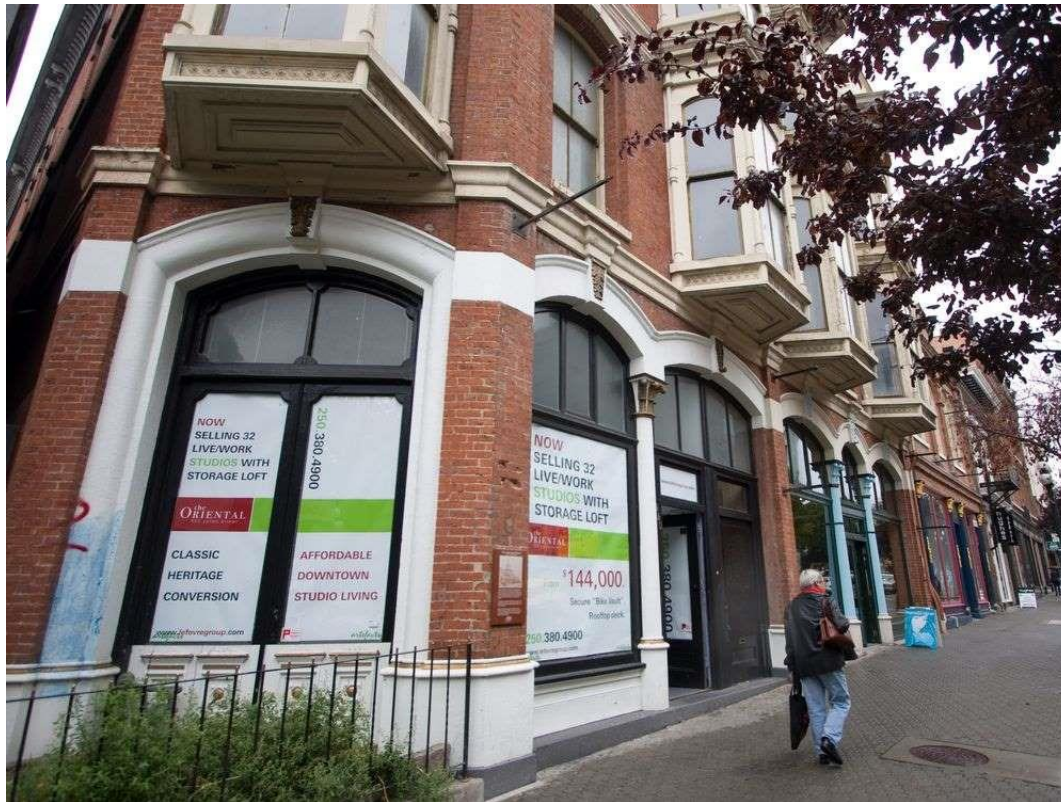


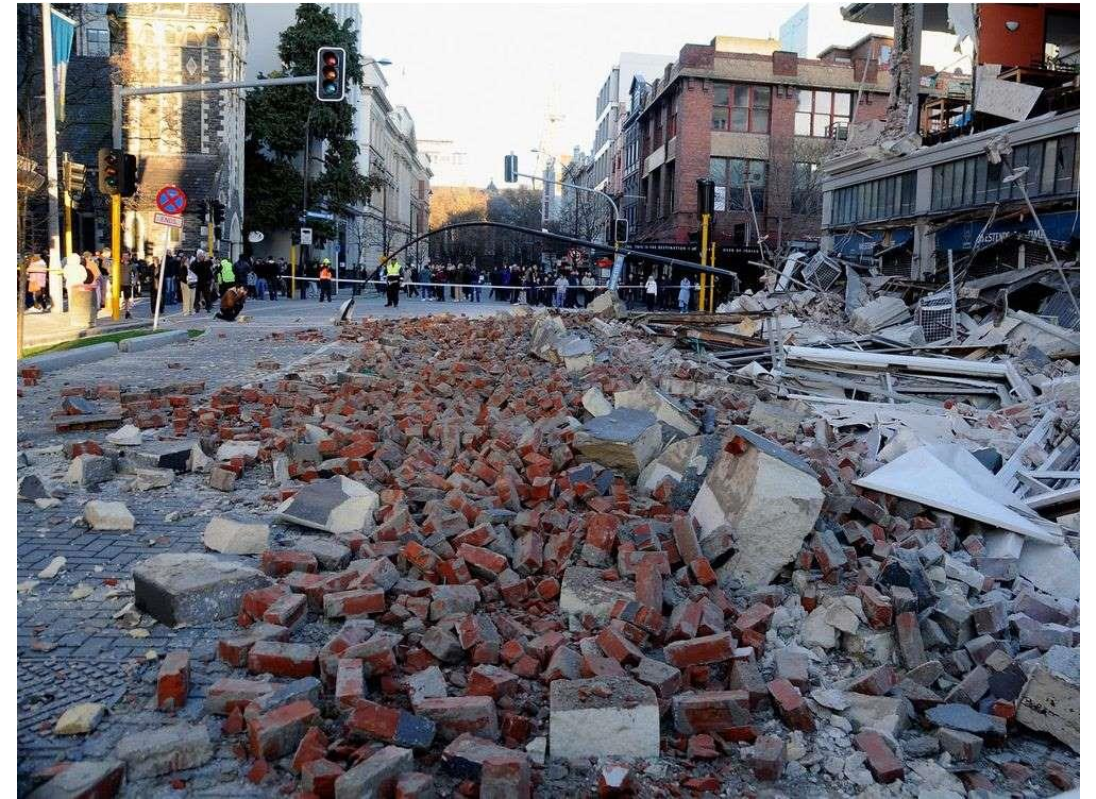
VictoriaReady
Community Powered Emergency Preparedness

*Everyday readiness for every person,
every business, every organization.*

Citywide Seismic Vulnerability Assessment



A new study shows nearly 4,000 buildings in Victoria are at risk of complete damage from a major earthquake. DARREN STONE / Times Colonist



Rubble is strewn across the street from collapsed buildings in Christchurch, New Zealand, after an earthquake in 2010. Getty Images / PNG

