

Congressional Hazards Caucus and Congressional Hazards Caucus Alliance Briefing

The Role of Earthquake Impact Assessment in Mitigation, Response and Recovery



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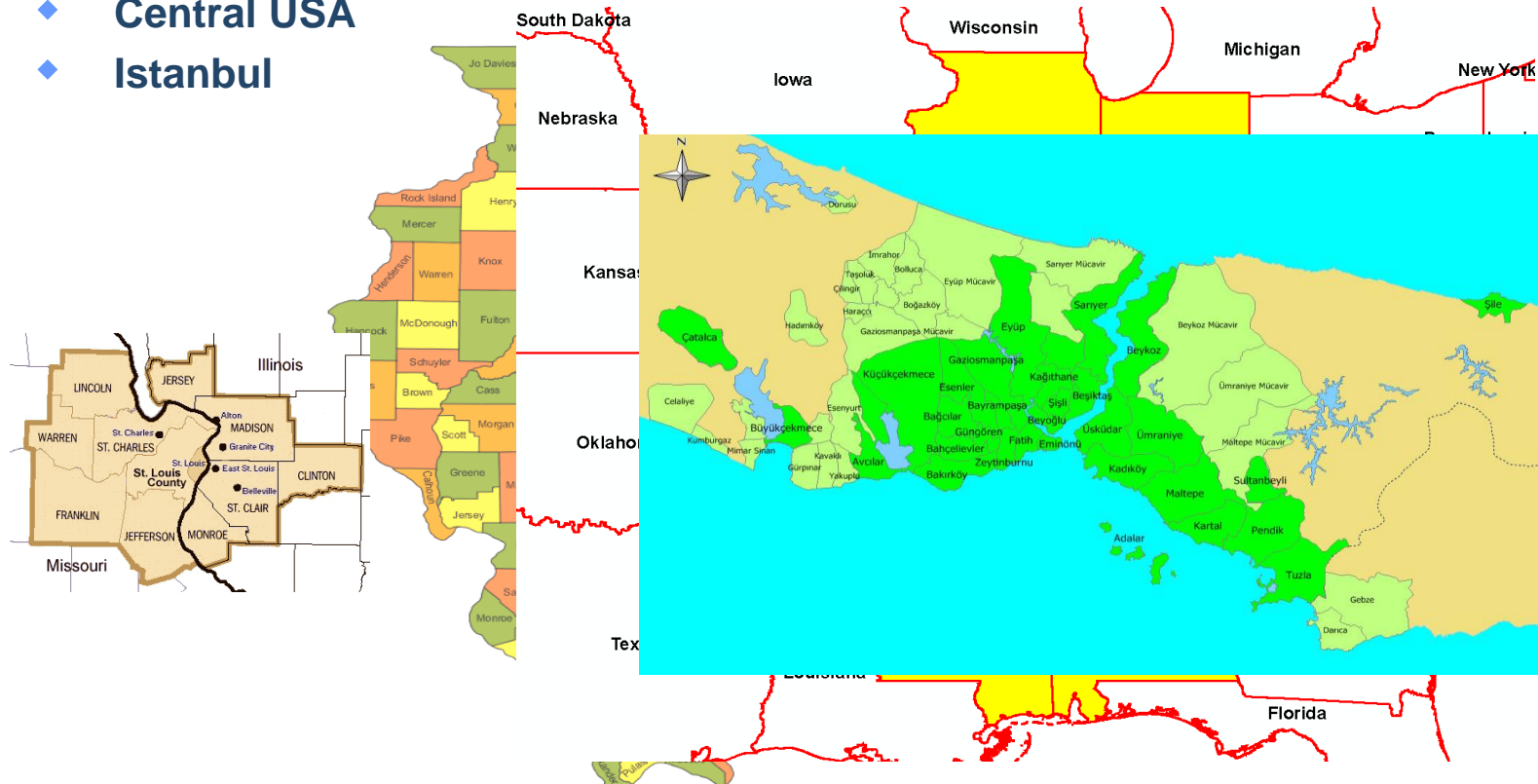
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Earthquake Risk Management in the MAE Center

