CITY OF VANCOUVER

COUNCIL REPORT

Report Date: March 5, 2024
Contact: Daniel Stevens
Contact No.: 604.829.4370
RTS No.: 15885
VanRIMS No.: 08-2000-20
Meeting Date: March 13, 2024
Submit comments to Council

TO: Standing Committee on City Finance and Services

FROM: Deputy City Manager

SUBJECT: Summary of Updated Hazard, Risk and Vulnerability Analysis

Recommendations

A. THAT Council approve in principle the summary of the 2024 Hazard Risk and Vulnerability Analysis.

B. THAT staff report back with an updated Hazard Risk and Vulnerability Analysis that addresses new provincial requirements within the timeline specified by the updated Local Authority Emergency Management Regulation or its successor.

C. THAT staff report back with an Emergency Management Plan considering these hazards in accordance with the timeline specified by the updated Local Authority Emergency Management Regulation or its successor.

Purpose and Executive Summary

The purpose of this report is to provide Council with a summary of the 2024 Hazard, Risk and Vulnerability Analysis (HRVA), its purpose, methods, results, and key findings and to seek Council endorsement of the key hazards for consideration in forthcoming plans and strategies.

HRVAs enable decision-makers to make informed decisions on how to reduce risk through hazard mitigation and preparation. Recent provincial legislation requires the development of an Emergency Management Plan that considers the hazards from this assessment and how the City will mitigate and prepare for them.

All local authorities in British Columbia are required to assess hazards and risks and an HRVA is the standard method recommended by the provincial government. Vancouver's HRVA is based on the provincial HRVA Toolkit, augmented to expand on inequities and disproportionate impacts of these hazards across communities. This HRVA was developed over a three-year period,

involving input from subject matter experts across City departments, First Nations and external agencies. It also included targeted engagement to identify disproportionate impacts and inequities exacerbated by hazards. The overall process is shown in Figure 1 in the Appendix. This HRVA process identified thirteen hazards of greatest concern and assessed their relative risk. The highest risk hazards to Vancouver are earthquakes and extreme heat events. These are followed by nine medium risk hazards and two lower risk hazards. It is important to note that even the lower-risk hazards represent events that may seriously impact Vancouver and require mitigation and preparation. The full list of hazards is shown in Figure 2 in the Appendix. In addition to the relative risk of each hazard, seven key findings were identified which will inform future risk reduction measures and HRVA work. These are summarized in the full report.

Council Authority/Previous Decisions

- On July 24, 2012, Council approved the first Climate Change Adaptation Strategy.
- On December 3, 2013, Council received the Earthquake Preparedness Strategy.
- On December 4, 2013, Council received a risk assessment related to the Transmountain Pipeline expansion, including assessment of coastal spill risk.
- On December 5, 2018, Council approved the Climate Change Adaptation Strategy five-year update.
- On April 23, 2019, Council approved the framework for the Resilient Vancouver Strategy.
- On November 5, 2019, Council approved the Rain City Strategy.

City Manager's Comments

The City Manager concurs with the foregoing recommendations.

Context and Background

Requirement to assess disaster risk

At the time the work on the HRVA began in 2021, the Emergency Program Act (EPA) outlined the requirement for risk assessments. This HRVA was designed to meet those requirements and build on gaps staff had identified related to equity and disproportionate impacts of hazards. On November 8, 2023, the EPA was replaced by the Emergency and Disaster Management Act (EDMA). Like the EPA, EDMA also requires local authorities to assess risk but introduces new requirements. These include the need for consultation with Indigenous governing bodies, integration of Indigenous and local knowledge, and consideration of impacts to people who experience intersectional disadvantage. Further details of the new requirements, including timeline for compliance, will be included in a new regulation expected in late 2024. While this HRVA addresses some of the new requirements, deeper consultation and engagement with xʷməθkʷəy̓ əm (Musqueam), Sḵwx̱ wú7mesh (Squamish) and səlilwətaɬ (Tsleil-Waututh) Peoples will be needed in future iterations of the HRVA.

Hazard risk assessment in Vancouver

The last HRVA was conducted in 2008. Since then, staff have assessed a number of hazards in more depth, including earthquakes, extreme heat, coastal flooding and sea level rise, extreme rainfall, wildfire smoke and coastal spills. In 2019, the City released the Resilient Vancouver Strategy which updated our understanding of hazards (shocks) and underlying stresses. These additional assessments and strategies have informed mitigation, preparedness, and response actions. Many of these have been documented in the Climate Change Adaptation Strategy (2012 ,2018), Earthquake Preparedness Strategy (2013), and Resilient Vancouver (2019).

