

## Concept Note

# DRR Pathways: City of Vancouver Seismic Mitigation Strategy Scenarios

### ➤ **Project Overview:**

This project will support the City of Vancouver (CoV) in developing its seismic mitigation policy options and mitigation strategy scenarios using the results of quantitative risk assessment, a risk tolerance and recovery threshold framework, and structured decision making process.

The work is organized in two phases. The outcome of the first phase is a set of different scenarios (3-5) for CoV Seismic Mitigation Strategy with comparable evaluation results of each scenario. The timeline of the first phase is April-October 2019. The team for Phase I consists of CoV seismic policy lead, Geological Survey of Canada, Sage on Earth Consulting, Compass Resource Management and UBC School of Community and Regional Planning.

Phase II will cover further evaluation of the strategy options based on the City Council inputs, modeling of mitigation outcomes in more detail as well as the required public consultations.

### ➤ **Background**

This project seeks to support the seismic policy options process within the City of Vancouver that is delivering the seismic risk assessment report and the matrix of seismic policy options in the Fall of 2019. The project provides direct support to the City of Vancouver resilience team to use the outputs of the seismic risk modeling and information on the key risk drivers through a process that enables decision makers to define risk tolerance and recovery thresholds, evaluate and prioritize risk reduction actions, and choose the best combination of actions to reduce Vancouver seismic risk. The project will closely follow the approaches taken in a recent COV Coastal Flood Risk Assessment project including the use of structured decision making for evaluating and selecting actions for adapting to sea level rise in short, medium and long term.

This project is a component of the NRCan DRR Pathways project, funded through Canada Safety and Security Program (CSSP) program. CoV seismic policy options project will contribute to two objectives of the DRR Pathways project:

- To enable an evidence-based approach to disaster resilience planning: the project contributes to this objective while supporting CoV, which is one of the key policy partners of DRR Pathways, in their seismic policy options process.
- To strengthen risk governance in BC and Canada through knowledge exchange and capacity buildings: Aligned with this objective, a practitioner's guideline will be developed to share information on the risk tolerance framework and policy design, process, and lessons learned with a wider set of DRR practitioners across BC and Canada.

➤ **The project team:**

- **Micah Hilt**, *Lead seismic policy planner at the City of Vancouver*  
(expertise in risk modeling; urban planning; seismic risk policy development)
- **Murray Journeay**, *Research Scientist at the Geological Survey of Canada, NRCan*  
(expertise in risk modeling; use of risk information in DRR)
- **Sahar Safaie**, *Disaster Risk Management Specialist at Sage on Earth Consulting*  
(expertise in use of risk information in DRR; DRR policy development)
- **Christian Beaudrie**, *Decision and Risk Analyst at Compass Resource Management*  
(expertise in structured decision making, stakeholder consultation and decision making)
- **Michael Harstone**, *Principal at Compass Resource Management*  
(expertise on structured decision making, stakeholder consultation and decision making)
- **Stephanie Chang**, *Professor at UBC-SCARP*  
(expertise in disaster recovery and resilience indicators)
- **Ryan Reynolds**, *Post doctoral research fellow at UBC-SCARP*  
(expertise in disaster recovery and resilience indicators)
- **Jackie Yip**, *Research Scientist at Public Safety Geoscience Program, NRCan*  
(expertise in disaster recovery and resilience indicators)

➤ **Terminology:**

In addition to the common terminology used in disaster risk management, the project uses few specific terms described below:

Indicators: A way to measure seismic risk, resilience or recoverability. For example:

- Risk Indicator: # of people injured
- Resilience Indicator: # of households with emergency management kit
- Recoverability Indicator: Housing reconstruction time frame (% in certain time period)

Decision objectives: Decision objectives are concise statements of the ‘things that matter’ in a decision. They describe how policy options will be evaluated and are usually expressed as a noun and with a preferred direction (e.g. maximize the health and wellbeing of citizens in the region, minimize cost). Each objective should be capable of consideration independently of the others; thus, all else equal, greater wellbeing better, lower costs are better.

Sub-Objectives: Statements that further clarify how an objective will be measured in smaller component parts (e.g. for the example health and wellbeing objective above, some sub-objectives could be ‘minimize mortalities’, or ‘minimize post-disaster homelessness’).

