
(San Francisco Chronicle)


(Soul of America)


(SFist)

Issues in Disaster Simulation for Recovery (and Resilience) Planning

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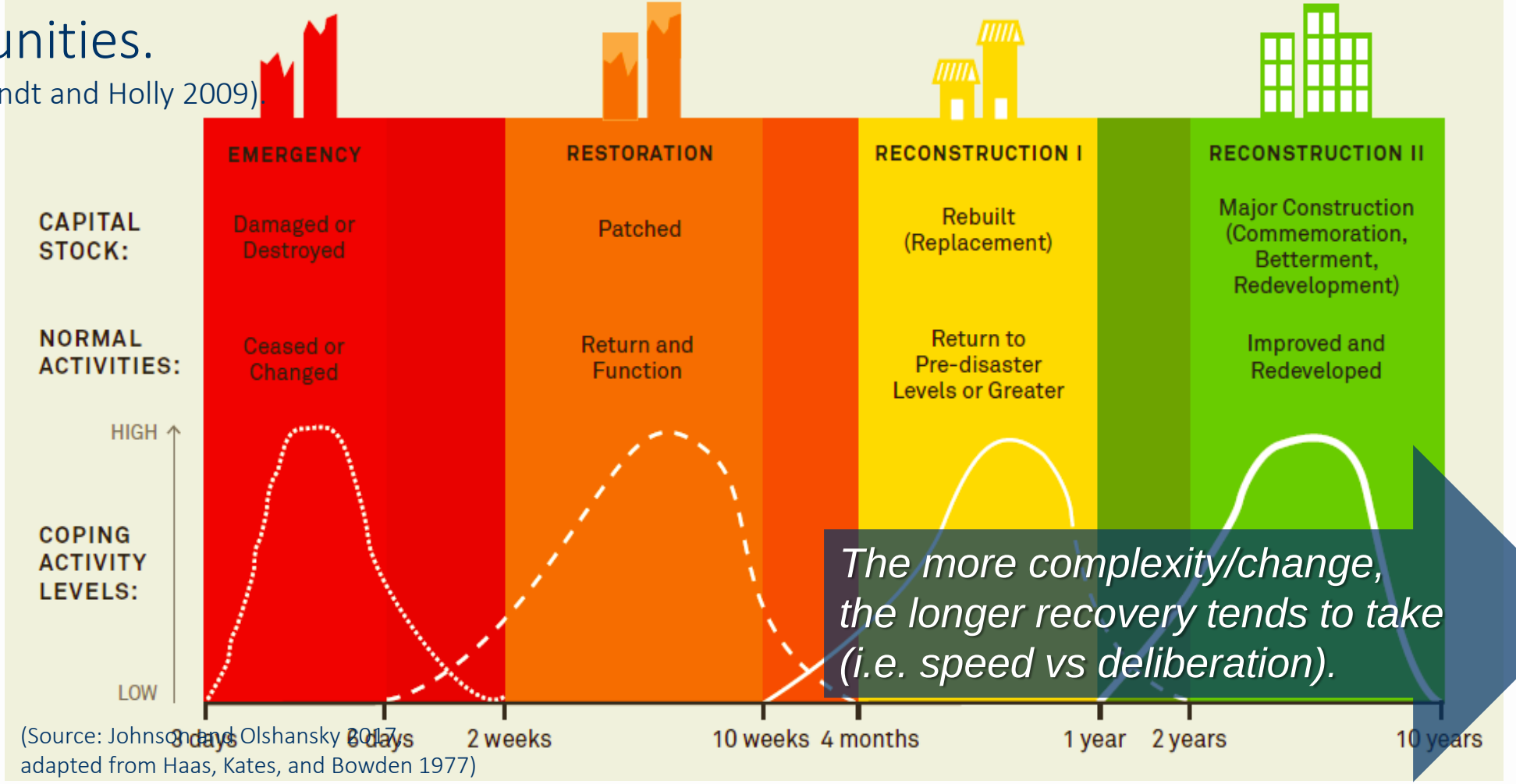
SimCenter Workshop
January 30, 2020

Disaster Recovery is not an "ordered, knowable process," but rather a complex process in which an array of actors make decisions and take actions in order to achieve stability within the self-organizing, complex, adaptive systems that are communities.

(Alesch, Arendt and Holly 2009).

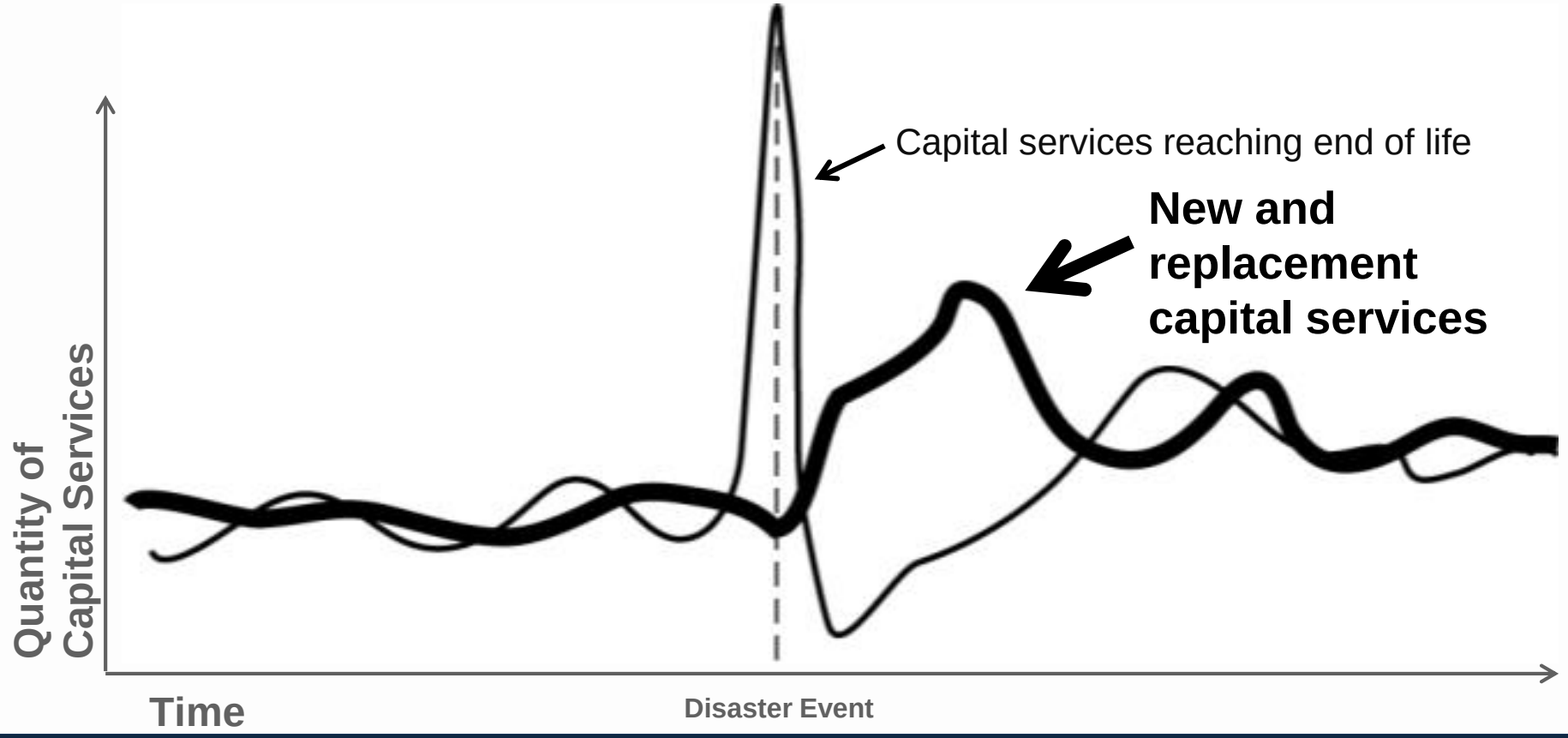


(Source: Johnson and Olshansky 2017, adapted from Haas, Kates, and Bowden 1977)

Sources: Adapted from Haas, Kates, and Bowden, 1977)

Time compression—a compression of urban development activities in time (e.g. 50 years -> 5 years) and space—is what distinguishes recovery from normal urban development.

(Olshansky, Hopkins, & Johnson, 2012)

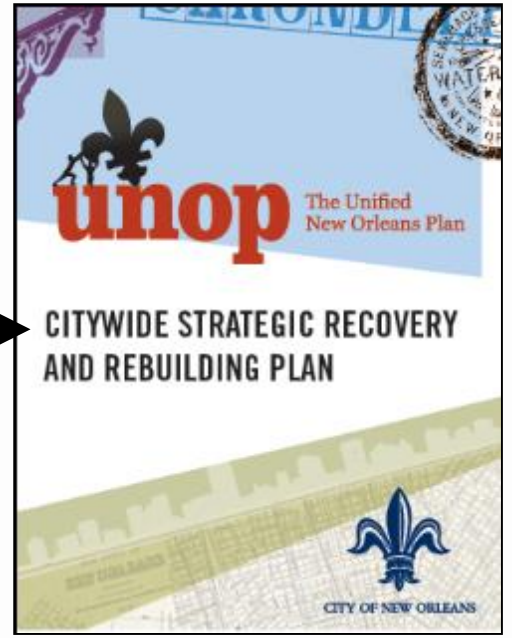


Recovery Facilitators/Impediments come from pre-existing conditions, disaster impacts and post-disaster policy/conditions.

Example: New Orleans' Recovery Assessment (1+ year after Hurricane Katrina)

- Population
- Flood Protection
- Funding
- Housing
- Education
- Infrastructure
- Public Safety
- Healthcare
- Transportation
- Economic Development
- Public Facilities
- Historic Preservation
- Culture

