The Critical Role of Multi-Stakeholder Engagement for Earthquake Hazard Mapping of Metro Vancouver

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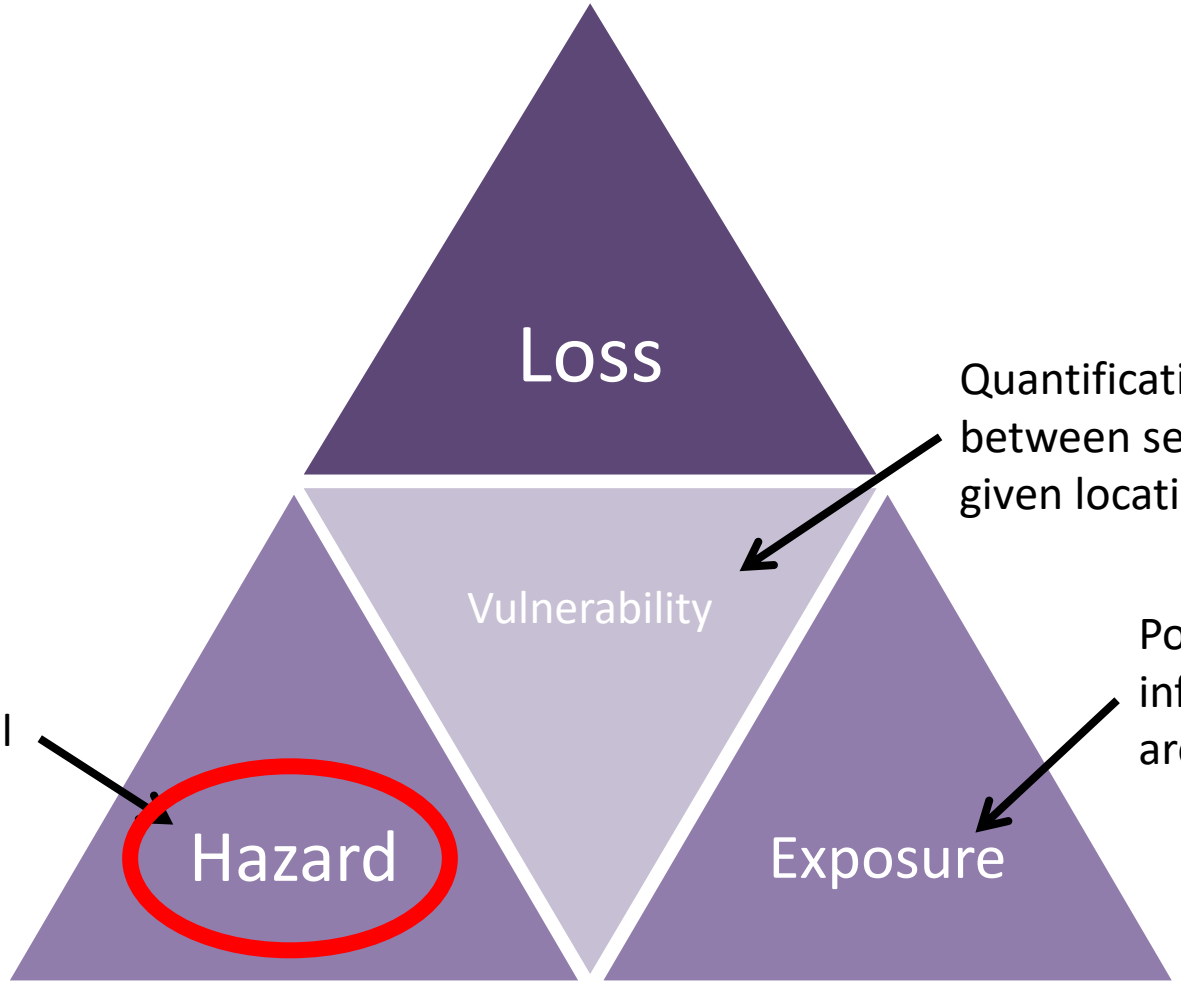
Emergency ManagementBC

Institute for Catastrophic Loss Reduction
Building resilient communities

Western University · Canada

Seismic Risk Assessment



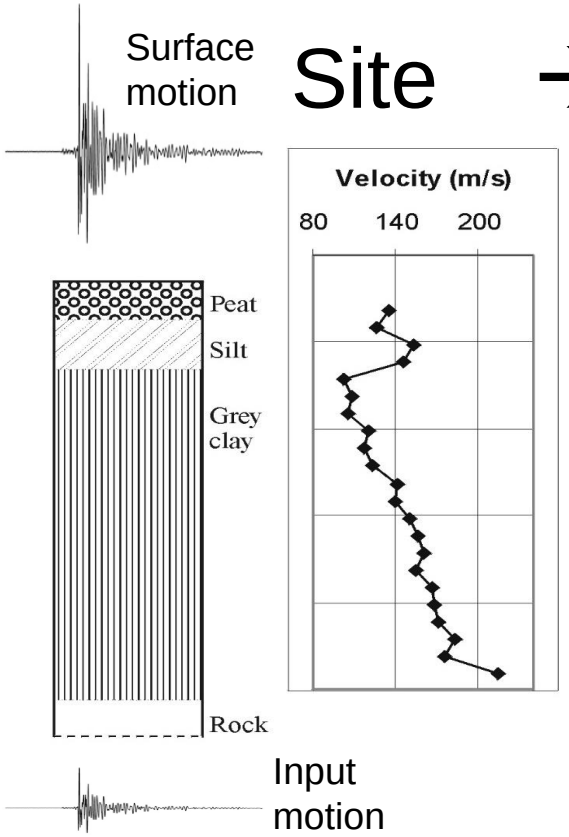
Quantification of relationship between severity of hazard at a given location and the resulting loss

Extent and intensity of a peril

Population, properties, infrastructure, and assets that are potentially at risk

Seismic Hazard Assessment

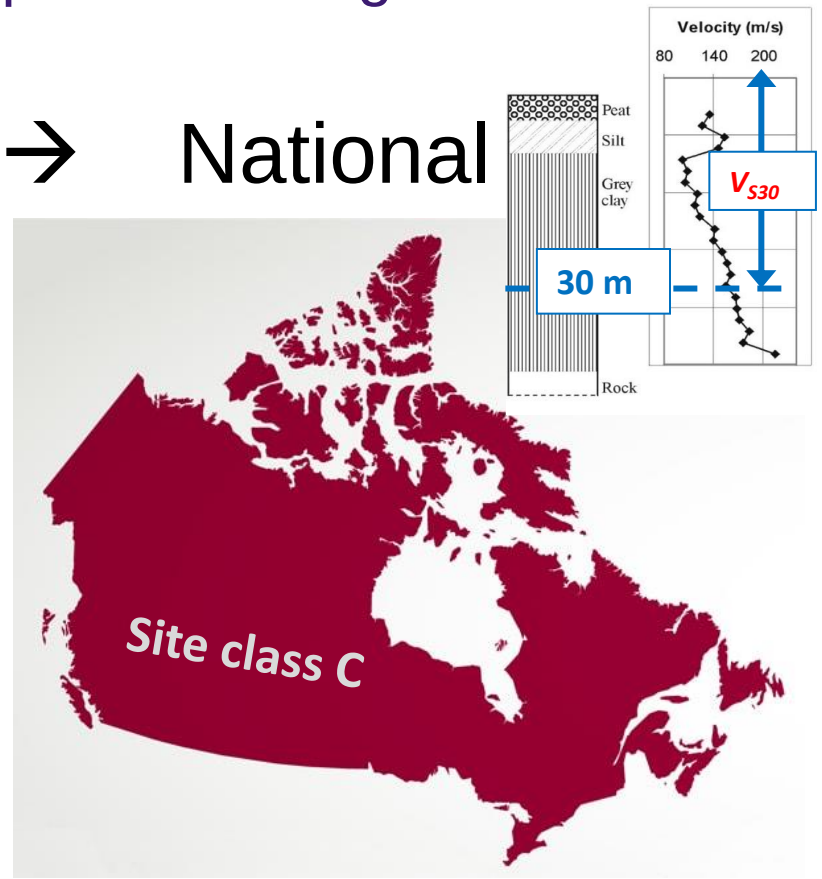
- Seismic hazard assessment is the prediction of earthquake shaking



Site → Urban → Regional → National

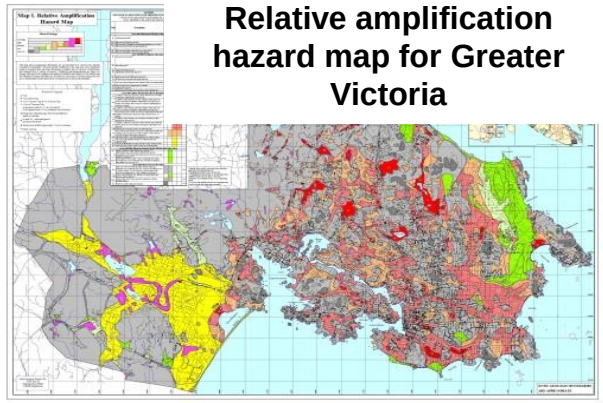
Microzonation mapping is urban or regional scale seismic hazard mapping

