



**HAZARD REDUCTION  
& RECOVERY CENTER**  
TEXAS A&M UNIVERSITY

# Assessing Resiliency

Lori Feild Schwarz, AICP

Interim Planning Director, City of Galveston

Shannon Van Zandt, Ph.D., AICP

Hazard Reduction & Recovery Center, Texas A&M University



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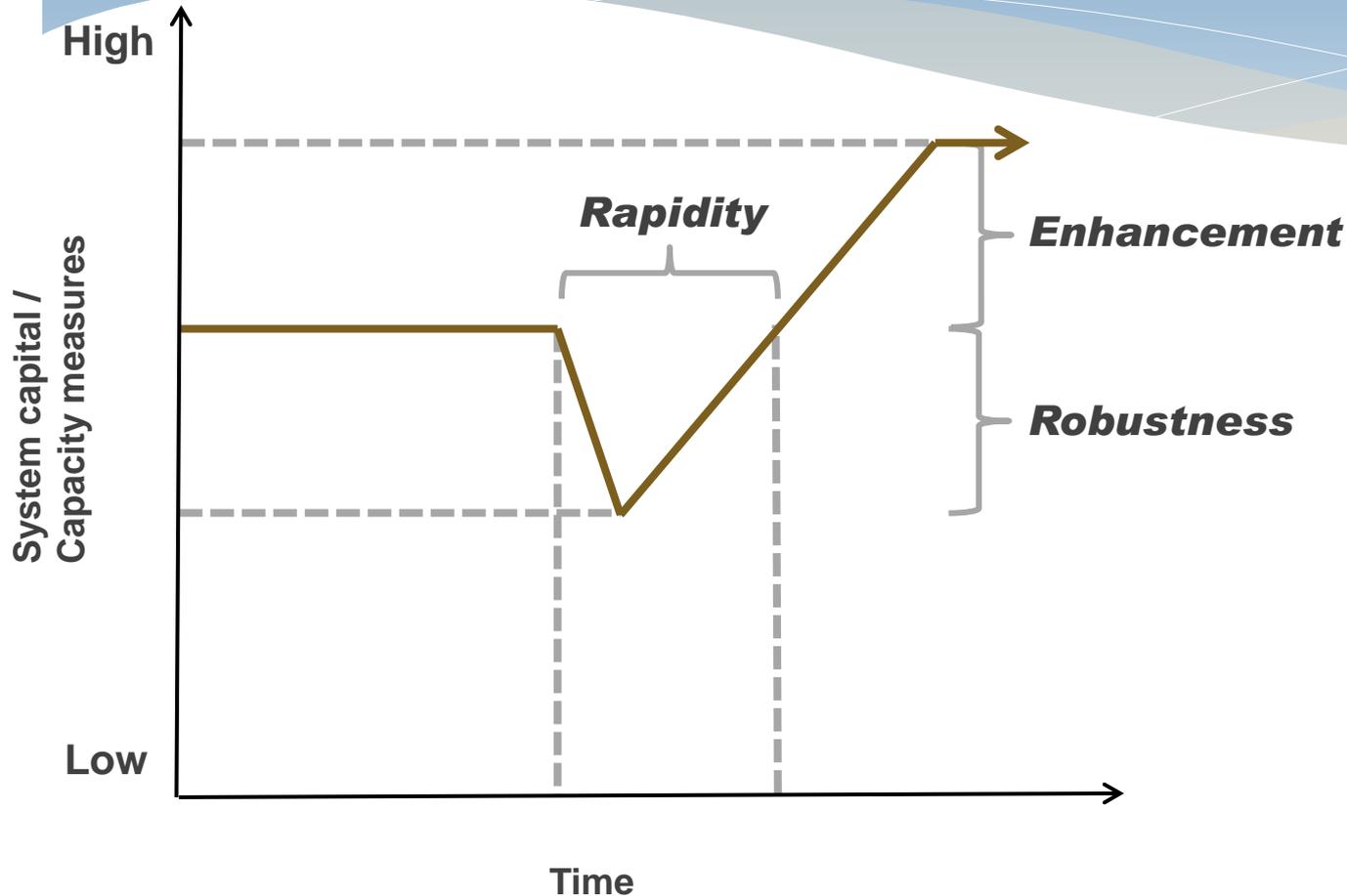
# What is resilience?

Resilience is the ability of a

**community**  and the **bio-physical systems**,  upon which they depend, to:

- \* *resist* or absorb the impacts (deaths, damage, losses, etc.) of natural hazards,
- \* *rapidly* recover from those impacts, and
- \* reduce future vulnerabilities through *adaptive* strategies (Peacock et al. 2008 RAVON).

# Three Dimensions of Resilience



**Robustness** captures the ability to withstand potential hazard impacts, which implies solid mitigation planning and implementation

**Rapidity** captures how quickly restoration or recovery levels are achieved, which clearly points to the importance of recovery planning & implementation

**Enhancement** captures the quality of recovery processes in terms of learning and adapting

# More Formalized Dimensions of Resilience

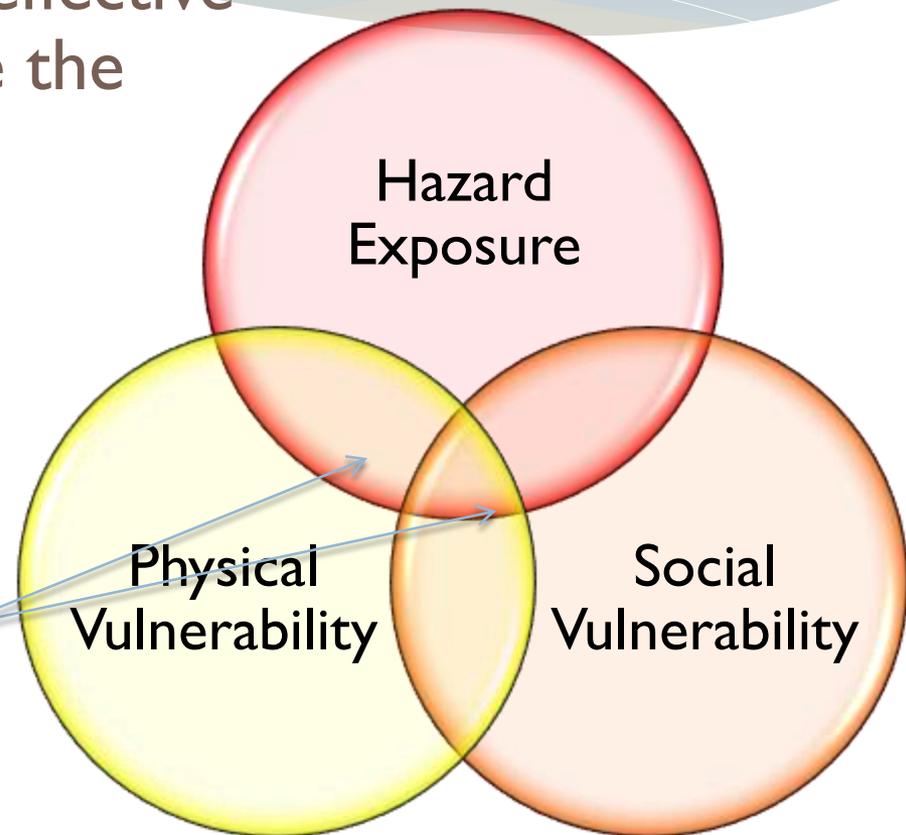
- \* Nature or quality of recovery implies **learning/adaptation** such that we see...
  - \* Improvements in mitigation status
    - \* Enhancing robustness
    - \* Reducing future loss potential
    - \* Reducing future failure probabilities
  - \* Reduction of pre-existing vulnerabilities
    - \* Reduced hazard exposure and risk
    - \* Reduced social vulnerabilities
  - \* Sustainable Disaster Recovery: improvements in the triple bottom line...
    - \* Enhanced economic sustainability
    - \* Enhanced ecological sustainability
    - \* Enhanced social sustainability