Comparison of Christ Church New Zealand to Victoria



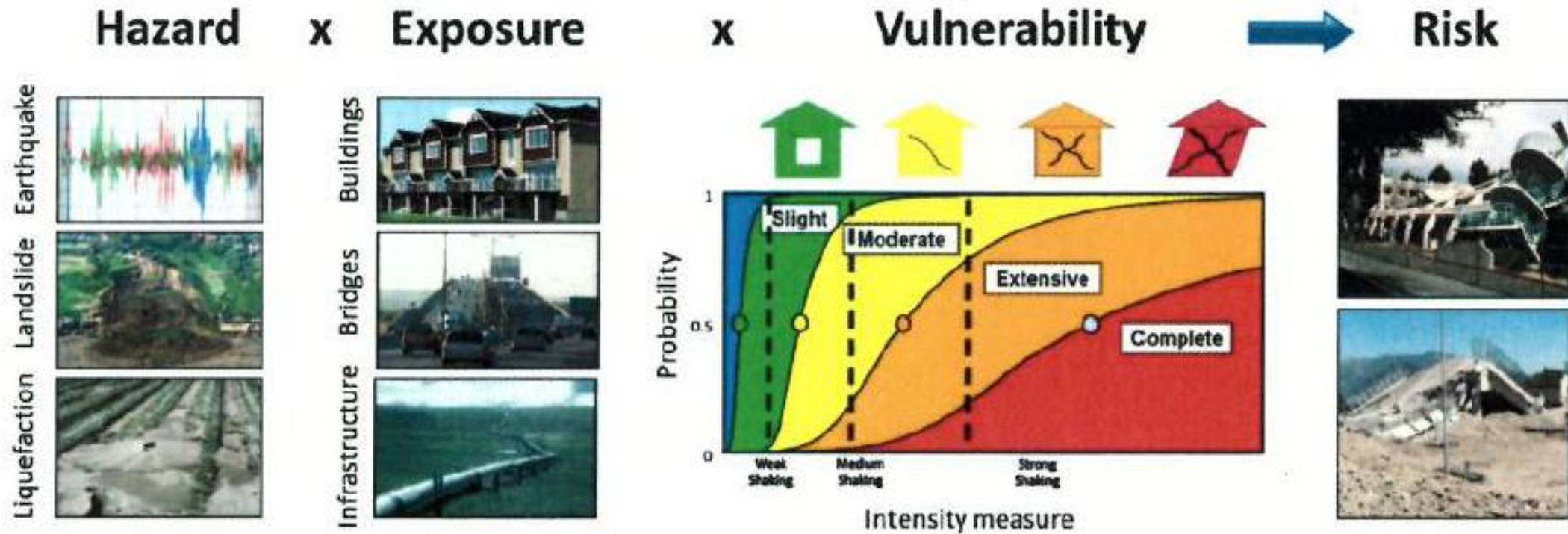


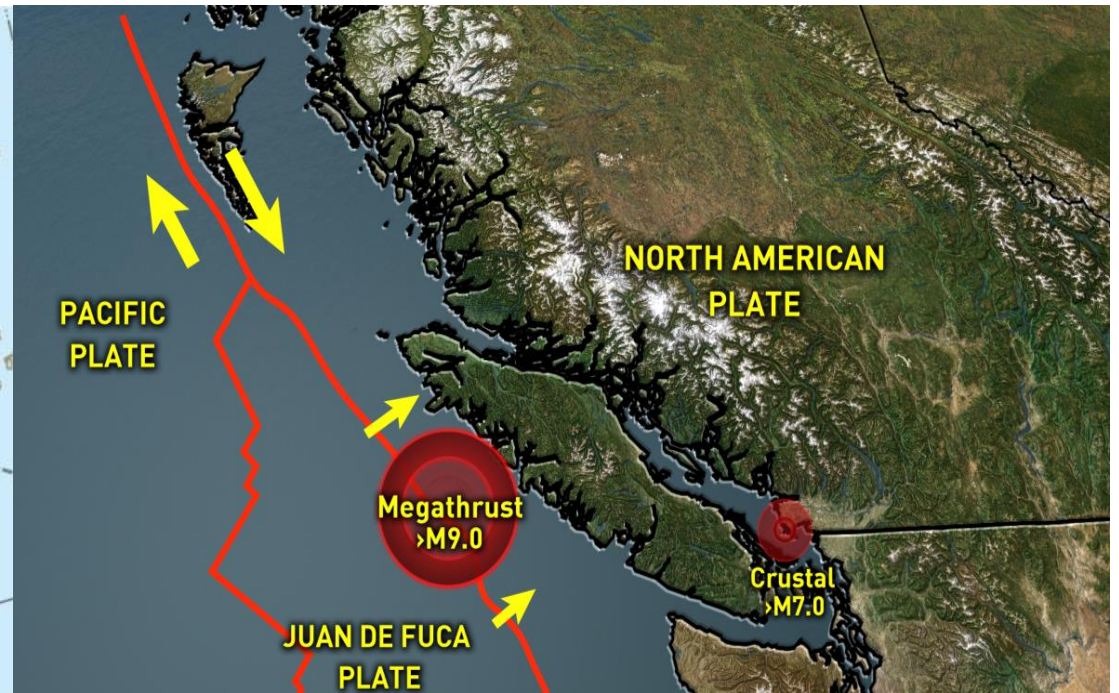
Figure 1: Relevant Factors Contributing to Risk

3 elements were examined:

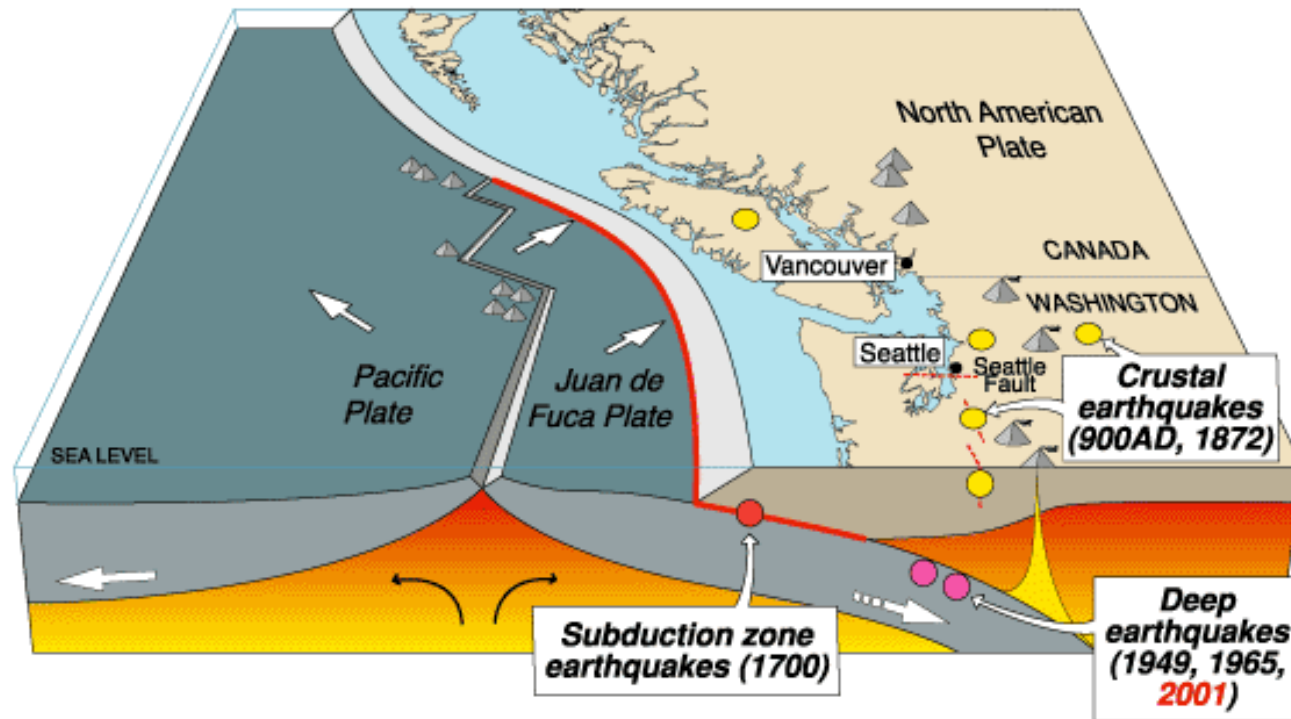
1. Types of earthquakes we are susceptible to
2. Soil stratigraphy (amplification or deamplification)
3. Building types

3 Types of Earthquake scenarios

1. Crustal: A magnitude 7 rupture of the shallow, crustal Leech River fault beneath the city;
2. Inslab: a deep magnitude 7 earthquake in the Strait of Georgia;
3. Interface: magnitude 9 full rupture of the Cascadia subduction fault.

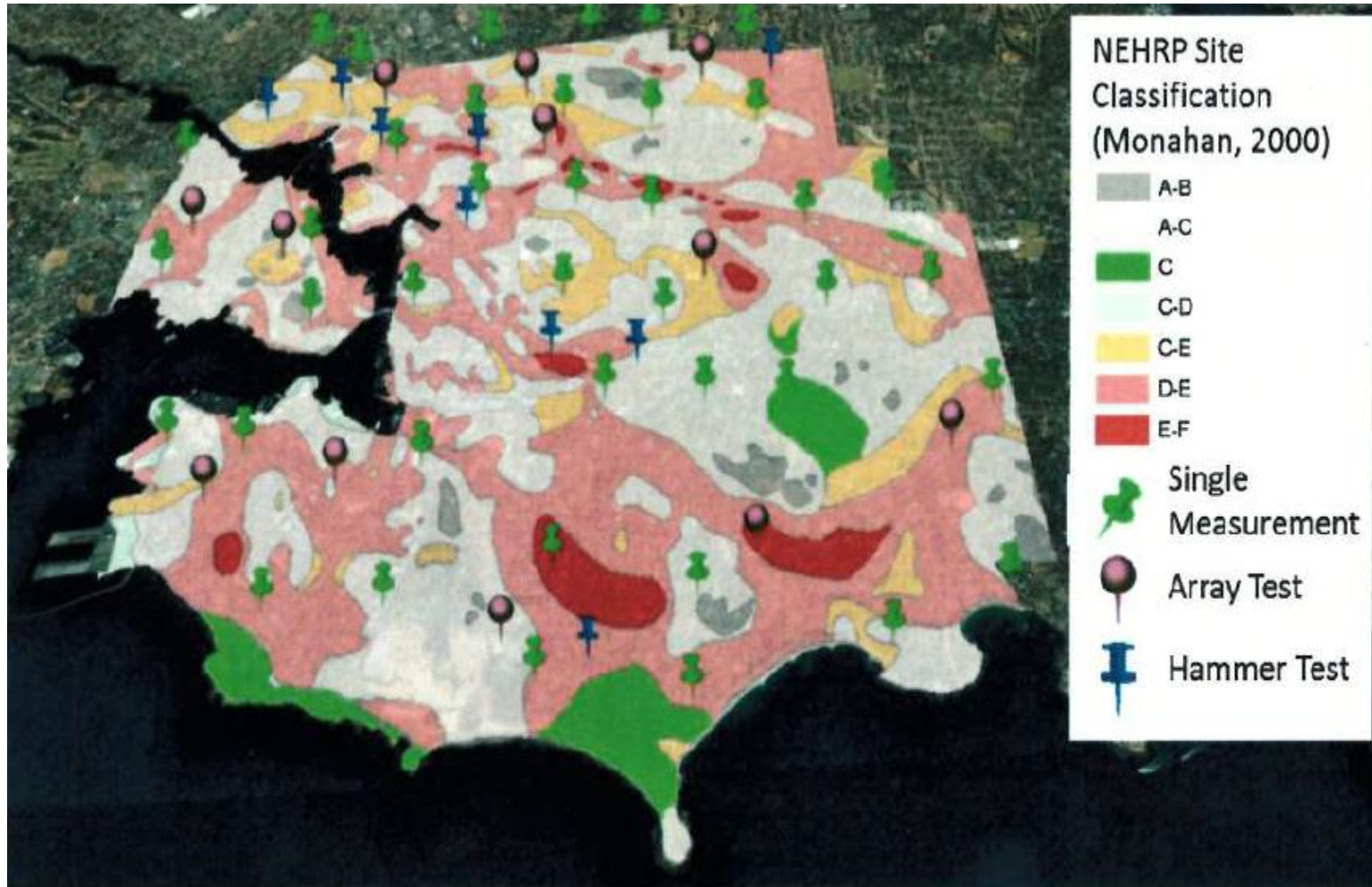


Cascadia earthquake sources



Source	Affected area	Max. Size	Recurrence
● Subduction Zone	W.WA, OR, CA	M 9	500-600 yr
● Deep Juan de Fuca plate	W.WA, OR,	M 7+	30-50 yr
● Crustal faults	WA, OR, CA	M 7+	Hundreds of yr?