■ Current projects

- ◆ St. Louis
- ◆ Illinois
- ◆ Central USA
- ◆ Istanbul



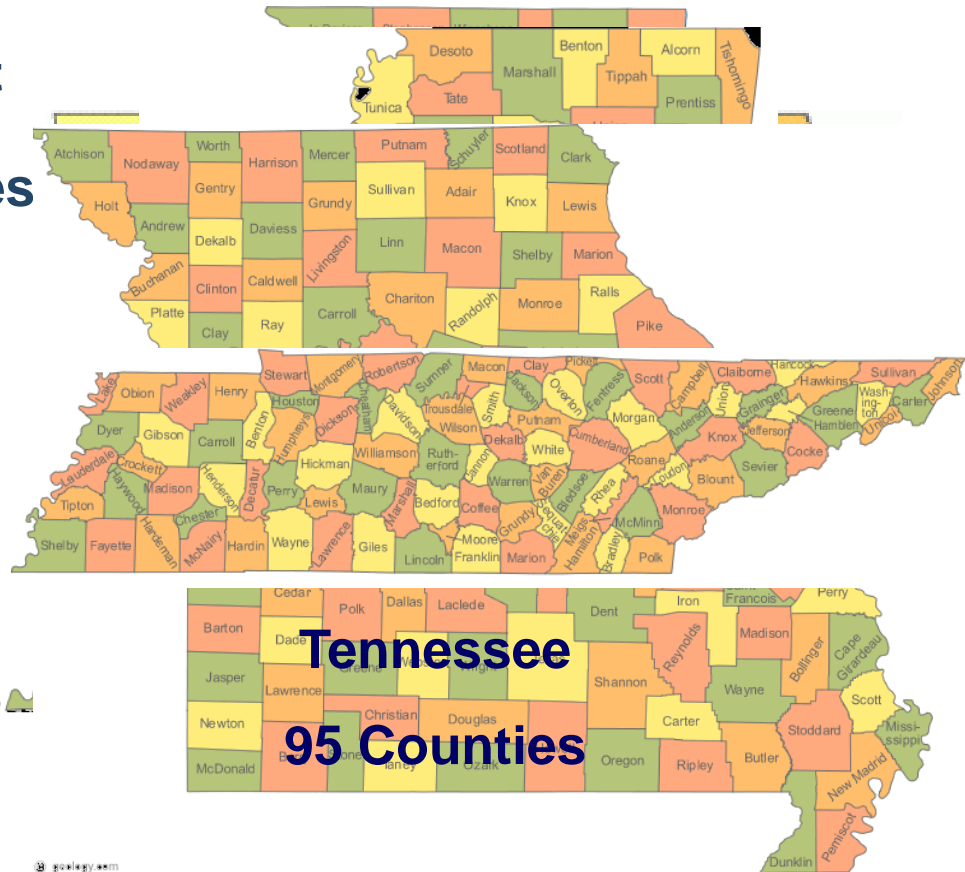
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State-Level Impact Assessment

- Worst-case impact assessment for each state
- Estimates for State and counties
 - ◆ Damaged structures
 - ◆ Damage and functionality
 - Essential facilities
 - Roads, bridges and other transportation infrastructure
 - Utility facilities, pipeline distribution networks, electric service
 - Fire ignitions
 - Debris
 - Social impacts (shelter and casualties)
 - HAZMAT vulnerability
 - Direct Economic losses
- Five Detailed site-specific studies of rural and urban sites