# Assessing Resilience

\* Critical elements in guiding effective resiliency planning should be the convergence of these three:

- \* Hazard exposure
- \* Physical vulnerability
- \* Social Vulnerability

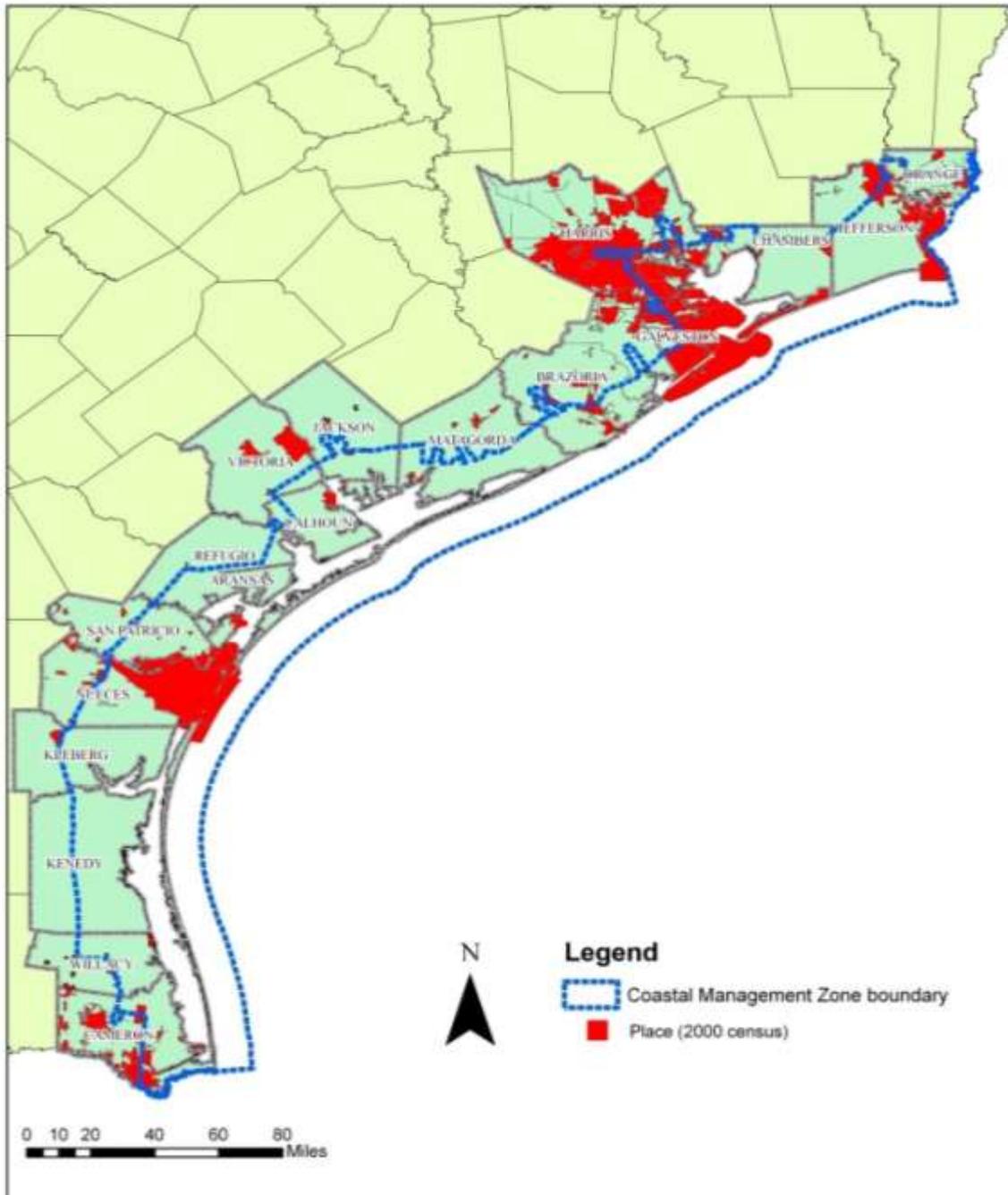
The overlap represent hotspots that are prime targets for resiliency planning issues whether considering mitigation, recovery, or other planning activities.



