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

Content for this presentation was derived from research funded by NOAA, the TGLO and the CCC. The views expressed herein and during the presentation are solely those of the author and presenter and do not necessarily reflect the views of the funding agencies.
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
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)
13 of 18 counties have 80% or more of their area falling into risk zones 3 or 4.

Essentially all coast county areas fall into Wind zones 2, 3, or 4.

The vast majority of the entire CMZ falls into the falls into Wind risk zones 3 or 4.

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

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

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.

Major Flooding Risk Zones:
5 = subject to ocean surge
4 = 100 year flood plain
3 = 500 year flood plain

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.

* From: coastalatlas.tamu.edu
Public Schools
Historic Places
Police stations

Police Stations
Fire stations

Many are in Category 1 & 2 surge zones. -- But actual structural features will vary.
Hospitals: Many are in Category 1 & 2 surge zones, but include some mitigation features.
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

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

The entire set can be combined to capture hyper-vulnerability, or identify hotspots.
Post Hurricane Ike research* has shown that areas with higher SV:

* Suffered greater levels of relative damage
* Were less likely to have homeowners and renters insurance
* Were more likely to have applied for FEMA assistance, but less likely to apply for SBA loans
* Were slower to be able to undertake significant repairs to their homes
* Were significantly slower to pull permits for repairs
* And, on the whole have been slower to recover.

This map is of the 3rd order social vulnerability (SV) measure indicating areas with high concentrations of socially vulnerable populations with lower ability to prepare and recover from a disaster like Hurricane Ike. The more red the color, the higher the SV.

*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.