Soil Conditions



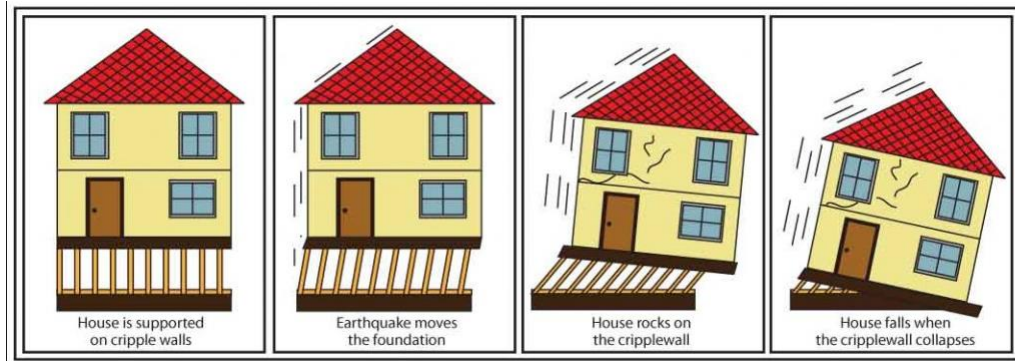
Profile Type
Hard rock
Rock
Very dense soil/soft rock
Stiff soil
Soft Soil
Special soils requiring site-specific evaluation

Figure 10: Locations of Single Instrument, Array, and Hammer Tests Performed in the City of Victoria Combined with the Original NEHRP Site Amplification from Monahan (2000)

Risk assessment for buildings

The building database used for this study included over 13, 000 buildings. The types of buildings at a high seismic risk include:

- Pre-1972 construction including low-rise buildings (concrete, steel, and reinforced masonry),
- Unreinforced masonry (of all heights),
- 3-4 storey wood apartment buildings,
- Pre-1960 single family wood homes



Example of Cripple wall failure after earthquake

Distribution of City of Victoria Buildings based on construction type



Distribution of buildings based on year built





single-family residential wood light frame California 1994



Unreinforced masonry- Christchurch 2011







high rise concrete shearwall building –Chile 2010



Multi-family wood light frame bldg.-California 1994

HAZUS damage states – light frame wood bldgs

Damage State		Description
	Slight	Small plaster cracks at corners of door and window openings and wall-ceiling intersections; small cracks in masonry chimneys and masonry veneers. Small cracks are assumed to be visible with a maximum width of less than 1/8 inch (cracks wider than 1/8 inch are referred to as “large” cracks).
	Moderate	Large plaster or gypsum-board cracks at corners of door and window openings; small diagonal cracks across shear wall panels exhibited by small cracks in stucco and gypsum wall panels; large cracks in brick chimneys; toppling of tall masonry chimneys.
	Extensive	Large diagonal cracks across shear wall panels or large cracks at plywood joints; permanent lateral movement of floors and roof; toppling of most brick chimneys; cracks in foundations; splitting of wood sill plates and/or slippage of structure over foundations.
	Complete	Structure may have large permanent lateral displacement or be in imminent danger of collapse due to cripple wall failure or failure of the lateral load resisting system; some structures may slip and fall off the foundation; large foundation cracks. Three percent of the total area of buildings with Complete damage is expected to be collapsed, on average.

Soft Story Buildings



URM Buildings





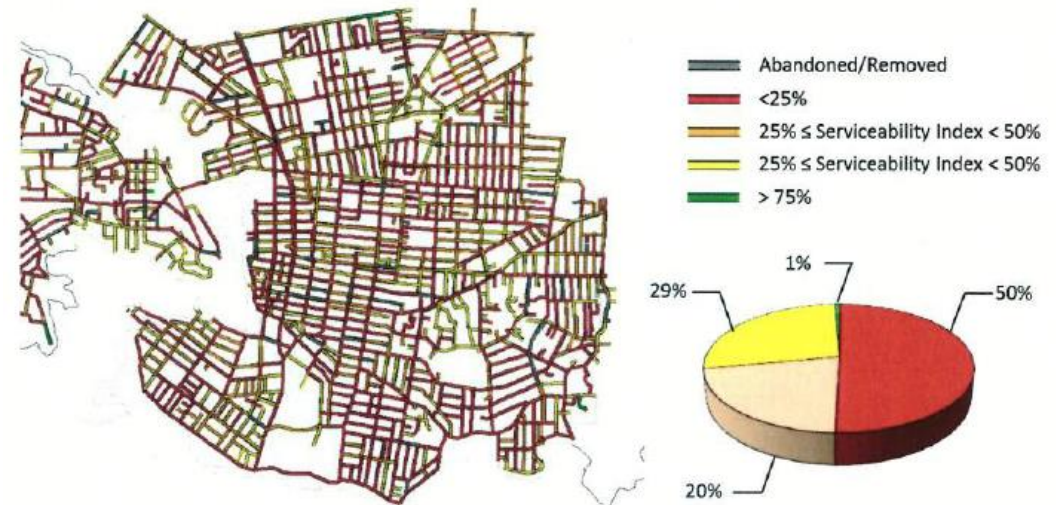
Wood Frame



Supporting infrastructure (water lines & pipelines)

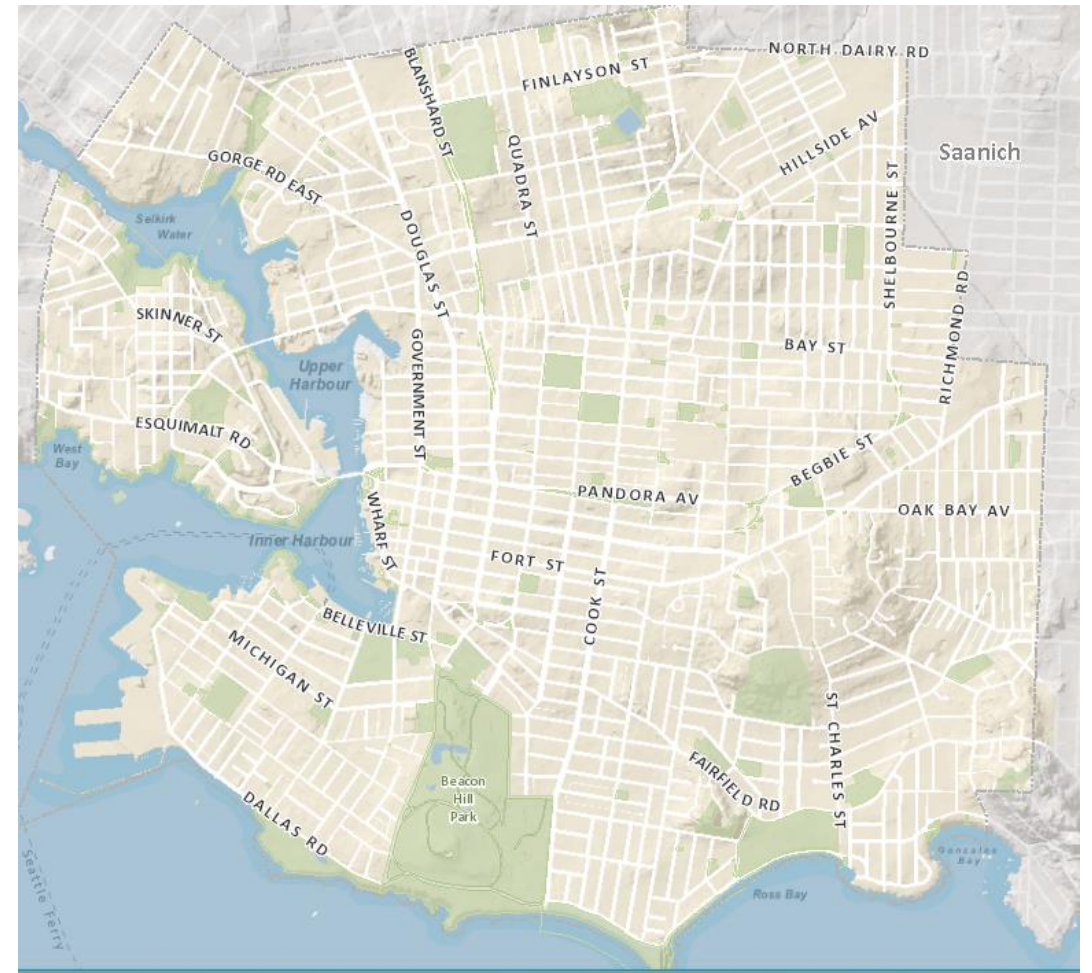
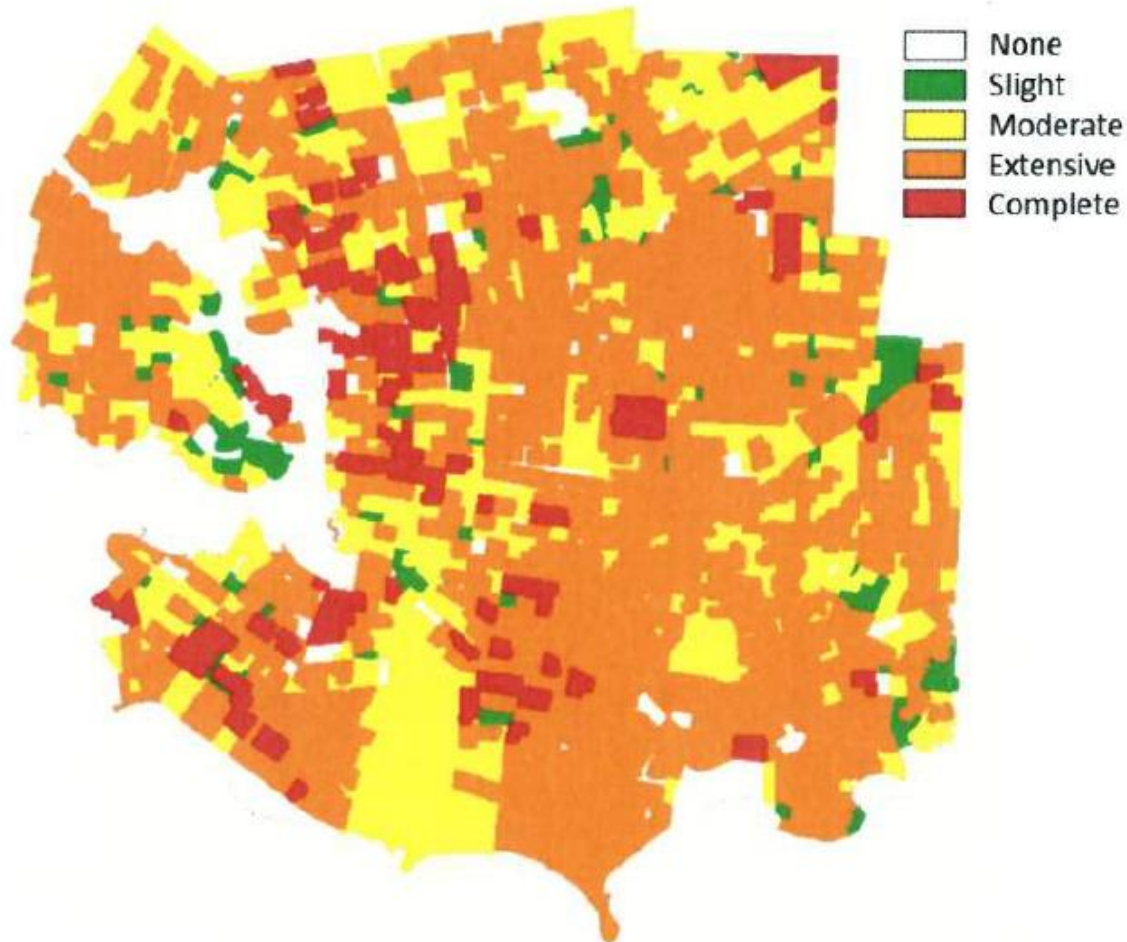
- Supporting infrastructure was also a component of the study. The number of breaks for each pipeline was carried out for the 3 scenarios using HAZUS for Water lines and Sewer pipelines.
- The prediction is that there will be poor performance of sewer pipelines due to existing old (pre-1935) and brittle pipeline systems.
- Recommendation was made to replace the older and brittle lengths of these pipelines.