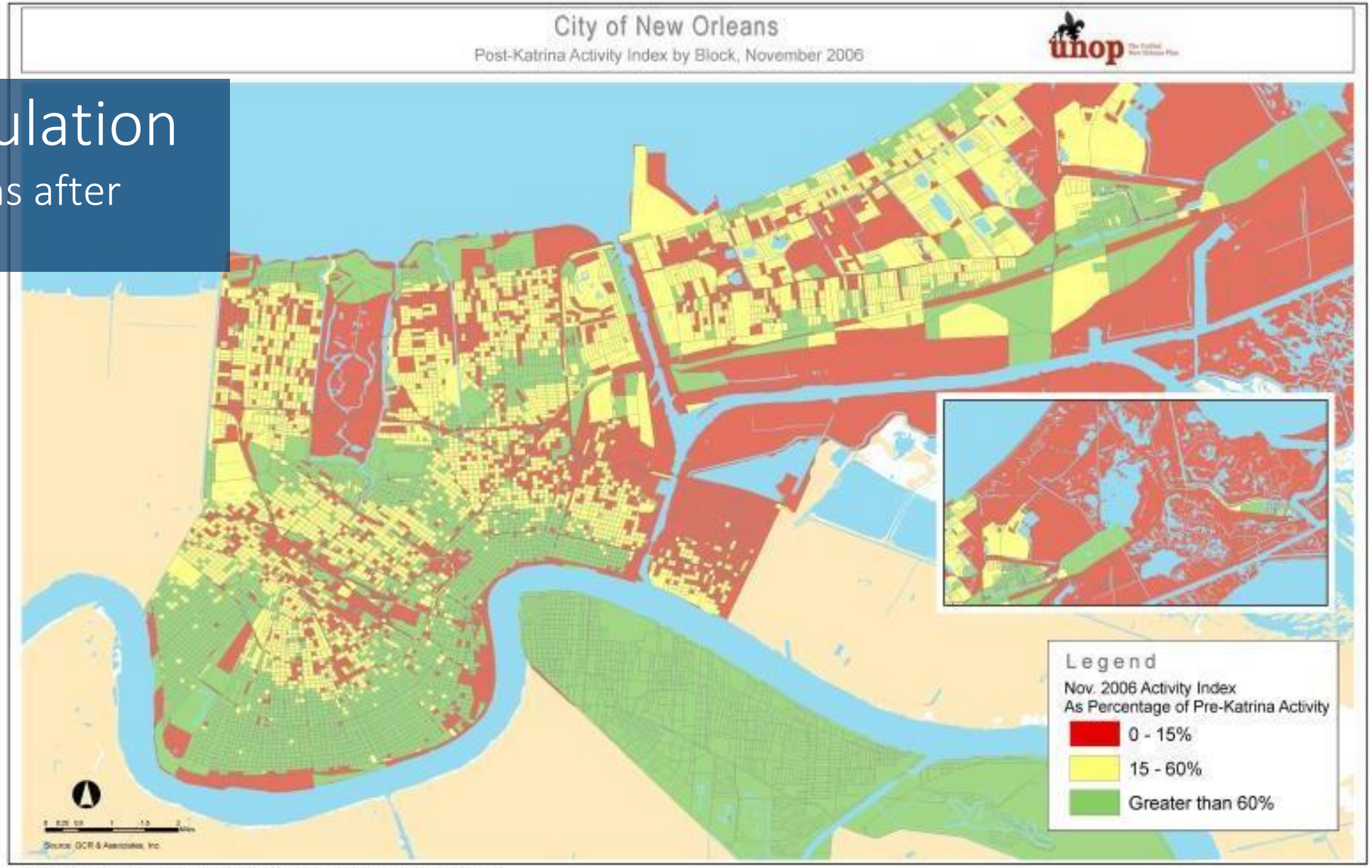
Citywide Recovery Assessment



District-level Assessments

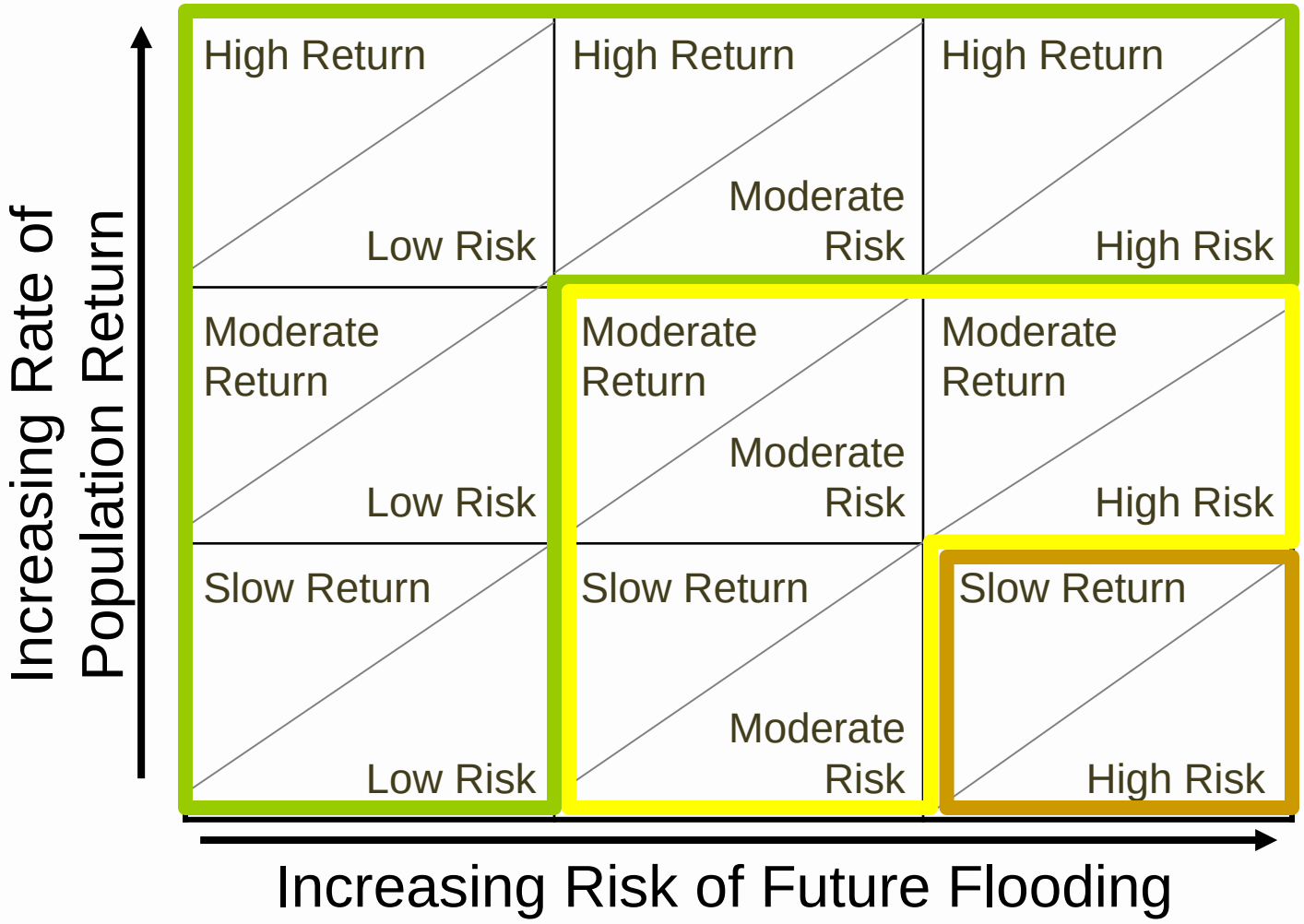
Pace of Repopulation

(Nov 2006 – 15 months after Hurricane Katrina)



Note: Index equals November, 2006 index divided by November, 2004 index

Example: UNOP Citywide Recovery Framework

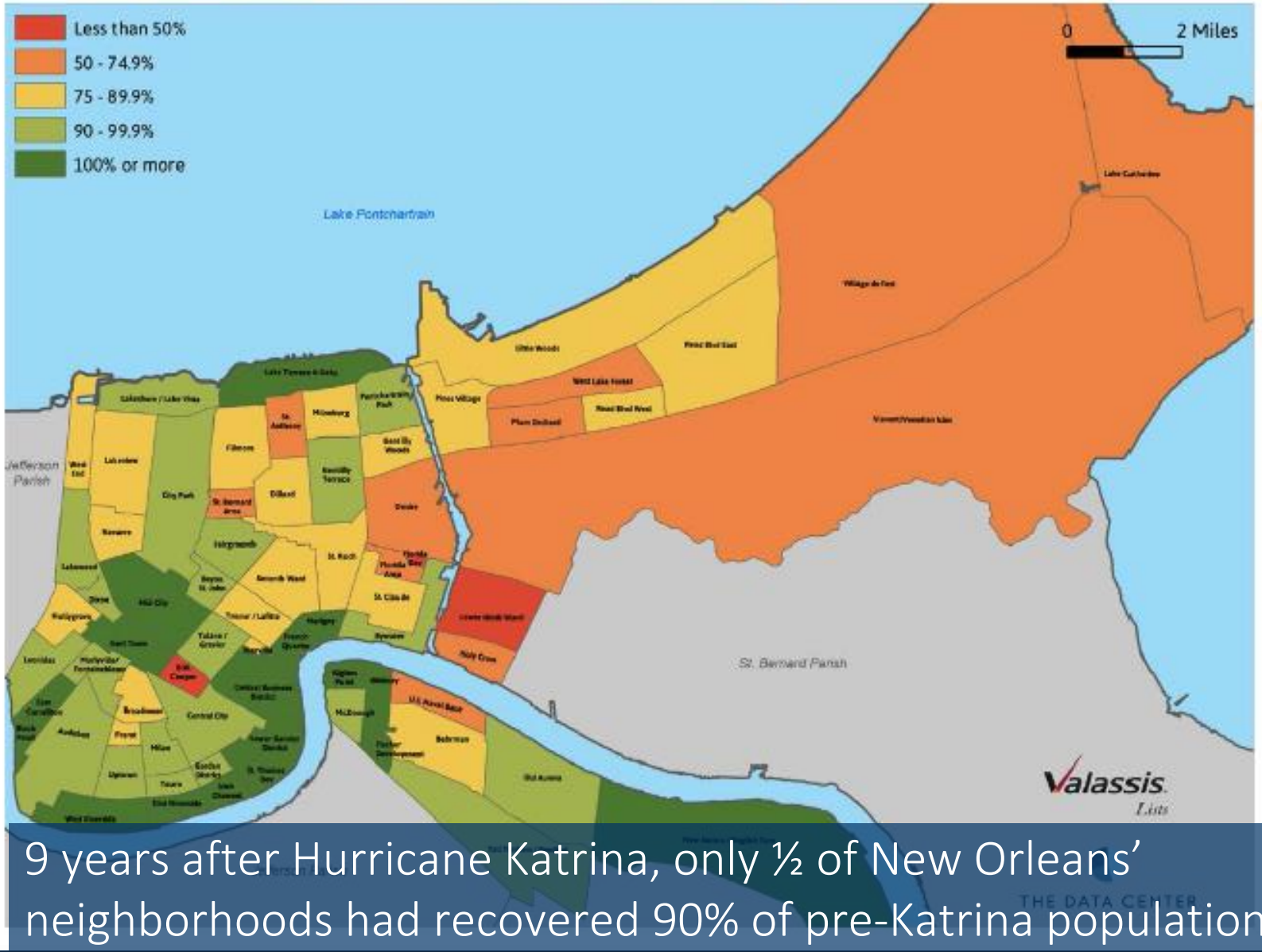


Recovery Implementation involves interdependent spatial, systematic, and timeline strategies (e.g. UNOP Citywide Recovery Framework)

(Murosaki 2007)

	Policy Area C	Policy Area B	Policy Area A
0 - 2 yrs	■ Stabilize neighborhoods and help rebuild together safely ■ Use modular or temporary facilities to provide full coverage	■ Help returning residents and businesses with elevation ■ Repair major infrastructure ■ Use modular or temporary facilities to provide full coverage	■ Ensure residents can fund individual flood protection ■ Accommodate additional residents and businesses ■ Repair major infrastructure ■ Restore permanent facilities
2 - 5 yrs	■ Continue neighborhood stabilization ■ Invest in permanent infrastructure ■ Re-vision public services and amenities	■ Help slow-recovery neighborhoods rebuild together ■ Improve infrastructure scalable to population and resettlement ■ Re-vision public services and amenities	■ Improve infrastructure to spur revitalization and accommodate additional population ■ Initiate re-visioning of public services and amenities
> 5 yrs	■ Complete reconstruction and revision of services and amenities	■ Complete reconstruction and revision of services and amenities	■ Complete reconstruction and re-vision of public services and amenities

