

# HARVEY, AMERICA'S FIRST \$200 BILLION HURRICANE



*Presented to*  
IDEA Distribution Workshop  
Emergency Preparedness  
and Response  
March 6, 2018

W. Lynn Crawford, PE  
Market Leader Energy and Utilities  
Affiliated Engineers, Inc.  
[lcrawford@aeieng.com](mailto:lcrawford@aeieng.com)

Jenna C. Taylor  
Manager, Communications  
The University of Texas Health Science Center at  
Houston, UTHealth  
[Jenna.C.Taylor@uth.tmc.edu](mailto:Jenna.C.Taylor@uth.tmc.edu)

# Agenda

- Rainfall
- Addicks and Barker Reservoirs / Buffalo Bayou
- San Jacinto River
- Brazos River Levee Districts
- The Worst Night of our Lives
- Rescues
- Two Success Stories
  - UTMB Galveston
  - UT Health Houston
- Communications

# Hurricane Harvey

## Harvey Rainfall Overview

Harvey – 7 Day Precipitation through 9/1/17



West Gulf  
River Forecast Center

### Observed Precipitation

National Weather Service

Valid Ending Friday September 1st, 2017 at 3 PM CDT

Up to 0.1 inch  
0.1 to 0.25 inches  
0.25 to 0.5 inches  
0.5 to 1.0 inches  
1.0 to 1.5 inches  
1.5 to 2.0 inches  
2.0 to 3.0 inches  
3.0 to 4.0 inches  
4.0 to 6.0 inches  
6.0 to 8.0 inches  
8.0 to 10.0 inches  
10.0 to 15.0 inches  
15.0 to 20.0 inches  
20.0 to 30.0 inches  
30.0 to 40.0 inches  
Greater than 40 inches



Graphic Created  
September 1st, 2017  
3:59 PM CDT

- Estimates for Texas alone...Harvey dumped an estimated 53.4 million acre-feet of water on Texas
- Gage reports in excess of 50 inches in the Houston area
- Heavy rainfall from just east of the Austin/San Antonio area to the Texas/Louisiana border
- Numerous new flood records on area rivers

9/1/2017 4:05 PM

[www.weather.gov/wgrfc](http://www.weather.gov/wgrfc)