Inclusive of:
Site effects
Basin effects
Topographic effects
Secondary shaking hazards
(e.g. liquefaction and landslide)

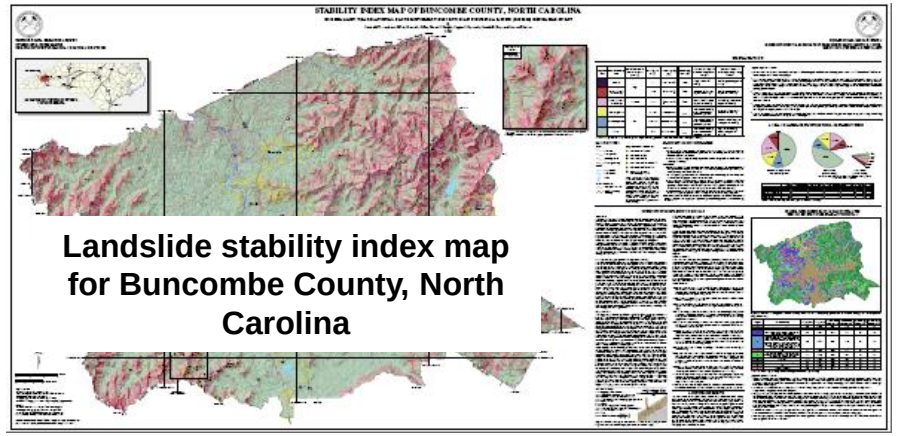


Seismic Microzonation Mapping

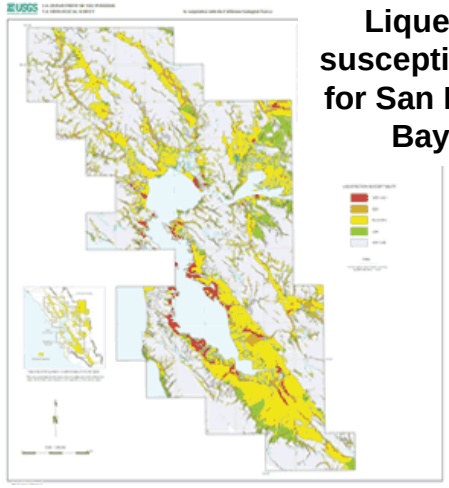
- Effects of earthquake shaking are not uniform due to variation in local site conditions
- Seismic microzonation maps display **predicted variation in earthquake shaking effects** due to local site conditions
- Requires surficial geological, geophysical and geotechnical information described using **technical site-classification metrics** (e.g. V_{S30}, f_0, T_0)



Relative amplification hazard map for Greater Victoria

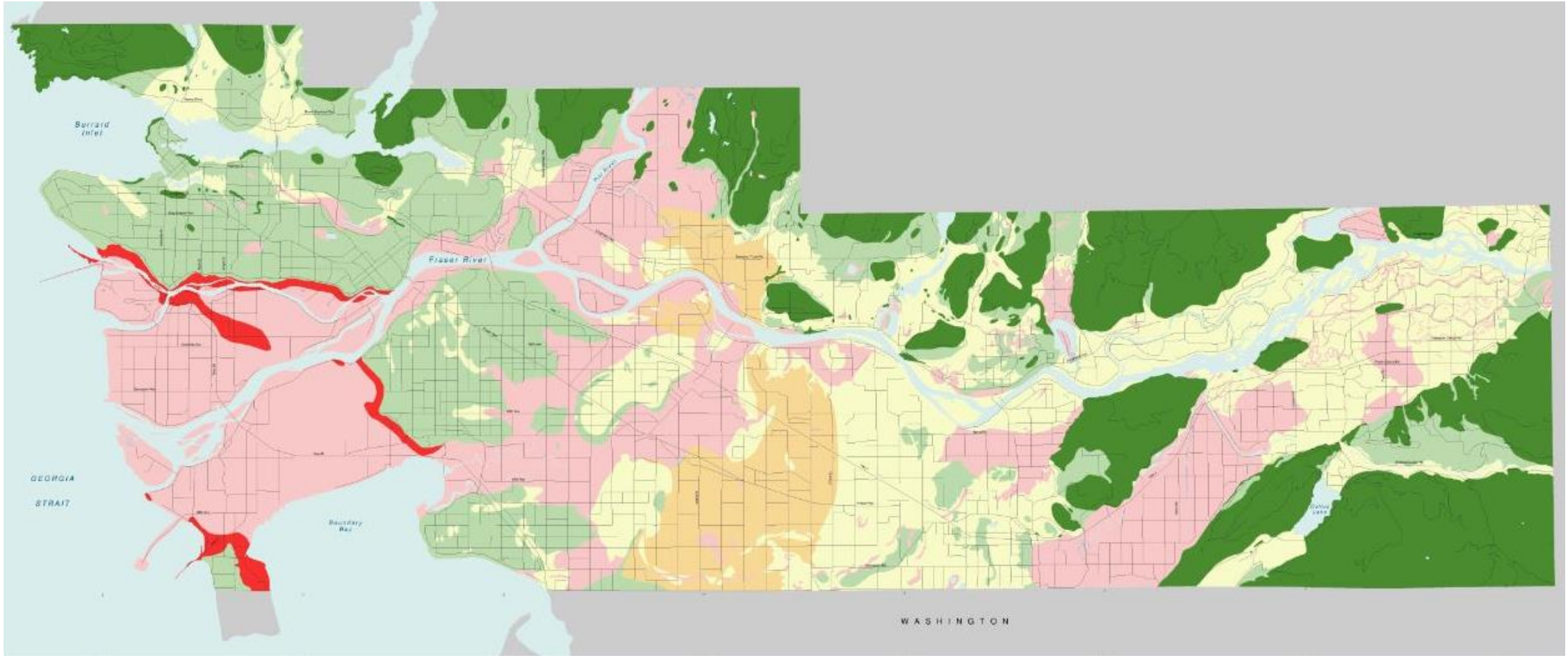


Landslide stability index map for Buncombe County, North Carolina



Liquefaction susceptibility map for San Francisco Bay Area

Existing Soil Hazard Classification Map



Published in Taylor et al., 2006

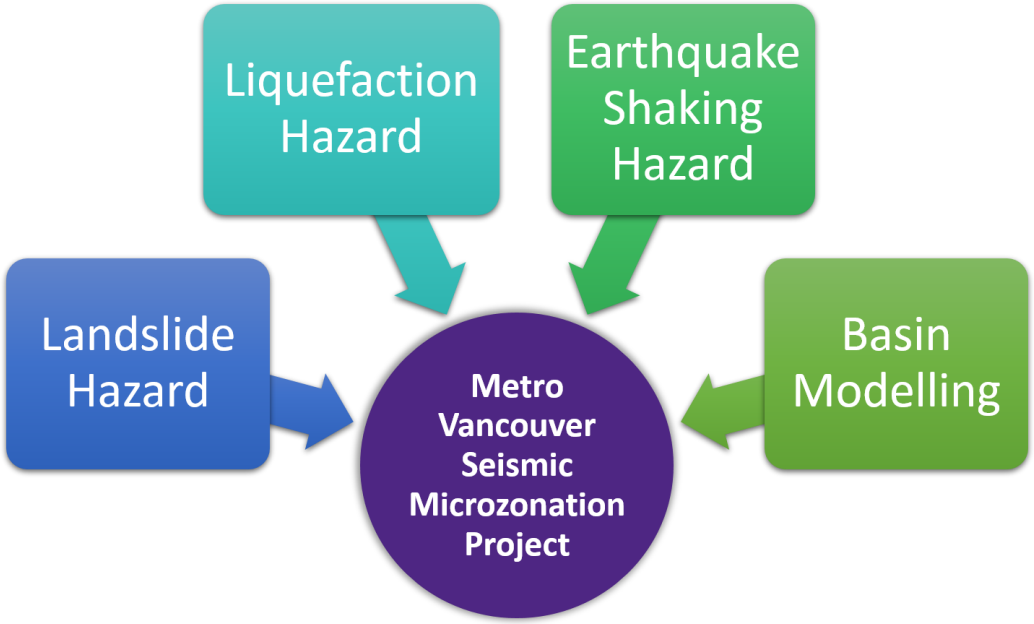
Metro Vancouver Seismic Microzonation Project

2017	2018	2019	2020	2021	2022	2023
Project Launch and Initial Geodatabase Development	Outreach to stakeholders for geodata collection			Summer Field Campaign	Develop and validate maps	Submit final maps and completion report
	Summer Field Campaign	Summer Field Campaign	Summer Field Campaign			
	Ongoing data & numerical analyses					

The University of Western Ontario and the **Institute for Catastrophic Loss Reduction (ICLR)** with support from **Emergency Management British Columbia (EMBC)** are working together to generate comprehensive earthquake hazard maps for the Metro Vancouver region.

