9/2001	Allison	18.28'
10/16/2006		15.40'
8/16/2007	Erin	7.20'
4/18/2009		14.80'
8/27/2017	Harvey	24.20'

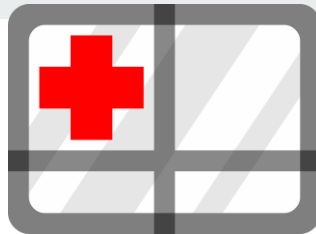
High water mark elevations are approximate.



Flood Safety

What to do before, during, and after a flood?

Safety Before a Flood

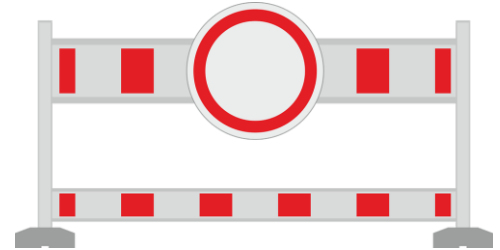


- Prepare a family disaster plan.
- Check if your insurance covers flood damages. If not, get flood insurance.
- Keep insurance and other important documents, such as copies of driver's licenses and credit cards, and other valuable items, in a safe place.
- Assemble a disaster supplies kit. Be sure to 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!



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!
- 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.



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!

Flooding Resources

Flood Safety

Turn Around Don't Drown

State Flood Information

Flood Hazards

NWS Flood Related Products

Forecasts and Observations

National Water Center

Education and Outreach Materials

Partner Agencies

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



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

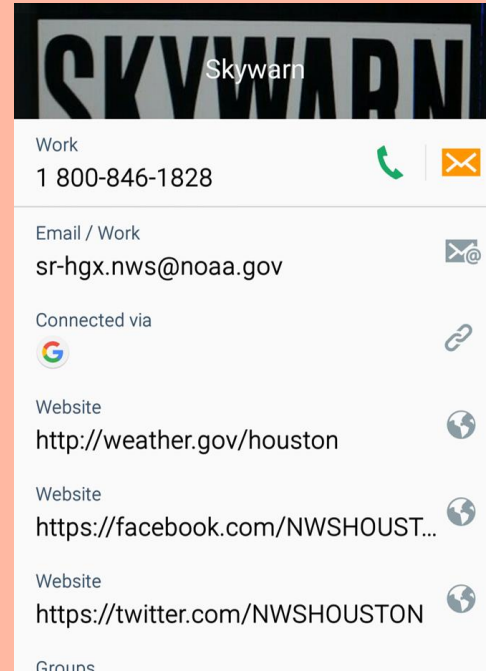
Email

sr-hgx.nws@noaa.gov

Social Media

Twitter: @NWSHouston

Facebook: NWSHouston



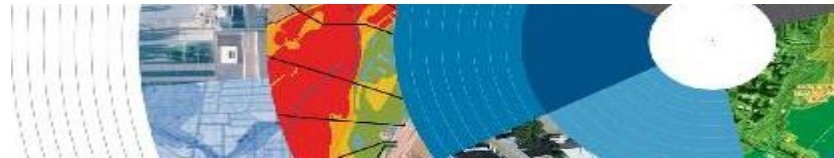
Spotter Tip

Set up SKYWARN as a contact
in your smartphone



Flood Risk

Flood Risk?



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

Everyone is at a risk for flooding.



FEMA

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.

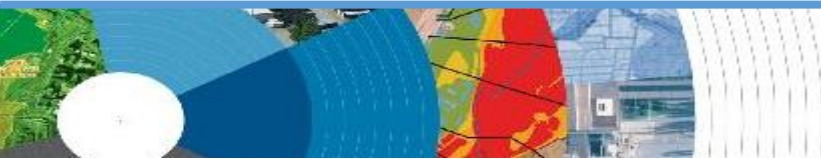
Renters and Business owners should also consider flood insurance for contents.

■ 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.

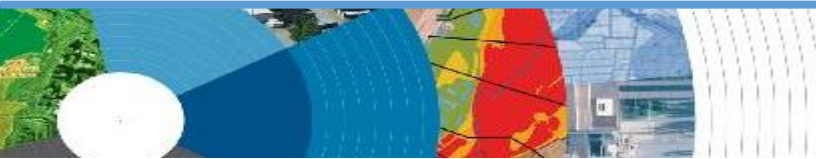


FEMA

Cost of Flood Damage?

