Inundation Modeling, Breach Parameters, and Consequences (USACE Approach)

Best Practices in Dam and Levee Safety Risk Analysis

Part C – Consequence Estimating

Last modified June 2017, presented July 2019

US Army Corps of Engineers®

U.S. DEPARTMENT OF THE INTERIOR BUREAU OF RECLAMATION

DEPARTMENT OF ENERGY · FEDERAL ENERGY REGULATORY COMMISSION

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Objective

- Participants will become familiar with numerical approach for estimating loss of life

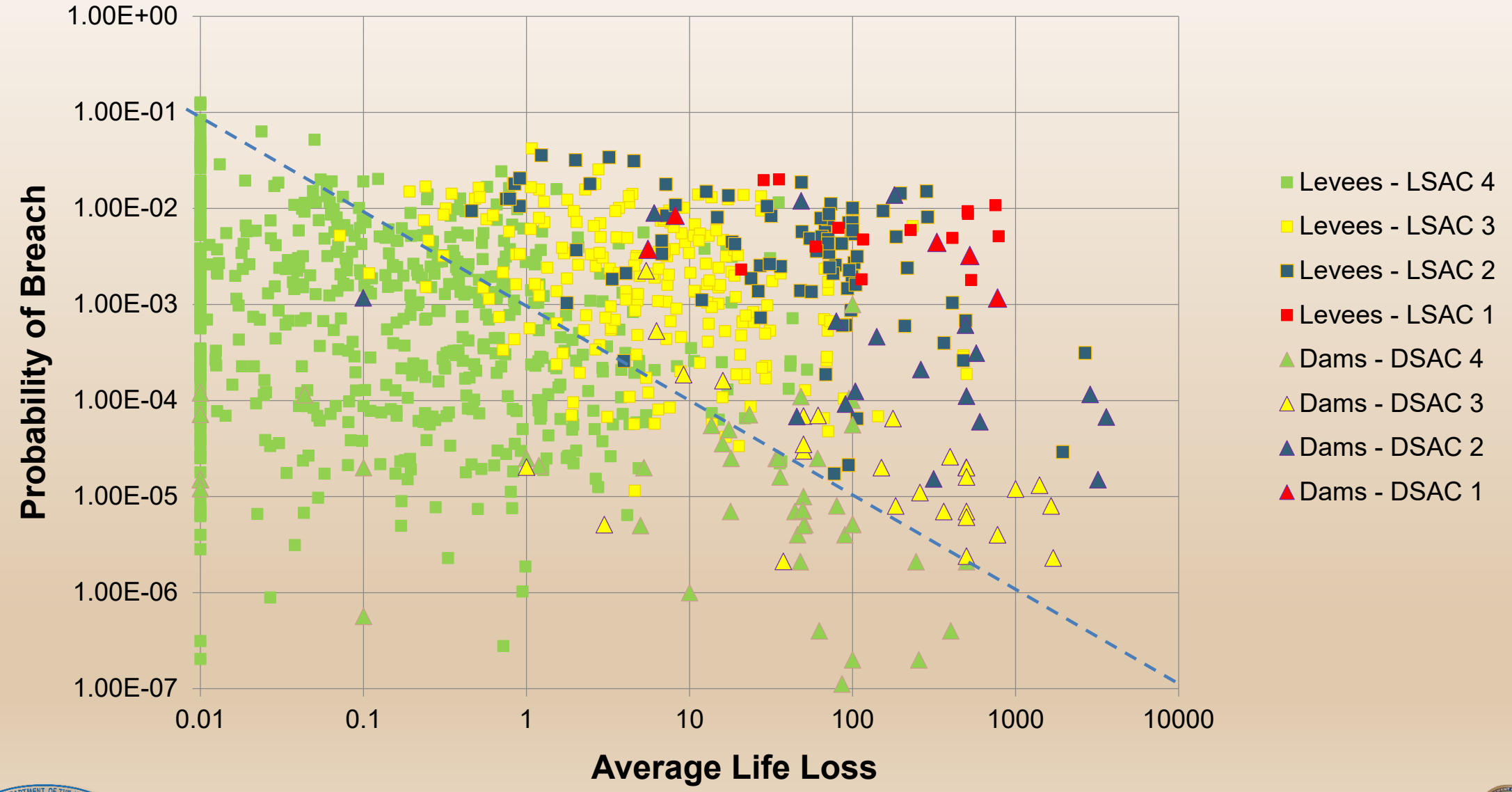
Why the Different Approaches?

