Attachment A

EMC EMERGENCY MANAGEMENT COWICHAN

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Cowichan Region Hazard, Risk, and Vulnerability Analysis

October 2024

CVRD

TOWN OF LAKE COWICHAN INC. A.D. 1946

DUNCAN

LADYSMITH

MUNICIPALITY OF NORTH Cowichan

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Revision History

Revision No.	Date	Description	Remarks
1	22 Sep 2023	Draft	Shared with client for comment
2	02 Oct 2024	Final	Client comments incorporated

Territorial Acknowledgement

The project area encompasses the unceded traditional territories of the Quw'utsun, Malahat, Ts'uubaa-asatx, Halalt, Penelakut, Stz'uminus, Lyackson, Pauquachin, Ditidaht, and Pacheedaht Peoples. The project workshop took place on the territory of the Cowichan Tribes (Quw'utsun). EMC pledges to collaborate with and support Indigenous communities in meaningful ways in the realm of hazard and risk management.

This report was written at the Ebbwater Consulting Inc. office, which is located on the unceded traditional territories of the xʷməθkʷəy̓əm (Musqueam Indian Band), Sḵwx̱wú7mesh (Squamish Nation), and səlilwətaɬ (Tsleil-Waututh Nation), as well as at the SHIFT Collaborative office located on unceded Kwakwaka'wakw Territory of the 'Namgis, Mamalilikala, and Kwakuitl Nations.

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Project team:

- April Diver (Manager, Emergency Operations & Planning, EMC), was the client project manager.
- Ryan Wainwright (Senior Manager, Emergency Management Division, EMC) provided EMC feedback.
- Silja Hund, PhD, (Ebbwater), was the consultant project manager and led the technical analysis and report writing, as well as supported the development of the engagement activities and materials.
- Jessica Boland, M.S., P.E, (Ebbwater), was the project analyst, and conducted analysis and contributed to reporting as well as engagement sessions.
- Yinlue Wang, M.Sc. (Ebbwater), provided general project support.
- Erica Crawford, MA (SHIFT Collaborative), led the development, coordination, and delivery of the engagement sessions. She also contributed to the report. Her support team included Devon Francis.
- Tamsin Lyle, M.Eng., MRM, P.Eng., (Principal of Ebbwater), provided senior review of the report as well as advice throughout.

Advisory Committee Members:

- Brian Murphy (City of Duncan), Cindy Smith (Malahat Nation); Josh James (Penelakut Tribes); Kate Miller (CVRD), Krista Perrault (Stz'uminus); Mike Gregory (City of Ladysmith); Sabrina Elliott (Cowichan Tribes); Shawn Cator (North Cowichan).

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1. Introduction

The Cowichan region faces various natural and anthropogenic hazards, with changing climate and community dynamics adding to the complexity. By taking proactive steps, the region can enhance its resilience to these hazards. Implementing a robust framework for disaster risk reduction is crucial, offering an opportunity to transform emergency management, increase resilience to stressor and shock events, and improve overall livability and health. The Hazards, Risk, and Vulnerability Analysis (HRVA) is a key tool for understanding and addressing priority hazards.

Emergency Management Cowichan (EMC) is a regional service, administered by the Cowichan Valley Regional District (CVRD), serving the regional district, member municipalities, and working with partner First Nations. EMC sought to develop an HRVA for the entire region. The HRVA involved input and engagement from a broad participant group to address the evolving hazard landscape and enhance risk and resilience understanding. The objectives of the HRVA were specifically to:

1. Characterize and prioritize hazards that are relevant for the Cowichan region.
2. Identify key vulnerabilities and risk associated with priority hazards.
3. Inform risk reduction and resilience measures.
4. Build capacity and resilience via workshops and engagement.

This report provides a brief overview of the HRVA. The appendices offer further details:

- Appendix A – Project Background
- Appendix B – Disaster Risk Reduction and Resilience Background
- Appendix C – Methods
- Appendix D – Regional Profile and Vulnerabilities
- Appendix E – Priority Hazards: Characteristics, Impacts, and Hazard-Specific Recommendations
- Appendix F – Key Steps towards Risk Reduction and Resilience in the Cowichan region
- Appendix G –References

This report is supplemented by the following attachments:

- Attachment 1 – Hazard Characterization Spreadsheet (for 57 HRVA hazards)
- Attachment 2 – Recommendations Overview Spreadsheet
- Attachment 3 – Workshop Handouts

Project Area

The Cowichan region, situated on the southern part of Vancouver Island, spans from the West Coast of the Pacific Ocean to the Salish Sea, including Thetis, Penelakut, and Valdes Islands (**Figure 1**). It encompasses the CVRD, consisting of nine electoral areas and four municipalities. The region is on the unceded traditional territory of many First Nations. The vast region has diverse geography, including mountains, coastlines, and settled communities along shores and river valleys. The population of 89,000 (2021 census) is primarily concentrated on the eastern side of the region.

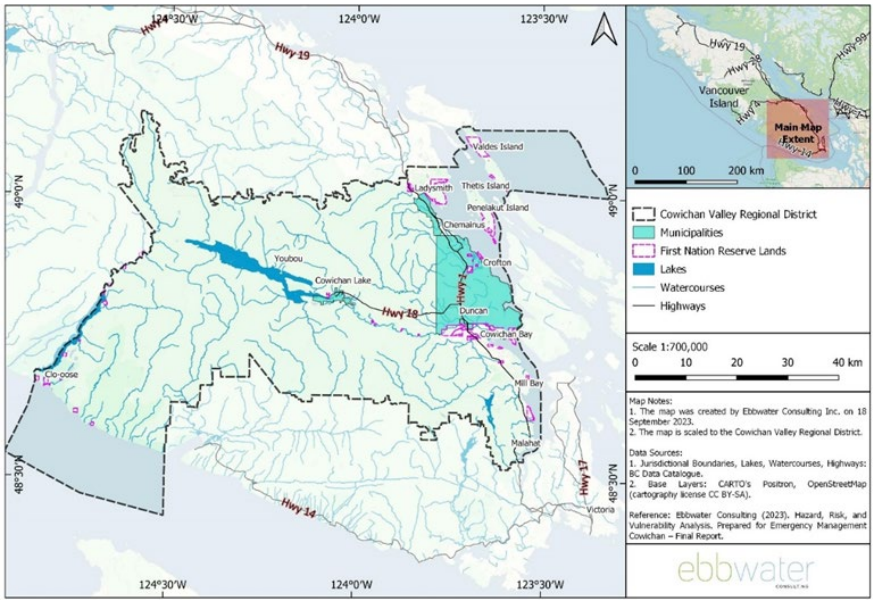

Figure 1: Cowichan region HRVA area.

2. Disaster Risk Reduction Background

Natural hazard **risk** arises from negative interactions between **hazards** and the things we care about such as assets, people, or the environment. Intentional decisions can decrease risk and enhance system resilience. Disasters are complex, impacting homes, businesses, economies, cultural assets, and the environment, with socio-factors influencing vulnerability. **Figure 2** provides a conceptual model for risk.

Hazard *is a potential source or event that may cause harm and damage to humans, property, businesses, and the environment.*

Exposure *refers to things we care about (e.g., assets, people, sensitive ecosystems) that are located in hazard-prone areas.*

Vulnerability *describes the susceptibility of exposed elements to hazards.*

Likelihood *is the chance of a hazard event happening.*

Consequence *describes the impact (exposure and vulnerability) of a hazard.*

Risk *involves the likelihood and consequences of an event.*

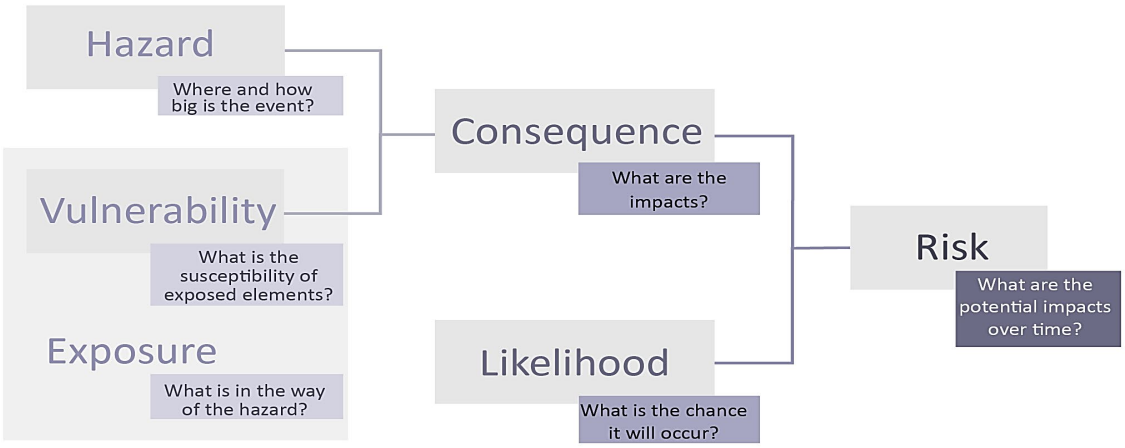

Figure 2: Risk as a function of consequence and likelihood.

For a given hazard event, people and communities with higher **social vulnerability** are likely to face more challenges and have limited capacities to be resilient in preparation, response, and recovery.

Equity, diversity, and inclusion play fundamental roles in addressing social vulnerability. Equity involves ensuring fairness and justice in policies, processes, and outcomes, particularly for historically marginalized groups. This entails addressing power imbalances, unequal access to resources, and systemic barriers that contribute to vulnerability.

Social vulnerability *refers to the predisposition of groups or communities to experience disproportionate impacts during events due to underlying social, economic, and institutional factors. The concept encompasses socioeconomic status, access to resources, physical and mental health, education, and social networks. Understanding these components is essential for effective assessment and the development of*

Resilience is crucial. It involves positive responses to shocks and chronic stresses, emphasizing quick recovery. The traditional hazard-focused approach is shifting towards a risk-based approach. A resilience-based approach takes this it one step further, and considers community recovery and thriving, requiring understanding both risk and community capacity.

Resilience *is the ability to resist, absorb, adapt, and recover from hazards.*

What are EDMA and HRVA?

Emergency Disaster Management Act (*EDMA*) replaced the previous *Emergency Program Act* [1995] in fall 2023. The goal of the new *EDMA* is a proactive approach to disaster management that includes mitigation, preparedness, response, and recovery. Its guiding principles reflect the United Nations Sendai Framework for Disaster Risk Reduction and acknowledge the relation between climate change and emergency management. Importantly, it is in alignment with the *Declaration on the Rights of Indigenous Peoples Act* [2019] (*DRIPA*), recognizes self-determination of Indigenous peoples, and requires shared decision-making.

EDMA serves as a legal framework for coordinating emergency response during crises and mandates the conduct of the locally driven and informed Hazards, Risk, and Vulnerability Analysis (HRVA) to assess potential threats, evaluate associated risks, and identify vulnerable areas or populations. By integrating HRVA into their emergency management programs, authorities can develop more informed emergency plans, allocate resources effectively, and implement targeted mitigation strategies to reduce the impact of disasters on communities. This relationship ensures that disaster management efforts are based on a thorough understanding of hazards, risks, and vulnerabilities, leading to more resilient and adaptive response measures.

The HRVA supports targeted preparedness by shifting from reactive to proactive approaches and facilitates community engagement initiatives for increased resilience.

3. HRVA Approach

Engagement and capacity building were crucial aspects of the HRVA project. Actively involving the community and developing necessary skills and resources not only deepened hazard understanding but also contributed to empowering the community to respond to and mitigate hazard risks. The project included three partner workshops (Hazard Prioritization, Participatory Risk Assessment, and Risk Reduction and Resilience Measures), through which diverse perspectives were gathered.

Of the many natural and anthropogenic hazards that may occur in the region, 15 were prioritized for deeper understanding, risk reduction, and resilience strategies. **Figure 3** shows the priority hazards that analysis and community feedback identified as highest risk.

More details are available on the project's approach in Appendix A: Project Background, Appendix B: Disaster Risk Reduction and Resilience Background, and Appendix C: Methods.

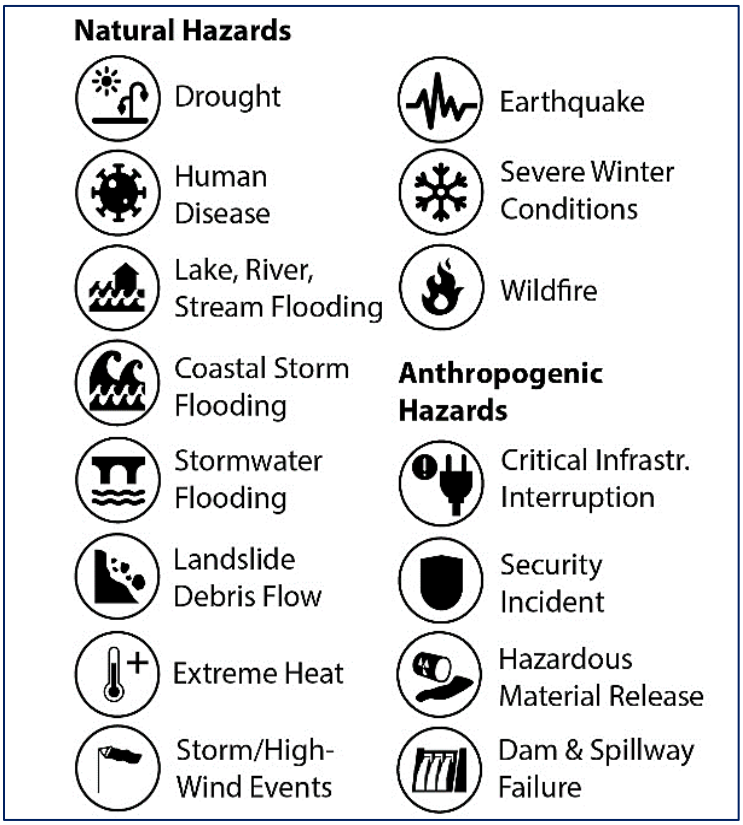

Figure 3: The 15 priority hazards for the Cowichan region.

4. Priority Hazard Profiles

Table 1 lists the priority hazards with definitions, an overview of hazard characteristics, and an indication of increasing risk due to climate change. Hazards are not shown in a prioritized order.

Table 1: Summary of the 15 priority hazards.

Hazard	Definition	Overview		Impacted by Climate Change?
Drought	Drought is a recurrent feature of climate involving a deficiency of precipitation over an extended period, resulting in a water shortage for activities, communities, or aquatic ecosystems (EMBC, 2021). Linked to heat, wildfire, and food source and water service interruption.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Chronic Months - Decades Mainly Summer Months - Years Increasing	↗
Human Disease	Diseases that are caused by pathogenic microorganisms and are spread from one person to another. A pandemic is the worldwide spread of a new disease (EMBC, 2021).	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Chronic Days - Years All Year Uncertain Increasing	↗

Hazard	Definition	Overview		Impacted by Climate Change?
Lake, River, Stream Flooding 	Lake, river, and stream flooding occurs when water from lakes, river channels, or streams overflows onto normally dry land in the floodplain adjacent to the shoreline or channel. Other names may include fluvial, riverine, inland, overbank, or riparian flooding.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Hours - Weeks All Year Days Increasing	↗
Coastal Storm Flooding 	Occurs when ocean water levels are higher than normal due to storm surge, tides, waves, and wind effects. Sea level rise will increase coastal flooding.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Hours - Days Fall - Spring Days Increasing	↗
Stormwater Flooding 	Precipitation cannot infiltrate or be carried by drainage infrastructure, creating flooding sometimes called stormwater, local, pluvial, or flash flooding.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Hours - Days Fall - Spring Days Increasing	↗
Landslides / Debris Flows 	Landslides are slope failures or downward movement of rock, debris, or soil. Excessive rainfall, earthquakes, and human activities are factors that commonly trigger landslides.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Minutes - Weeks Fall - Spring Hours - Days Increasing	↗
Extreme Heat 	Heat waves can be characterized by temperatures significantly above average for an extended period. Linked to drought, reduced air quality, and wildfire risk.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock/Chronic Days - Weeks Summer Days - Weeks Increasing	↗
Storm / High-Wind Event 	Wind gusts, sustained winds, or high wind speeds. Often associated with heavy rain, storms, or extratropical cyclones. Linked to infrastructure impacts (powerlines), causing cascading impacts.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Hours - Days Fall - Winter Days Increasing	↗
Earthquake 	Ground-shaking due to movement along a fault rupture that can also trigger landslides and liquefaction. Secondary hazards include fires, floods, and tsunamis.	**Type** **Duration** **Seasonality** **Warning Time**	Shock Days (Aftershocks Weeks – Months) All year Seconds - Minutes	
Severe Winter Conditions 	Snowstorms and blizzards. Meteorological disturbance giving rise to a heavy snowfall, often accompanied by strong winds (blizzard). Linked to infrastructure impacts.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Days - Weeks Winter Days - Weeks Increasing	↗
Wildfire 	Unplanned fires, including unauthorized human-caused fires, occurring on forest or range lands, which burn forest vegetation, brush, etc., and can spread to developed areas such as the wildland urban interface (WUI).	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Days - Weeks Spring -Summer Hours - Days Increasing	↗

Hazard	Definition	Overview		Impacted by Climate Change?
Critical Infrastructure Interruption 	Any interruption of critical infrastructure, that is essential for the functioning of society and will lead to cascading consequences. Includes electrical service, food source, telecommunications, transportations, wastewater services, water services, and fuel source interruptions.	**Type** **Duration** **Seasonality** **Warning Time**	Shock Hours - Months All Year Variable (None – Hours)	↗
Security Incident 	An act or interruption that poses major threat to society. Examples include riots, bomb threats, active shooter, etc.	**Type** **Duration** **Seasonality** **Warning Time**	Shock/Chronic Hours – Days All Year Variable	
Hazardous Materials Release 	A hazardous material (HazMat) release is any uncontrolled release of material (e.g. toxic gases, radioactive material, acids, chemicals, gas, or oil spills), either in transit or at a fixed location, that poses an immediate threat to health, safety, and property. Sources include facilities, industrial sites, ports, marinas, boats, railways, and roadways.	**Type** **Duration** **Seasonality** **Warning Time**	Shock Days All year None - Hours	
Dam & Spillways Failure 	Failure of a dam or spillway structure that would release water/debris downstream. This can be a 'sunny-day' failure outside a storm due to engineering failure or seismic event or a 'rainy-day' failure because of high-water levels and inflows.	**Type** **Duration** **Seasonality** **Warning Time**	Shock Minutes - Days All Year Seconds - Days	↗

Figure 4: Hazard-specific consequence graphic from community engagement.

More in-depth information for each hazard, including historic events, potential impacts, as well as existing and recommended measures for risk reduction and resilience are available in Appendix E. This includes learnings from the three partner workshops. For example, **Figure 4** shows the impact (or consequence) scores assigned by community partners for a range of categories as part of the Participatory Risk Assessment. Considering several categories allowed for a holistic assessment of risk from multiple perspectives. The categories are defined below for full understanding of scope.

People: *Potential number of people injured, ill, or killed as a result of the hazard as well as disruption to regular living situations, requiring people to either leave their home or be confined to their home without access to regular services. This category represents the Fatalities, Injury/Disease/Hospitalization, and Displacement HRVA categories.*

Economy: *The direct negative consequences of a hazard on buildings, structures, and other forms of property, as well as disruption or loss of ability for individuals, businesses, and governments to generate income. This category represents the Property Damage and Economic Impact HRVA categories.*

Social/Culture: *Impacts to the emotional and social well-being of an individual, family group and/or community; Loss of accessibility to supports/networks or community groups, community reciprocity, trust, and cooperation between community members; Loss of cultural heritage and/or identity. May include loss of works, objects, places, practices, and ecology that are directly associated with an important aspect or aspects of human history and culture. This category represents the Psychosocial, Support System, and Cultural Impact HRVA categories.*

Environment: *The negative consequences of a hazard on the environment, including the soil, water, air and/or plants and animals. This category only represents the Environmental Damage HRVA category.*

Government/Reputation: *A negative change in the perception of the government or organization, in the minds of the community, its partners and others who are vital to its success. This can result in socioeconomic damage or disruption such as loss of community or partners' trust and an increase in negative media attention. This category only represents the Reputational Impact HRVA category.*

Critical Infrastructure: *An impact to critical infrastructure, including its processes, systems, facilities, technologies, networks, assets, and/or services, that results in consequences to the health, safety, security or economic well-being of community members and the effective functioning of the government. This category only represents the Critical Infrastructure Impact HRVA category.*

Figure 5 compares risk (as the combination of likelihood of a hazard planning scenario and its associated consequences) for the six impact categories for selected hazards. Consequences are based on scores assigned in the Participatory Risk Assessment workshop for specific hazard planning scenarios. Figure 5 shows how some hazards may have a bigger impact on some assets than others. For instance, for drought and extreme heat, as well as for hazardous material spills, consequences were scored as high (detrimental) for the environment.

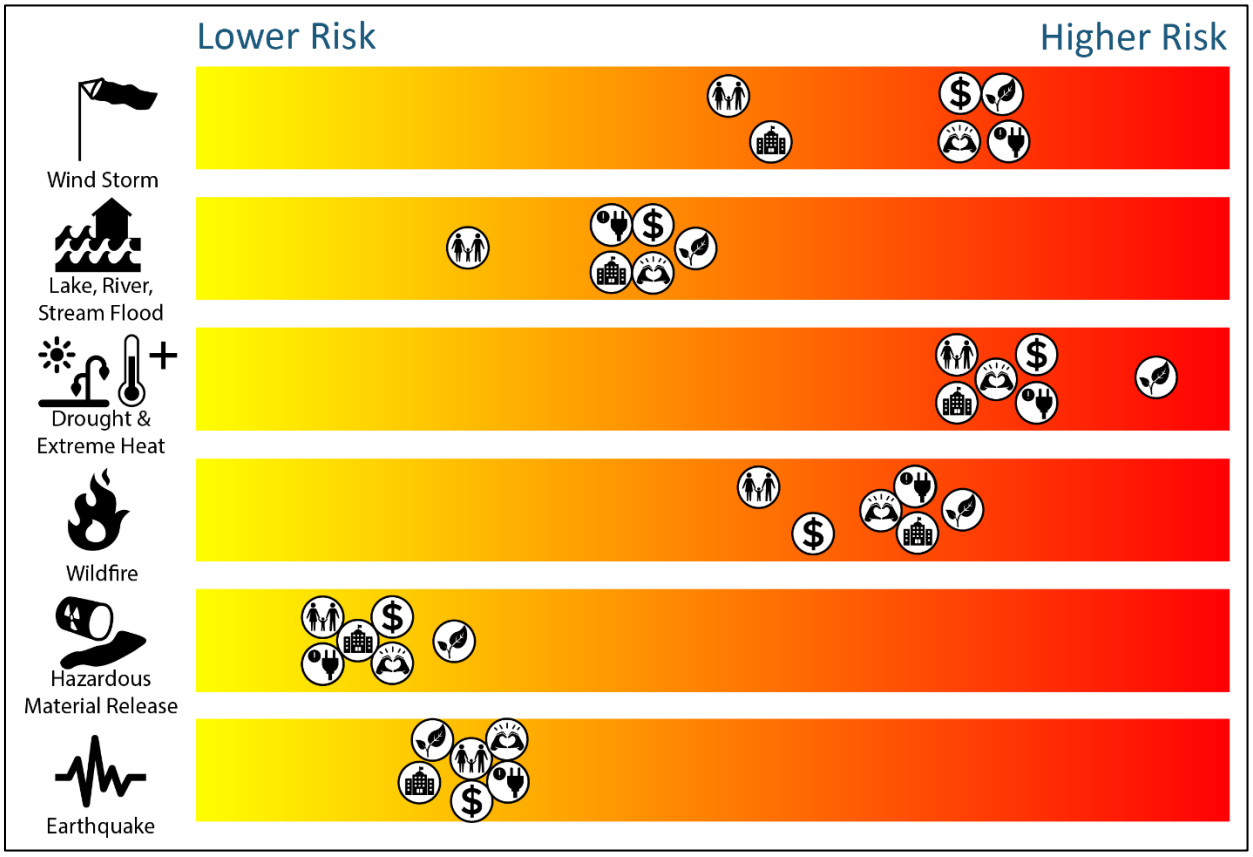

Figure 5: Risk profiles for specific scenario, based on Participatory Risk Assessment for selected hazards scenarios.

A risk summary for the 15 priority hazards is in **Figure 6**. Risk is the likelihood (unlikely to almost certain) of a hazard to occur and the associated consequence (low to high impact to people, environment, economy etc.) of these hazards. The high-level risk shown only indicates general tendencies of a hazard. The figure shows that the priority hazards with the highest risk are human disease, extreme heat, drought, flooding, windstorms, wildfire, and earthquake.

Both **Figure 5** and **Figure 6** also visualize how a smaller, more frequent hazard (such as extreme heat) can lead to a higher risk, than a more catastrophic but rare hazard (such as earthquake), given the cumulative impacts of the re-occurring hazard event over time. It is important to not only prepare for the big and catastrophic hazards, but also for the smaller, yet more frequent ones.