Importance of assessing hazard risk and disaster risk reduction

Emergencies and disasters continue to have significant impacts on cities around the world. These events have occurred in Vancouver and will happen again. Understanding our risks enables us to proactively reduce them now and into the future.

Hazards impacts are wide-ranging. They can affect physical and mental health, damage buildings and infrastructure, ecological systems and disrupt the economy. In 2021, over 600 people across BC died during the heat dome, with 117 deaths in Vancouver.[i] According to the Insurance Bureau of Canada, severe weather in 2022 and 2023 caused $3.1 billion in insured losses in Canada, making it the 3rd worst year for insured damage.[ii] This is expected to rise. In 2022 the winter storm and king tides (Dec 23rd and 27th) cost $80 million in losses.[iii] Even smaller-scale emergencies can be devastating to those impacted, especially if there are not adequate and equitable recovery measures in place.

The risks we face today are changing, and assessing risk is dynamic. Climate change is increasing the frequency and severity of climate hazards and is straining existing response and recovery capacity. The 2024 Global Risk Report identifies extreme weather events as the number two global risk over the next two years.[iv] Aging buildings and infrastructure, historical land-use decisions and compounding factors like social inequities also contribute to their increased severity. Disasters are occurring more frequently, lasting longer and are more severe.

Reducing disaster risk not only benefits social and economic development but can reduce cost to governments and society. According to Canada's National Adaptation Strategy, every $1 invested in preventative actions can save governments $13-$15 over the long term.[v] Similar statistics have been reported by the Federal Emergency Management Agency in the USA[vi] and studies in Australia. In 2018, insured damages for severe weather events across Canada reached $1.9 billion. For every dollar paid out in weather-related insurance claims for homes and businesses, the Insurance Bureau of Canada estimates that Canadian governments pay three dollars to recover public infrastructure damage. In order to make sound disaster risk reduction investments, cities need to better understand their hazard risks.

While risk reduction is a shared responsibility across all levels of government, more than 90% of emergencies and disasters in Canada are managed locally and provincially.[vii] Cities have a key role and responsibility in hazard mitigation, preparing for hazard events, and coordinating response and recovery. To meet these responsibilities, cities must be able to clearly articulate and prioritize risk reduction measures to make informed investment decisions and effectively access support from Provincial and Federal governments.

While the most visible work in disaster risk management occurs in response, there is much that must be done to prevent emergencies and disasters in the first place, or at minimum reduce potential impacts. The information in this report will help support decision-making to reduce risks and increase resilience in Vancouver to advance a city that safeguards the health, wellbeing, safety and security of all residents.

An important premise in disaster risk reduction is that while many hazards are natural events (e.g. landslides, earthquakes), disasters are created by a combination of these events and societal decisions. Where and how communities are built and designed leaves them exposed and vulnerable to hazards, and inadequate social investment results in increased vulnerability in some groups. The term “natural disaster” implies that disasters from natural hazards are unavoidable, but this is not the case. Disasters can be significantly reduced or avoided entirely through thoughtful, risk-informed planning and resilience-building. Past choices have created disaster risk, but the choices made now and in the future, can significantly reduce that risk.

Discussion

Method

The method used to create this HRVA was adapted from the provincial HRVA toolkit and was conducted in two phases (Figure 1 in appendix). Phase 1 included subject matter experts examining the full set of hazards identified by the Province and selecting thirteen hazards of greatest concern to Vancouver. These hazards were workshopped with subject matter experts, staff, First Nations representatives and partner agencies who assessed the consequences and likelihood of each scenario. Likelihood was assessed for the present time (current likelihood) as well as year 2050 (future likelihood). Consequences were assessed across eleven categories (Figure 4 in appendix). Phase 2 supplemented this with lived experience and feedback from communities who are disproportionately impacted by emergencies and disasters. This input was obtained through a series of workshops, meetings, interviews and surveys. The information from phases 1 and 2 was analyzed to determine the hazard risk ratings. Analysis within the HRVA is largely qualitative. While contributors brought a wealth of expertise and perspectives, repeating the analysis with a different group of people may lead to differences in the results. HRVAs should not be a substitute for site-specific or engineering risk assessments.

