

# Toward Developing a Flood Resilient Community

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TFMA 2019 Fall Technical Summit

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## Resilience

- Ability to bounce back from the harmful impacts of a disaster.
- Resilience may be measured by the amount of shock a system is able to absorb and the rapidity with which it rebounds after the shock.



Photo by David Johnson

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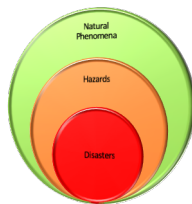
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## Disaster vs Natural Phenomena

- Hazards become disasters after interaction with human systems.
- Average annual number of natural disasters has more than doubled since 1980.



source: American Museum of Natural Disasters

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## Disaster Types


- Flood / Hurricane
- Drought
- Earthquake
- Tsunami
- Tornado
- Wildfire
- Landslide
- Volcanic Eruption
- Sea Level Rise
- ...



- Cyber Attacks
- Economic Inequality
- Traffic Congestion
- ...

source: <https://www.tec.com/lessons/16W4ozR1EBGQ/natural-disasters>

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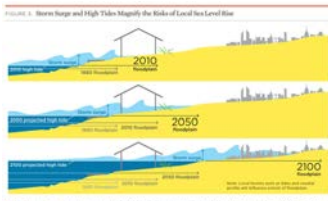
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## Sea Level Rise



- Global Warming
- Melting Ice Sheets and Glaciers
- Subsidence

- Less Strong Storms will cause major flooding
- Storm surge will cause more damage due to higher sea water levels
- Flooding will be more frequent

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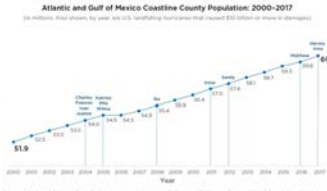
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## Disasters by Design

☐ Communities grow and develop into hazardous areas : hurricane-prone coastal lines, within floodplains, atop unstable slopes, or along fault


☐ The US is most dense along its coastlines.

Atlantic and Gulf of Mexico Coastline County Population: 2000-2017



Source: National Oceanic Data Center <https://www.noaa.gov/follow-us>; U.S. Census Bureau, "2007 Population Estimates, and 2000 to 2009 Interim Estimates."

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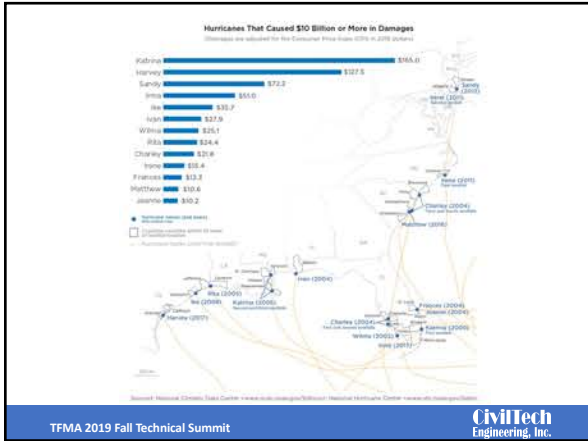
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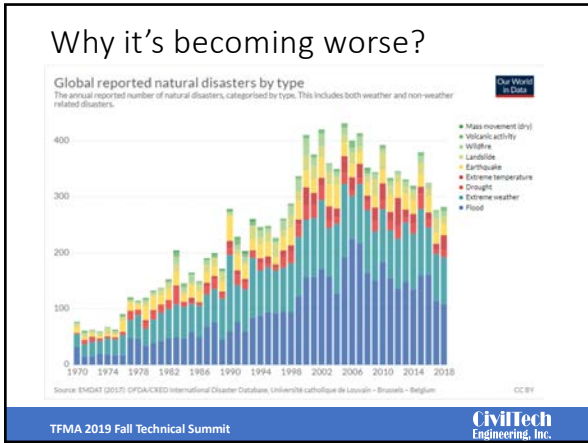
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### How to face disasters?