This multi-year project involves assessment and mapping of:

- **Earthquake shaking hazard** (site and basin effects)
- **Liquefaction hazard**
- **Landslide hazard**



Like technical practitioners, non-technical users should be informed of the factors involved in ground motion modelling, and therefore the level of risk assigned in risk analyses.

These intermediate practitioners should understand the role of site effects in building for resilience and the expected "bounce back" after a disaster.

How should we be producing and presenting updated maps?

What metrics are suitable to tell the story of the region's seismic hazard to users?

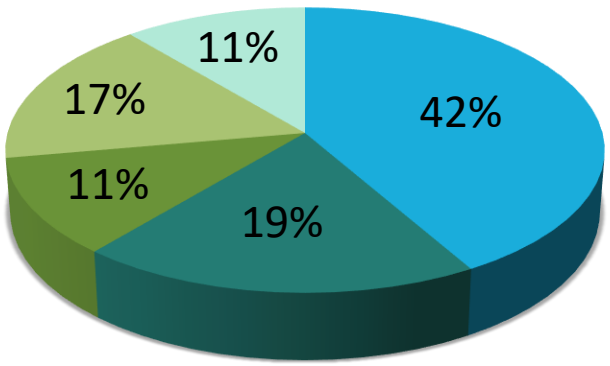
How is this hazard information applied to improve the region's resilience strategy?

Stakeholder Consultation

- Combined with biannual project update meeting
- Wider scope of attendees
- Break the silos – opportunity for stakeholders to interact
- Forum to express thoughts/opinions/general concerns
- Involvement in decision making *during* the project's progression
- Held at a convenient, central location allowing for greater attendance

Workshop Participants

36 in-person participants:



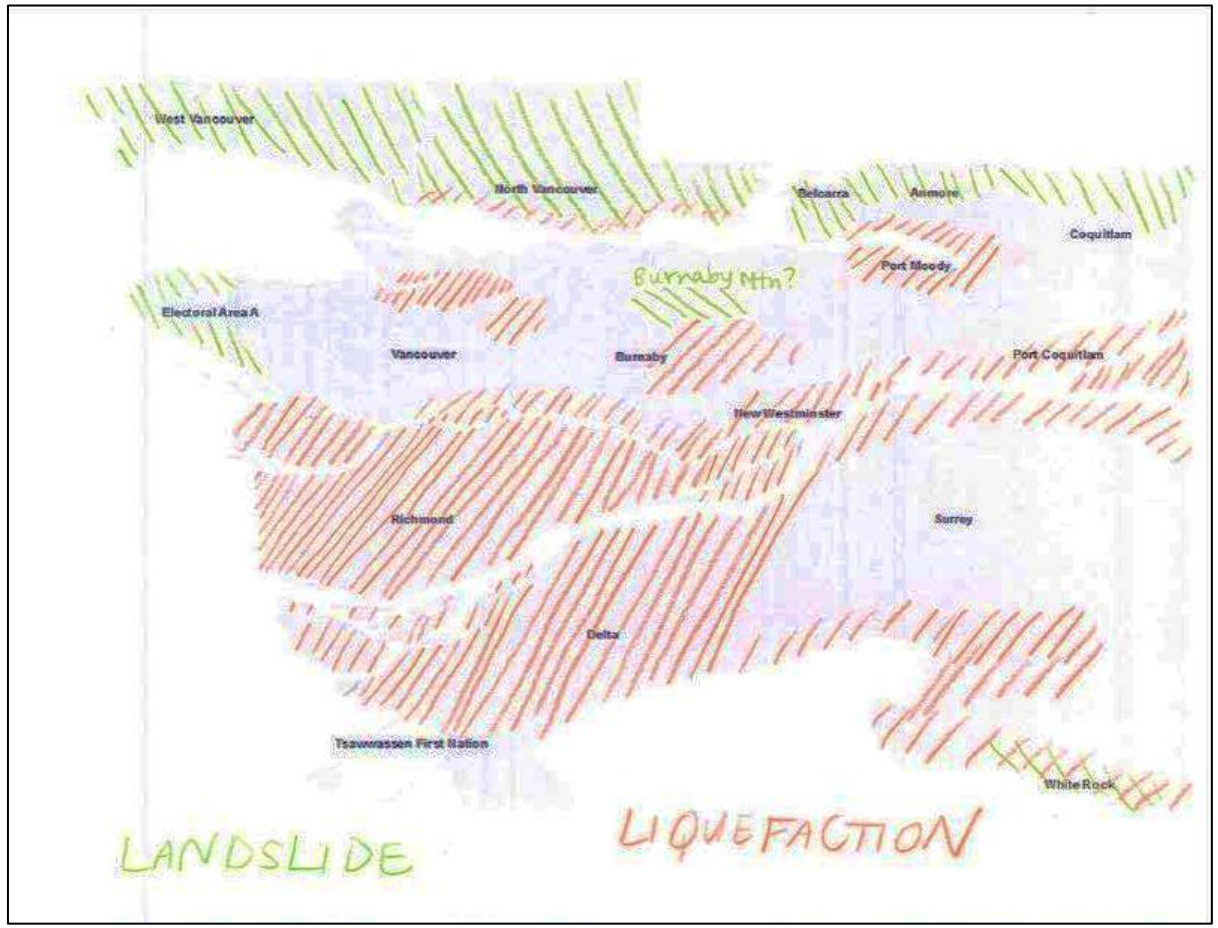
- Engineer (15)
- Emergency Manager (7)
- Planner (4)
- Seismic Research/Science (6)
- Other (4)

Affiliations:

EMBC
GSC/NRCan
ICLR
City of Vancouver
City of Coquitlam
City of Surrey
Metro Vancouver
Port of Vancouver
IPREM
MOTI
NBCC
BC Hydro
EGBC
UBC
Golder
Ausenco
Mott MacDonald
BGC Engineering
ConeTec
BOMA