Hazard Risk Ratings

Relative risk for each hazard is shown on a risk matrix (see Figure 2 in the Appendix). Overall risk categories were created to balance the weighting of likelihood and consequences. This helped correct for limitations in the risk assessment process which de-emphasizes hazards that occur at very low frequencies but with catastrophic consequences, such as earthquakes.

The hazard matrix shows the highest risk hazards for Vancouver are earthquakes and extreme heat events. They both have high impacts to the life, health and safety of residents as well as high impacts across many or all of the other consequence categories. These events also impact the whole city at once rather than a limited area. Nine of the remaining hazards are categorized as medium risk (wildfire smoke and poor air quality, snowstorm and extreme cold, large structure fires, coastal spills, drought, disease outbreaks, hazardous materials release, extreme rainfall, and public disturbance), and two as low risk (coastal flooding, windstorm and power

outage). It is important to note that these hazards are not low risk, but low risk when compared with other hazards with higher consequences and likelihood.

Consequences

All hazards assessed have high consequences in at least one consequence category. Some hazards, such as earthquakes, have significant consequences across many categories while others, such as coastal spills, dominate just one or two categories. Consequences are a major driver of the overall risk.

Earthquakes, extreme heat, disease outbreak and hazardous materials releases all had the most significant impacts to health categories (i.e., fatalities, injuries and illnesses and psychosocial consequences). Earthquake, extreme rainfall, coastal flooding, snowfall and extreme cold all have high potential for infrastructure damage. Figure 4 in the Appendix compares the consequence graphs for all thirteen hazards.

Changing hazard risk

The likelihood and severity of many hazards is expected to change over time. Likelihood for each hazard event was assessed for the present and for the year 2050. Nine hazards showed changes in likelihood by 2050, largely driven by climate change. Figure 3 in the Appendix compares current and projected 2050 likelihoods for all hazards.

Nearly all climate-related hazards will increase in likelihood. Extreme heat, wildfire smoke and poor air quality and drought will increase during the spring, summer and fall seasons, while extreme rainfall and coastal flooding will increase in winter months. Wildfire smoke and poor air quality is the only weather-related hazard which is currently considered to occur an annual basis, though the duration and severity of poor air quality events is expected to increase over time. One climate-related hazard, snowstorm and extreme cold, will decrease in likelihood by 2050 due to the changing climate. This does not mean, however, that these events will cease entirely. They may happen less frequently but can still be severe when they occur. Without adequate mitigation and preparedness, the City and community response capacity will be taxed by increasing frequency and severity of climate-related events, and damage to infrastructure will increase.

Other hazards, including large structure fires, coastal spills and disease outbreaks are also increasing in likelihood due to a variety of factors. The number of structure fires has increased year-over-year recently and is expected to continue increasing as buildings age, driven in a large part by fires in aging SROs. Coastal spills will continue to increase in likelihood with increased marine and tanker traffic. Disease outbreaks also increase in likelihood due to population growth and increasing global travel, in addition to many other complex factors.[viii]

There is some degree of uncertainty in likelihood scores for a number of hazards. For some hazards, likelihood data exists based on historical events and modelled projections (e.g. climate-related hazards and earthquakes). However, other hazards do not have objective measures of likelihood or are influenced by complex factors that make it difficult to predict. For example, public disturbance and hazardous materials releases do not have strong data to draw from. For these hazards, the HRVA relied on expert opinion which introduces a level of uncertainty in the assessment but is a standard approach to conducting HRVAs.

Given the changes in risk over time and the timeline of many mitigation measures (e.g. land use planning, retrofit and replacement of aging and unsafe buildings or infrastructure, etc.), risk reduction decisions today should consider the risk of hazards in the future.

Key Findings

Key findings of the HRVA are listed below.

1. *Disproportionate impacts and inequities:* The impact of hazards is not spread evenly across the city nor across the population. In many cases, neighbourhoods with exposure to the greatest number of hazards also have higher proportions of socially vulnerable people living within them. People do not experience hazards the same way, with some hazards having greater impact on certain demographics. Renters are one group who are particularly vulnerable due to precarity of housing, lack of decision-making authority over their homes, and fewer financial resources to improve the safety of their homes. Underlying stresses like poverty, ableism, racism and other inequities create substantial barriers for some people to prepare for and recover from emergencies. Risk reduction plans must continue to analyze and address inequities by listening to the needs of those most directly and disproportionately affected by hazards.

