HAZUS 2014

7th Annual Conference

Welcome

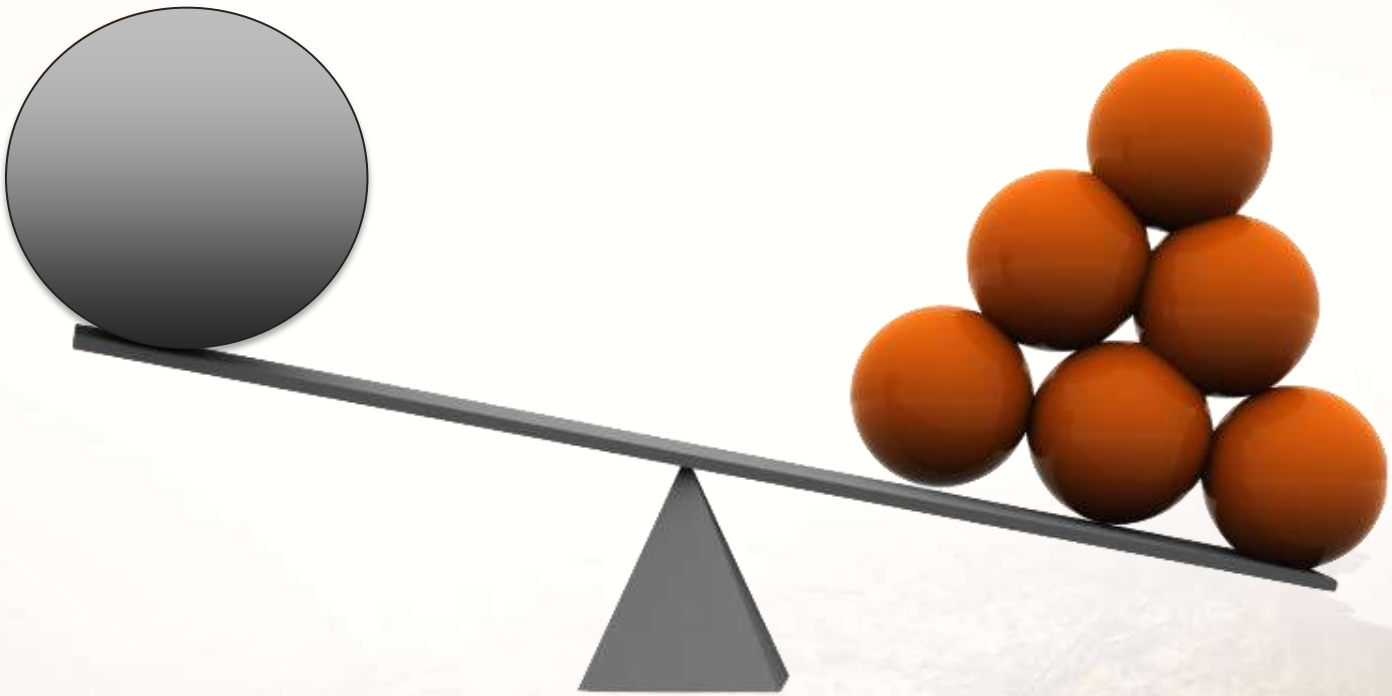
Nicky Hastings, Natural Resources Canada

REFLECTING ON AN EARTHQUAKE ANALYSIS FOR A MID-SIZED URBAN COMMUNITY IN WESTERN CANADA

Opportunity *or* Liability?

Resilience

Risk



Resilience = capacity to withstand, respond & recover

Risk = probability x consequence

What can we expect from a major quake?

hazards:

- ~ 20 seconds of severe ground shaking
- liquefaction along river valleys and waterfront
- landslides along steep/unstable slopes

building damage:

- ~ 300 with significant damage, but repairable
- ~ 850 damaged beyond repair

casualties:

- ~ 2,350 people injured ; ~100 are life-threatening
- ~165 fatalities

lifelines:

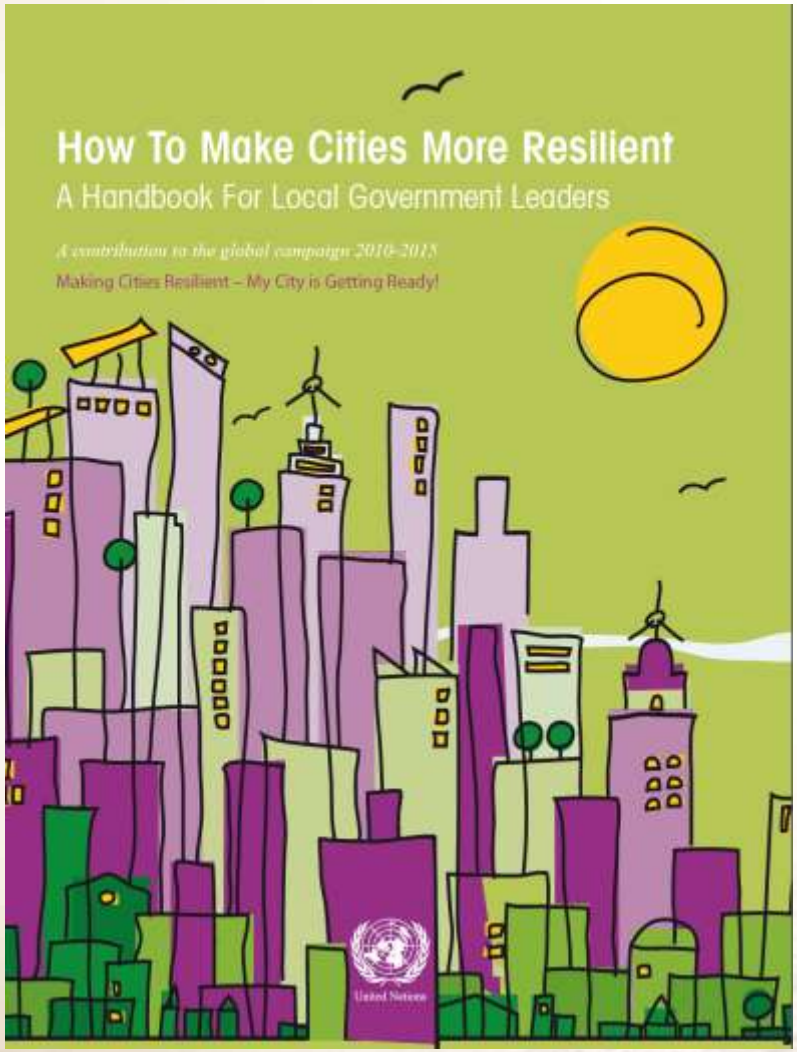
- ~14,000 homes without potable water @ 7 days
- ~6,700 homes without power @ 7 days
- ~11,000 truckloads of disaster debris

economic losses:

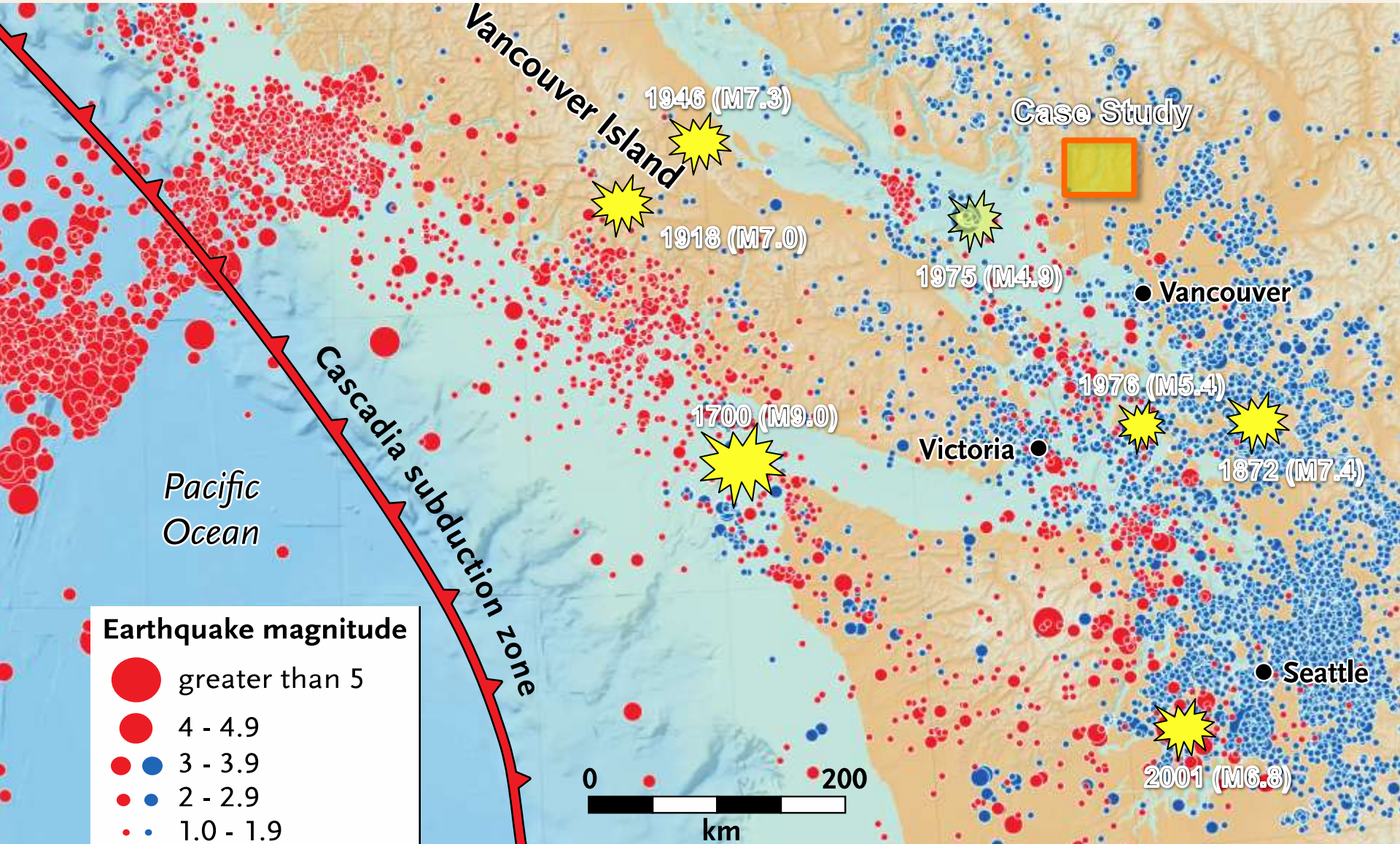
- ~ $2.3 Billion of building-related losses
- ~ $4.4M per day of business-related losses