Serviceability for water pipeline
for 9.0 subduction scenario + 1
(greater ground motion)

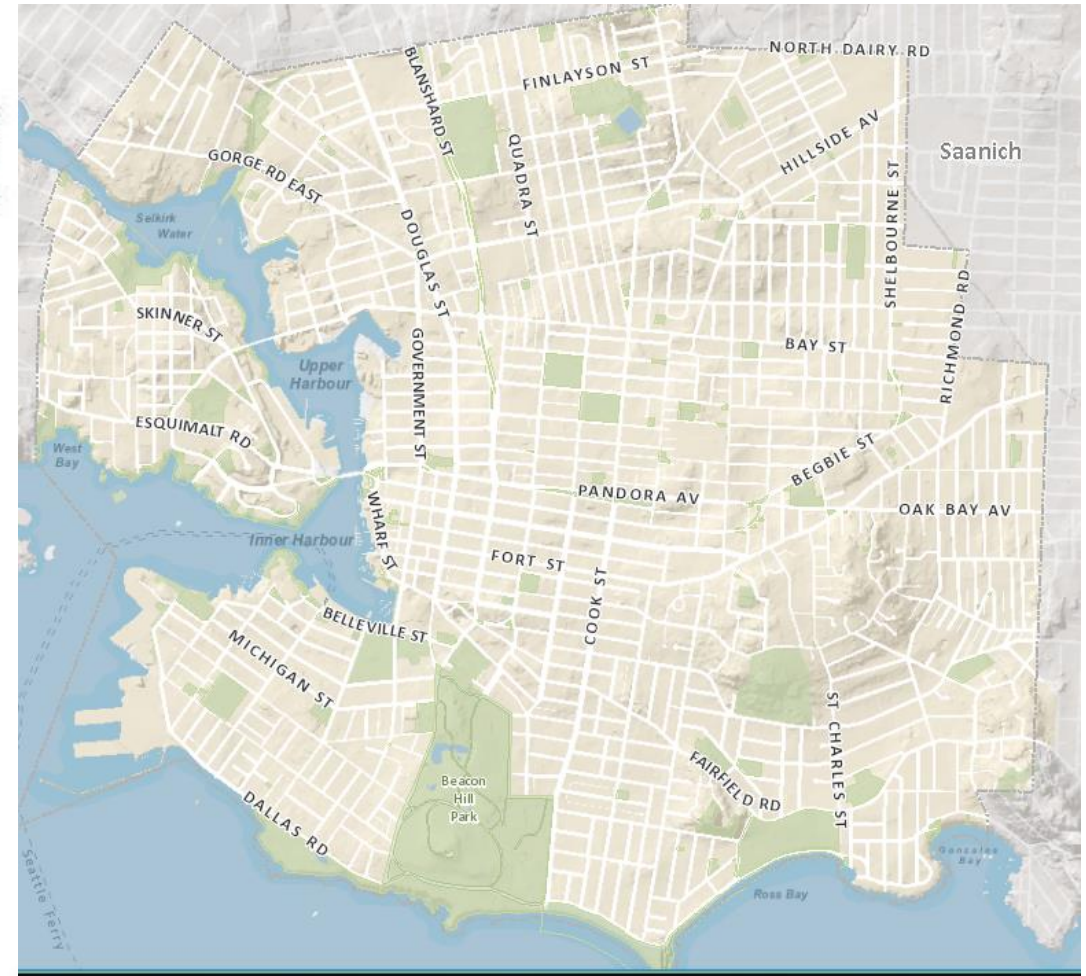
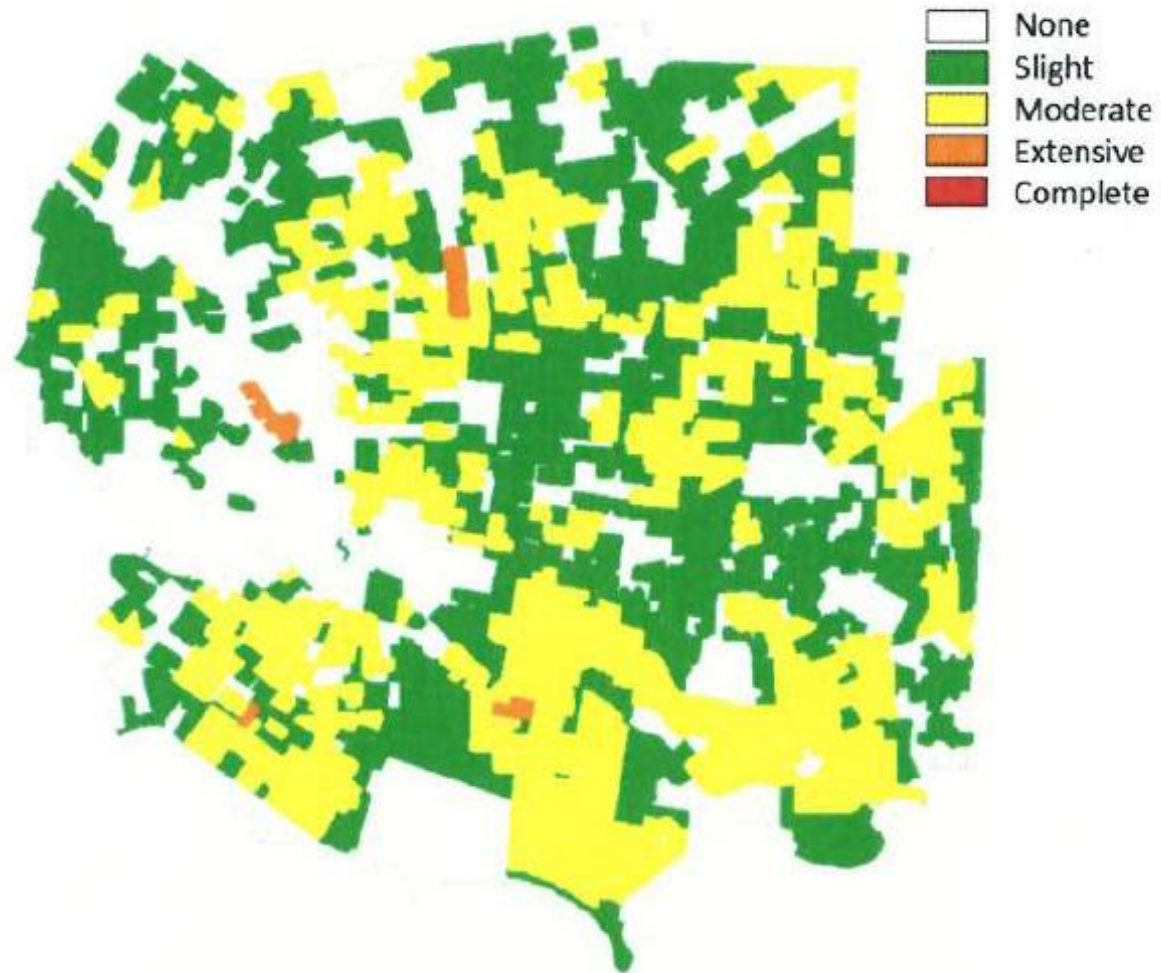