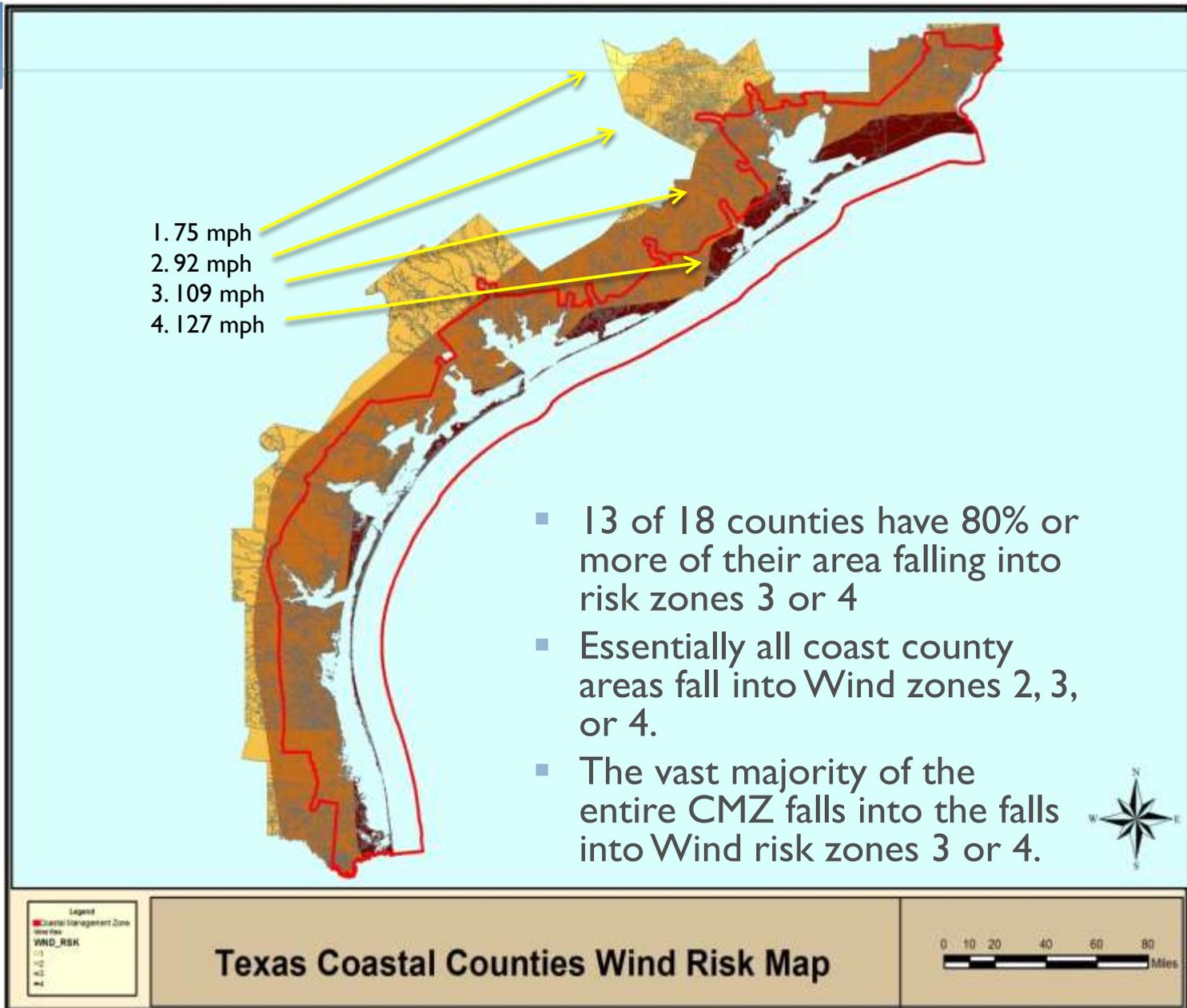
# Hazard Exposure and Identification

- \* Geographical areas can be affected by disaster impact, in part, because of their exposure to hazard agents
  - \* Flood, Wind, Surge, Earthquake, urban/rural fringe
  - \* Technological or man-made hazards
- \* Identification of the potential hazards in a location, the likelihood of exposure, and some assessment of probability of impact
  - \* Hurricane risk zones (slosh models and wind fields)
  - \* Flood zones (Flood insurance Rate Maps –FIRM)
  - \* Coastal erosion/accretion
  - \* Hazardous sites
  - \* Wildfire
  - \* Drought

# Texas Coastal Counties & Coastal Hazards

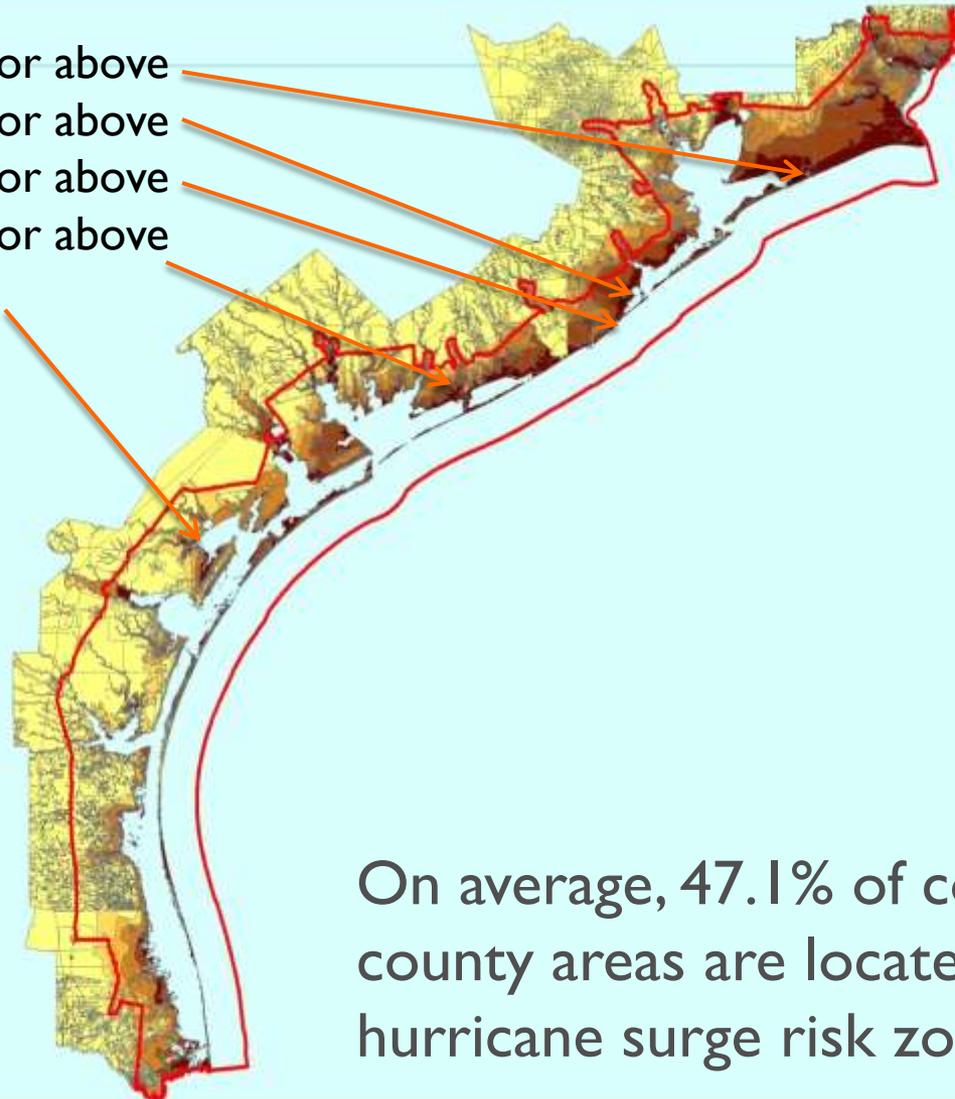


- \* The Texas Coast:
  - \* 18 coastal counties
  - \* 228 coastal municipalities
  - \* 39,546 sq. kilometers
  - \* 47.6% of this area is located in our Coastal Management Zone (CMZ)