Natural Resources Canada Methods for Disaster Risk Reduction

Risk Reduction & Disaster Resilience Planning

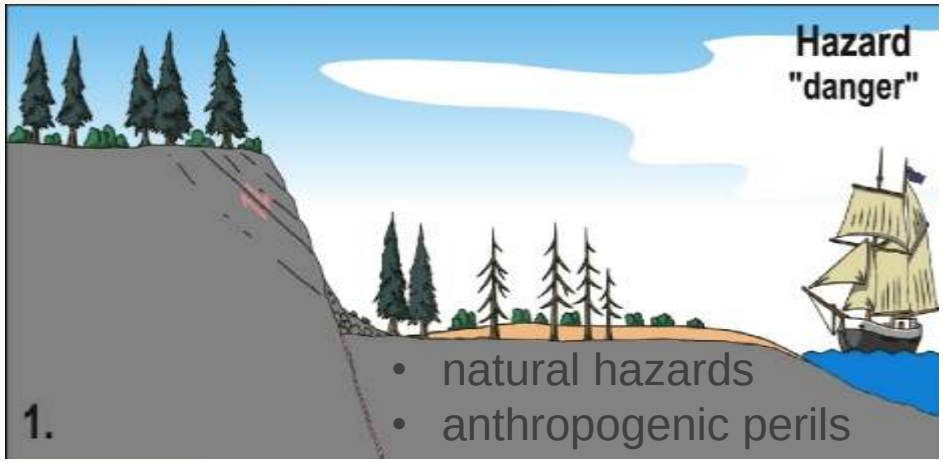


We live in earthquake country



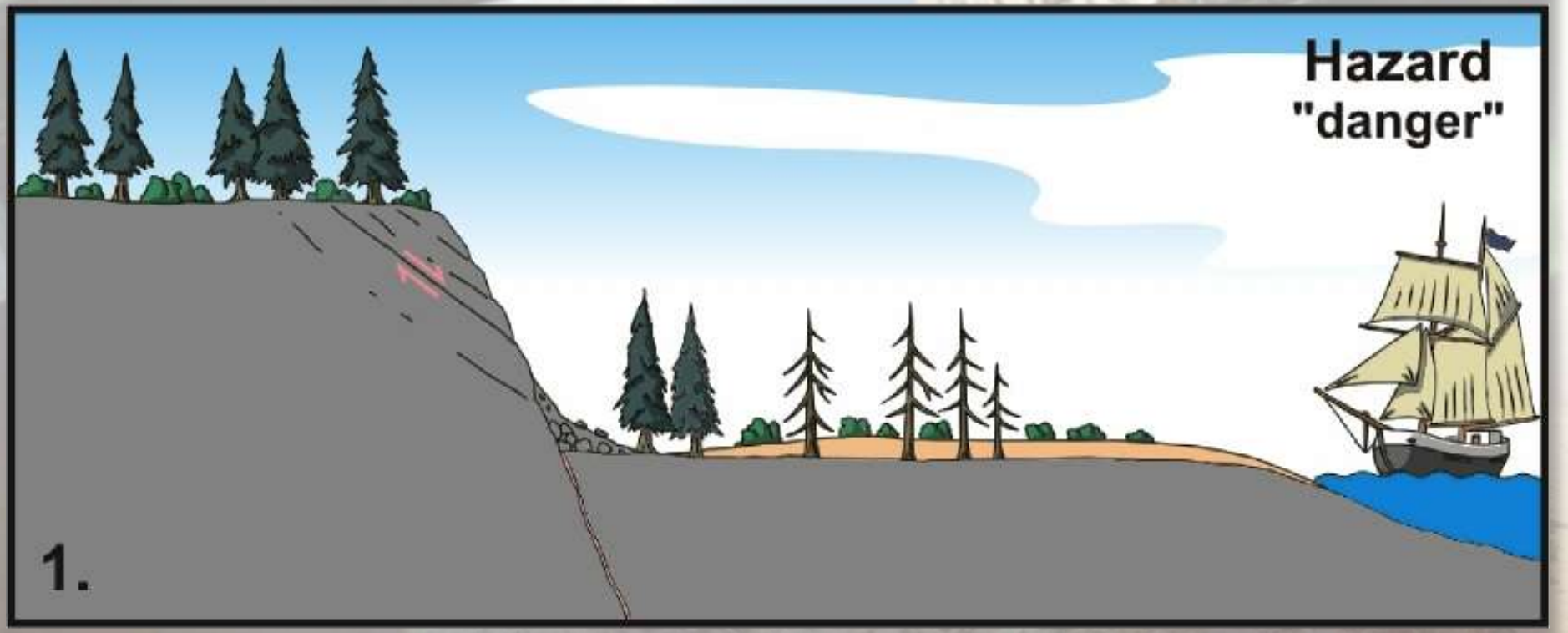
What can we expect from a major earthquake?

Coming to terms with earthquake risk



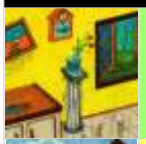
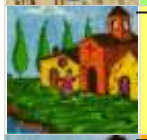
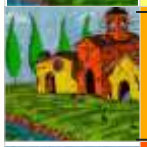
Part I

1) What are the earthquake hazards for North Vancouver?



Seismic hazard potential - shaking

Probabilistic — Deterministic

MMI Scale		Perceived Shaking	Damage Potential
	V	Light felt by some	Pictures move
	VI	Moderate *felt by all*	Objects fall to ground
	VII	Strong *difficulty standing*	Non-structural damage
	VIII	Very strong *difficulty driving*	Moderate structural damage
	IX	Violent *general panic*	Heavy structural damage
	X	Very violent *general panic*	Extreme structural damage

2% in 50-year ground motions

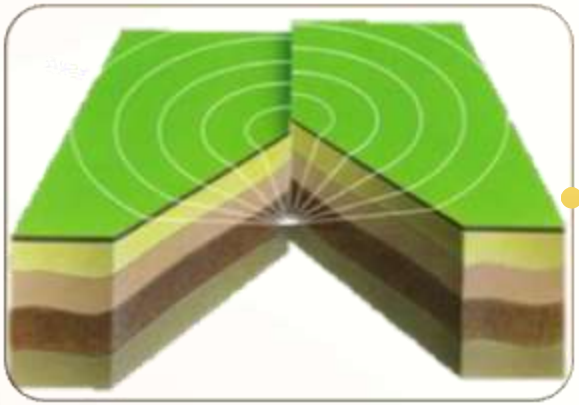
Who and what are vulnerable to known earthquake hazards in the region?

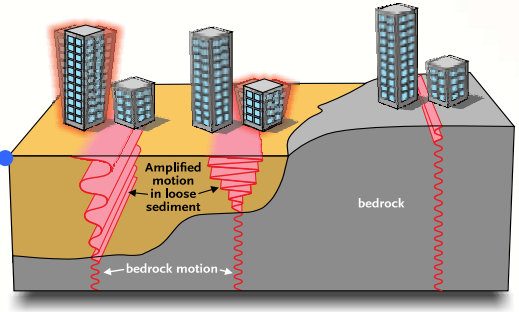
M7.3 scenario earthquake

What are the likely consequences of a major earthquake in the region?

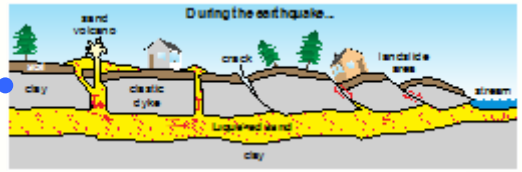
Earthquake Hazards

✓ Ground Shaking

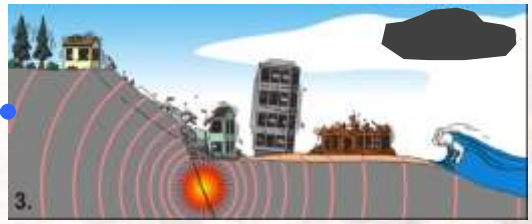




✓ Site amplification



✓ Liquefaction



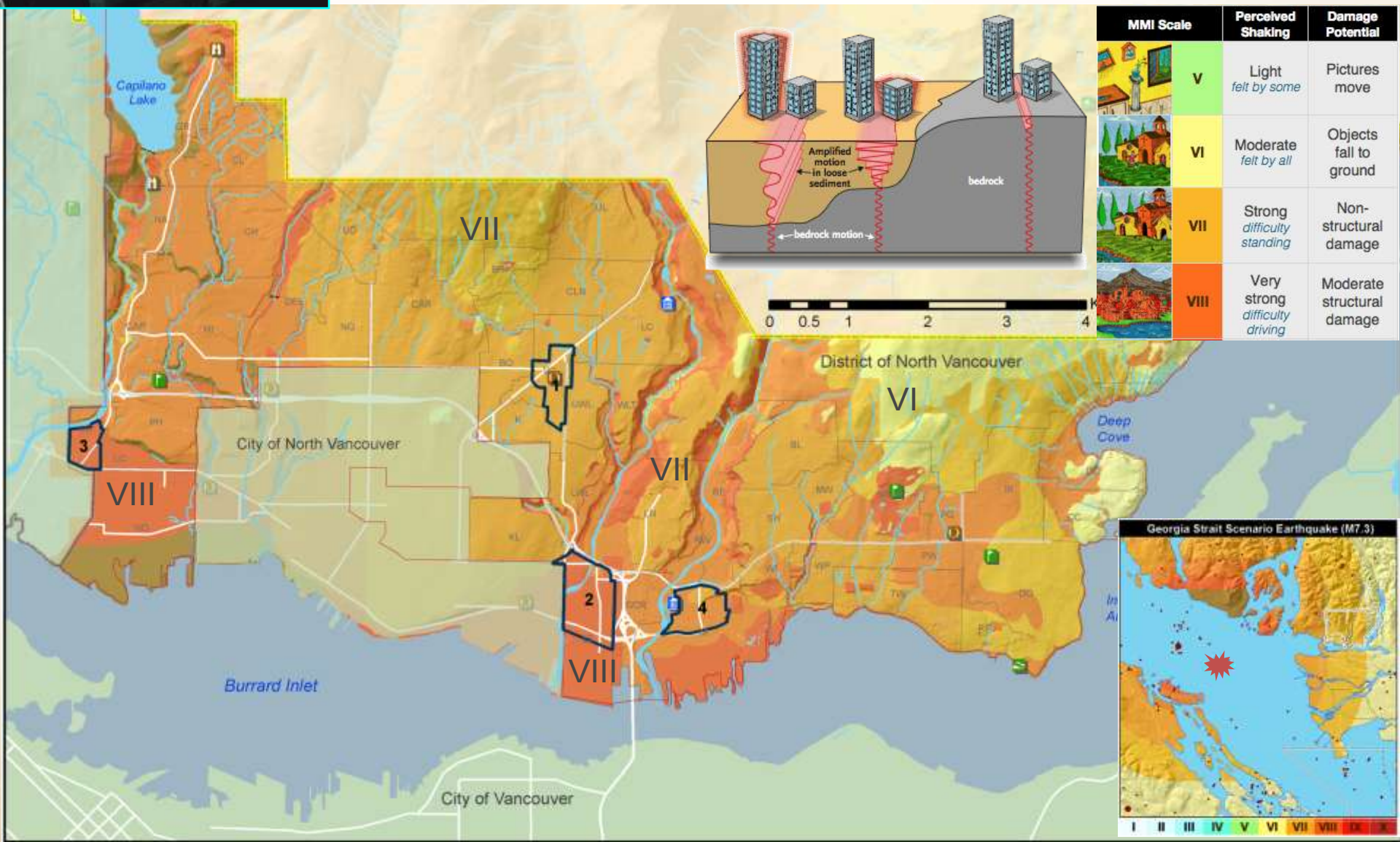
✓ Landslides
✓ Fire Following

Not Considered in analysis

- Aftershocks
- Basin & topographic effects
- Tsunami
- Interdependency & uncertainty