- Empirical approaches tie important parameters to historic events
  - Characteristics of built infrastructure, population, etc
  - Historic record doesn't include scenario for typical USACE flood control dam (large dam above major population center)
  - Limited number of parameters make it harder to understand risk drivers and recommend appropriate risk reduction measures
- Simulation approaches improve ability to measure impacts on "non-structural" risk reduction measures
  - Explicit consideration of evacuation factors
  - Consider interaction of people with water throughout event

Essential Elements of Life Loss Estimate

- How many people are exposed to the flooding?
  - Initial distribution of people
  - Redistribution through evacuation
- How severe is the flooding?
- Are the people in a structure that can withstand the flooding?
- Will the people subjected to flooding die?

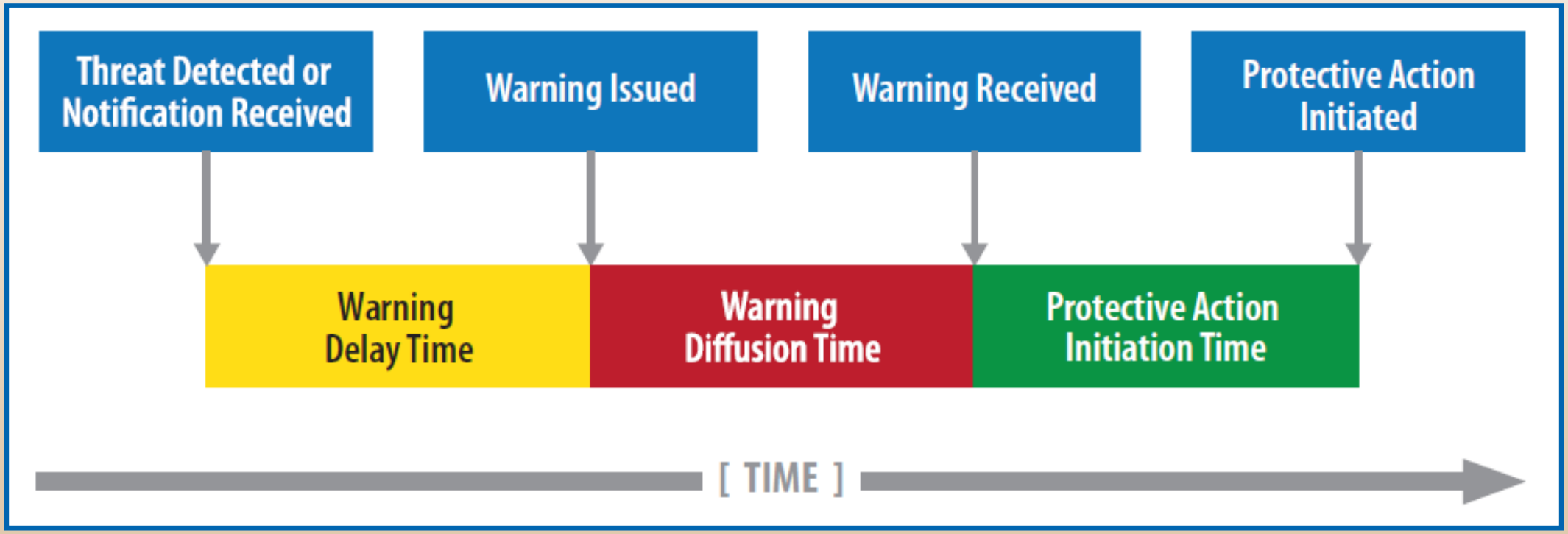
Risk Characterization



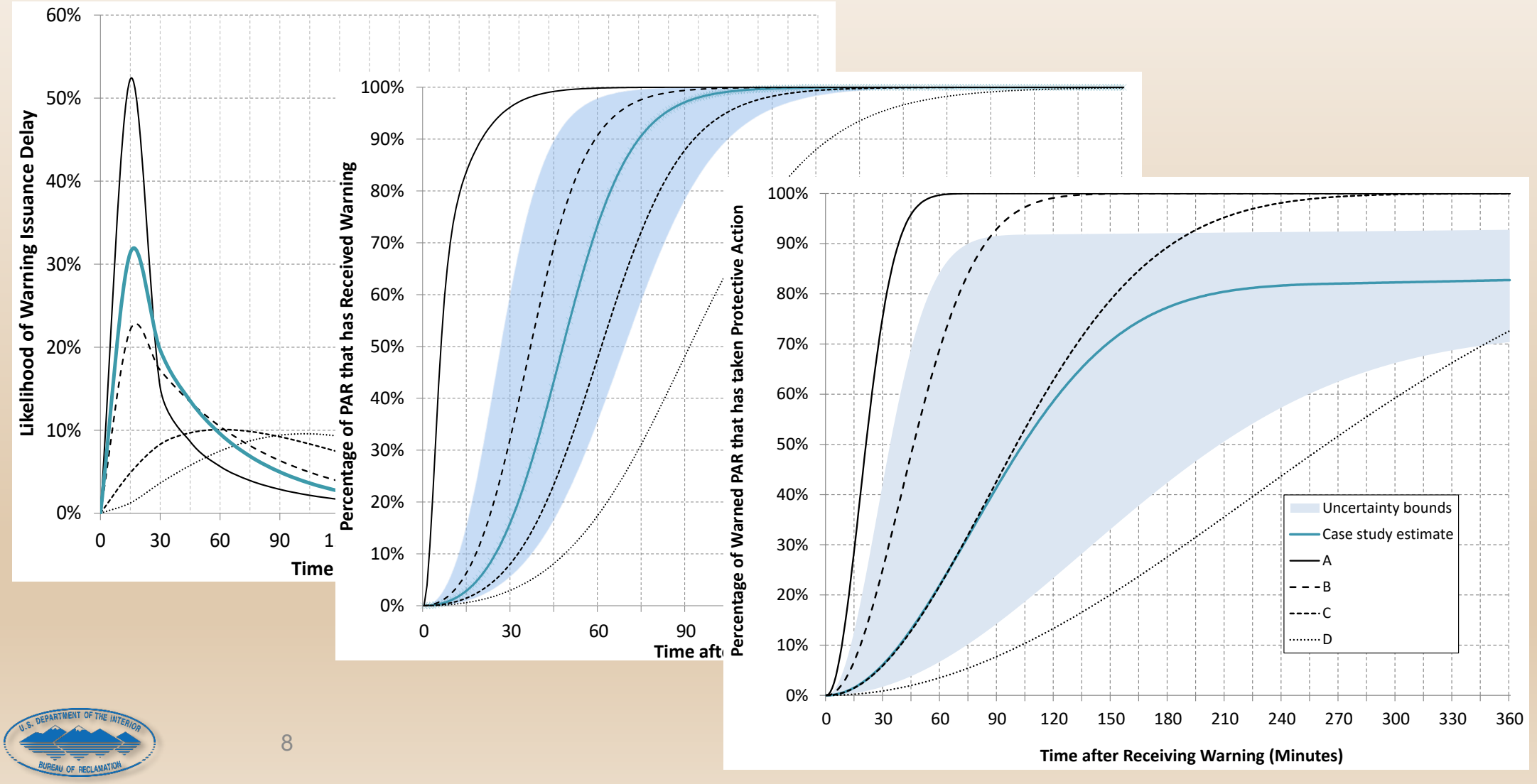
Numerical Life Loss Estimation Methods – Decision Driven

- Screening
  - Dams - Modified DSO-99-06 Method
  - Levees - Jonkman's Method
- Higher-level Risk Assessments
  - HEC-FIA (aka LifeSim)
    - Screening validation, issue evaluation and periodic assessments, major modification studies
    - Scalable application (simplified or detailed evacuation)

Redistribution of People (Evacuation Effectiveness)