77 Counties

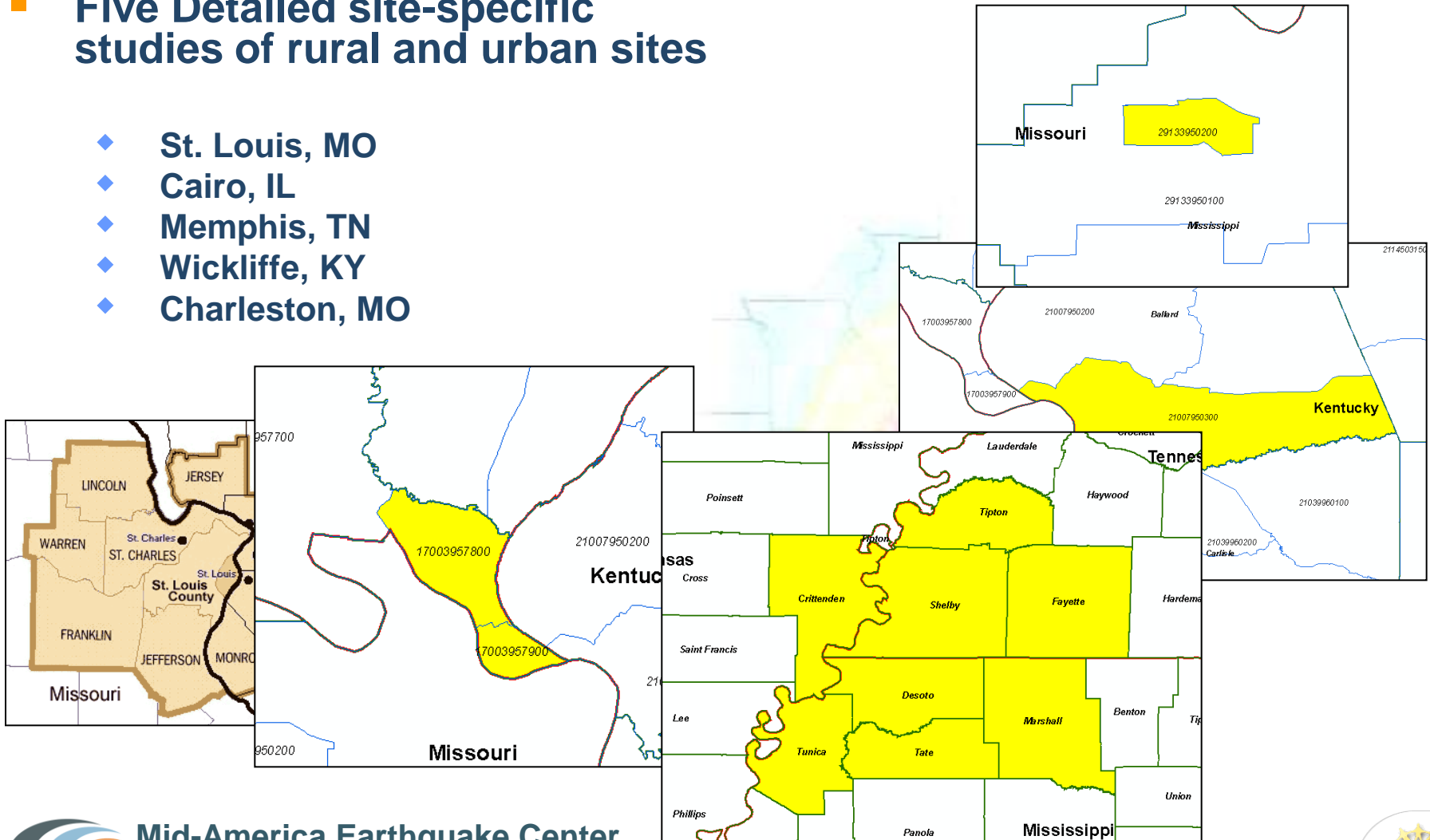
89 Counties



City-Level Impact Assessment

- **Five Detailed site-specific studies of rural and urban sites**

- ◆ St. Louis, MO
- ◆ Cairo, IL
- ◆ Memphis, TN
- ◆ Wickliffe, KY
- ◆ Charleston, MO



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Objective

**Provide the Most Credible Estimates of
Impact of New Madrid and Wabash Valley
Earthquakes with Associated Uncertainty**

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**Estimates that can Stand Scientific
and Political Scrutiny**

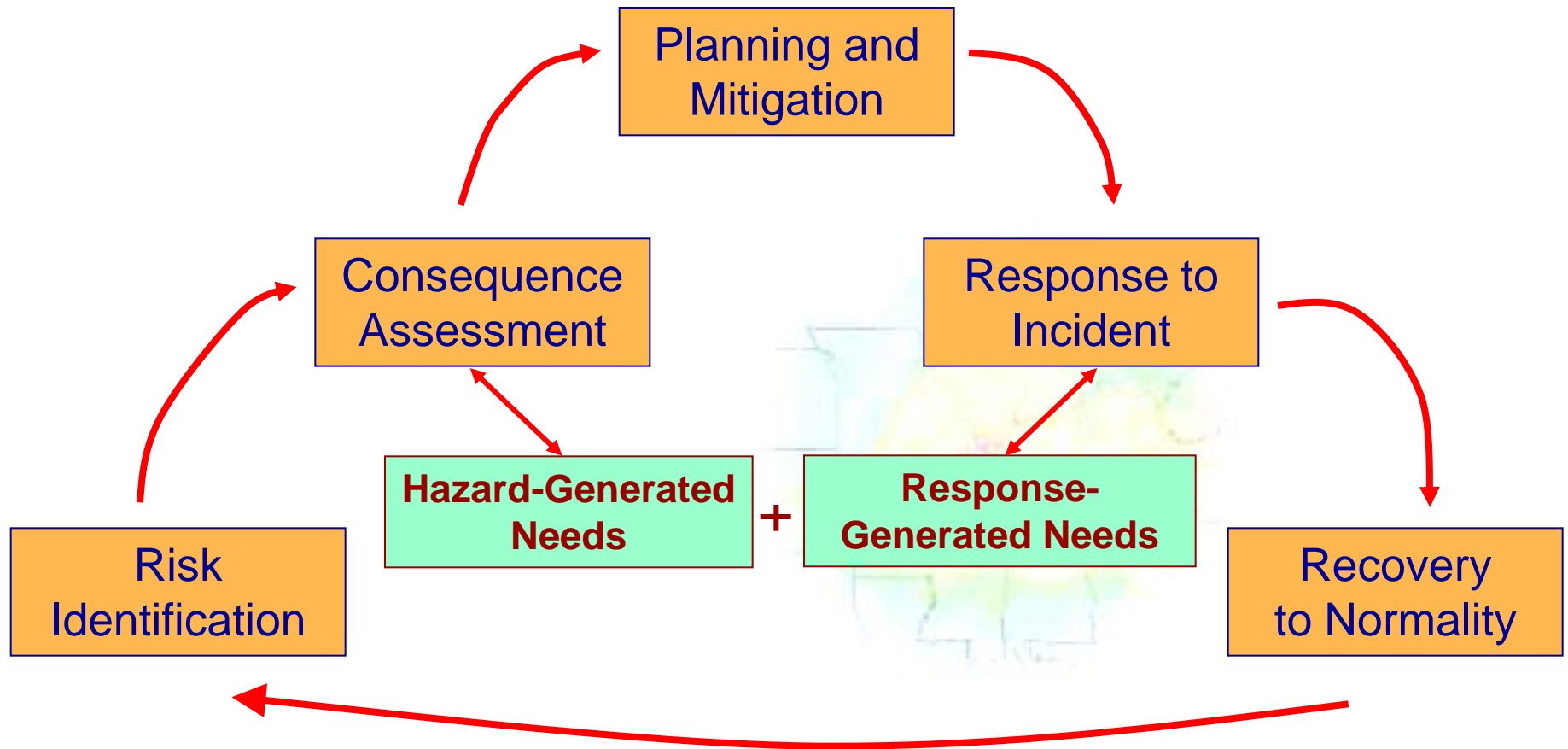


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The Total Earthquake Risk Cycle