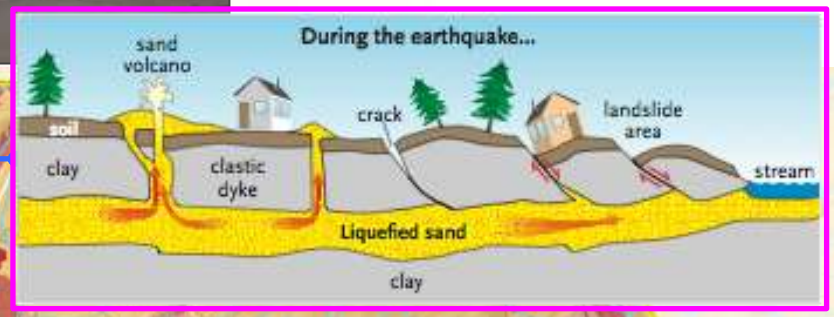
Ground shaking hazards

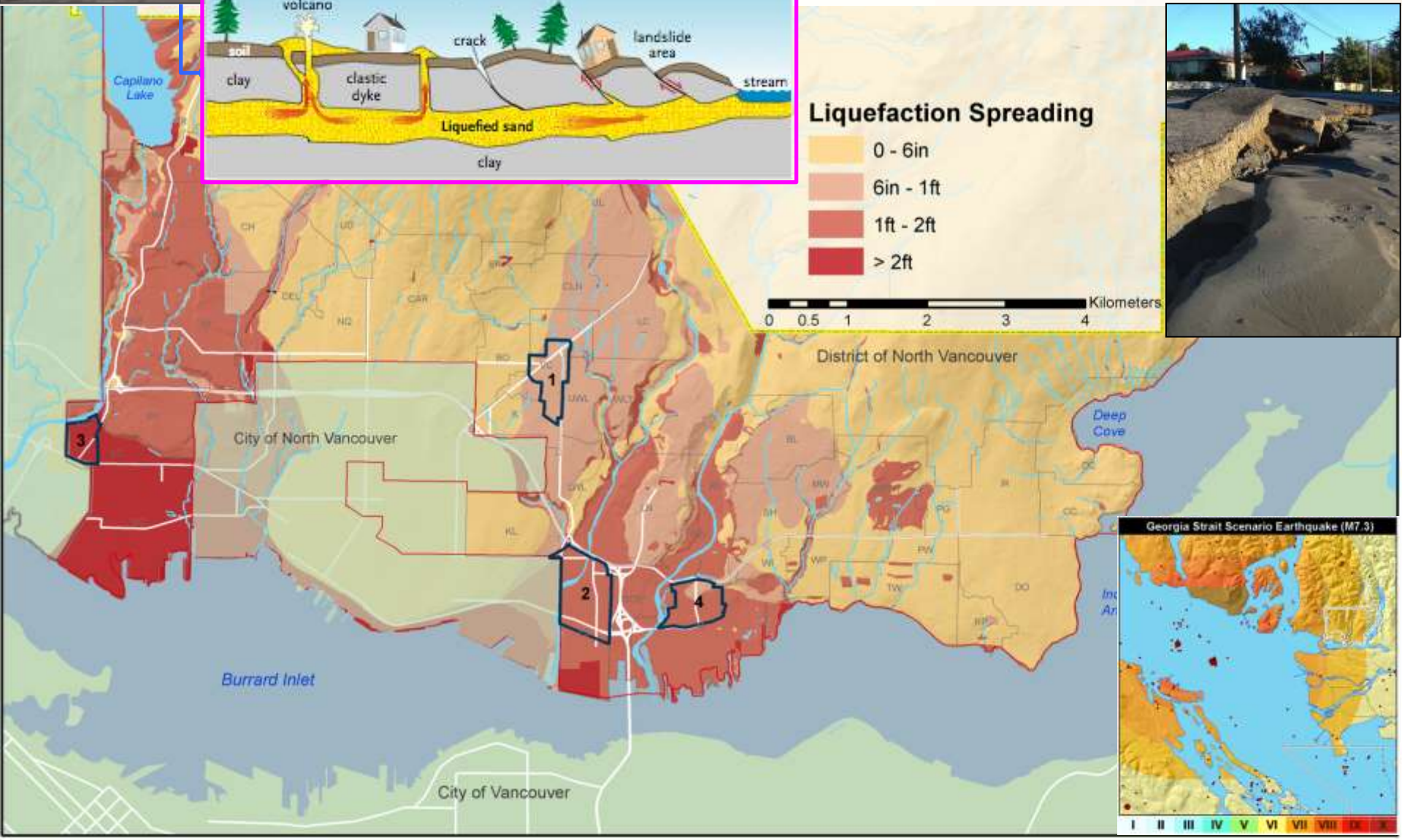
estimates based on a Georgia Strait M7.3 scenario earthquake



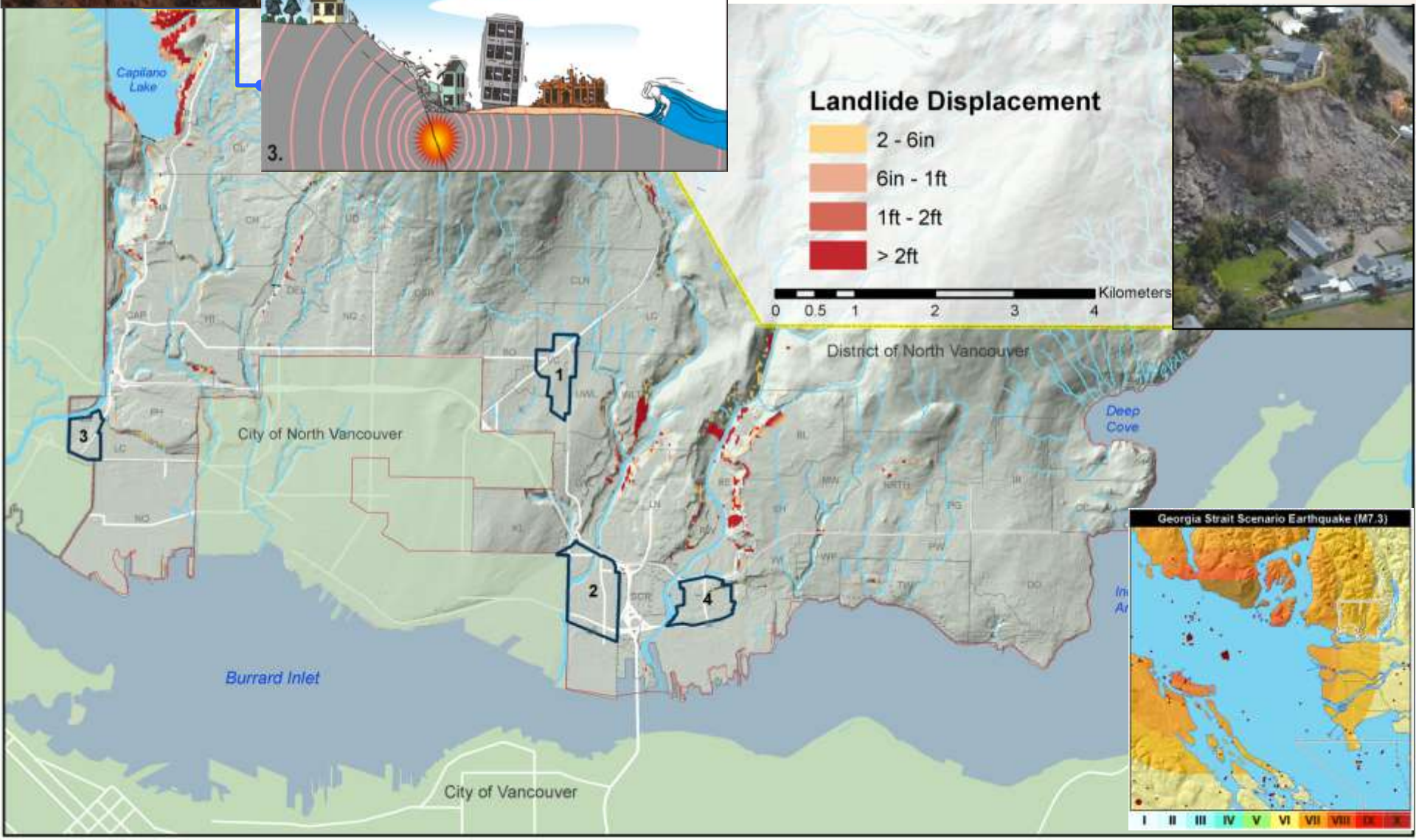
MMI Scale		Perceived Shaking	Damage Potential
	V	Light *felt by some*	Pictures move
	VI	Moderate *felt by all*	Objects fall to ground
	VII	Strong *difficulty standing*	Non-structural damage
	VIII	Very strong *difficulty driving*	Moderate structural damage

Liquefaction hazards



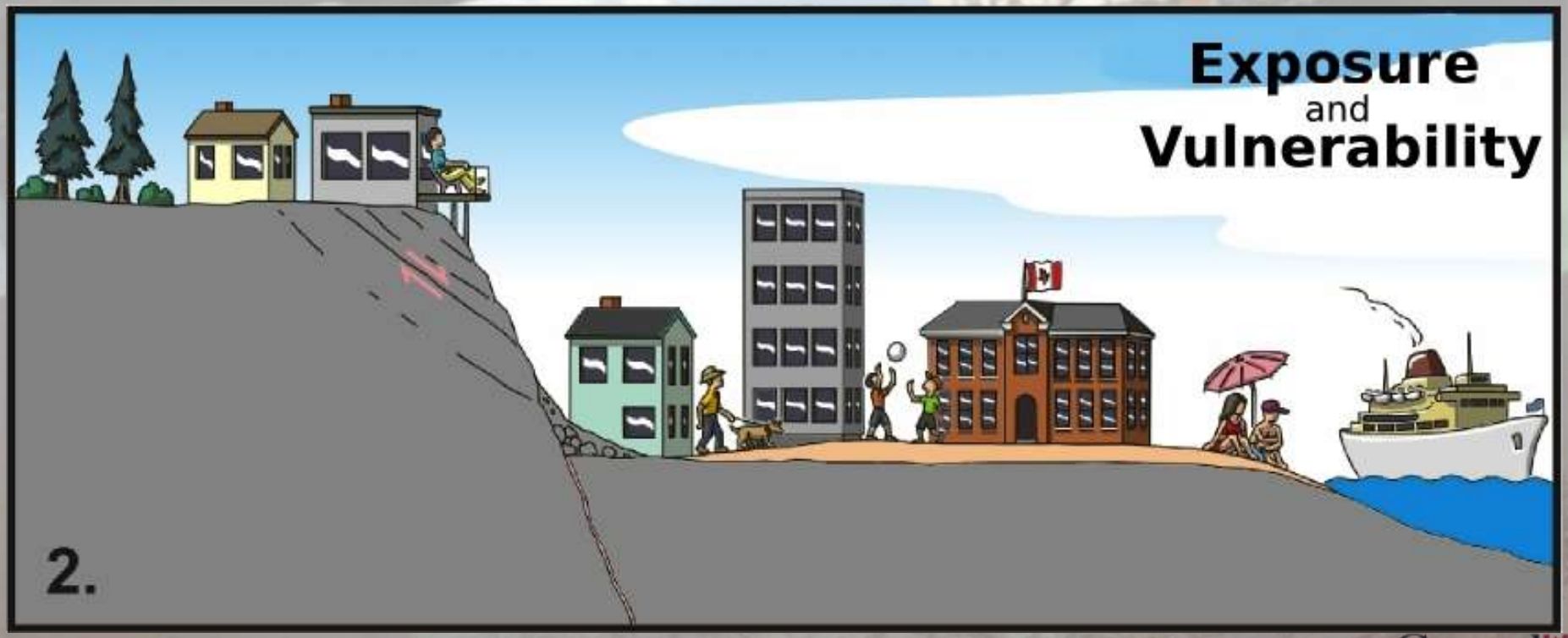


Earthquake-triggered landslides



Part II

2) Who and what are vulnerable to earthquake hazards?