PERCENT OF JUNE 2005 RESIDENTIAL ADDRESSES THAT WERE ACTIVELY RECEIVING MAIL IN JUNE 2014



August 2014

DATA CENTER RESEARCH.ORG

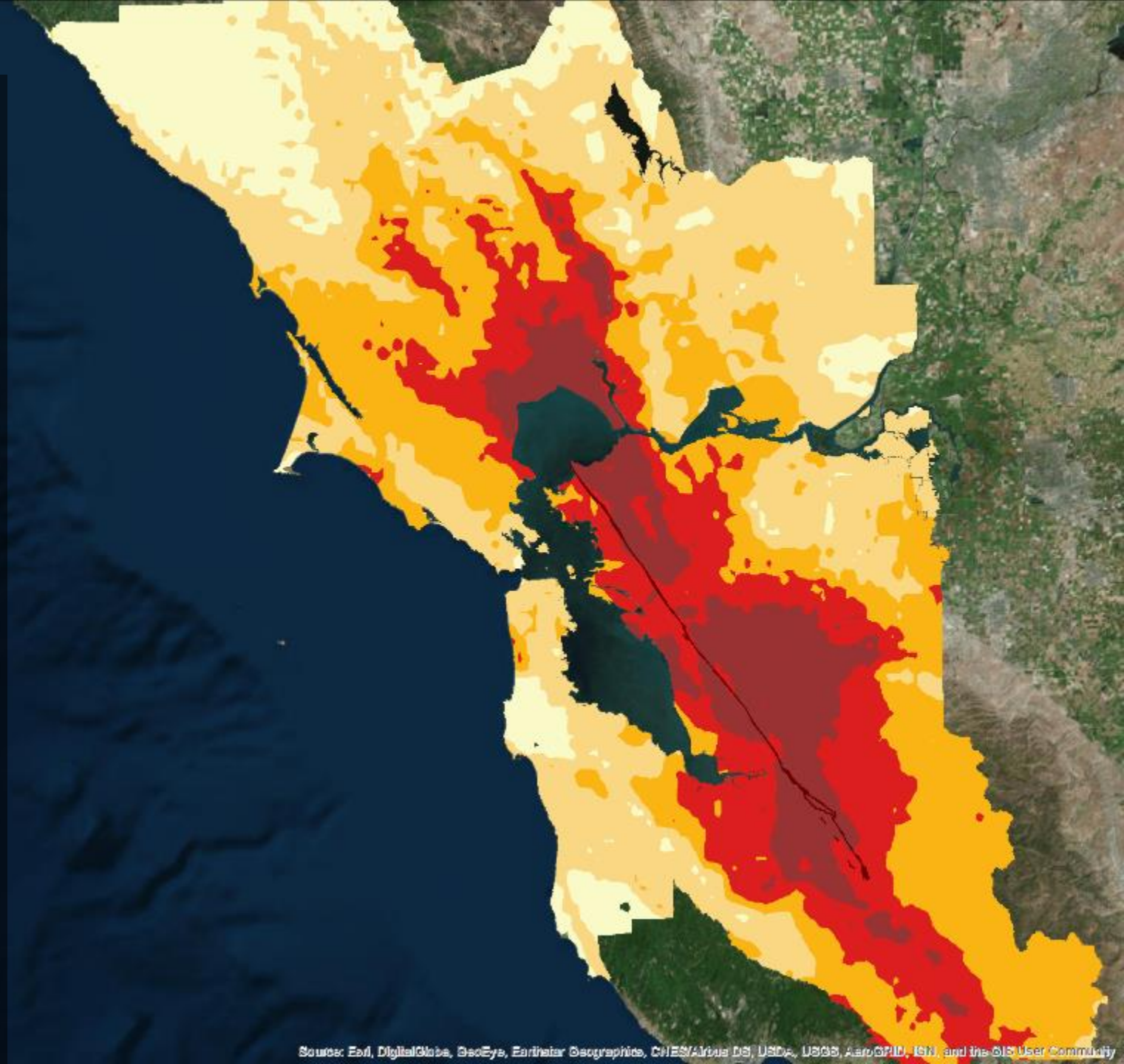
9 years after Hurricane Katrina, only ½ of New Orleans' neighborhoods had recovered 90% of pre-Katrina population

SCIENCE APPLICATION FOR RISK REDUCTION

HAYWIRED

Magnitude 7 earthquake
on the Hayward Fault

USGS
science for a changing world



HayWired Scenario – Communities-at-risk Analysis

(Johnson, Jones, Wein, and Peters, 2020 (in press))

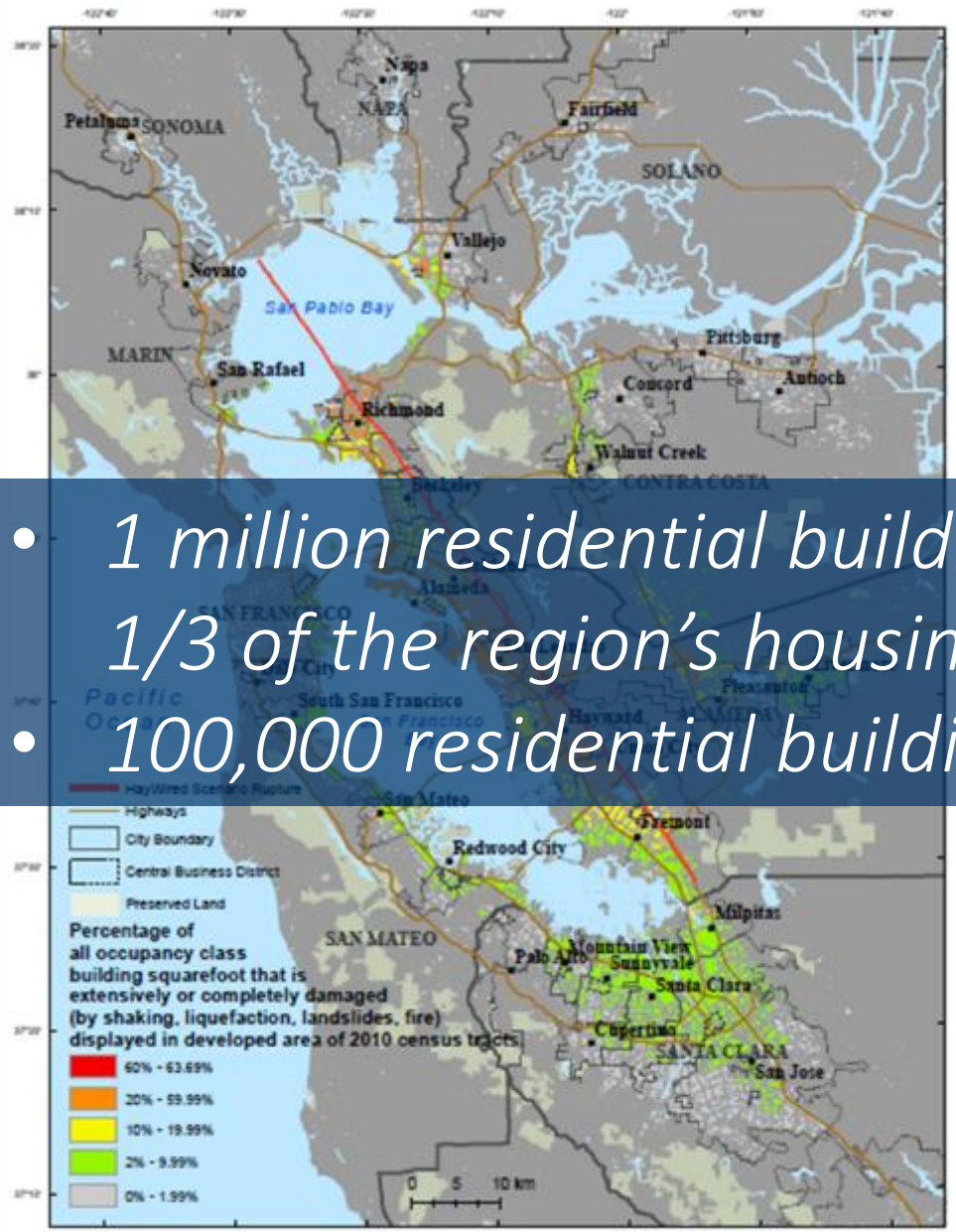
- Integrated Building Damage and Areas of Concentrated Damage – Identify areas of concentrated damage by combining the Hazus estimates of building damage resulting from earthquake shaking, landslide and liquefaction with the fire following building damage
- Population Movements and Vulnerabilities– Consider studies of short- and long-term population displacement following large disasters and analyze displacement risk using a range of methods – areas of concentrated damage, socioeconomic vulnerability, families with school-age children, disabled and homeless populations, young-mobile-renter households, sheltering and interim housing resources, and utility disruptions
- Long-Term Community Recovery Challenges– Explore 3 key challenges for communities and residents: limited insurance availability and time required to assemble recovery funding resources, repair and replacement of damaged housing units, and areas requiring substantial governmental intervention and re-planning in order to recover.
- Policy Implications for Community Resilience – Highlight the spatial and systematic approaches needed to build community resilience and truly realize the community-wide benefit of resilience investments

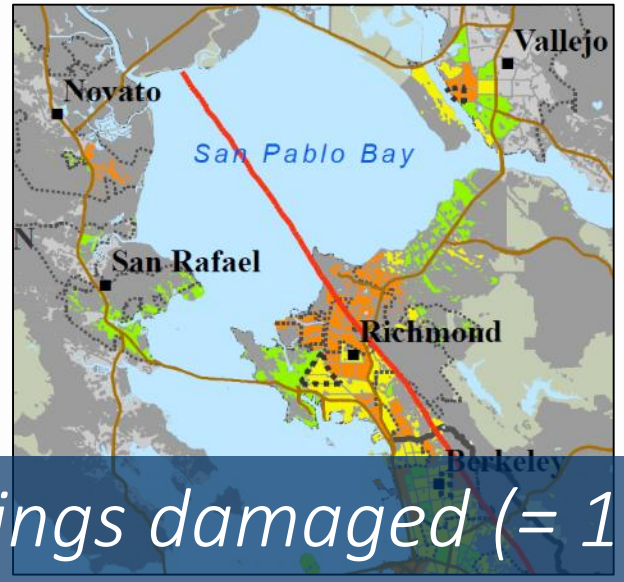
HayWired Scenario Communities-at-risk Analysis: Areas of concentrated damage

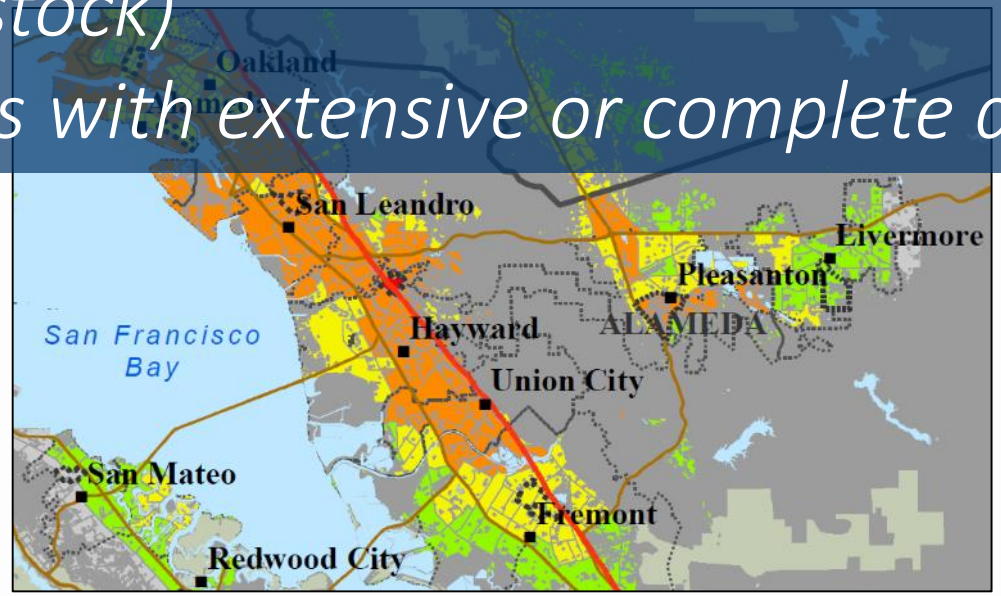
(Johnson, Jones, Wein, and Peters, 2020 (in press))

Defined by combining the different analyses of building damage resulting from earthquake shaking, landslide, liquefaction and fire.