# Addicks and Barker Dams / Buffalo Bayou

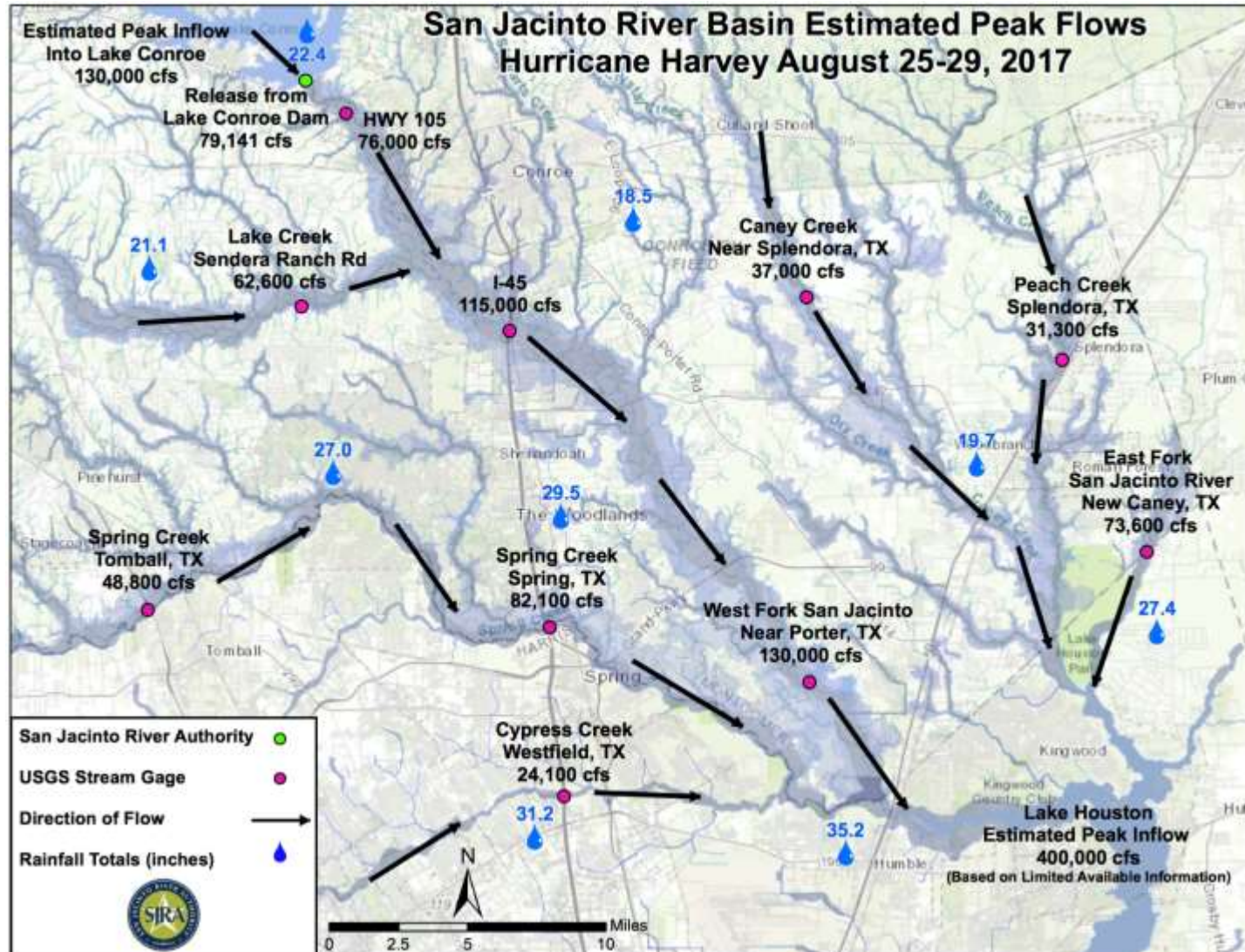




# Addicks and Barker Dams / Buffalo Bayou

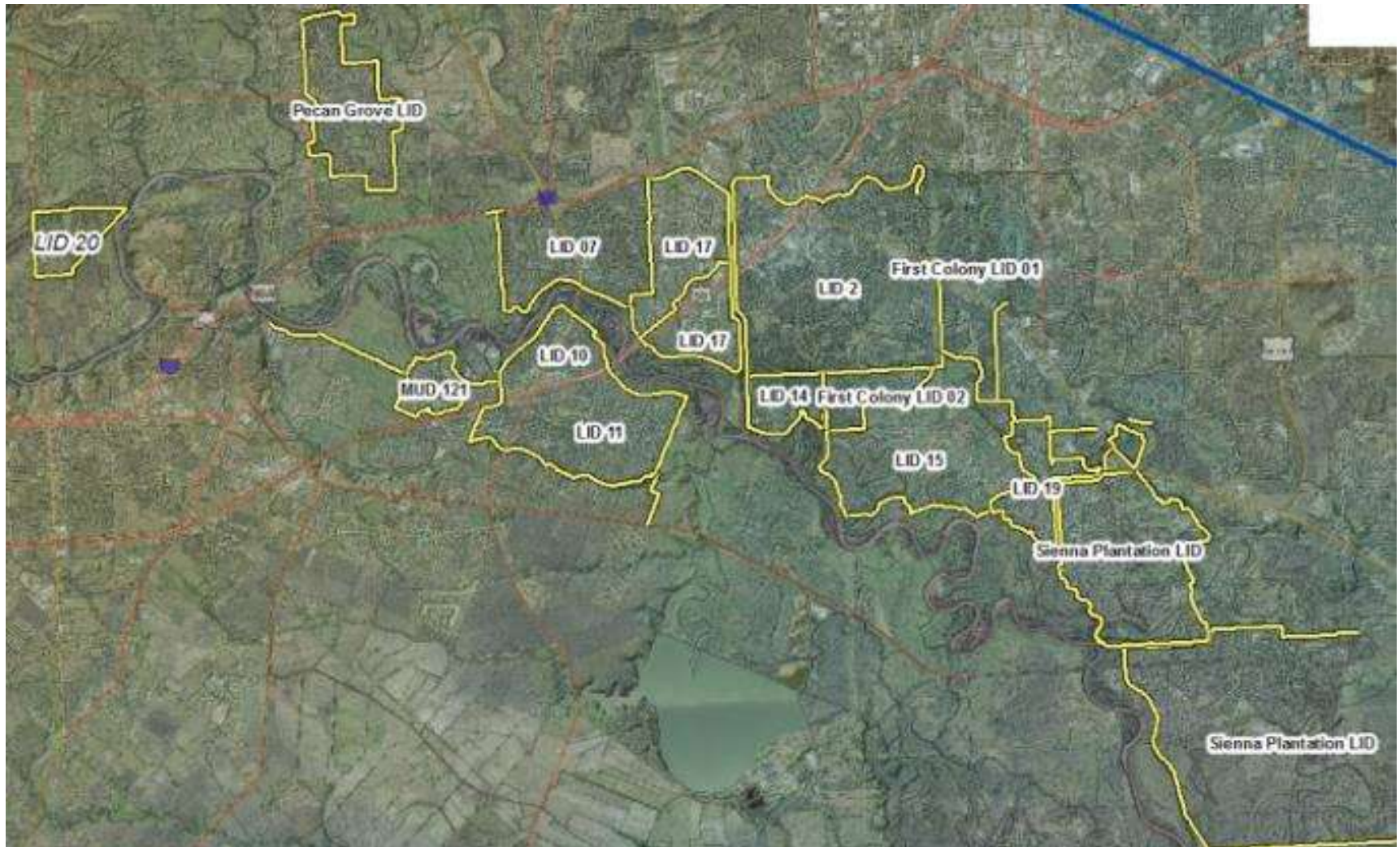


# San Jacinto River Flooding





# Brazos River Levee Districts



# The worst night of our emergency responders' lives

All quotes are from The Houston Chronicle

- “911 overloaded (received more than 120,000 calls in 5 days), some callers got no answer, others were put on hold”.
- “More than 7,800 calls for help from residents trapped by high water”
- The county had deployed “every available rescue asset” said County Judge Ed Emmett. People were still stranded and needed help. State resources couldn’t get in because of the flooding.
- “We can’t wait for assets to come from the outside, Emmett said. “So those of you who have boats and high-water vehicles ...We need your help”.



# Rescues



# Rescues



# Two Success Stories

- UTMB Galveston
- UTHealth and the Texas Medical Center



# Agenda

- UTMB Galveston circa 1890's
- Hurricane Ike
- A Three Step Solution
- Hurricane Harvey



# Galveston Island, circa 1890's



*UTMB Photos: Old Red/John Sealy*



# The Great Storm of 1900



*UTMB Photos: Old Red/John Sealy*



# Hurricane Ike, September 13, 2008

## Water/Storm Surge –

Approximately 17 ft to 18 ft based on the information gathered to date. NOAA



Image courtesy: noaa.gov

# Hurricane Ike, September 13, 2008



*Image courtesy: noaa.gov*

# Impact of Ike

- Cost of stabilization: \$14,000,000
- Unable to operate hospital: over 90 Days
- Lost business revenue: \$2,000,000/day
- Cost of evacuation unknown
- Underground steam distribution system a complete loss
- Over \$1 million sf of campus buildings damaged estimated over \$1 billion dollars in damages
- Lost research materials priceless