Components of Impact Assessment

HAZARD

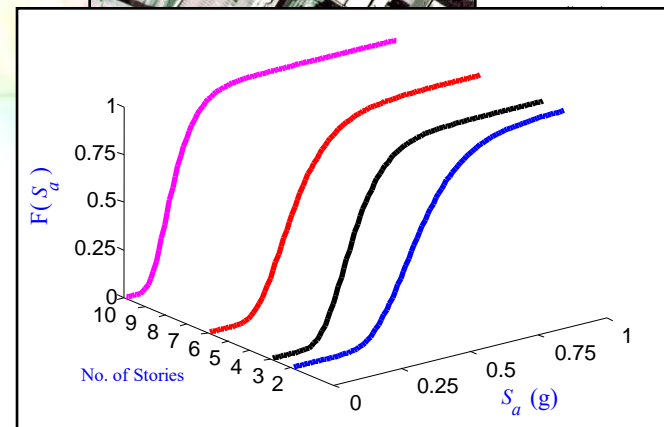
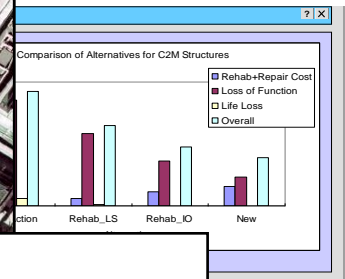
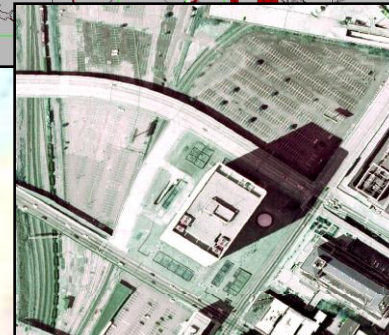
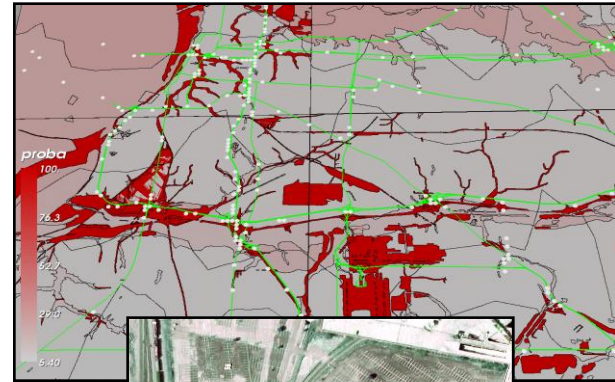
Description of the ground shaking

INVENTORY

Assets that are subjected to the Hazard

FRAGILITY

Sensitivity of the assets to damage from intensity of shaking



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Tools: HAZUS and MAEviz

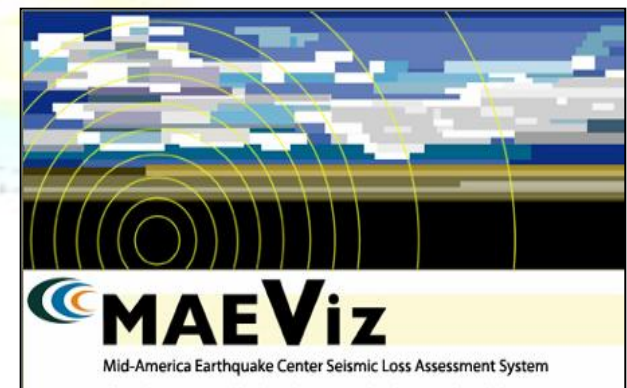
- **HAZUS is FEMA's Loss Assessment Software**
- **It includes three levels, I, II and III**

Level 1 (Default Data Analysis)

Level 2 (User-supplied Data Analysis)

Level 3 (Advanced Data and Models Analysis)

- **MAEviz is the MAE Center specialized loss assessment software**
- **It is complementary to HAZUS**
- **It has transportation modeling and decision-support capabilities**



HAZUS Advanced Analysis

Preliminary Results

For 240 out of 745 Counties



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General Building Stock

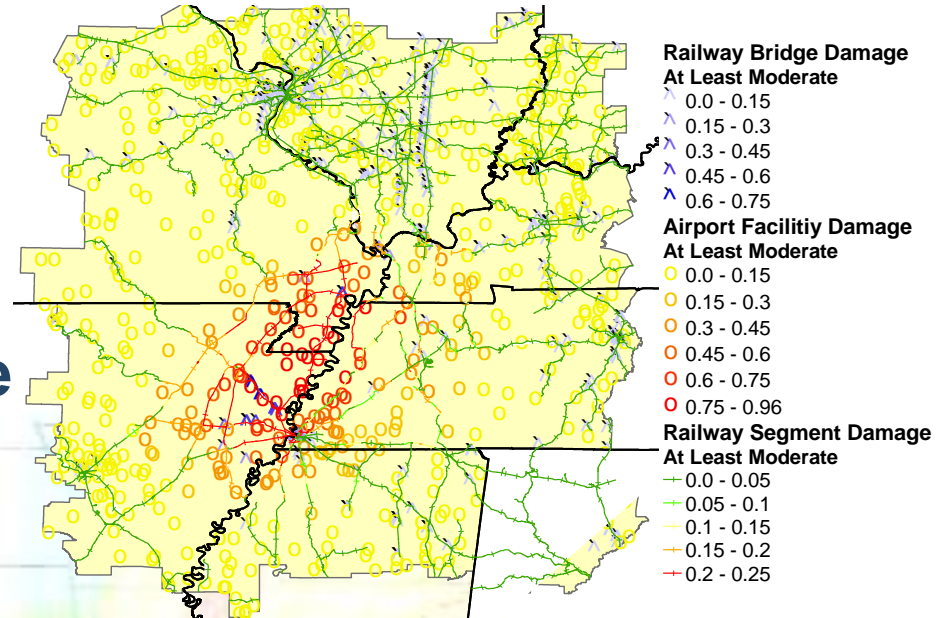
- Ground failure more than doubles damage to regional buildings, making it the single most critical factor influencing building damage, particularly collapse
- Building stock data is based on aggregated census tract data and **improved data is likely to increase damage and economic loss** as the number of buildings increases