- *1 million residential buildings damaged (= 1.37 million housing units or 1/3 of the region's housing stock)*
- *100,000 residential buildings with extensive or complete damage*





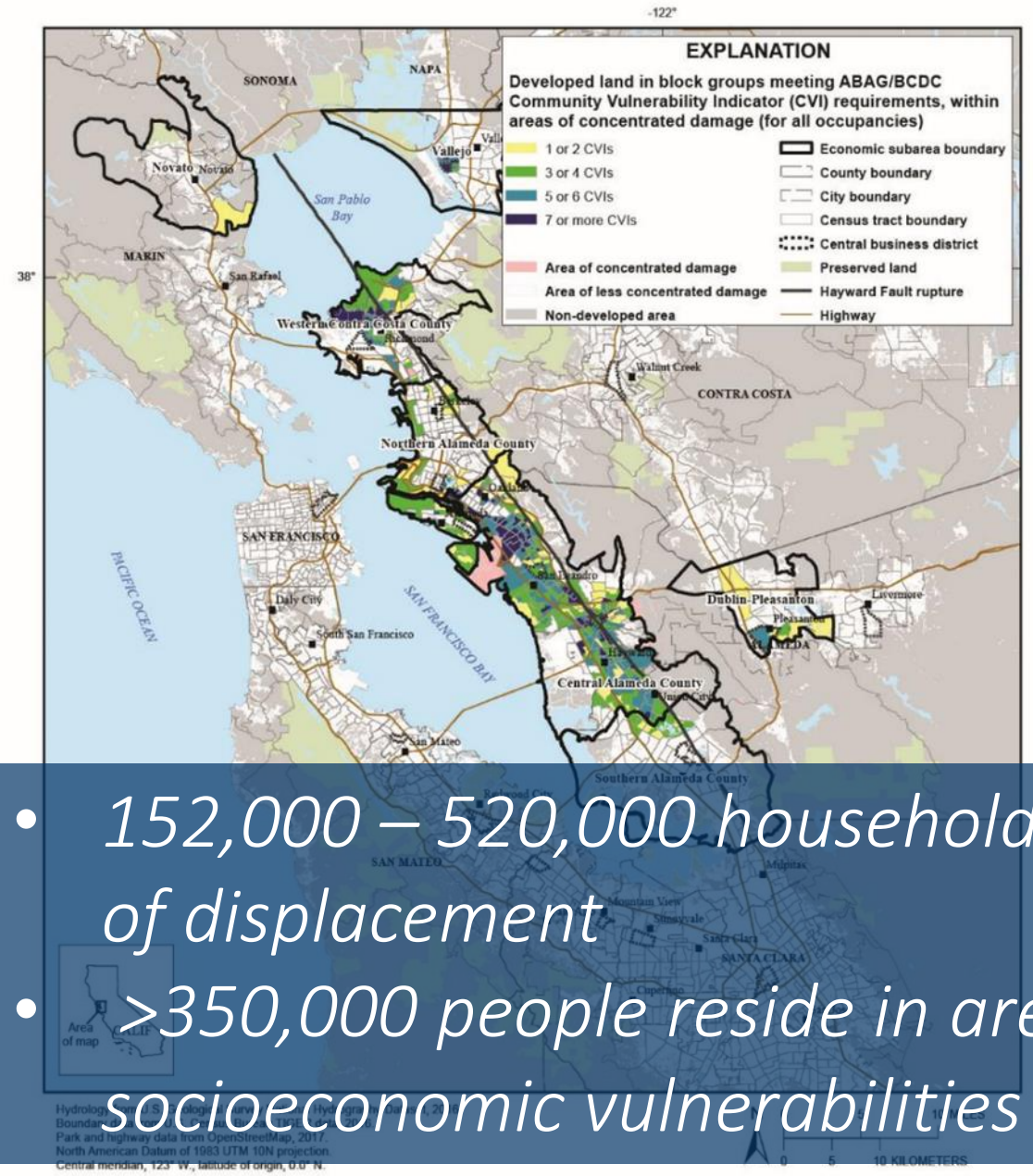


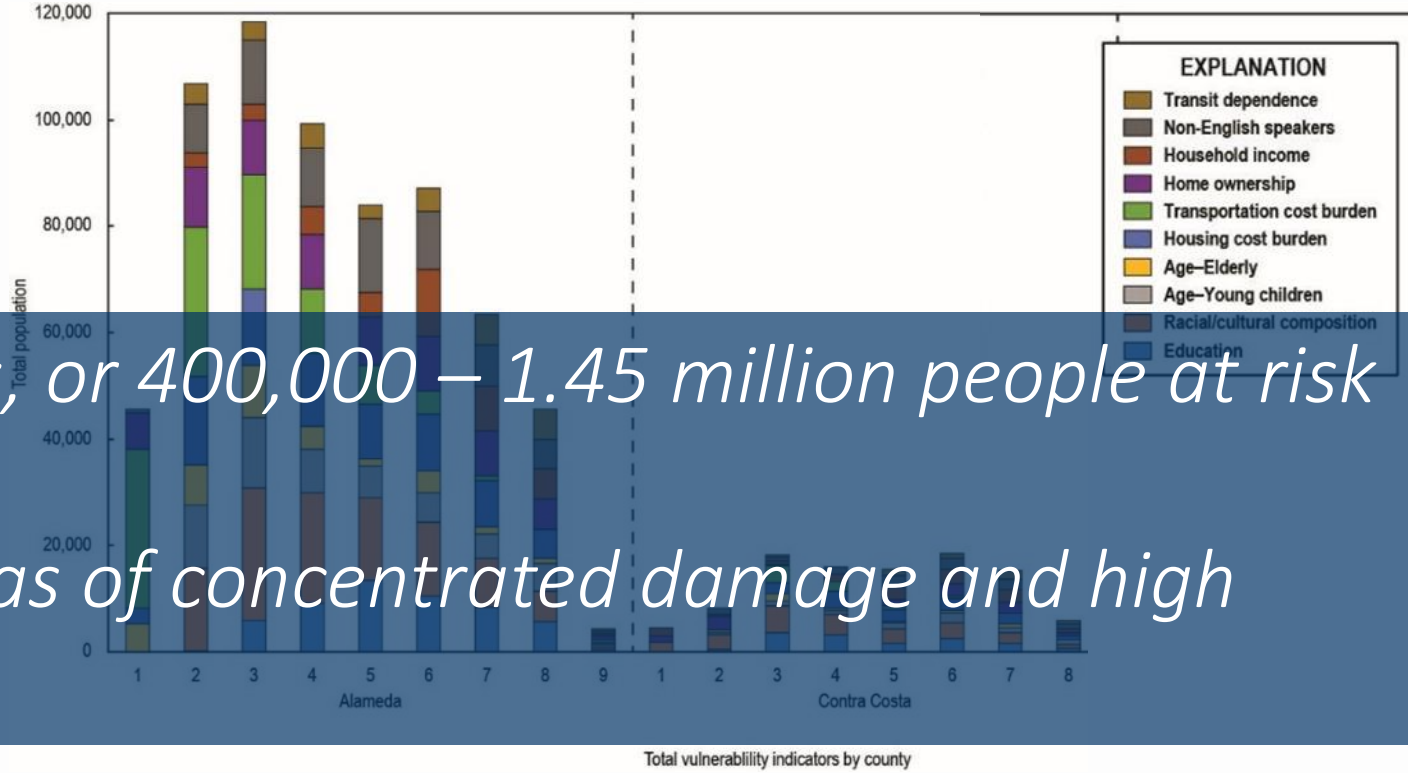
Percentage of all building area in a census tract in an extensive or complete damage state

- >60%
- 20% - 60%
- 10% - 20%
- 2% - 10%
- <2%

HayWired Scenario Communities-at-risk Analysis: Potential population displacement and vulnerabilities

(Johnson, Jones, Wein, and Peters, 2020 (in press))





Total vulnerablility indicators by county

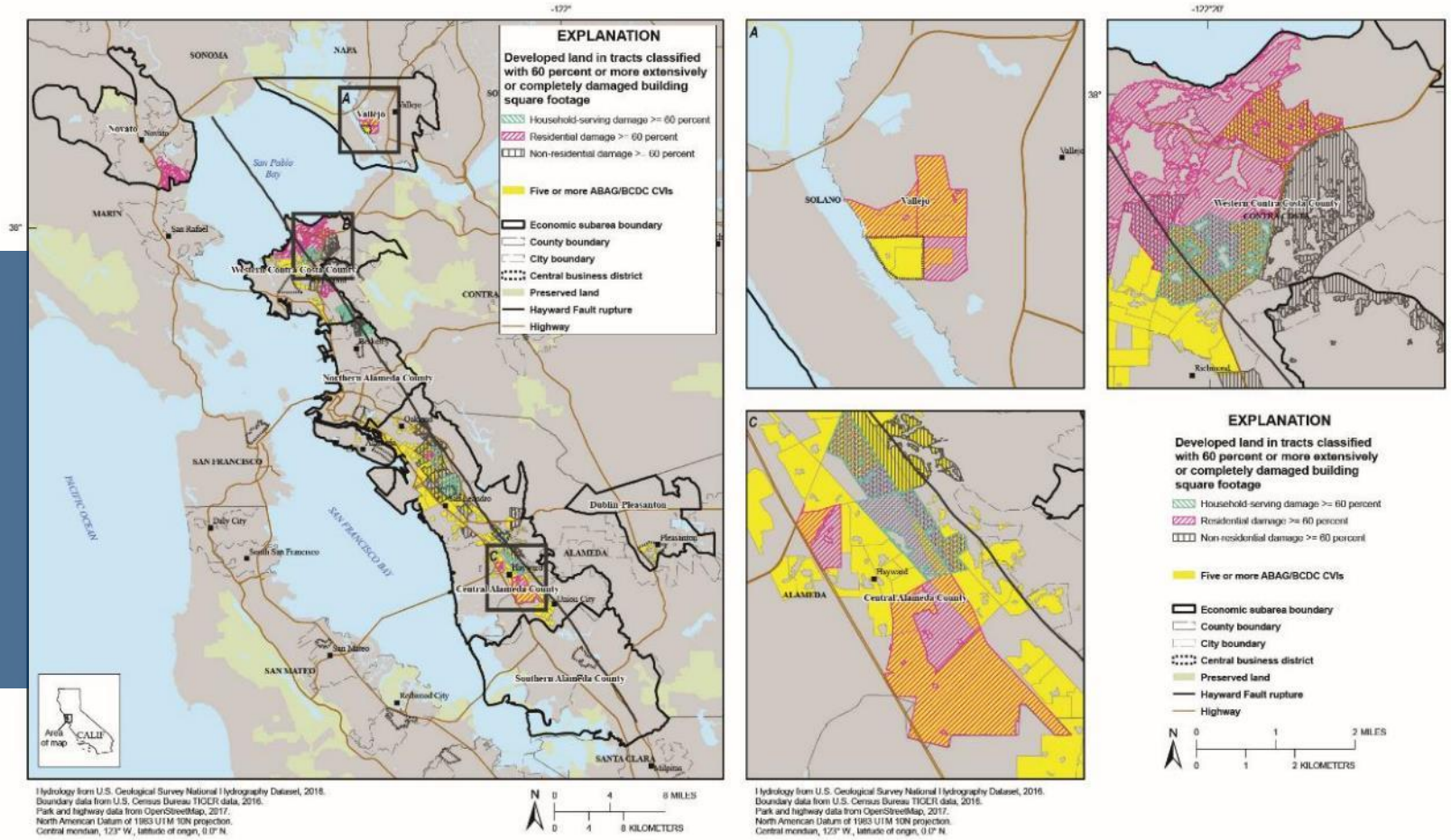
- *152,000 – 520,000 households, or 400,000 – 1.45 million people at risk of displacement*
- *>350,000 people reside in areas of concentrated damage and high socioeconomic vulnerabilities*