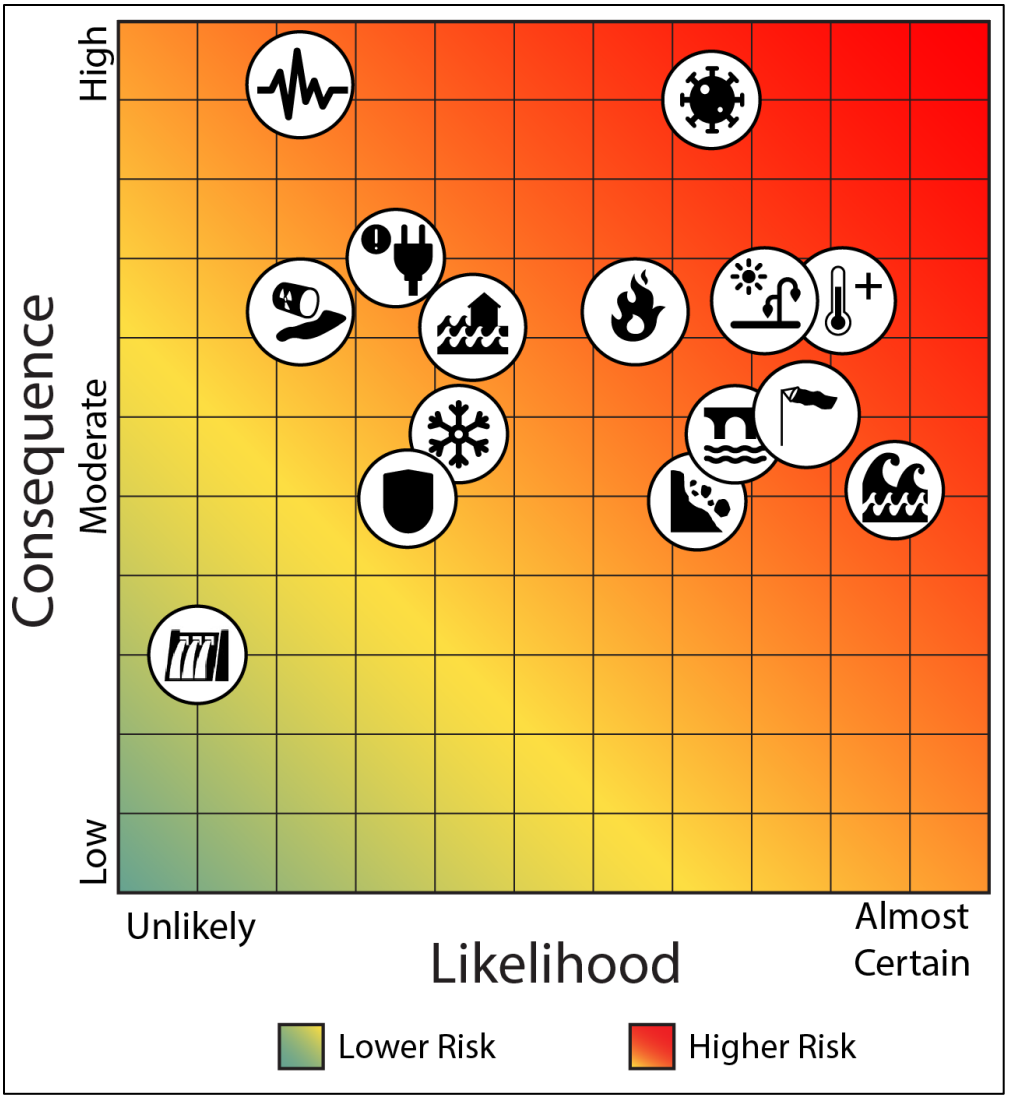

Figure 6: Risk matrix for priority hazards. Note that for the hazards presented in Figure 5, risk is based on the planning scenario used in workshop.

5. Current Preparedness & Preparedness Perception for Priority Hazards

In addition to assessing the risk for the priority hazards, the project included reviewing the current preparedness for these hazards in the Cowichan region. Based on a scan of the existing risk reduction and resilience measures, **Table 2** summarizes preparedness by five emergency planning and response categories and their average. The partner workshop provided additional information on how participants viewed preparedness in the region for a hazard (last column in table). Hazards with lowest preparedness were mostly anthropogenic (hazardous material release, security incident and critical infrastructure interruption), as well as stormwater flooding. Workshop participants also highlighted drought, where much has been done already, but more work is considered needed. The hazard with the highest preparedness was extreme heat. Workshop participants also considered extreme winter conditions and lake/riverine flooding as well prepared. While some categories of preparedness were marked as very low, no category scored very high, indicating room for continued improvement for all hazards.

Table 2. Overview of current hazard preparedness, ordered from least to most prepared.

Hazard	1. Understand & Plan	2. Mitigate Risk	3. Build Resilience	4. Respond	5. Recover	Preparedness (Average)	Partner Workshop Results
Hazardous Materials Release						Low	
Security Incident						Low	Needs work
Critical Infrastructure Interruption						Low	Needs work
Stormwater Flooding						Low	
Dam & Spillways Failure						Medium	
Landslides / Debris Flows						Medium	
Severe Winter Conditions						Medium	Best Prepared
Storm / High-Wind Event						Medium	
Human Disease						Medium	Needs work; Best Prepared
Drought						Medium	Needs work
Lake, River, Stream Flooding						Medium	Best Prepared
Coastal Storm Flooding						Medium	
Earthquake						Medium	
Wildfire						Medium	
Extreme Heat						High	Best Prepared

Preparedness:	Very low	Low	Medium	High	Very High

6. Key Steps towards Risk Reduction and Resilience

6.1 All-Hazards Recommendations – Big Ideas and Next Wise Actions

One of the key recommendations heard from the community, and which is becoming more urgent in a world of multi-hazard events, is to use an all-hazards approach towards risk reduction and resilience.

This section provides recommendations for key steps for the Cowichan region, listed below and further described on the following pages:

1. Multi-jurisdictional Collaboration.
2. Community Building & Preparedness.
3. Understanding & Planning for Risk.
4. Social Resilience & Wellbeing.
5. Emergency Response & Recovery.
6. Critical Infrastructure Resiliency.
7. Participation in Provincial Activities.
8. Healthy Ecosystems.

Multi-hazard Relationships
Hazards and hazard assessments are often developed with a singular focus, and an assumption that hazards are independent events. However, some hazards, like earthquakes and tsunamis, are inherently linked, and others may coincidentally occur simultaneously, especially with prolonged stressors like pandemics. In the Cowichan region, locations typically face multiple hazards with the potential for interrelated effects and simultaneous occurrences.

All-hazards Approach
The term all-hazards refers to the entire spectrum of hazards, whether they are natural or human induced. An all-hazards approach focuses on actions that increase preparedness and resilience and reduce vulnerabilities of the community in general (i.e., not specific for one hazard).

6.1.1 Multi-Jurisdictional Collaboration

Collaboration is vital for enhancing disaster resilience in the region. Participants recognized collaboration as a key strength, leveraging the willingness, abundance of experience, and existing relationships across governments, community leaders, organizations, and neighbourhoods.

To improve coordination and alignment:

- Clarify roles, priorities, and responsibilities at a regional level.
- Hold regular regional meetings, training, and learning sessions on Disaster Risk Reduction and Emergency Management.
- Proactively foster relationships and capacity building across the region to improve regional resilience during events.
- Utilize experience, reports, and plans in the region, ensuring institutional memory is maintained.
- Ensure consistent and accessible communication before, during, and after disasters/emergencies (e.g. one source of truth).
- Secure funding for region-wide and targeted initiatives.
- Embed resilience into all facets of operations.

BIG IDEA #1: REGIONAL COLLABORATION

- Bring together organizations and individuals (e.g., municipalities, First Nations, first responders, community/service organizations, volunteer groups).
- Host regular tabletop/scenario-based exercises to enhance awareness, role clarity, and relationships across the region.
- Utilize exercises to collaborate on all disaster management phases (mitigation, preparedness, response, recovery).
- Collaborate to advance shared recommendations to incorporate into community policies such as Official Community Plans, bylaws, and other tools.

Next wise actions…

- *Continue to regionalize efforts by getting partners on board, beginning with participants and extending to leaders, councils, and community organizations.*
- *Regular (monthly) region-wide emergency management meetings (discuss initiatives and plans, hold capacity-building sessions, etc.).*
- *Update the regional response plans and build cross-jurisdictional teams for implementation.*
- *Develop hazard-specific and community-specific information though a common platform.*

6.1.2 Community Building & Preparedness

There is opportunity to build on existing systems and resources by tapping into community capacity and collaboration. For example, Ladysmith holds monthly emergency preparedness meetings, and Thetis Island has volunteer-coordinated emergency response zones. Drawing on local knowledge and teamwork, we can all take ownership of preparing for emergencies. This means those who can prepare should do so, freeing up services for those who do not have the ability.

To build public awareness for emergencies:

- Create easy-to understand resources accessible across communities, considering cost, language, relevance, distribution, etc.
- Have difficult conversations (what happens beyond tolerable level of risk?), following good practice for risk communications, about risk and what people can do to be ready.

To promote neighbourhood and household preparedness:

- Revive/continue programs that teach people how to be ready.
- Connect people to tools, resources, or workshops to build resilience.
- Encourage neighbours to help neighbours before, during, and after emergencies.

BIG IDEA #2: DEVELOP COMMUNITY RESILIENCE HUBS

- Look for areas where there is capacity, interest, or need.
- Call for interest from neighbourhoods and groups to get involved.
- Support groups with information and tools.
- Organize practice emergencies to bring neighbours together.
- Provide grants to encourage local activities and support functions over time.
- Facilitate collaboration for those in emergency preparedness and response.

Next wise actions…

- *Provide useful information and ways to get involved for individuals, groups, and neighbourhoods.*
- *Start with a few people who can become resources to others in the community.*

6.1.3 Understanding & Planning for Risks

Workshop participants reported that a lot has been done to understand hazards (e.g., flood modelling and mapping; groundwater supplies), but that gaps exist in linking this to vulnerabilities. Similarly, plans exist for some hazards and impacts, but not all, especially for critical infrastructure and how to recover (e.g., response and recovery plans).

To strategically advance assessments and plans:

- Look at the potential of multiple hazards and plan for how they might interact.
- Prioritize a collaborative approach and "multi-solving" lens for disaster risk management. Use this foundation to plan for multiple hazards across jurisdictions and departments and to consider the multiple values and co-benefits.
- Prioritize plans and assessments with multiple applications and benefits like recovery, critical infrastructure protection, and business continuity for priority sites.
- Plan as a region for events that are too big for a local area to handle alone.

Make use of land use policies and tools to reduce risk:

- Align policies across the region for consistency and to support public awareness.
- Update policies to integrate hazard and risk considerations.
- Restrict or prevent development in hazard areas.
- Implement risk tolerance guidance for land use.
- Protect or restore natural areas as a hazard mitigation tool.

BIG IDEA #3: PLAN THOUGHTFULLY, TAKE ACTION

- Think carefully and translate thoughts into action.
- Build from what already exists – get clear on the big picture to focus on priorities.
- Prioritize hazards, risks, and actions by focusing first on likely hazards, then building on that to address others.

Next wise actions…

- *Use prioritization from the HRVA process, lessons learned from experience and plans, and best practices to determine next steps.*
- *Take any idea and just start!*

6.1.4 Social Resilience & Wellbeing

Hazards disproportionately affect vulnerable populations ("priority populations"), including under-housed, low-income, seniors and First Nations people. Vulnerable and isolated people often have fewer resources and less ability to prepare for and recover from disasters. Disasters, repeated experiences, or anticipation of disasters can have ongoing impacts on mental health and wellness that can exacerbate trauma for individuals and communities.

To equitably plan, respond, and recover:

- Ensure the needs of priority populations are identified and included in planning such as in evacuations, communications, and recovery plans.
- Address basic needs of priority populations such as safe housing and food security.
- Strengthen joint planning between government, first responders, and service providers to include and support priority populations during response and recovery.

To support mental health and wellness:

- Educate community groups on trauma-informed support during emergency response and recovery.
- Publicize mental health resources available following disaster events.

BIG IDEA #4: UNDERSTAND AND INCLUDE PRIORITY POPULATIONS

- Engage with priority populations and those who serve them to understand needs and capabilities.
- Engage community organizations, service providers, and government to ensure better tools and supports during and after disaster events.
- Share information with the public so everyone can include and support priority populations during emergencies.

Next wise actions…

- *Identify groups most at risk during hazards.*
- *Work with first responder and community organizations to develop targeted plans (e.g. communications) to support priority populations during hazards.*
- *Identify specific plans necessary to support priority populations, along with the necessary training and funding for success.*

6.1.5 Emergency Response & Recovery

Ensure that coordination and communication during emergencies is improved and understood for effective response. Build capacity in communities and the region to ensure response options and capacity are available when needed. In addition, recovery efforts need adequate attention and planning as they are essential after all events.

Improve Coordination & Communication:

- Communicate proactively with the public, using a range of formats for accessibility but leveraging a single source of truth for accuracy and trust. Cater to groups like seniors who may lack smartphones or internet.

Provide Training Regionally:

- Use Shakeout drills as a model to raise awareness and preparedness.
- Develop and practice evacuation strategies, including for remote areas and unique situations (e.g., people in the backcountry; large events; mass care).
- Train volunteers, service agencies, and neighbourhood groups to support during emergencies.
- Train response teams and ensure they have sufficient depth to accommodate for illnesses and attrition.

Plan for Recovery:

- Develop recovery plans for common hazard events and adapt them as needed.
- Develop re-entry plans for safe return of residents as well as long-term recovery plans for stability and security.

6.1.6 Critical Infrastructure Resiliency

Addressing critical infrastructure resilience is another area with widespread application, as many hazards can have cascading critical infrastructure impacts.

Prioritize and enhance infrastructure resilience:

- Reference and enforce codes, standards, and regulations that promote resilience in infrastructure design, construction, and maintenance.
- Build back to higher standards, following disaster events, or opportunistically during upgrades, to enhance regional infrastructure resilience over time.
- Conduct a comprehensive critical infrastructure risk assessment to identify vulnerabilities to natural and anthropogenic threats as well as climate change.
- Prioritize critical infrastructure based on their function for society and public safety.
- Allocate sufficient funding and/or leverage grant funding to upgrade infrastructure. This can include implementing innovative technologies or pilot projects.
- Improve power infrastructure resilience to wildfires, storm/high-wind events, and other hazards.

Plan for interruptions and failures of critical infrastructure:

- Integrate resilience considerations into urban planning, land use zoning, and development regulations to ensure that new infrastructure projects are resilient to future hazards and climate impacts.
- Generate strategies to address remote communities, transportation routes, supply lines, business continuity, essential services (medical, communications, food, fuel, etc.)
- Diversify electricity sources, both individually and regionally.
- Plan for water scarcity and drought resilience.

6.1.7 Participation in Provincial Activities:

- Ensure that the EMC voice is heard at provincial and broader regional tables related to the Provincial Climate and Disaster Risk Assessment, especially as regional assessments are carried out starting in 2025.
- Foster collaboration among all levels of government (agencies, private sector entities, community organizations, and other stakeholders) to coordinate efforts, share information, and implement resilience measures effectively.
- Understand the implications of *EDMA* changes and provide feedback towards regulation development.

6.1.8 Healthy Ecosystems

- Work with community partners to preserve and restore ecosystems (ecosystems that have high biodiversity and functioning are more resilient to natural hazards, such as wildfires, floods, landslides).
- Leverage programs and grant opportunities to build in ecosystem resilience to hazards.

6.2 Hazard-Specific Recommendations

While the all-hazard section above provides recommendations applicable across all hazards and supports general risk reduction and resilience for the Cowichan region, hazard-specific recommendations for the priority hazards are detailed in Appendix E.

6.3 Project Prioritization and Evaluation Criteria

The report offers recommendations for risk reduction and enhancing resilience. While all-hazard recommendations and next steps have been provided, there may be the need to prioritize between projects, hazards, communities, and funding allocation. To guide decisions and strategic planning for the regional emergency management service (EMC), a set of evaluation criteria are summarized below and provided in full in Appendix F.

- **Multi-hazard approach:** Can this project reduce risk and increase resilience for multiple (or all) hazards?
- **Risk-based approach:** Is the focus of the project on the hazards/areas of highest risk?
- **Resilience-based approach:** Does the project consider current resilience measures, and will it increase community resilience into the future?
- **Reconciliation-focused approach:** Does the project actively implement the principles of DRIPA (Declaration of the Rights of Indigenous Peoples Act, 2019), e.g. include Indigenous partners or leadership)?
- **Equity-focused approach:** Does the project account for social vulnerabilities, disproportionately affected populations, and other equity-related aspects?
- **Climate change approach:** Does the project acknowledge climate change and provide recommendations into the future that allow adapting to a 'New Normal'?
- **Co-benefits approach:** Does the project provide co-benefits to the community or ecosystems?
- **Opportunistic approach:** While this project has originally not been planned as a risk reduction and resilience project, could a planned project be opportunistically used to serve such a purpose (along with its original intent)?

7. Conclusion

This HRVA highlights priority hazards for the Cowichan region, including their hazard and risk profiles, impacts, and recommended actions. These recommendations outline key steps toward risk reduction and resilience in the Cowichan region, emphasizing the importance of collaboration, community engagement, and proactive planning. By prioritizing the all-hazard recommendations, from multi-jurisdictional collaboration to community building and critical infrastructure resilience to the preservation of healthy ecosystems, the region can build a more resilient and prepared community for current and future challenges. Additionally, hazard-specific recommendations are available in the Appendix E.

Through concerted efforts and ongoing commitment from all partners and the public, the Cowichan region can strengthen its capacity to mitigate and withstand and recover from various hazards and threats, ensuring the safety, well-being, and sustainability of its residents and ecosystems.

Appendix A: Project Background

Acronyms

AEP	Annual Exceedance Probability
COVID-19	Coronavirus disease of 2019
CVRD	Cowichan Valley Regional District
DPA	Development Permit Area
DRIPA	Declaration of the Rights of Indigenous Peoples Act
EDMA	Emergency and Disaster Management Act
EMBC	Emergency Management BC (now EMCR)
EMC	Emergency Management Cowichan
EMCR	Emergency Management and Climate Readiness (BC)
ESS	Emergency Support Services
FCL	Flood Construction Level
FNLG	First Nation and Local Governments
HRVA	Hazards, Risk, and Vulnerability Analysis
MoTI	Ministry of Transportation and Infrastructure
OCP	Official Community Plan
RCMP	Royal Canadian Mounted Police
Sendai Framework	Sendai Framework for Disaster Risk Reduction
SVI	Social Vulnerability Index
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
WUI	Wildland Urban Interface

Project Inception

The Cowichan region is susceptible to multiple environmental, biological, and anthropogenic hazards. With the changing climate and the dynamic nature of the community, these hazards will also change over time, which has substantial implications. But, if steps are taken now, the Cowichan region can ready itself to become a resilient region. If a robust framework is put in place today, the region can look at disaster risk reduction as an opportunity to change the emergency management regime, increase resiliency to chronic stressors and acute shocks, and improve the overall livability and health of the region.
A community achieves increased resilience when its risks are managed proactively, it is prepared for disaster events, and it demonstrates an ability to recover after events. A key component of preparation is understanding potential priority hazards and how they may unfold. A Hazards, Risk, and Vulnerability Analysis (HRVA) is a framework that can be used for this understanding. An HRVA is an initial tool for emergency management and strategic risk reduction planning. It can be used to understand gaps in emergency planning and management systems, to prioritize and target resources to reduce vulnerabilities and risks, and to support community engagement and education. In British Columbia (BC), the development of an HRVA or similar document was mandated under the *Local Authority Emergency Management Regulation of the Emergency Program Act* [1995], which was replaced by the *Emergency and Disaster Management Act (EDMA)* (November 2023). The updated legislation reflects the realities of today's world including global pandemics, security threats, and climate change. It aims to shift focus from emergency response to emergency management: mitigation, preparation, response, and recovery. Acknowledging the growing complexity of the hazard landscape, the increasing influence of climate change and the need for community engagement to better understand risk and resilience, Emergency Management Cowichan (EMC) sought to develop a fulsome HRVA for the whole of the region. Emergency Management Cowichan (EMC) was established as a regional service, administered by the Cowichan Valley Regional District (CVRD), serving the regional district, and its member municipalities (the Town of Ladysmith, the Town of Lake Cowichan, the City of Duncan, and the Municipality of North Cowichan), and works with partner First Nations (Quw'utsun (Cowichan Tribes), Stz'uminus First Nation, Penelakut Tribe, Ditidaht First Nation, Malahat First Nation, Pacheedaht First Nation, Pauquachin First Nation, Halalt First Nation, Lyackson First Nation, Ts'ubaa-asatx Nation). EMC sought to develop an HRVA for the entire region. The HRVA was completed by Ebbwater Consulting Inc. with support from Shift Collaborative. The consultant team worked closely with EMC and relied on input from a broad participant group to drive the process. This reflected the need of the process to be "closely owned by the community" (Emergency Management BC, 2019).

Project Goal and Objectives

The project goal was to develop an HRVA for EMC. Specifically, the project had the following objectives for the Cowichan region:

1. Characterize and prioritize hazards.
2. Identify key vulnerabilities and risk associated with the priority hazards.
3. Inform risk reduction and resilience measures.
4. Build capacity and resilience via workshops and engagement.

In support of the project objectives, the following principles guided the overall approach:

- Local engagement is key.
- Focus on the geographical scale of the Cowichan region.
- Prioritize hazards that are associated with the highest risk in the region, but also identify a range of all-hazard risk reduction and resilience measures.

Study Area

The Cowichan region stretches across the southern portion of Vancouver Island (Figure 1), from the Pacific Ocean in the west to the Salish Sea in the east, including the Southern Gulf Islands of Thetis, Penelakut, and Valdes. It encompasses the area of the Cowichan Valley Regional District (CVRD), which is comprised of nine electoral areas ("A" through "I") and four municipalities (the Town of Ladysmith, the Town of Lake Cowichan, the City of Duncan, and the Municipality of North Cowichan). It is situated on the unceded traditional territory of the Cowichan Tribes, Stz'uminus First Nation, Penelakut Tribe, Ditidaht First Nation, Malahat First Nation, Pacheedaht First Nation, Pauquachin First Nation, Halalt First Nation, Lyackson First Nation, and Ts'ubaa-asatx Nation.

The region covers mountain ranges to coastal geography, as well as the different settled communities that are dominantly located along coast and lake shores and within river valleys. The population comprises 89,013 inhabitants (2021 census[1]) and is mostly concentrated on the eastern side of the region.

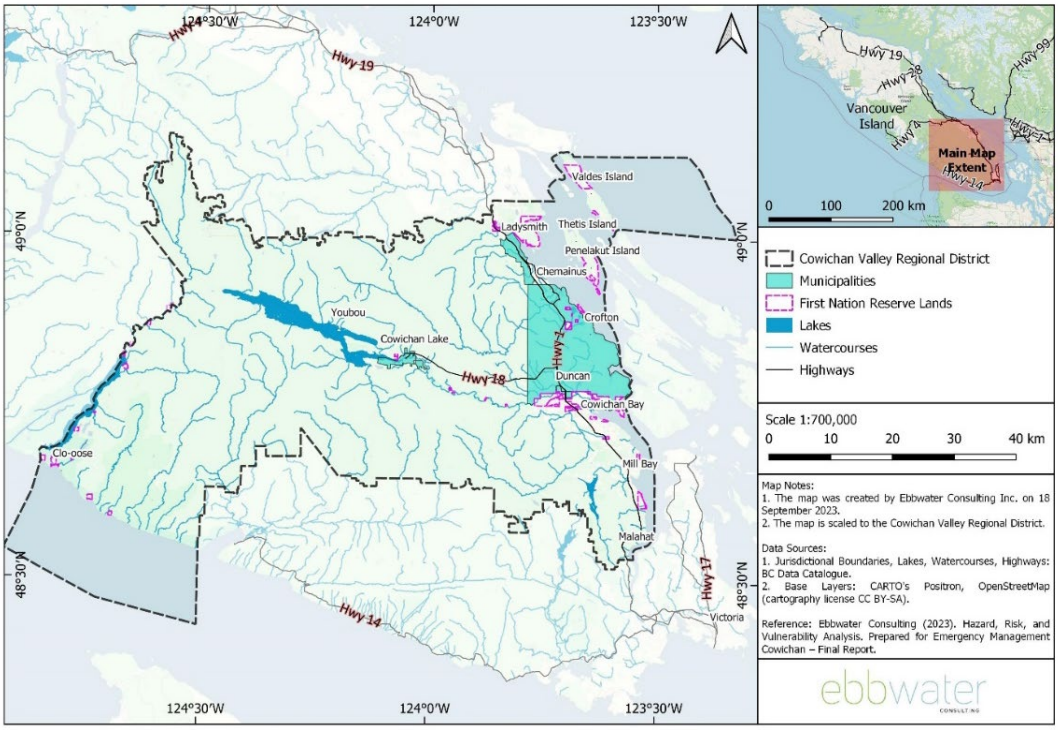

Figure 7: Cowichan region HRVA Area.

Limitations

The following limitations apply to this project:

- **Regional Scale**: This HRVA focused on the scale of the entire Cowichan region, given the mandate of the EMC to serve the region. This necessitated an approach where the focus was on determining hazards and risks at a coarse scale, and with less focus on locally specific hazards and risks. This report provides information for risk profiles present in the entire region.
- **Limited Data Availabilities**: While some detailed hazard datasets and studies exist for some hazards for specific areas, there is limited data coverage for most hazards. Specifically, hazard data that is consistent and comprehensive throughout the entire Cowichan region is scarce.

[1] Weblink: https://www12.statcan.gc.ca/census-recensement/2021/search-recherche/productresults-resultatsproduits-eng.cfm?LANG=E&GEOCODE=2021A00035919. Accessed June 2023.

- **Focus on 15 Priority Hazards:** Given the need to discuss hazards and associated vulnerabilities and resilience in workshops, the project primarily focused on 15 priority hazards that were selected from the 57 HRVA hazards based on their relevance and risk in the Cowichan region. All other hazards were treated with a less detailed approach, drawing on relevant learnings from the priority hazards.
- **Scoping Level:** Given the timeline of the project and the many diverse hazards, landscapes, and communities to be considered, the goal was not to provide a detailed hazard study and risk assessment for each hazard for each community, but instead, to assess specific hazard, vulnerability and risk characteristics via high-level analysis and community engagement and identify priorities for future action towards resilience.
- **Hazard Expertise:** Considering the wide range of natural and anthropogenic hazards discussed in this HRVA, information from available literature and local knowledge (through clients, advisory committee, and workshops) were heavily relied upon to supplement scientific expertise. While every effort was made to ensure accuracy and reliability, users are advised to exercise discretion for hazards in their local context.
- **Limited Policy Review:** Given the many jurisdictions within the study area, it was out of scope to conduct a detailed policy review for each as part of this project. Documents have been reviewed at a high-level for the existing risk reduction and resilience measures table, but this may not include all local policies and regulations.
- **Report Date:** Note that this project was completed in September 2023 and was not substantially updated for events and changes since this time.

Appendix B: Disaster Risk Reduction and Resilience Background

This section provides background information on key concepts and terminology that is used throughout the report.

Understanding Risk and Resilience

Natural hazard risk exists not because hazards exist, but because these hazards sometimes interact negatively with assets, people, or the environment. These negative interactions can be reduced through intentional decisions that decrease risk and increase the resilience of the system. This section provides context on the terminology used in disaster risk reduction.

Risk

Risk is a function of both the *likelihood* of an event (i.e., what is the chance of an event occurring?) and the *consequences* (or impacts) if that event occurs. C*onsequence* is defined as a function of the *hazard* (where and how severe is the event?) and *vulnerability*. *Vulnerability* can be further described as a function of *exposure* (what is in the way?) and the susceptibility (or inversely the capacity) of the exposed elements to the hazard (UN, 2016). **Figure 1** provides a conceptual model for risk, and terminology definitions follow the figure.