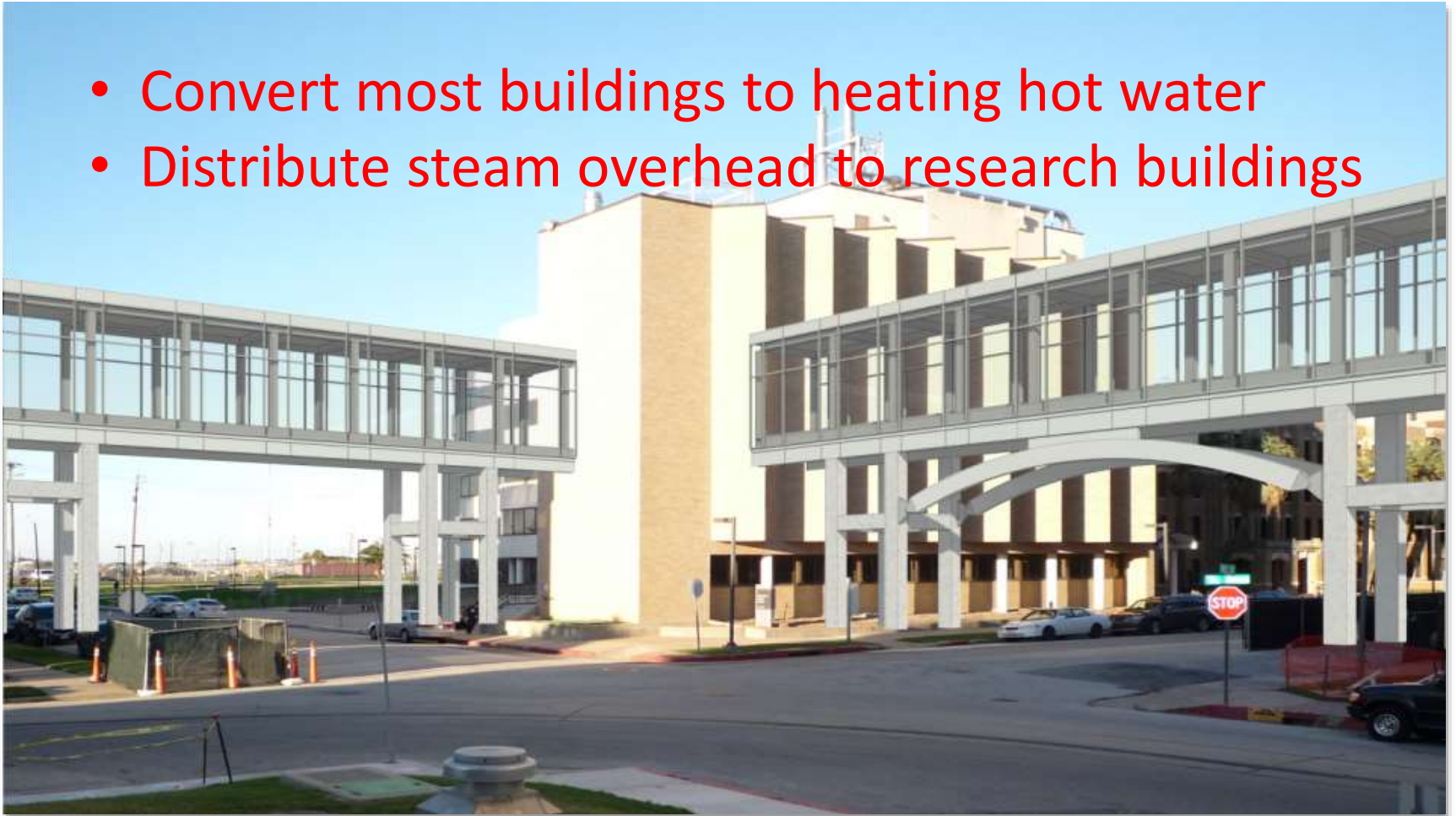


# A Three Step Solution



# Step One Go Away from Buried Steam Pipe

- Convert most buildings to heating hot water
- Distribute steam overhead to research buildings





## Step Two Elevate or Protect the Boilers and Chillers





# Step Two Elevate or Protect the Boilers and Chillers



# Step Three Produce On-Site Electricity via Combined Heat & Power (CHP)

Combined heat and power systems are approximately 50% more efficient than traditional systems





## Step Three Produce On-Site Electricity via Combined Heat & Power (CHP)





# Hurricane Harvey vs. UTMB Galveston

- Local utility lost two electrical feeders due to a flooded transformer vault, *no problem*.
  - The East Plant CHP system operated trouble free in *Island Mode*
- Heavy rainfall caused some street flooding, *no problem*.
  - For the new overhead steam and underground heating hot water distribution systems “It was just another day at the office”.
  - The West Plant floodwall gates were secured.

# Tropical Storm Allison June 2001



# Tropical Storm Allison Crippled the Texas Medical Center



Source: Houston Chronicle



“...eight area hospitals declared internal disasters because of flooding and power losses”

“...Herman Hospital was hardest hit, evacuating all 540 patients and stopping all services for the first time since opening in 1925.”