2. *Complexity of replacement and retrofits for existing buildings:* The majority of the city's buildings were constructed under older building codes and safety standards. These existing buildings represent the majority of buildings in Vancouver and are not subject to the requirements of newer building codes unless certain triggers are met (e.g. major renovations). For example, in 2025, all new multi-unit residential buildings will be required to have mechanical cooling to protect occupants from extreme heat, but this does not apply to existing buildings. Damage to older buildings from other hazards may also impact business and service delivery which can have wide-reaching impacts on community recovery. As such, existing buildings and their occupants are at disproportionate risk of death, injury and displacement due to hazards. Replacing or mandating upgrades to existing buildings is complex and must be done with significant forethought to avoid unintended consequences such as residential displacement and unreasonable cost to building owners.

3. *Lag time in building codes keeping pace with emerging hazard knowledge:* New buildings incorporate policy and regulation for energy efficiency, seismic resilience, higher flood construction levels, storm water management and thermal safety. While these safety standards continue to evolve, there are current limitations on their effectiveness, especially for earthquakes. The current building code mandates that most buildings are designed to survive a significant earthquake so that occupants can exit safely. However, they are not necessarily designed for safe occupancy or functionality afterwards and may need significant and costly repairs. In many cases, damaged buildings may need to be replaced. The City is in the process of developing new seismic risk reduction policies for buildings, including targeted enhancement of post-disaster requirements in the building bylaw.

4. *Aging civic facilities:* Civic facilities are a critical component of the City's emergency management plans. Many community centres and libraries act as cooling centres, cleaner air spaces, as well as reception centres and group lodging for evacuees. These buildings are aging, many are not seismically resilient and some still lack mechanical

cooling or air quality controls. These assets are part of Vancouver's network of critical facilities and require investments to ensure they can function to support community through different types emergencies and disasters. While the City is upgrading facilities, the pace of upgrades and replacements is slow. The City should continue to prioritize upgrades of these assets and leverage funding from senior levels of government.

5. *Aging and vulnerable critical infrastructure:* Critical infrastructure is owned and operated by a combination of organizations, including the City of Vancouver and other levels of government. Much of the City's critical infrastructure (e.g. roads, bridges, sewers and water infrastructure) was designed and constructed decades ago for a smaller population and was not designed to withstand earthquakes or adapt to a changing climate. Major investments are required to ensure that City-owned infrastructure can accommodate future hazards. Additionally, more work is needed to understand the interdependencies between infrastructure types within the region, including between City-owned infrastructure and that owned and operated by other organizations.

6. *Natural assets and solutions:* Natural assets play a key protective role in relation to hazards. Nature-based solutions like urban forestry, green infrastructure and wetlands help cool dense urban environments from extreme heat, absorb heavy rainfall and act as a barrier against coastal flooding. These assets also provide important benefits for health and wellbeing and strengthen overall city resilience and adaptation to climate change. As part of Vancouver Plan staff are developing an Ecological Land Use Plan that will help leverage natural assets to reduce disaster risks, ensure this is done equitably across the city, and protect natural assets so they can in turn protect us.

7. *Partnerships:* Reducing disaster risks requires working with other levels of government, external organizations and community partners. Government agencies with different but overlapping mandates are crucial partners in reducing risks and building resilience. Recently, the Chief Public Health Officer released a report explicitly recommending collaboration between public health and disaster management sectors.[ix] Partnerships with community-based organizations are also critical to reducing risk and building community resilience, especially for disproportionately impacted people. The City should continue to support community-based organizations and partner with other government agencies to collaborate on disaster risk reduction and build capacity for resilience.

The 2024 HRVA provides a base understanding of hazard risk to support disaster risk reduction decisions at the City of Vancouver. It provides a high-level summary of hazards of greatest concern, their overall likelihood now and in the future, and their potential impacts. Hazards identified in the HRVA are already considered in many of the City's ongoing planning efforts. Investments into seismic upgrades and the Dedicated Fire Protection System are examples of where we are already working to mitigate these risks. This HRVA strengthens the City's ongoing work to take a risk-informed approach to land use planning, urban design and the development of policies crucial in order to create a resilient future for all.

Financial Implications

There are no financial implications associated with this report's recommendations.

Legal Implications

There are no legal implications associated with this report's recommendations.