HayWired Scenario Communities-at-risk Analysis: Typology of areas requiring substantial governmental intervention and re-planning

(Areas with ground failure, concentrated building and utility damage, and high socioeconomic vulnerabilities)

(Johnson, Jones, Wein, and Peters, 2020 (in press))

Example: Areas with concentrations of residential, household-serving and non-residential damage (>60%) and high socioeconomic vulnerabilities)



Blue outlined areas have both high social vulnerability and high hazards (liquefaction, surface faulting or landslides

HayWired Scenario Communities-at-risk Analysis: Opportunities to Improve Community Resilience

(Johnson, Jones, Wein, and Peters, 2020 (in press))

1. Accelerate the seismic mitigation of homes
2. Strengthen or replace infrastructure
3. Build more new housing for all income groups
4. Promote seismic resilience in land use and development policies across the region
5. Address population movements and long-term displacement in local, regional and state preparedness, response, and recovery plans
6. Plan for the management of long-term recovery at all levels of government
7. Develop a recovery financing strategy for the region

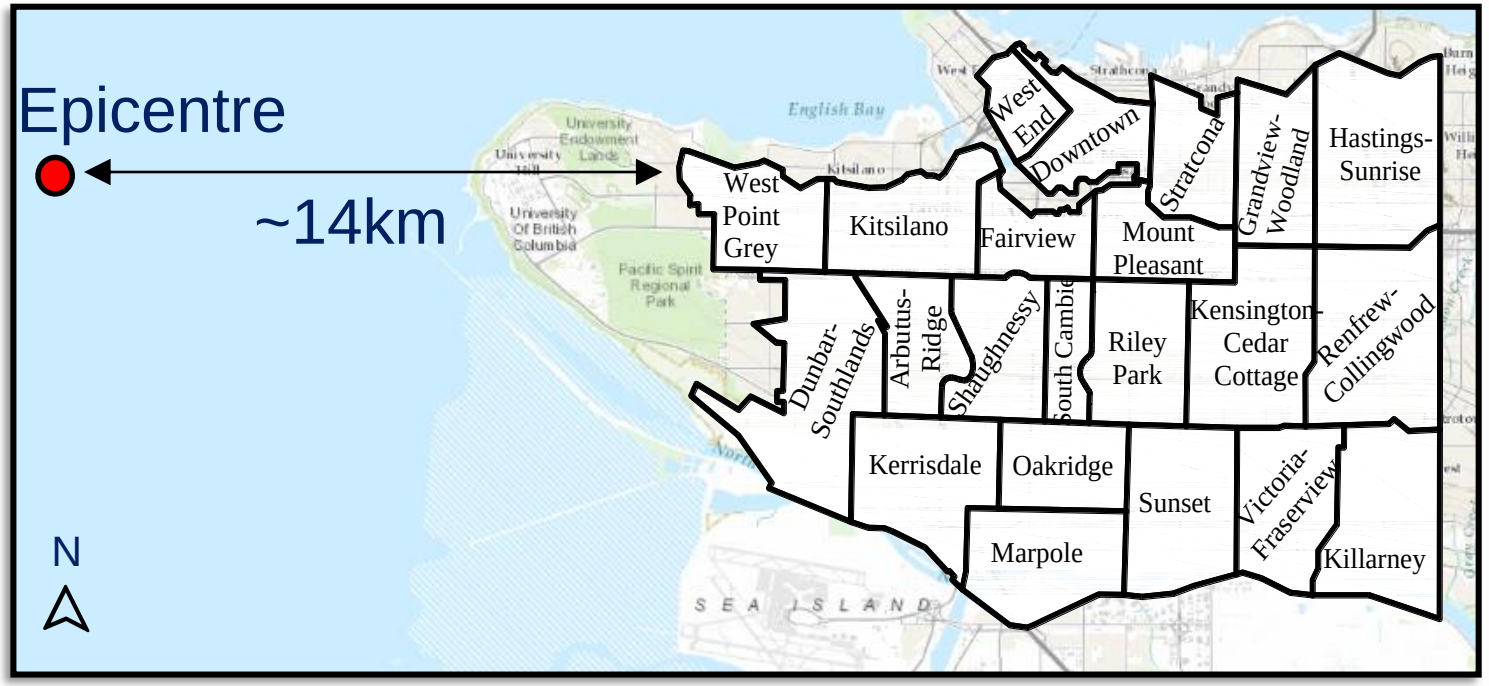
Development and Application of a Computer Simulation Framework for Assessing Disaster Recovery

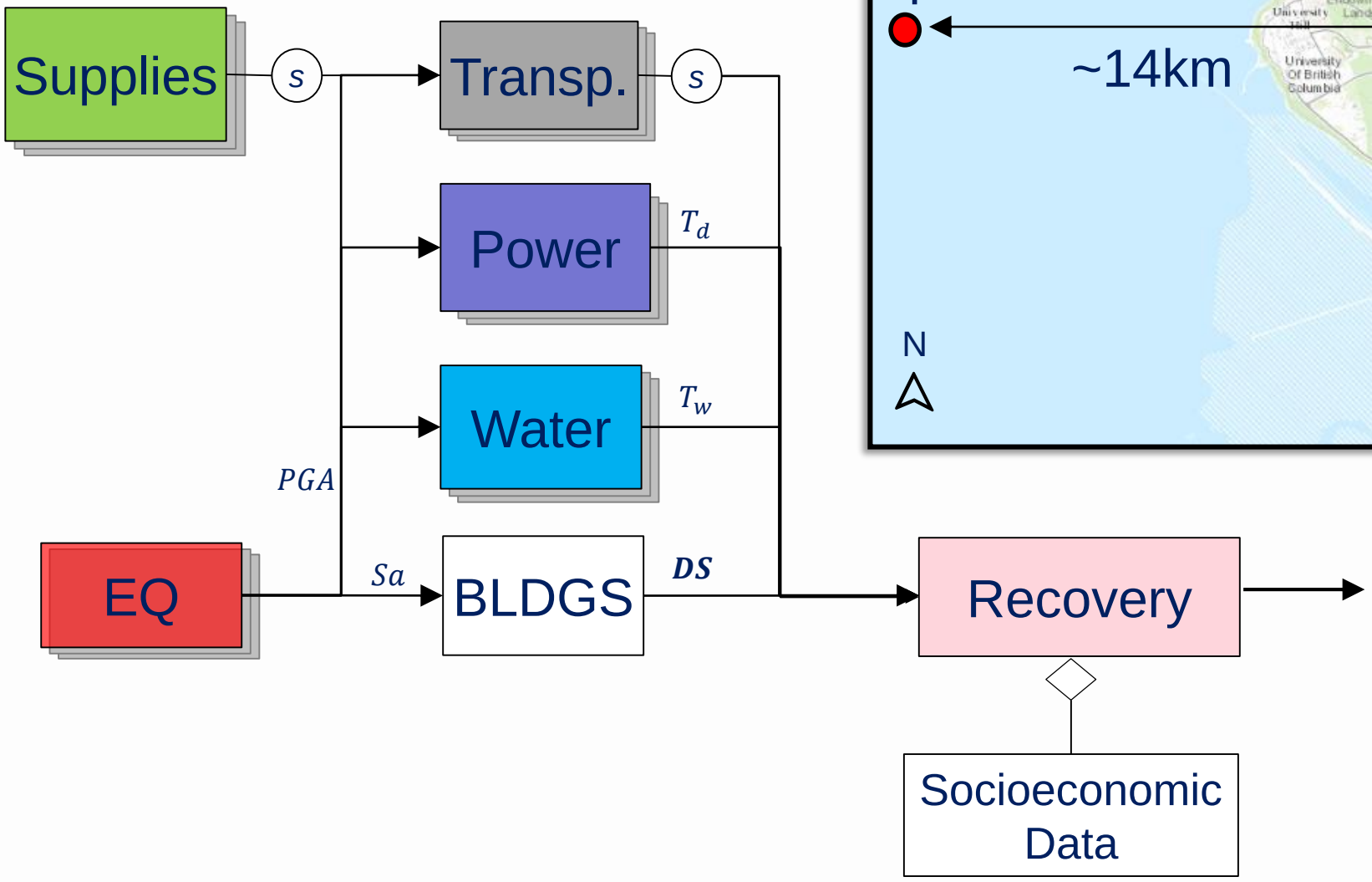
Rodrigo Costa, Ph.D.