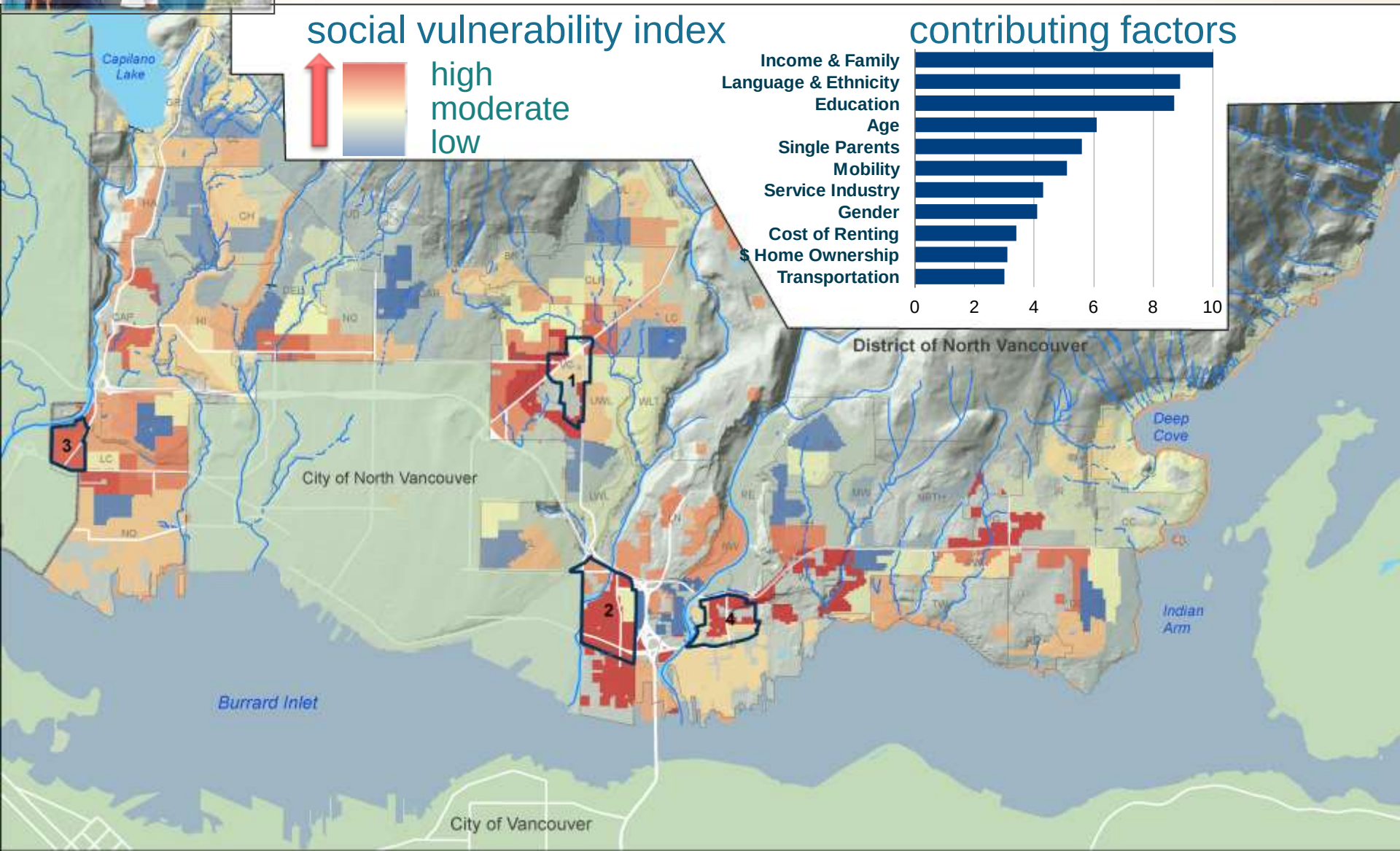


Who is vulnerable ?