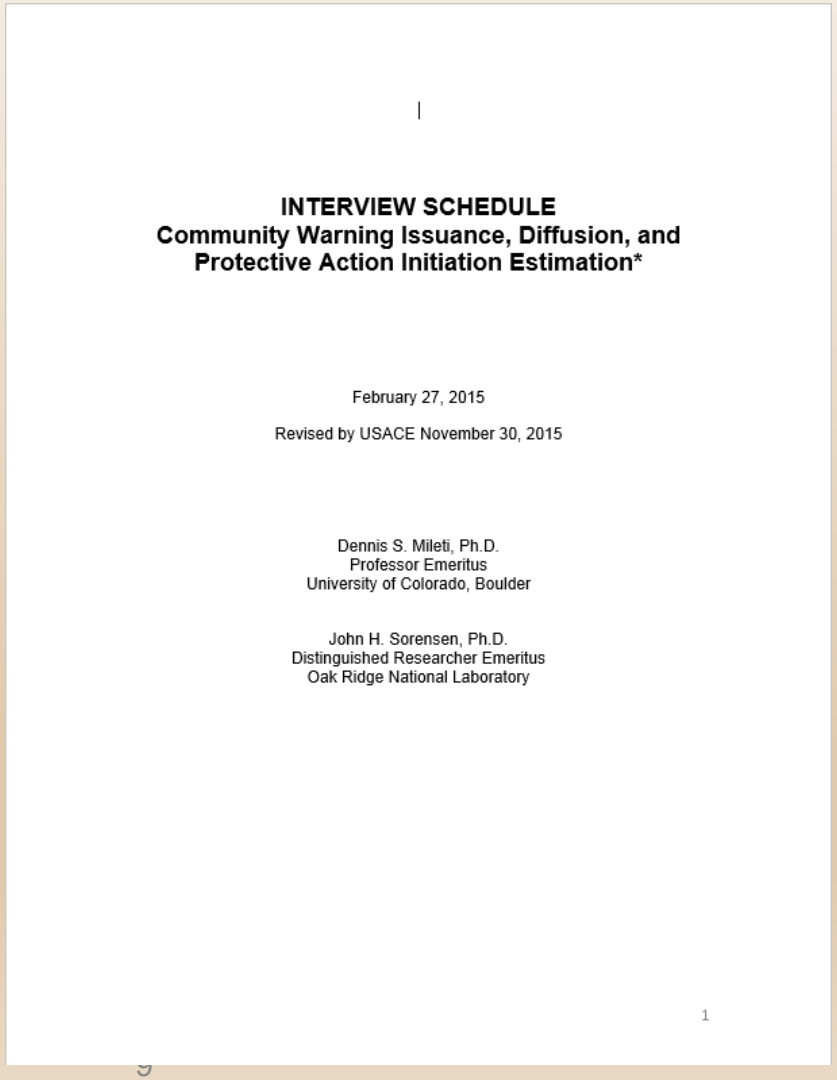


Redistribution Through Evacuation



How Do We Reduce Uncertainty?

- Existing Information
  - Levee Screening Tool
  - Existing Reports
  - Informal Discussions
- Formal Elicitation



INTERVIEW SCHEDULE
Community Warning Issuance, Diffusion, and Protective Action Initiation Estimation*