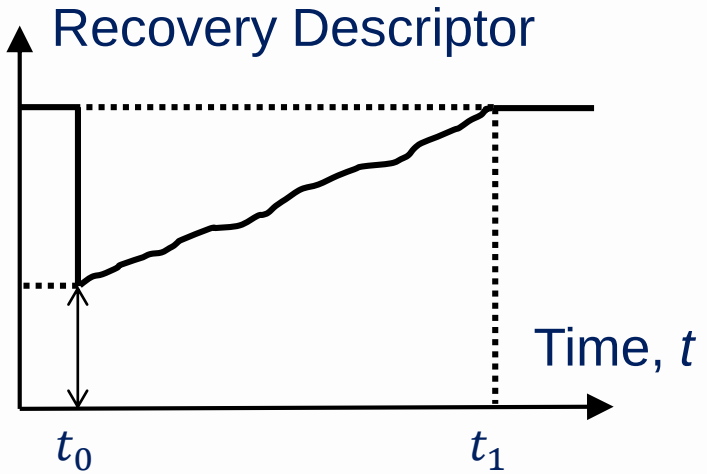
SimCenter Workshop
January 30, 2020

Framework for Disaster Recovery Modelling

Application: M7.3 earthquake near Vancouver, CA



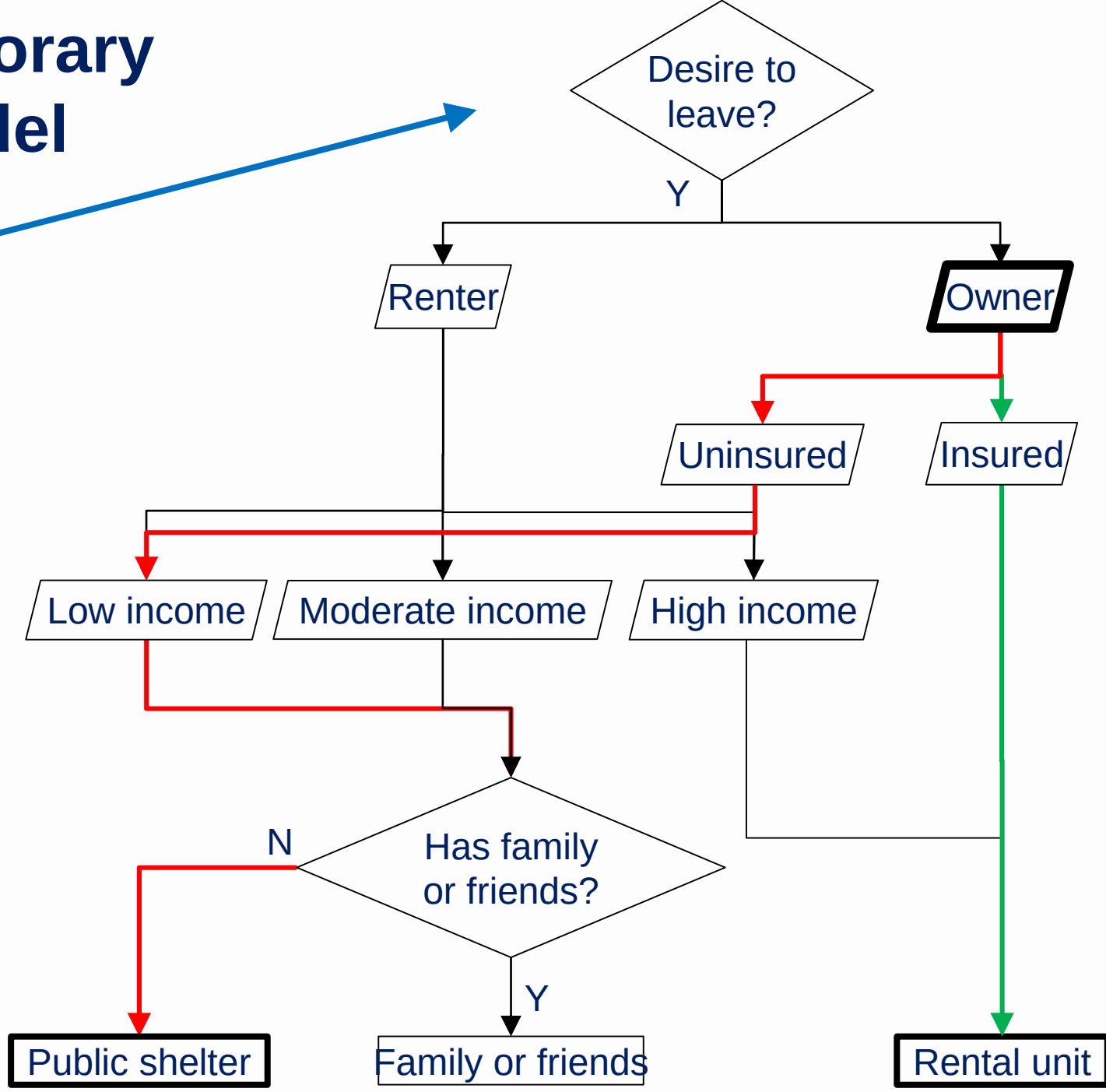




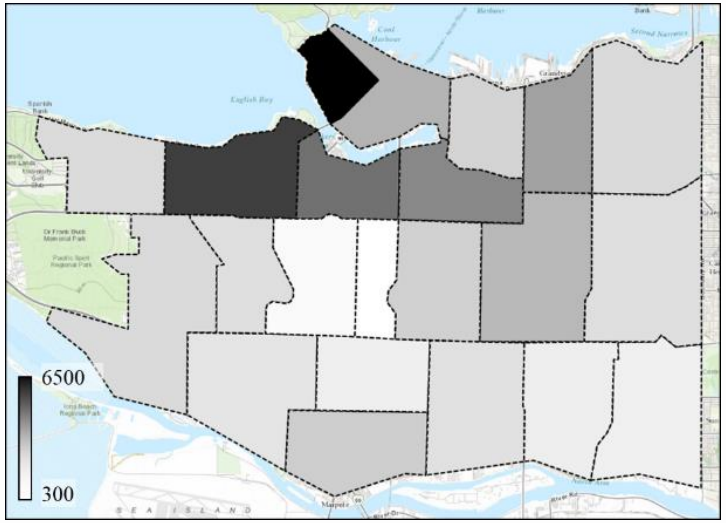
Semi-heuristic Temporary Displacement Model

- Building damage
- Water & power
- Disaster preparedness
- Housing tenure
- Insurance availability
- Income
- Neighborhood conditions
- Weather conditions
- Social support

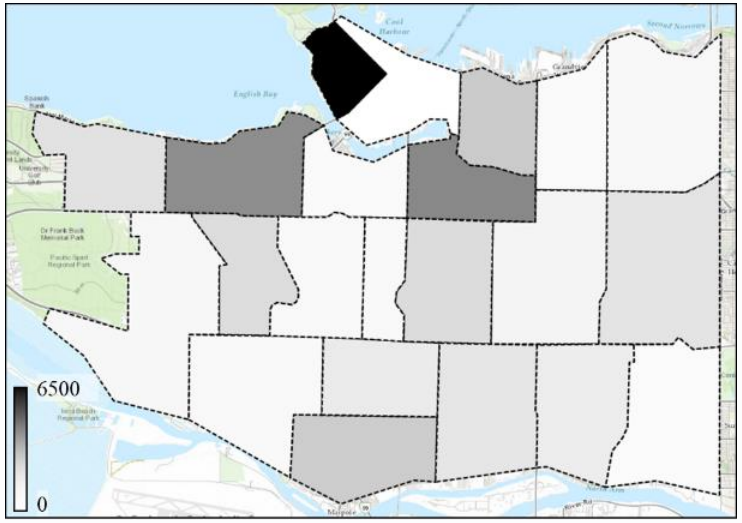
Challenge: Systematic Longitudinal Data Collection