Damage results predicted for each earthquake scenario

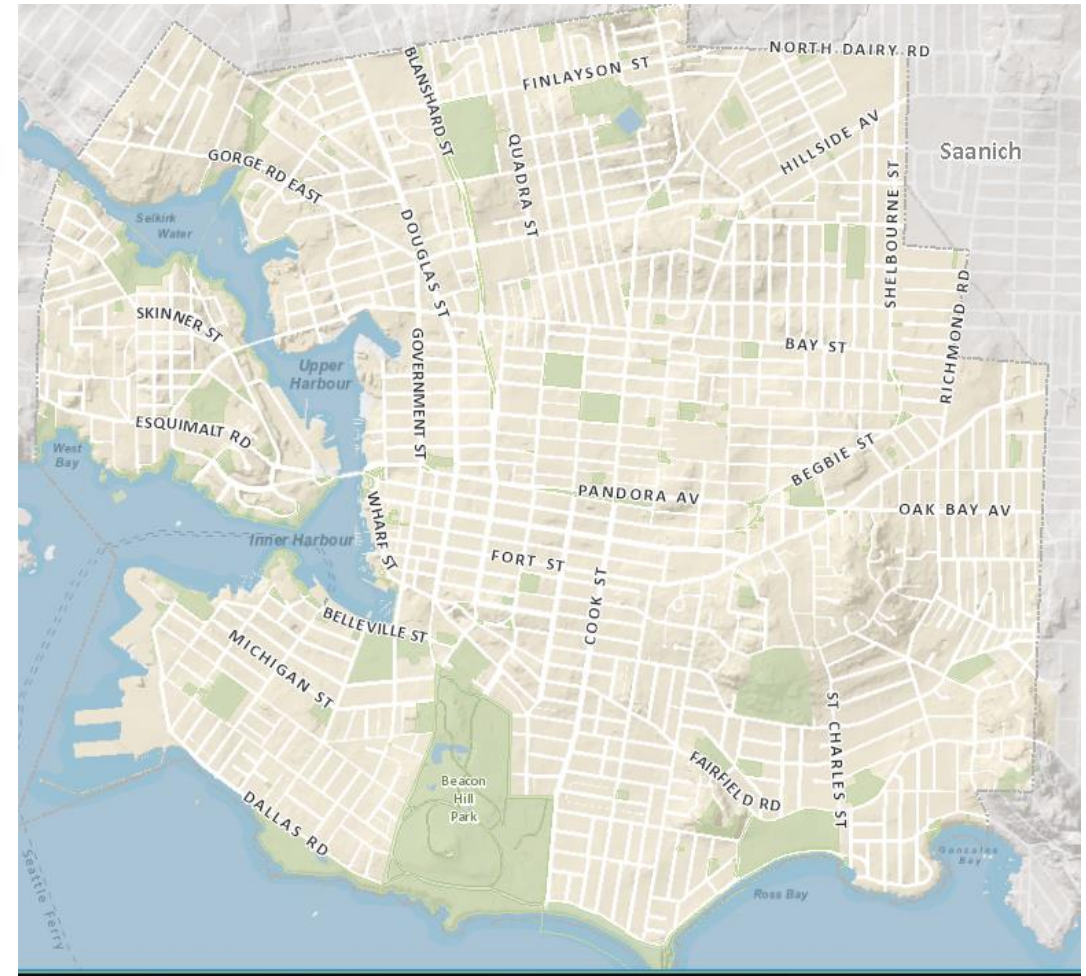
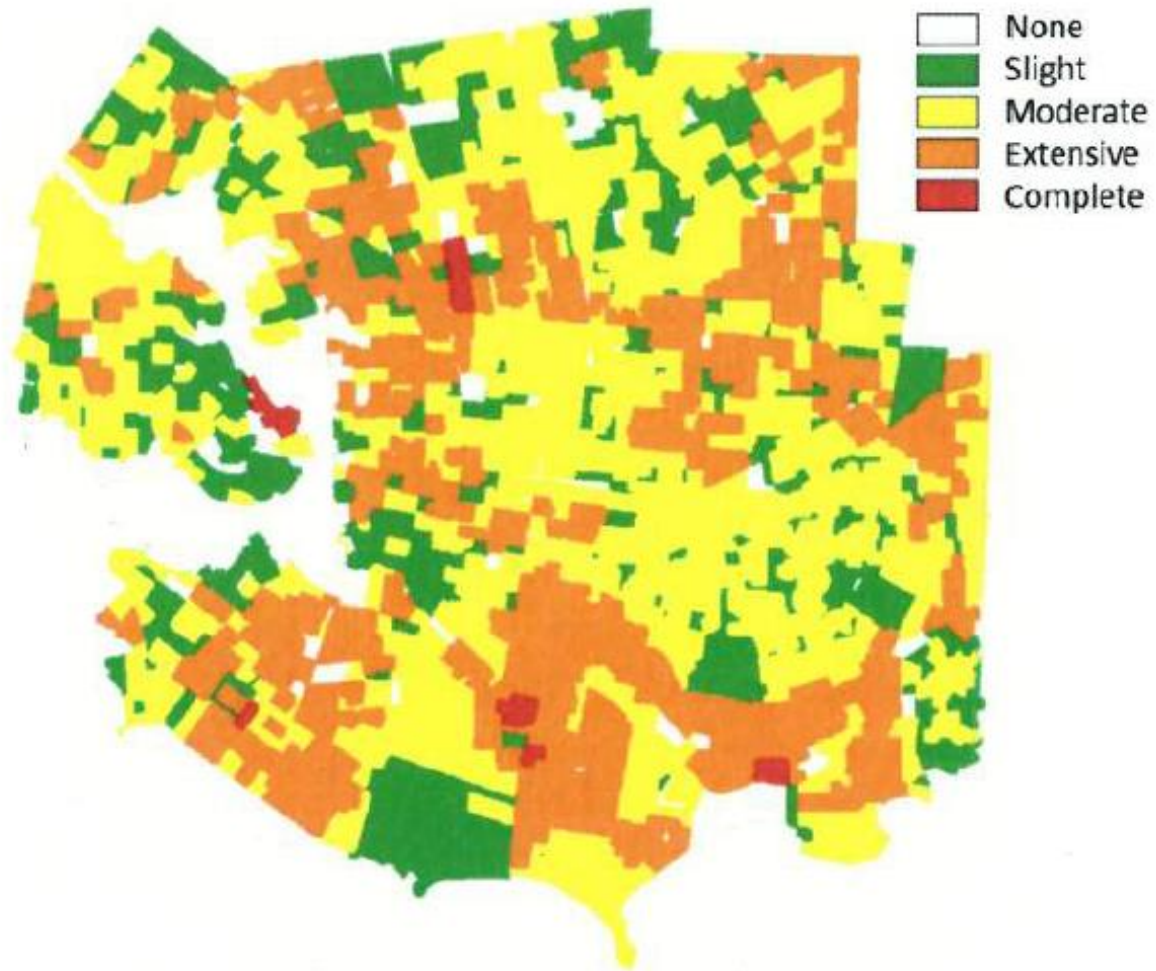
Crustal scenario – M=7 on the Leech River Fault