Workshop Activities

- **Colouring Activity:**
  - Groups illustrated landslide and liquefaction hazard on blank maps
- **4 map comparison exercises:**
  - Landslide hazard vs. liquefaction susceptibility
  - Liquefaction susceptibility vs. liquefaction potential
  - f_0 vs. T_0
  - f_0 vs. V_{S30}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Coquitlam
Port Moody
Burnaby Nth?
Electoral Area A
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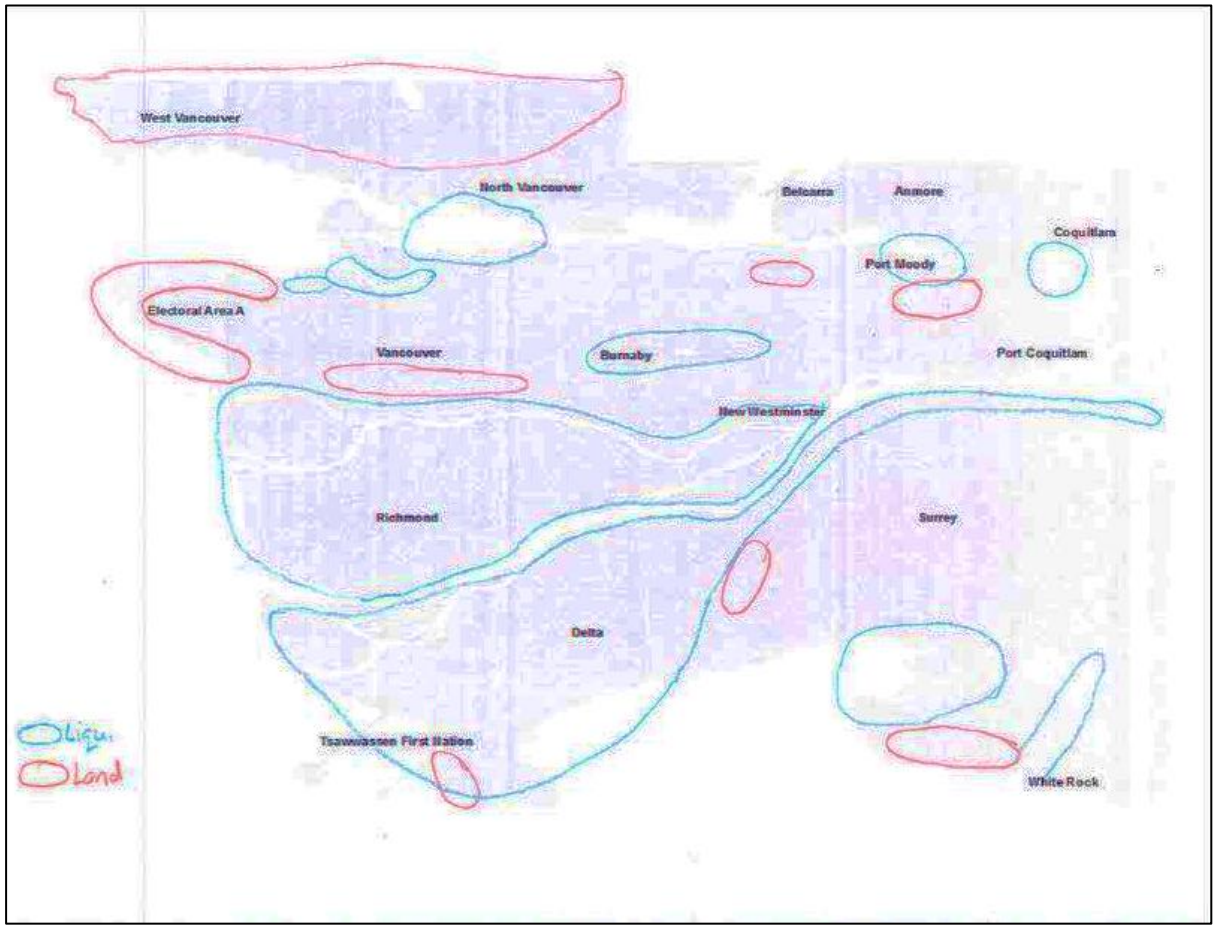