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

Interior Water Depth (Inches)	Cost to Home	Cost to Personal Property	Combined Loss Potential
1"	\$23,635	\$3,172	\$26,807
2"	\$23,720	\$3,172	\$26,892
3"	\$24,370	\$4,917	\$29,287
4"	\$31,345	\$7,207	\$38,552
5"	\$31,425	\$13,914	\$45,339
6"	\$37,260	\$14,777	\$52,037
7"	\$37,691	\$17,700	\$55,391
8"	\$38,122	\$20,624	\$58,746
9"	\$38,553	\$23,547	\$62,100
10"	\$38,983	\$26,470	\$65,453
11"	\$39,414	\$29,394	\$68,808
12"	\$39,845	\$32,317	\$72,162
24"	\$44,325	\$43,001	\$87,326
36"	\$47,905	\$46,633	\$94,538
48"	\$53,355	\$50,000	\$103,355



FEMA

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

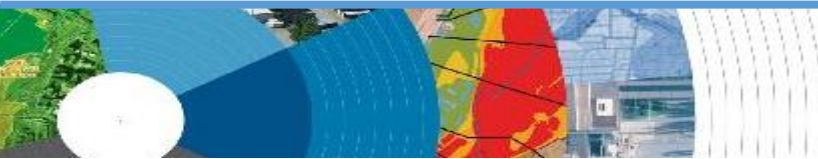
- Contents is an optional addition (except for Preferred Risk Policy)
- Max coverage \$100,000 coverage.
- Renters can purchase flood insurance for contents.

▪ 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

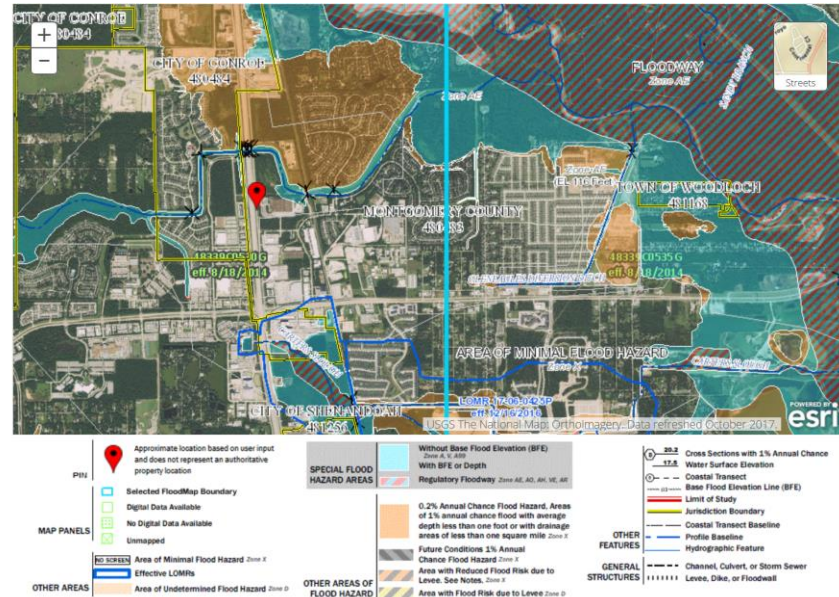


FEMA

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 Coastal and Riverine flood risk



Find your zone at <https://msc.fema.gov/portal/home>



FEMA

Structure Elevation Impact Insurance Rates



High Risk =
\$\$\$

Medium Risk =
\$\$

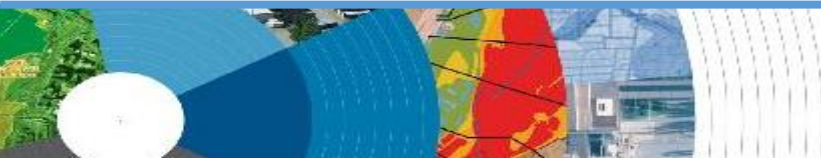
Lower Risk = \$

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.

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.**



FEMA

Contact Information

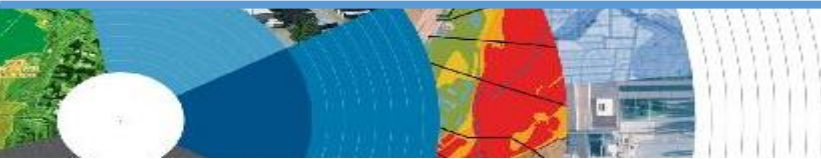
NFIP Hotline
1-800-427-4661
www.fema.gov/nfip

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

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



FEMA



Questions

National Weather Service