	Level I		Improved Level I		Level II	
	At Least Moderate	Complete	At Least Moderate	Complete	At Least Moderate	Complete
Light Wood Frame	61,126	142	64,049	442	118,148	63,242
Unreinforced Masonry	48,854	5,734	73,852	13,754	76,534	21,673
Mobile Home	109,736	3,564	99,089	13,839	101,097	22,667



Transportation Facilities

- 30,000 bridges in region, Level II incurs greatest number of bridges with at least moderate damage
- Improved inventories are likely to show more structures than HAZUS default
- Better inventories will elicit **more damage and economic loss**

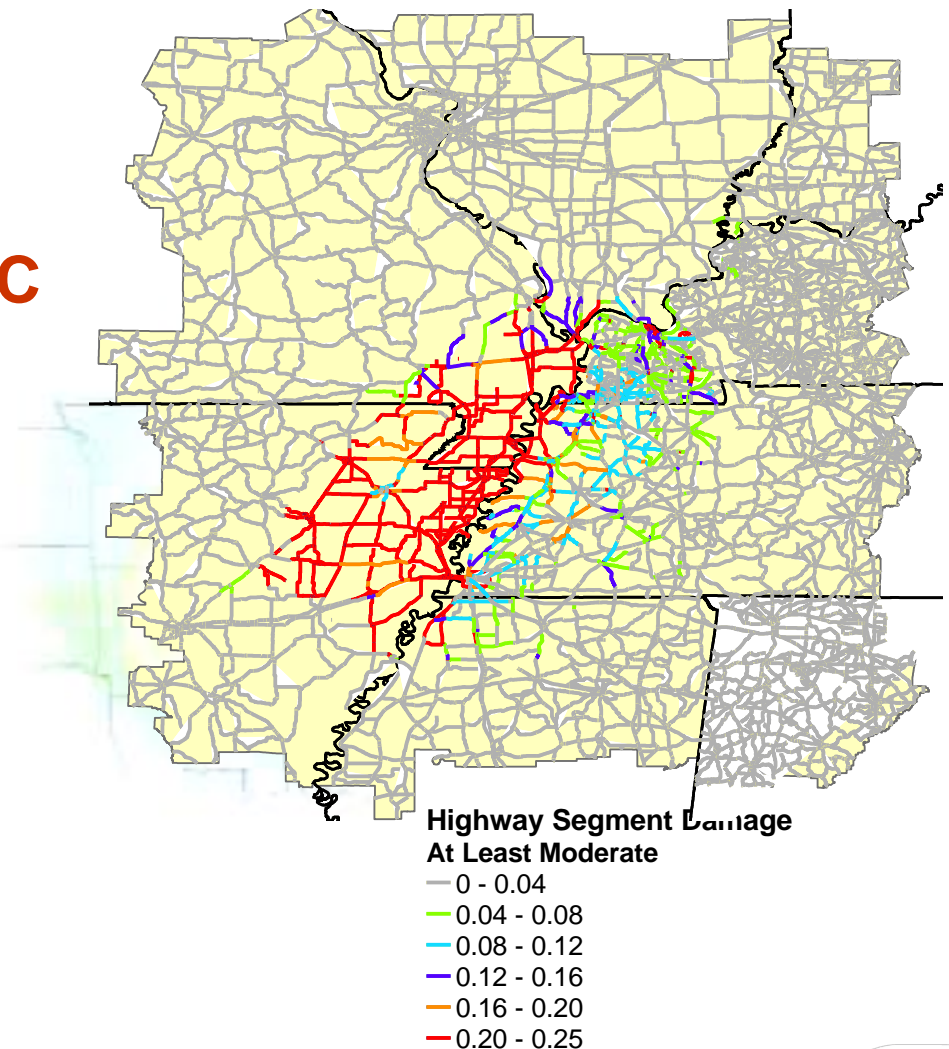


	Level I	Improved Level I	Level II
Highway Bridges	379	1,179	1,987
Railway Facilities	42	46	85
Port Facilities	38	114	138
Airport Facilities	6	48	64