Burnaby
Port Coquitlam
New Westminster
Richmond
Surrey
Delta
Tsawwassen First Nation
White Rock
LANDSLIDE
LIQUEFACTION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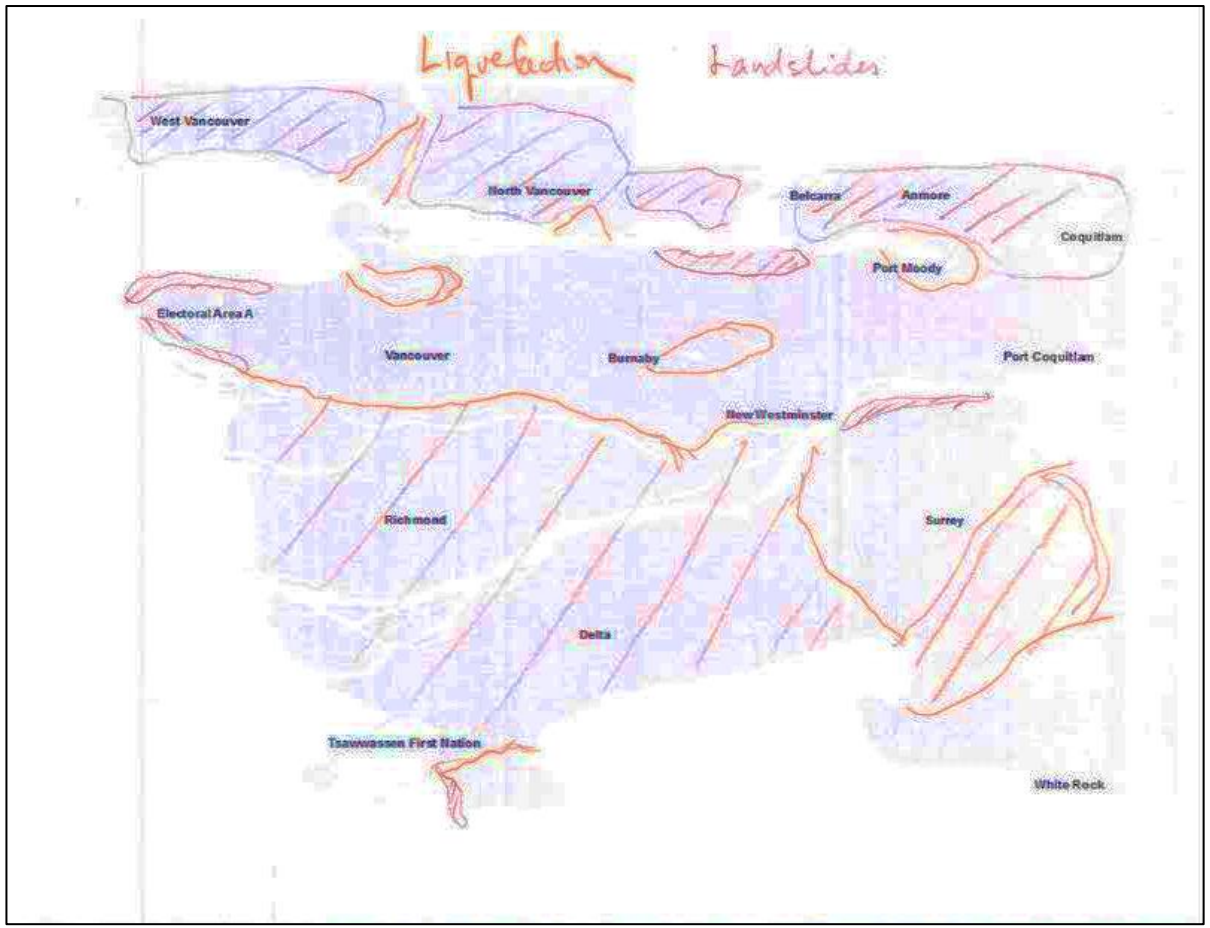
Liquefaction
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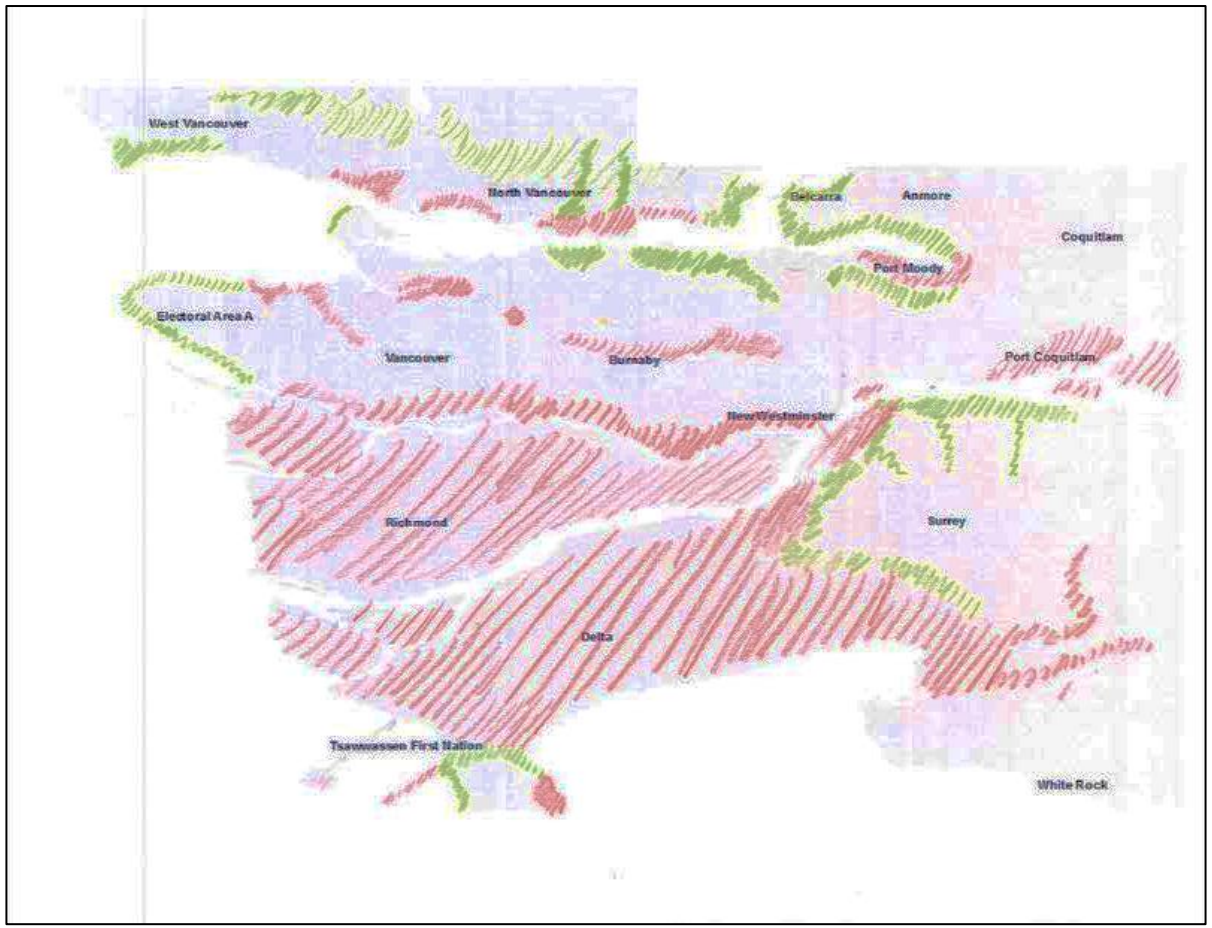
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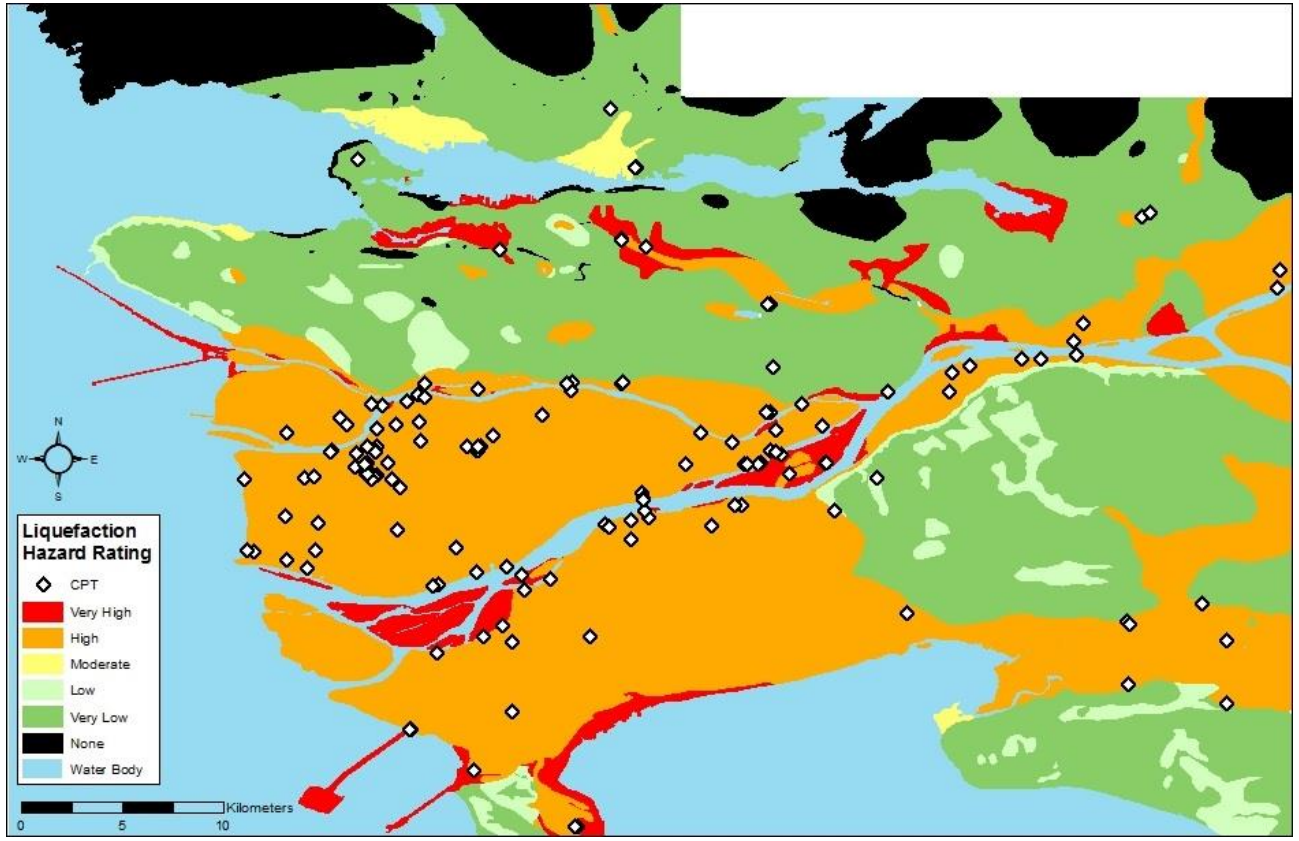
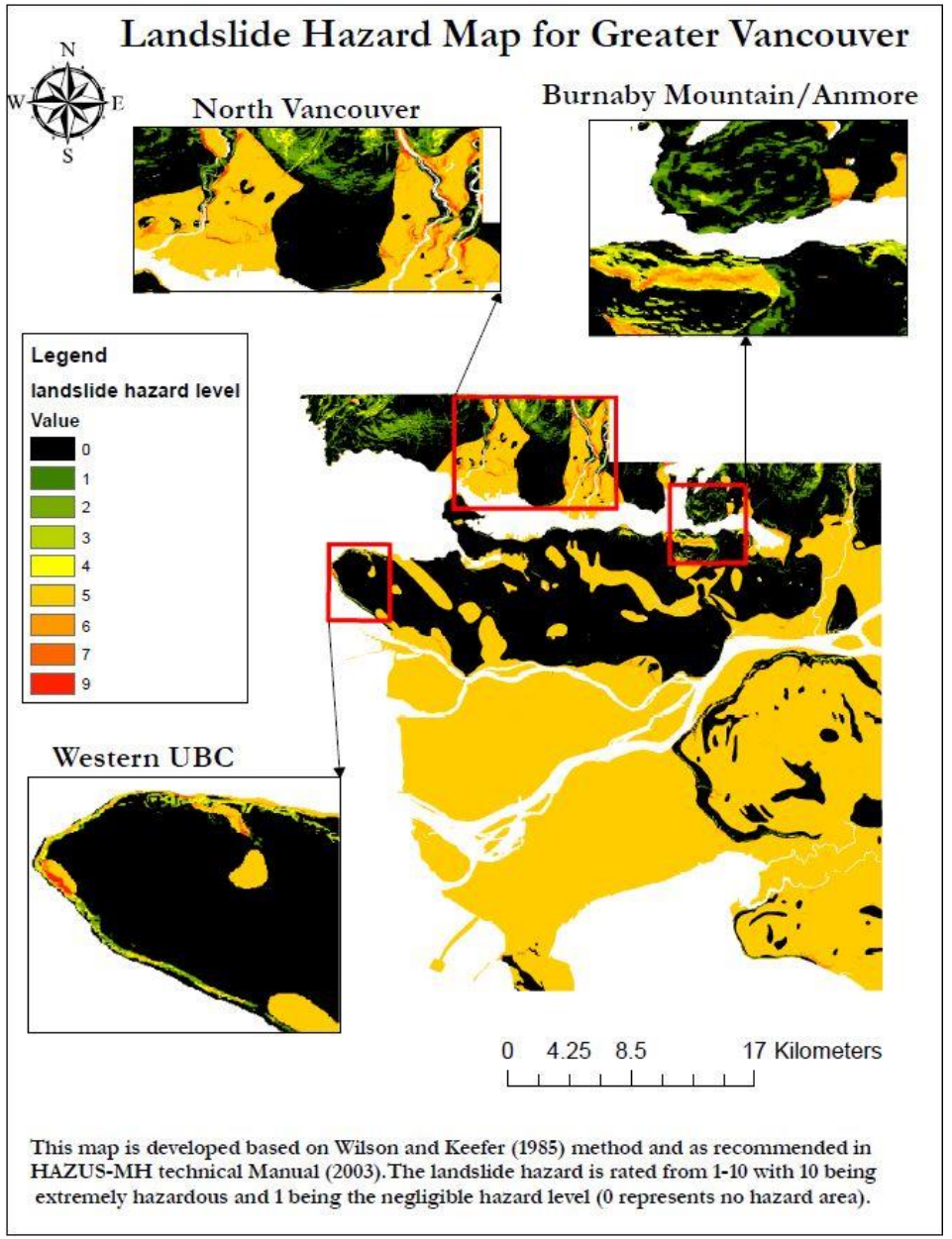
Map Comparison Exercise 1