* * * * * * * * * *

APPENDIX A: FIGURES

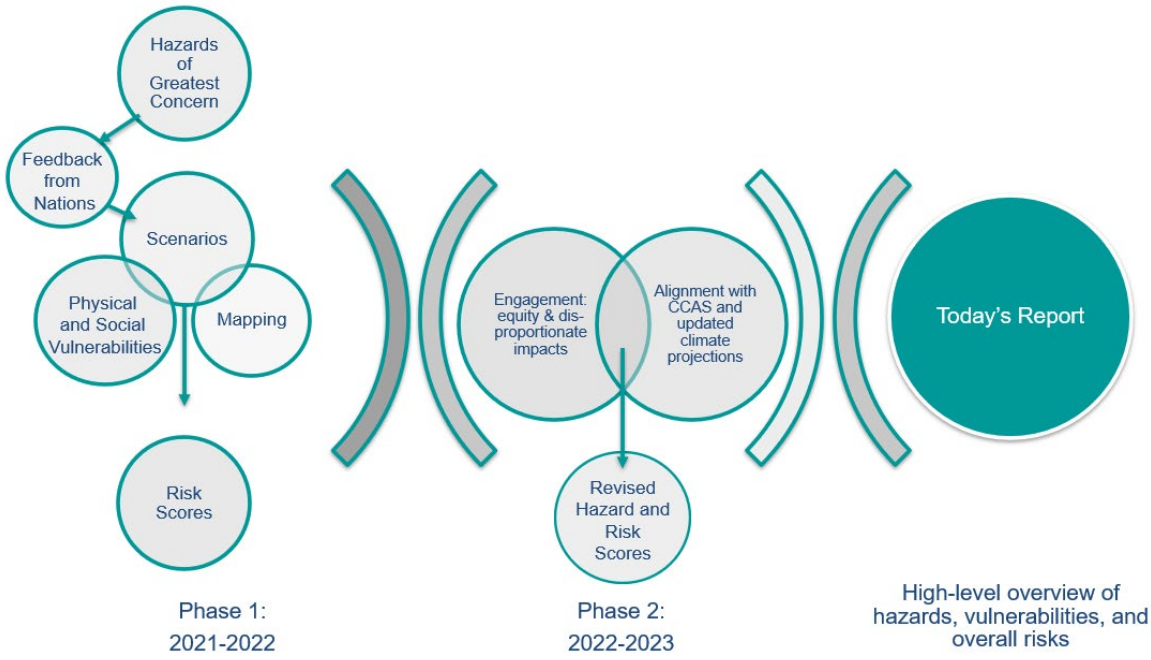


Figure 1 Process used to develop the HRVA.