\* A more complete discussion of Texas coastal county hazard exposure can be found in the following report -- [Status and Trends of Coastal Hazard Exposure and Mitigation Policies for the Texas Coast: The Mitigation Policy Mosaic of Coastal Texas](#) by Walter Gillis Peacock, Jung Eun Kang, Yi-Sz Lin, Himanshu Grover, Rahmawati Husein, and Gabriel R. Burns. 2009. Hazard Reduction and Recovery Center.

- 5 = Cat. 1 or above
- 4 = Cat. 2 or above
- 3 = Cat. 3 or above
- 2 = Cat. 4 or above
- 1 = Cat. 5



On average, 47.1% of coastal county areas are located in hurricane surge risk zones.

Legend

- Coastal Management Zone
- Surge Risk

SUR\_RISK

- 1 = 0
- 2 = 1
- 3 = 2
- 4 = 3
- 5 = 4

### Texas Coastal Counties Surge Risk Map



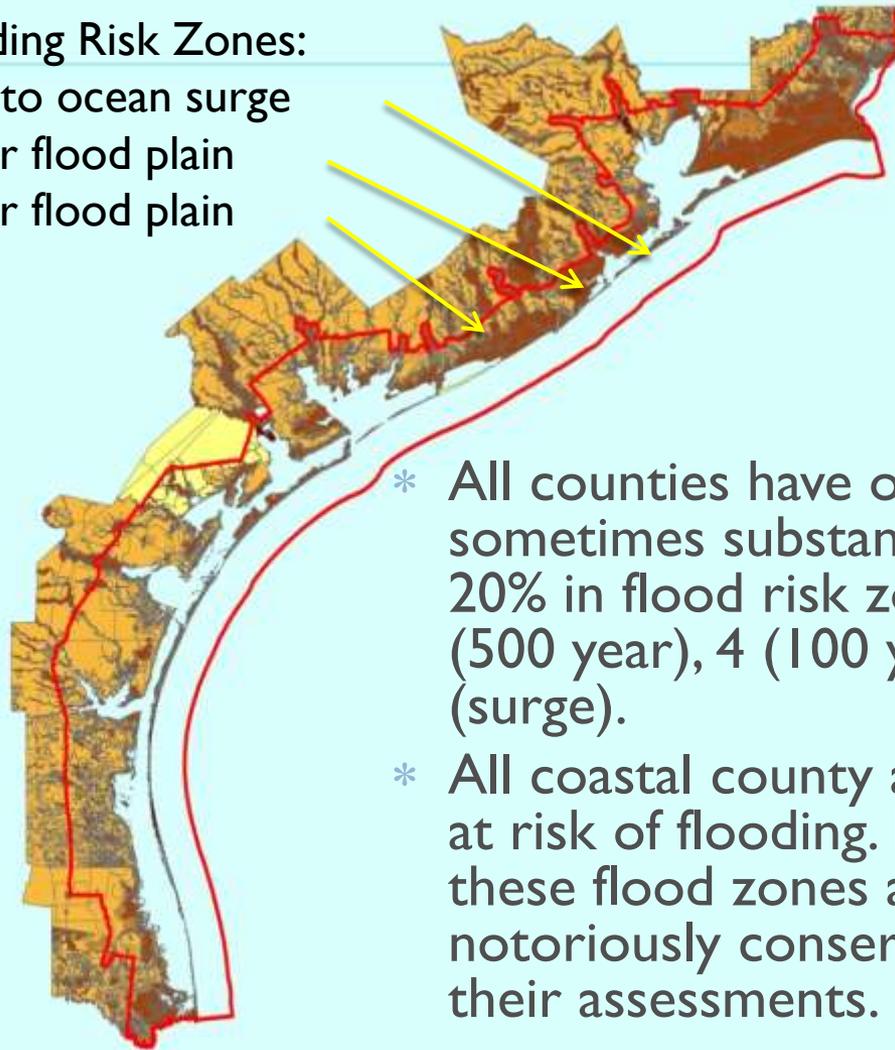
\* see: [Status and Trends of Coastal Hazard Exposure and Mitigation Policies for the Texas Coast: The Mitigation Policy Mosaic of Coastal Texas](#) by W.G.Peacock, J.E.Kang, Y.S. Lin, H. Grover, R.Husein, and G.R. Burns. 2009. Hazard Reduction and Recovery Center.

## Major Flooding Risk Zones:

5 = subject to ocean surge

4 = 100 year flood plain

3 = 500 year flood plain

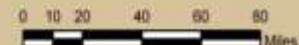


\* All counties have over, sometimes substantially over, 20% in flood risk zones 3 (500 year), 4 (100 year) or 5 (surge).

\* All coastal county areas are at risk of flooding. Indeed, these flood zones are notoriously conservative in their assessments.