Objectives hierarchy: a list of objectives and associated sub-objectives that are collectively used to demonstrate how well each policy option performs. There is no

importance, preference or priority given to the order of objectives/sub-objectives in the list.

Evaluation Criteria: A set of criteria to evaluate how well a policy option or seismic mitigation strategy scenario (see the definition of strategy scenarios below) is expected to perform against a particular objective. The criteria would include expected risk reduction outcome as well other objectives to consider in decision making such as social equity, cost-outcome ratio. An example evaluation criterion for the sub-objective 'minimize mortalities' could be the 'number of mortalities' estimated to occur for a given scenario or policy objective in the event of a disaster. Similar indicators may be used both for describing the baseline risk, resilience and recoverability conditions and for measuring sub-objectives under evaluation criteria.

Baseline: Indicators values determined from risk assessment and other assessments of the current conditions.

Risk Tolerance Levels: The values assigned to each indicator as the acceptable level of risk. The risk tolerance values are basically the desired goal of risk mitigation efforts and are only used internally in the project to provide direction and a way to grasp the scale of actions and investments needed. Very similar definition is used for Resilience and Recovery thresholds.

Seismic Mitigation Policy (in short "Policy"): The possible actions required to mitigate risk to achieve the desired risk tolerance levels from the current baseline level. Example: Retrofitting wooden frame single housing with soft story.

Policy Implementation Method (in short "Implementation Option"): The possible ways to implement a policy by defining the actor/s, sources of financing and/or incentives for financing implementation.

Seismic Mitigation Policy and Implementation Option (in short "Policy Options"): The list of all possible policies and their relevant implementation options.

Policy Options Matrix: A matrix that brings together all the policy options with information or scores on all evaluation criteria.

Seismic Mitigation Strategy (in short "Seismic Strategy"): A bundle of few seismic mitigation policy options.

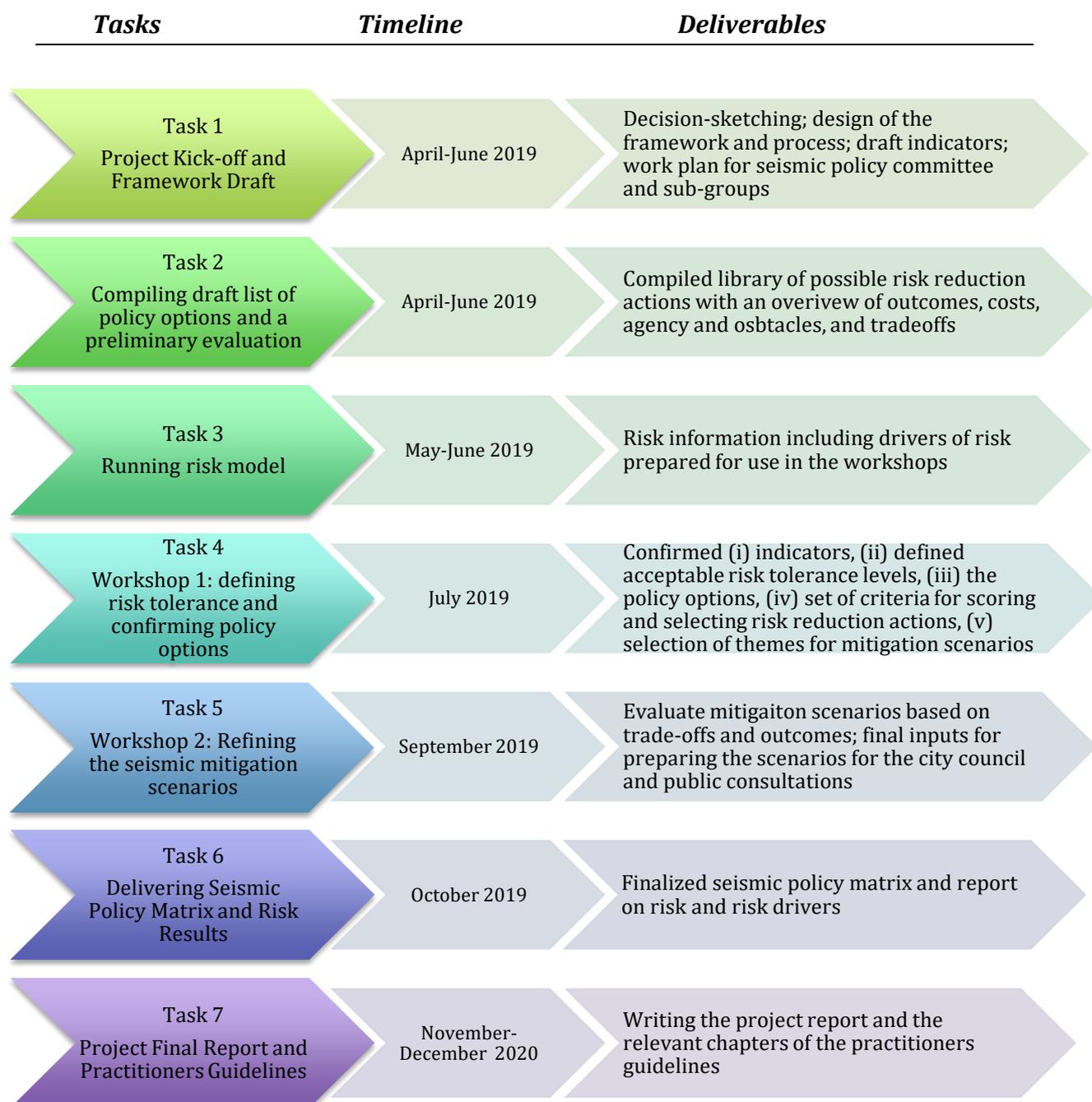
Seismic Mitigation Scenarios: Few different set of seismic strategies put together with different focus such as social equity, or risk reduction impact, or cost. Having access to a set of seismic mitigation strategy scenarios allows a more insightful evaluation, public consultation, and final decision making to select the best scenario.