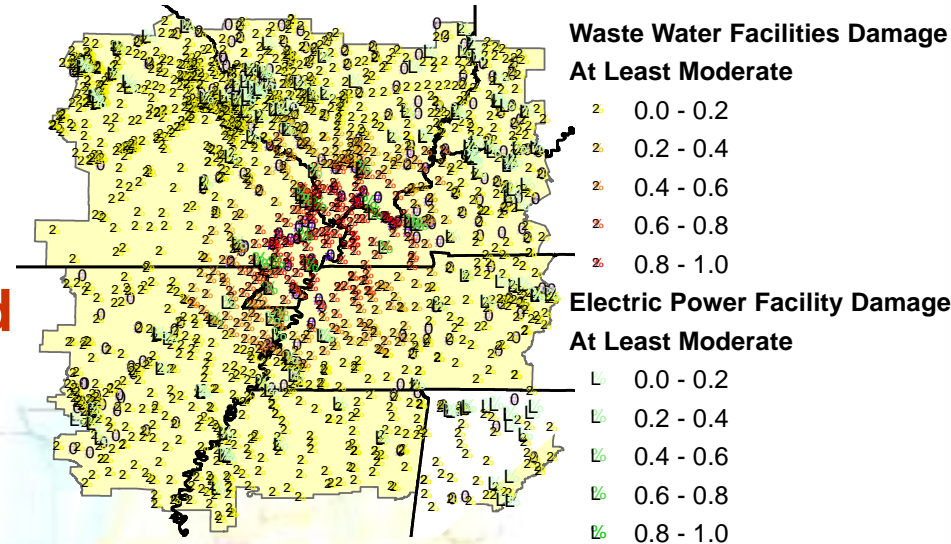
Transportation Networks

- Over 86,000 miles of highways in 230 county study region
- Effect is **CATASTROPHIC**
- Dense Memphis transportation grid is most vulnerable to southwest source event
- Updated roadway fragilities and regional inventory is likely to **increase** regional highway damage



Utility Facilities

- Wastewater facilities are largest inventory category and thus most facilities damaged – **waste water services will be hit very hard**
- Underestimation of utility inventory, making damage and loss estimates less reliable
- Improved inventory is likely to **increase** damage rates at all levels

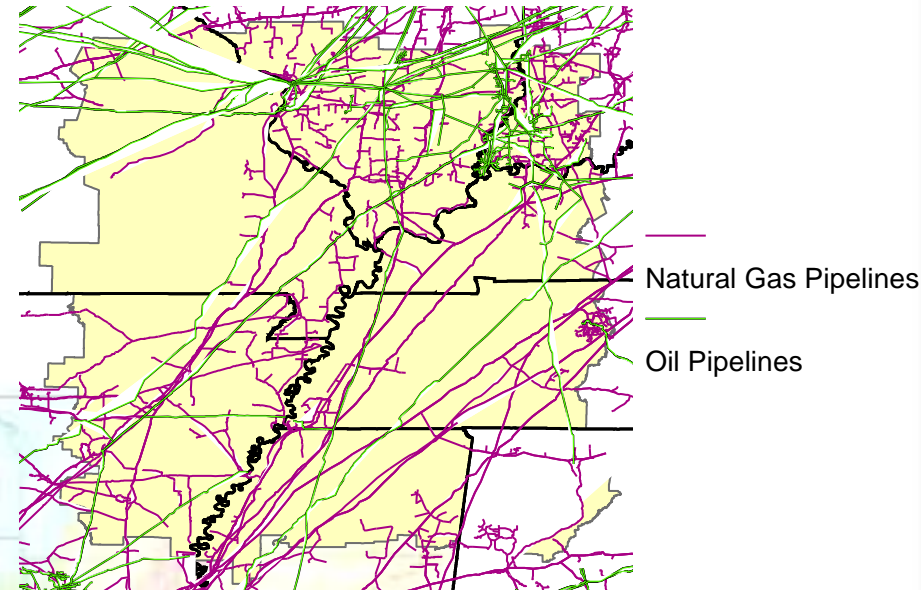


Facility Type	Level I	Improved Level I	Level II
Potable Water	8	36	36
Waste Water	47	180	180
Natural Gas	2	12	12
Oil	8	12	12
Electric Power	5	17	17
Communication	25	111	111



Utility Networks

- All utility networks are based on assumed pipeline lengths, not actual field surveys
- Addition of HSIP pipelines for major distribution lines only
- Overall pipeline damage is unreliable, additional network data will indicate a major increase in damage

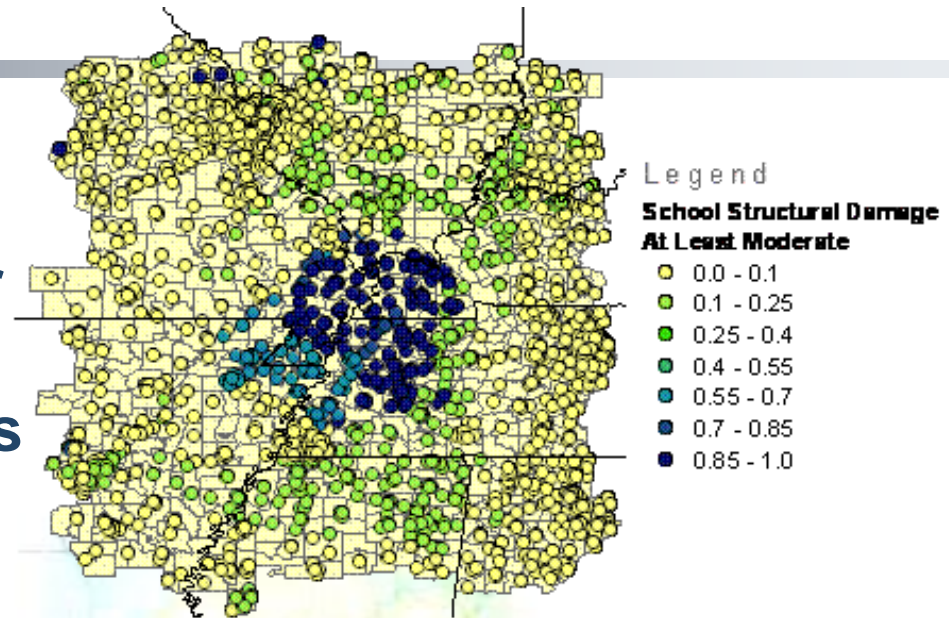


	Total Pipeline Length (kms)	Number of Leaks	Number of Breaks
Potable Water	500,560	39,540	58,974
Waste Water	300,336	31,273	46,643
Natural Gas	200,224	33,430	49,860