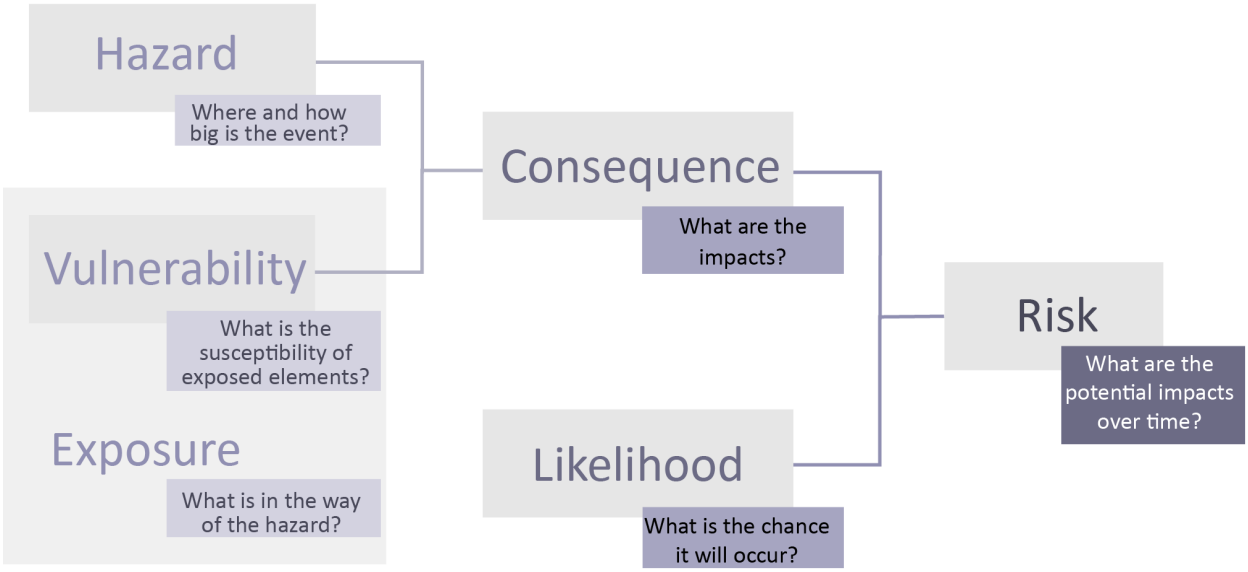

Figure 8: Risk as a function of consequence and likelihood.

Hazard is "a source of potential harm, or a situation with a potential for causing harm, in terms of human injury; damage to health, property, the environment, and other things of value; or some combination of these" (EMBC, 2020).

Vulnerability describes the "conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards" (EMBC, 2020; UN, 2016; UNDRR, 2017b; EMBC, 2020).

Exposure is the "situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas. Measures of exposure can include the number of people or types of assets in an area." (UN, 2016; UNDRR, 2017a; EMBC, 2020)

Consequence is "the physical/environmental, social, economic, and political impact or adverse effects that may occur as the result of a hazardous event" (EMBC, 2020).

Capacity is the "combination of all the strengths, attributes and resources available within an organization, community or society to manage and reduce disaster risks and strengthen resilience." (UN, 2016; UNDRR, 2017a)

Likelihood is "chance of an event or an incident happening" (EMBC, 2020).

Risk is a "concept that takes into consideration the likelihood that a hazard will occur, as well as the severity of possible impacts to health, property, the environment, or other things of value" (EMBC, 2020). Thus, risk is a function of the likelihood of an event occurring and the consequences of that event.

Figure 2 shows risk is a function of hazard likelihood and consequence. Risk increases radially across the diagram. A virtually certain but insignificant event can have the same risk as a catastrophic but unlikely event. This becomes particularly important across time-horizons. For example, a nuisance hazard, which occurs annually over several decades and accumulates losses, may in fact be more impactful over time than a catastrophic hazard that occurs once.

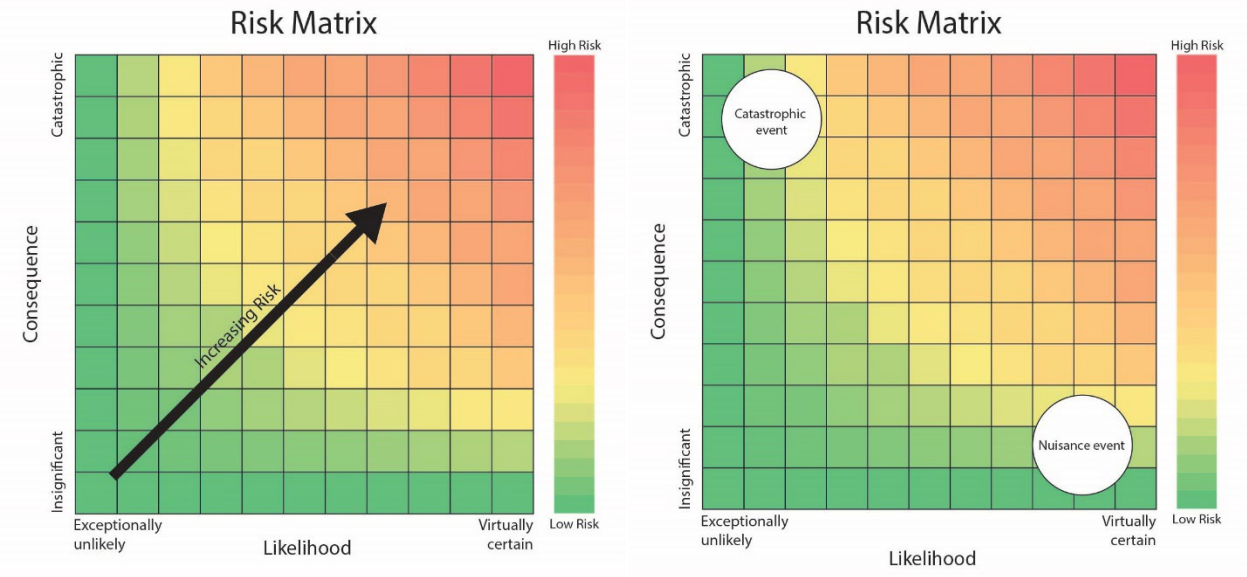

Figure 9: Risk as a function of hazard likelihood and consequence, showing risk for both catastrophic and nuisance events.

Further, risk is dynamic and changes over time (GFDRR, 2016). The variables that form risk are prone to change, driven by natural and human influences. These changes are a result of both global-scale issues, such as climate change that can impact local hazard profiles, and local issues such as land-use decisions.

For many natural hazards it is expected that climate change will increase the likelihood of occurrence (it may also increase the severity and therefore the consequences), which shifts risk from the left to the right of the diagram, resulting in increased risk (**Figure 3**). Alternatively, risk can be changed by increasing the consequences of the hazard occurring, for example by allowing increased development in hazard areas. In this case, the risk shifts from the bottom to the top of the graphic, resulting in increased risk. It should also be noted that these issues can be compounded, and increased likelihood combined with increased consequences will result in dramatically increased risk (as illustrated by the top right of the graphic). Even

with increasing hazard likelihood, it is possible to maintain or decrease risk. This can be achieved by reducing the consequences of the hazard either by changing the exposure or vulnerability of assets, and overall, making the system more resilient to the natural hazard.

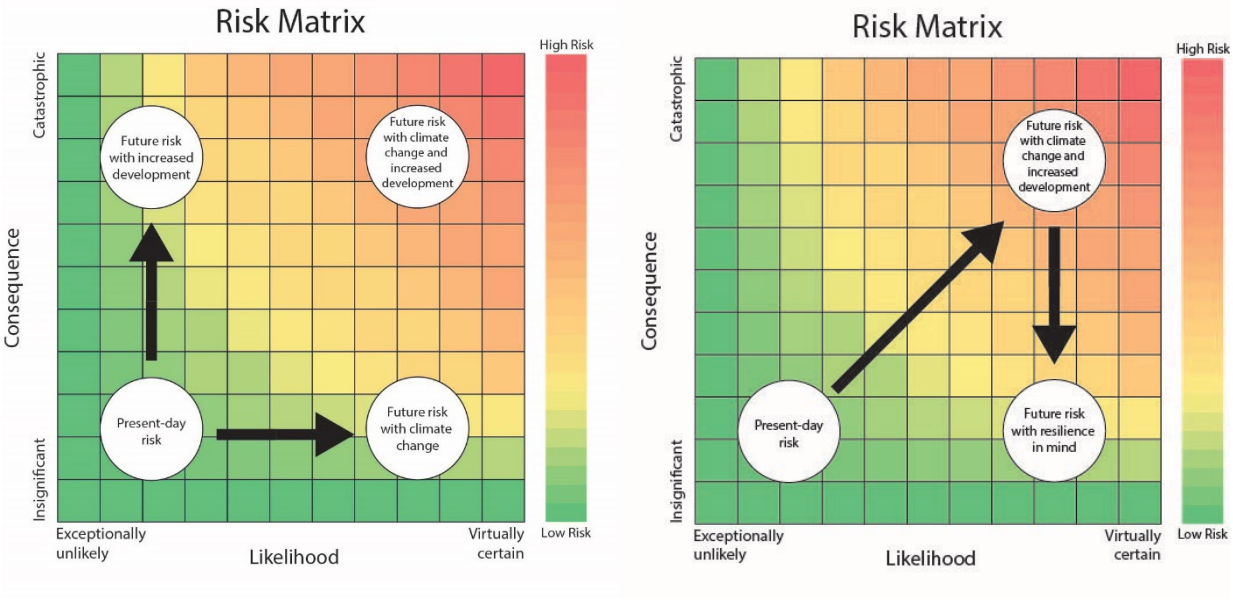

Figure 10: Dynamic risk and resilience.

Lastly, disasters are extremely complex, and hazards can affect many things in different ways. People might lose their homes or treasured possessions or might be seriously injured or killed. Businesses are damaged and may close for short periods or permanently. Economies suffer with disruption of critical services and business closure, and there are large financial implications associated with damages to infrastructure. Further, hazards can cause damage to cultural artefacts and cultural spaces, the reputation and trust of government may be impacted in case of inadequate response, and hazards can cause substantial environmental damages, especially when contaminants enter the natural environment. Within each of these broadly grouped consequence categories, there are additional nuances and complexities. Additionally, the sociological factors of vulnerability, such as race, gender orientation, mental and physical health, play a crucial role in influencing how individuals are impacted by and recover from a hazard event. Within each of these broadly grouped consequence categories, there are additional nuances and complexities. For example, the potential for an individual to be impacted by a hazard, their age, income, education, and even personality will affect their capacity to plan for, respond to, and recover from a hazard event. Similar variation in impacts is seen across all indicator categories. Thus, risk reduction efforts must consider the many facets of disaster impacts and equity.

Resilience

Whereas risk describes the negative impacts associated with the shock of an event, resilience describes the positive responses to both the shock and recovery periods.

Resilience is the "ability of a system, community, or society exposed to hazards to resist, absorb, accommodate, adapt to, transform, and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management" (UN, 2016; EMBC, 2020).

Resilience can be framed around the ability to withstand and bounce back from both shocks such as

floods, earthquakes, hurricanes, wildfires, chemical spills, or power outages, as well as chronic stresses such as sea level rise or socio-economic issues such as homelessness and unemployment.
Given that the world is faced with increasing risks, the field of disaster risk reduction is moving toward promoting solutions that allow for quicker recovery (i.e., resiliency) rather than focusing solely on hazard or risk reduction. Conventionally, focus has been mostly on hazard management – for example, by defining a hazard standard that should be met such as designing for a 0.5% Annual Exceedance Probability (AEP) flood event. However, there is increasing evidence that this approach is failing, and that as a next step, a risk-based approach is needed that considers the hazard and consequences of multiple events as the basis of mitigation. A risk-based approach is a great improvement but is still focused on the shock itself, and not on how a community will respond. Consideration of how a community will recover (and potentially thrive) is a resiliency-based approach, this is an evolution in approach requiring understanding the risk and the capacity of the community to respond and recover.

Drivers for Action on Risk Reduction and Resilience

Disaster risk is always around us. Governments, communities, and individuals are constantly making decisions to avoid or reduce risks. It is becoming increasingly important to understand and address disaster risk, especially to critical infrastructure. Key drivers for action currently include (Australian Government - Department of Home Affairs, 2018):

1. **Increasing intensity and frequency** of many natural hazards with climate change, where more extreme events ill directly impact communities and infrastructure.
2. **Critical services are interconnected and interdependent.** Our modern systems include infinite connections between critical services, where failure of one piece of critical infrastructure (e.g., electricity) could have negative consequences to other aspects (water supply systems, hospitals, emergency response, etc.).
3. **Exposure to natural hazards is increasing.** As communities grow and develop, they are pushing further into hazard areas. For example, as readily developable shallow sloped lands are filled, communities build on steep slopes, increasing overall community exposure to slope hazards. Similarly, with increasing sea levels, coastal areas are becoming more exposed to coastal flood hazards.
4. **Disaster impacts are complex and long-term**. As evidenced by the COVID-19 pandemic, we are beginning to understand the many facets of disaster impacts. This has historically been ignored due to the complexity of the problem. With better understanding of the intangible and secondary impacts of disaster events, it is imperative that these are considered in planning and design for resilience.

Multi-Hazard Interrelationships

Hazards and hazard assessments are often developed with a singular focus, and an assumption that hazards are independent events. However, some hazards are innately linked, for example, a tsunami following an earthquake. Further, some hazards may by chance occur simultaneously, especially when considering longer duration stressors. For example, if a pandemic lasts for years, there is a high chance that another hazard may occur over this period. Typically, and as discussed throughout this report for the Cowichan region, a specific location faces not just a single hazard, but many.

Multi-Hazard "means (1) the selection of multiple major hazards that the country faces, and (2) the specific contexts where hazardous events may occur simultaneously, cascading, or cumulatively over time,

and taking into account the potential interrelated effects". (UN, 2016)

Therefore, one location may not only be exposed to many different, single hazards, but also the interrelationships between these hazards. These interrelationships are often described by a range of terminology, with the latest international framing presented below:

Multi-Hazard Interrelationships

Trigger: "One hazard causes another hazard to occur" (Gill *et al.*, 2022). "Triggering hazards can result in hazard cascades, chains, or networks when the primary hazard sets off a secondary hazard which then triggers a further hazard." (Gill and Malamud, 2014; Hochrainer-Stigler *et al.*, 2023).

- Example: "Heavy rain results in the destabilisation and collapse of a slope (a landslide). A landslide blocks a river and causes a flood." (Gill *et al.*, 2022)
- Related concepts: "cascading hazard […], consecutive disasters" (Gill *et al.*, 2022)

Amplify: "One hazard can change the likelihood and/or magnitude of additional hazards in the future". (Gill *et al.*, 2022)

- Example: "Drought increases the likelihood of wildfires. Wildfires increase the likelihood of floods and debris flows." (Gill *et al.*, 2022)
- Related concepts: "change conditions, association, and amplification" (Gill *et al.*, 2022)

Compound: "Two or more hazards may impact the same region and/or time period with impacts different (greater, lesser) than their sum. These compound relationships can take different forms, including (i) a primary hazard triggering multiple secondary hazards simultaneously, and (ii) two independent hazards impacting the same region and/or time period (or in close succession)." (Gill *et al.*, 2022); "These independent hazards can occur with no underlying interrelationship between them" (Hochrainer-Stigler *et al.*, 2023). "Consecutive disasters refer to a case in which one or more disasters occur after each other and their associated direct impact overlaps in space whereas the recovery from the initial event is still ongoing". (Hochrainer-Stigler *et al.*, 2023).

- Examples: "(i) a storm could trigger floods and landslides simultaneously or a volcanic eruption can produce and trigger multiple hazards that could occur simultaneously; (ii) an earthquake followed by a period of extreme cold" (Gill *et al.*, 2022), or a volcanic eruption followed by a typhoon (Hochrainer-Stigler *et al.*, 2023).
- Related concepts: "coinciding hazards" (Gill *et al.*, 2022).

For independent events, processes are typically well documented for the analysis of a hazard and associated risk assessment. However, as noted above, hazard interactions may occur with unexpected effects that are beyond the scope of the single-hazard analysis. Analyzing multiple hazards and their associated risks poses challenges not only for the hazard analysis itself, but also as associated risk may change given the occurrence of multi-hazards. This is a concept called 'multi-risk':

Multi-risk: Risk generated from multiple hazards and the interrelationships between these hazards (and considering interrelationships on the vulnerability) (Gill *et al.*, 2022).

Thus, given the drivers for action on risk reduction and resilience (Section 1.2), as well as the increasing importance of multi-hazards, all-hazards approaches to risk reduction and resilience are becoming more and more important. These would be risk reduction and resilience measures that are not specific to a single hazard, but that decrease the overall risk of a community (e.g., by reducing vulnerabilities), and

increase the overall resilience of a community (e.g., by improving emergency response and recovery tools, and providing education to the public).

All-Hazards: Referring to the entire spectrum of hazards, whether they are natural or human induced. For example, hazards can stem from natural events (e.g., geological or meteorological), industrial accidents, national security events, or cyber events.

What is a Hazard, Risk, and Vulnerability Analysis (HRVA)?

A key component of preparation for disasters is understanding how potential hazards may unfold. Assessments at the local level, such as an HRVA, provide a framework to support the understanding and prioritization of hazards. It can be used to understand gaps in emergency planning and management systems, to prioritize and target resources to reduce vulnerabilities and risks, and to leverage support for community education and engagement.

EMC needed a structured framework to aid in the identification of potential threats across the multiple jurisdictions it serves. The identification of threats helps emergency responders, local authorities, and even individuals understand the specific challenges they may face. EMC wished to support several types of resilience activities. First, the knowledge of potential hazards supports targeted emergency preparedness. Next, additional assessment enables the identification of gaps in emergency planning and pinpoints areas of effective resource allocation. Also, the timing of activities can shift portions of response from a reactive to proactive approach, to minimizes the likelihood of severe consequences and maximizes the efficiency of EMC resource utilization. Moreover, EMC aims to leverage the HRVA findings to support community education and engagement initiatives.

The *Emergency Disaster Management Act (EDMA)* replaced the previous *Emergency Program Act* [1995] in fall 2023[2]. The goal of the new *EDMA* is a proactive approach that includes mitigation, preparedness, response, and recovery. Its guiding principles reflect the United Nations Sendai Framework for Disaster Risk Reduction and acknowledge the relation between climate change and emergency management. Importantly, it is in alignment with the Declaration on the Rights of Indigenous Peoples Act (DRIPA), recognizes self-determination of Indigenous peoples, and requires shared decision-making. These are aspects considered in this HRVA.

EDMA serves as a legal framework for coordinating emergency response during crises and mandates the conduct of the locally driven and informed HRVA to assess potential threats, evaluate associated risks, and identify vulnerable areas or populations. By integrating HRVA into the *EDMA*, authorities can develop more informed emergency plans, allocate resources effectively, and implement targeted mitigation strategies to reduce the impact of disasters on communities. This relationship ensures that disaster management efforts under the *EDMA* are based on a thorough understanding of hazards, risks, and vulnerabilities, leading to more resilient and adaptive response measures.

The HRVA supports targeted preparedness by shifting from reactive to proactive approaches and facilitates community engagement initiatives for increased resilience.

[2] *EDMA* replaced the *EPA* after the substantial completion of this project in September 2023; this project was conducted based on current guidance available at the time of the project execution. Some minor edits have been made to better reflect *EDMA* in the final reporting.

International Guidance: the Sendai Framework

The Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) (UNDRR, 2015) outlines the international best practice and actions to protect development gains from the risk of disaster. This framework is the underlying concept used for this HRVA.

Sendai is the global blueprint for reducing disaster risk and increasing community resilience. The goal of Sendai is to "prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures… to strengthen resilience". The framework is thus multi-disciplinary and follows four priorities (**Figure 4**). The Sendai Framework recognizes that humans are at the centre of disasters; not only are humans responsible for increasing hazards, but also hazards themselves are not problematic unless they interact with humans. The framework thus places human decisions at the centre of disaster risk reduction, and advocates for a risk-based approach to managing multiple hazards (i.e., all-hazards approach). The Federal Government is a signatory to the Sendai Framework, with Public Safety Canada as the lead agency[3]. The BC Government was the first jurisdiction in Canada to have formally adopted the Sendai Framework. It forms a cornerstone of BC's modernization of the *Emergency and Disaster Management Act* (EDMA)[4].

Figure 11: Four priorities of the Sendai Framework for Disaster Risk Reduction.

Consideration for Indigenous People

The Sendai Framework encourages whole-of-society engagement and holistic actions such as, "to empower local authorities, as appropriate, through regulatory and financial means to work and coordinate with civil society, communities and Indigenous People**s** and migrants in disaster risk management at the local level." (UNDRR, 2015). In this sense, the Sendai Framework is supported by the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). UNDRIP establishes a universal framework for minimum standards for the survival, dignity, and well-being of the Indigenous Peoples of the world and it elaborates on existing human rights standards and fundamental freedoms. BC was the first Canadian province to enact a version of UNDRIP; the *Declaration of the Rights of Indigenous Peoples Act (DRIPA)* [2019], in November 2019. At the federal level, Bill C-15, *United Nations Declaration on the Rights of Indigenous Peoples Act* [2020] received Royal Assent in June 2021.

[3] Public Safety Canada. Sendai Framework for Disaster Risk Reduction 2015-2030. Weblink:. Accessed 4 July 2019.
[4] BC Emergency Program Act Modernization: https://engage.gov.bc.ca/govtogetherbc/consultation/emergency-program-act-modernization/. Accessed 14 May 2021.

Appendix C: Methods

The approach for the project generally followed the Emergency Management BC HRVA process (EMBC, 2020, 2021)[5]. This section provides an overview of the methods.

Engagement

Engagement and capacity building were key components of this project, and fundamental to a successful and comprehensive HRVA. By actively involving the community and fostering development of necessary skills and resources, the process enhances both the depth of our understanding and empowers the community to effectively respond to and mitigate hazard risk.

Overall, three partner workshops were conducted throughout the course of the project (Workshop 1 – Hazard Prioritization, Workshop 2 – Participatory Risk Assessment, and Workshop 3 – Risk Reduction and Resilience Measures), as outlined in **Figure 1** (next page). Workshops 1 and 3 were conducted virtually, while workshop 2 was held in person in the Cowichan region. The same participants were invited to each workshop and the goal was to support a range of perspectives, with participants including representative from:

- First Nations in the Cowichan region.
- CVRD jurisdictions.
- emergency response services (RCMP, BC Wildfire Service).
- health organizations, and environmental and social non-for-profit organizations.

More information on the workshops, and the respective materials (handouts and workbooks) is provided in Attachment 3.

[5] Emergency Management British Columbia (EMBC, now Emergency Management and Climate Readiness (EMCR)) 2020: Hazard, risk, and vulnerability analysis (HRVA) for local authorities and First Nations – Companion Guide for the HRVA Tool.
EMBC (2021): HRVA for Local Authorities and First Nations – Hazard Reference Guide for the HRVA Tool.

Figure 12: Workshop progression.

Hazard Characterization

As an initial step, the general characterization of potential hazards in the Cowichan region was conducted. The intent of this step is to ensure that most, if not all, potential hazards are identified, and to then gather enough information to support the later step of prioritization.

The HRVA guidance includes 57 hazards across several categories (**Figure 2**). For example, the first category, atmospheric hazards, includes hazards like air quality, lightning, and snowstorms. All hazards in the atmospheric hazards category are natural and subject to climate change considerations, in contrast to an anthropogenic hazard category, such as hazardous materials and explosions. For each of the 57 hazards, the following steps were conducted:

1. **Research**: The approach to uncover and collect available data and information included requests to CVRD, internet searches of public and academic databases, consultation with EMC staff, along with searches of newspaper articles and other historical information.

2. **Data review**: Using the research gathered in the first step, an initial review was conducted to highlight the data gaps as well as the well-studied hazards. The data gaps span many technological hazards that are less frequently or inconsistently reported as well as some natural hazards that have not been heavily present historically.

3. **Characterization**: For each of the 57 hazards, this included consistently recording hazard characteristics (see **Table 1** for a summary). The hazard characterization for all 57 hazards is provided in Attachment 1.

4. **Preliminary Ranking**: This included assigning high-level consequence and likelihood scores based on available information, and then assigning a risk-based hazard priority ranking (from not applicable to the Cowichan region to high priority) for each hazard.

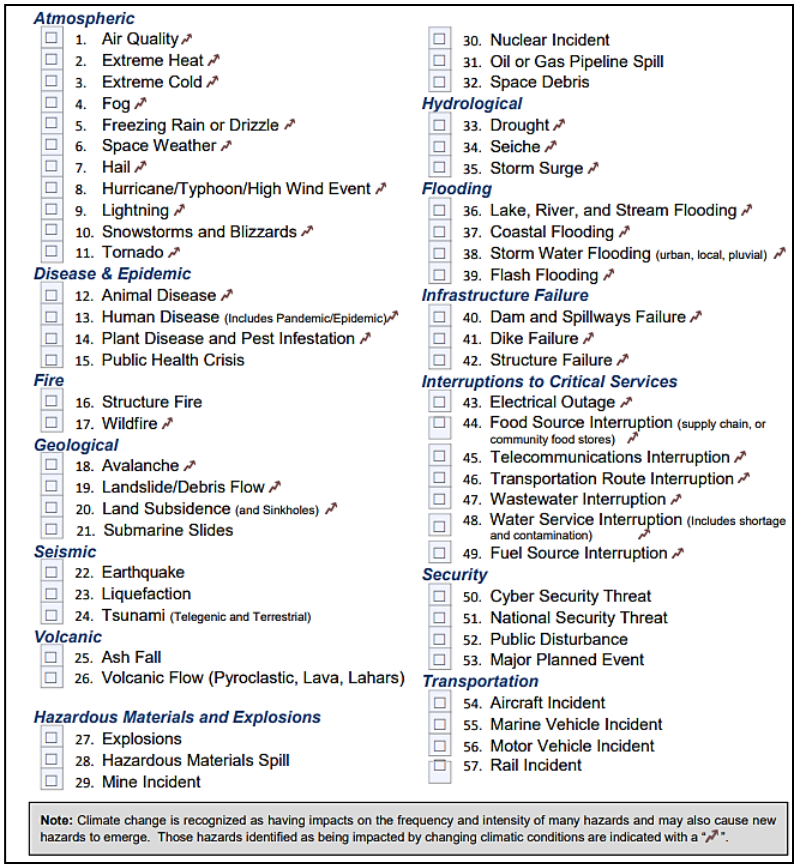

Figure 13: HRVA hazard list (EMBC, 2021).

Table 3: Descriptions of attributes in comprehensive list of hazards table.

Attribute	Description
Overview of Hazard Characterization	This provides a summary of key characteristics for the hazard (see Attachment 1). These include: • Type: Shock or Chronic • Duration: Typical time (hours, days, weeks, etc.) • Seasonality: Most probable time of year, if any. • Warning/Onset Time: measure of time from none through days or weeks. • Extent: Spatial extent of hazard from intensive/local through extensive/regional • Likelihood: Narrative description of annual likelihood on a nominal five-part scale (very unlikely, unlikely, likely, very likely, almost certain) • Likelihood Trend: Noted trend (e.g., increasing or decreasing) if known.

