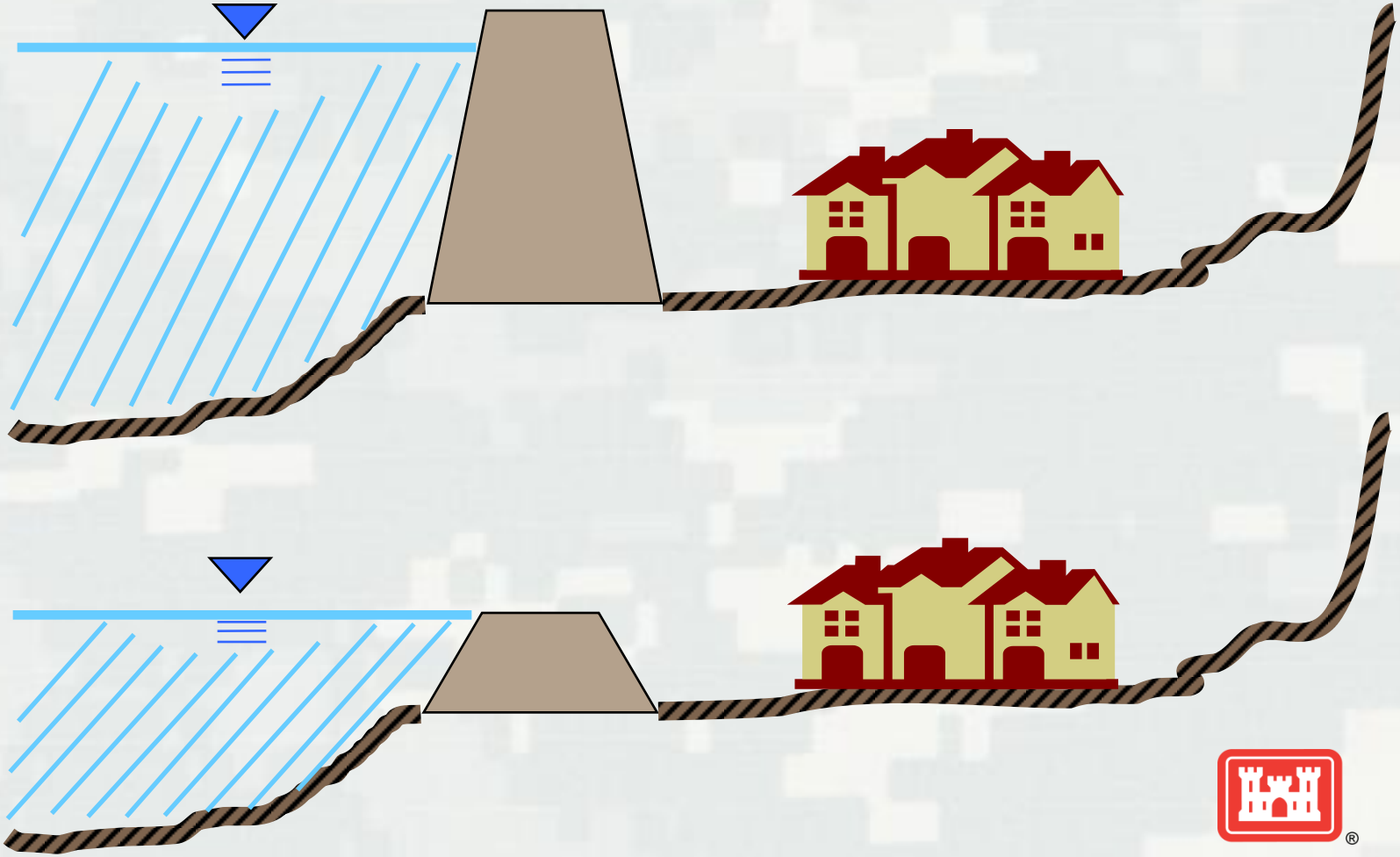
Estimating Loss of Life from Flooding

Jason Needham

USACE Risk Management Center

US Army Corps of Engineers
BUILDING STRONG®

Life Loss vs. PAR



USACE Life Loss Estimation Methods – Decision Driven

- Screening - Minimal resource requirement
  - Dams - Modified DSO-99-06 Method
  - Levees - Jonkman's Method
- Higher-level Risk Assessments
  - HEC-FIA
    - Screening validation, issue evaluation and periodic assessments
    - Moderate resource requirement
  - LifeSim
    - Support studies when HEC-FIA simplifications lead to too much uncertainty
    - Larger resource requirement