Structured Decision Making (SDM): Structured decision making is an approach for carefully organized analysis of problems in order to reach decisions that are focused clearly on achieving fundamental objectives. Based in decision theory and risk analysis, SDM encompasses a simple set of concepts and helpful steps, rather than a rigidly-prescribed approach for problem solving. Key SDM concepts include making decisions based on clearly articulated fundamental objectives, dealing explicitly with uncertainty, and responding transparently to legal mandates and public preferences or values in decision making; thus, SDM integrates science and policy explicitly. Below are the main components of SDM.



From Compass Resource Management

➤ Schedule of Tasks and Deliverables



➤ Detailed List of Activities per Task

	<b>Title and Task Deliverable</b>	<b>Activities</b>	<b>Actors</b>	<b>Timeline</b>
Task 1	Project kick off and preparation	<ul style="list-style-type: none"> <li>▪ Initial meeting(s) with CoV</li> <li>▪ Research risk tolerance and recovery thresholds from other jurisdictions</li> <li>▪ A mini-retreat on risk tolerance framework design with</li> <li>▪ A working meeting on decision sketching</li> <li>▪ Developing Framework Draft Design including:               <ul style="list-style-type: none"> <li>○ a draft set of damage and loss indicators on all four risk indicator types (damage, dollars, lives, recovery days),</li> <li>○ list of required information on the drivers of risk,</li> <li>○ DRAFT criteria for DRR actions evaluation</li> <li>○ working groups composition,</li> <li>○ decision makers group composition, and/or community representatives committee</li> <li>○ templates and guidance for working groups for preliminary evaluation of DRR actions,</li> <li>○ Overview of input-output-outcomes of workshop 1 and workshop 2; and</li> <li>○ Project implementation detailed schedule</li> </ul> </li> </ul>	All	April- June 2019
Task 2	Compiling draft list of actions with expected outcomes, costs, agency and obstacles, and tradeoffs, and further developing draft evaluation criteria.	<ul style="list-style-type: none"> <li>▪ Review DRR policies from other jurisdictions and internationally and compiling a list of good seismic actions/policies</li> <li>▪ Meeting, guiding and coordinating the seismic policy committee working groups to further develop the list of policy options, provide initial impressions of the performance of the policy options on the DRAFT set of criteria, provide suggestions for initial bundling of policy options into a few example mitigation strategies, and provide suggestions for evaluation criteria.</li> </ul>	Sage and COV	April- June 2019