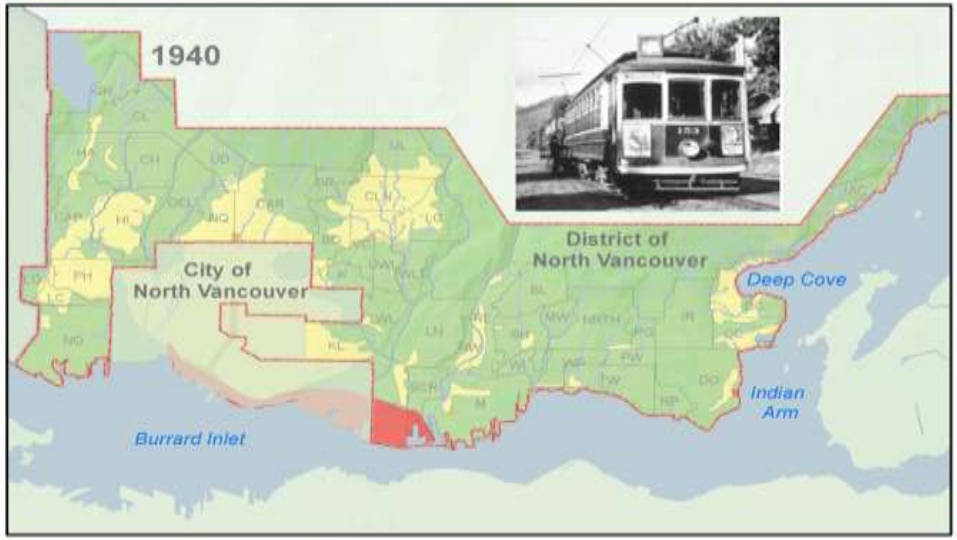
social vulnerability index

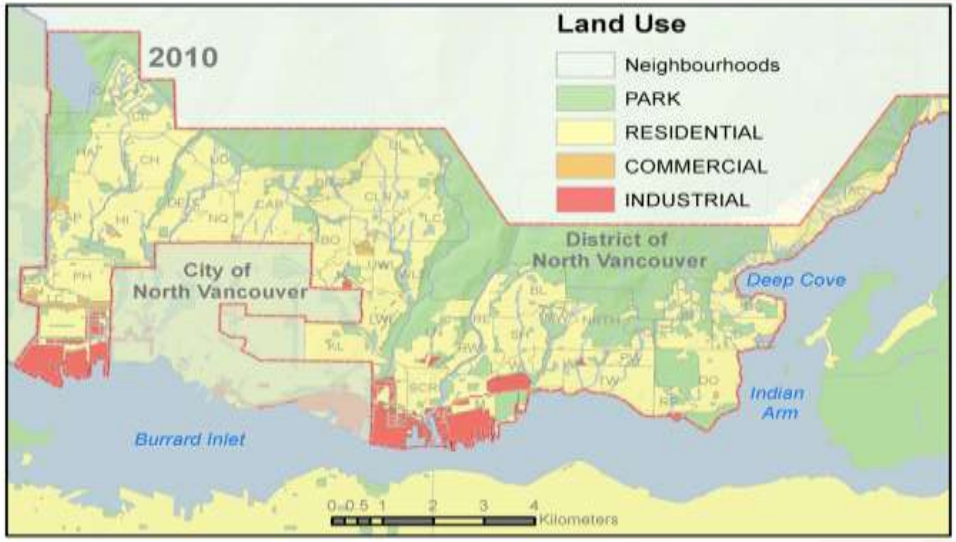
high
moderate
low

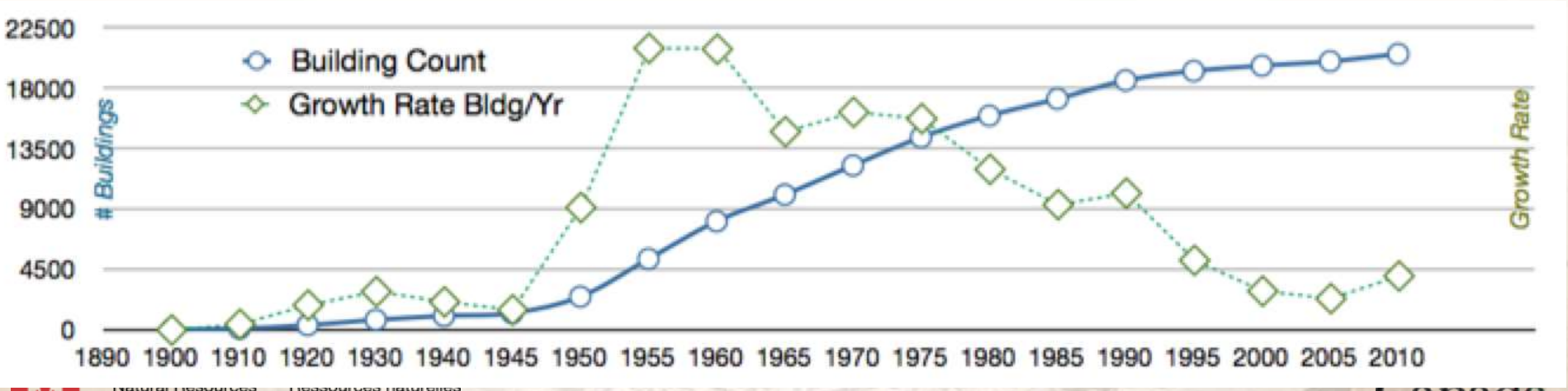
contributing factors



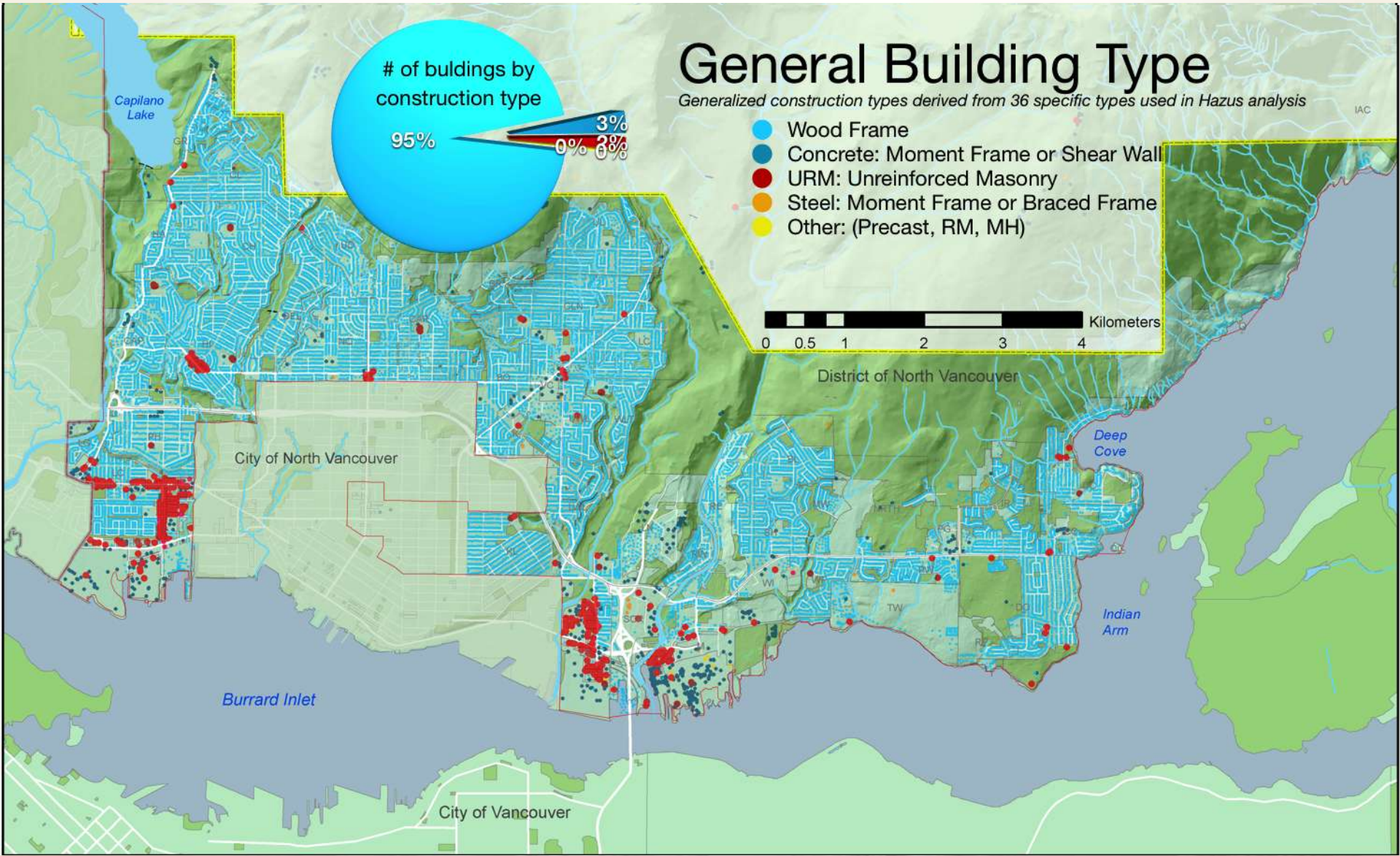
An evolving pattern of vulnerability



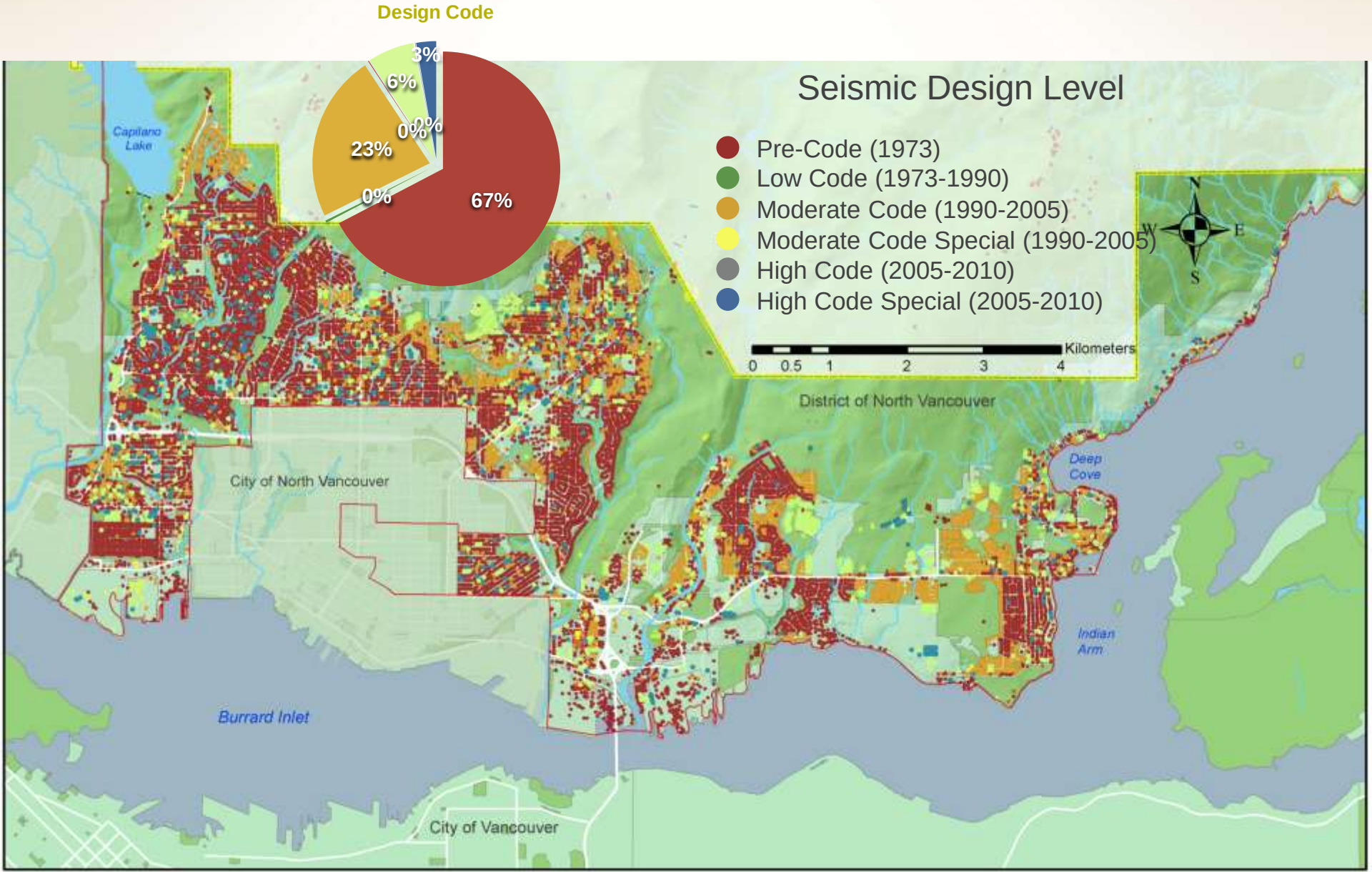




What is vulnerable ?



Development history & vulnerability

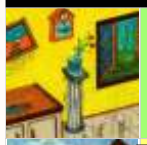
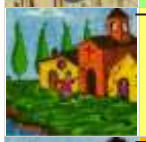
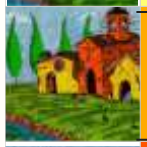


Part III

3) What are the likely impacts & consequences of a major earthquake?

Disaster Risk Reduction - *Performance Measures*

Georgia Strait M7.3 scenario earthquake

MMI Scale		Perceived Shaking	Damage Potential
	V	Light felt by some	Pictures move
	VI	Moderate *felt by all*	Objects fall to ground
	VII	Strong *difficulty standing*	Non-structural damage
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M7.3 scenario earthquake

Building Damage

Casualties

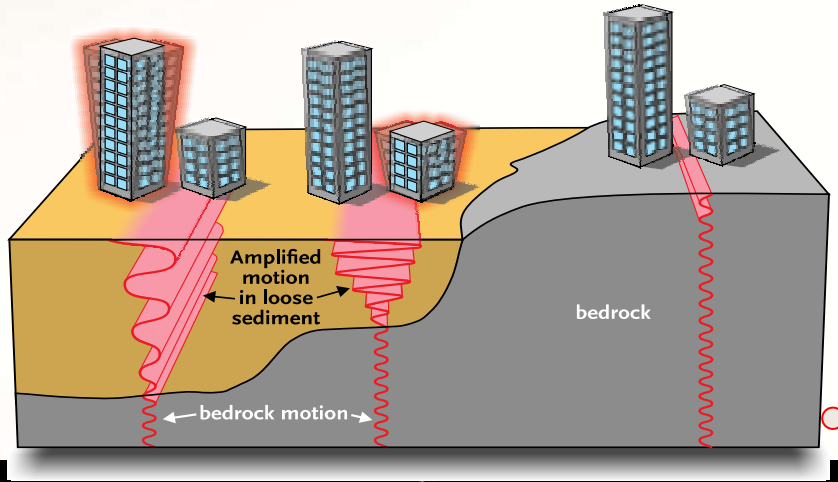
Lifelines

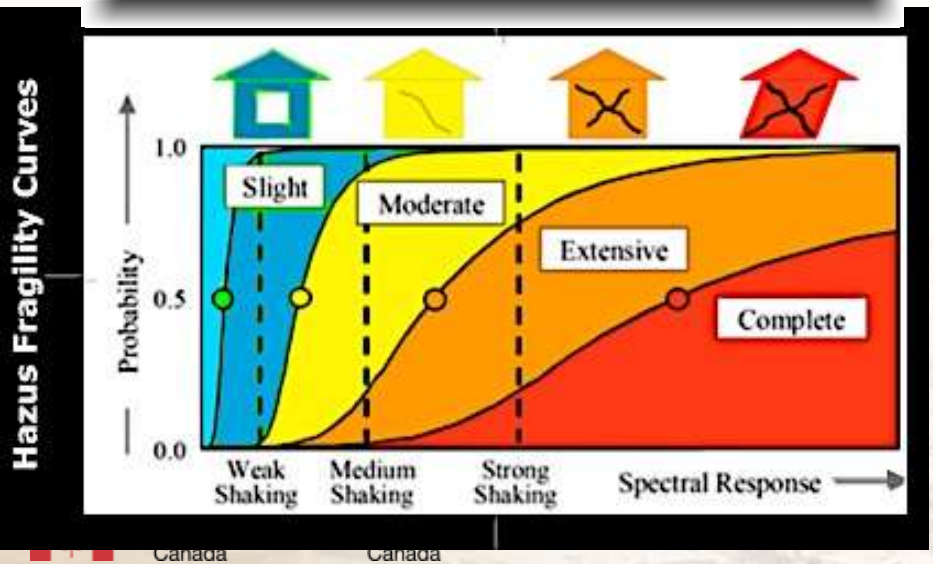
Economic Loss

What are the likely consequences of a major earthquake in the region?