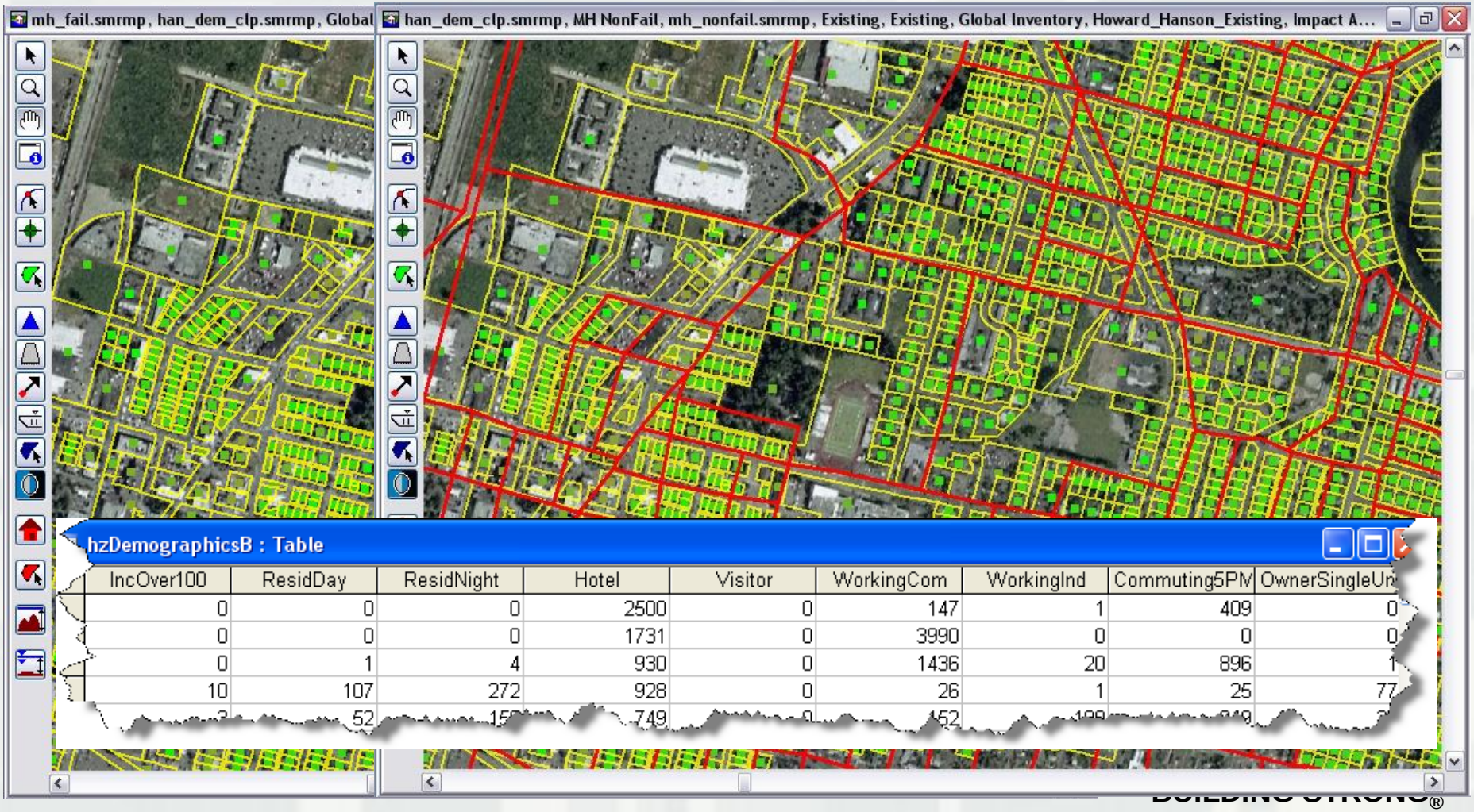
Scalable methods – effort from one applicable to more rigorous method

Life Loss Estimation – Essential Elements

- Initial distribution of people
- Redistribution of people
  - Warning
  - Response
  - Evacuation potential

  } Evacuation Effectiveness
- Flood characteristics
  - Arrival time, depth, velocity
- Shelter provided by final location
- Fatality rates

Initial Distribution of People: Detailed



IncOver100	ResidDay	ResidNight	Hotel	Visitor	WorkingCom	WorkingInd	Commuting5PM	OwnerSingleUn
0	0	0	2500	0	147	1	409	0
0	0	0	1731	0	3990	0	0	0
0	1	4	930	0	1436	20	896	1
10	107	272	928	0	26	1	25	77
[illegible]	52	[illegible]	749	[illegible]	152	[illegible]	[illegible]	[illegible]