		<ul style="list-style-type: none"> <li>▪ A report with the list of actions/policies under each category (i.e., a ‘skeleton’ of a Policy Options Matrix) and the preliminary evaluations done by the working groups</li> </ul>		
Task 3	Running the risk model for baseline and preliminary 2 level risk reduction scenarios	Preparing the outputs of seismic risk modeling results, including information on drivers of risk and the simple 2 level risk reduction scenarios	COV and NRCan	May-June 2019
Task 4	Workshop 1: Confirming indicators, defining risk tolerance and recovery thresholds and confirming criteria and policy options	<ul style="list-style-type: none"> <li>▪ Prepare workshop pre-reading materials</li> <li>▪ Prepare workshop agenda and exercises</li> <li>▪ Workshop facilitation</li> <li>▪ Workshop 1 summary report</li> </ul> <p>The expected outcomes of the workshop are:</p> <ul style="list-style-type: none"> <li>▪ Confirm indicators with participants</li> <li>▪ Review, revise, and confirm criteria for evaluating policy options</li> <li>▪ Review, revise, and confirm the long-list of policy options</li> <li>▪ Review baseline risk info</li> <li>▪ Review of the performance of policy options (at this point only based on the simple 2 level risk reduction scenarios)</li> <li>▪ Define initial acceptable risk tolerance and recovery thresholds</li> <li>▪ Prepare for Workshop 2 by getting familiar with the long list of policy options (Sent as pre-reading) and understanding different actions trade-offs and outcomes</li> <li>▪ Confirm the structure of the Policy Options Matrix including the final output of few policy packages (bundles of policy options)</li> <li>▪ Develop a process for scoring individual policy options and/or policy packages on the criteria and populating the Policy Options Matrix</li> </ul>	All (Compass lead)	July 2019
Task 5	Workshop 2: Refining the Seismic mitigation scenarios	<ul style="list-style-type: none"> <li>▪ Prepare workshop pre-reading materials</li> <li>▪ Prepare workshop agenda and exercises</li> </ul>	All (Compass lead)	September 2019

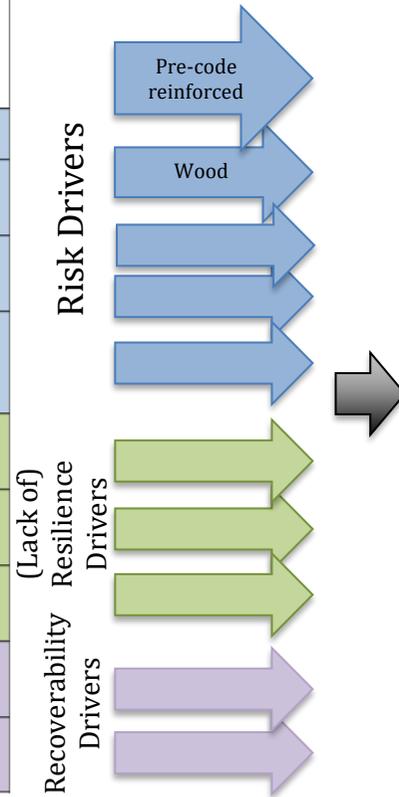
		<ul style="list-style-type: none"> <li>▪ Workshop facilitation</li> <li>▪ Workshop 2 summary report</li> </ul> <p>The expected outcome of the workshop are:</p> <ul style="list-style-type: none"> <li>▪ Ground-truthing the risk tolerance and recoverability thresholds from workshop 1 and finalizing them based on policy packages</li> <li>▪ Review and revise draft Policy Options Matrix and seismic mitigation scenarios (populated with estimated performance on objectives/criteria and risk indicators)</li> <li>▪ Initial exploration of trade-offs between Policy Packages and preferences</li> <li>▪ Identify remaining work to prepare the Policy Packages Matrix for presentation to Council</li> </ul>		
Task 6	Delivering Seismic Policy Options Matrix and Risk Results	<ul style="list-style-type: none"> <li>▪ Report on Seismic Policy options (individual options and mitigation scenarios) including information on risk and drivers of risk</li> <li>▪ Annex on the risk tolerance and policy options process including engagements and contributions from working groups and community representative committee</li> </ul>	CoV Lead, others support	October 2019
Task 7	Practitioners Guideline	<p>One document will be developed in the format of a guidelines for practitioners that will use the project as a case example. The document will share information on the process, findings, lessons learned, workshop reports, participants, etc.</p> <p>Activities include:</p> <ul style="list-style-type: none"> <li>▪ Draft report/guideline</li> <li>▪ Revisions</li> <li>▪ Final Report/Guideline</li> </ul>	All (Sage Lead)	November-December 2019