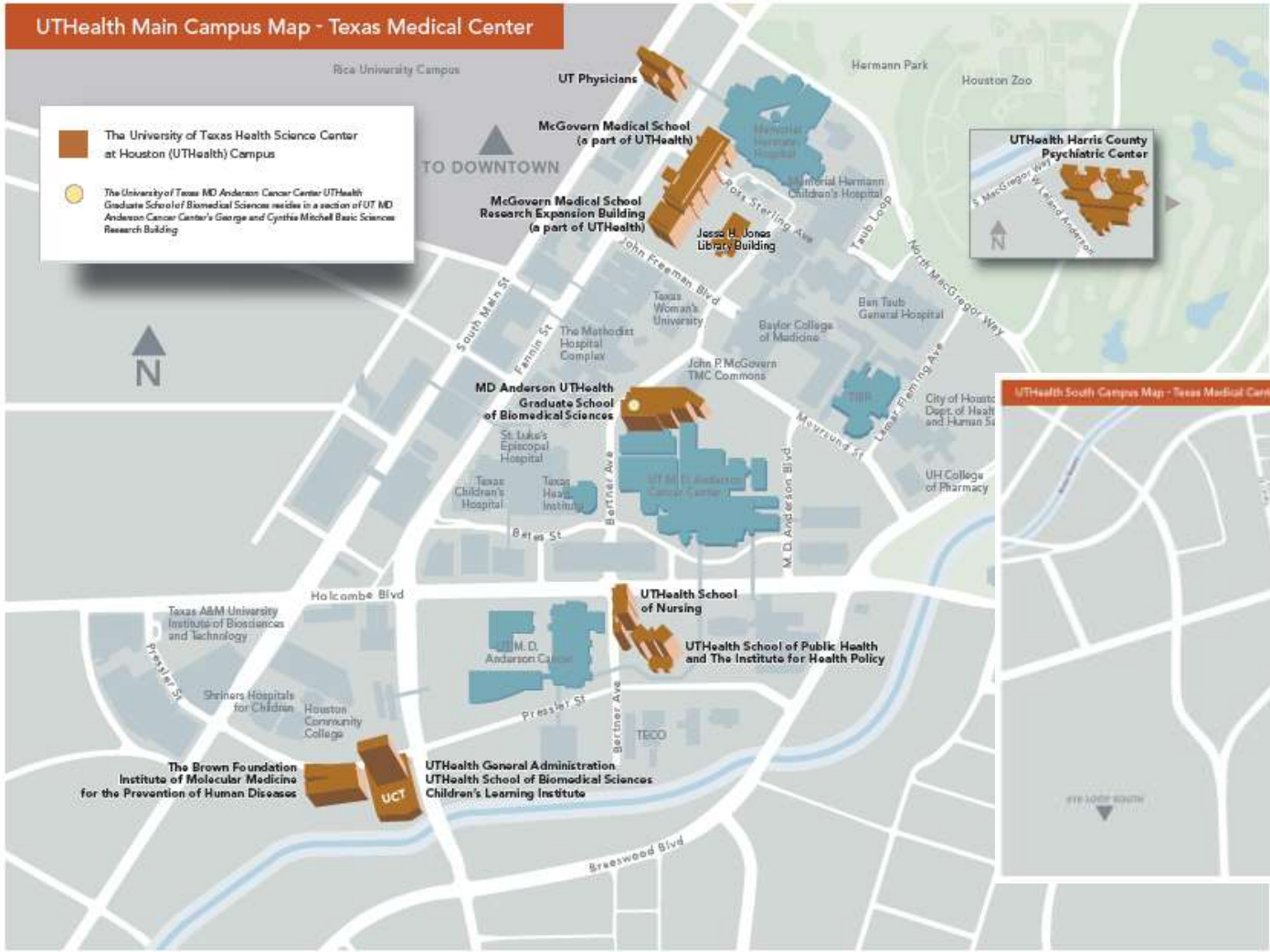


# Texas Medical Center Post Allison Protection



# Texas Medical Center TECO Post Allison Protection







# UTHealth Emergency Event Retrospective 2001 - 2017

**Over a 16 year period of EOC “activations”....**

Event Type	Number	% of Total
Flooding (rain, hurricanes)	16	60%
Tornado (warnings)	3	10%
Fires (actual, not alarms)	3	10%
Ice Storm	2	7%
Terrorism (9/11/2001)	1	3%
Disease Outbreak	1	3%
Administrative Actions	2	7%
TOTAL	28	100%