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Warning Diffusion

REVERSE 911

Emergency Notification System

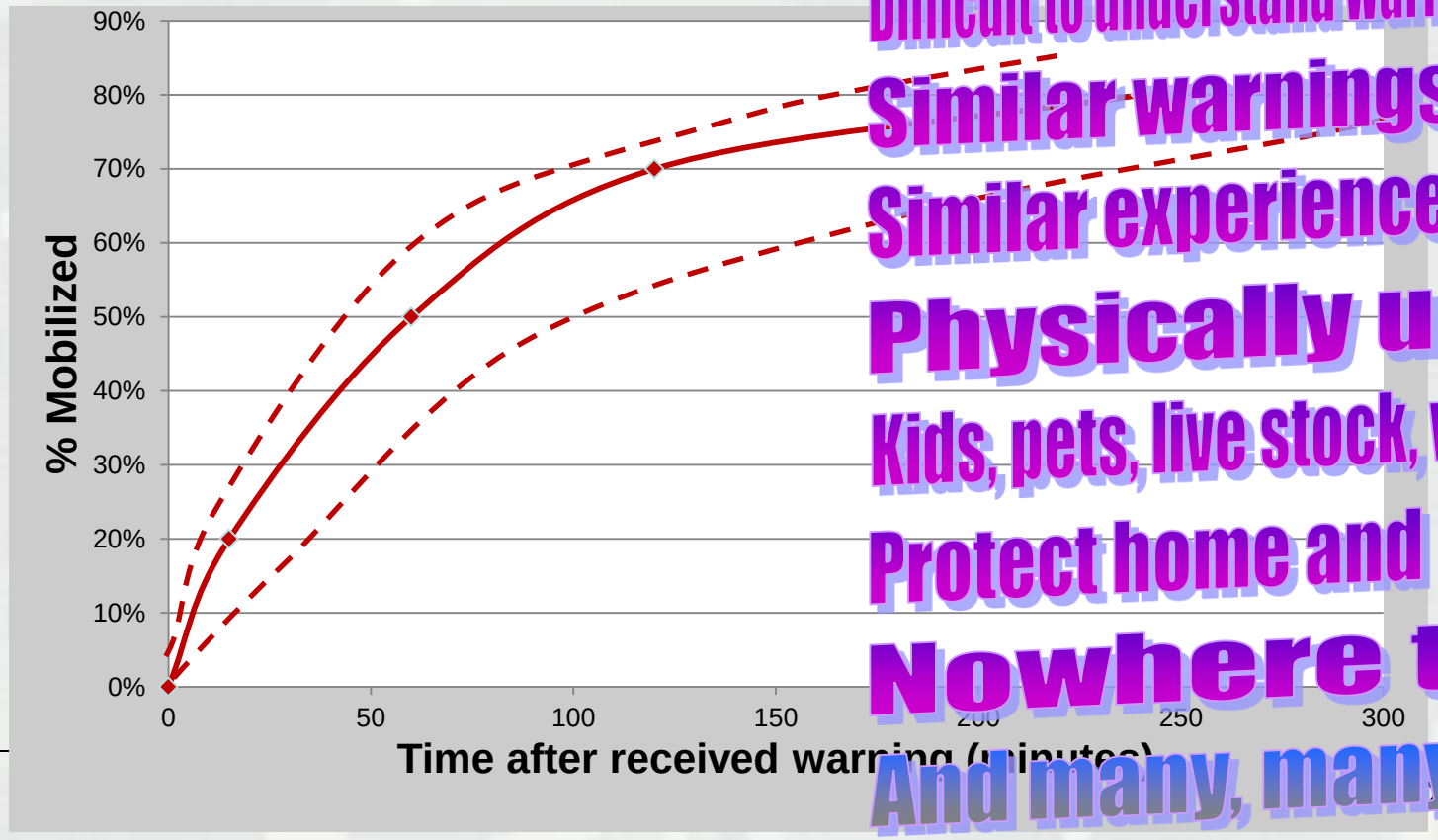
Warning Effectiveness: Likelihood Factors

Factors that would make warning more efficient than EAS only	Factors that would make warning less efficient than EAS only
Alert LA (reverse 911)	Description of alert system is only in English*
Social Media (Twitter, Facebook, etc.)	Language barriers
Internet	Likely wide-spread electric outage (message conveyance)
Heightened awareness due to storms and/or flooding	Physical limitation of how many can be contacted (~15,000/hr)*
Dense urban environment – word of mouth may spread quickly	Phone systems overloaded
Sherriff manual drive-around for notification	Only 1% of LA County has registered mobile phones for Alert LA*
Population downstream are tight-knit communities (i.e. – families)	Based on interviews (Sacramento County/Bakersfield), approximately 25% have mobile phones only
	Homeless population may only have access to secondary means of notification

* indicates change for future without Federal action condition

Evacuation Effectiveness

- Response: Mobilization
  - Relationship defining response to warning



Difficult to understand warning message.