- Evacuation?
- Hurricane Rita 2005 – Largest Evacuation in US History [3.7m people].
- Rita Changed course.
- No evacuations has been ordered in Houston since 2005.

source: Stan Honda/APP/Getty Images

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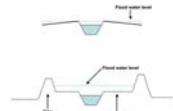
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### Other Solutions

- Levees, seawalls, and beach nourishment.
  - Environmental Impacts!
- Paradox: Levees can only withstand the impact up to their design parameters but will fail in larger events.



source: <http://weirbank.nrc.nl/levies/leuven/leuven/131779>



Netherlands Seawall source: <https://www.oh-resources.org/dutch-river-defences-in-historical-perspective/>

➔ Resilient Community

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### Resilient Community

- Not to return to pre-storm conditions!
- Adapting to circumstances as they arise!
- Appreciating the change in situation,
- Creating strength and beauty in unexpected places.

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### Resiliency Components



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## Mitigation

- Reduce or eliminate the risks
  - Engineering solutions such as bayous, reservoirs, dams, levees, and seawalls
  - Policy-related solutions such as land use planning and management to limit development in hazardous areas and provide passive protection.

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## Preparedness

- Preparing a community before the disaster
- Crisis management
- Education
- Announcement/reliable source

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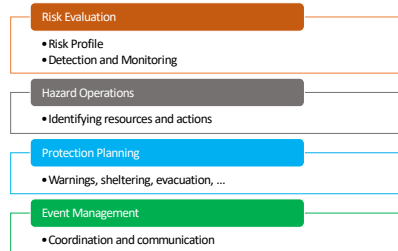
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## Response



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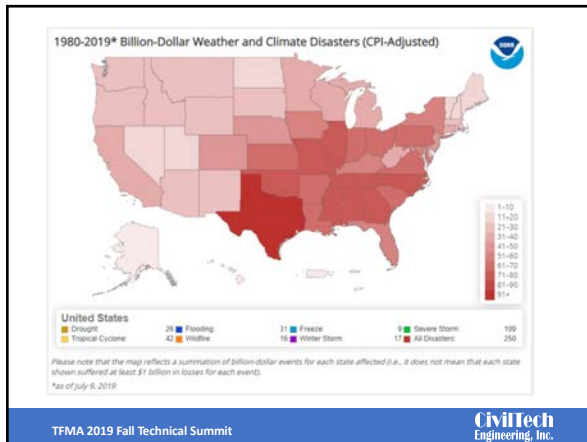
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### Historic Natural Disasters in Texas

Date Mo./Yr.	Name	Location	Fatalities	Precipitation	Damage Cost
9/1900	Galveston Hurricane	Galveston	~ 12,000	9 in	\$35.4M
5/1953	Waco Tornado	Waco	114	-	\$41M
9/1961	Hurricane Carla	Port Aransas	43	17.5 in	\$326M
6/2001	TS Allison	Houston	43	40 in	\$8.5B
9/2005	Hurricane Rita	Several Counties	119	10 in	\$24.4B
9/2008	Hurricane Ike	Galveston	112	-	\$35.7B
10/2011	Bastrop County Complex Fire	Bastrop County	4	-	\$325M
8/2017	Hurricane Harvey	Several Counties	89	60 in	\$127.5B

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### Harvey – 2017: Worst Rainfall Disaster in US History

**Mitigation**

- Infrastructure
- Hazard Maps/Risk Maps
- HCFCO Flood Warning System

**Preparedness**

- Educating people on the severity of the hurricane
- Active on Social Media – Minimizing rumors

**Response**

- Focus on safety – Emergency Response
- Monitoring and Warning
- Millions of Volunteer Hours – Evacuation Assistance

**Recovery**

- Damage Assessment
- Housing/Funding
- Infrastructure and Mitigation

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*"This is a defining moment for the city of Houston. It's not enough for us just to rebuild in the same way, in the same place. If we do that, then we will miss the mark and quite frankly we will miss the opportunity this storm has afforded us."*

--Mayor Turner

Thank You!

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