Definitions of the key characteristics are below:

Type: This describes the nature of the hazard event as either an acute shock (something that occurs suddenly) or a chronic stressor, which is a chronic threat that plays out over time.
Duration (of Event): This describes how long the direct impact of the hazard event is likely to occur. This can vary from minutes through years.
Seasonality: The time of year or season, if any, that the event is most likely to occur (e.g., summer, winter).
Warning/Onset Time: The length of time ahead of an event that a warning could be issued. This ranges from none through weeks.
Extents: This describes the general nature of the spatial extent of the hazard as being either widespread (affecting a large area at one time, extensive), or localized (affecting a small area at a given time, intensive). In some cases, multiple localised events might be expected at the same time.
Likelihood: The probability of an event occurring. This is generally tied to severity, where more catastrophic events are rare and more frequent events cause less damages and losses. See also next section.
Likelihood Trend: The projected trend in future, primarily given climate change drivers that will affect hazard likelihood and severity.

Hazard Prioritization

Following hazard characterization, prioritization of the 57 HRVA hazards was necessary to arrive at a manageable number of hazards for discussion and further research. This process resulted in 15 short-listed hazards. The process to screen and identify priority hazards is illustrated in **Figure 3**.

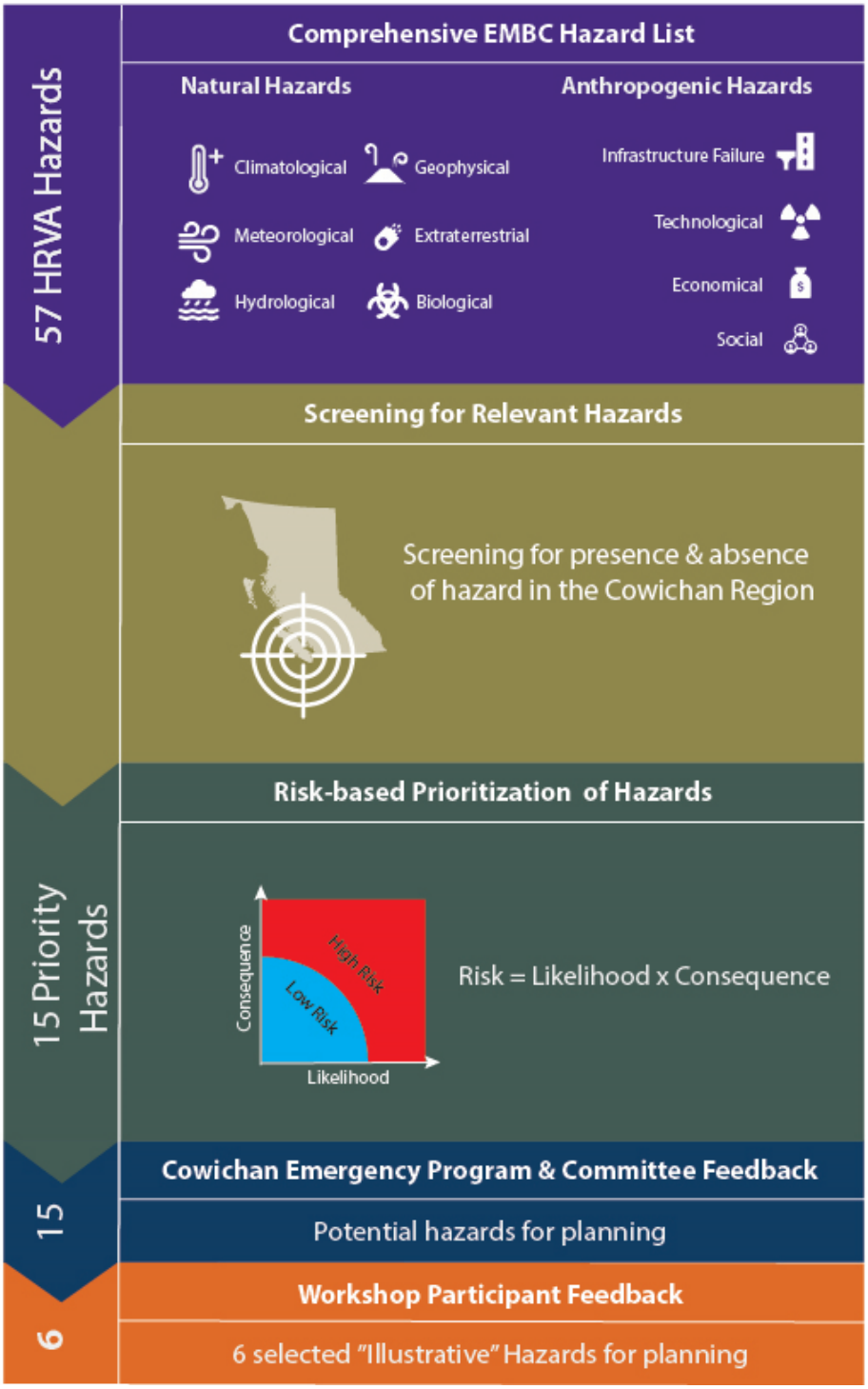

Figure 14: Hazard prioritization to select 15 priority hazards and six illustrative hazards for workshop 2.

Engagement was critical at this point to incorporate local knowledge. An Advisory Committee Meeting opened the floor for local advisors to discuss, share personal experiences, and rank the hazards prior to any workshop engagement.
This was followed by workshop 1, which had the following objectives:

- Orient participants to the project and approach.
- Review the 15 priority hazards and identify 6 illustrative hazards.
- Gather preliminary ideas on risk reduction and resilience building measures.

The key was the selection of the six illustrative hazards for the workshop 2 – the participatory risk assessment, for which not only the hazards with the highest risk, but also with unique characteristics were selected so that information from these could be applied to other hazards. The goal was to include illustrative hazards that represented a range of likelihood/consequence combinations (e.g., a higher likelihood/lower consequence hazard such as windstorm, as well as a lower likelihood/higher consequence hazard such as earthquake), as well as a range of scales (local versus regional), types (shock versus chronic stressors), durations (short versus long), and warning times (none versus long).

Participatory Risk Assessment

The project team was aware that a limited hazard number (maximum of six) could reasonably be considered in a single-day risk assessment workshop, based on experience facilitating similar workshops. Illustrative hazards that would be fully developed for the HRVA were therefore kept to six (note that one multi-hazard scenario was included, drought and extreme heat):

- High-Wind Event
- Lake, River, Stream Flooding
- Drought & Extreme Heat
- Wildfire
- Hazardous Material Release
- Earthquake

For each of the selected illustrative hazards, planning scenarios were developed based on local knowledge and historical context. Planning scenarios are hypothetical situations used for emergency response planning that set the scene for the risk assessment. They describe a realistic event, identifying specific variables (such as time of year, magnitude, and location), that would trigger a regional response. Planning scenarios provide a basis for discussion that helps to better understand and assess impacts, assumptions, response, and readiness strategies.

With these planning scenarios as the basis of the exercise, workshop participants were asked to score the consequences for six categories. The consequence scoring guide was based on HRVA guidance (EMBC, 2021) but summarized from the eleven HRVA categories to six categories (shown in **Figure 4**) for ease of discussion.

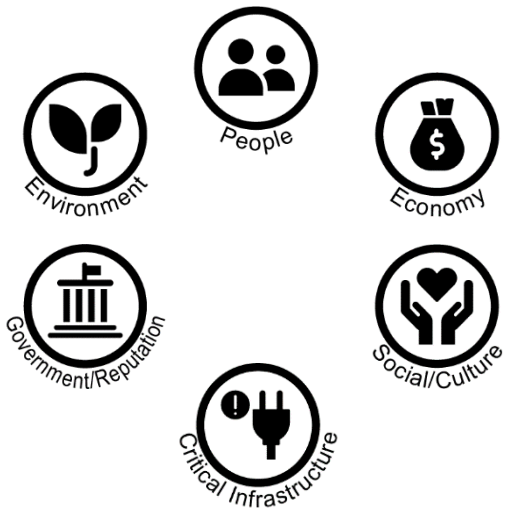

Figure 15: Consequence categories for HRVA participatory risk assessment.

The categories are defined below for full understanding of scope:

People: Potential number of people injured, ill, or killed as a result of the hazard as well as disruption to regular living situations, requiring people to either leave their home or be confined to their home without access to regular services. This category represents the Fatalities, Injury/Disease/Hospitalization, and Displacement HRVA categories.
Economy: The direct negative consequences of a hazard on buildings, structures, and other forms of property, as well as disruption or loss of ability for individuals, businesses, and governments to generate income. This category represents the Property Damage and Economic Impact HRVA categories.
Social/Culture: Impacts to the emotional and social well-being of an individual, family group and/or community; Loss of accessibility to supports/networks or community groups, community reciprocity, trust, and cooperation between community members; Loss of cultural heritage and/or identity. May include loss of works, objects, places, practices, and ecology that are directly associated with an important aspect or aspects of human history and culture. This category represents the Psychosocial, Support System, and Cultural Impact HRVA categories.
Environment: The negative consequences of a hazard on the environment, including the soil, water, air and/or plants and animals. This category only represents the Environmental Damage HRVA category.
Government/Reputation: A negative change in the perception of the government or organization, in the minds of the community, its partners and others who are vital to its success. This can result in socioeconomic damage or disruption such as loss of community or partners trust and an increase in negative media attention. This category only represents the Reputational Impact HRVA category.
Critical Infrastructure: An impact to critical infrastructure, including its processes, systems, facilities, technologies, networks, assets, and/or services, that results in consequences to the health, safety, security or economic well-being of community members and the effective functioning of the government. This category only represents the Critical Infrastructure Impact HRVA category.

The consequence scoring guide is included in Attachment 3 and the five-point consequence scores range from no consequences (0) to extreme consequences (4).
The results of the participatory risk assessment were applied to several visual outputs, in addition to the discussion of key concerns for each hazard in the hazard-specific sections (Appendix E).

Risk Reduction and Resilience Measures

Workshop 3 focused on discussing existing resilience strategies that would prepare the Cowichan region for the 15 priority hazards. This was completed in two parts: First, existing information was scanned and compiled, and second, participants provided feedback and insight on the collection to highlight gaps and opportunities for future strategies. The relevant reports and initiatives were categorized by the following:

1. Understand & Plan *Research, studies, plans, etc.*	**2. Mitigate Risk** *Keep hazard out, reduce severity, move/adapt*	**3. Build Resilience** *Strengthen individual/collective capacity*	**4. Respond** *Actions for effective emergency response*	**5. Recover** *Actions/investments into recovering functions*

This format supported quickly referencing the existing risk reduction and resilience measures table to discern whether a hazard had very low to very high levels of preparedness (see the overview in **Figure 1** in the workshop 3 block, as well as Attachment 3 for the full table). All workshop handouts and the summaries of results are presented in Attachment 3.

Appendix D: Regional Profile and Vulnerabilities

During a hazard event, people and communities with higher social vulnerability are more likely to have limited capacities to be resilient. Understanding vulnerability and exposure is required for a risk assessment that leads to effective and inclusive action.

This section is not a detailed assessment, but it does provide an overview of social vulnerability and relevant concepts such as equity, diversity, and inclusion. Following a section with definitions, this section continues with a regional profile and population growth projections to show the large area and census statistics (that are important considerations within emergency management). It recognizes and briefly overviews the First Nations that have occupied the area since time immemorial, who are emphasized because, across Canada, Indigenous populations have been consistently disproportionately impacted by hazards such as flood (Thistlethwaite et al., 2020). This section closes with vulnerability maps that aim to encourage considering vulnerability from different perspectives.

Vulnerability and Why It Matters

For context of why vulnerability matters, social vulnerability is a critical consideration. Research for social vulnerability explores how some individuals are more susceptible than others to exposures (differential susceptibilities) and capacities of populations affected by disasters (Tate and Emrich, 2021). However, the research is complex, has limitations, and is still evolving. Importantly, addressing vulnerability means addressing a wider range of issues related to equity, diversity, and inclusion. These terms are defined below according to UBC's Equity & Inclusion Glossary of Terms[6].

Equity: Refers to fairness and justice in policies, processes, and outcomes for historically and/or currently underrepresented and/or marginalized people and groups. It considers power, access, opportunities, treatment, impacts and outcomes.

Diversity: Refers to the presence of differences. These differences can relate to the different dimensions of the following: race, ethnicity, colour, ancestry, place of origin, political belief, religion, marital status, family status, physical disability, mental disability, sex, gender identity or expression, sexual orientation, age, class and/or socio-economic situations.

Inclusion: Refers to feeling welcome, belonging, with the capacity to engage and succeed in any given environment. It also relates to recognizing, reducing, and removing barriers to belonging and true participation. It is an active, intentional, and continuous process to address inequities in power and privilege and build a respectful and diverse community that ensures welcoming spaces and opportunities to flourish for all.

In the context of the disproportionate impacts of disasters (and climate change) on populations (IPCC, 2022), the notions of disaster equity and climate equity are gaining policy attention. These terms are related but distinct. For example, disaster equity is "the provision of community-specific services and resources for disaster survivors that are accessible, and culturally and linguistically tailored to mitigate

[6] Weblink: https://equity.ubc.ca/resources/equity-inclusion-glossary-of-terms/. Accessed 21 September 2023.

disparities in health and well-being and support resilience" (Office of Human Services Emergency Preparedness and Response, 2022). In other words, disaster equity focuses on what happens after a disaster. Climate equity is a broader approach that "ensures the just distribution of the benefits of climate protection efforts and alleviates unequal burdens created by climate change" (City of Portland and Multnomah County, 2015). This requires intentional practices and processes that address the effects of climate change, inequity, and the systems that perpetuate both (Ibid).

The City of Vancouver Equity Framework states, equity as an outcome is dependent on equity as a process that achieves the following:

- Seeks to integrate the views of those impacted by a decision, particularly those who have been underrepresented or underserved.
- Requires listening and co-creation across differences in identity and power.
- Redistributes power across different groups (City of Vancouver, 2022).

Understanding these concepts is important within the risk assessment because it can inform risk reduction measures. Additional characteristics that contribute to equity and vulnerability can be gleaned from the population profile, summarized in the next section.

Regional Profile and Growth Projections

A regional snapshot for select indicators is provided in Table 1. The table shows that the large region has a population nearing 90,000 with an average age of 47. Clustered in central and eastern CVRD, the working population has an average household income of $74,725. In terms of infrastructure, occupied dwellings built before 1980 make up more than 40% of dwellings. This indicates aging infrastructure that may have been subject to less protective building codes, and thus may be more vulnerable to impacts from natural hazards such as earthquakes. Each of these indicators are important to understanding the potential vulnerability and capacity of the region to hazards.

Table 4: Regional snapshot based on the Statistics Canada census profile, which uses the 2021 census of population and 2020 income data[7].

Region size (km^2)	**Population** (2021)	**Average Age** (yrs.)	**Occupied Households**	**Household Income** (from 2020)
3,473	89,013	47.0	37,290	Average: $74,725 Median: $39,600
Occupied households built before 1980: 16,075 (43%) **Largest Industry:** Health care and social assistance, Retail, and Construction.				

The CVRD Plan Your Cowichan website[8] discloses projections for affordability and population from recent reports (Licker Geospatial Consulting Co., 2019; rennie intelligence, 2019). The projections are summarized

[7] Statistics Canada Weblink: https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/details/page.cfm?Lang=E&SearchText=Cowichan%20Valley&DGUIDlist=2021A00035919&GENDERlist=1,2,3&STATISTIClist=1&HEADERlist=0. Accessed 14 August 2023.

[8] CVRD Plan Your Cowichan website: https://www.planyourcowichan.ca/long-range-projections. Accessed 11 August 2023.

below and consider factors such as population growth, dwelling growth, and demographic factors such as age distribution. A summary of key points from these studies is provided below (for the projection period to 2050).

1. **Factors**. Factors contributing to the projected population growth include pandemic impacts to migration, availability of developable land, sufficient water capacity, and sanitary sewer capacity.
2. **Trends and growth rate**. The projections suggest a continued influx of Canadians into the area, also referred to as in-migration, and includes an influx of families and seniors to all electoral areas. A steady growth rate is expected between now and 2032 and on to 2050. The projected annual population growth rate for the entire period from 2021 to 2050 is approximately 1.15%.
3. **Dwelling growth**. Dwelling growth is expected to mirror population growth, at a slightly slower pace due to increased occupancy of owner-occupied dwellings. The annual dwelling stock growth rate is projected at 1.04%, also for 2021 to 2050.

First Nations Profile

The Cowichan region is located on the unceded and traditional territory of the Quw'utsun (Cowichan Tribes), Malahat, Ts'uubaa-asatx, Halalt, Penelakut, Stz'uminus, Lyackson, Pauquachin, Ditidaht, and Pacheedaht Peoples[9]. Cowichan Tribes is the largest single First Nation band in British Columbia with over 5,300 members (i.e., more than 5% of the regional population), split almost equally between members living on- and off-reserve[10]. As stated on their website, they are the Hul'q'umi'num people which means people who speak the Hul'q'umi'num language and are a part of a larger first nations group referred to as the Coast Salish People. A summary of the Indigenous Nations in the region is provided below (sourced from Economic Development Cowichan[11]).

Cowichan Tribes is the largest single First Nation Band in BC. Cowichan Tribes administration offices in Duncan include service areas such as health, housing, education, fisheries, and recreation, including forestry and water stewardship.
Stz'uminus First Nation is the second largest nation in the Cowichan region, with approximately 1,319 members. Shts'emines is the origin of the English name Chemainus. The Stz'uminus First Nation have developed a Memorandum of Understanding with the Town of Ladysmith and the tribe's economic development agency is creating a new residential and commercial community.
Penelakut Tribe villages were traditionally found on Penelakut Island, Galiano Island, and Vancouver Island near the mouth of the Chemainus River. Today, the Penelakut have about 876 members and have additional reserves on Tent Island and the lower reaches of the Chemainus River.
Ditidaht First Nation has traditional territory that extends from Cowichan Lake through Nitinaht Lake to the west coast of Vancouver Island. The 350-member tribe has projects underway, including hydro, forestry, tourism, and aquaculture initiatives. Nitinaht Lake is central to tourism initiatives.
Malahat Nation is a member government of the Naut'samawt Tribal Council and their ancestral tongue is the Hul'q'umi'num language. The 302-member Malahat Nation has two reserves near Mill Bay, Goldstream, and the highland districts.
Pacheedaht First Nation territory includes the lands and waters along the southwest coast of Vancouver Island between Bonilla Point and Sheringham Point. The Pacheedaht language is similar to

[9] Weblink: https://www.tourismcowichan.com/explore/indigenous-culture. Accessed 30 August 2023.
[10] It is acknowledged that reservations were established as part of the 14 Douglas Treaties on Southern Vancouver Island. These treaties were a historical policy to recognize the aboriginal possession of land. The creation of reservations reflects the colonial context and the dynamics of that time.
[11] Weblink: https://www.ecdevcowichan.com/living-in-cowichan/first-nations-communities/. Accessed 30 August 2023.

that of its neighbours and relatives amongst the Ditidaht First Nation and the Makah people across the Strait of Juan de Fuca. The tribe has an estimated population of 268 members.
Halalt First Nation originated from the village of *xeláltxw*, which means 'marked or painted houses', a reference to decorated house posts in this village. According to information collected in 1985, this village was once located in the Cowichan Valley where the Silver Bridge currently crosses the Cowichan River southeast of Duncan. According to Cowichan oral history, the forefathers of both the Cowichan and Chemainus people (*Siyóletse* and *St'éts'en* respectively) originated from this village.
Lyackson First Nation are a Central Coast Salish Hul'q'umi'num community of 204 members presently based in Chemainus, Vancouver Island. The Lyackson traditional territory is part of the Hul'q'umi'num Mustimuhw, which includes the Chemainus First Nation, Cowichan Tribes, Halalt First Nation, Lake Cowichan First Nation, Lyackson First Nation and Penelakut Tribe.
Ts'uubaa-asatx Nation owns 39 waterfront acres adjacent to the Town of Lake Cowichan. The 20-member tribe is currently implementing a comprehensive development plan that includes opportunities for cultural tourism, watersport recreation, and new residential growth.
Pauquachin Nation[12] located off the Saanich Inlet, consists of 403 members (residing in Coles Bay). Only Hatch Point is within the region with two additional reserves and shared claim land.

Maps

At first glance, communities and individuals are often exposed to the physical effects of natural hazards in similar ways. For example, they often live near a body of water, which can flood homes and damage belongings. However, certain groups and individuals within a community can feel disproportionate impacts from natural hazards.

[12] https://www.pauquachin.ca/ourhistory

Critical Infrastructure Vulnerabilities

The critical infrastructure map used for workshop 2 shows provincial datasets (**Figure 1**). The map shows the infrastructure is concentrated primarily along the populated east coast and Cowichan Lake. The map also shows major roads and ferry routes connecting communities. These can be viewed as access or emergency routes, especially for more remote communities, as well as line features that utilities (electricity) follow.

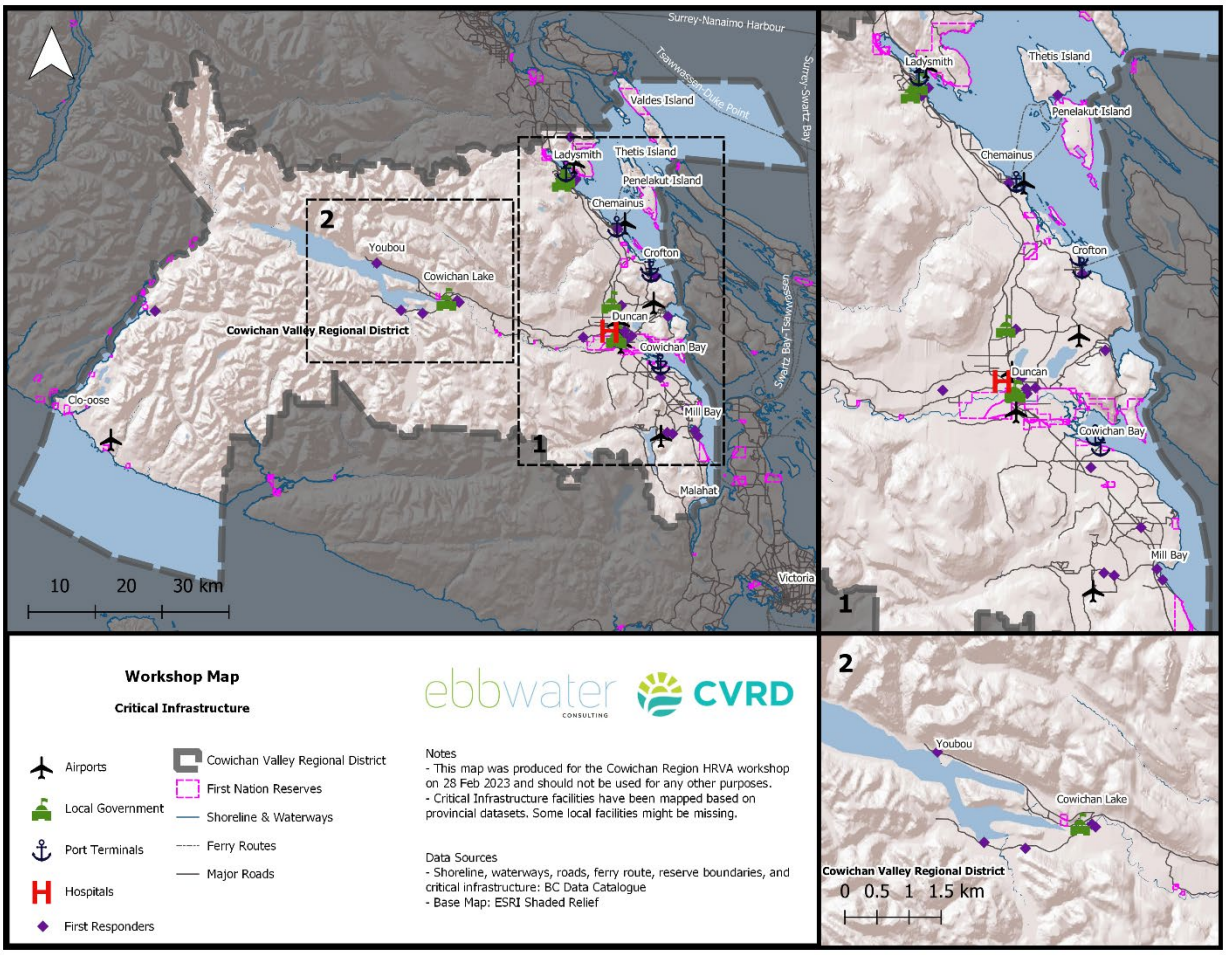

Figure 16: Critical Infrastructure map used in the workshop.

Social Vulnerability

The social vulnerability index (SVI) map used for workshop 2 shows provincial datasets (**Figure 2**). The social vulnerability index is calculated based on 20 variables indicating individual autonomy, financial agency, social capital, and housing conditions with the 2016 census data (Journeay *et al.*, 2022).
The social vulnerability index map shows elevated vulnerability in several areas: around Cowichan Lake, on First Nation reserves (as shown in Inset 1), and Ladysmith. For these higher-ranking areas as well as the lower-ranking areas, diving into the many variables of the index may better explain the final index values (see Attachment C for workshop handout with maps of all indices).