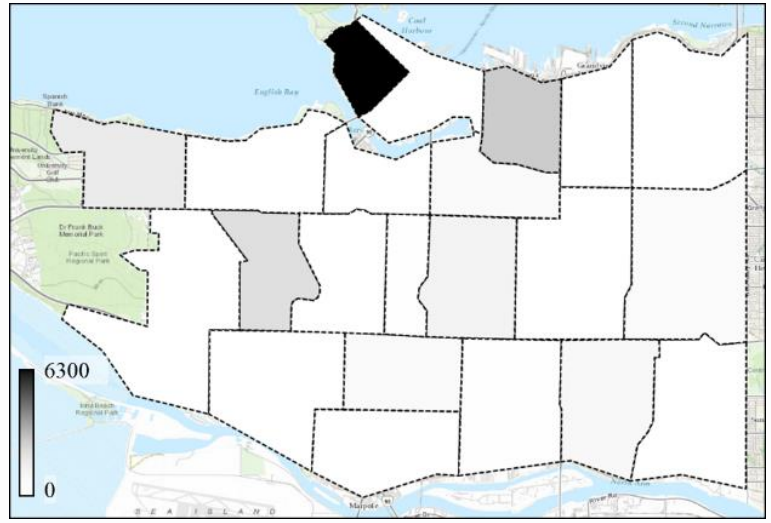
Damaged dwellings, 0 years



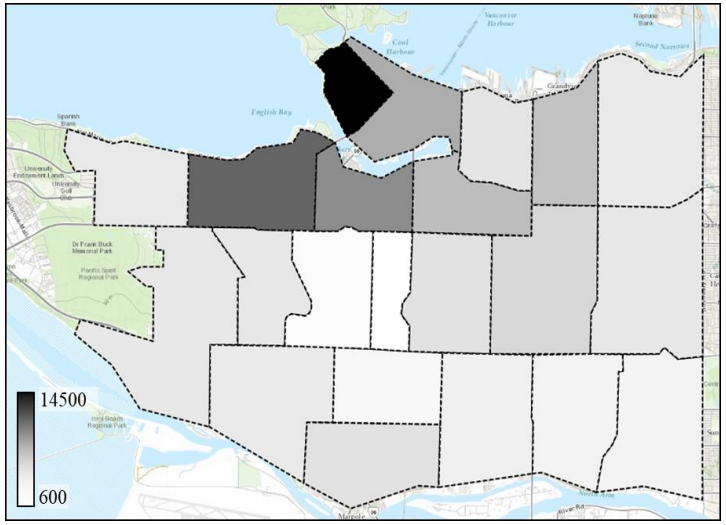
Damaged dwellings, 1 year



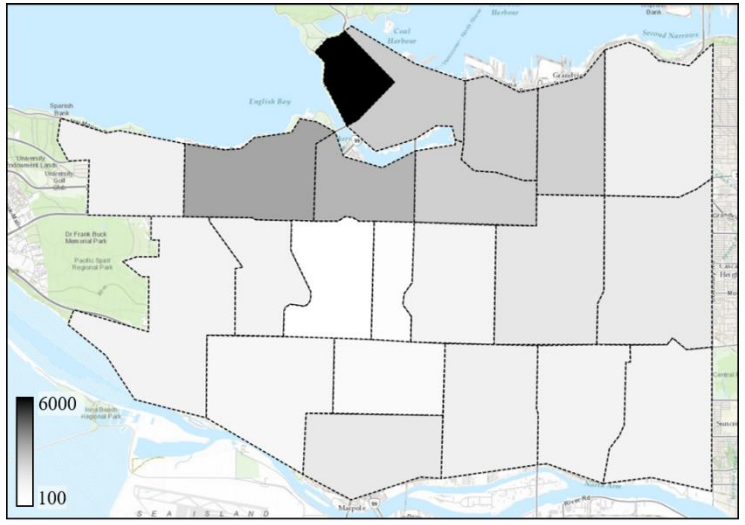
Damaged dwellings, 2 years



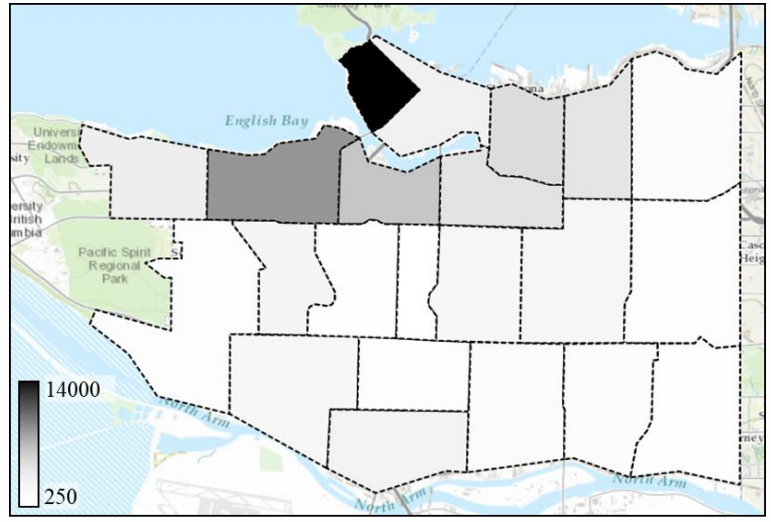
Displaced persons



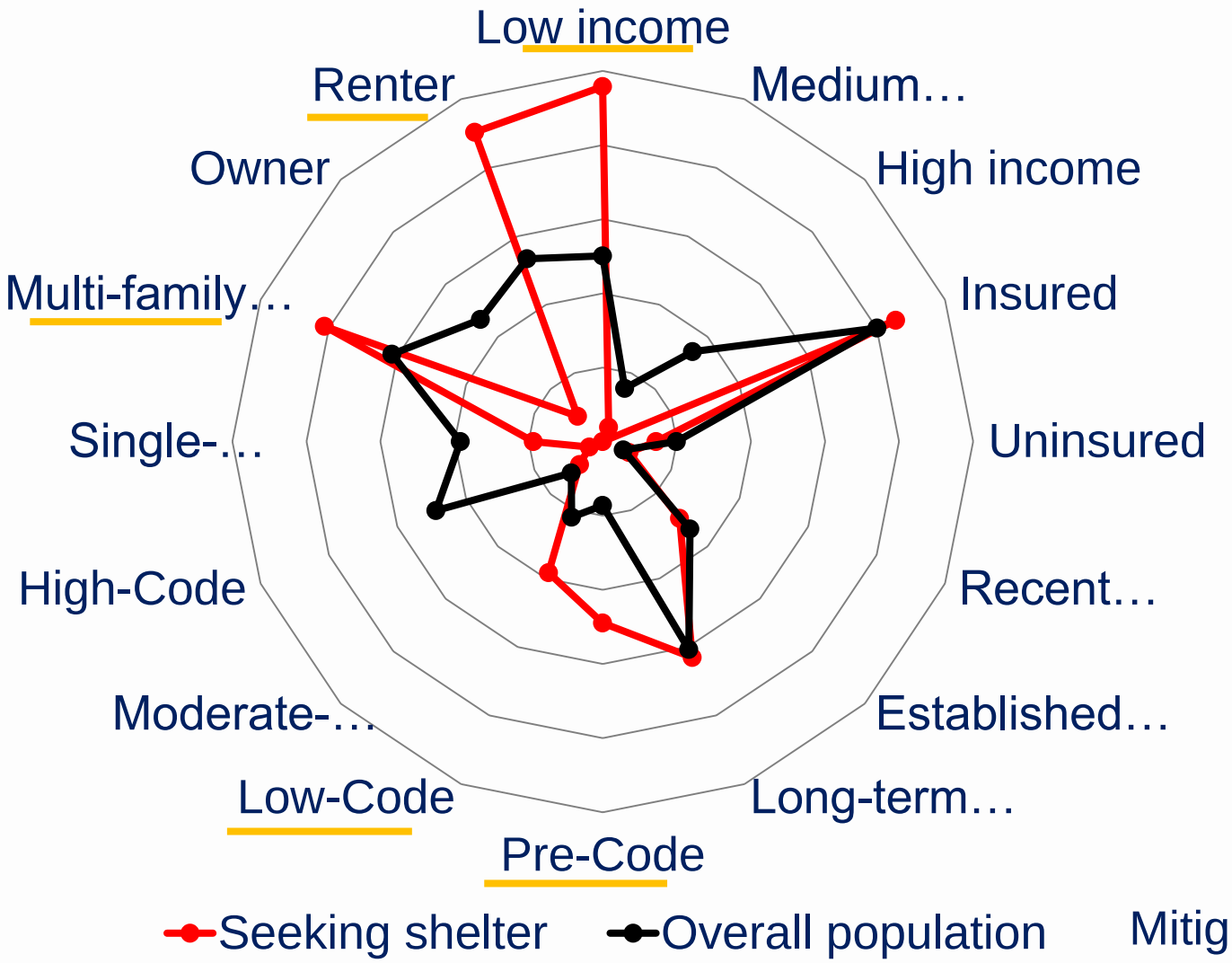
Public sheltering needs



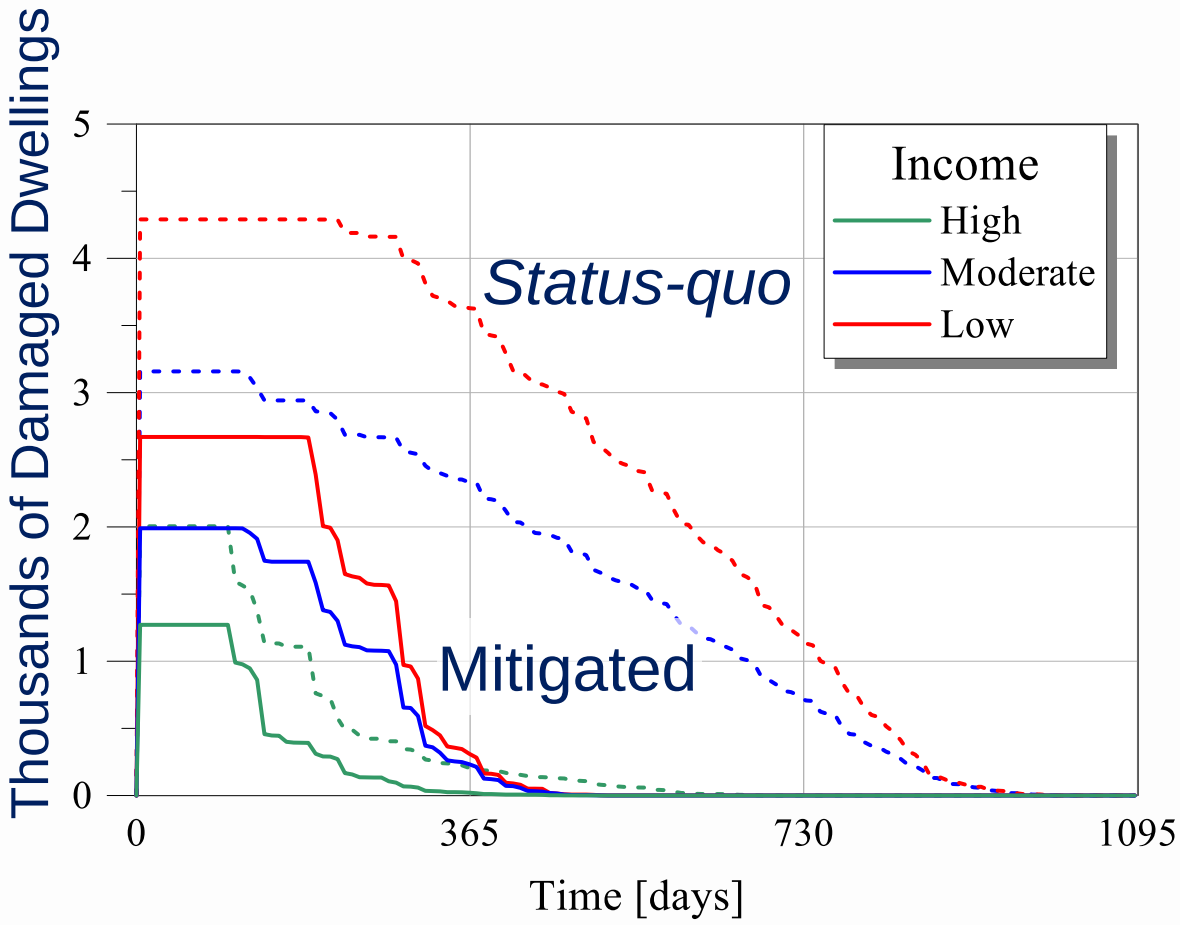
Population loss after 2 years



Understanding the Impact

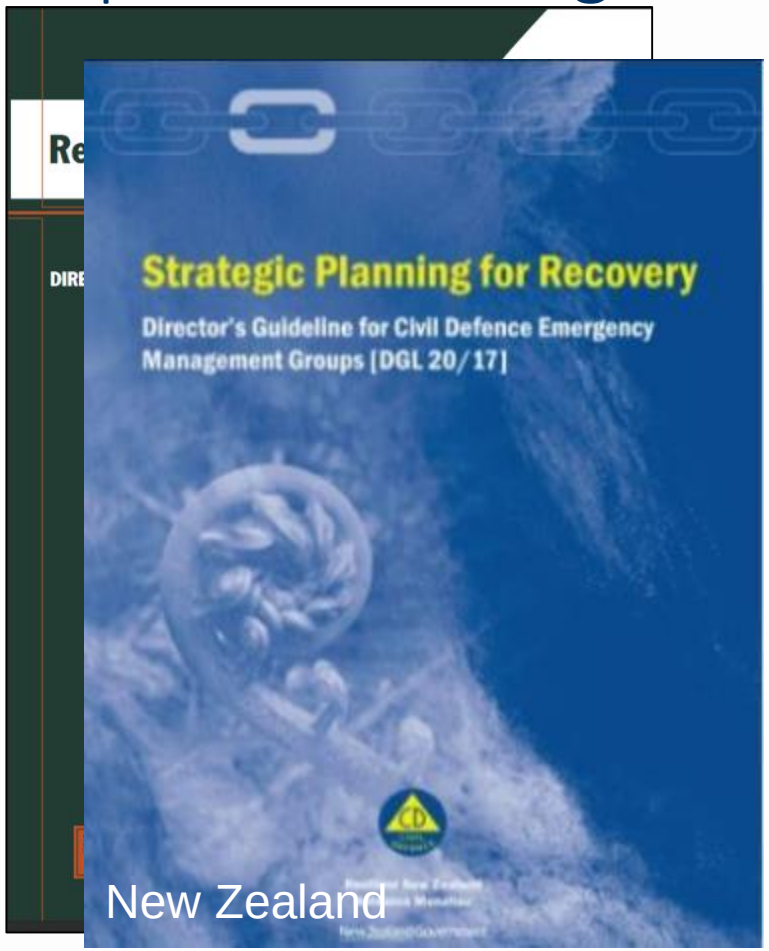


Evaluate Mitigation Actions



Mitigation actions: retrofit pre- and low-code buildings
+ double the workforce in the community

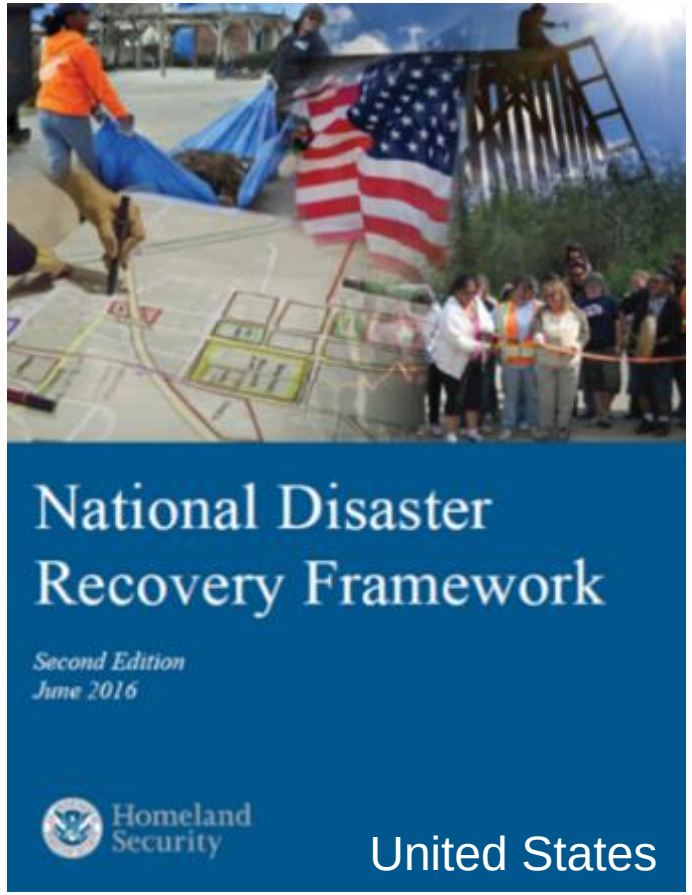
Model disaster recovery planning guidance is also taking a more holistic, community-systems view, but does not adequately address process management, governance and system interdependencies.