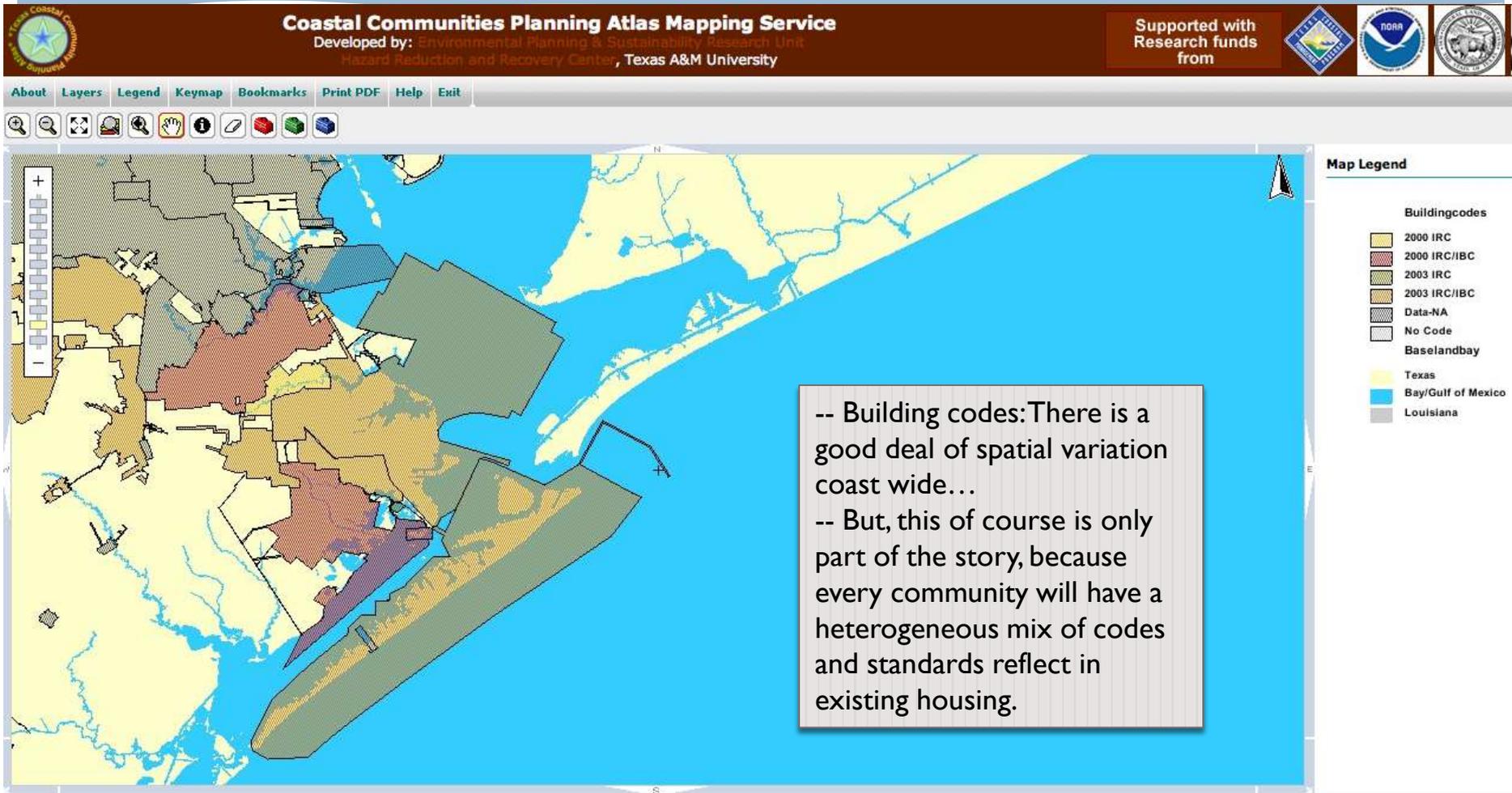
## Texas Coastal Counties Flood Risk Map



# Physical Vulnerability

- \* Susceptibility to physical damage and loss based on exposure and:
  - \* Building methods, materials, and codes
  - \* Infrastructure
    - \* Vulnerabilities due to location and other characteristics
    - \* Can these be enhanced??
  - \* Natural environment – eco-services
    - \* Will these be compromised by the development?
    - \* Can these be preserved or restored to increase system services?
- \* Forms:
  - \* Vulnerability assessment = The likely damage given the nature of the quality of construction
  - \* Risk Analysis: = Includes probability assessments of damage