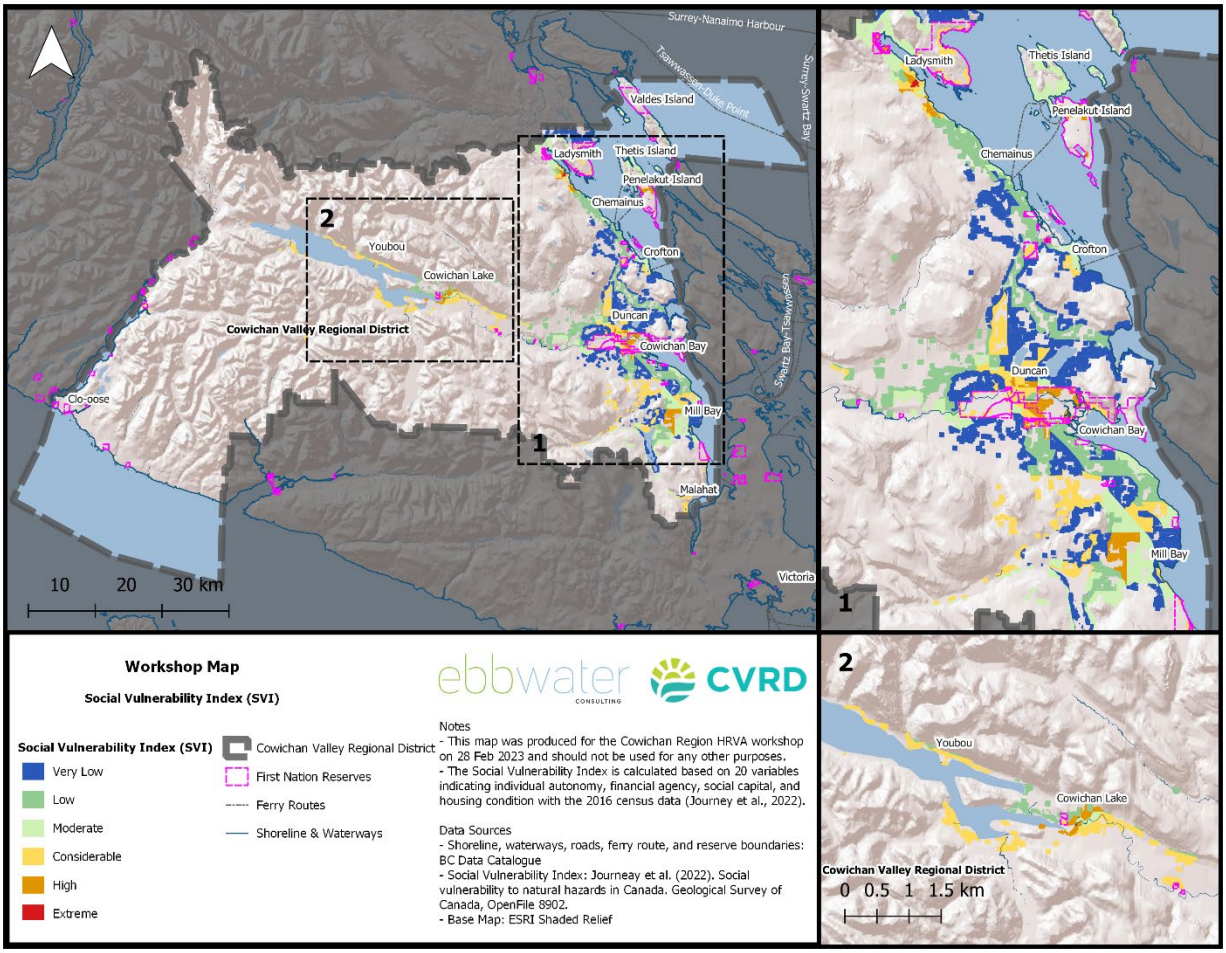

Figure 17: Social Vulnerability Index map used in the workshop.

Appendix E: Priority Hazards - Characteristics, Impacts, and Hazard-Specific Recommendations

This appendix provides first an overview of the 15 priority hazards (**Figure 1**). This is followed by discussion of climate change projections in the Cowichan region and their relevance for priority hazards. The next section discusses each of the priority hazards, including hazard characteristics, potential impacts, existing risk reduction and resilience measures, and hazard-specific recommendations. Note that for six of the priority hazards, a more detailed risk profiling was conducted as part of the participatory risk assessment, where workshop participants scored consequences for planning scenarios. This is reflected in additional figures and information below.

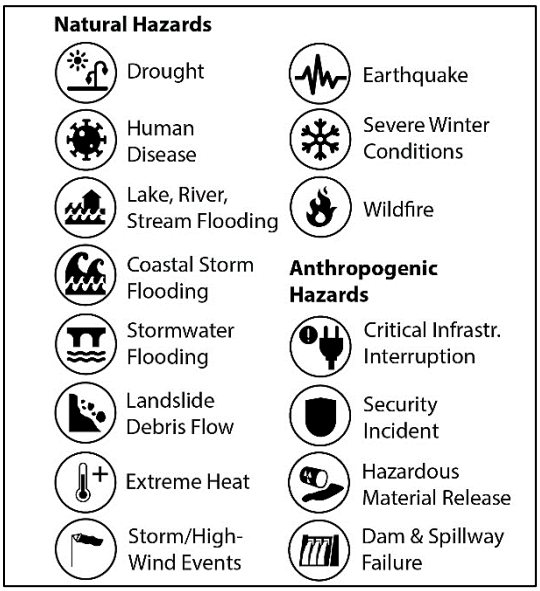

Figure 18: The 15 priority hazards identified for the Cowichan region.

Priority Hazards Overview

There are many natural and anthropogenic hazards that may occur in a region. However, primary focus for risk reduction and resilience strategies should be first and foremost on priority hazards to target resources appropriately. Hazard-specific recommendations (as discussed in the following Section 1.3) can then be combined with all-hazard approaches (Appendix F) that may be effective beyond the priority hazards as they encompass general disaster resilience-building.

Priority hazards are those hazards that show the highest risk (as combination of likelihood of occurrence and associated impacts) for a specific region. **Figure 1** lists the priority hazards that specialist analysis and community feedback identified as having the highest risk for the Cowichan region. Many of these are climate, weather, or environment related (e.g., drought, flooding, or wildfire), and others are also anthropogenic hazards (such as interruptions to critical infrastructure, or hazardous material releases). Detailed description and characteristics of each of these hazards are provided in Section 1.3.

The priority hazards differ widely in their characteristics, such as their spatial extent, warning time and duration, as well as their risk profile, and how prepared the Cowichan region currently is for a specific hazard. Consideration of hazard characteristics, risk profiles, and current preparedness is key for developing adequate risk reduction and resilience strategies.

Hazard Characteristics

An important hazard characteristic to consider for risk reduction and resilience recommendations is the spatial extent of a hazard. The priority hazards vary in that aspect – while some hazards, such as hazardous material release or dam & spillway failure tend to be more local (e.g., primarily affecting one site or community), other hazards have a more local to regional extent (**Figure 2**). In particular, droughts, extreme heat events, windstorms, and earthquakes tend to occur at regional to provincial scale. This is important to consider for emergency response planning, as resources from outside the Cowichan region may also be occupied with their own emergencies.

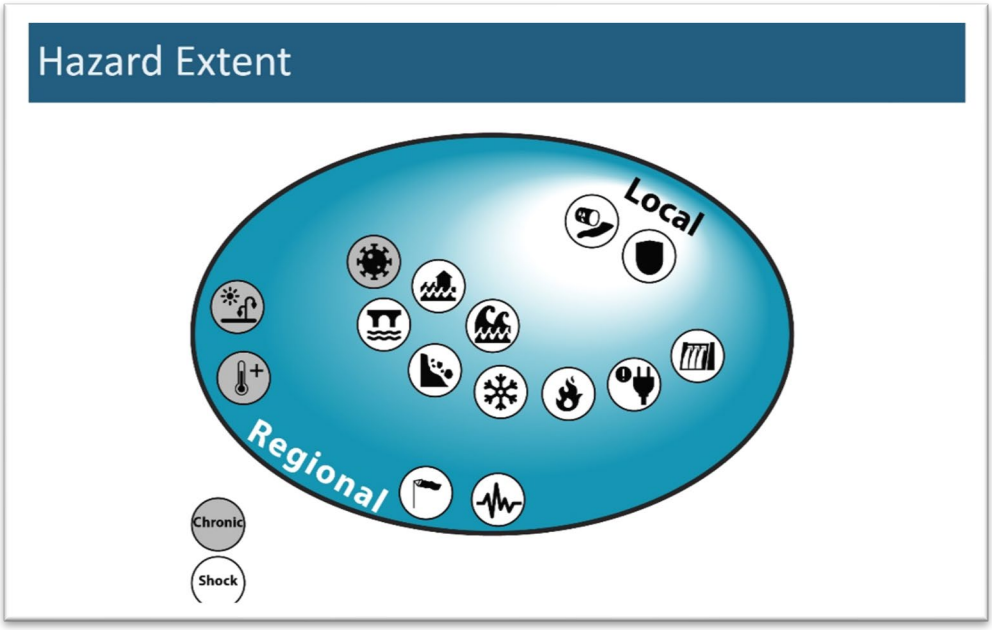

Figure 19: Typical spatial extent of priority hazards.

The priority hazards also differ in their temporal characteristics. They may occur as a shock (time-limited) or as a chronic (ongoing) stressor (**Figure 2**, **Figure 3**). For instance, drought typically has a fairly long warning time and can last from months to years and is described as a chronic stressor. In contrast, earthquakes have little to no warning time and the typical event duration is short (though aftershocks may follow the initial earthquakes) and are an example of a shock hazard. Drought, extreme heat, and human disease outbreaks generally classify as chronic stressors, as they tend to have longer durations. Other than these, most of the priority hazards classify more as shocks than as chronic stressors, though they have a range of warning times and durations. Furthermore, while they may currently qualify as shock, in the future with climate change, some hazards may shift from shocks to more chronic stressors if they are occurring with higher and higher frequencies (such as frequent windstorms, where one event may blend into the previous one).

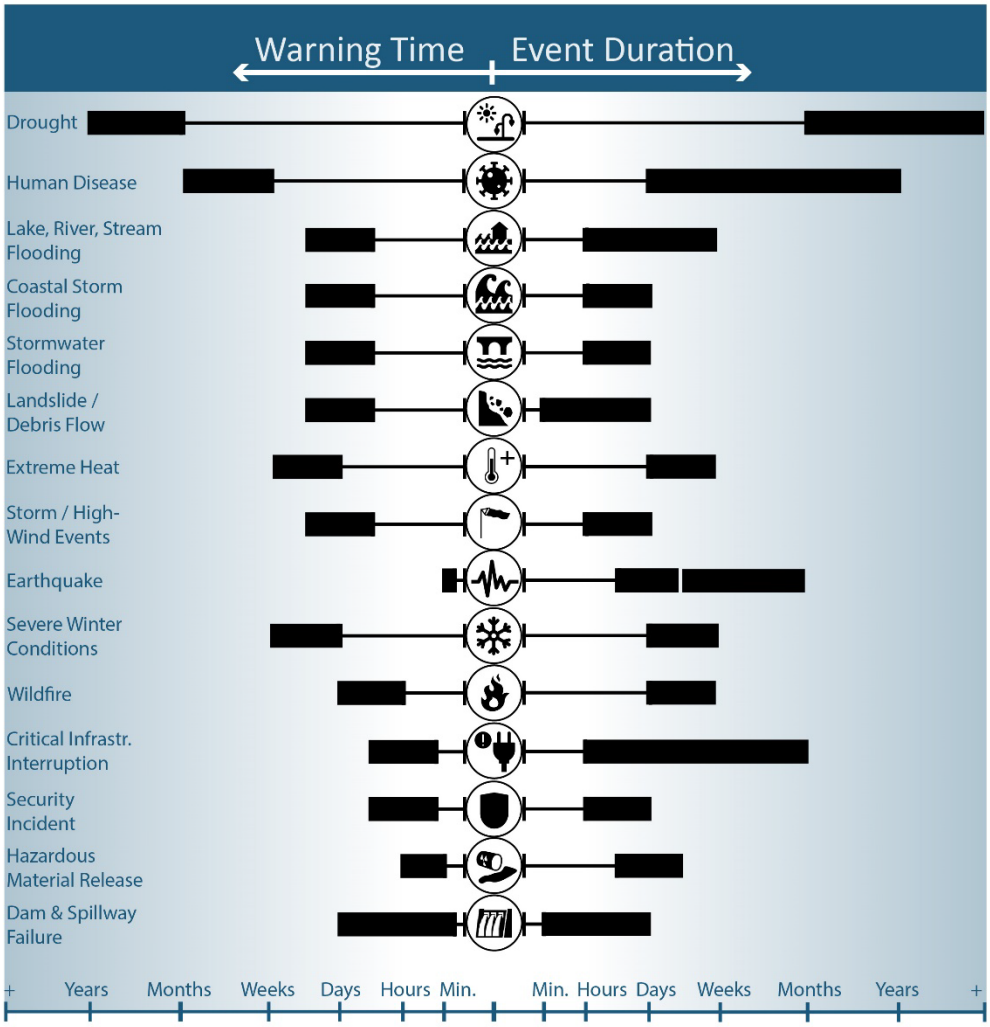

Figure 20: Approximate warning time and event duration of priority hazards. Uncertainty ranges are indicated by the thick bars.

An overview of all hazard characteristics of the 15 priority hazards is provided (**Table 1**).

Table 5: Summary of the 15 priority hazards.

Hazard	Definition	Overview		Impacted by Climate Change?
Drought 	Drought is a recurrent feature of climate involving a deficiency of precipitation over an extended period, resulting in a water shortage for activities, communities, or aquatic ecosystems (EMBC, 2021). Linked to heat, wildfire, and food source and water service interruption.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Chronic Months - Decades Mainly Summer Months - Years Increasing	↗
Human Disease 	Diseases that are caused by pathogenic microorganisms and are spread from one person to another. A pandemic is the worldwide spread of a new disease (EMBC, 2021).	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Chronic Days - Years All Year Uncertain Increasing	↗
Lake, River, Stream Flooding 	Lake, river, and stream flooding occurs when water from lakes, river channels, or streams overflows onto normally dry land in the floodplain adjacent to the shoreline or channel. Other names may include fluvial, riverine, inland, overbank, or riparian flooding.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Hours - Weeks All Year Days Increasing	↗
Coastal Storm Flooding 	Occurs when ocean water levels are higher than normal due to storm surge, tides, waves, and wind effects. Sea level rise will increase coastal flooding.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Hours - Days Fall - Spring Days Increasing	↗
Stormwater Flooding 	Precipitation cannot infiltrate or be carried by drainage infrastructure, creating flooding sometimes called stormwater, local, pluvial, or flash flooding.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Hours - Days Fall - Spring Days Increasing	↗
Landslides / Debris Flows 	Landslides are slope failures or downward movement of rock, debris, or soil. Excessive rainfall, earthquakes, and human activities are factors that commonly trigger landslides.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Minutes - Weeks Fall - Spring Hours - Days Increasing	↗
Extreme Heat 	Heat waves can be characterized by temperatures significantly above average for an extended period. Linked to drought, reduced air quality, and wildfire risk.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock/Chronic Days - Weeks Summer Days - Weeks Increasing	↗
Storm / High-Wind Event 	Wind gusts, sustained winds, or high wind speeds. Often associated with heavy rain, storms, or extratropical cyclones. Linked to infrastructure impacts (powerlines), causing cascading impacts.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Hours - Days Fall - Winter Days Increasing	↗

Hazard	Definition	Overview		Impacted by Climate Change?
Earthquake 	Ground-shaking due to movement along a fault rupture that can also trigger landslides and liquefaction. Secondary hazards include fires, floods, and tsunamis.	**Type** **Duration** **Seasonality** **Warning Time**	Shock Days (Aftershocks Weeks – Months) All year Seconds - Minutes	
Severe Winter Conditions 	Snowstorms and blizzards. Meteorological disturbance giving rise to a heavy snowfall, often accompanied by strong winds (blizzard). Linked to infrastructure impacts.	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Days - Weeks Winter Days - Weeks Increasing	↗
Wildfire 	Unplanned fires, including unauthorized human-caused fires, occurring on forest or range lands, which burn forest vegetation, brush, etc., and can spread to developed areas such as the wildland urban interface (WUI).	**Type** **Duration** **Seasonality** **Warning Time** **Likelihood Trend**	Shock Days - Weeks Spring -Summer Hours - Days Increasing	↗
Critical Infrastructure Interruption 	Any interruption of critical infrastructure, that is essential for the functioning of society and will lead to cascading consequences. Includes electrical service, food source, telecommunications, transportations, wastewater services, water services, and fuel source interruptions.	**Type** **Duration** **Seasonality** **Warning Time**	Shock Hours - Months All Year Variable (None – Hours)	↗
Security Incident 	An act or interruption that poses major threat to society. Examples include riots, bomb threats, active shooter, etc.	**Type** **Duration** **Seasonality** **Warning Time**	Shock/Chronic Hours – Days All Year Variable	
Hazardous Materials Release 	A hazardous material (HazMat) release is any uncontrolled release of material (e.g. toxic gases, radioactive material, acids, chemicals, gas, or oil spills), either in transit or at a fixed location, that poses an immediate threat to health, safety, and property. Sources include facilities, industrial sites, ports, marinas, boats, railways, and roadways.	**Type** **Duration** **Seasonality** **Warning Time**	Shock Days All year None - Hours	
Dam & Spillways Failure 	Failure of a dam or spillway structure that would release water/debris downstream. This can be a 'sunny-day' failure outside a storm due to engineering failure or seismic event or a 'rainy-day' failure because of high-water levels and inflows.	**Type** **Duration** **Seasonality** **Warning Time**	Shock Minutes - Days All Year Seconds - Days	↗

Risk Profiles

The risk profile visually indicates the risk of a hazard occurring as the combination of likelihood and consequence. Note that these risk profiles were developed at a high-level and are meant to display general tendencies (e.g., in general, a windstorm occurs more frequently and has smaller impacts than an earthquake, which tends to occur more rarely and could have catastrophic impacts). Of course, each hazard can occur along a continuum of likelihoods from frequent to rare with associated consequences from low to high. For instance, there may also be smaller, more frequent earthquakes with less catastrophic impacts.

Or floods may occur both as a smaller and more frequent event, as well as a rare, large event with catastrophic impacts. Thus, the high-level risk profile shown in **Figure 4** only indicates general tendencies of a hazard. More detailed risk profiles were developed for illustrative hazards as part of the participatory risk assessment process (**Figure 5**) and are discussed below, as well as within Section 1.3.

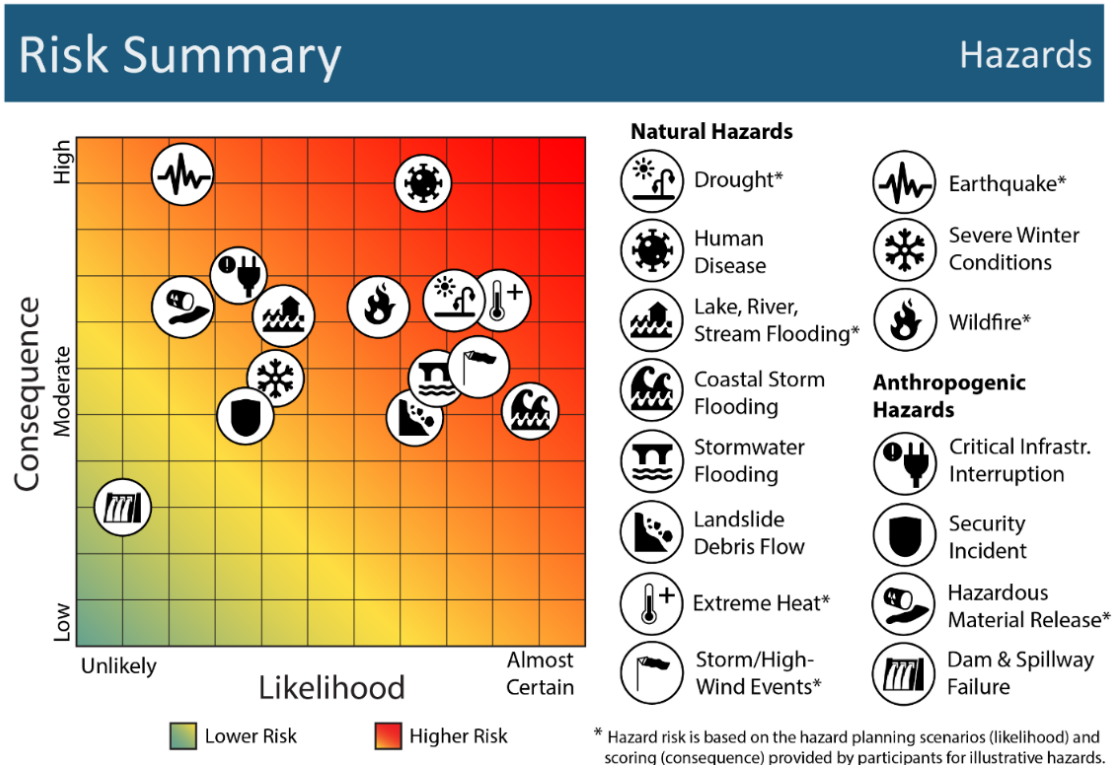

Figure 21: High-level risk profiles that indicate general tendencies of priority hazards. Risk considers the combination of likelihood and associated consequences.

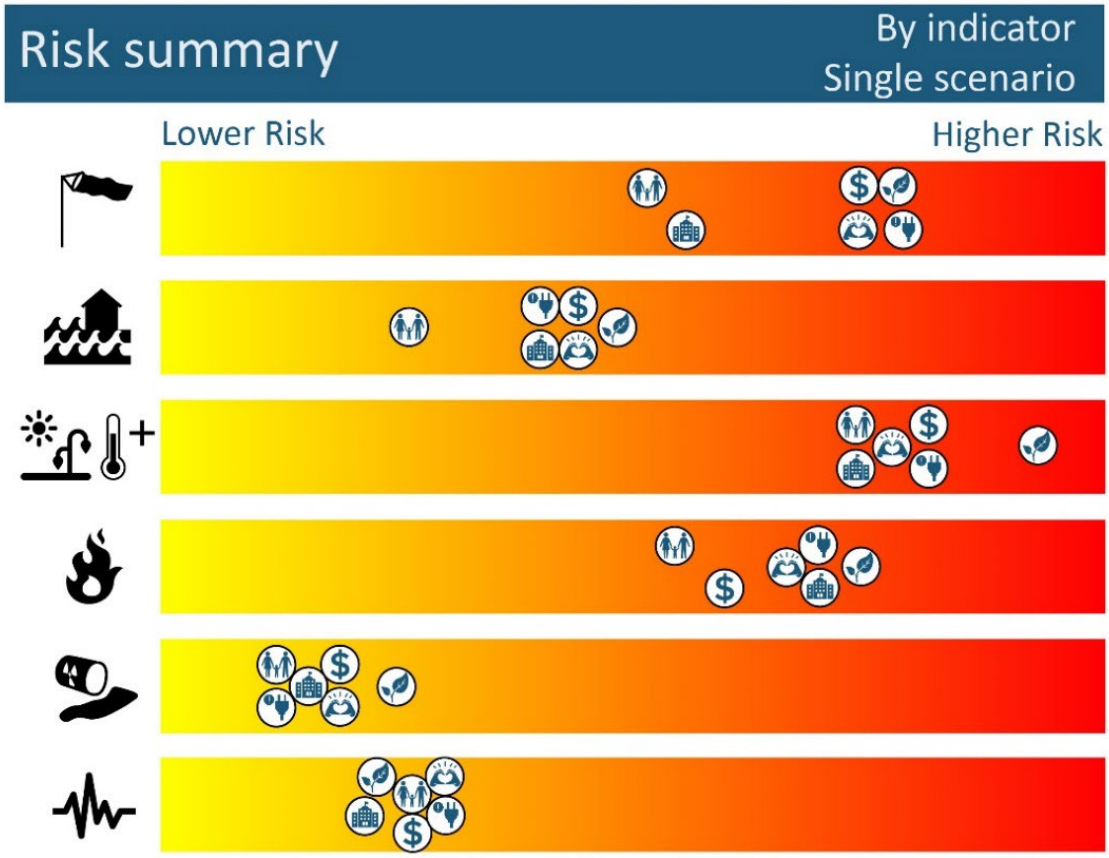

Figure 22: Risk profiles considering a range of consequence indicators for illustrative hazards (from top to bottom: storm/high-wind event; lake, river, stream flooding; drought & heat extreme; wildfire; hazardous material release; and earthquake). Note that the consequence scoring for these risk profiles were developed in the participatory risk assessment and refer to a specific planning scenario (see Appendix C – Methods and Attachment 3 – Workshop Handouts for planning scenarios).

The risk profile was developed in more detail for 6 illustrative hazards during the participatory risk assessment for specific planning scenarios (see Appendix C – Methods and Attachment 3 – Workshop Handouts for planning scenarios). **Figure 5** shows how some hazards may have a bigger impact on some assets than others. For instance, for drought and extreme heat, detrimental consequences were scored high for the environment. Similarly, for hazardous materials spill, consequences for the environment were considered to be worse. On the other hand, for some hazards, impacts to people scored less than for other indicators, which may have been however due to the scoring table[13]. **Figure 5** also visualizes how a smaller, more frequent hazard can lead to a higher risk, than a more catastrophic but rare hazard, given the cumulative impacts of the re-occurring hazard event over time. It is important to not only prepare for the big and catastrophic hazards, but also for the smaller, yet more frequent ones.

[13] The scoring criteria for affected people was based on percentage of the total population according to HRVA guidance, and scoring in workshop may have been biased towards lower impacts than for other hazards due to the scoring table distribution. Workshop participants noted and discussed this issue in the workshop itself.

Risk information is also summarized in **Table 2**, which combines results from the participatory risk assessment process (illustrative hazards) and general (high-level) risk scoring (for the other priority hazards), based on consequence scoring[14] and likelihood scoring[15] guidelines. The results highlight the priority hazards with highest risk – and such, of key concern for risk reduction and resilience measures in the Cowichan region. These include drought and extreme heat (combined hazards), storm/high-wind events, and wildfire (for the illustrative hazards), as well as human disease, coastal and stormwater flooding, critical infrastructure interruption, and landslides/debris flows for the other hazards. Note however that the choice of planning scenario influences how consequences (and ultimately, risk) are scored, and that the consequence and likelihood scoring for the non-illustrative hazards was conducted at a high-level.

Table 6: Consequence, Likelihood, and Risk Scoring Overview.

Risk Method	Hazard	Consequence Scoring*						Consequence (Avg.)	Likelihood	Risk Score	Risk Description
		People	Economy	Cultural	Environment	Government	CI				
Planning Scenario	Drought & Extreme Heat[16]	3	4	3	4	3	4	3	4	14	High
	Storm / High-Wind Event	2	3	3	3	2	3	3	4	11	High
	Wildfire	3	3	3	4	4	4	3	3	10	High
	Lake, River, Stream Flooding	2	4	4	4	3	3	3	2	7	Med
	Earthquake	5	5	5	4	4	5	5	1	5	Med
	Hazardous Material Release	3	3	4	4	3	3	3	1	3	Low
General (high-level)	Human Disease							4	4	16	V. High
	Coastal Storm Flooding							3	5	15	High
	Critical Infrastructure Disruption							4	3	12	High
	Stormwater Flooding							3	4	12	High
	Landslides / Debris Flows							3	4	12	High
	Severe Winter Conditions							3	3	9	Med
	Security Incident							3	3	9	Med
	Dams and Spillways Failure							2	2	4	Low

Notes:
*Note that for the illustrative hazards, the risk method and scoring is based on a planning scenario (i.e., likelihood score refers to a specific scenario and consequence scores were assigned by participatory risk assessment workshop attendants according to that scenario). In contrast, consequence and likelihood scoring for the remaining hazards was assigned at a high-level for the hazard in general (see Appendix C - Methods).

[14] Consequence Scoring: 1 – None; 2 – Low; 3 – Medium; 4 – High; 5 – Extreme.
[15] Likelihood Scoring: 1 – Rare; 2 – Unlikely; 3 – Possible; 4 – Likely; 5 – Almost Certain.
[16] Note that participants scored the consequence of Drought and Extreme Heat as a combined planning scenario.