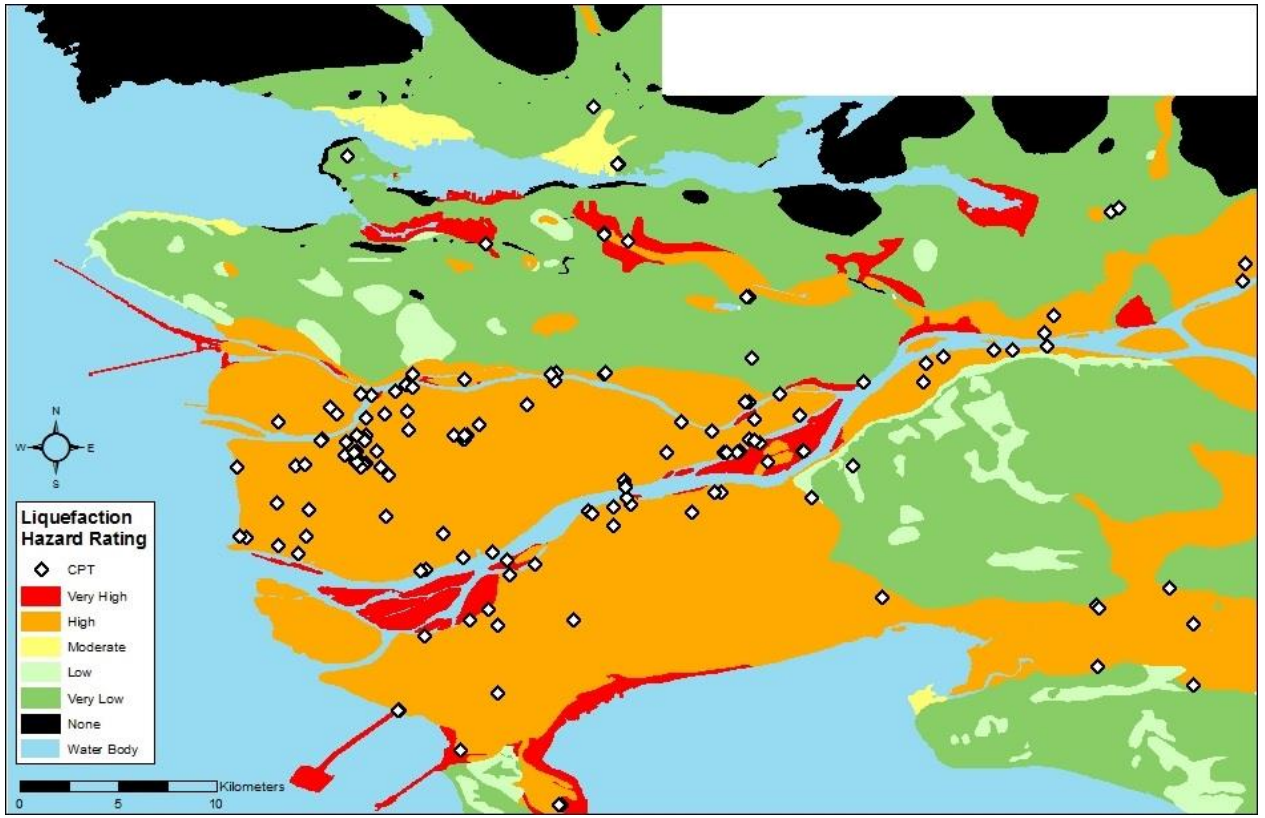
Reviewing draft liquefaction and landslide maps