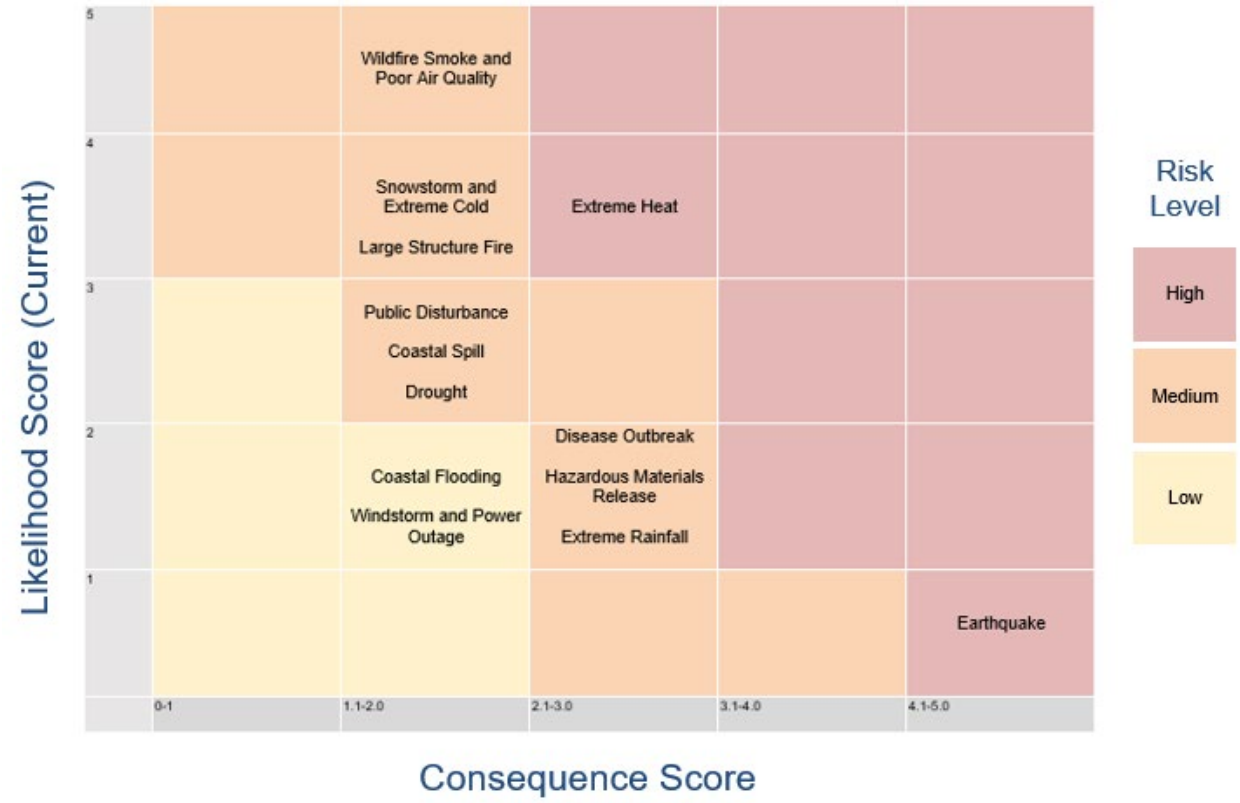
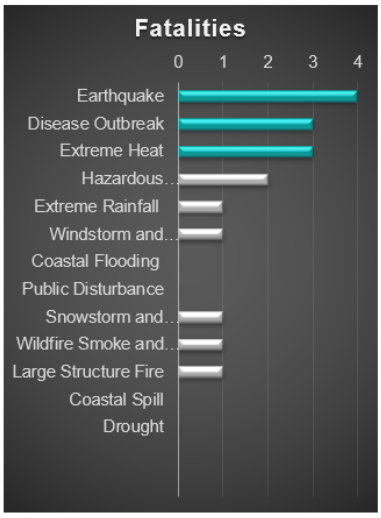


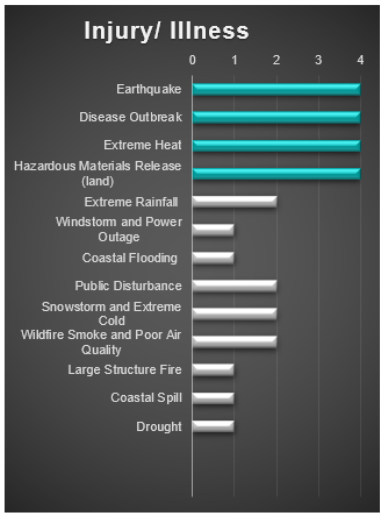
Figure 2 Summary of hazard risk levels of hazards assessed in this assessment.

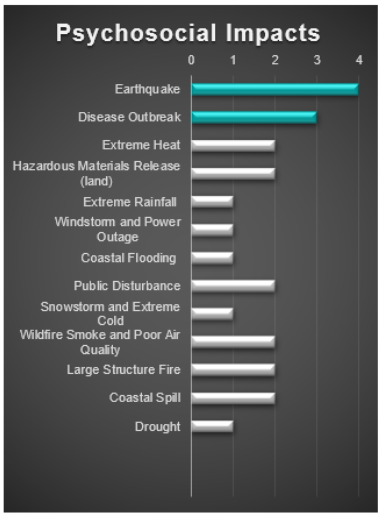
Hazard	Current Likelihood	Hazard	2050 Likelihood
Wildfire Smoke & Air Quality	5	Wildfire Smoke & Air Quality	5 ↑
Extreme Heat	4	Extreme Heat	5 ↑
Snowstorm & Extreme Cold	4	Large Structure Fire	4
Large Structure Fire	4	Coastal Spill	4 ↑
Public Disturbance	3	Drought	4 ↑
Coastal Spill	3	Snowstorm & Extreme Cold	3 ↓
Drought	3	Public Disturbance	3
Disease Outbreak	2	Disease Outbreak	3 ↑
Hazardous Materials Release	2	Extreme Rainfall	3 ↑
Extreme Rainfall	2	Coastal Flooding	3 ↑
Coastal Flooding	2	Windstorm & Power Outage	3 ↑
Windstorm & Power Outage	2	Hazardous Materials Release	2
Earthquake	1	Earthquake	1