# Physical vulnerabilities

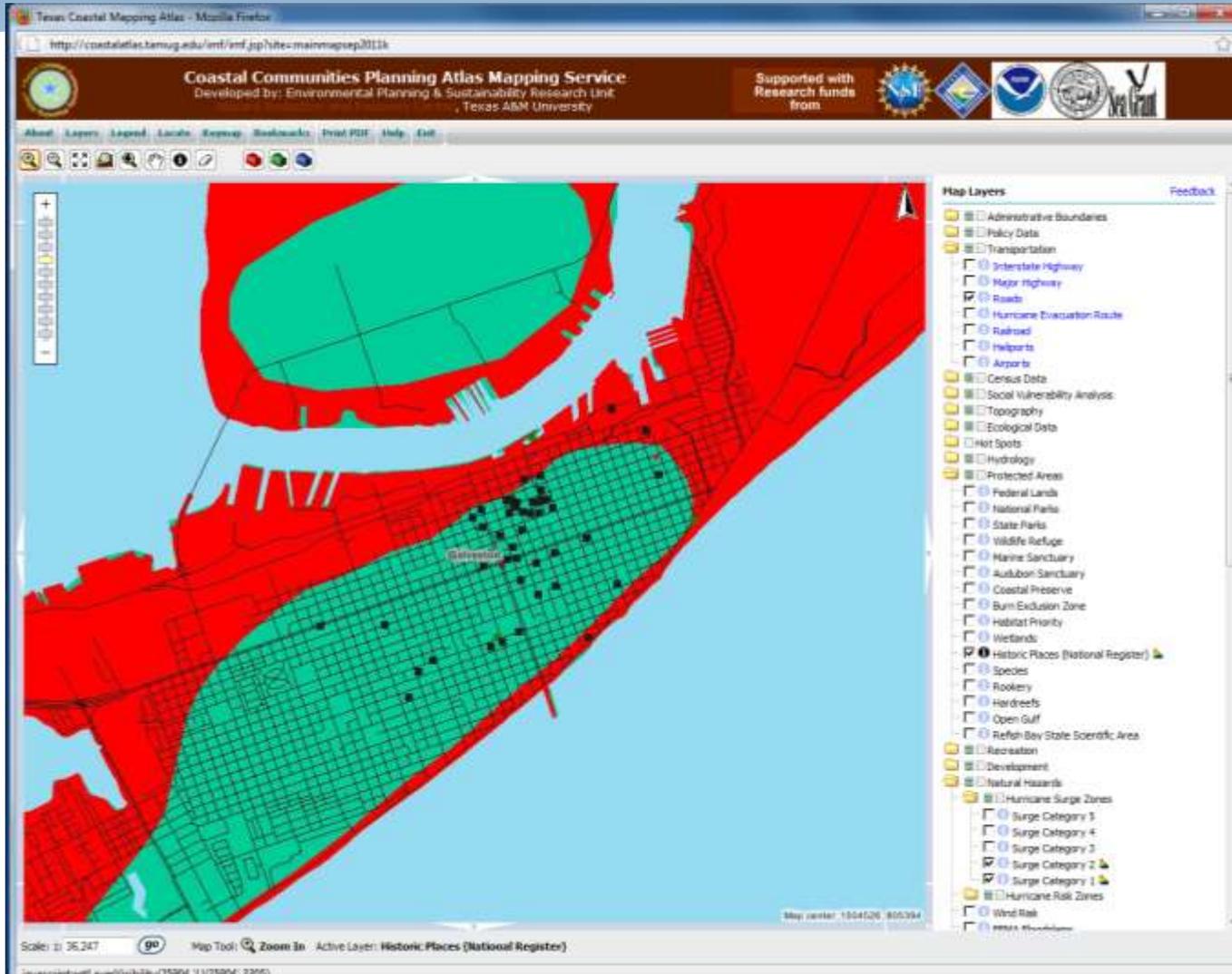


-- Building codes: There is a good deal of spatial variation coast wide...  
-- But, this of course is only part of the story, because every community will have a heterogeneous mix of codes and standards reflect in existing housing.

# Public Schools

The screenshot displays the Texas Coastal Mapping Atlas web application. The browser window shows the URL <http://coastalatlus.tamug.edu/inf/inf.jsp?site=mainmapocp2011k>. The header features the text "Coastal Communities Planning Atlas Mapping Service" and "Developed by: Environmental Planning & Sustainability Research Unit, Texas A&M University". It also includes logos for NOAA, the Texas Department of Transportation, and the Texas A&M University System. The main map area shows a coastal region with a grid overlay. A legend on the right side lists various layers, with "Public Schools" selected and highlighted in red. The legend also includes layers for Roads, Hurricane Evacuation Routes, Railroads, Airports, Census Data, Social Vulnerability Analysis, Topography, Ecological Data, Hot Spots, Hydrology, Protected Areas, Recreation, Development, Property Values (2000), Ecosystem Criticality Measure, Location Quotient Analysis, Populated Places, Dams, Wetland Permits, Natural Hazards, Coastal Data, Coastal Development, Offshore Rigs, Places and Facilities, Place Names, Populated Places, Climate, Basemap, Coastal County Name, Coastal County (shaded), Texas County Boundaries, State Boundary, Water, and Texas Image. The status bar at the bottom indicates a scale of 1:45,473 and the active layer is "Public Schools".

# Historic Places



# Police stations

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## police stations

- Galveston Police Department** - more info »  
601 54th St, Galveston, TX - (409) 765-3702
- Galveston County Sheriff** - more info »  
601 54th Street, Galveston, TX - (409) 766-2300  
Category: Police
- Police Departments: Galveston County Sheriff** - more info »  
715 19th Street, Galveston, TX - (409) 766-2222
- Galveston Island Beach Ptd** - more info »  
201 Seawall Boulevard, Galveston, TX - (409) 763-4769  
Category: Police Department
- Galveston County Sheriff** - more info »  
2516 Texas Avenue, Galveston, TX - (409) 770-5817  
Category: Police
- Galveston Police Training** - more info »  
5301 Avenue South, Galveston, TX - (409) 741-0068
- Galveston Police Impound Lot** - more info »  
5303 Avenue South, Galveston, TX - (409) 741-4612
- Tiki Island Police Department** - more info »  
747 Tiki Drive, Galveston, TX - (409) 935-8579
- Texas City Police Department** - more info »  
1004 9th Ave N, Texas City, TX - (409) 948-2525  
Edited
- Bayou Vista Police Department** - more info »  
2929 Highway 6, Hitchcock, TX - (409) 935-0449

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- A** [City of Galveston: Fire Station No 1](#) - more info »  
2514 Sealy Avenue, Galveston, TX - (409) 797-3865
- B** [Galveston Fire Station Central](#) - more info »  
2517 Ball Street, Galveston, TX - (409) 766-3303
- C** [Port Bolivar Vol Fire Department](#) - more info »  
1806 Broadway Avenue J, Galveston, TX - (409) 684-1984
- D** [Fire Station #2](#) - more info »  
428 Church Street, Galveston, TX - (409) 766-3306
- E** [Galveston Fire Marshal](#) - more info »  
2517 Ball Street, Galveston, TX - (409) 766-2147
- F** [City of Galveston: Fire Dept](#) - more info »  
715 19th Street, Galveston, TX - (409) 797-3850
- G** [Fire Station](#) - more info »  
1104 56th Street, Galveston, TX - (409) 740-2061
- H** [Galveston Fire Station #4](#) - more info »  
8710 Cessna Drive, Galveston, TX - (409) 741-4602
- I** [Galveston Fire Station #7](#) - more info »  
3902 Buccaneer Boulevard, Galveston, TX - (409) 737-4324
- J** [City-City of Texas Fire Department: Station No 2](#) - more info »  
825 10th Street North, Texas City, TX - (409) 643-5712

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Houston, TX

### Fire Stations



Fire Stations: Many are in Category 1 & 2 surge zones.  
-- But actual structural features will vary.

# Hospitals

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## hospitals

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Find Listings for All Hospitals  
In Houston with YellowPages.  
yellowpages.com  
Houston, TX

**A University of Texas Medical Branch at Galveston (UTMB)** - more info »  
301 University Boulevard, Galveston, TX - (409) 772-1011  
Category: Hospitals  
23 reviews

"In Overall Performance, this hospital is rated at the national average ..."

**B Shriners Hospital For Children** - more info »  
815 Market Street, Galveston, TX - (409) 770-6600

**C John Sealy Hospital** - more info »  
301 University Boulevard, Galveston, TX - (409) 772-1011  
Category: Hospitals  
3 reviews

"Based on 1 response, when asked if they would recommend Dr. Phelps to ..."

**D Mccauley Robert L MD** - more info »  
815 Market Street, Galveston, TX - (409) 770-6600  
Category: Hospitals  
4 reviews

"Users on average felt the waiting time during a visit was "Excellent". ..."

**E Utmb Surgery: Gomez Guillermo A MD** - more info »  
301 University Boulevard, Galveston, TX - (409) 772-7320  
Category: Hospitals  
3 reviews

"Based on 2 responses, when asked if they would recommend Dr. Gomez to ..."