Similar warnings in past.

Similar experiences in past.

Physically unable.

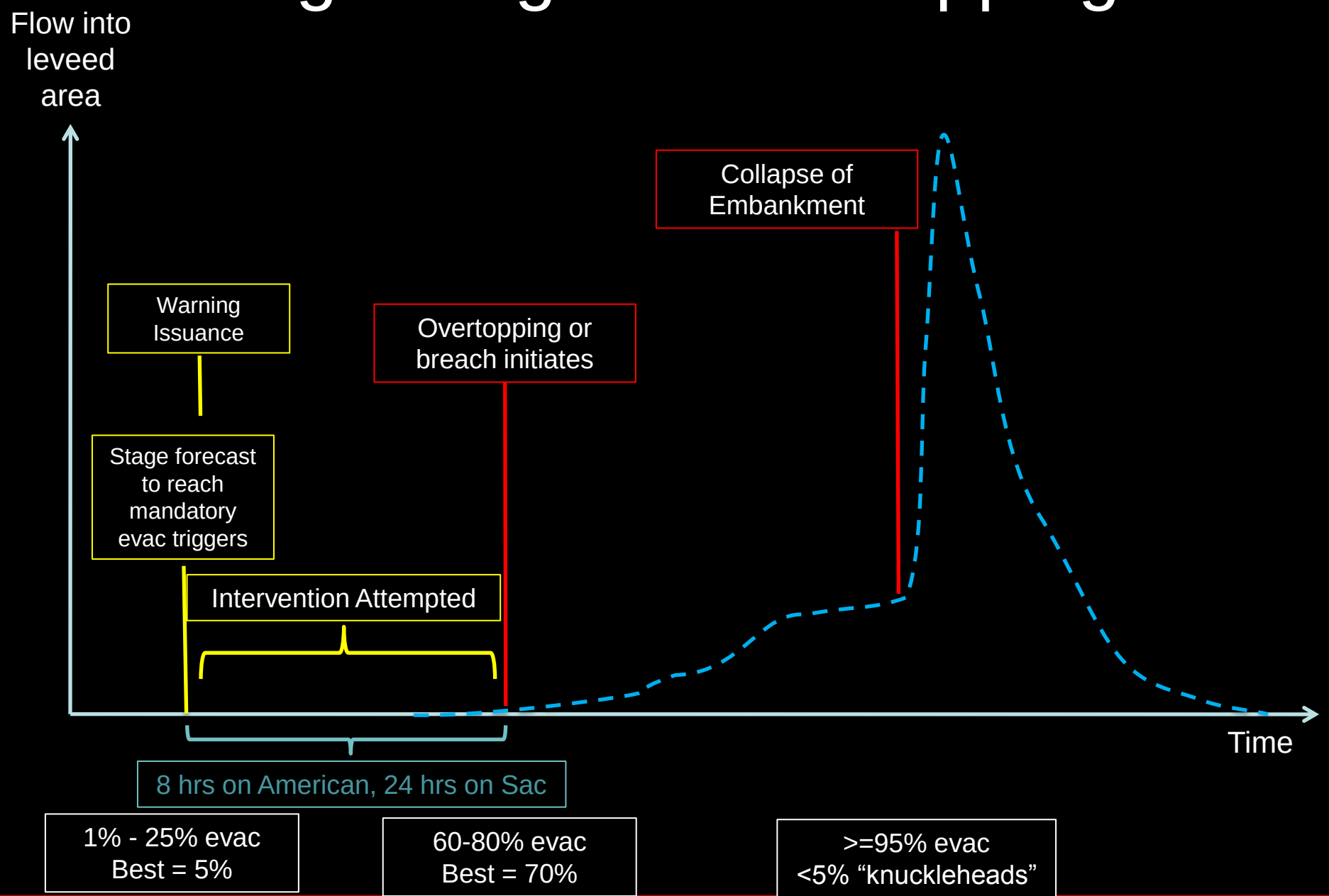
Kids, pets, live stock, valuables...

Protect home and property.

Nowhere to go.

And many, many more...