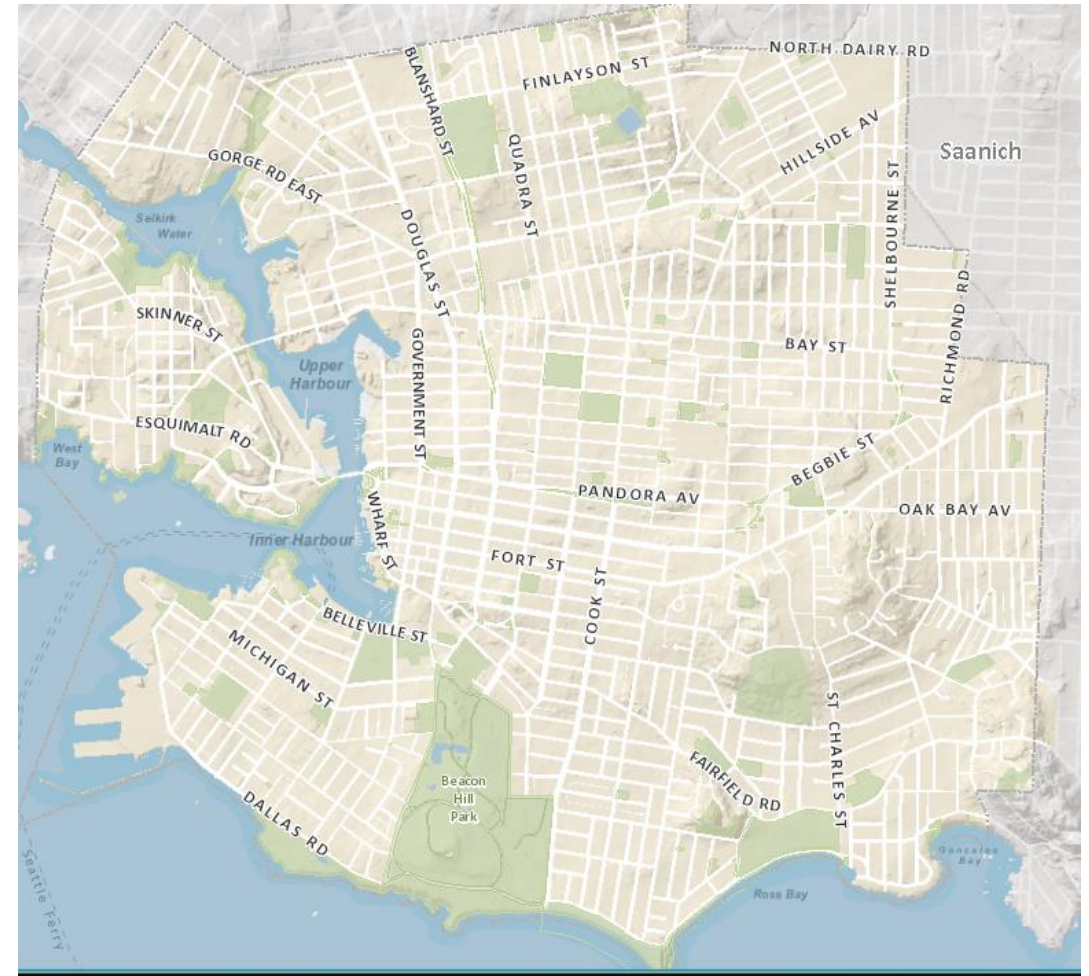
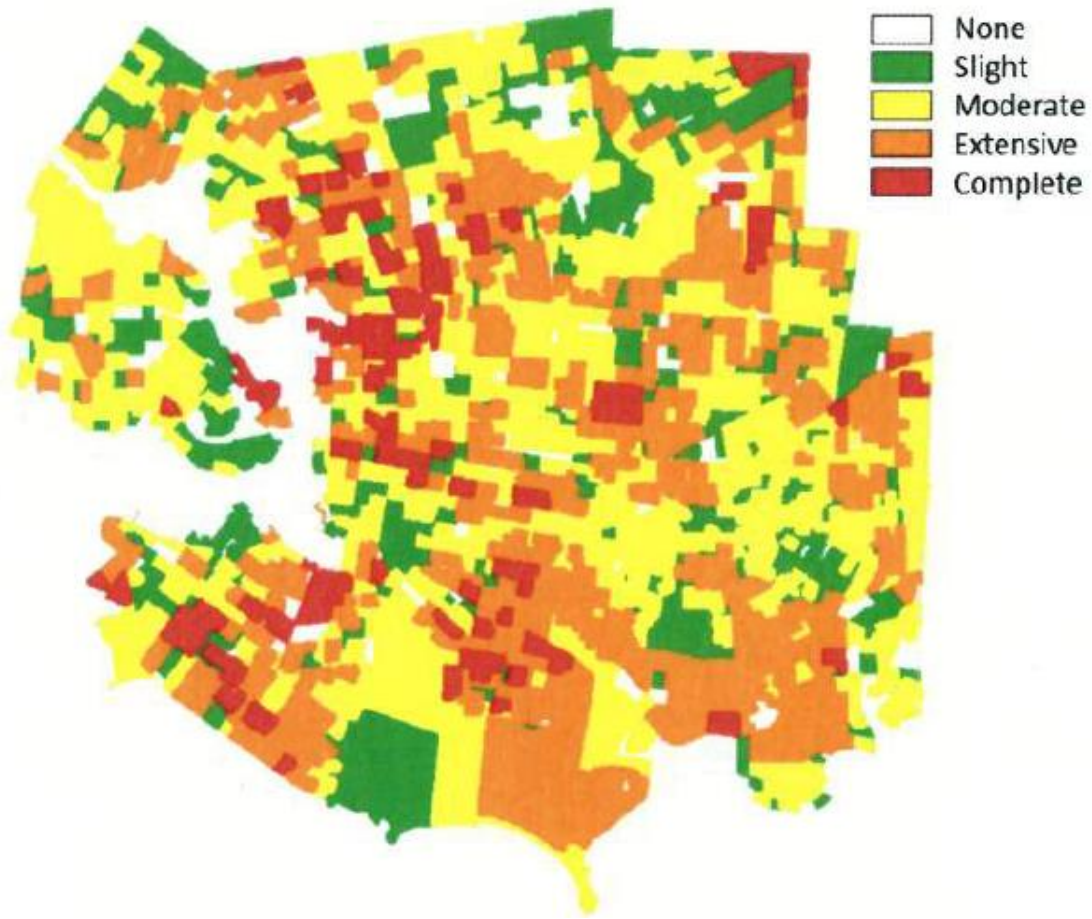
Inslab Scenario: M=7 under the Strait of Georgia



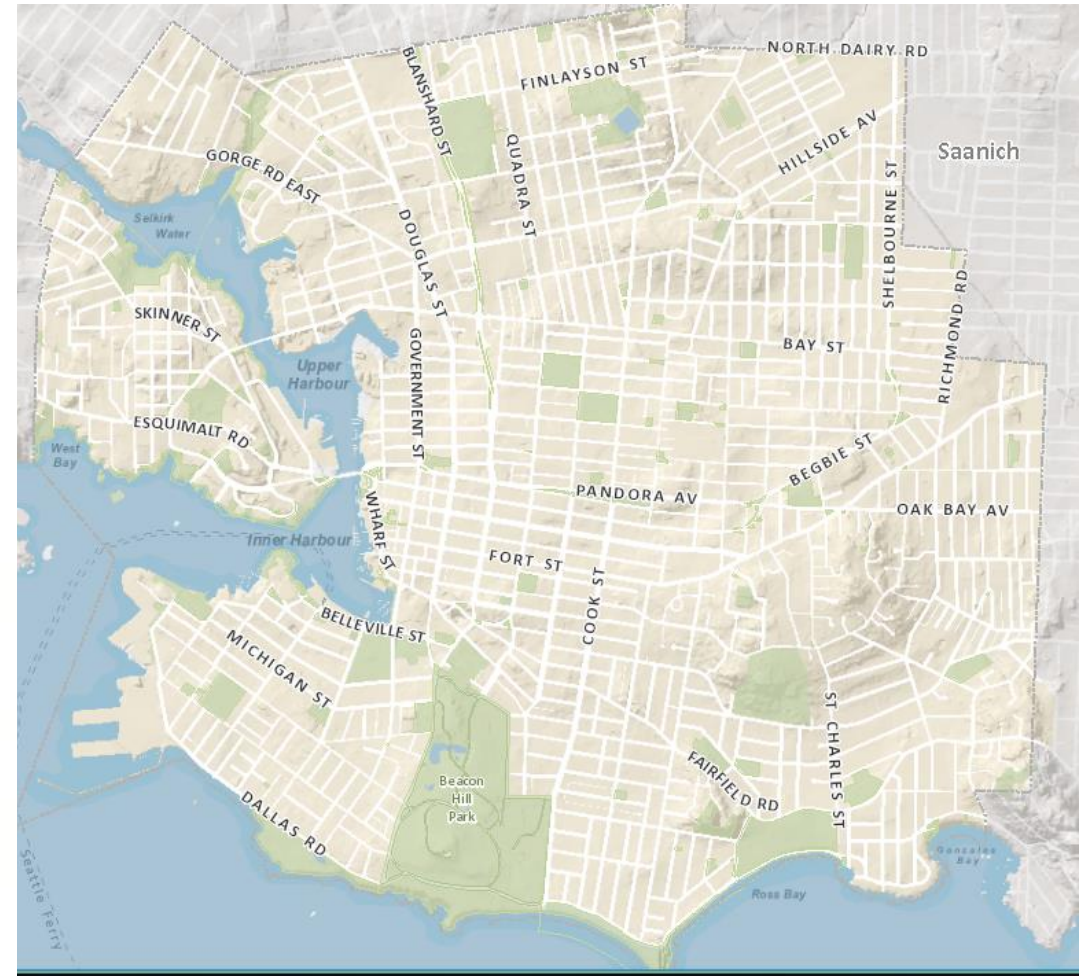
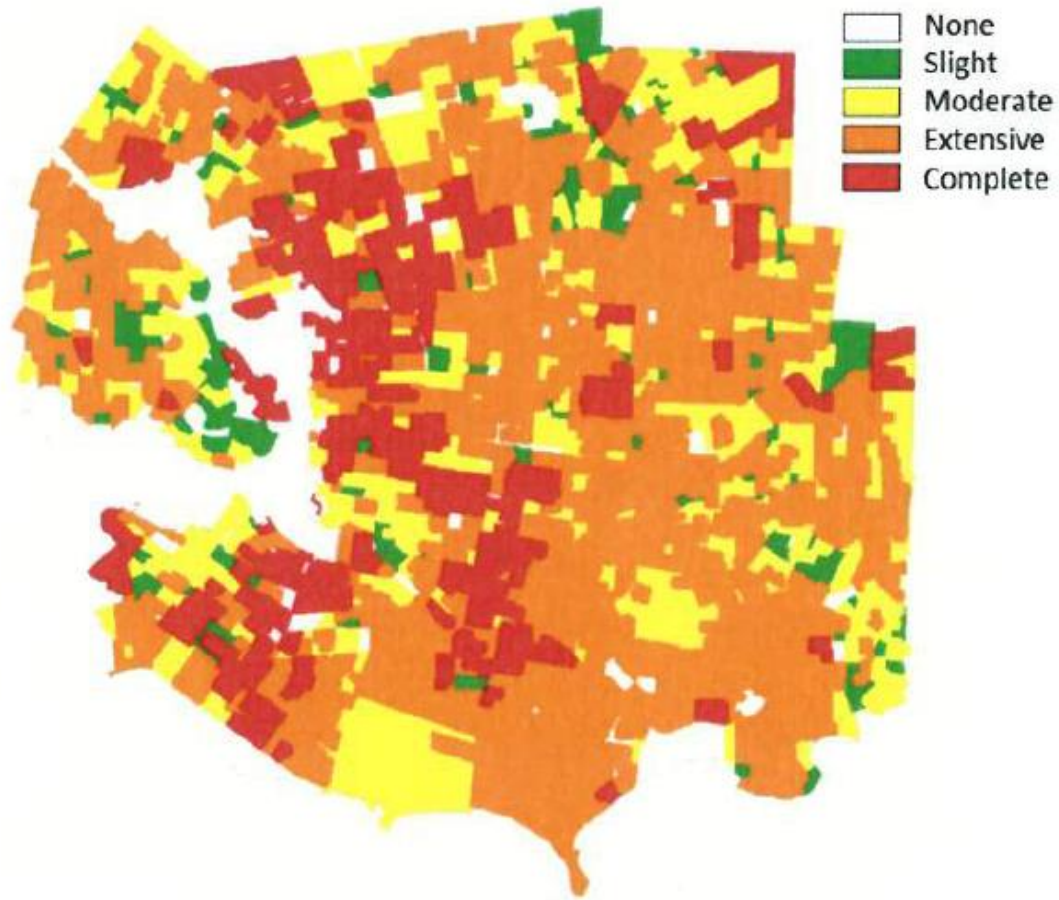
Inslab M=7 Strait of Georgia rerun with greater ground motion acceleration:



Subduction Scenario: M=9 Cascadia Rupture “The Big One”



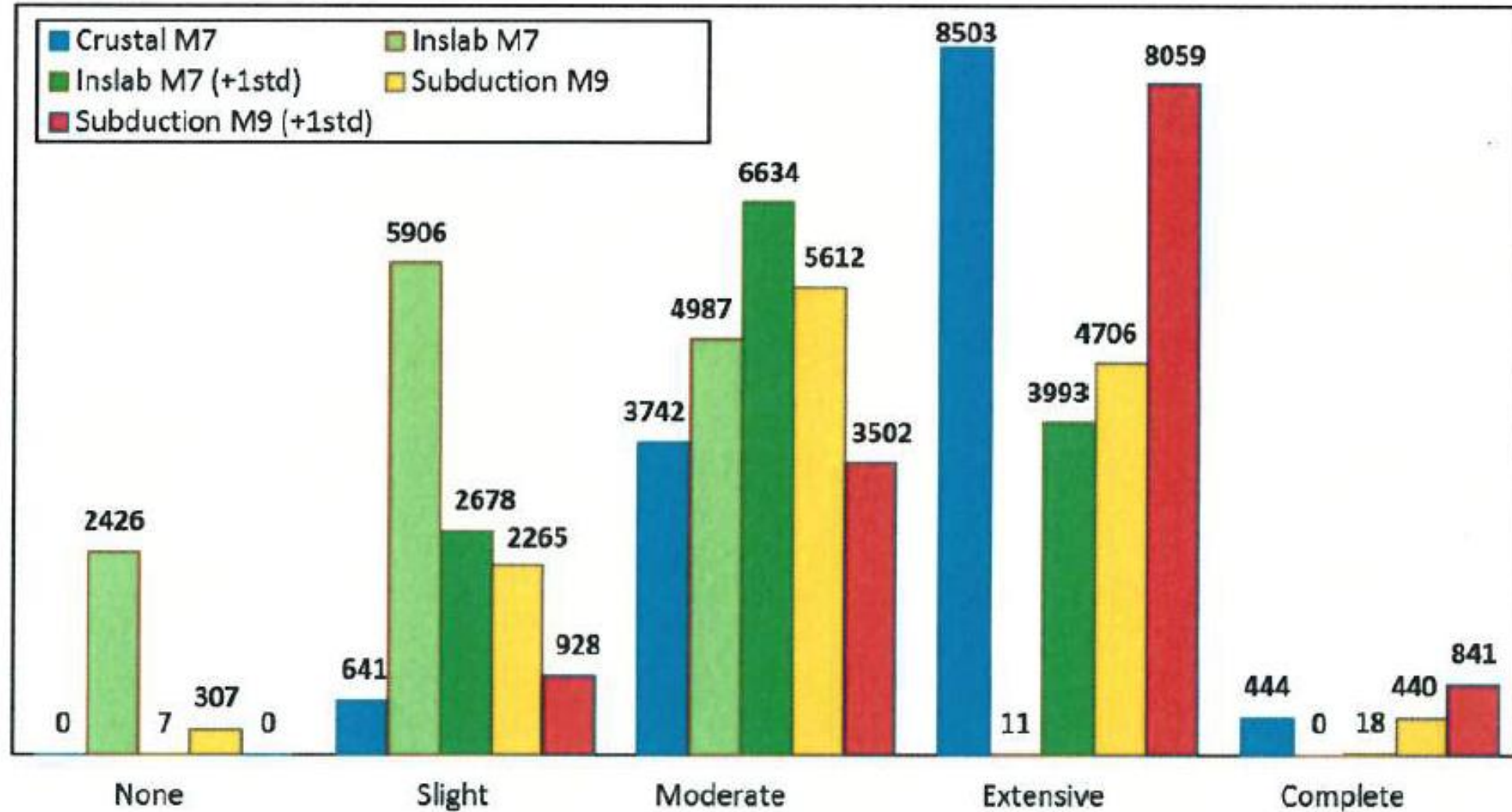
Subduction Scenario: M=9 Cascadia Rupture “The Big One” with greater ground motion acceleration:



Damage state results from Five Earthquake Scenarios:

	None	Slight	Moderate	Extensive	Complete	Risk (% in 50 years)
M7 Crustal	0 (0%)	641 (5%)	3742 (28%)	8503 (64%)	444 (3%)	1
M7 Inslab	2426 (18%)	5906 (44%)	4987 (37%)	11 (0%)	0 (0%)	5
M7 (+1std) Inslab	7 (0%)	2678 (20%)	6634 (50%)	3993 (30%)	18 (0%)	2
M9 Subduction	307 (2%)	2265 (17%)	5612 (42%)	4706 (35%)	440 (3%)	5
M9 (+1std) Subduction	0 (0%)	928 (7%)	3502 (26%)	8059 (60%)	841 (6%)	2

