Vulnerable Vancouver

Finding residents at risk in an earthquake in Vancouver, BC, Canada

1. Purpose

- Find residents who are especially at risk in the event of an earthquake in Vancouver, BC, Canada
- These residents are those with particular social and physical characteristics, for example:
  - Reside in buildings that were created prior to seismic codes in 1980
  - Do not speak English as their first language
  - Have low income
  - Have low education
  - Are physically challenged by age or disability
- Fortunately there are methods for finding these residents!

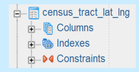
2. Methods

1. Download 2011 census data from Statistics Canada

2. Download building footprint data from City of Vancouver

3. Process data to generate statistics

4. Put data into database



5. Display on map and analyze

3. Tools

Icon	Tool	Purpose
	• PostgreSQL database with PostGIS spatial extension	• Store data • Insert Shapefiles into data • Execute spatial operations on data
	• Python program language	• Download census data • Perform statistical analysis on census data • Insert census data into database
	• PHP program language	• Generate dynamic web pages • Query spatial operations on data from database
	• Javascript program language	• Provide underlying language for Google Maps • Execute Ajax calls to PHP program on server

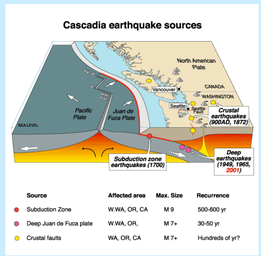
	• Google Maps	• Create map of Vancouver
		• Add symbology to map
		  - markers
		  - colours
		  - heatmaps

4. Vancouver Demographics

Population	603,000
Percent with English not as first language	52%
Average annual income per household	$67,090
Percent with high school or less education	34%
Average age	39
Percent 65 years or older	13%

(City-data.com, 2010)

5. Earthquake Facts



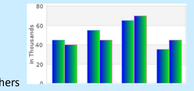
(Wikipedia.org, 2007)

- There are three types of earthquakes to which Vancouver is susceptible (Natural Resources Canada, 2011):

Earthquake Type	Earthquake Action	Example	Expected frequency
Megathrust (aka - Subduction)	Oceanic plate slips under North American plate	• 1700 Cascadia earthquake • 2004 Indian Ocean tsunami	300 - 800 years?
Intraplate (aka - Intraslab - Deep)	Fault in subducting Juan de Fuca plate ruptures	• 1949 Olympia earthquake • 2001 Nisqually (Washington) earthquake	30 years?
Crustal	Fault in North American plate ruptures	• 1946 Vancouver Island earthquake • Great Hanshin earthquake (Japan, 1995)	100s of years?

(Pacific Northwest Seismic Network, 2011)

6. Results (Expected)



- Certain locations in Vancouver have significantly more vulnerable residents than others
- Changing weights of indicators reveals unexpected vulnerabilities
- Certain earthquake indicators are not significant factors in Vancouver demographics
- Certain census tracts contain significantly more earthquake-susceptible buildings than others
- Earthquake-susceptible buildings tend to cluster in groups
- Earthquake-susceptible buildings clusters may prevent egress in the event of an earthquake
- Earthquake-susceptible buildings often coincide with locations of vulnerable residents

7. Actions (Expected)

- Focus earthquake-preparedness on locations of most vulnerable residents of Vancouver
  - Provide workshops
  - Establish information / crisis centres
  - Mail safety guides to residents
  - Clearly mark disaster response routes in multiple languages
  - Solicit and train volunteers to respond in given areas
- Increase efforts to retrofit earthquake-susceptible buildings
- Establish multiple disaster response routes where earthquake-susceptible buildings cluster
- Coordinate with senior levels of government to prepare vulnerable residents

8. References

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