➤ High level outline of the framework and process components

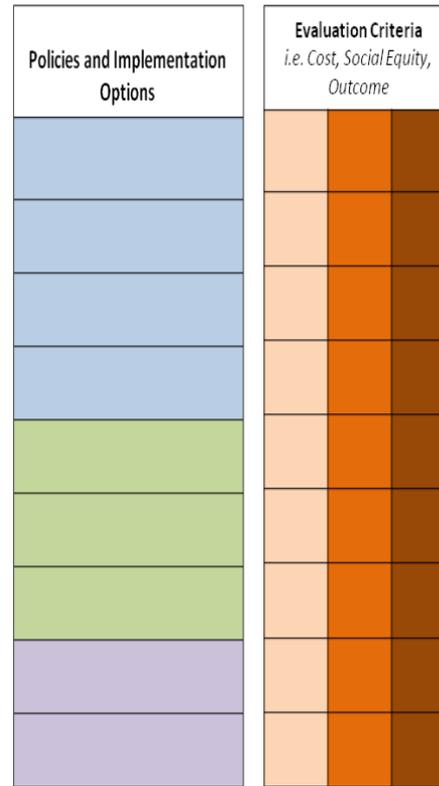
# Risk Tolerance Framework

Indicators <i>Risk, Resilience, Recovery</i>	Baseline Values	Risk Tolerance and Acceptable Thresholds
# of people injured	30,000	15,000
# of people displaced	180,000	90,000
Uninhabitable units	60,000	30,000
Uninhabitable units as a percentage of housing in the affected area	10%	5%
% of households with (seismic) home insurance	50%	80%
% of households with Emergency Kit and household emergency plan	15%	100%
% of small businesses with Business Continuity Plan	50%	100%
Housing Reconstruction timeframe	80% in two years; 100% in four years	100% in two years

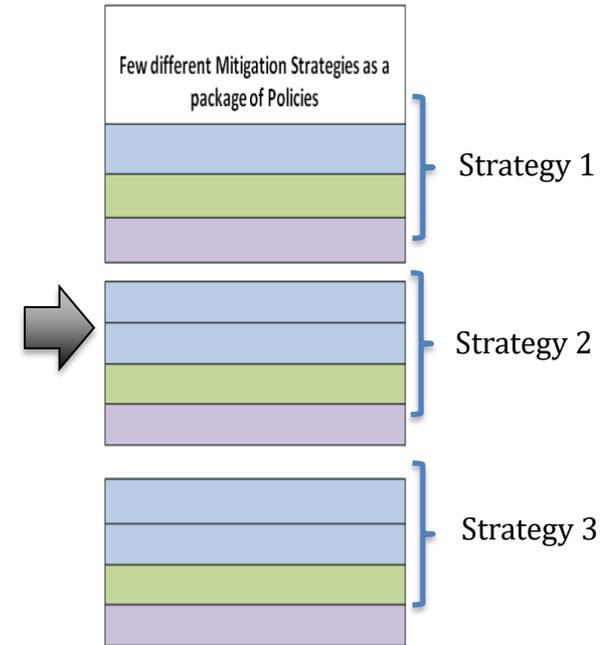
## Drivers



## Policy Options and Evaluation Criteria



## Seismic Mitigation Scenarios For Selection by Decision Makers



➤ **EXAMPLE Policy Options Matrix skeleton:**

Adapted from City of Palo Alto Seismic Risk Assessment Study

<https://www.cityofpaloalto.org/civicax/filebank/documents/61421>

POLICY OPTION #	Category	Driver	Building Type	Approx. Number	Date of Construction	Occupants	Performance on Risk, Loss, and Recovery Indicators			Objectives/Criteria & Highlight Trade-offs					Policy Options (EXAMPLE CATEGORIES)					
							X	Y	Z	A	B	C	D	E	Evaluation Report	Voluntary, Triggered, or Mandatory Retrofit	Engineering	Disclosure	Incentives	Etc.
1A	1	D1																		
1B	1	D1																		
1C	1	D1																		
2A	2	D2																		
2B	2	D2																		
3A	3	D1, D3																		
4A	4	D4																		
5A	5	D5																		

*This is a very rough example for illustration purposes only.*