Current Preparedness & Preparedness Perception for Priority Hazards

Current preparedness in the Cowichan region also varied strongly between the different priority hazards. Results in **Table 3** are based on a region-wide scan of existing risk reduction and resilience measures (see Appendix C - Methods) for each priority hazard. The results of this high-level scan were then categorized on a scale from very low to very high preparedness. **Table 3** indicates for which priority hazards the Cowichan region was found to be least prepared. This includes primarily anthropogenic hazards (hazardous materials release, security incident, and critical infrastructure interruption), as well as stormwater flooding. The main hazard of concern identified in the workshop was drought, for which it was felt that more work is needed. This is likely also due to the high risk that is associated with drought, i.e., while there has been quite a lot of work done regarding drought, given the higher risk of drought, more work is needed. In contrast, workshop participants felt that the region is relatively well prepared with respect to extreme heat events. It should also be noted that there were four different types of flooding within the priority hazards, and potentially, this may have influenced some of the workshop survey results related to flooding. **Table 3** also indicates that the Cowichan region is relatively well prepared with respect to understanding and mitigating risk and response, but that especially recovery, as well as building resilience in the community could be improved.

Table 7: Current Preparedness for the Priority Hazards in the Cowichan region. Scoring is based on high-level scan of existing risk reduction and resilience measures (see related section for each priority hazard in Section 1.3 in this appendix) and further information may be available), as well as input received in workshop 3 (see Attachment 3). Participants in Workshop 3 were asked to select the 3 hazards that they felt the Cowichan region is best prepared for, and the 3 hazards they felt needed more attention. Percentages of this survey are reported in the table. See preparedness scale on the following page.

Hazard	1. Understand & Plan	2. Mitigate Risk	3. Build Resilience	4. Respond	5. Recover	Prepared-ness (Average)	Workshop 3	
							Needs work	*Best prepared*
Hazardous Materials Release	2	1	3	2	1	Low		
Security Incident	1	1	3	3	1	Low	46%	
Critical Infrastructure Disruption	2	1	3	1	3	Low	69%	
Stormwater Flooding	3	3	2	2	1	Low		
Dam & Spillways Failure	4	4	1	3	1	Med		
Landslides / Debris Flows	4	4	3	2	1	Med		
Severe Winter Conditions	4	2	3	4	1	Med		43%
Storm / High-Wind Event	1	3	3	4	4	Med		
Human Disease	3	2	3	4	4	Med	23%	29%
Drought	4	4	3	4	2	Med	54%	
Lake, River, Stream Flooding	4	4	3	3	3	Med		29%
Coastal Storm Flooding	4	4	3	3	3	Med		
Earthquake	4	3	4	3	3	Med		
Wildfire	4	4	4	4	1	Med		
Extreme Heat	4	3	3	4	4	High		64%

Preparedness:	Very low	Low	Medium	High	Very High

Preparedness Scale: 1 – very low (no actions have been taken so far); 2 – low (some small actions have been taken, but preliminary); 3 – medium (there are quite a few actions but could be better); 4 – high (many actions have been taken, but there is some room for improvement); 5 – very high (well prepared, nothing more to do).

Changing Climate

Many of the priority hazards are also increasing in intensity or likelihood with the changing climate. For the Cowichan region, projections show that air temperatures will continue to rise and precipitation will become more extreme, with wetter winters and drier summers in the future (CVRD, 2017). Specifically, by the 2050s, projections[17] indicate an increase from 16 summer days (days above 25°C) to 39 compared to the historic baseline. Daytime high air temperatures in the summer will also increase (by an average of 3.2°C). Winters will also become warmer, with average nighttime low temperatures increasing by 2.6°C. Warming will be

[17] Projections discussed in this section are based on the CVRD (2017) report and refer to a change from the historic baseline (1971-2000) to the 2050s (2041-2070), following the representative concentration pathway (RCP) 8.5. For an overview of climate change terminology and methods, as well as for details on the CVRD analysis, please refer to the CVRD (2017) report.

relatively uniform across the Cowichan region, but valleys and low-lying areas will experience most warming. In contrast, only the highest elevations will still experience nighttime low temperatures below freezing.

Projections further indicate that there will be a slight increase in total annual precipitation by the 2050s, but importantly, this increase will be dominantly in the fall (11% increase in fall precipitation[17]), as well as with some precipitation increases in the winter and spring. In contrast, summers will continue to become drier, with a decrease in average summer precipitation by 17% by the 2050s. Regional differences will be similar to historic differences, with drier conditions in the developed east of the CVRD in contrast to the West Coast and the mountainous region south of Cowichan Lake. In particular, precipitation intensity will increase overall, and projections indicate longer and more intense storms coming from the Pacific Ocean (e.g., atmospheric rivers events during the fall and winter may become more prevalent in the region).

These climate change projections for temperature and precipitation indicate major changes for many of the priority hazards, namely:

- Extreme Heat, Drought, Wildfire, Flooding (Lake, River, Stream Flooding; Coastal Storm Flooding; Stormwater Flooding); Landslides/Debris Flows; and Storm/High-Wind Events.

More extreme air temperatures in the summer will increase the likelihood and intensity of extreme heat events, with impacts on human health and ecosystems (see Section 1.3.3). A reduced snowpack and drier summer conditions, combined with increasing water use, will increase drought conditions (see Section 1.3.3). Drier and hotter conditions will also increase the risk of wildfires (Flannigan *et al.*, 2015; Flannigan, 2018) (see Section 1.3.4). More intense precipitation events will increase the likelihood of Stormwater Flooding (see Section 1.3.8), and Lake, River, and Stream Flooding, especially when also combined with coastal storms and sea level rise in estuarine areas (see Section 1.3.2). Sea level rise will also continue to increase the likelihood of coastal storm flooding along coast (James, Robin, Henton, and M. Craymer, 2021) (Section 1.3.7). Higher intensity precipitation, along with other factors such as increased wildfires, will also likely lead to more landslides (Jakob and Lambert, 2009; Cloutier *et al.*, 2017). While frost and ice days are projected to decrease in the future (CVRD, 2017), weather extremes will likely be increasing, in particular storms/high-wind events (Cheng, 2014; Radić *et al.*, 2015; Jeong and Sushama, 2018) (Section 0).

Overall, with climate change, there are also increasing concerns about multi-hazard events, where one hazard triggers another (e.g., heavy rainfall triggering landslides), where a hazard amplifies the likelihood or magnitude of additional hazards in the future, or where multiple hazards impact a region at the same time (compound hazard events) (see Appendix B on multi-hazards terminology).

Hazard Characteristics, Impacts, and Recommendations

This section provides an overview of each priority hazard, including hazard characteristics and a brief description, potential impacts, existing risk reduction and resilience measures, as well as hazard-specific recommendations.

The section starts with the six illustrative hazards. The potential consequences for these hazards (storm/high-wind events; lake, river, stream flooding; drought & extreme heat; wildfire; hazardous material

release; and earthquake) were identified at the participatory risk assessment workshop. The results of the consequence scoring in that workshop are based on a specific planning scenario (see Attachment 3 – Workshop Handouts), and are shown as a figure, as well as summary of key impacts and resilience factors noted in the group discussions that gave rise to those scores. Next, the potential consequences of the priority hazards were informed by discussions in workshops 1 and 3. Note that recommendations provided in this section target hazard-specific recommendations only; any recommendations applicable to more hazards are discussed in the All-Hazards Recommendations (Appendix F). Recommendations cover a wide range of actors and responsibilities, and while not all recommendations are within the jurisdiction of the EMC, they are listed here for completeness. Often, there may also be opportunity for EMC to collaborate with partners, First Nation and neighbouring local governments to encourage some of these risk reduction/resilience actions to occur.

Appendix E-1: Storm/High-Wind Events

Storm/High Wind Characteristics

Type	Shock	**Extents**	Regional
Duration	Hours - Days	**Likelihood Trend**	Increasing
Seasonality	Fall - Winter		
Warning Time	Days		

High-wind events are characterized by wind gusts and high wind speed. Over recent history, the speed of wind gusts has already increased, and is projected to further increase with climate change (Cheng et al., 2014). Wind has cascading or triggering impacts to critical infrastructure, which may be interconnected with other hazards. Wind-induced damage to systems can disrupt daily life, hamper emergency response efforts, and lead to prolonged service outages. Environment and Climate Change Canada issues a high wind warning when there is 70 km/h or more sustained wind and/or gusts to 90 km/h or more. While the event seasonality is more common from fall to winter, storm/high-wind events also occur outside of this window.

Sample Events
1962 – Big Blow from Typhoon Freda in October
2006 – Wind speeds 75+ km/h, widespread in December
2010 – Wind speeds 80+ km/h
2018 – 30,000 outages (BC Hydro) in the Cowichan region in December
2023 – Widespread outages of up to 50,000 (BC Hydro) in February

Potential Storm/High Wind Impacts

Participants in the workshops reported that high-wind events impact many aspects of peoples' lives and pose emergency preparedness challenges. This is indicated visually in **Figure 6** with consequence scores[18] for six categories (people, social/cultural, economic, environment, government/reputation, and critical infrastructure). The storm/high-wind event diagram shows a "Medium" consequence for four categories: economy, social/cultural, environment, and critical infrastructure. Of those, critical infrastructure was a repeated concern. Participants indicated that power lines block roads and egress/ emergency response routes, power outages last multiple days, and outages could impact other systems (e.g., medical, drinking water). The diagram is followed by a summary of key impacts and resilience factors noted in the group discussions in workshop 2 that gave rise to those scores.

[18] Consequence scores are an average of four group scores by participants in workshop 2. Scores were based on a hazard planning scenario.

Figure 23: Storm/High-Wind Event Consequence Scores, based on scoring of a planning scenario by participatory risk assessment workshop participants. Consequence is shown on a sliding scale from the outside (4 = extreme) to the centre (1 = low). The score for no impact/ disruption (0 = None) was not scored in the workshop and is thus not included on the figure. Consequence scores shown are an average of four group scores.

Key impacts:

- Trees falling on powerlines
- First responders cut off from access
- Disruption, isolation, cut off from critical services, power, and supplies
- Damage to nature reserves
- Impedes safe use of natural spaces
- Closure of industry, shops, and ferries (longer-term in some areas like Youbou)
- Small impact on government reputation

Factors affecting resilience:

- Resilience measures are available (e.g., trimming trees; personal preparedness; alternative power/heat sources; neighbourhood preparedness) but are unevenly distributed
- Impacts and preparedness vary for different groups depending on factors such as location, remoteness, income level, health status, elderly, and neighbourhood connectedness

CRITICAL INFRASTRUCTURE (DISRUPTION). Primary impacts are blow-down from windstorms, where trees and large objects are knocked down, damage powerlines and obstruct linear infrastructure, such as powerlines, roadways, and railways. These interruptions can isolate communities, making it challenging for emergency responders to promptly reach affected areas. Additionally, traffic disruption can hinder the

movement of supplies and services during the initial demand and prolonged during recovery. Longer-term disruption can impact industry and the local economy.

PEOPLE: HEALTH & SAFETY. In addition to infrastructure damage, the consequences of high-wind events can be wide-ranging to health, safety, and security. Wind events can lead to injuries and even loss of life. Isolated communities may face challenges in accessing medical facilities or critical services. For instance, remote communities may be cut off from electricity and heat for prolonged periods, which is particularly challenging if it occurs during the winter. Many people in the Cowichan region have experienced power outages and are likely prepared for shorter power outages. Yet, others may have barriers to preparedness (e.g., cost, language, access, etc.), and overall, vulnerable populations tend to be impacted more. Further, the overall security and resilience of affected areas can be compromised due to the disruption of critical infrastructure.

ECONOMY. Critical infrastructure disruptions caused by high-wind events can also have impacts for businesses and stores, and many of these impacts can be months-long, with closures of grocery stores and other shops due to loss of products or ferry shut-downs, leading to long-term financial impacts.

Existing Storm/High Wind Risk Reduction and Resilience Measures

With the foundation of key impacts and resilience factors, workshop 3 participants[19] considered the strengths and gaps in current regional preparedness and resilience. Participants reported feeling somewhat prepared for storm/high-wind events (but less prepared than for other atmospheric hazards, extreme heat, and severe winter conditions). The strengths and gaps are informed by reports or initiatives listed in the preparedness and resilience categories in **Table 4**. An empty box, like the first one, indicates a clear gap.

Table 8: Workshop table of strengths and gaps in storm/high-wind event preparedness and resilience.

1. Understand & Plan *Research, studies, plans, etc.*	2. Mitigate Risk *Keep hazard out, reduce severity, move/adapt*	3. Build Resilience *Strengthen individual/collective capacity*	4. Respond *Actions for effective emergency response*	5. Recover *Actions/investments into recovering functions*
	CVRD Policies to support tree health.	BC Power outage checklist[20] CVRD Windstorm webpage[21].	General utility response / downed powerline response. EM Local Authority Plan.	General utility response / downed powerline response.

[19] 18 people attended workshop 3, representing a range of organizations. 15 people participated in the polling at the start of the workshop from local or regional government (40%), First Nations (13%), provincial or federal government (13%), non-profit or service sector (13%), and other (20%).

[20] BC 'Get prepared for a power outage' webpage with resources such as emergency plan, emergency kit, and other checklists. https://www2.gov.bc.ca/gov/content/safety/emergency-management/preparedbc/know-your-hazards/power-outages

[21] CVRD windstorm webpage with information and links to provincial resources. https://www.cvrd.ca/3192/Windstorms

Storm/High Wind Recommendations

Given the potential seriousness of high-wind events, it is crucial for governments, communities, and organizations to take proactive measures to prepare for and mitigate their impacts. Some hazard-specific strategies are provided below, and recommendations for general all-hazards approaches to reduce risk and increase resilience are provided in Appendix F. Note that the brackets […] before a recommendation indicate the potential actor for a recommended action:

1. **[EMC] Early Warning System:** Continue to develop, test, and promote Cowichan Alert for advance notice of impending high-wind events, allowing communities to take precautions or evacuate.
2. **[EMC & partnerships] Community education and preparedness:** Educate the public about risks and promoting preparedness to increase safety and reduce damage. Examples includes promoting family and community emergency plans, identifying safe shelters, and securing loose objects.
3. **[EMC; CVRD; BC Hydro] Vegetation management:** Manage trees and vegetation in urban and select rural areas can reduce damage from blow-down during high-wind events. Work with BC Hydro to improve preparedness.
4. **[EMC in cooperation with First Nation and local governments] Response and recovery:** Establish, review, or update response plans and resources for recovery that help communities bounce back faster (see also Appendix F for related all-hazards recommendation). Work with BC Hydro to improve recovery. Clean up park trails after more urgent impacts have been addressed, as trail closures may lead to impacts on mental health.
5. **[EMC] Collaboration:** Work with BC Hydro to improve recovery.

Appendix E-2: Lake, River, Stream Flooding

Fluvial Flooding Characteristics

Type	Shock	**Extents**	Local - Regional
Duration	Hours - Weeks	**Likelihood Trend**	Increasing
Seasonality	All year		
Warning Time	Days		

Flooding is the overflow of water onto land that is normally dry, i.e., when the rivers and streams overflow the natural channels. Climate change is expected to bring changes in weather patterns, leading to more intense rainfall events. This will likely contribute to more frequent and severe flood events in the future (Cowichan Valley Regional District, 2017). Flooding of lakes, rivers, and streams is a notable natural hazard that can have devastating consequences for communities and the environment. Flooding can also trigger critical infrastructure disruptions, including power outages, traffic rerouting and road closures, and backed-up sanitary systems.

Notable events are listed below. Events may occur year-round, with more events in the fall to winter. This includes atmospheric rivers, river-like regions in the atmosphere that transport water vapor[22]. They are a key feature in the water cycle and are tied to both water supply and flood risks. Most recently, atmospheric rivers have caused widespread flooding for consecutive years.

Sample Events

- 1892-1982 – Flooding on average every 3 years
- 1986 – Cowichan River large flow event
- 2007 – Island Highway closure, evacuation
- 2009 – 50+ home flooded; dozens flooded "up to the doorknobs" in November near the Cowichan and Koksilah Rivers
- 2021/2022 – Record rainfall from November atmospheric rivers

Potential Fluvial Flooding Impacts

Workshop participants shared how flooding impacted the environment, culture, and critical infrastructure for emergency response to communities. This is indicated visually in **Figure 7** with consequence scores[23]. The lake, river, stream flooding diagram shows a "Medium to High" consequence for five categories, all except for the people indicator. Of those, the environment indicator was of highest concern. This tracks with how participants expressed a connection to the outdoors and recreation. Specifically, participants highlighted that flood impacts low-lying areas for agriculture and river morphology for fish habitat and may lead to contamination due to septic system failure. Impacts to low-lying areas extend to vulnerable

[22] Weblink: https://www.noaa.gov/stories/what-are-atmospheric-rivers. Accessed 21 September 2023.
[23] Consequence scores are an average of four group scores by participants in workshop 2. Scores were based on a hazard planning scenario.

populations in or adjacent to the floodplain. For First Nations, flooding can also mean a loss of cultural activities, sacred medicines, and traditional harvesting sites.

The diagram is followed by a summary of these key impacts and resilience factors noted in the group discussions in workshop 2 that gave rise to those scores.

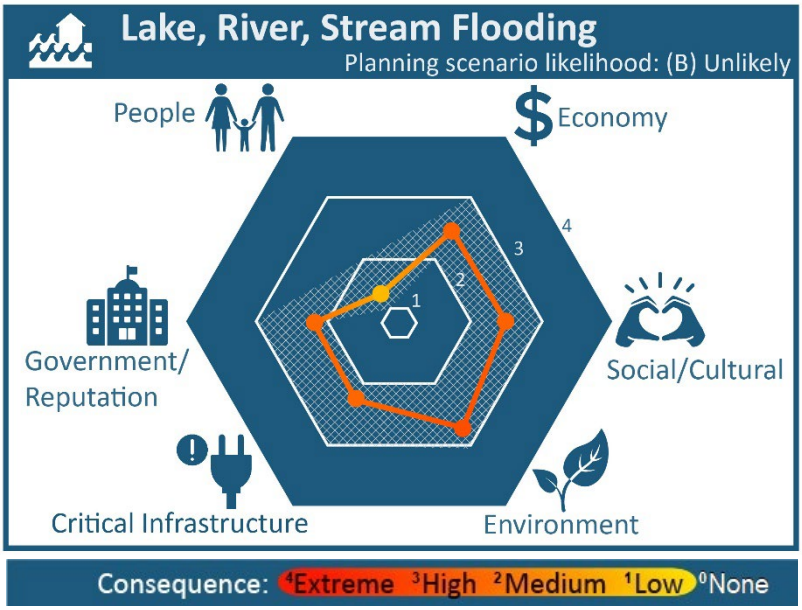

Figure 24: The Lake, River, Stream Flooding Consequence Scores, based on scoring of a planning scenario by participatory risk assessment workshop participants.

Key impacts:

- Severe impacts to agriculture, livelihoods, insurance losses
- Long-term and/or permanent changes to river morphology, geomorphology, fish habitat, estuary
- Water/sewer systems wiped out and/or contaminated
- Highway cut off
- Homes and properties shrinking/damaged/lost
- Danger to tubers, paddlers in the rivers (logs, banks collapsing, obstructions)
- Mental health impacts
- Government blamed for building on floodplain, particularly for low-income housing and First Nations

Factors affecting resilience:

- Acute impacts very localized to floodplains, vulnerable populations, First Nations, low-income, farmers
- Can have wider impact on communities if critical infrastructure damaged (water, sewer, highways)
- Impacts are often long-term; recovery can take months/years
- Government can mitigate impacts through unified response from different regions/levels

ENVIRONMENTAL. Flooding can lead to environmental damage including soil erosion, water contamination, and ecosystem disruption (e.g., river morphology, geomorphology, fish habitat, estuary). In addition to harming fish habitat, inundation of low-lying land can impact agricultural lands.

CRICITICAL INFRASTRUCTURE (DISRUPTION). Floods can devastate critical infrastructure such as transportation networks, sanitation systems (e.g., water and wastewater), and even electric grids. Water or electric grids may experience outages or require pre-emptive shutdowns. Roads may become impassable due to flooding, causing road closures and rerouting, or even isolating communities.

HOMES, PROPERTIES. Residential and commercial properties in flood prone areas are at risk of damage during flood events. Floodwater can cause structural damage, contamination of water or building materials, and result in costly losses for both owners and tenants.

PEOPLE: HEALTH & SAFETY. In addition to environmental and infrastructure damage, the consequences of flood events can range to health, safety, and security. Flood events can cause injuries and even loss of life.

Existing Fluvial Flooding Risk Reduction and Resilience Measures

With the foundation of key impacts and resilience factors, workshop 3 participants[24] considered the strengths and gaps in current regional preparedness and resilience. Participants reported feeling moderately prepared, more prepared for lake, river, stream flooding than other types of flooding, and that this may need more attention. The strengths and gaps are informed by reports or initiatives listed in the preparedness and resilience categories in Table 5. A box with less information, like the last category, may indicate a gap.

[24] 18 people attended workshop 3, representing a range of organizations. 15 people participated in the polling at the start of the workshop from local or regional government (40%), First Nations (13%), provincial or federal government (13%), non-profit or service sector (13%), and other (20%).

Table 9: Workshop table of strengths and gaps in lake, river, stream flooding preparedness and resilience.

1. Understand & Plan *Research, studies, plans, etc.*	2. Mitigate Risk *Keep hazard out, reduce severity, move/adapt*	3. Build Resilience *Strengthen individual/collective capacity*	4. Respond *Actions for effective emergency response*	5. Recover *Actions/investments into recovering functions*
Flood Studies[25] for Lower Cowichan / Koksilah River (2021); Shawnigan Lake (2020); Cowichan River – Riverbottom Road Area (2020); Cowichan Lake (1984); Chemainus River (2022).	Integrated Stormwater Management Plans Lower Cowichan / Koksilah River Integrated Flood Management Plan (2009). CVRD OCP designation mapping[26] (e.g., restrict development near water). Diking and barriers. Flood Construction Levels (FCLs).	Living the New Normal Education. Cowichan Watershed Resiliency Program (use of Disaster Mitigation and Adaptation Fund). Groups like Cowichan Lake & River Stewardship Society.	Early warning system (Cowichan Alert). Response plans in low-lying communities, First Nations. Emergency Support Services (ESS) Program.[27] EM Local Authority Plan.	Long-term recovery assistance[28].

Fluvial Flooding Recommendations

Given the potential seriousness of flood events, it is crucial for governments, communities, and organizations to take proactive measures to prepare for and mitigate their impacts. Some strategies to consider include:

1. **[EMC; First Nation and local governments] Floodplain management:** Implement and enforce standard regulations on buildings in flood-prone areas as well as control development to reduce property damage and protect human safety.
2. **[CVRD; First Nation and local governments] Infrastructure resilience:** Design critical infrastructure to be more resilient to flood impacts to minimize service disruptions and accelerate recovery after events. This includes critical infrastructure such as drinking water and wastewater treatment systems. Further, this includes working with property owners and communities to make septic systems flood-resilient to reduce potential contamination of flood waters.
   "With increased flooding, drought, episodic snow events, and heat waves, the business case for "futureproofing" infrastructure will become stronger."(Cowichan Valley Regional District, 2017)
3. **[CVRD; First Nation and local governments] Natural flood management:** Implement nature-based solutions, such as restoring natural wetlands and creating modern retention ponds (sized for climate projections), can slow and retain excess water, potentially reducing the flood hazard. For

[25] CVRD flood studies, contact information, and links to provincial information. https://cvrd.ca/3195/Flooding
[26] CVRD Official Community Plan for the Electoral Areas. https://www.cvrd.ca/3206/Official-Community-Plan-for-the-Electora
[27] Emergency Assistance from the Emergency Support Services (ESS) Program. ESS is typically available to any evacuation for up to 72 hours, and due to its limitations, it is considered a response measure not recovery.
[28] Long term recovery assistance may be activated through NGOs (e.g. Red Cross). https://www.cvrd.ca/89/Emergency-Assistance.

highly managed lands, such as agricultural areas, extend solutions to afforestation or flood-resilient crops for areas that regularly flood.

4. **[EMC; community groups] Public awareness:** Educate the public about flood hazards and risk, preparedness, and response to empower individuals or groups to respond effectively. This potentially reduces the strain on emergency management resources.

Appendix E-3: Drought & Extreme Heat

Drought & Extreme Heat Characteristics

Drought	**Type**	Chronic
	Duration	Months - Decades
	Seasonality	Summer
	Warning Time	Variable

Extreme Heat	**Type**	Chronic
	Duration	Days - Weeks
	Seasonality	Summer
	Warning Time	Days - Weeks

Drought, a recurrent climatic phenomenon, involves a deficiency of precipitation over an extended period, resulting in a water shortage in various sectors such as for communities, aquatic ecosystems, or agriculture. Often, extreme heat events occur alongside droughts. Drought conditions and increased temperatures may also negatively impact the ability of people to enjoy summer tourism opportunities (Cowichan Valley Regional District, 2017). While the precipitation intensity is projected to increase with climate change, summer rainfall is expected to decrease by 17% and dry spells will lengthen from 22 consecutive days to 26 days, or by about 20%, making drought and extreme heat events more likely in the future (Cowichan Valley Regional District, 2017).

Several factors contribute to the onset and severity of drought. Drought is driven by:

- **Insufficient snow accumulation:** Water availability in the Cowichan region relies, in part, on snowpack accumulation during the colder months. When the snow accumulation is below average, it can lead to reduced water availability in the drier summer months that follow.
- **Delay in rainfall:** The timing of rainfall is crucial to sustaining water resources. Increased precipitation variability or less frequent rainfall can exacerbate drought conditions.
- **Increased hot and dry weather:** Prolonged periods of hot and dry weather increase evaporation rates, which means higher rates of water loss from soils and waterbodies. This contributes to drought conditions.

Sample Events

- 2015 – The drought season started early with low snowpacks that melted off early in the spring due to a heat wave. Drought levels ramped up with hot dry conditions and southern BC experienced severe drought, peaking in late August until rain in late August.[29]
- 2009 – Heat wave - temperatures over 35°C and 5 consecutive days over 32°C. Smog brought on by very hot weather and forest fires.
- 2014 – Extreme heat in July with public safety warnings.
- 2021 – The 2021 heat dome temperatures previously unseen of 41.9°C in Duncan and possibly higher at Lake Cowichan.
- 2023 – In August 2023, a heat wave set records in Malahat and North Cowichan. The prolonged hot and dry weather has led to drought conditions in the Cowichan region and water restrictions are implemented in water systems.