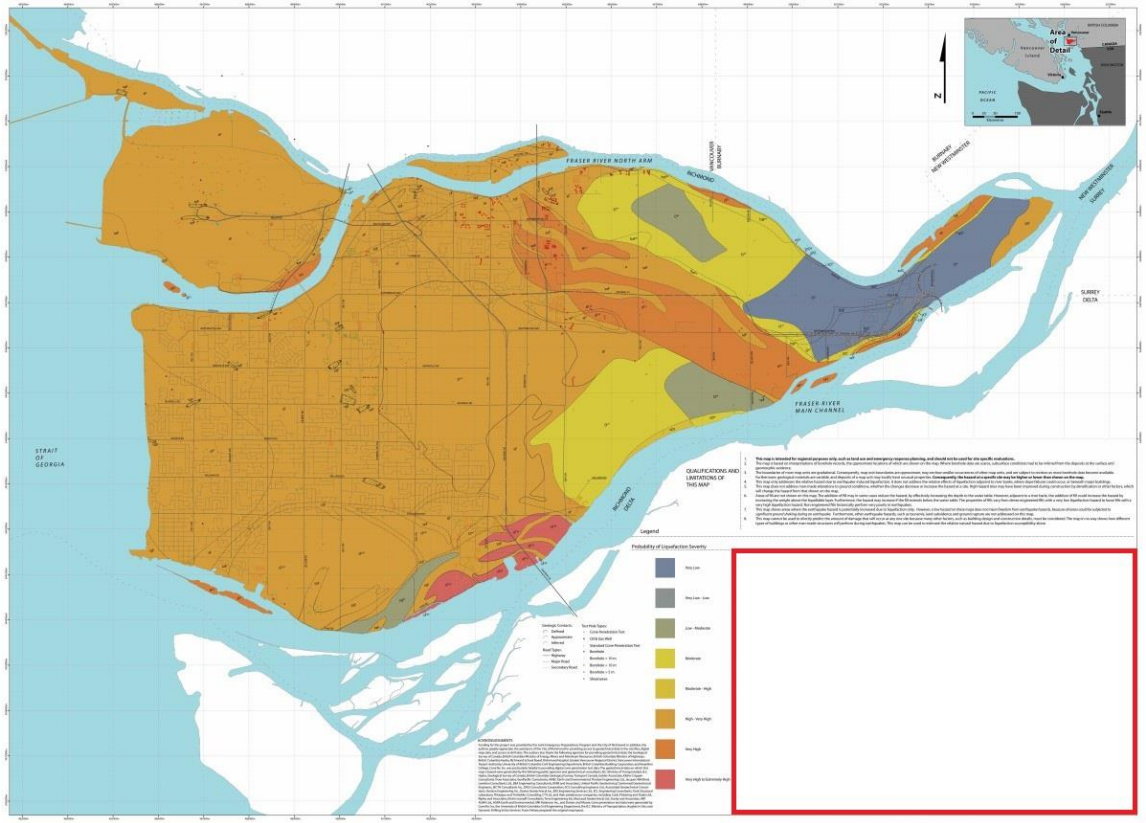




Map Comparison Exercise 2

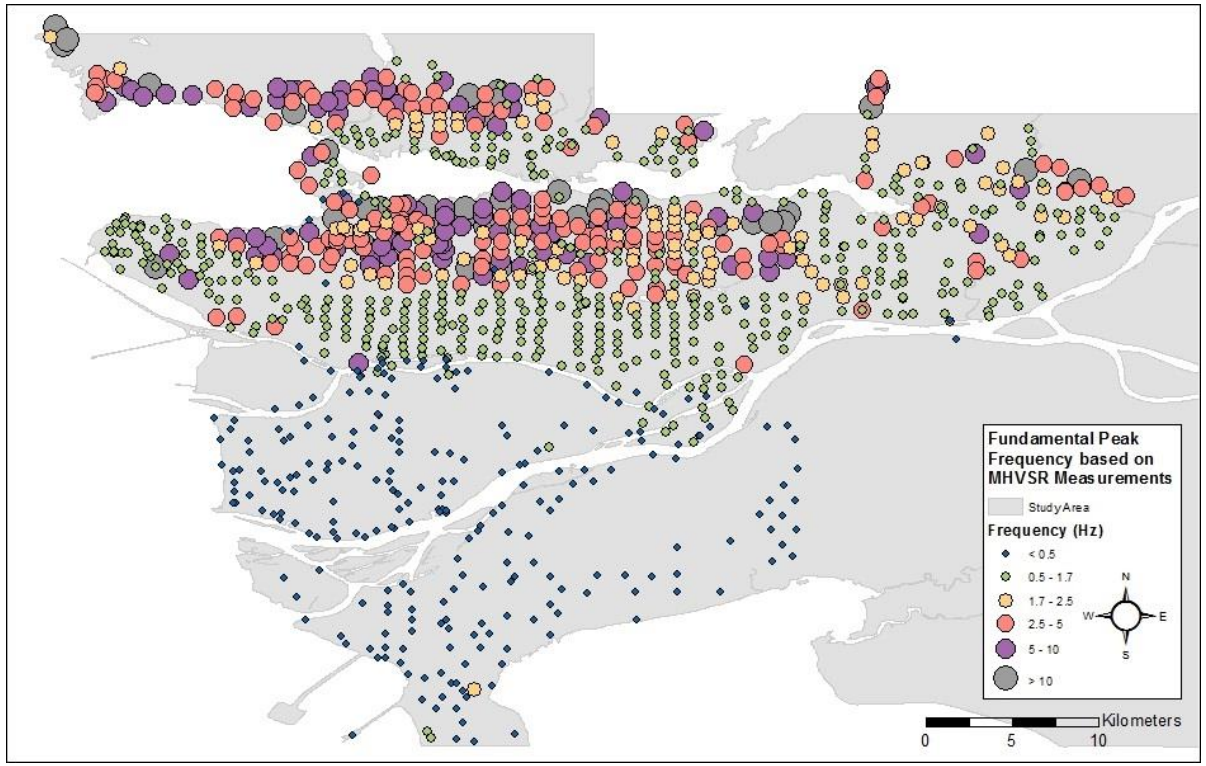
Comparing liquefaction susceptibility and liquefaction potential