February 27, 2015

Revised by USACE November 30, 2015

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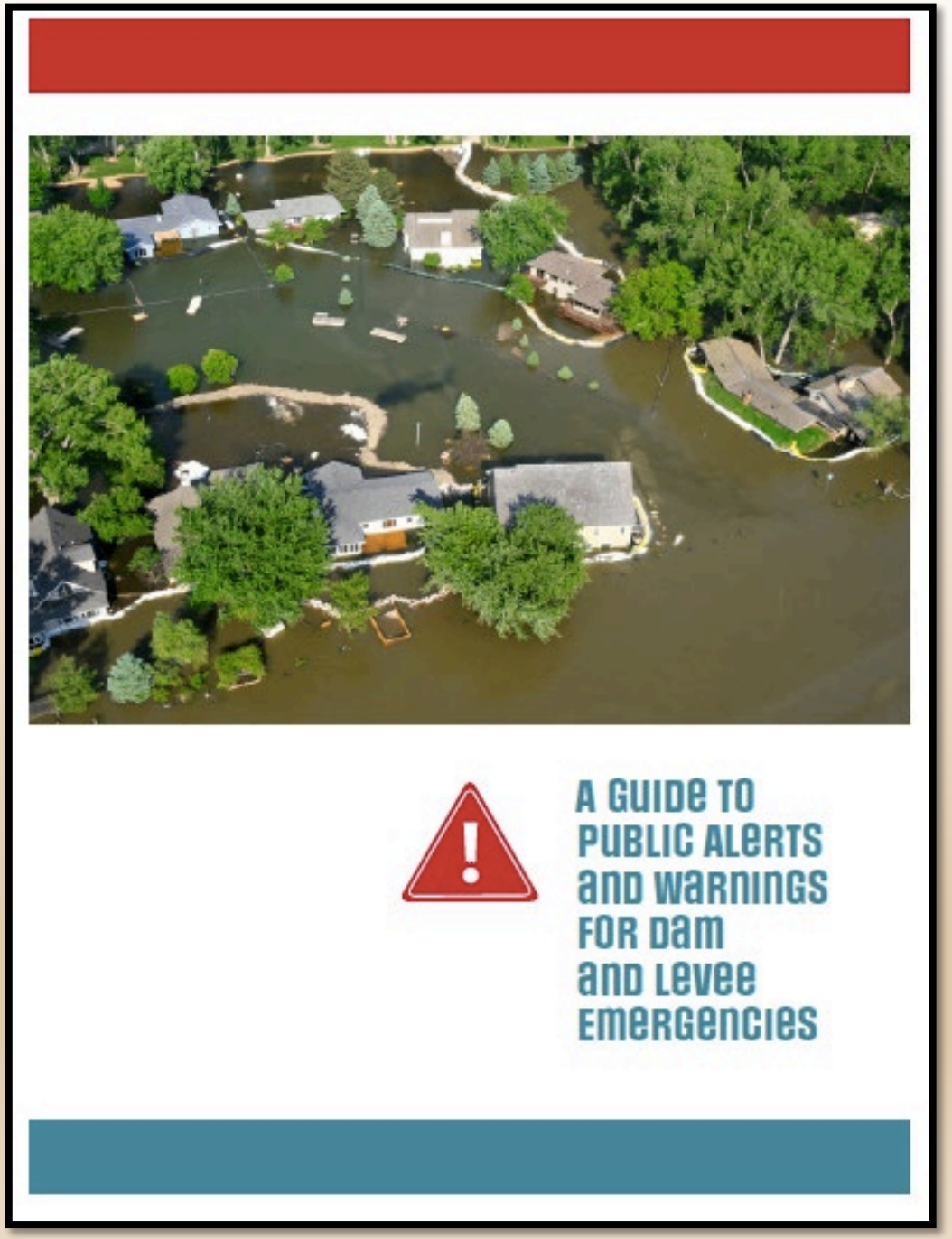
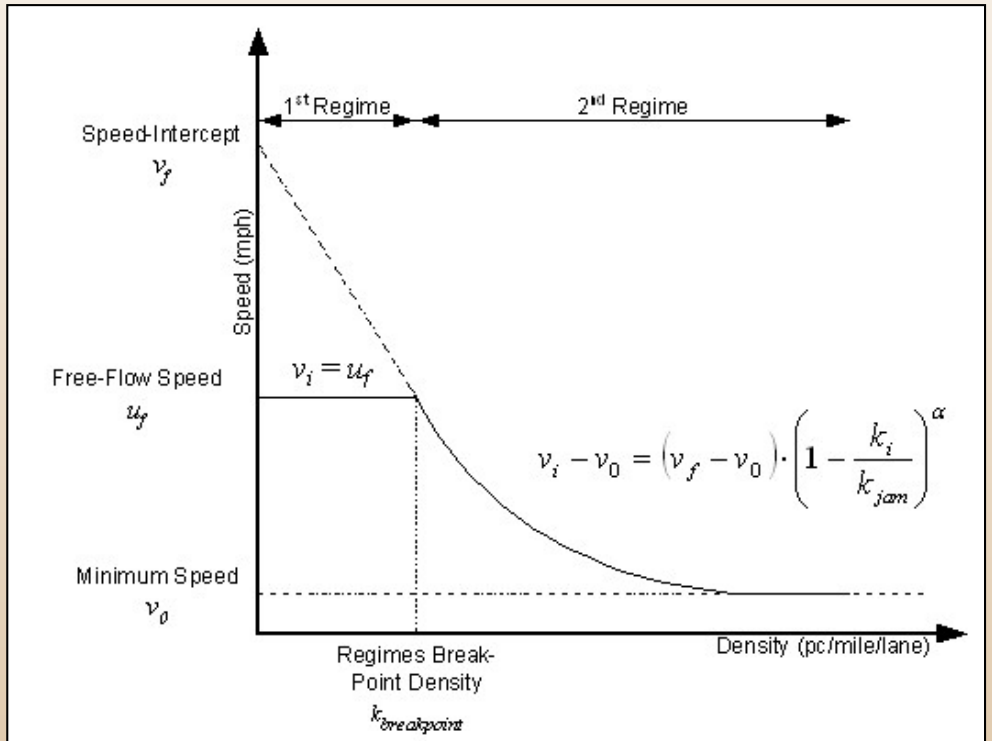
Managing Consequences – Improving Emergency Response