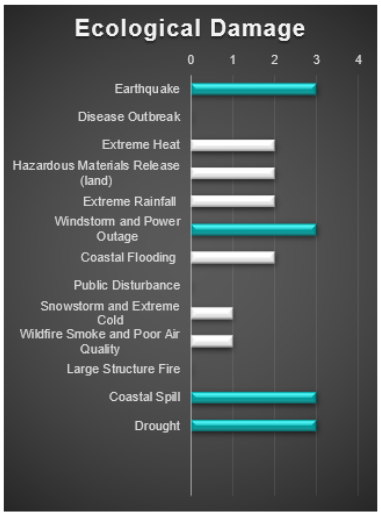
Figure 3 A comparison of current and projected (2050) likelihood scores for each hazard, based on maximum credible scenarios for each hazard. Likelihood scores range from 1 (rate events) to 5 (events expected to happen annually)

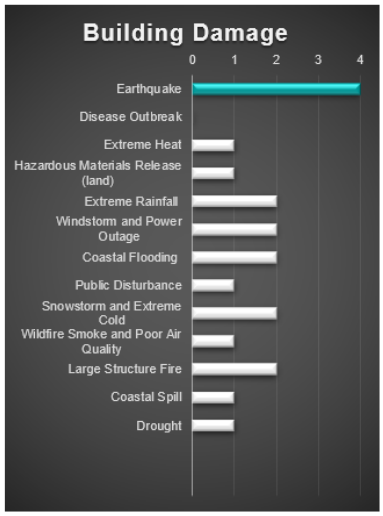
Graphs of consequences ratings for all hazards contained in the HRVA across eleven consequence categories:

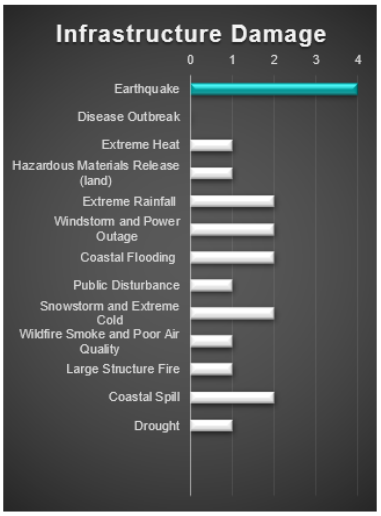


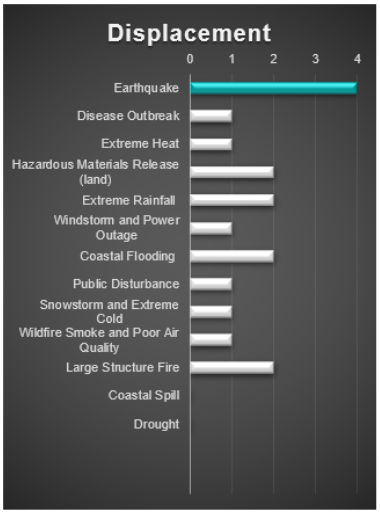


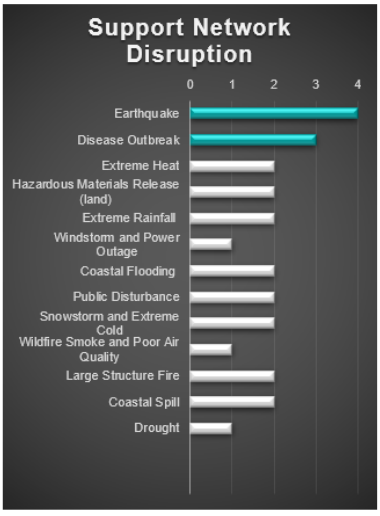


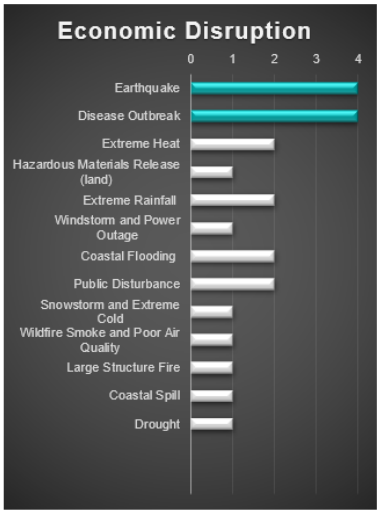












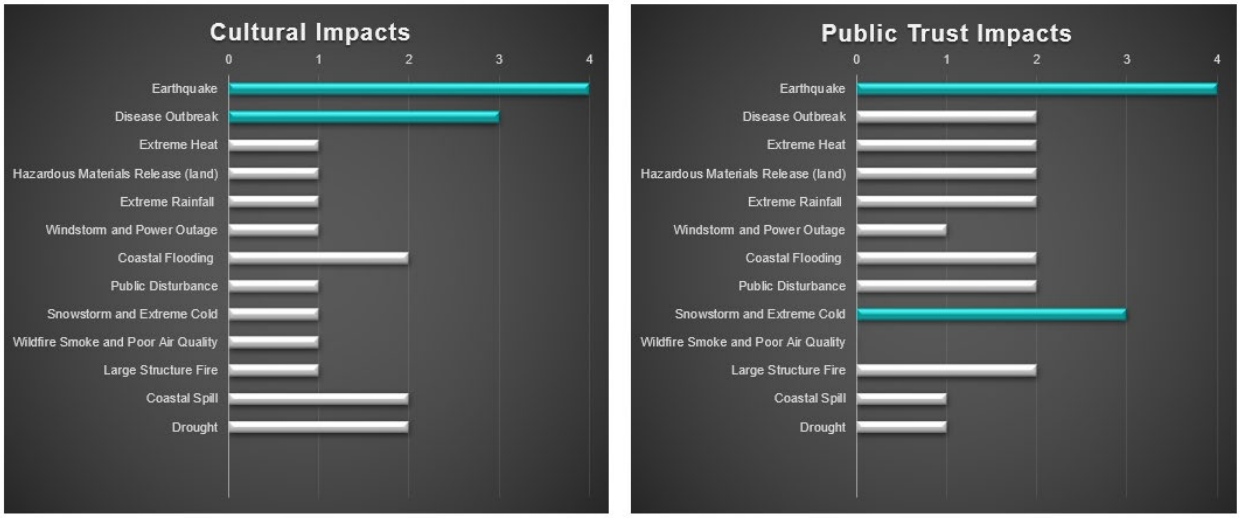


Figure 4 Hazard consequence graphs.

---

[i] British Columbia Coroners Service. (2022). Extreme Heat and Human Mortality: A Review of Heat-Related Deaths in B.C. in Summer 2021: https://www2.gov.bc.ca/assets/gov/birth-adoption-death-marriage-and-divorce/deaths/coroners-service/death-review-panel/extreme_heat_death_review_panel_report.pdf

[S] Insurance Bureau of Canada. (2024). Severe Weather in 2023 Caused Over $3.1 Billion in Insured Damage: https://www.ibc.ca/news-insights/news/severe-weather-in-2023-caused-over-3-1-billion-in-insured-damage

[iii] Insurance Bureau of Canada. (2023). Severe Weather in 2022 Caused $3.1 Billion in Insured Damage: https://www.ibc.ca/news-insights/news/severe-weather-in-2022-caused-3-1-billion-in-insured-damage-making-it-the-3rd-worst-year-for-insured-damage-in-canadian-history

[iv] World Economic Forum. (2024). Global Risks Report: https://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2024.pdf

[v] Government of Canada. (2023). Canada's National Adaptation Strategy: https://publications.gc.ca/collections/collection_2023/eccc/en4/En4-544-2023-eng.pdf

[vi] FEMA Federal Insurance and Mitigation Administration. (2018). Natural Hazard Mitigation Saves Interim Report Fact Sheet: https://www.fema.gov/sites/default/files/2020-07/fema_mitsaves-factsheet_2018.pdf

[vii] Public Safety Canada. (2022). National Emergency Response System: https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/ntnl-rspns-sstm/index-en.aspx

[viii] Vancouver Coastal Health Chief Medical Health Officer. (2023). "Protecting population health in a climate emergency: Report of the Vancouver Coastal Health Chief Medical Health Officer." https://www.vch.ca/sites/default/files/2024-02/vch-climate-change-health-report.pdf

[ix] Chief Public Health Officer of Canada's Report on the State of Public Health in Canada. (2023). Creating the Conditions for Resilient Communities: A Public Health Approach to Emergencies: https://www.canada.ca/content/dam/phac-aspc/documents/corporate/publications/chief-public-health-officer-reports-state-public-health-canada/state-public-health-canada-2023/report/report.pdf