New Zealand

- Built environment
- Social environment
- Economic environment
- Natural environment
- Institutional environment

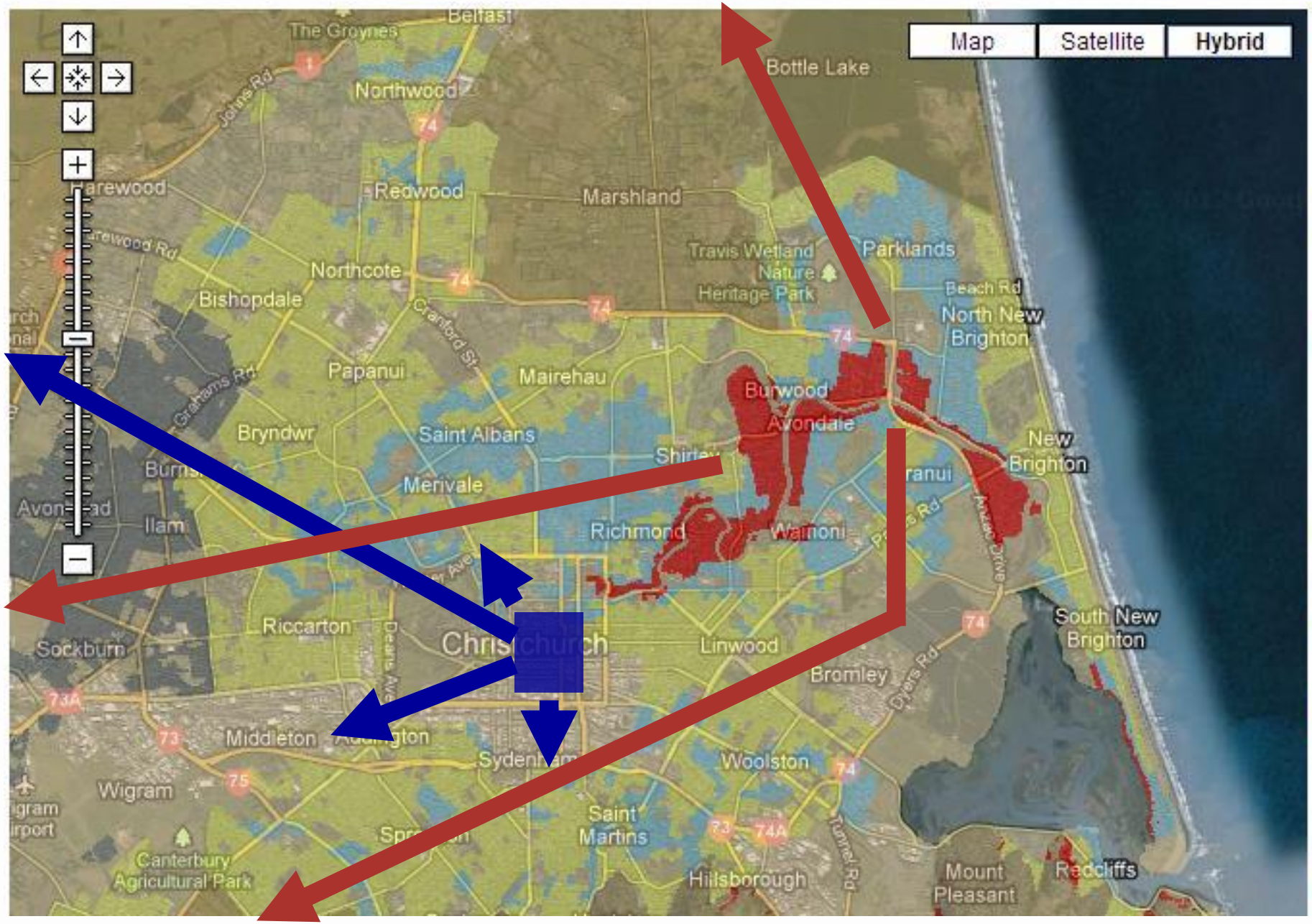
- Housing
- Infrastructure Systems
- Economic Recovery
- Health and Social Services
- Natural and Cultural Resources
- Planning
- Public Information and Warning
- Operational Coordination



United States

M6.3 Earthquake, Christchurch New Zealand
February 22, 2011 12:51 pm

Dust cloud rising as building collapse in downtown Christchurch NZ on 2/22/11
Photo: Gilly Needham

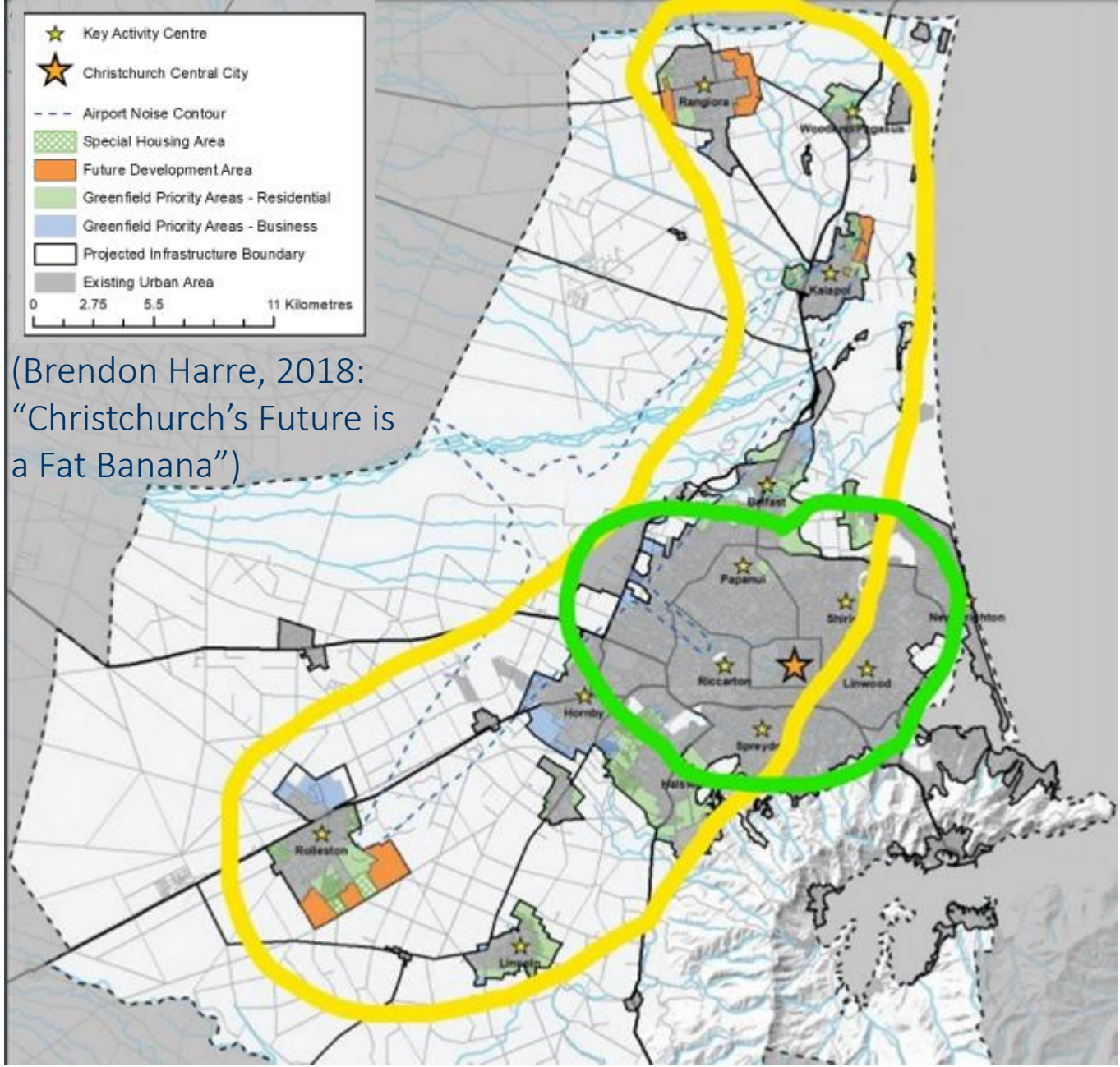


Key

- Technical Category 1
  Future land damage from liquefaction is unlikely.
- Technical Category 2
  Minor to moderate land damage from liquefaction is possible in future significant earthquakes.
- Technical Category 3
  Moderate to significant land damage from liquefaction is possible in future significant earthquakes.
- N/A - Urban Nonresidential
- N/A - Rural & Unmapped
- Port Hills & Banks Peninsula
- Orange Zone
  Further assessment required.
- Red Zone
  Land repair would be prolonged and uneconomic.
- CBD Cordon and Redevelopment

Zoom to areas

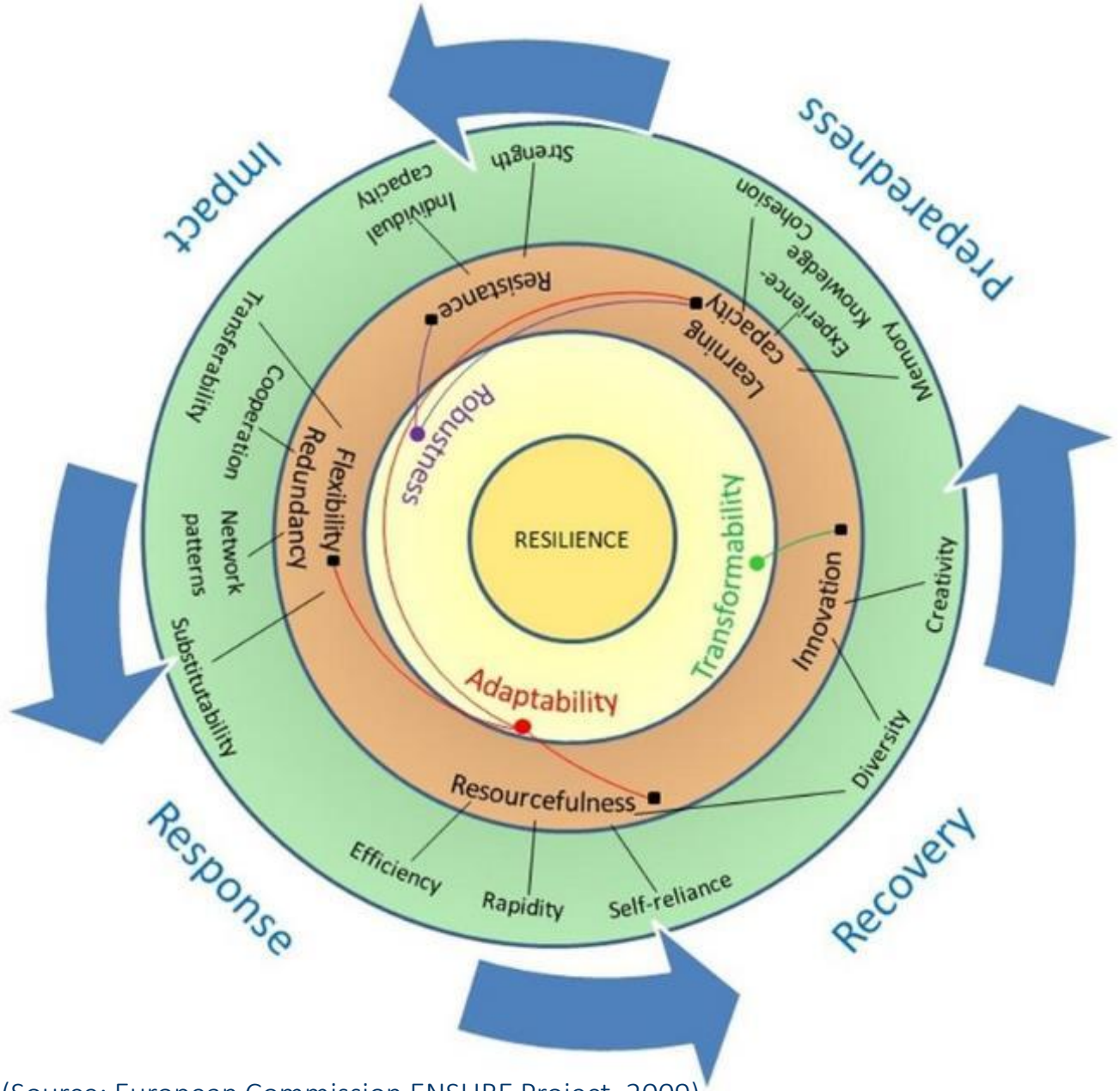
Time. Remember there is no clear endpoint to recovery; at some point recovery policy is subsumed by normal urban development policy and actions. Furthermore, recovery and resilience needs/ opportunities have interdependencies and change with time.



(Brendon Harre, 2018: "Christchurch's Future is a Fat Banana")

Value/Challenges of Disaster Simulation for Recovery and Resilience Planning

- Provide plausible futures to use in planning for emergency response as well as recovery/rebuilding
- Help evaluate benefits/costs of mitigation options and resilience investments
- Inform land use, building and infrastructure standards
- *Need to consider societal dimensions (e.g. socioeconomic conditions, cultural values, issues of equity, political context)*
- *Need to be open and transparent, accessible to a range of audiences and users*
- *Need to be timely (especially post-disaster) and consider the elements of time and multi-hazard (i.e. shocks and stresses)*



(Source: European Commission ENSURE Project, 2009)

Thank You

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