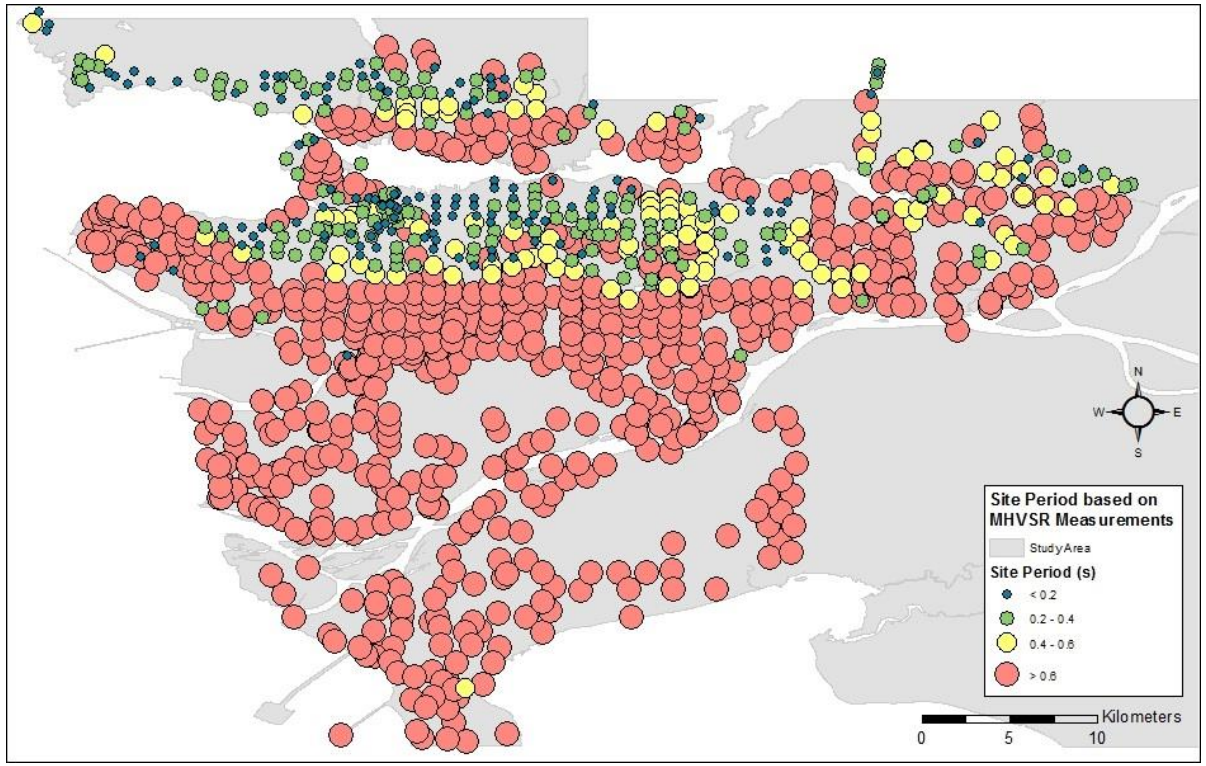




Map Comparison Exercise 3

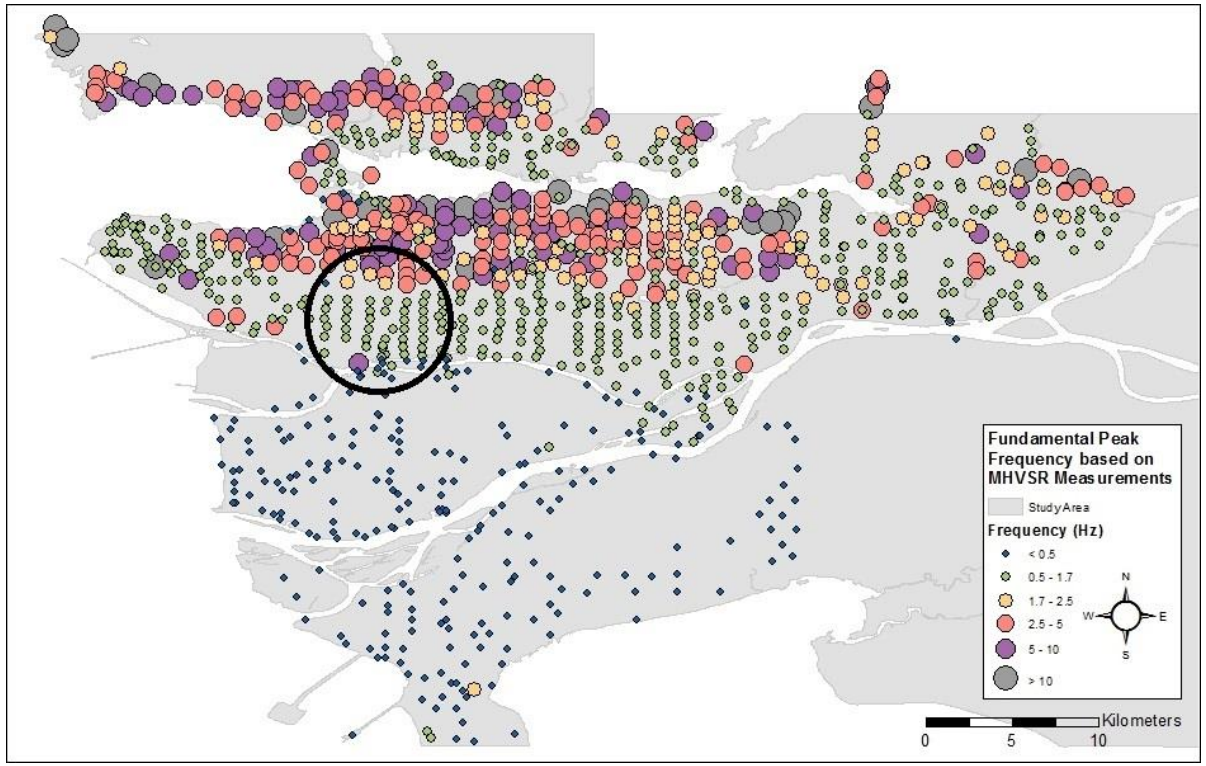
Comparing f_0 and T_0

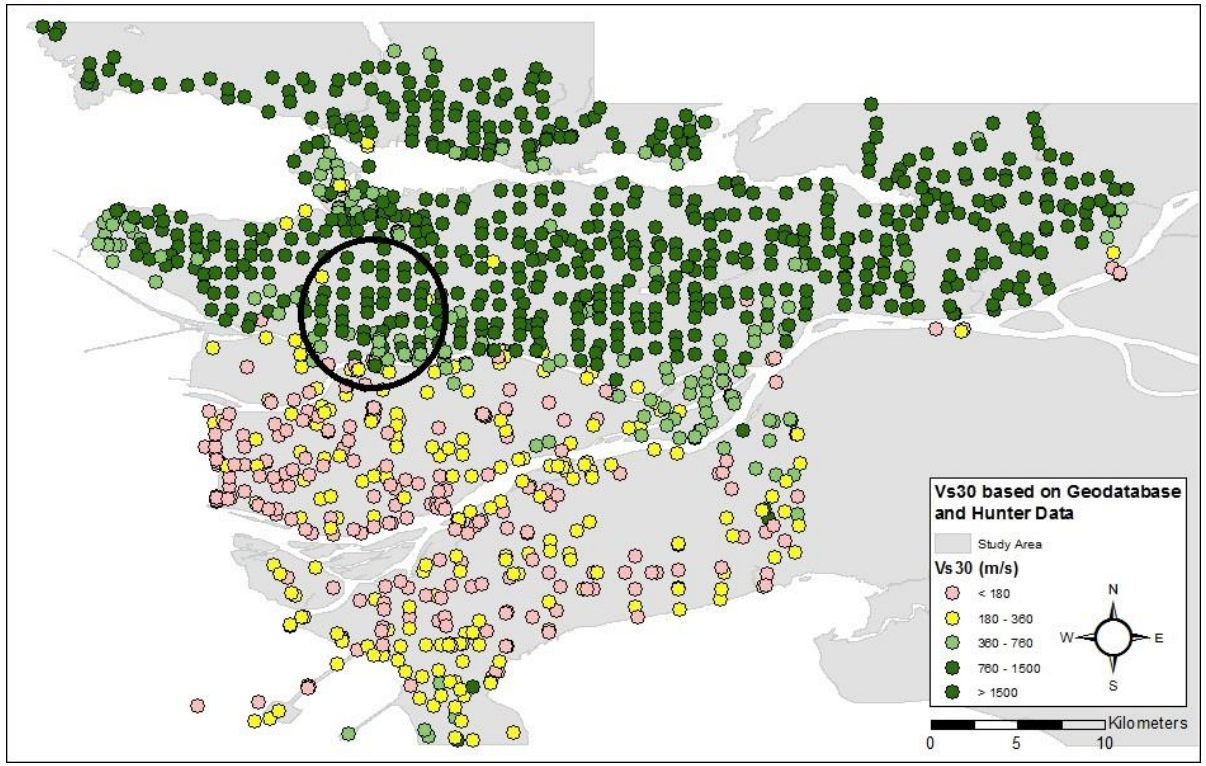




Map Comparison Exercise 4

Comparing f_0 and V_{S30}



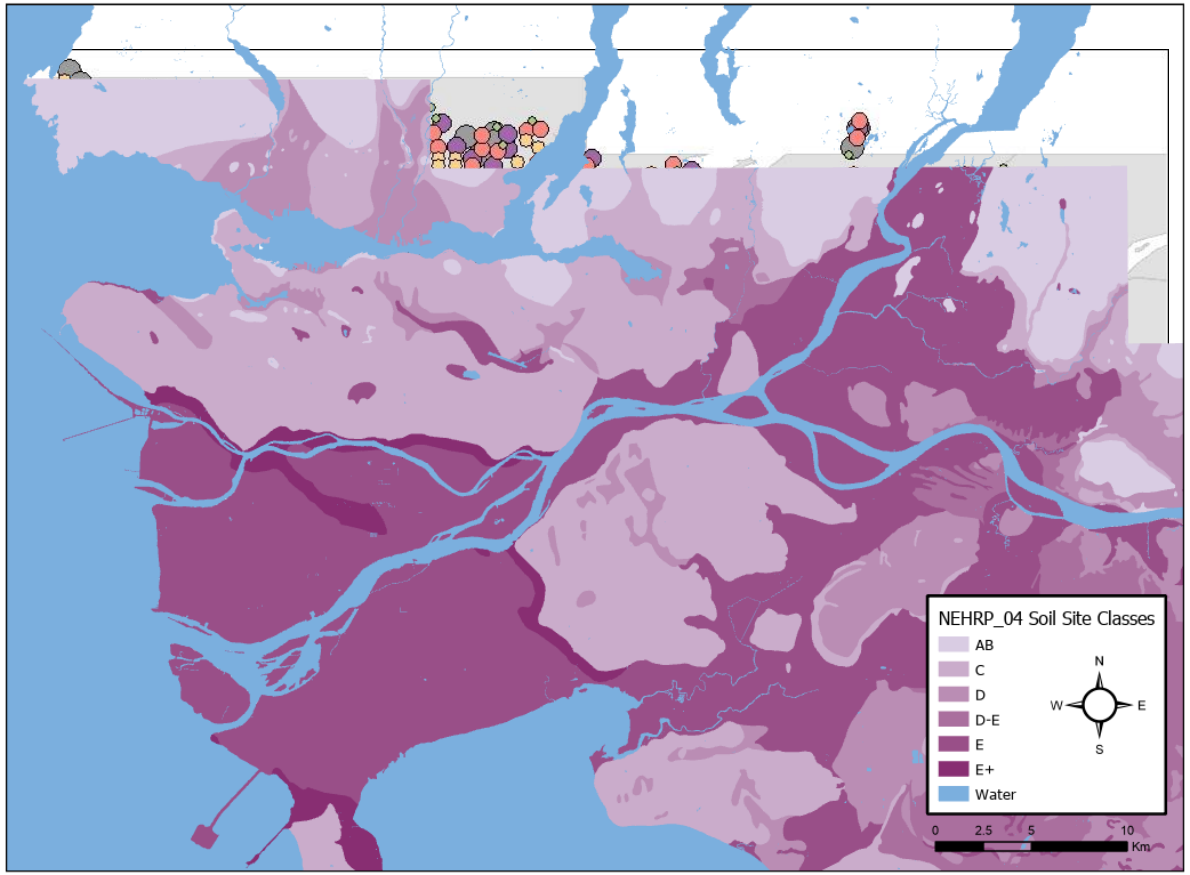


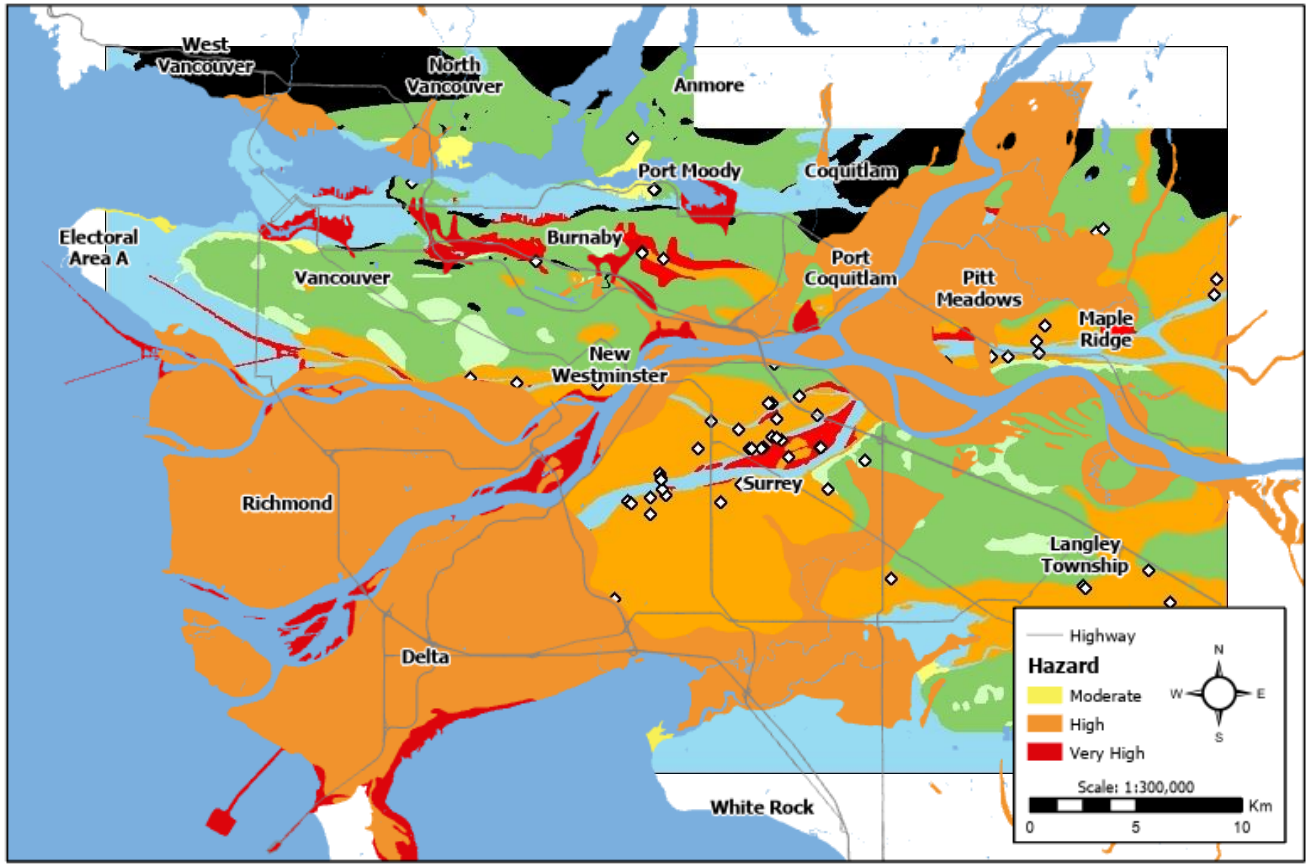
Workshop Feedback

- **Data Classification/Visualization/Symbolization**
  - Raster maps preferred to discrete data points
  - Fewer classes (maximum 7, 3-4 preferred)
  - Avoid use of green, black, alarming red hues

- **Metrics/Site Response Proxies**
  - f_0 and T_0 preferred to V_{S30}
  - Consider including other site response info/proxies (e.g. soil depth/strength, V_S profile)
  - Intermediate users don't understand technical metrics or their implications

Example Maps





Workshop Feedback

- **Map Format/Interaction**
  - Digital product
  - Ability to manipulate layers, view individual measurements, view metadata

- **Data Access/Availability/Maintenance**
  - Geodatabase must be maintained and updated
  - Full access to all background data is desirable
  - Preference for a portal to store and access data/information

Take-Aways:

- **Break the silos**
  - Multi-stakeholder or bust
- **If you don’t know “who”, recruit someone who does know**
  - Consultants exist for a reason
- **Consult with stakeholders always, and early in the process**
  - Saves time and sanity
- **Run the workshop/session/seminar**
  - One session can redirect your focus and efforts, and much can be accomplished if properly designed

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Metro Vancouver Seismic Microzonation Project website:

https://metrovanmicromap.ca/