[29]https://governmentofbc.maps.arcgis.com/apps/MapSeries/index.html?appid=838d533d8062411c820eef50b08f7ebc

Potential Drought & Extreme Heat Impacts

Participants reported in the workshops that drought and extreme heat events impact several aspects of peoples' lives regarding water availability, the environment, and the economy. This is indicated visually in **Figure 8** with consequence scores[30] that show a medium to high consequence for all categories. Water availability was an immediate concern for drinking and sanitation. Some communities feel the shortage when water is trucked in seasonally. Beyond the basic use, the environment was a repeated concern for potential irreparable damages to wild and cultivated species. Participants tied this to economic concerns in food-production and security, agriculture, and industry.

> "Warmer temperatures and prolonged summer drought, combined with extreme out-of-season storm events can be expected to bring uncertainty to the forestry, agricultural, and tourism sectors."(Cowichan Valley Regional District, 2017)

The diagram is followed by a summary of key impacts and resilience factors noted in the group discussions in workshop 2 that gave rise to those scores.

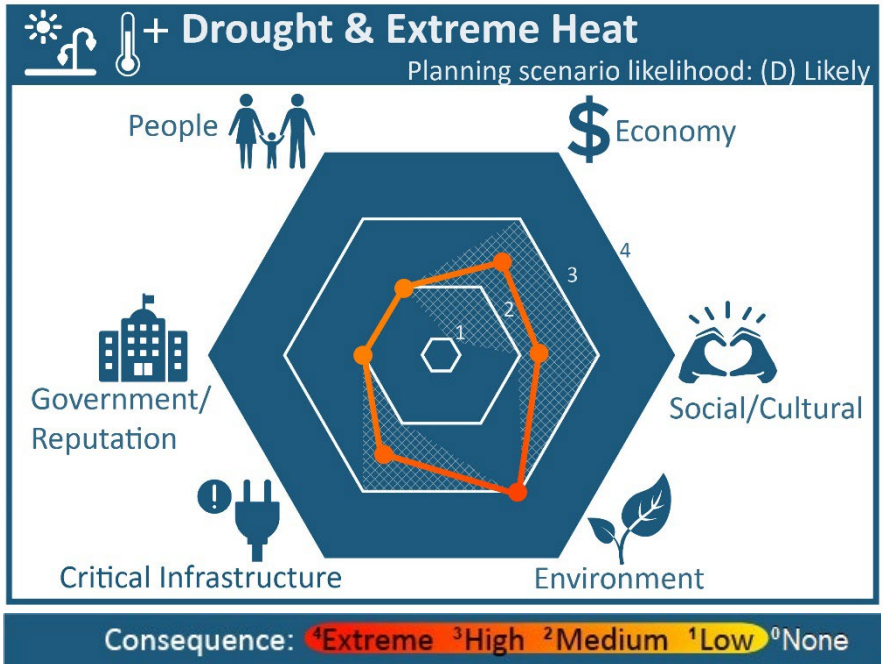

Figure 25: The Drought and Extreme Heat (combined) Event Consequence Scores, based on scoring of a planning scenario by participatory risk assessment workshop participants.

[30] Consequence scores are an average of four group scores by participants in workshop 2. Scores were based on a hazard planning scenario.

Key impacts:

- Severe illness and health impacts, death
- Short-term economic impacts to businesses with water restrictions, WorkSafeBC claims
- Long-term and possibly irreparable impacts to environment: loss of species, new species coming in that disrupt ecosystem, soil damage, unable to plant trees
- Long-term impacts to food/resources and jobs: agriculture, wine, timber, fishing, forest service, tourism

Factors affecting resilience:

- More severe health and social impacts for elderly
- Increasing population & energy demands on already strained power grid
- Length of event: shorter-term (few weeks) recovery possible after one drought/heat event, longer-term impacts with multiple years of drought
- Government can increase resilience by preparing ahead of heat events, i.e., cooling centres
- Difficult to change habits of people to conserve water

WATER AVAILABILITY. The immediate impact of drought is the scarcity of water, seasonally or for extended periods. This leads to reduced availability for use such as drinking, sanitation, agriculture, and industrial and economic purposes.

ENVIRONMENTAL. The potential environmental impacts are abundant and potentially irreparable. Aquatic ecosystems (rivers, lakes, and wetlands) deteriorate with low water levels, leading to habitat degradation or loss. These disruptions can result in ecological imbalances and fish population (e.g., salmon stocks) decline.

- **WATER QUALITY.** Lower water levels during drought also concentrate pollutants, leading to decreased water quality. This can have adverse effects on aquatic ecosystems and human health.
- **FIRES.** Prolonged dry conditions during a drought can increase fire risk. The drier vegetation is more susceptible and can carry fires rapidly, threatening the forests as well as the wildland urban interface.

CRITICAL INFRASTRUCTURE. Drought can change the surface and subsurface. As the ground dries and contracts, it can lead to structural impacts to buildings and roads. The damage increases repair costs.

PEOPLE: HEALTH & SAFETY. Droughts can contribute to health and social impacts. Water scarcity can lead to poor sanitation and waterborne illnesses. Extreme heat compounds health concerns and can cause heat-related illness and even death, especially for vulnerable populations.

ECONOMY. Droughts can impact the local economy through multiple pathways. A community dependent on agriculture can have increased costs for water supply (e.g., water trucks rather than mains) and decreased productivity and output, leading to losses for the farmers, businesses, and industries.

Existing Drought & Extreme Heat Risk Reduction and Resilience Measures

With an understanding of impacts and resilience factors, workshop 3 participants[31] considered the strengths and gaps in current regional preparedness and resilience. Participants reported feeling most prepared for extreme heat but identified drought as definitely needing more attention in the future. The strengths and gaps are informed by reports or initiatives listed in the preparedness and resilience categories in Table 6. A box with less information, like the recover category, may indicate a gap.

Table 10: Workshop table of strengths and gaps in drought and extreme heat preparedness and resilience.

Hazard	1. Understand & Plan *Research, studies, plans, etc.*	2. Mitigate Risk *Keep hazard out, reduce severity, move/adapt*	3. Build Resilience *Strengthen individual/collective capacity*	4. Respond *Actions for effective emergency response*	5. Recover *Actions/investments into recovering functions*
Drought	Results of Coupled Groundwater Surface Water Model of the Cowichan Valley Watershed (2015). Cowichan Agricultural Water Demand Model (2013).[32] Watershed Planning (Koksilah)[33]. BC Data Catalogue: BC Drought Levels	Living the New Normal website[34] resources for conservation for the home, business, agriculture, and watershed level. Water conservation early.	Drought Contingency Plan[35] Living the New Normal Education.	Living the New Normal Education. Cowichan Alert[36] (applicable for all hazards). EM Local Authority Plan.	Cowichan Weir Project[37]
Extreme Heat	PreparedBC - Extreme Heat Preparedness Guide. Island Heath - Heat Safety Information. Climate Projections	Prevention & long-term mitigation strategies: Climate Change Adaptation and Risk Management Strategy (2021)[38]	Living the New Normal Education. EPIC (Eldercare Project in Cowichan) education and resources for seniors.	North Cowichan heat event page to resources (Health Link BC, Environment Canada)[39]. CVRD follows	Creating cooling centres (e.g., Our Cowichan, Cowichan Tribes, Ladysmith, North Cowichan, and CVRD Recreation Centres).

[31] 18 people attended workshop 3, representing a range of organizations. 15 people participated in the polling at the start of the workshop from local or regional government (40%), First Nations (13%), provincial or federal government (13%), non-profit or service sector (13%), and other (20%).
[32] Cowichan Agriculture Water Demand Model. https://cowichanwatershedboard.ca/document/document-agriculture-water-demand-model/
[33] Koksilah Watershed Water Sustainability Planning. https://healthywatersheds.ca/project/koksilah-watershed-water-sustainability-planning/
[34] CVRD Living the New Normal – Drought Smart resources. https://cvrdnewnormalcowichan.ca/drought-smart/
[35] CVRD Drought page for water levels and restrictions. https://www.cvrd.ca/2496/Drought
[36] The emergency notification service, Cowichan Alert by the Alertable mass notification tool is signup based. https://www.cvrd.ca/3369/Emergency-Alert-System
[37] Cowichan Lake Weir Design Project. https://cowichanlakeweir.ca/weir-design/
[38] ICLEI Canada. (2021). Climate Change Adaptation and Risk Management Strategy. https://www.cvrd.ca/DocumentCenter/View/100254/2021-01-18-CVRD-Climate-Change-Adaptation-and-Risk-Management-Strategy
[39] North Cowichan heat events webpage with information and links to provincial resources. https://www.northcowichan.ca/EN/main/community/emergency-services/heat-events.html

	for the CVRD (2017). BC Catalogue: climate normal (1961-1990).	for community health and emergency management.	guidelines from the BC HEAT committee.

Drought & Extreme Heat Recommendations

Given the potential seriousness of events, it is crucial for governments, communities, and organizations to take proactive measures to prepare for and mitigate their impacts. Proactive water management is crucial for improving water availability and mitigating impacts of drought. Some strategies to consider include:

1. **[CVRD; EMC] Conservation:** Promote water conservation (e.g., behavior, water-efficient technologies) at the individual and community level for responsible water use.
    a. Use BC acts to protect wildlife (e.g., Water Sustainability Act to protect fish in Koksilah, Upper Cowichan rivers).
    b. Consider land use/development policies that acknowledge landscaping built for both drought and FireSmart (all-hazards approach).
2. **[CVRD; First Nation and local governments] Sustainable agriculture practices:** Support the adoption of water-efficient techniques (e.g., drip irrigation, moisture sensors). Encourage drought-resistant and, therefore, water-efficient crop varieties.
3. **[CVRD; EMC; First Nation and local governments] Drought contingency plan:** Maintain and implement the drought contingency plan developed by the CVRD (e.g., water restrictions, emergency water supply plans, water allocation strategies, etc.) at local and regional levels.
4. **[CVRD; First Nation and local governments; community groups] Rainwater harvesting:** Implement systems to capture rainwater that can be beneficial on many scales, from individuals to the city.
5. **[CVRD; First Nation and local governments] Water recycling:** Implement and normalize (grey) water recycling and reuse, notably for non-potable uses such as irrigation and industrial processes. This practice reduces the overall water demand.
6. **[CVRD; First Nation and local governments] Ecosystem restoration:** Restore natural ecosystems that play crucial roles in regulating water, such as wetlands and forests.
7. **[CVRD; EMC; community groups] Collaboration:** Collaborate among sectors (agriculture, environmental groups, first nations, municipalities, etc.) to optimize water use, allocation, and planning.
8. **[CVRD; MoTI; First Nation and local governments] Water infrastructure:** Upgrade or retrofit water infrastructure to optimize supply and distribution. This may include decommissioning select groundwater wells.

Appendix E-4: Wildfire

Wildfire Characteristics

Type	Shock	**Extents**	Local - Regional
Duration	Days - Weeks	**Likelihood Trend**	Increasing
Seasonality	Spring - Summer		
Warning Time	Hours - Days		

A wildfire is an unplanned fire, including human-caused fires, occurring on forest, grass, brush, scrub, peat lands, or a prescribed fire which spreads. Fire can spread to developed areas. The wildland urban interface (WUI) is any area where combustible forest fuel is adjacent to structures. Wildfires are both inevitable and essential to the health of ecosystems. Climate change projections indicate increased wildfire season length, wildfire frequency, and burned area.[40]

Wildfires are often triggered by lightning (see the 2018 sample event below) and earthquakes. The earthquake damages to gas pipelines, powerlines, and building-level electrical wiring can ignite fires. Wildfires can trigger hazards such as critical infrastructure disruptions and worsen flooding.

Wildfires can have far-reaching impacts on both the natural and human communities. The 2017 Climate study indicated "An increase in the risk of wildfires can also be expected, further stressing upland forest water-holding capacity, exposing soils directly to the elements, and causing further erosion."(Cowichan Valley Regional District, 2017)

Sample Events[41]

- 1924 – 3,750 ha burned
- 1927 + 1929 + 1933 – 3,751 ha burned
- 2015 - 15.5 ha north of Hwy 18 between Lake Cowichan and Duncan and 400 ha near Lizard Lake
- 2018 – in August, 34 new fires were ignited on the Island
- 2022 - Mt. Hayes fire in August put critical infrastructure at risk
- 2023 – the worst wildfire season on record for Canada

For economic reference, the 2017 fire season in BC resulted in:[42]

- over $600 million cost (as did 2018),
- about 65,000 people evacuated,
- 502 impacted structures, and 229 destroyed homes.[43]

[40] https://www.epa.gov/climate-indicators/climate-change-indicators-wildfires#ref2
[41] B.A. Blackwell & Associates Ltd. 2017. Cowichan Valley Regional District
West Zone Community Wildfire Protection Plan Update 2017.
https://www.cvrd.ca/DocumentCenter/View/100048/Cowichan-Valley-Regional-District-West-Zone-Community-Wildfire-Protection-Plan-2017?bidId=
[42] https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-statistics/wildfire-averages
[43]BC Wildfire Service. 2017. Provincial Strategic Threat Analysis: 2017 Update.
https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/wildfire-status/prevention/fire-fuel-management/fuels-management/provincial_strategic_threat_analysis_2017_update.pdf

Potential Wildfire Impacts

Participants in the workshops reported that wildfire events impact people's lives, especially for health and safety (e.g., smoke inhalation, especially for vulnerable populations), the environment, and critical infrastructure. This is indicated visually in **Figure 9** with consequence scores[44] that show medium to high consequence. Again, participants noted the environmental impacts, explaining that losses of forest and species is irreplaceable for generations. Additionally, these losses can trigger social, culture, and mental health impacts. Participants were concerned about having adequate infrastructure for timely wildfire response. The diagram is followed by a summary of key impacts and resilience factors noted in the group discussions in workshop 2 that gave rise to those scores. Note that people consequence scores may be biased towards lower than expected, due to the scoring criteria from the HRVA guidance (see also Section 1.1.2).

Figure 26: The Wildfire Consequence Scores, based on scoring of a planning scenario by participatory risk assessment workshop participants.

[44] Consequence scores are an average of four group scores by participants in workshop 2. Scores were based on a hazard planning scenario.

Key impacts:

- Smoke inhalation affects everyone and especially vulnerable people
- Loss of wine, agriculture, tourism, hunting, back country, etc. Smoke can cause widespread economic shutdown
- Species loss, forest loss is irreplaceable for generations
- Pollutes air and water quality
- Government blamed for lack of adequate infrastructure (fire hydrants), unable to respond sufficiently
- Social/cultural/mental health impacts can last a long time after evacuations
- First Nation communities, cultural impacts

Factors affecting resilience:

- Vulnerable people more impacted by smoke inhalation
- Farmers, people in backcountry are more vulnerable because they are harder to evacuate
- Busy tourist season means much larger populations to evacuate, harder when people intoxicated
- People are more isolated these days so social impacts greater
- Closing back country becoming more common during high-risk times
- Fire damage depends on size, proximity to critical infrastructure
- Climate extremes (drought/heat) = higher intensity fires
- Firefighting equipment unavailable, too overwhelmed to respond, prioritization

ENVIRONMENTAL. Wildfires can destroy natural habitat, leading to the loss of plant species and animal habitat. The destruction of habitats can mean a loss of biodiversity as some species may not adapt to the affected areas. Additionally, the loss of plants and vegetation leave soil exposed, increasing soil erosion and sedimentation of creeks and waterbodies. The overall disruption to the system affects the health and function of the ecosystems.

- **WATER QUALITY.** Wildfires can deposit the ash and debris into waterbodies, in addition to sediment. This potentially contaminates drinking water sources.
- **WATER AVAILABILITY.** Intense wildfires can lead to changes in the hydrological patterns, impacting the watershed (Hope *et al.*, 2015).
- **FLOODING.** Wildfire changes the landscape and ground conditions. Following wildfire, the changes in soil properties and reduced vegetation result in reduced rainwater infiltration and increased overland flow and, therefore, flooding (Hope *et al.*, 2015). In the years following the wildfire, this flash flooding can further impact ecosystems and communities downstream. The flood severity will vary with local conditions such as steep slopes.

CRITICAL INFRASTRUCTURE. Wildfires can spread from the wildland to the urban interface, leading to the destruction of homes and critical infrastructure on which people depend. The damage can, in turn, result in economic losses for individuals and the community.

PEOPLE: HEALTH & SAFETY. Wildfires emit smoke and particulate matter into the air, reducing the air quality and posing health concerns, especially for those with pre-existing respiratory conditions. The inhalation of wildfire smoke can cause issues for everyone in the impacted area.

In addition, wildfire evacuations lead to displacement that ranges from temporary to permanent. The displacement itself, unknown length of displacement, and social and mental strain can be substantial following a wildfire.

Wildfires can result in injury or death for residents and firefighters.

ECONOMY. Property damage can result in substantial costs and economic losses for individuals and communities.

Existing Wildfire Risk Reduction and Resilience Measures

With an understanding of impacts and resilience factors, workshop 3 participants[45] considered the strengths and gaps in current regional preparedness and resilience. Participants reported feeling well prepared for wildfire. Participants only felt more prepared for extreme heat. The strengths and gaps are informed by reports or initiatives listed in the preparedness and resilience categories in Table 7. A box with less information, like the recover category, may indicate a gap.

Table 11: Workshop table of strengths and gaps in wildfire preparedness and resilience.

1. Understand & Plan *Research, studies, plans, etc.*	2. Mitigate Risk *Keep hazard out, reduce severity, move/adapt*	3. Build Resilience *Strengthen individual/collective capacity*	4. Respond *Actions for effective emergency response*	5. Recover *Actions/investments into recovering functions*
Wildfire Protection Plan Updates (several communities). **CVRD OCP Fire Protection Map**[46]	Community Wildfire Protection Plans DPA 5 – Wildfire Hazard[47]. CVRD reference	Living the New Normal FireSmart BC Fuel Management Education[49]. Insurance policies	EM Local Authority Plan. Fire Rescue Services[50]. Urban Forest Masterplan.	

[45] 18 people attended workshop 3, representing a range of organizations. 15 people participated in the polling at the start of the workshop from local or regional government (40%), First Nations (13%), provincial or federal government (13%), non-profit or service sector (13%), and other (20%).
[46] CVRD OCP Schedule E: Fire Protection Maps. https://www.cvrd.ca/DocumentCenter/View/102787/2021-10-13-Fire-Protection-Maps. OCPs from other jurisdictions may also include wildfire measures.
[47] Protection of Development from Hazardous Conditions: DPA 5 – Wildfire Hazard. https://www.cvrd.ca/1825/Technical-Reports
[49] CVRD webpage for the program, FireSmart in the Cowichan Area, has information for home assessments, farms and ranches, and neighbourhoods as well as links to FireSmart BC. https://www.cvrd.ca/2517/FireSmart-Information
[50] Within the Cowichan Valley, there are 18 Volunteer Fire Departments and 21 fire stations. https://www.cvrd.ca/170/Fire-Rescue-Services

	website[48].	Provincial number to report fires.

Wildfire Recommendations

Given the potential seriousness of wildfires, it is crucial for governments, communities, and organizations to take proactive measures to prepare for and mitigate their impacts. Like drought, proactive water management and planning plays an important role in wildfire mitigation. Strategies to consider include:

18. **[BC Wildfire Service; First Nation and local governments; CVRD] Firefighting resources:** Maintain and test resources such as hydrants to ensure working condition during an emergency.
    a. Water infrastructure: Maintain, inspect, and retrofit underground water infrastructure (e.g., pipelines, water treatment and distribution facilities) to limit unnecessary losses and ensure a reliable supply.
    b. Water sources: A water source is necessary in all areas of the communities for a timely response. Where hydrants are limited or non-existent, site strategically located water storage (e.g., water tanks) to provide a reliable source for firefighting.
    c. Water recycling: Implement systems for grey water reuse and recycling to save water resources for other uses such as firefighting.
19. **[EMC] Water conservation:** Continue or extend water use restrictions during dry seasons or drought conditions to help conserve water resources.
20. **[EMC encourages CVRD, First Nation and local governments, private homeowners] Adoption and enforcement of best practices:**
    a. Defensible space: Establish defensible spaces in and around the wildland urban interface to create fire-resistant areas. Adopt a FireSMART approach and assessment (e.g., scorecard) for the region.
    b. Prescribed burns: Manage controlled or prescribed burns to reduce fuel loads and prevent larger, hotter fires. Work with Knowledge Keepers to identify the suitability, location, and frequency of prescribed burns.
    c. Training: Continuously train firefighters on techniques and response strategies to optimize water use and the overall effectiveness. This also includes local and First Nations training.
    d. Public Education Programs: Continue implementation of FireSmart principles, assessments, incentives, and education in all communities.
    e. Critical Infrastructure Fuel Management: Establish ongoing strategy and implementation of FireSmart fuel management practices for critical assets.
21. **[EMC] Consistent communications:**
    a. Ensure regular meetings (e.g., monthly) to discuss initiatives, plans, and exercises with the emergency management team, in full or portions, enhances the meetings that are already occurring, supports a proactive approach, and connects different specialists.
    b. Plan meetings and opportunities to engage with vulnerable communities supports conversations around emergency management plans, progress on current initiatives (e.g.,

[48] CVRD Wildfire references, contact information, and links to provincial information. https://www.cvrd.ca/3198/Wildfires

Regional Cowichan Wildfire Resiliency Committee'), and resources (i.e., identifying where help can be given and is needed).

c. Meet with organized groups such as farmers associations to leverage capacity and extend planning to specific needs such as plans for livestock.

22. **[EMC] Emergency management plans:** Update Local Authority Plans regularly and add community-specific hazard plans
23. **[EMC; CVRD, First Nation and local governments, private homeowners] Wildfire smoke mitigation strategies:** Develop, publicize, and implement strategies to mitigate the impact of wildfire smoke on indoor air quality, such as installing high-efficiency particulate air (HEPA) filters in buildings, sealing windows and doors, and creating clean air shelters in vulnerable communities.

Appendix E-5: Hazardous Material Release

Hazardous Material Release Characteristics

Type	Shock	**Extents**	Micro - Local
Duration	Days	**Likelihood Trend**	Uncertain
Seasonality	All year		
Warning Time	None		

Hazardous materials are substances that are dangerous to human health, safety, and the environment. These include toxic gases, radioactive material, acids, any number of chemicals and goods, and gas or oil spills when they pose a risk of fire, explosion, or damage to the environment.

Hazardous material spills can happen under two circumstances: on site or in transit by aircraft, rail, ship, or truck. A hazardous material release can be triggered by hazards such as earthquakes, flooding, or high-wind events.

Sample Events

- 2000 – Propane Tanker Spill (49,000L) on Malahat highway
- 2011 – Malahat highway fuel truck spill[51]
- 2020 – Fishing vessel sank off Vancouver Island, killing two crewmembers[52] (not within Cowichan region)
- 2020 – Schnitzer Steel Fire[53]
- 2022 – Fuel-leaking Aleutian Isle fishing vessel sank near San Juan Island, crews spent weeks deploying absorbent booms[54] (not within Cowichan region)

Potential Hazardous Material Release Impacts

Participants reported in the workshops that hazardous materials release is a different hazard that can impact especially the environment for aquatic life and harvesting areas and, therefore, livelihoods. This is indicated visually in **Figure 10** with consequence scores[55] that show medium to high consequence. Beyond the impacts described explicitly in the diagram, spills can trigger mental health impacts and generate public mistrust for the entity at-fault. The diagram is followed by a summary of key impacts and resilience factors noted in the group discussions in workshop 2 that gave rise to those scores.

[51] https://www.cbc.ca/news/canada/british-columbia/malahat-fuel-spill-kills-off-thousands-of-salmon-1.987375
[52] https://www.vancouverislandfreedaily.com/news/insufficient-maintenance-contributed-to-fatal-2020-sinking-of-arctic-fox-ii-report/
[53] https://www.cheknews.ca/groundwater-testing-underway-following-schnitzer-steel-fire-south-of-nanaimo-airport-700069/
[54] https://www.cowichanvalleycitizen.com/news/fuel-leaking-fishing-boat-pulled-to-surface-one-month-after-sinking-near-victoria/
[55] Consequence scores are an average of four group scores by participants in workshop 2. Scores were based on a hazard planning scenario.

Figure 27: The Hazardous Material Release Consequence Scores, based on scoring of a planning scenario by participatory risk assessment workshop participants.

Key impacts:

- Large area of people affected/evacuated, but short term (egress routes/mass care/urgency)
- Mass illness from gas → unknown consequences
- Specific industry closure could be long or short term, impact on economy
- Socioeconomic shut down but could be short-term
- Agricultural farmland impacts
- Long term impacts to aquatic life (cultural food security)
- Could impact cultural beds/harvesting for Malahat First Nation
- Long-term and/or irreversible damage to environment, aquatic livelihood
- Critical infrastructure impacts would be short-term, e.g., ferry disruptions
- At fault private company will be more criticized than the government
- Long term water quality impacts (as seen with Schnitzer Steel Fire)

Factors affecting resilience:

- Impacts depend on type of chemical, size of release, location, and environmental conditions
- Capacity exceeds available systems, need to activate required emergency support
- Unknown if week-long or life-long impacts
- Fuel leak not a big impact, due to diesel floats

- Systems in place for rapid response, but unclear who is responsible to respond and how

The severity of impacts depends on the type and quantity of material, as well as the location.

ENVIRONMENTAL. Environmental impacts can span soil, water, and air pollution depending on the material. Hazardous materials can enter the soil, contaminating the groundwater or land, both of which can have additional impacts. The hazardous materials can also contaminate nearby waterbodies, impacting natural aquatic ecosystems, plant and animal species, drinking water, and recreational areas. For volatile hazardous materials (e.g., volatile organic compounds or VOCs such as paints or fuels), toxic vapors can cause air pollution and respiratory hazards.

CRITICAL INFRASTRUCTURE. Releases can damage infrastructure such as buildings, roads, and services (e.g., water supply), depending on the hazardous material type.

HOMES, PROPERTIES. Releases can damage valuable assets, including homes, property values (e.g., via long-term damage to the environment), businesses, business equipment, and contents or inventory.

PEOPLE: HEALTH & SAFETY. Exposure to hazardous materials can impact health, including respiratory issues, skin irritation, and illness and death. In addition to short-term toxicity, chronic exposure to materials could lead to long-term impacts such as cancer. Impacts can result for people in the vicinity of the release as well as first responders, volunteers, and cleanup crews.

In addition, evacuations due to a hazardous material release can lead to displacement that ranges from temporary to permanent. The displacement itself, unknown length of displacement, and social and mental strain (e.g., fear, anxiety) can be substantial following an event.

ECONOMY. Cleaning hazardous material releases can require substantial funding (public or private), time, and resources. During the cleanup period, the releases can lead to prolonged closures of businesses in the area, resulting in both economic losses and work displacement (e.g., salary losses).

LEGAL CONSEQUENCES. Individuals or companies responsible for the release may face legal liabilities (e.g., fines, penalties) based on safety regulations, environmental laws, or other non-compliance.