Tropical Storm Allison June 2001

# What's your plan?





# What's your role?





# Before landfall



# Day 4

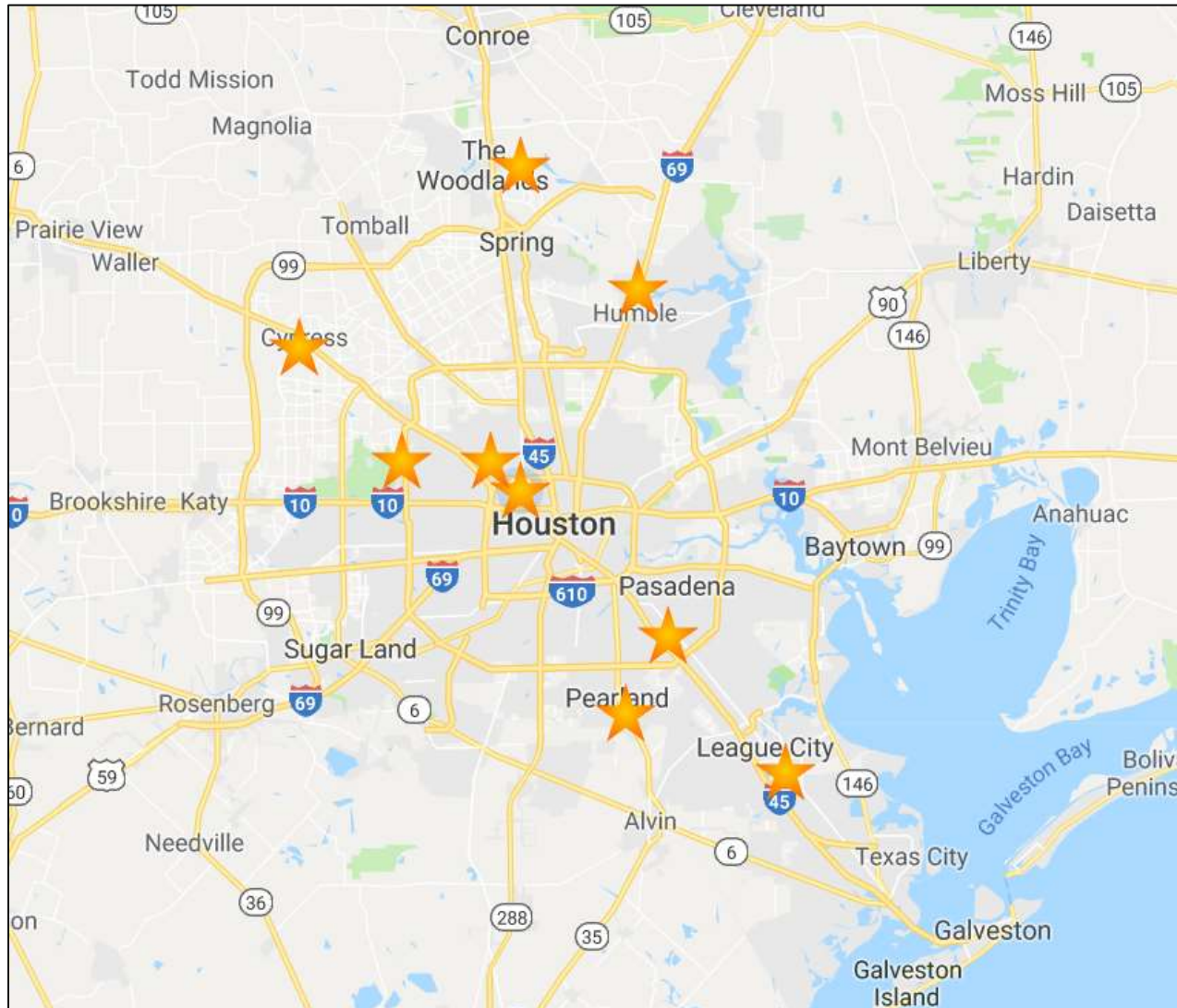


# Day 5

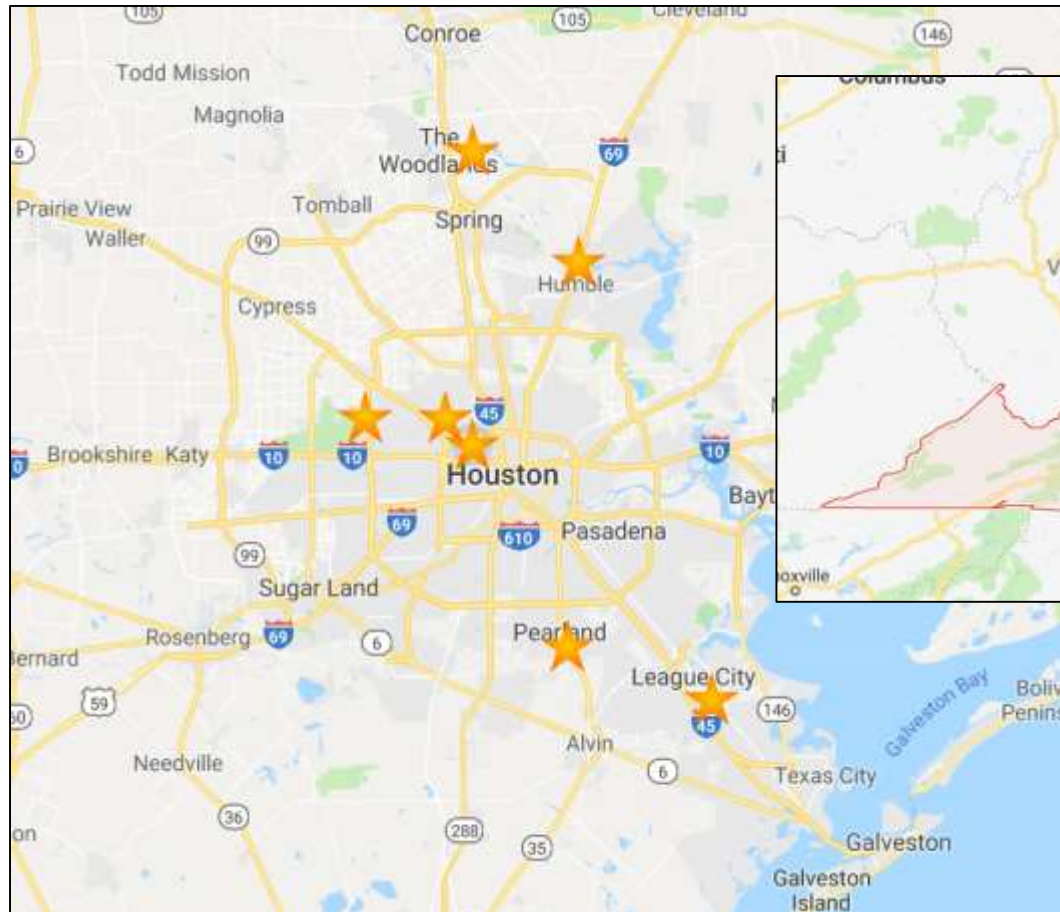




# The perfect team



# The available team

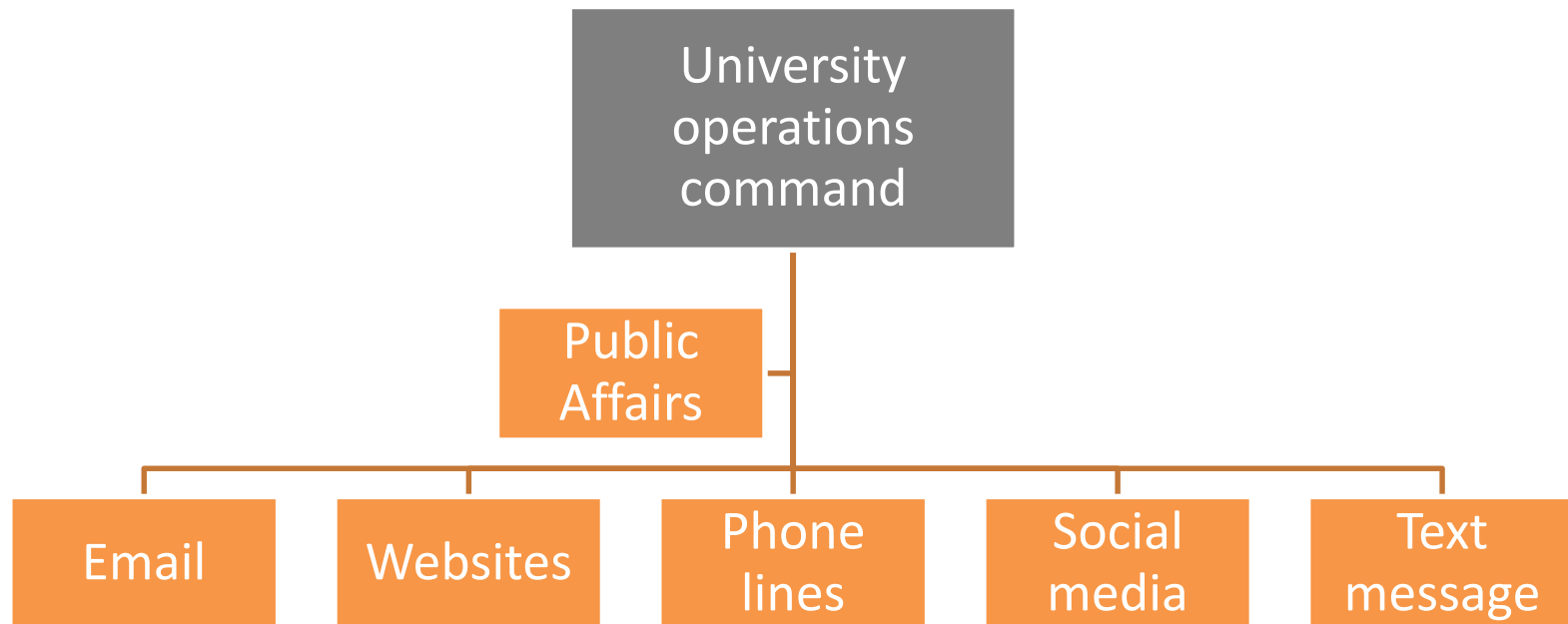


# 3 phases of a disaster

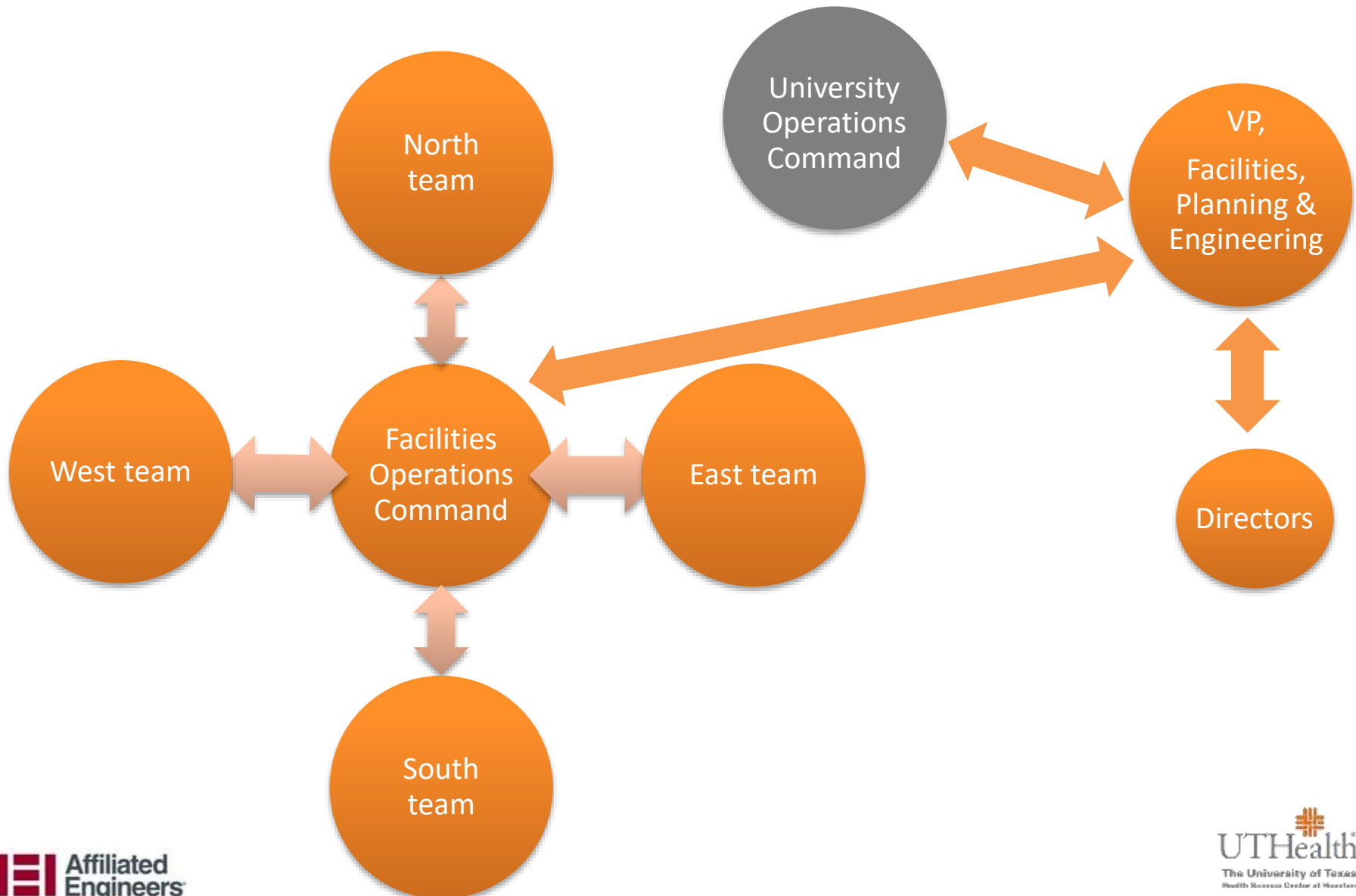
- Prepare
- Event (ride out)
- Recovery



# Communications during event



# Communications during event (Facilities example)



# Lessons learned

- 1) Acute need for “high water assistance vehicle(s)” or boat(s) to assist in movement of key personnel, clinicians, supplies – but important to differentiate from “*swift water rescue*”
- 2) Building flood protections largely worked, but institutional constituencies paralyzed
- 3) Re-assessment of the size of various “ride out teams” to be able to effectively function for a longer period of time – and re-visit the definition of “ride out team” as it may not be necessary for them to be on campus
- 4) The “soft opening” of the institution was well received by constituencies –including de-coupling of messaging about use of leave, timesheets, etc.
- 5) Executive Team relied heavily on phone conference calls – but what if this had been a high wind event that destroyed cell phone and the electric grid?



# Final thoughts



# Q & A