Analysis of Damage Potential

Likelihood of damage





None & Slight

minor damage to walls & supports

Moderate

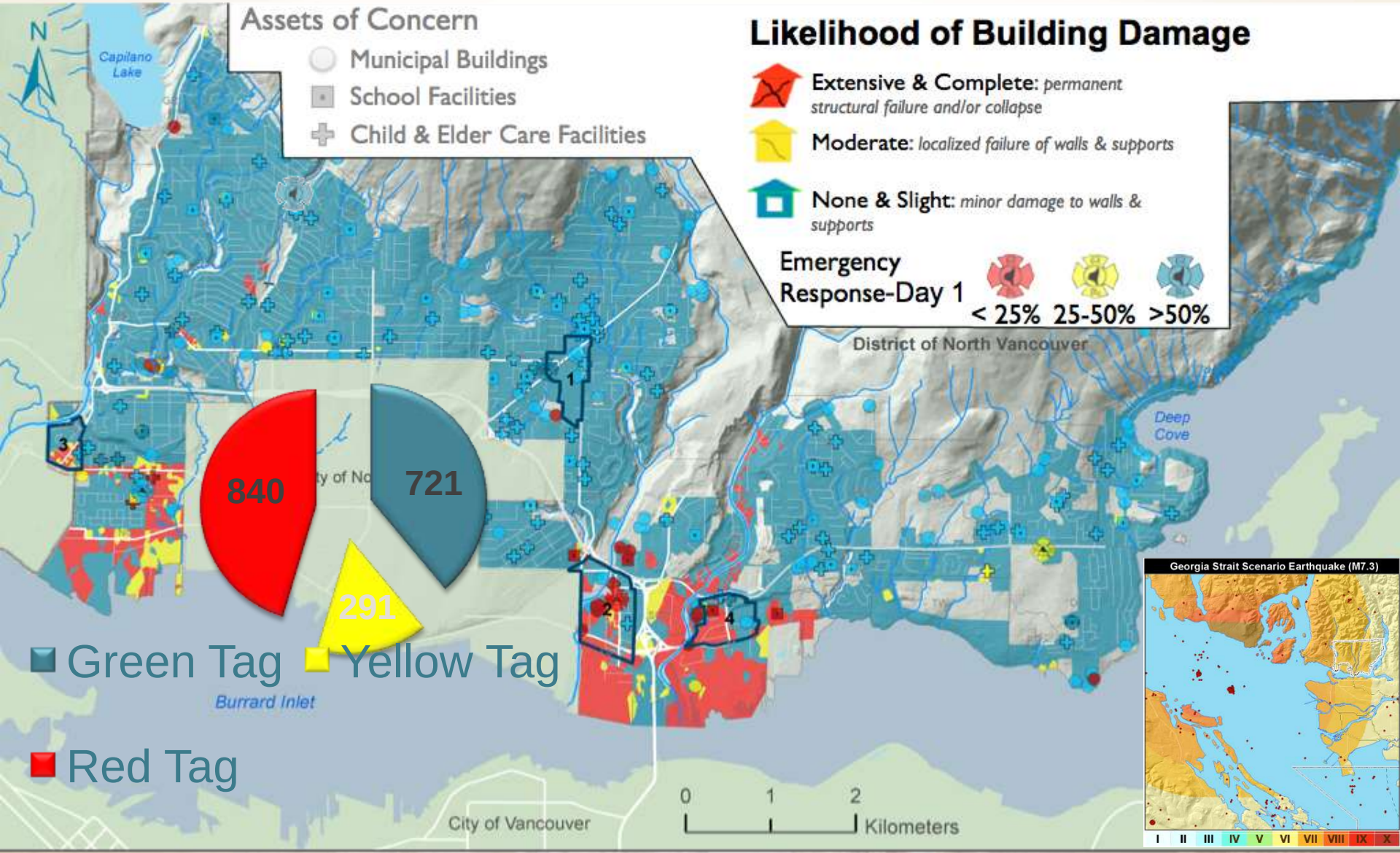
localized failure of walls & supports

Extensive & Complete

permanent structural failure & imminent danger of collapse

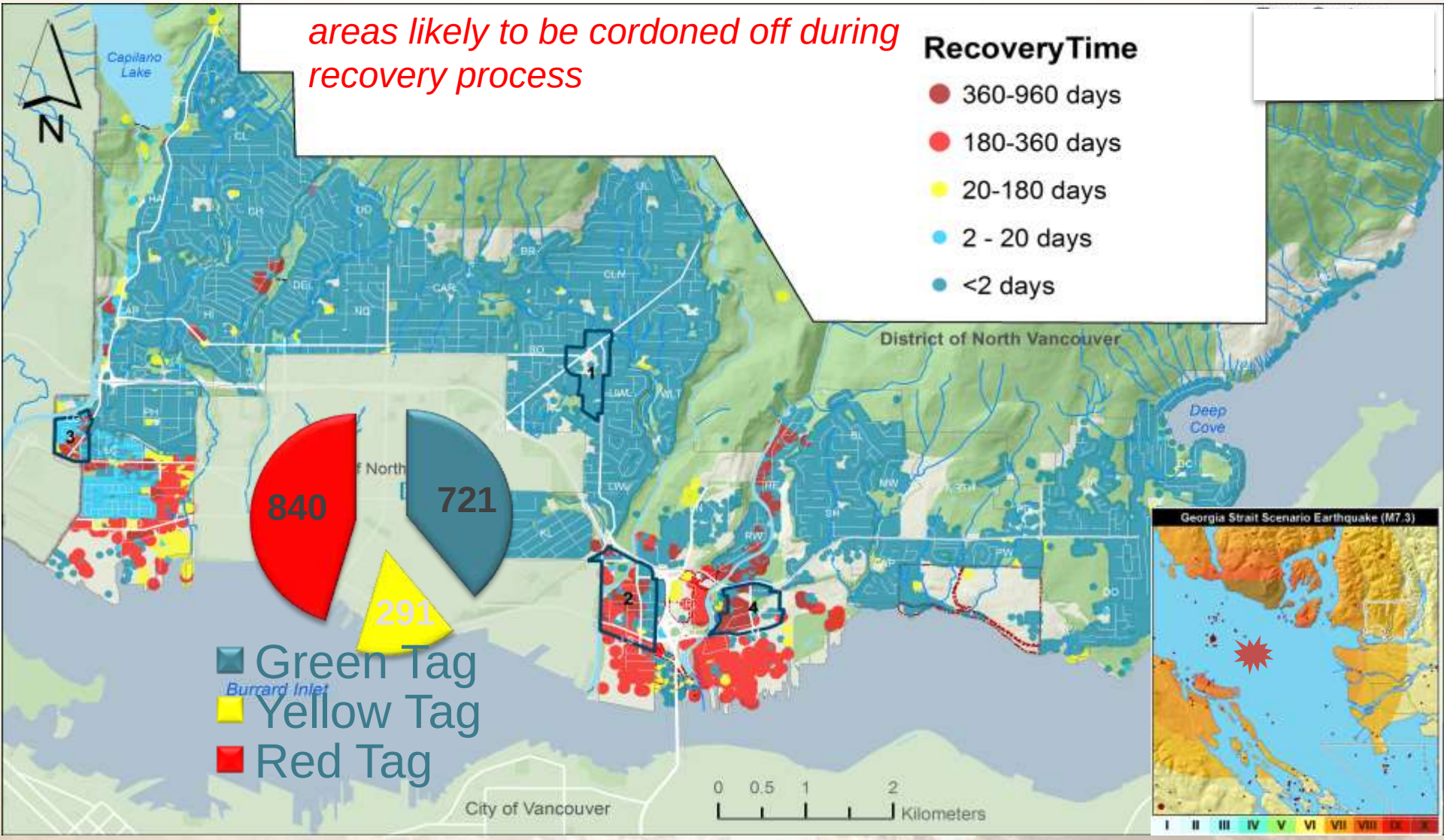
Buildings – *likelihood of damage*

estimates based on M7.3 Georgia Strait earthquake scenario



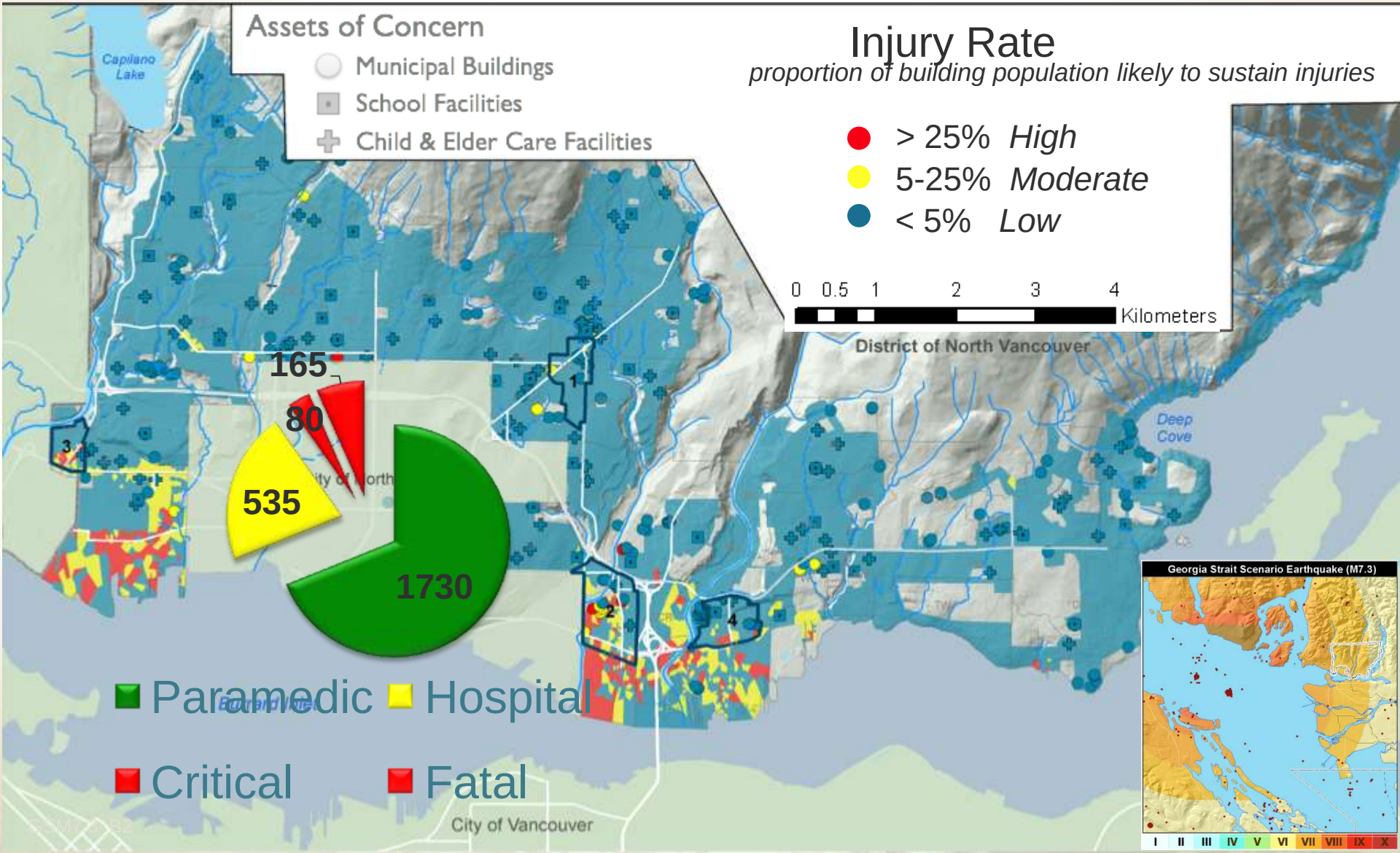
Recovery Time- *Buildings*

estimates based on Georgia Strait M7.3 scenario earthquake



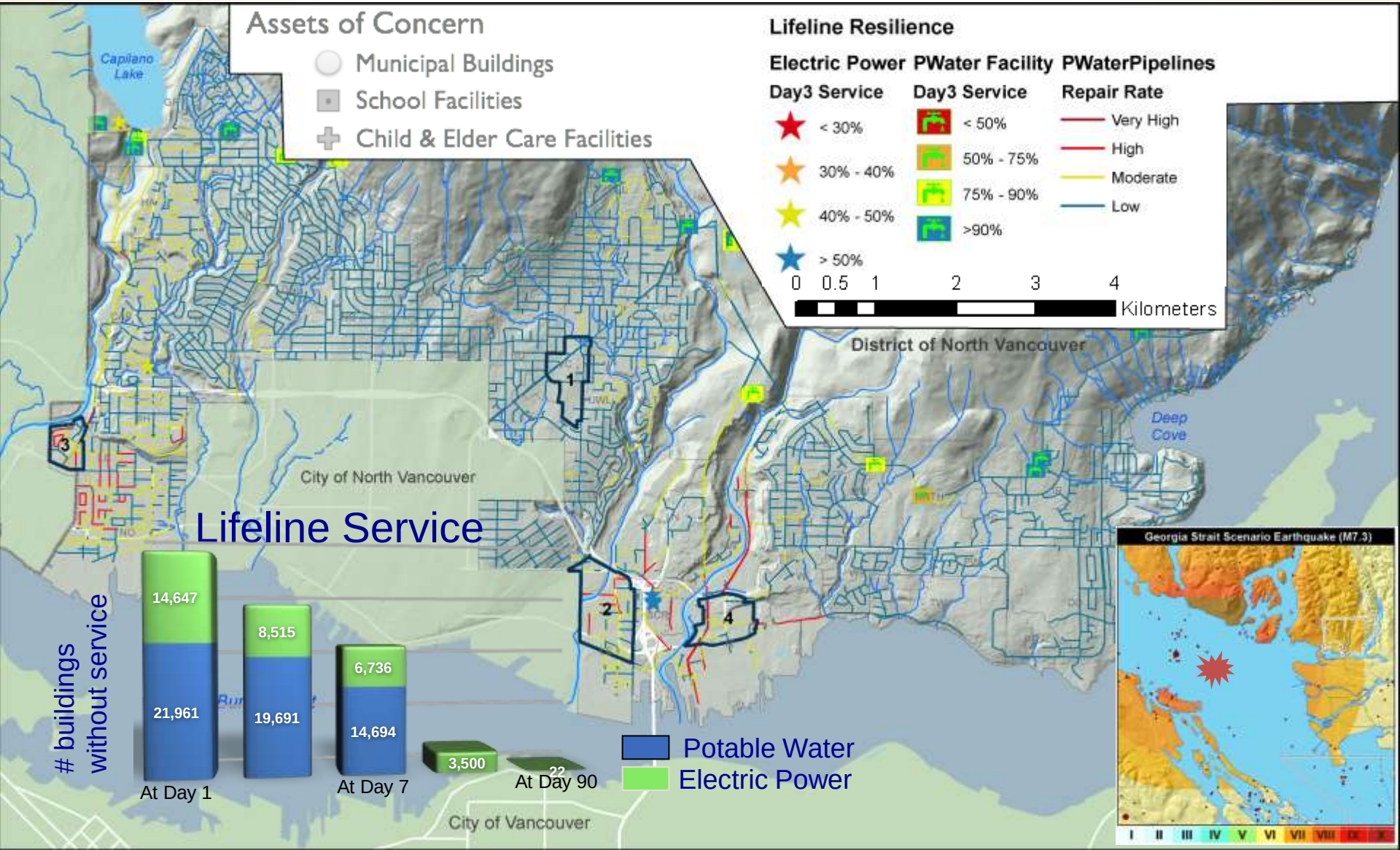
Injuries – *daytime scenario*

estimates based on Georgia Strait M7.3 scenario earthquake



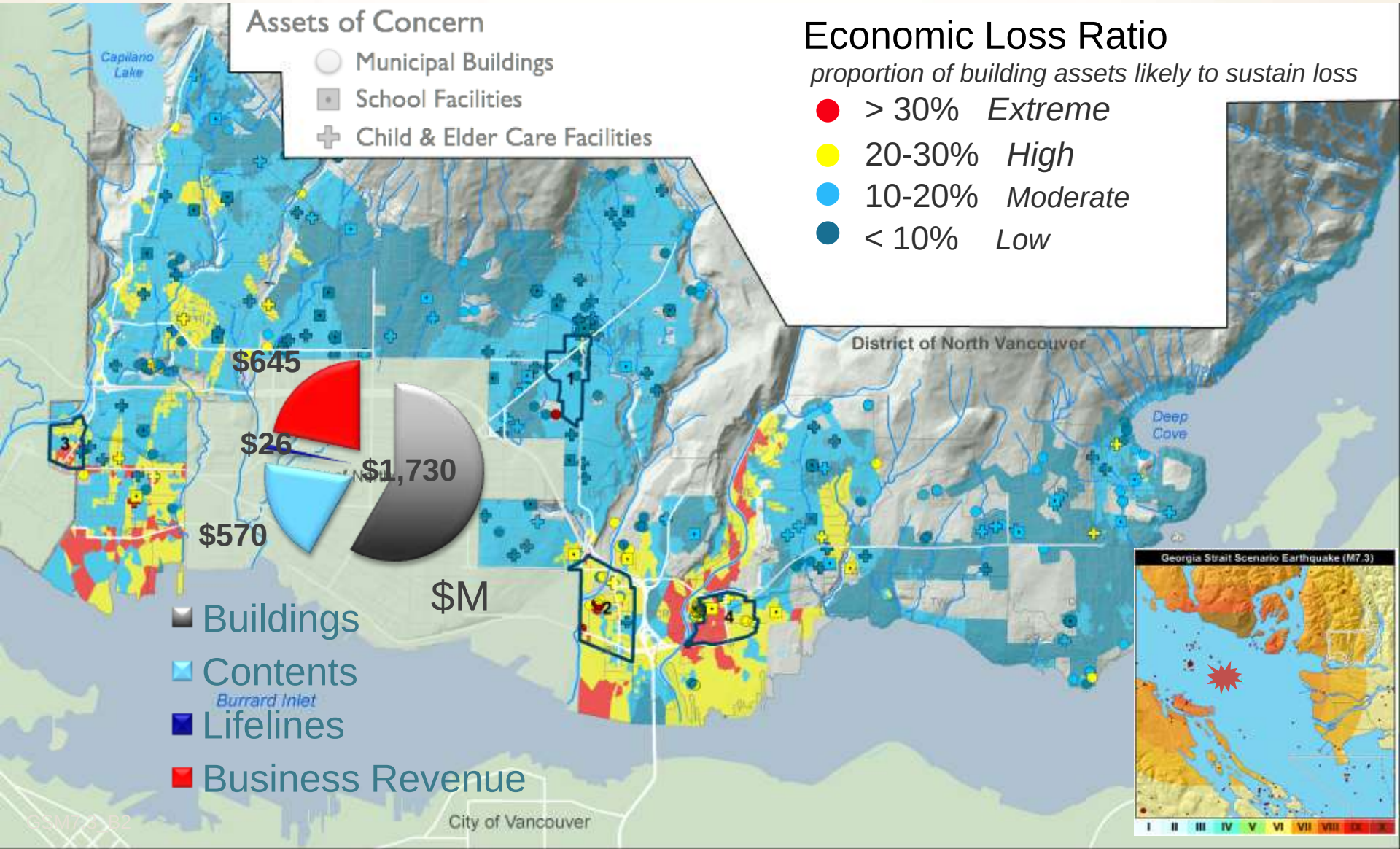
Lifeline Functionality - *Utilities*

estimates based on Georgia Strait M7.3 scenario earthquake



Economic Losses

estimates based on Georgia Strait M7.3 scenario earthquake

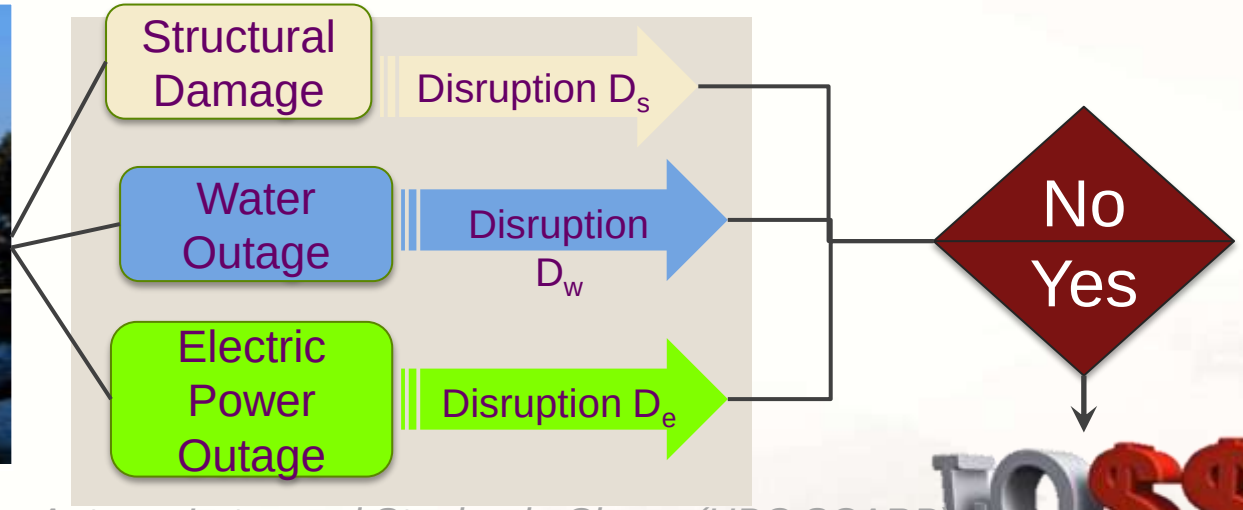


Business Disruption & Loss

estimates based on Georgia Strait M7.3 scenario earthquake

What about system interdependencies?

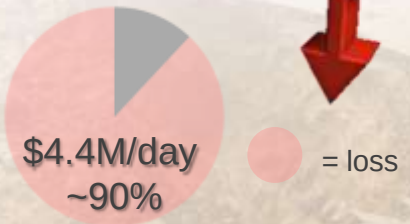
~ $2.3 Billion of building-related losses



Research contribution by Autumn Lotze and Stephanie Chang (UBC SCARP)

~ $4.4 M per day of business-related losses