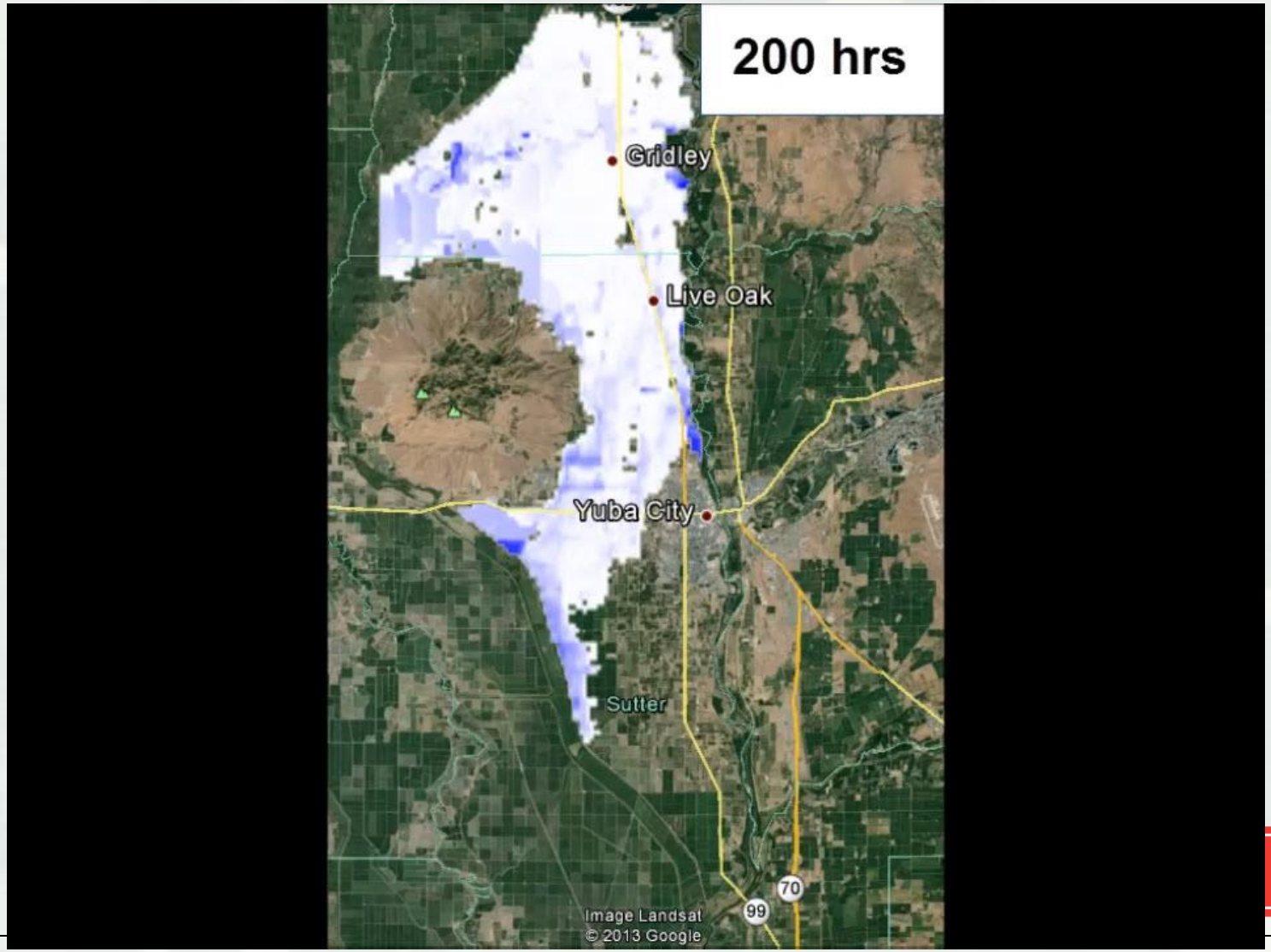
High Stage or Overtopping



Redistribution of People

- Evacuation potential
  - Can people get to safety before water arrives?

Flood Characteristics



Shelter Survivability

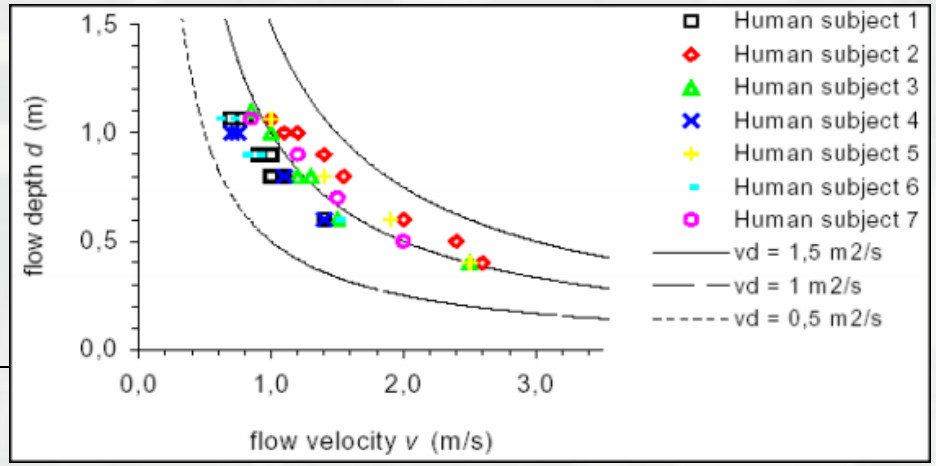
- Understanding effects of depth and velocity on structures, vehicles, and people.
  - ▶ Structure damage criteria (RESCDAM 2000, USACE 1985)
  - ▶ Human stability criteria (Abt et al., 1989, RESCDAM 2000)
  - ▶ Vehicle stability criteria (NSW, 1986, UWRAA, 1993)