Social Impacts and Essential Facilities

- Fire ignitions at approximately 50 for higher levels of analysis
- Debris generation increases from 7 to **18 million tons**
- These numbers are likely to **increase** as building inventories and regional demographics are updated to current values



- **Very significant impact on hospitals, fire and police stations** as analysis levels increase, thus fewer services in hardest hit areas are available

	Level I	Improved Level I	Level II
Displaced Households	18,837	27,513	118,743
Temporary Housing	5,849	8,095	34,181
Casualties	13,616	21,026	36,350



Direct Economic Losses

- The southwest extension event produces the greatest regional losses at every level of analysis
- These values provide a **lower bound** due to uncertainties in each of the three components of earthquake impact assessment
- It is highly probable that inventory improvements, updated fragilities and refining regional hazard will increase direct economic losses

Direct Loss Category	Level I	Improved Level I	Level II
Buildings	\$12,942,294,000	\$19,656,812,898	\$34,383,750,000
Transportation	\$575,128,000	\$1,286,888,816	\$5,044,643,000
Utility	\$2,033,110,000	\$8,506,970,890	\$11,034,740,000
Total	\$15,550,532,000	\$29,450,672,604	\$50,463,133,000



HAZUS Advanced Analysis

Parameters Influencing Impact Analysis

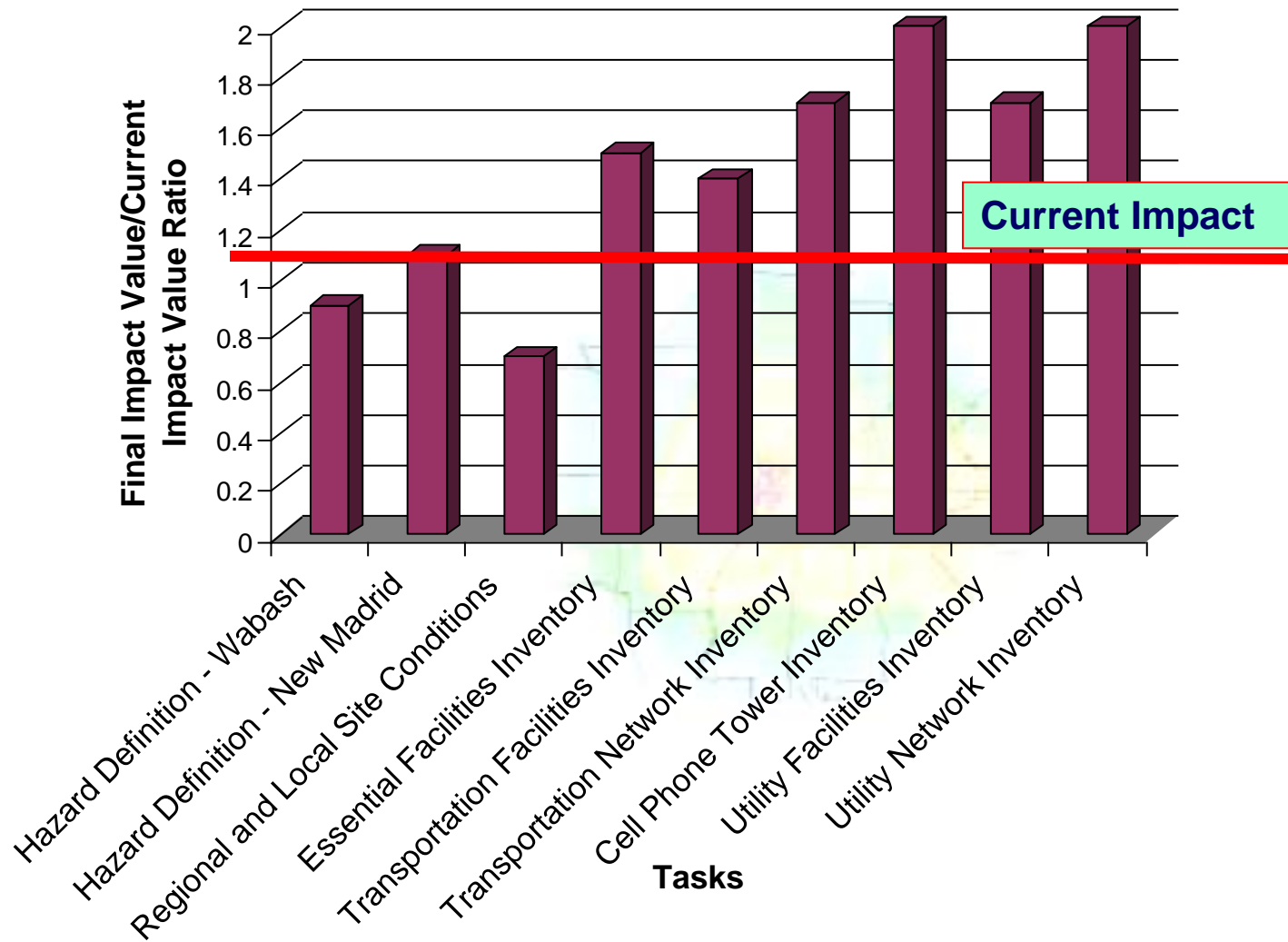


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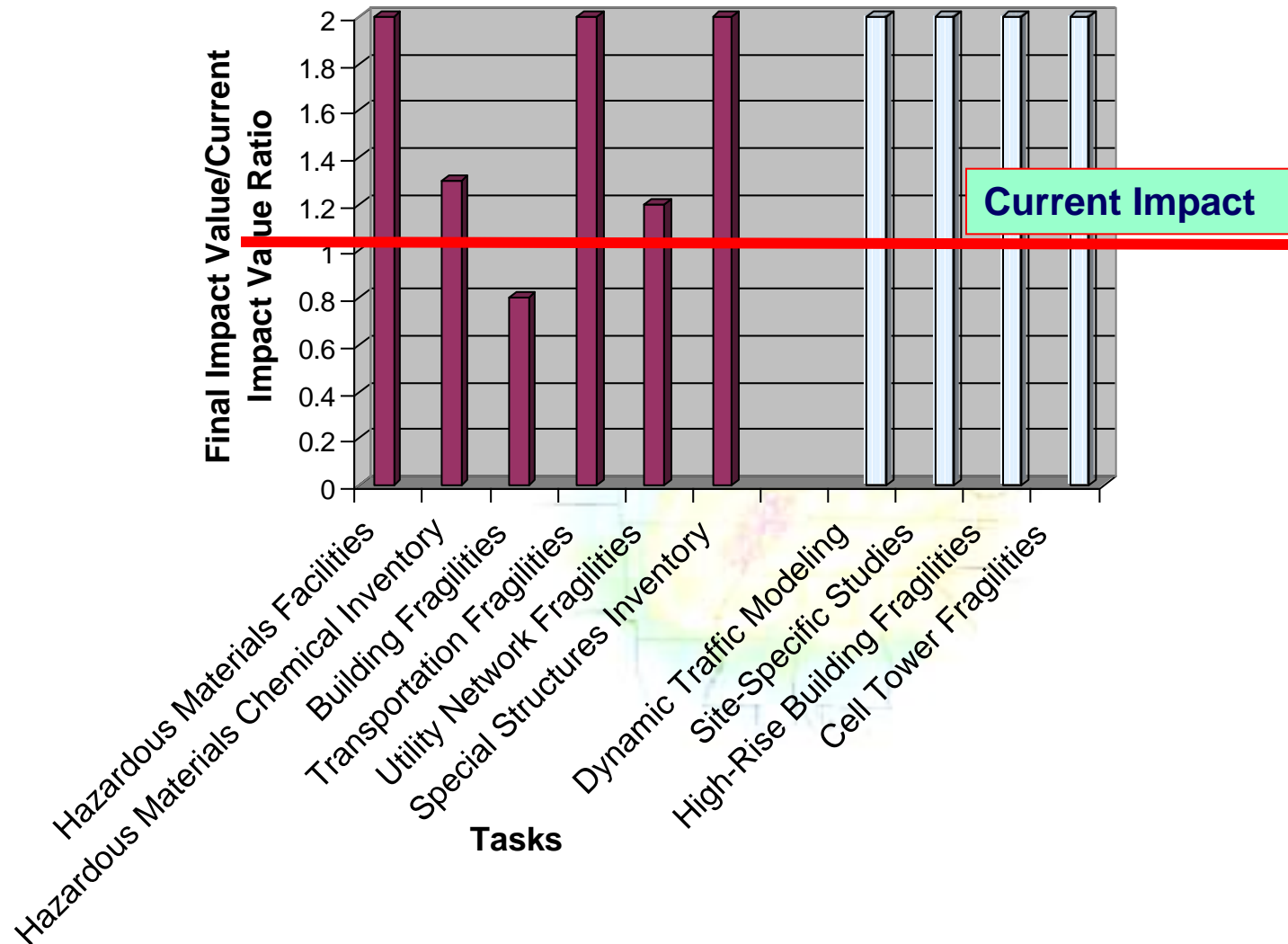
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Factors Influencing Assessment Improvement



Factors Influencing Assessment Improvement



Upcoming Activities

■ Planned Work

- ◆ Finalize regional hazard for New Madrid and Wabash scenarios
- ◆ Determine hazard for site-specific scenarios
- ◆ Obtain best available inventory for as many categories as possible of the following:
 - Hazardous materials facilities and storage
 - Highway bridges – including long-span bridges
 - Essential facilities
 - Pipeline networks
 - Electric power networks
 - Cell phone towers and communications facilities
 - Levees



Upcoming Activities

■ Planned Work – cont'd

- ◆ Development of analytical fragilities for high-rise buildings for St. Louis and Chicago
- ◆ Development of fragilities for communications systems
- ◆ Develop detailed response and recovery models
- ◆ Implement the Temporary Housing Optimization module in MAEviz
- ◆ Use of MAEviz for local assessments, including transportation traffic modeling, utilities networks flow, decision-making tool and uncertainty quantification





Q and A



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