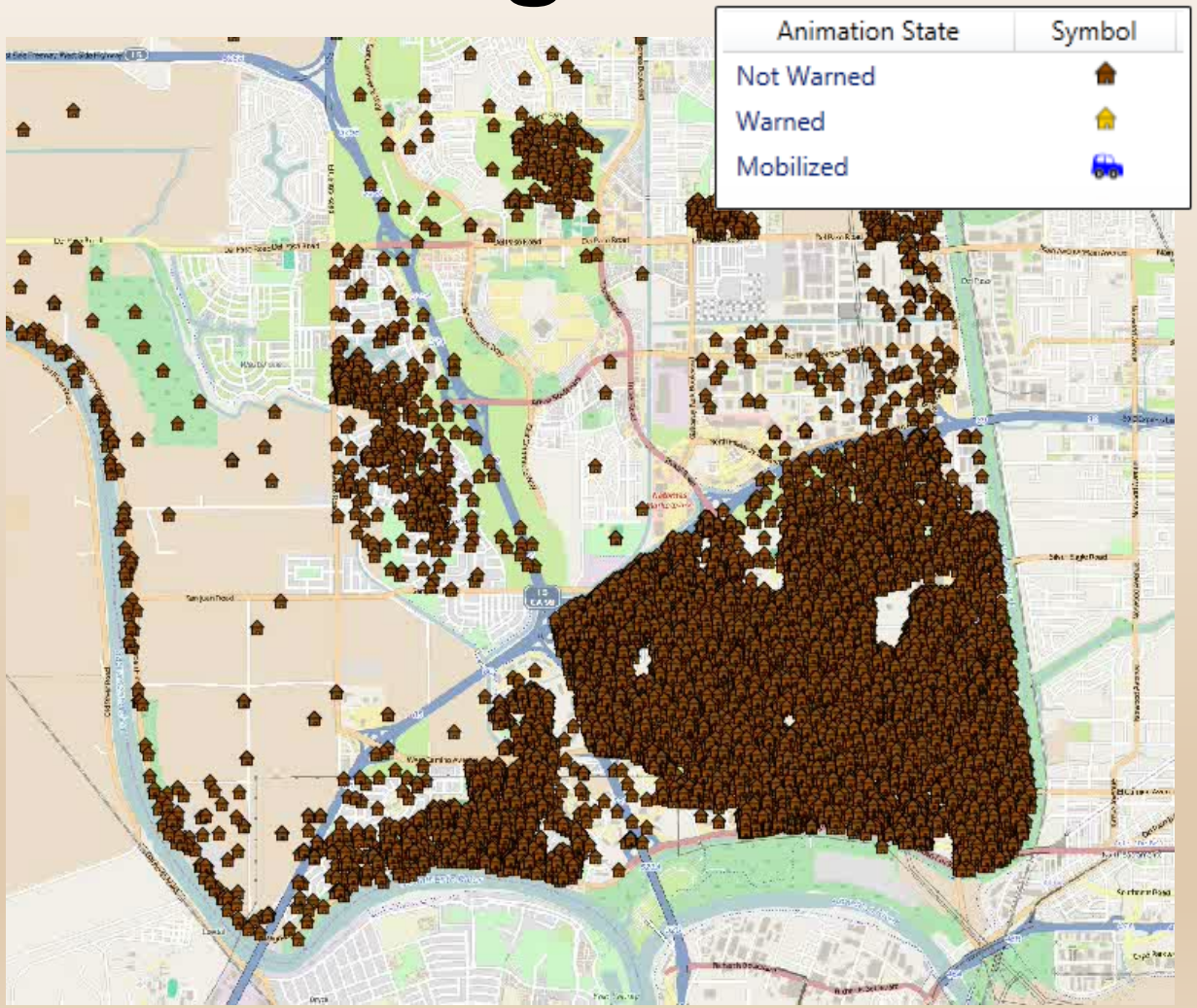
Detailed Evacuation Modeling



In mathematical terms, the dual-regime modified Greenshields is expressed as follows:

$$v_i = u_f, \qquad 0 \le k_i \le k_{bp}$$

$$v_i - v_0 = (v_f - v_0) \cdot \left(1 - \frac{k_i}{k_{jam}}\right)^{\alpha}, \qquad k_{bp} \le k_i \le k_{jam}$$



LifeSim Demo