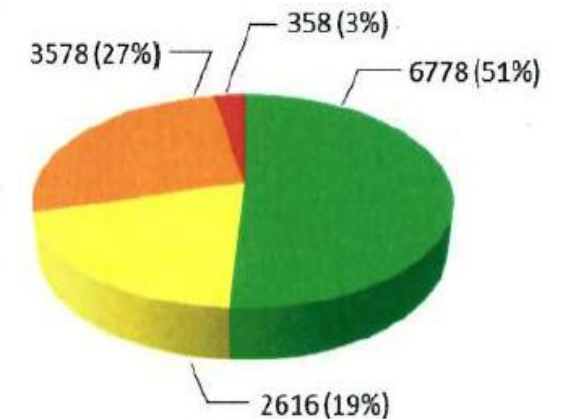
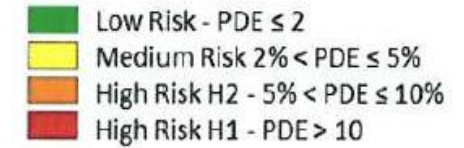
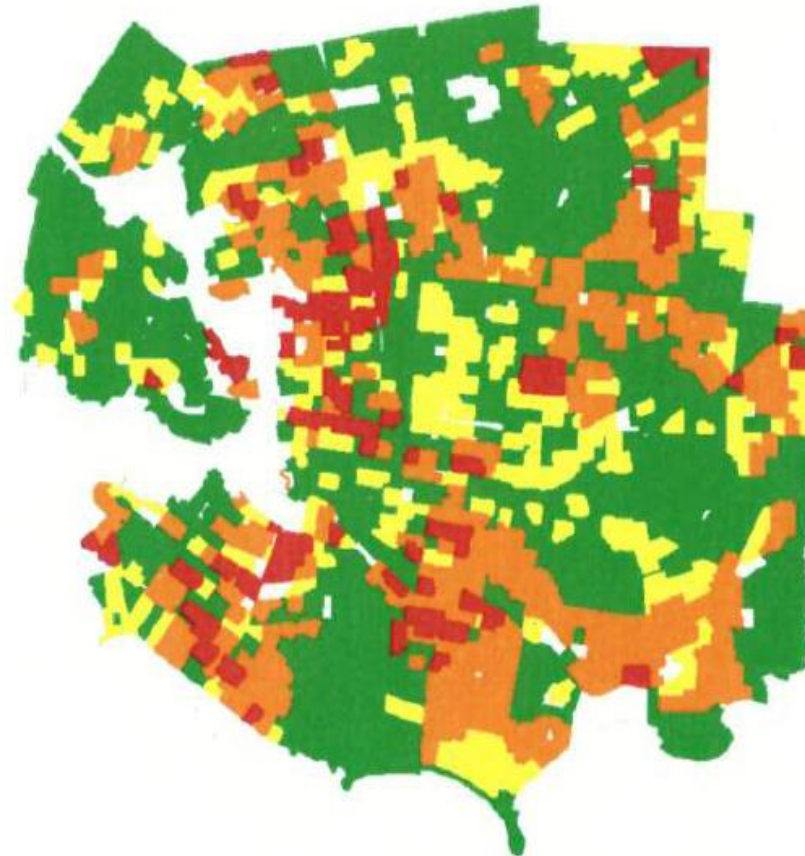
of Buildings at each Damage State for the Five Earthquake Scenarios



Ranking and Prioritization

Structures were ranked based on their damage risk based on their probability of complete damage in a 50 year period.

Priority Ranking	Probability of Complete Damage (PDE) in 50 years
H1 – High Level 1	> 10%
H2 – High Level 2	5-10%
M – Medium	2-5%
L – Low	< 2%



Probability of complete damage results for buildings

Building ranking and prioritization summary

Soil Type	High Risk (H2): 5% ≤ PDE <10%	High Risk (H1): PDE ≥10%
BC/C/CD	<p>Pre-1972 construction Including:</p> <ul style="list-style-type: none"> • Concrete /Steel/RM low-rise (1-3 stories) • URM (all heights) • 3-4 storey wood apartment buildings <p>Pre-1960 single family wood construction with cripple walls or sub-floors</p>	
DE/E	<p>1972-1990 construction Including:</p> <ul style="list-style-type: none"> • Concrete/Steel/RM low-rise (1-3 stories) • 3-4 storey wood apartment buildings <p>Post-1960 Single family wood construction with cripple walls or sub-floors</p> <p>Pre-1972 Mid- and high-rise buildings on Site Class DE</p> <p>1972-1990 Mid- and high-rise buildings on Site Class E</p> <p>URM (all heights) post-1972</p>	<p>Pre-1972 construction Including:</p> <ul style="list-style-type: none"> • Concrete/Steel/RM low-rise (1-3 stories) • URM (all heights) • 3-4 storey wood apartment buildings <p>Pre-1960 single family wood construction with cripple walls or sub-floors</p>

Two major heritage restorations and the big, new Union building at the foot of Fisgard and Pandora have transformed the west end of Chinatown in the last two years, adding 191 condos and a whole lot of new retail to Victoria's original live/work neighbourhood



What do do during an earthquake



DO NOT:

- Stand in a doorway
- Run out of a building
- Sit or lay beside a table (Triangle of Life theory)

Alternatives



In a car: pull over safely, do not park under bridges or overpasses, next to buildings, or near power lines

Outside: try and find cover to protect yourself from objects falling off nearby structures, trees, power lines and other hazards

Things to shelter from

What do you need to shelter from in the places you spend most of your time?

- Ceiling tiles
- Glass
- Hanging lights & plants
- Bookcases
- Cabinets
- Wall hangings
- Hot water tanks



Shaking has stopped. Now what?

Count to 60 out loud after the shaking has stopped

- Are you ok?
- Check on others around you
- Evacuate building if necessary
- Be aware of potential new dangers
- Radio, Vic-Alert, social media, and City of Victoria website
- Aftershocks



BE PREPARED

Most people survive disasters.

Following a disaster your safety, health, comfort, and general well-being may be entirely in your hands.

Use the phone only for emergencies, listen to radio for updates

Toilets

EMERGENCY SUPPLIES

You should have a few different emergency kits

- What if you have to evacuate your house quickly?
- What if you're stuck in your car or have to leave it and walk home?
- What if you have to shelter in place at home?
- Do you have pets or animals to consider?



WHAT'S IN YOUR KIT?

Plan once and apply your kits to many hazards

- 7 days of supplies minimum (for shelter in place kit)
- Special circumstances
- USB drive with copies of documents and photos
- Cash
- First aid supplies
- Battery or crank operated radio
- Spare vehicle keys
- Rethink your needs yearly and keep track of expiry dates
- Putting together your own kit versus buying one

WATER

Essential for life

- 4 litres/person per day
- Storage
- Purification tablets and filter system (Brita doesn't count)
- Camp containers with a spigot
- As much as possible!
- Rotate



Purchasing supplies or kits

Where to buy?

- Total Prepare – 5471 Hamsterley Road
- Columbia Fire & Safety – 410 Garbally Road
- St John's Ambulance – 3214 Douglas street
- Capital Iron – 1900 Store Street
- Mountain Equipment Coop – 1450 Government Street
- Canadian Tire – multiple locations
- Getyourkittogether.ca
- Etc...

DAMAGES



RECOVERY

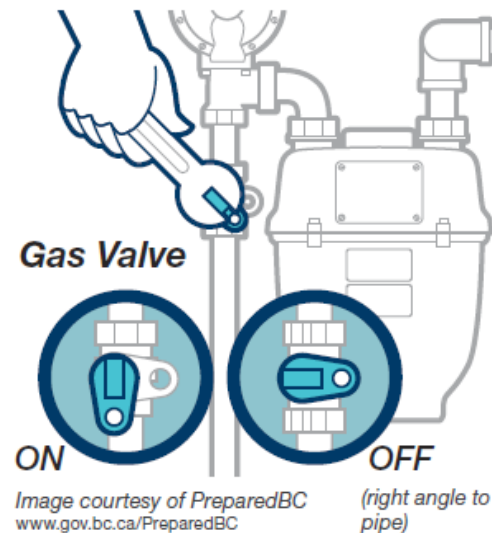
Recovery begins during the emergency

- Rescue phase is simple, it's the recovery that takes time
- “An ounce of prevention is worth a pound of cure”

Help will eventually come but it will take time

TIPS

- Have a plan to reconnect with your family.
- Does everyone in your household know where the emergency supplies are?
- Take time and put thought into your preparations
- Insurance
- Know where and how to turn off utilities. Tools required?



Recommendations: PERSONAL SAFETY

- 1** Practise safe responses before disaster strikes. Training your body to respond automatically will free your mind to think more clearly during an event.
- 2** In an earthquake, DROP, COVER and HOLD ON. When the shaking stops, COUNT to 60 and assess your escape route before moving.
- 3** Plan and review escape routes with your whole family. Practise escaping from each room in daylight and in the dark.
- 4** Before taking action at a disaster scene, always check for hazards around you and in your intended path. Don't leave a safe place for one that could be more dangerous.
- 5** Always have grab & go bags ready.

Understand your homeowner or tenant insurance policy in detail: what disasters and damages are covered, your responsibility after a disaster occurs, etc. Home insurance can mean the difference between eventual disaster recovery and financial loss.

Connect and Prepare

“Neighbour helping neighbour” is the principle behind our Connect and Prepare program

The goal is to prepare neighbourhoods to be self-sufficient for at least 7 days after a disaster.

To learn more about our neighbourhood program contact us:
emvic@victoria.ca or call 250-920-3373.

Vic-Alert



[Help](#) [Sign in](#)

Welcome to Vic-Alert

Sign up to receive emergency notifications from the City of Victoria

I live, work or play in Victoria

I'm a Visitor

Vic-Alert is a notification service to inform residents, businesses, those who work or play downtown, and visitors in the event of major emergencies or disasters that may impact them. To sign up, please click one of the buttons above.



Simple Sign-up

It only takes seconds to sign up to receive emergency notifications that impact you and your loved ones.



Add those you care about

Add and manage multiple family members.
Keep your loved ones informed.



Be informed

Receive notifications and updates specific to your neighbourhood and City-wide.

Community Powered Emergency Preparedness

Know your risks!

Make a Plan!

Do something. Do anything.

**Get your kit(s)
together!**

**Connect with your
neighbours!**

MORE INFORMATION

www.victoriaready.ca

emvic@victoria.ca

250-920-3373

Social Media:

@cityofvictoria on Twitter

VictoriaReady on Facebook

Interested in volunteering with VictoriaReady?

QUESTIONS?

Together we are ready.