- lost wages & business income
- rental & relocation costs



DNV Gross Daily Revenue ~$5M per day

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economic losses:

- ~ $2.9 Billion capital stock losses
- ~ $4.4M per day of business-related losses

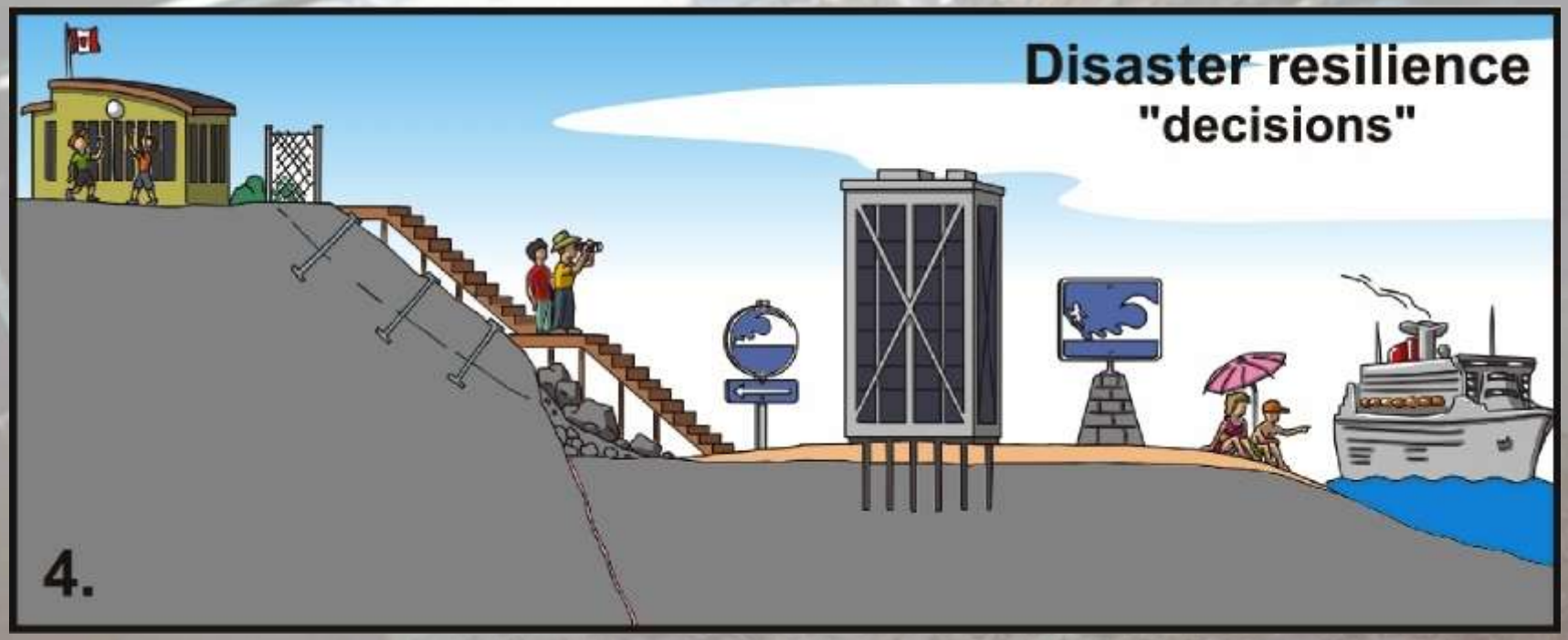
The 2011 Christchurch earthquake

M6.3 Earthquake Event and Related Aftershocks

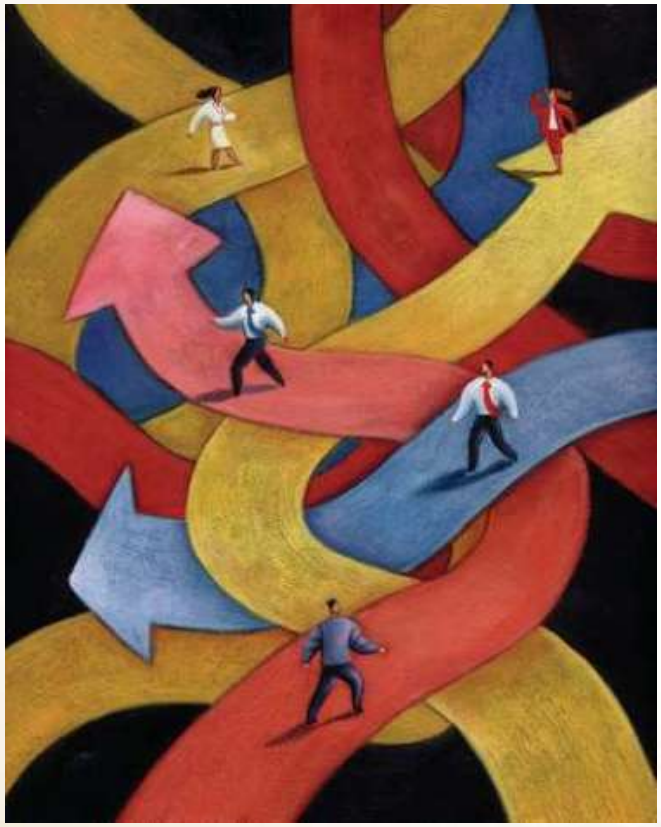
24 seconds of violent ground shaking which triggered liquefaction and landslides
837 buildings have so far been demolished
7000 buildings classified as being in suburban red zone, -not economically viable to repair
1200+ police officers from Christchurch and nationwide on duty 7 days following quake
185 died as a result of the earthquake
11310 people uprooted two weeks after February quake
300km of sewer pipes and about **124km** of water pipes are being fixed
4 million tonnes (~160,000 trucks) of rubble carted away from commercial and residential areas
$2 billion- Christchurch City Council's predicted cost to rebuild city infrastructure
$30 billion- Reserve Bank's estimated total cost of earthquake claims

from knowledge to action

4) How might knowledge about earthquake risk be used to reduce future losses and increase disaster resilience in the community?