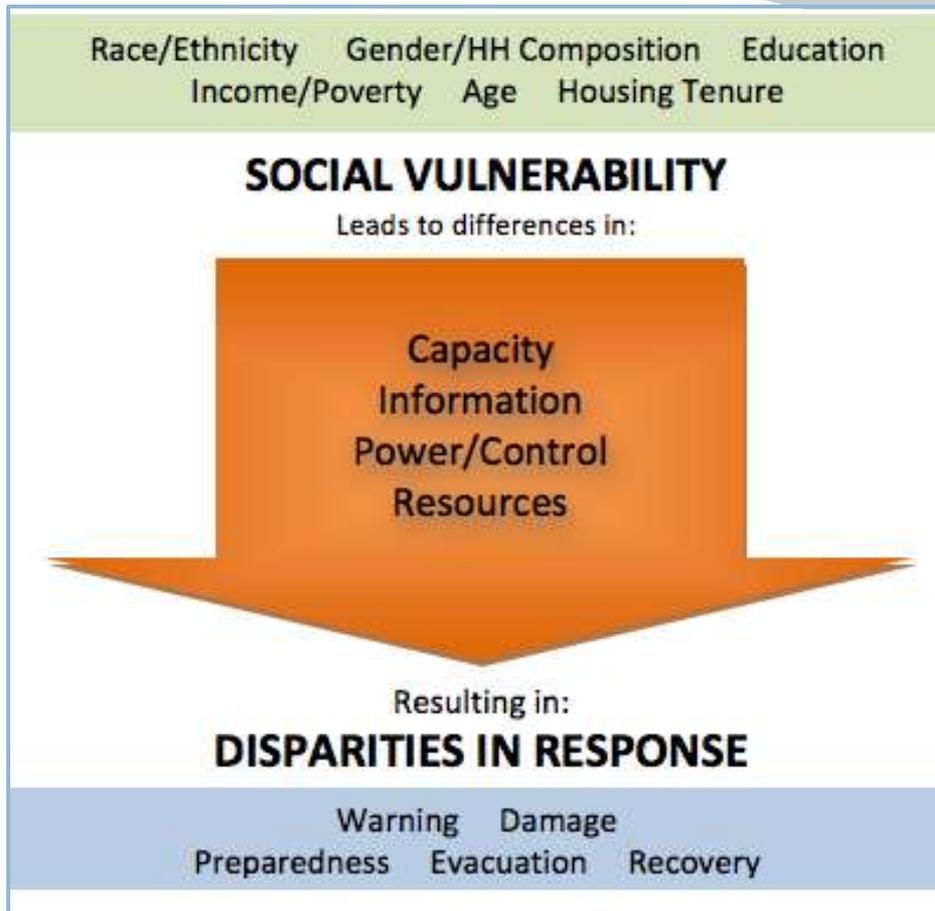


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Protect Our Values - petitions.com/petition/bachmann - Bachmann stands for Individualism, Liberty & Freedom. Stand with her!

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# Social vulnerability



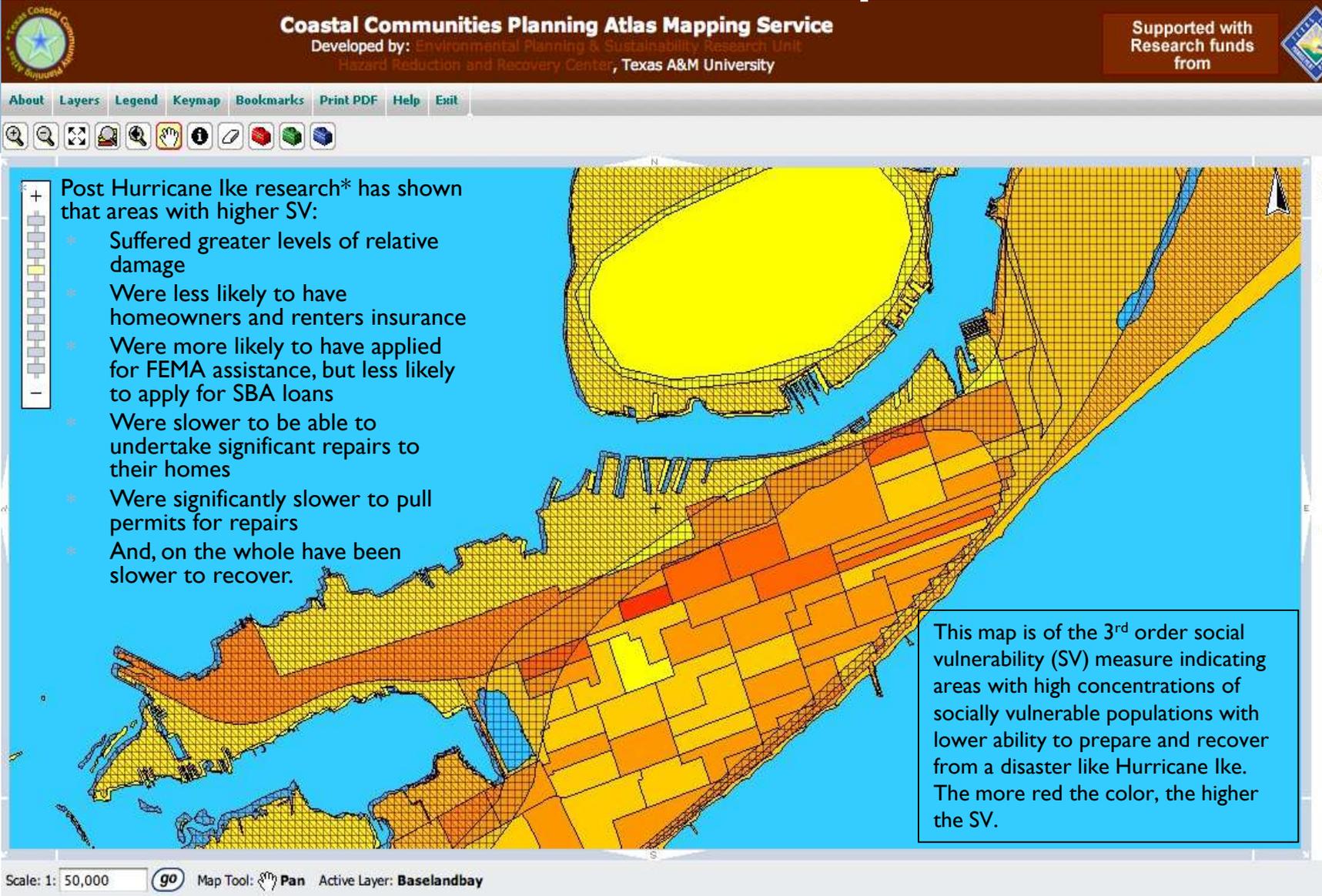
- \* Much like physical vulnerability, except focused on social units
- \* Focus is on social factors and processes that generate vulnerability in terms of a person's or group's capacity to anticipate, cope with, resist and recover from the impact of a natural hazard
  - \* These factors include:
    - \* Race/ethnicity, gender, education, poverty, age, and housing tenure
- \* Social vulnerability will rarely be uniformly distributed among the individuals, groups, or various populations comprising social systems
  - \* As a consequence we can develop mapping tools to identify areas with higher concentrations of socially vulnerable populations