USACE (1985) building collapse criteria

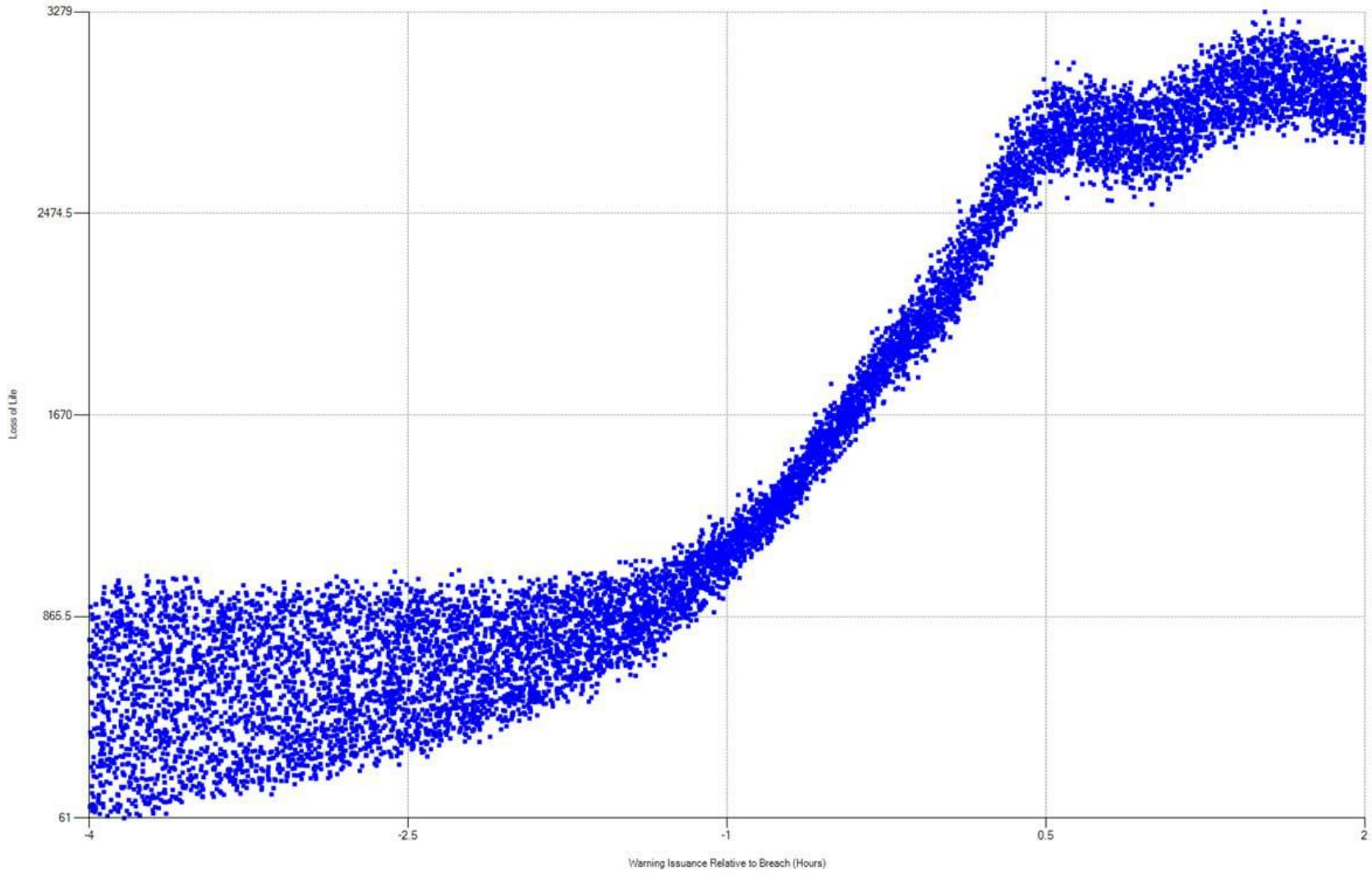
	1-Story	2-Story	3-Story
C-Masonry or concrete	$v < 1.92$ m/s $d*v^2 < 12.80$ m3/s	$v < 2.29$ m/s $d*v^2 < 38.80$ m3/s	$v < 2.29$ m/s $d*v^2 < 54.70$ m3/s
D-Wood buildings	$d < 3.05$ m $d*v^2 < 7.51$ m3/s	$d < 4.57$ m $d*v^2 < 7.51$ m3/s	$D < 6.10$ m $d*v^2 < 7.51$ m3/s
D-Steel buildings	$v < 5.40$ m/s $d*v^2 < 10.13$ m3/s	$v < 5.40$ m/s $d*v^2 < 20.00$ m3/s	$v < 5.40$ m/s $d*v^2 < 28.74$ m3/s