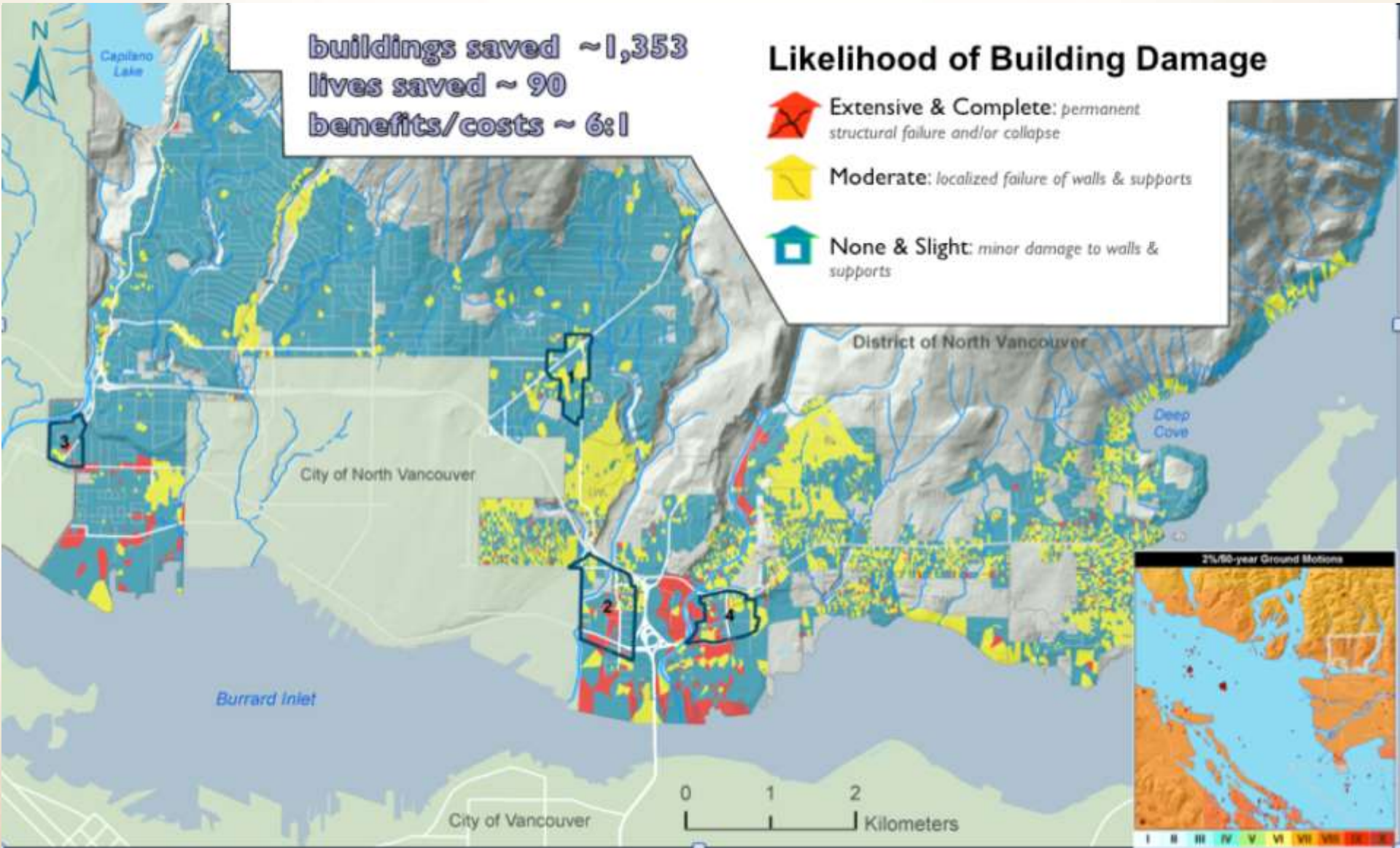


Land Use Planning

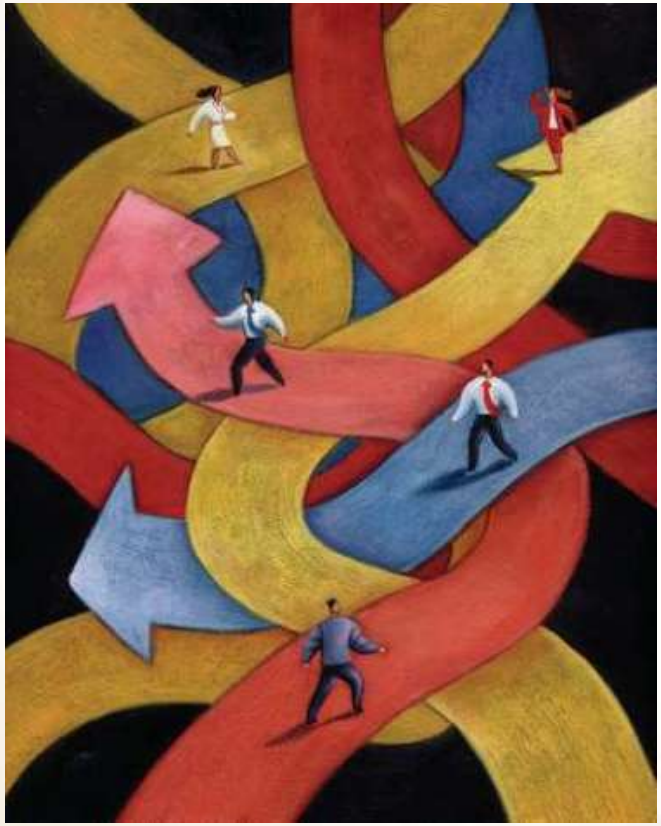


- Performance measures - disaster resilience:
  - ✓ *societal risk*
  - ❑ *building safety*
  - ❑ *economic security*
  - ❑ *lifeline functionality*
- Incorporate disaster resilience measures into development process
- Seismic retrofits of most vulnerable buildings

Potential Benefits of Seismic Retrofits

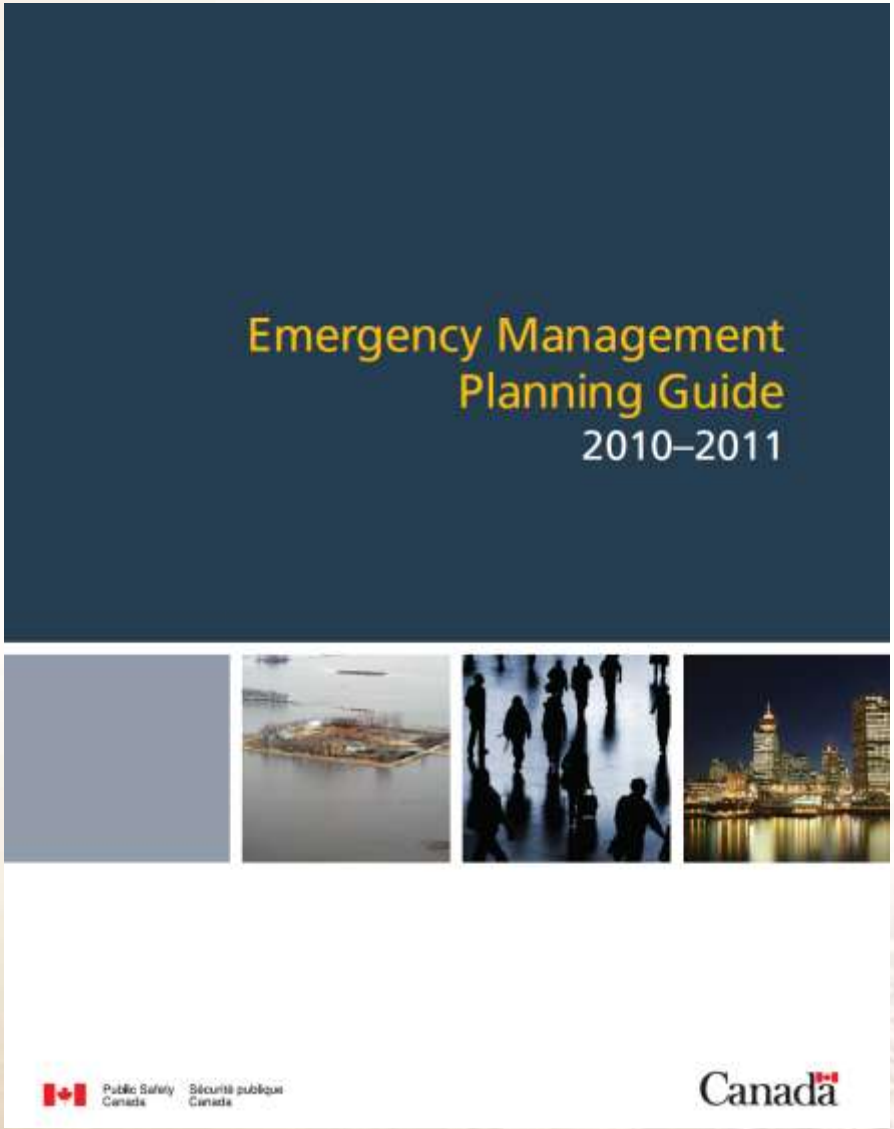


Emergency Management



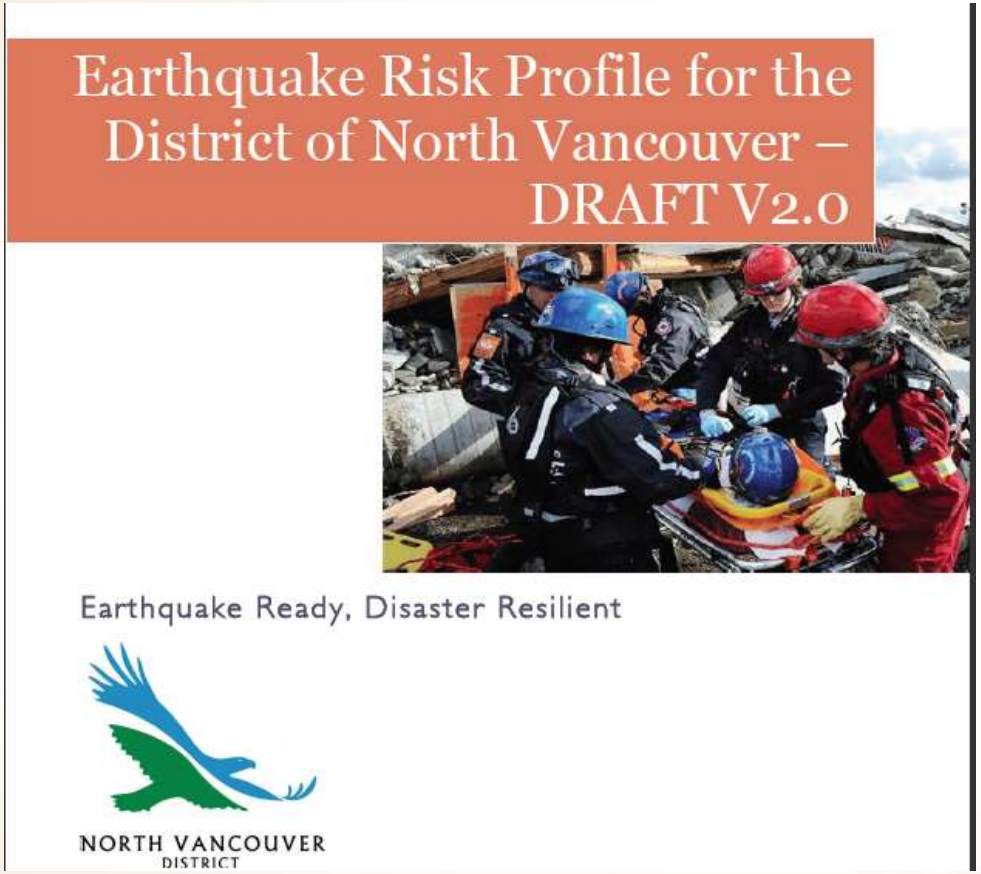
- Emergency Plans
  - *earthquake response plan*
  - *business continuity plan*
  - *recovery plan*
- Strengthen capabilities for response and recovery
- Community outreach and engagement to promote a culture of disaster resilience

Emergency Management



Canada

Next steps …



- Goals
  - *Mitigation*
  - *Earthquake Ready Community*
  - *Coordinated Response*
  - *Rapid Recovery*

UBC Civil Engineering

SCARP School of Community And Regional Planning

Natural Resources Canada / Ressources naturelles Canada

NORTH VANCOUVER DISTRICT

North Shore Emergency Management Office

CRTI

EARTHQUAKE READY ACTION PLAN

1. MITIGATION

1.1. Increase resiliency of District facilities and infrastructure
1.2. Develop Utility service resiliency
1.3. Seismic design guidelines for liquefaction hazard areas
1.4. Seismic retrofits in high risk areas

2. EARTHQUAKE READY COMMUNITY

2.1. Culture of preparedness in the DNV workplace
2.2. Encourage residents to be prepared to be self-sufficient for 72hrs to one week.
2.3. Business Continuity and emergency plans for commercial/industrial
2.4. Multifamily strata councils, senior facilities and daycares
2.5. Recreation Centre, Library and Museum

3. COORDINATED RESPONSE

3.1. Rapid Damage Assessment Unit
3.2. Engineering Department Operations Centre
3.3. Emergency Transportation Strategy
3.4. Operations Earthquake response plan
3.5 Emergency Communications Strategy

4. RAPID RECOVERY

4.1. Development Services Procedures for Recovery
4.2. Disaster Logistics Capacity

Questions?

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www.hazuscanada.ca