## Levels of Social Vulnerability Analysis

Base Social Vulnerability Indicators (percentages)	2 <sup>nd</sup> Order	3 <sup>rd</sup> Order
1. Single parent households with children/Total Households	Child care Needs	Socially Vulnerable Hotspot
2. Population 5 or below/Total Population		
3. Population 65 or above/Total Population	Elder Care Needs	
4. Population 65 or above & below poverty/Pop. 65 or above		
5. Workers using public transportation/Civilian pop. 16+ and employed	Transportation needs	
6. Occupied housing units without a vehicle/Occupied housing units (HUs)		
7. Occupied Housing units/Total housing units	Temporary Shelter and housing recovery needs	
8. Persons in renter occupied housing units/Total occupied housing units		
9. Non-white population/Total population		
10. Population in group quarters/Total population		
11. Housing units built 20 years ago/Total housing Units		
12. Mobile Homes/Total housing units		
13. Persons in poverty/Total population		
14. Occupied housing units without a telephone/Total occupied HU	Civic Capacity needs	
15. Population above 25 with less than high school/Total pop above 25		
16. Population 16+ in labor force and unemployed/Pop in Labor force 16+		
17. Population above 5 that speak English not well or not at all/Pop > 5		

The entire set can be combined to capture hyper-vulnerability, or identify hotspots.

# SV and hazard exposure



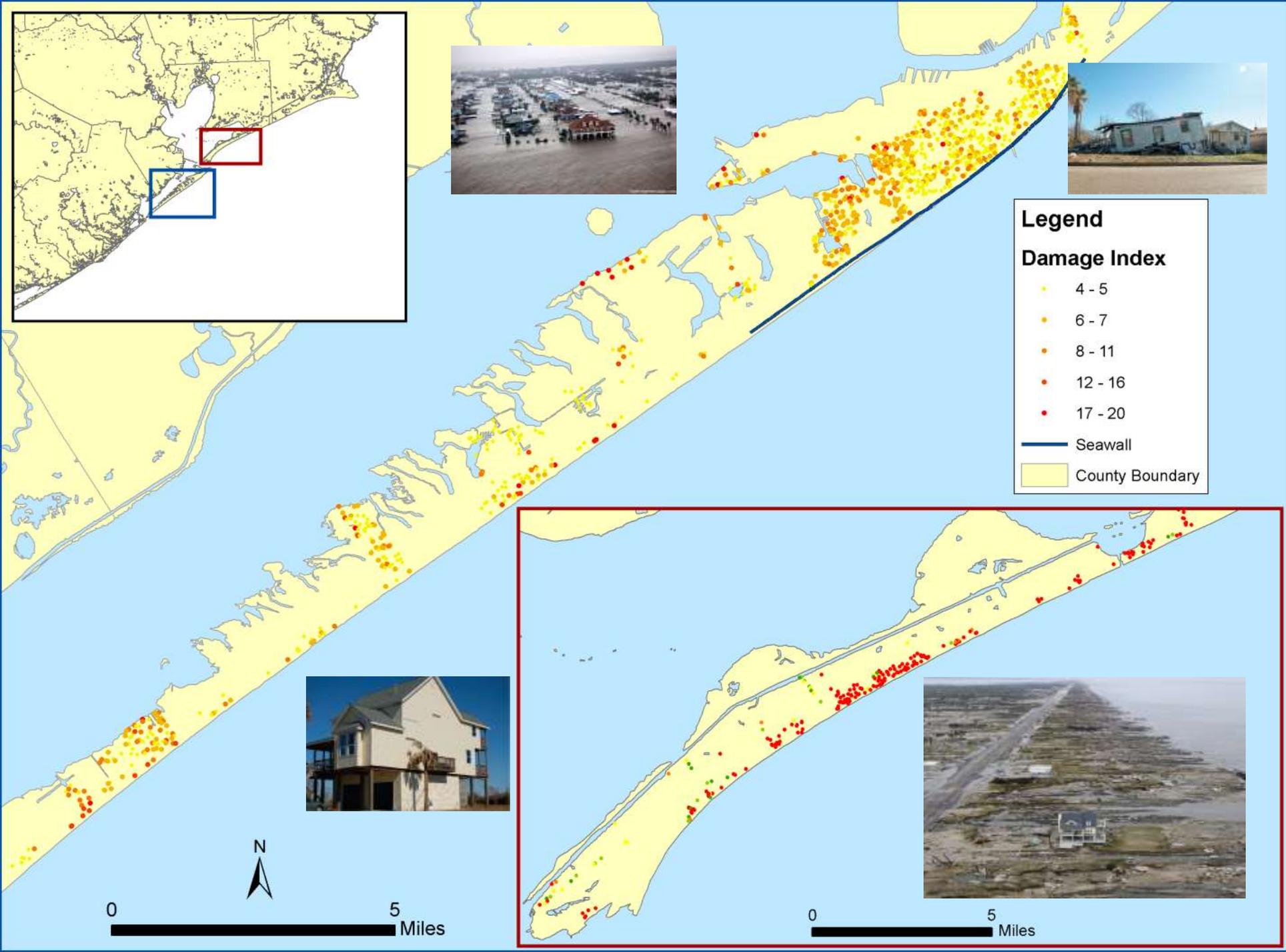
\*For a more complete discussion of these data, analysis and findings see: Van Zandt et al forthcoming, Peacock et al. forthcoming; Highfield et al. 2011, and [Peacock et al 2011](#).

# Putting the pieces together: Hazard Exposure, Physical vulnerability, and Social Vulnerability...Hurricane Ike



- \* **Hazard Exposure: Structure's exposure to potential hazards**
  - \* Wind, surge, and flooding
- \* **Physical vulnerabilities: Structure's physical characteristics**
  - \* Elevation, building codes, etc.
- \* **Social vulnerabilities: social and economic factors that may shape disaster impact**
  - \* Housing quality, maintenance, mitigation issues
  - \* Neighborhood characteristics





# In summary

- \* The physical and social impacts of disasters are results of the exposure to hazards, the physical vulnerabilities, and the social vulnerabilities present in a community
- \* That vulnerability analysis should be based on assessments