RESCDAM (2000) recommended building damage criteria

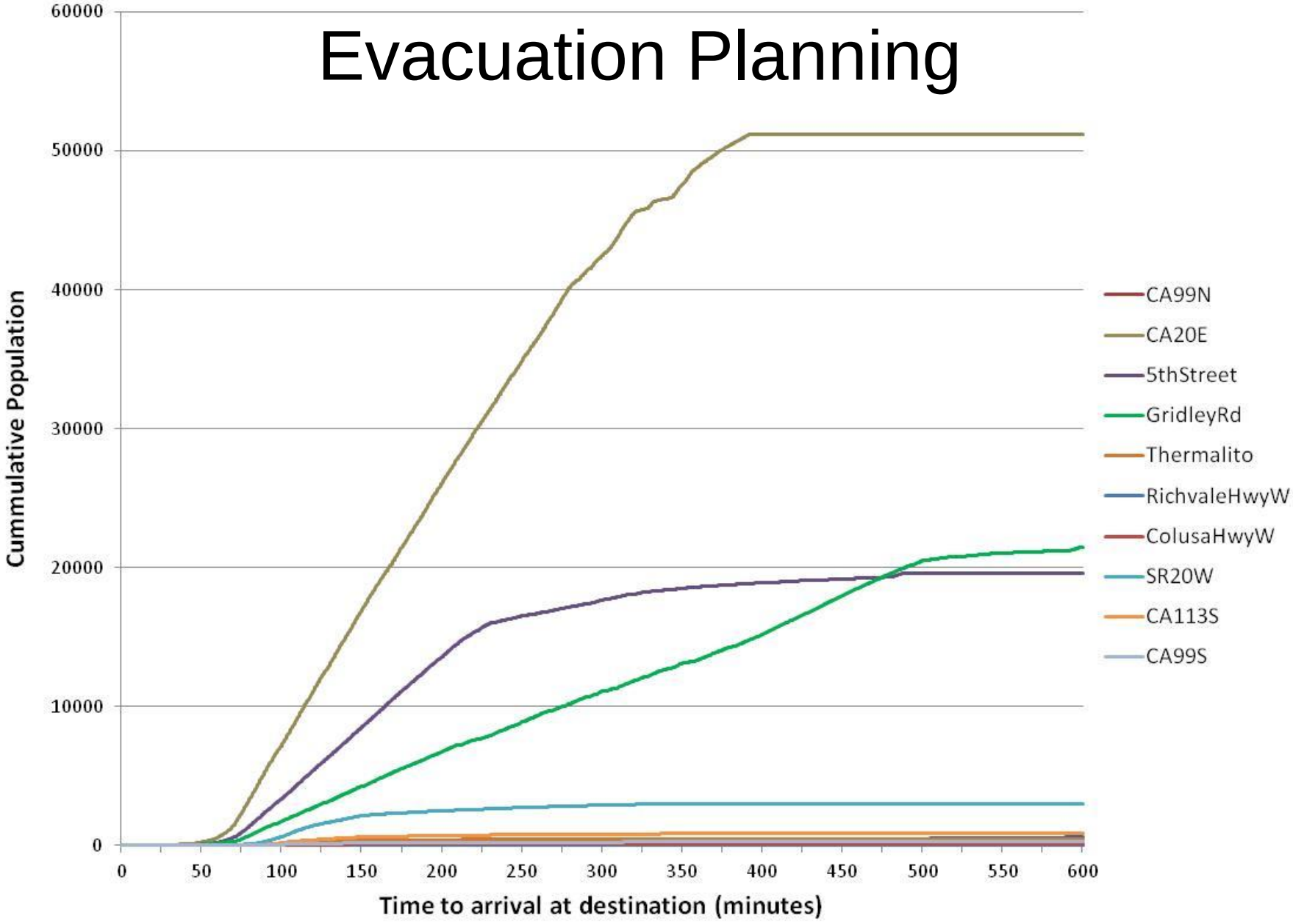
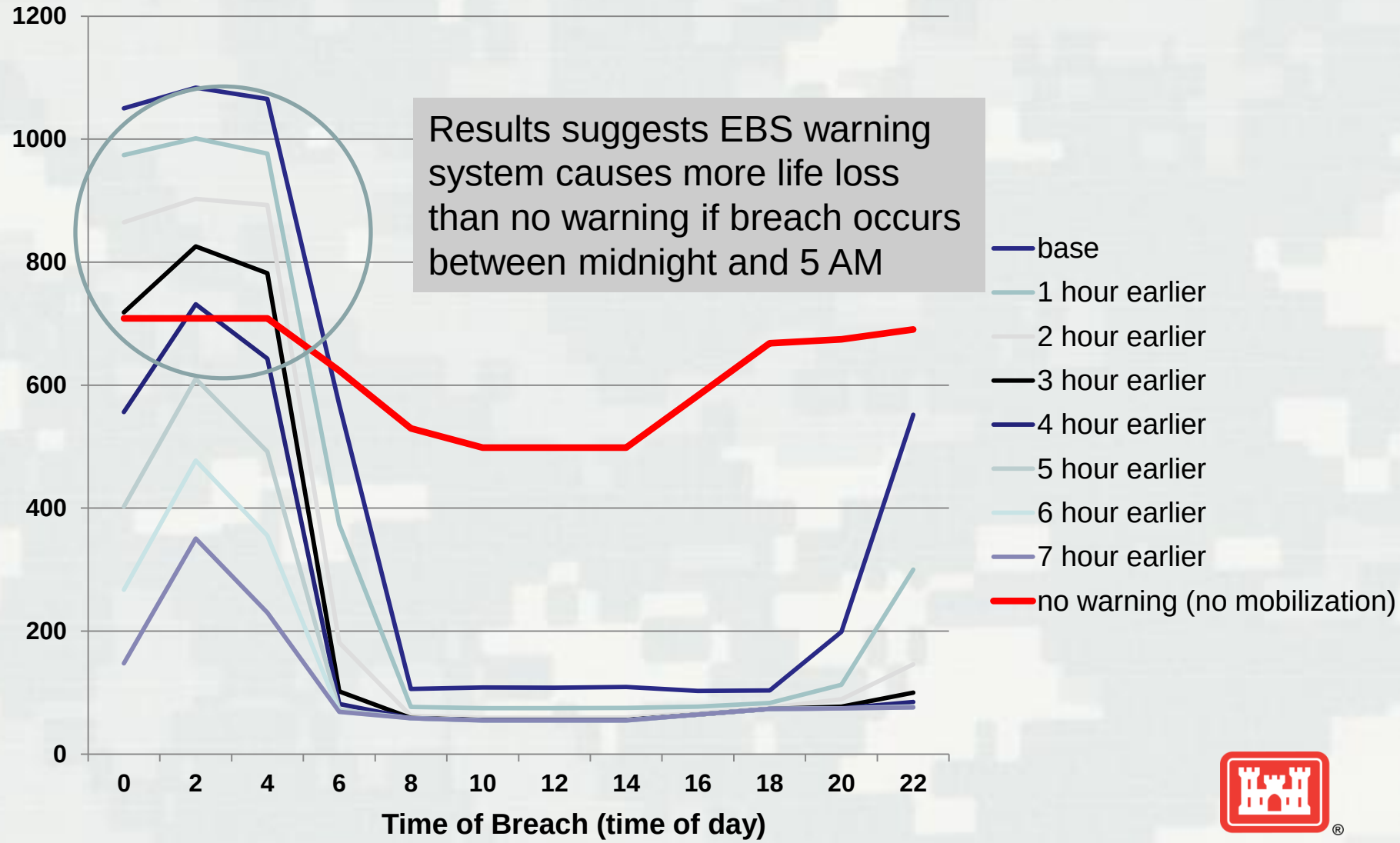
Building type	Partial damage	Total damage
Wood-framed		
unanchored	$v*d \geq 2$ m^2/s	$v*d \geq 3$ m^2/s
anchored	$v*d \geq 3$ m^2/s	$v*d \geq 7$ m^2/s
Masonry, concrete & brick	$v \geq 2$ m/s & $v*d \geq 3$ m^2/s	$v \geq 2$ m/s & $v*d \geq 7$ m^2/s



Results: Uncertainty



Evacuation Planning



Non-structural considerations