Existing Hazardous Material Release Risk Reduction and Resilience Measures

With an understanding of impacts and resilience factors, workshop 3 participants[56] considered the strengths and gaps in current regional preparedness and resilience. Participants reported feeling not prepared for hazardous material release and, accordingly, that the hazard could use more attention.

[56] 18 people attended workshop 3, representing a range of organizations. 15 people participated in the polling at the start of the workshop from local or regional government (40%), First Nations (13%), provincial or federal government (13%), non-profit or service sector (13%), and other (20%).

The strengths and gaps are informed by reports or initiatives listed in the preparedness and resilience categories in Table 8. A box with less information, like the mitigate risk and recover categories, indicate gaps.

Table 12: Workshop table of strengths and gaps in hazardous material release preparedness and resilience.

1. Understand & Plan *Research, studies, plans, etc.*	2. Mitigate Risk *Keep hazard out, reduce severity, move/adapt*	3. Build Resilience *Strengthen individual/collective capacity*	4. Respond *Actions for effective emergency response*	5. Recover *Actions/investments into recovering functions*
BC Data Catalogue: Coastal BC marinas.		BC 'Get prepared for a hazardous material spill'[57]. WHMIS training in specific organizations[58].	BC preparedness and response planning. EM Local Authority Plan.	

Hazardous Material Release Recommendations

Given the potential seriousness of hazardous material release, it is crucial for governments, communities, and organizations to take measures to prepare for and mitigate impacts. Like many hazards, maintaining robust emergency response plans plays an important role in mitigation. Strategies to consider include:

1. **[EMC; MoTI] Hazard and risk assessment for materials release:** Identify, document (in a readily available location) and communicate areas at higher risk based on proximity to industrial sites and transportation routes (i.e., air, rail, ship, or truck hubs). Additionally, outside of these high-risk areas, consider existing codes or guidelines for restricting the transportation of materials through densely populated as well as environmentally sensitive areas.
2. **[EMC] Communication:** Establish communication protocols between industries, emergency responders, and other necessary parties to facilitate response coordination (use hazard materials database from previous step if available). Also, determine how to communicate with the public for timely and accurate updates that support community trust.
3. **[Provincial] Regulatory compliance:** Identify the pathways of inspections or audits. Determine how to highlight the importance of strict enforcement and adherence.
4. **[EMC and others] Additional planning scenarios:** Consider the emergency response plans under various planning scenarios (e.g., different hazard combinations). Organize, exercise, and train with planning scenario round tables between industry, government, and emergency responders.
5. **[EMC; Regional] Aid agreements:** Establish aid agreements with neighbouring regions or industries can increase support and resources during a large-scale event.

[57] BC 'Get prepared for a hazardous material spill' webpage with materials for developing emergency plan and emergency kit. https://www2.gov.bc.ca/gov/content/safety/emergency-management/preparedbc/know-your-hazards/hazardous-material-spills

[58] Workplace Hazardous Materials Information System (WHMIS) Online Training. https://worksitesafety.ca/

Appendix E-6: Earthquake Hazard

Earthquake Characteristics

Type	Shock
Duration	Days (Aftershocks Weeks - Months)
Seasonality	All year
Warning Time	Seconds - Minutes

Earthquakes strike suddenly and can damage buildings, property, and infrastructure. An earthquake is defined as the shaking of the ground due to seismic movement along a fault rupture. The three primary hazards of earthquakes are ground shaking, liquefaction, and landslides. When a large magnitude earthquake occurs, energy travelling in seismic waves may cause damage to structures or *trigger* the following hazards:

- landslides
- liquefaction
- fires
- hazardous material spills
- critical infrastructure disruptions (e.g., health care, roads, power, water & sewer)
- other geologic hazards
- tsunamis
- floods

Earthquakes can have widespread impacts on communities. The severity of the impacts depends on many factors discussed in this section.

Sample Events

- 1946 – Magnitude 7.3[59] earthquake on Vancouver Island.
- 1975 – Magnitude 4.9 earthquake in Georgia Strait.
- 1997 – Magnitude 4.3 earthquake in Georgia Strait.
- 2022 – Magnitude 4.8 earthquake near Tofino

Potential Earthquake Impacts

Participants reported in the workshops that an earthquake would impact peoples' lives and pose emergency preparedness challenges. This is indicated visually in **Figure 11** with extreme consequence scores[60] for all six impact categories. Critical infrastructure and culture were the top concerns. Participants indicated that impacts could be irreparable to important cultural places. The triggered critical infrastructure impacts could extend to long-term outages of power, roads and egress/ emergency response routes, and other systems (e.g., medical, drinking water).

The diagram is followed by a summary of key impacts and resilience factors noted in the group discussions in workshop 2 that gave rise to those scores.

[59] on the Richter scale, according to Earthquakes Canada. However, seismologists are describing earthquakes according to the magnitude of the moment scale (M_W or M), more and more. Weblink: https://earthquakescanada.nrcan.gc.ca/info-gen/faq-en.php. Accessed 21 September 2023.

[60] Consequence scores are an average of four group scores by participants in workshop 2. Scores were based on a hazard planning scenario.

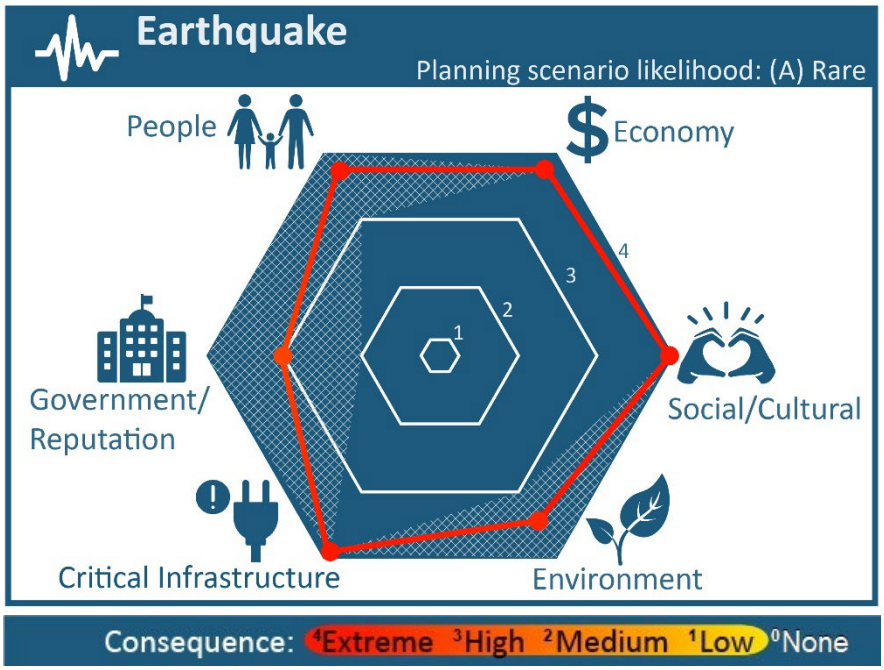

Figure 28: The Earthquake Consequence Scores, based on scoring of a planning scenario by participatory risk assessment workshop participants.

Key impacts:

- More impacted: First Nations, elderly, homeless, rural communities, challenging geography
- Fatalities and critical injuries
- Loss of land, species, shorelines, estuary
- Wastewater system damage can contaminate freshwater system
- Government reputation will depend on response - can be negative because of lack of preparation, lack of resilience built into policy, lack of equitable response, building codes, public infrastructure not up to code
- Long term impacts to water systems, sewage/underground piping, structural damage, transportation, liquefaction

Factors affecting resilience:

- Lack of redundancy in critical infrastructure (fiberoptic networks, etc.)
- Resources and non-profit capacity are more stretched due to lack of personal preparedness
- Assets: personal preparedness (frees up other resources for marginalized communities), social planning groups, caring communities, education, good relationship with local government
- Specific considerations needed for: First Nations, elderly, homeless, rural communities, diverse geography.

ENVIRONMENTAL. While environmental impacts may not be the immediate concern, earthquakes can lead to impacts such as localized erosion and larger landslides, changes to water resources such as estuaries and ground water, and damage to natural habitats or broader ecosystems.

- **CONTAMINATION.** Damage to wastewater systems such as underground pipelines can release contaminates to waterbodies, impacting aquatic ecosystems, plant and animal species, drinking water, and recreational areas.

CRITICAL INFRASTRUCTURE. The ground shaking, liquefaction, and landslides caused by earthquakes can severely damage buildings, roads and bridges, and other infrastructure. For buildings not rated or designed for earthquakes, this could mean complete collapse. For linear infrastructure, this leads to disruptions for people and goods and slows response efforts.

- **UTILITIES.** Damage to utilities disrupts the distribution of power (and communication networks), gas, and drinking water causing outages from limited service areas to widespread areas. Damage to communication networks can make response coordination even more challenging. Additionally, damage to power lines and gas lines have the secondary hazard of fires that can be harder to contain with already thinned emergency response efforts. Some of the systems have more resiliency and redundancy than others. For instance, internet/fibre optic, power, and water supplies do not have a lot of redundancy and may likely be cut off.

HOMES, PROPERTIES. Damage to or loss of homes, like other buildings, can be substantial. Earthquakes can require people to evacuate their homes due to damage and safety concerns, leaving them displaced for an uncertain period. Depending on the scope of damage, home damage assessments can be a lengthy process due to the high demand and limited resources when large areas are impacted.

PEOPLE: HEALTH & SAFETY. The shaking of the ground can result in injuries and death for the people caught in collapsing buildings, falling debris, or other related hazards. In addition to physical trauma, earthquakes can have psychological impacts on people (e.g., anxiety, post-traumatic stress disorder).

ECONOMY. The damages create economic losses for individuals, communities, businesses, and different levels of government.

Existing Earthquake Risk Reduction and Resilience Measures

With the foundation of key impacts and resilience factors, workshop 3 participants[61] considered the strengths and gaps in current regional preparedness and resilience. Participants did not report feeling prepared for earthquakes. The strengths and gaps are informed by reports or initiatives listed in the preparedness and resilience categories in Table 9. An emptier box, like the recover category, may indicate a gap.

[61] 18 people attended workshop 3, representing a range of organizations. 15 people participated in the polling at the start of the workshop from local or regional government (40%), First Nations (13%), provincial or federal government (13%), non-profit or service sector (13%), and other (20%).

Table 13: Workshop table of strengths and gaps in earthquake preparedness and resilience.

1. Understand & Plan *Research, studies, plans, etc.*	2. Mitigate Risk *Keep hazard out, reduce severity, move/adapt*	3. Build Resilience *Strengthen individual/collective capacity*	4. Respond *Actions for effective emergency response*	5. Recover *Actions/investments into recovering functions*
NRCan Earthquake reports, mapping, and hazard data[62]. Geological Survey of Canada Earthquakes Canada website. BC Data Catalogue: Fault Lines and Seismic Lines.	Building Codes[63]. CVRD Risk Tolerance Policy (2019).	Living the New Normal. Information - Earthquake Ready Action Plan, Great ShakeOut drills and handouts, Insurance add-on policy. School kiosks and kits. CVRD Natural Hazards education[64].	Provincial Earthquake Immediate Response Strategy (2022)[65]. EM Local Authority Plan.	Provincial.

Earthquake Recommendations

Given the seriousness of earthquakes, it is crucial for governments, communities, and organizations to take measures to prepare for and mitigate impacts. Like many hazards, maintaining robust emergency response plans, supporting conservative building codes, and educating the public about preparedness all play important roles in earthquake mitigation. Strategies to consider include:

1. **[CVRD, First Nation and local governments] Risk assessment:** Undertake seismic risk assessments to identify areas at higher risk of damage based on both the hazard and exposure (e.g., building age, type, subsurface, critical infrastructure condition, etc.).
    a. Review the Natural Resources Canada (NRCan) Risk Profiler[66] for potential risks and damages in the Cowichan region.
    b. Research to increase hazard understanding and improve mitigation technologies.
2. **[Provincial] Infrastructure resilience:** Construct critical infrastructure, especially infrastructure that is entirely under the authority of local jurisdictions (utility plants, transportation networks, etc.), with the consideration of seismic hazards to ensure functionality following events. To minimize disruption, resilient designs or retrofits include underground utilities. Key services such as water and emergency services/operations centres must be supported through seismic construction.
3. **[First Nation and local governments] Building codes:** Enforce conservative building codes that encompass seismic hazards to ensure new construction is safer[67]. Retrofit government existing structure (e.g., schools[68]) to, at the minimum, meet current seismic safety standards.

[62] Natural Resources Canada Earthquake Hazard. https://earthquakescanada.nrcan.gc.ca/hazard-alea/index-en.php
[63] National building codes. http://www.nationalcodes.ca/
[64] CVRD Natural Hazards page. https://www.cvrd.ca/3187/Natural-Hazards
[65] Provincial Earthquake Immediate Response Strategy. https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/plans/peirs.pdf
[66] Weblink: https://natural-resources.canada.ca/simply-science/new-tool-assess-earthquake-risks-canada/25202
[67] Weblink: https://www.egbc.ca/Practice-Resources/Programs-Resources/Seismic-Retrofit-Guidance.
[68] Weblink: https://www2.gov.bc.ca/gov/content/education-training/k-12/administration/capital/seismic-mitigation

4. **[First Nation and local governments] Land use planning:** Support land use planning that considers seismic hazards such as avoiding developments in high-risk earthquake areas.
5. **[CVRD; EMC; First Nation and local governments; community] Community preparedness:** In addition to public awareness, communities can establish community-based preparedness initiatives (e.g., at neighbourhood level) to support each other during and after events. This may also take pressure off first responders. Examples include:
    c. Creating or posting evacuation and meeting points.
    d. Hosting events to assemble or review earthquake emergency kits.
    e. Establishing a neighbourhood watch system to look out for vulnerable individuals, so everyone knows who to check on.
6. *(See also Recommendation #28 above):* **[EMC; other EM] Aid agreements:** Establish aid agreements with neighbouring regions, emergency response agencies, and private organizations to increase support and resources for an effective response to an (earthquake) event. Consider agreements with host communities outside the area (who may not be impacted by the event).

Appendix E-7: Coastal Storm Flooding[69]

Coastal Storm Characteristics

Type	Shock	**Extents**	Local - Regional
Duration	Hours - Days	**Likelihood Trend**	Increasing
Seasonality	Fall - Spring		
Warning Time	Days		

Coastal flooding can have wide-ranging impacts on people and the environment. Coastal storm flooding is due to higher-than-normal water levels along the coast caused by tidal changes or storms (storm surge) that result in inundation of coastal areas, which can last from days to weeks (Smith, 2015).

A critical consideration for coastal flooding is sea level rise (Section 1.2) because gradual increases contribute to the baseline water level at the coast. If the sea levels are higher, the high tides and storm surges add to the elevated level, amplifying coastal flooding.

Potential Coastal Storm Impacts

Workshop participants shared how flooding (lake, river, stream flooding, specifically) impacted the environment, culture, and critical infrastructure for emergency response to communities. The lake, river, stream flooding diagram shows a "Medium to High" consequence for five categories, all except for the people indicator, consequences may be similar for coastal storm flooding. Of those, the environment indicator was of highest concern. This tracks with how participants expressed a connection to the outdoors and recreation. Impacts to low-lying areas extend to vulnerable populations in or adjacent to the floodplain. For First Nations, flooding can also mean a loss of cultural activities, sacred medicines, and traditional harvesting sites. This information can be extrapolated to areas at risk of coastal storm flooding.

The summary of key impacts and resilience factors from workshop 3 discussions is below. Unique to coastal storm flooding, participants highlighted tsunami risk for the West Coast, and tides.

[69] Coastal storm flooding and the remaining hazards in this section draw information from the six illustrative hazards (Sections 1.3.1 - 1.3.6). The impacts and consequences were not determined from participants at workshop 2. Therefore, coastal storm flooding draws information from the illustrative hazard – lake, river, stream flooding, in addition to discussion from Workshop 3.

Key impacts:

- West coast risks include tsunami risk
- King Tide correlation with lake / river flooding can increase impacts
- Agricultural land is fertile and floods mean delays in production
- Localized within the region to coastal areas
- First Nations located near coast

Factors affecting resilience:

- Opportunities to retrofit housing
- Working with farmers to anticipate future risks
- Make way for nature
- How do we live with these events with greater harmony?

ENVIRONMENTAL. Coastal flooding can lead to environmental damage to the beaches and waterbodies that impact coastal ecosystems.

- **EROSION.** Coastal events can erode shorelines and alter sensitive coastal habitats, affecting wildlife.
- **SALTWATER INTRUSION.** Coastal flood waters can contaminate freshwater with saltwater. This leaves the water (i.e., surface water or aquifers) unfit for consumption nor agricultural uses. The saltwater can also disrupt long-standing habitats and ecosystems that can't withstand the brackish water.

CRITICAL INFRASTRUCTURE. Disruption of transportation infrastructure along the coast (e.g., ports) can affect the region and island communities.

HOMES, PROPERTIES. Coastal flooding can damage homes near the shoreline. This can be disruptive and lead to substantial repair costs.

PEOPLE: HEALTH & SAFETY. In addition to environmental and infrastructure damage, the consequences of coastal flood events can range to health, safety, and security. Coastal flood events can cause injuries and even death for residents and first responders. For example, floodwaters can carry a multitude of harmful things such as human or animal waste, chemicals or hazardous material waste, debris, wild animals, etc.

People living in low-lying coastal areas may need to evacuate during events, potentially leading to temporary or long-term displacement.

ECONOMY. The livelihood of coastal communities can rely on ocean resources. Those individuals or communities may be impacted by losses or changes due to flooding. Coastal flooding can also potentially damage low-lying agricultural areas, leading to delays in production, decreased crop yields, or even crop shortages.

Existing Coastal Storm Risk Reduction and Resilience Measures

With the foundation of key impacts and resilience factors, workshop 3 participants[70] considered the strengths and gaps in current regional preparedness and resilience. Participants reported feeling more

[70] 18 people attended workshop 3, representing a range of organizations. 15 people participated in the polling at the start of the workshop from local or regional government (40%), First Nations (13%), provincial or federal government (13%), non-profit or service sector (13%), and other (20%).

prepared for lake, river, stream flooding and only somewhat prepared for coastal storm flooding. They added that both flooding hazards could use some attention. The strengths and gaps are informed by reports or initiatives listed in the preparedness and resilience categories in Table 10. A box with less information, like the last category, may indicate a gap.

Table 14: Workshop table of strengths and gaps in coastal storm flooding preparedness and resilience.

1. Understand & Plan *Research, studies, plans, etc.*	2. Mitigate Risk *Keep hazard out, reduce severity, move/adapt*	3. Build Resilience *Strengthen individual/collective capacity*	4. Respond *Actions for effective emergency response*	5. Recover *Actions/investments into recovering functions*
Sea Level Rise coastal flood hazard extents[71] – Updated Cowichan-Koksilah River Flood Mapping Project Final Report (2021). **Sea Level Risk Adaptation Primer (2013)[72].** **Surveys (e.g., King tides).**	Flood Construction Levels (FCLs)[73]. Shoreline Protection Plan DPA 6 - Floodplain Hazard[74].	Living the New Normal Education. Cowichan Watershed Resiliency Program (use of Disaster Mitigation and Adaptation Fund). CVRD Low Impact Development programs like 'Green Shores'[75].	Early warning system (Cowichan Alert). Response plans in low-lying communities, First Nations. EM Local Authority Plan.	2021 Flooding Response – Emergency Support Services (ESS) Program[76].

Coastal Storm Recommendations

It is crucial for governments, communities, and organizations to take measures to prepare for and mitigate coastal storm impacts. Like other flood hazards, managing flood-prone areas, supporting and investing in infrastructure resilience, and educating the public about preparedness all play important roles in mitigation. Strategies to consider include:

1. **[CVRD; First Nation and local governments] Coastal hazard mapping:** Maintain coastal hazard mapping to highlight high hazard areas and risks. Identify areas lacking assessments (e.g., First Nations Reserves) and pathways forward. Ensure that assessments are applied for planning purposes (e.g., Chemainus FCLs).

[71] CVRD flood studies, contact information, and links to provincial information. https://cvrd.ca/3195/Flooding
[72] The Arlington Group Planning +Architecture Inc. et al. 2013. Sea Level Rise Adaptation Primer: A Toolkit To Build Adaptive Capacity On Canada's South Coasts. https://www2.gov.bc.ca/assets/gov/environment/climate-change/adaptation/resources/slr-primer.pdf
[73] CVRD 2100 FCLs summary. https://socialsciences.viu.ca/sites/default/files/cowichan-valley-regional-district-sea-level-rise-analysis-map.pdf
[74] Protection of Development from Hazardous Conditions: DPA 6 – Floodplain Hazard. https://www.cvrd.ca/1825/Technical-Reports
[75] CVRD Green Shores for Homes incentive-based program to restore natural shorelines. https://www.cvrd.ca/2475/Green-Shores
[76] Emergency Assistance from the Emergency Support Services Program. This may include financial support for flood recovery (e.g., 2021 floods) from the Canadian Red Cross. https://www.cvrd.ca/89/Emergency-Assistance

    - Implement conservative flood construction levels for coastal high hazard zones. This can extend to new construction by retrofitting infrastructure with smart designs to withstand events (e.g., storm surge).
2. **[CVRD; First Nation and local governments] Land use regulations and management:** Implement and enforce local bylaws and regulations in coastal hazard areas as well as control development to reduce damages, especially repeat losses, and protect human safety.
3. **[Provincial; MoTI; First Nation and local governments] Infrastructure resilience:** Design or adapt critical infrastructure to be resilient to flood impacts can minimize service disruptions and accelerate recovery after events.
4. **[Jurisdictions; community groups] Nature-Based Solutions:** Implement nature-based solutions, such as restoring natural wetlands and sand dunes/gravel spits to potentially reduce flood hazards.
5. **[EMC; jurisdictions] All-water management:** Consider interactions between different flood types. To prevent excess water from entering the coastal areas during a storm, manage urban stormwater runoff.
6. *(See also Recommendation #1 above):* **[EMC] Early Warning System:** Create a reliable early warning system. This system should include automated alerts for events with rising water levels, including king tides. Establish clear targets for when these alerts should be issued. Develop situational assessment tools or dashboards that consolidate real-time flood data to aid in making informed safety decisions.

Appendix E-8: Stormwater Flooding

Storm Water Characteristics

Type	Shock	**Extents**	Local - Regional
Duration	Hours - Days	**Likelihood Trend**	Increasing
Seasonality	Fall - Spring		
Warning Time	Days		

Stormwater flooding can have impacts that are distinct from other types of flooding. Precipitation, predominantly rainfall, that cannot infiltrate into the ground, or be carried by manmade infrastructure (e.g., drain systems), will create localized stormwater flooding sometimes called stormwater, local, pluvial, or flash flooding. Stormwater flooding is most prevalent in urban areas. Recent events include the atmospheric rivers. A critical consideration for stormwater flooding are more intense precipitation events that will exacerbate stormwater flooding (Section 1.2).

Potential Storm Water Impacts

The potential impacts of stormwater floods are associated with localized and rapid-onset flooding caused by intense rainfall. Workshop participants shared how flooding (lake, river, stream flooding, specifically) impacted the environment, culture, and critical infrastructure for emergency response to communities. Impacts to low-lying areas extend to vulnerable populations in or adjacent to flood-prone areas. For First Nations, flooding can also mean a loss of cultural activities, sacred medicines, and traditional harvesting sites. This information can be extrapolated to areas at risk of stormwater flooding.

Key impacts:

- Typically connected to lake/river/storm flooding (see impacts)
- First Nations located in floodplain and flood-prone areas
- Koksilah Watershed Study – high urban/road density
    - High number of roads => runoff

Factors affecting resilience:

- Groundwater recharge not happening /potential opportunity
- Study needed on absorption capacity
- Focus on decreasing risk into discharge into rivers in an extreme
- Work with farmers to anticipate future risks or flood forecasts

ENVIRONMENTAL. Stormwater runoff can carry non-point source pollutants found in yards and roads (oil, grease, pesticides, pet waste, road salts, etc.) and can impact waterbodies, wildlife, and vegetation.

Agricultural runoff is also of concern for nutrient loading. The high levels of nutrients (nitrogen and phosphorus) that can cause eutrophication and harmful algal blooms can be managed with best practices.

CRITICAL INFRASTRUCTURE. Flooded roadways can disrupt transportation networks, leading to road closures and detours as well as delays in emergency response.

The events that drive stormwater flooding can also trigger hazards such as critical infrastructure disruption. The flooding of electrical substations or downed power lines can lead to power outages.

HOMES, PROPERTIES. Stormwater can cause damage to properties, usually including the ground floors and basements. The contents can also be destroyed, leading to more financial losses for the individuals, families, or businesses.

PEOPLE: HEALTH & SAFETY. Floodwater can carry pathogens or even electrical hazards that pose health risks, cause injuries, or even cause loss of life. Like other flood events, this can leave people with stress and anxiety.

The impact on vulnerable populations (the elderly, those with disabilities, the economically disadvantaged, etc.) is even more challenging during events.

ECONOMY. Stormwater flooding can disrupt businesses, leading to temporary closures, loss of revenue, or damage to inventory.

Existing Storm Water Risk Reduction and Resilience Measures

With the foundation of key impacts and resilience factors, workshop 3 participants[77] considered the strengths and gaps in current regional preparedness and resilience. Participants reported not feeling prepared for stormwater flooding. However, they did not suggest that stormwater flooding needs more attention like the other flood hazards. This may be due to the consideration of many different flood types. Overall, participants discussed flooding generally as a concern that needs more attention.

The strengths and gaps are informed by reports or initiatives listed in the preparedness and resilience categories in Table 11. A box with less information, like the last category, may indicate a gap.

[77] 18 people attended workshop 3, representing a range of organizations. 15 people participated in the polling at the start of the workshop from local or regional government (40%), First Nations (13%), provincial or federal government (13%), non-profit or service sector (13%), and other (20%).

Table 15: Workshop table of strengths and gaps in preparedness and resilience.

1. Understand & Plan *Research, studies, plans, etc.*	2. Mitigate Risk *Keep hazard out, reduce severity, move/adapt*	3. Build Resilience *Strengthen individual/collective capacity*	4. Respond *Actions for effective emergency response*	5. Recover *Actions/investments into recovering functions*
BC Catalogue: monitoring sites. Climate Projections for the CVRD (2017)[78]. **See Lake, River, Stream Flooding, above.**	Lower Cowichan / Koksilah River Integrated Flood Management Plan (2009). Stormwater and Rainwater Design Guidelines.	Living the New Normal Education.	Living the New Normal Education. Early warning system (Cowichan Alert). EM Local Authority Plan. Emergency Support Services (ESS) Program.[79]	

Storm Water Recommendations

Given the potential seriousness of flood events, it is crucial for governments, communities, and organizations to take proactive measures to prepare for and mitigate their impacts. Some strategies to consider include:

1. **[CVRD; First Nation and local governments] Pluvial floodplain mapping:** As with other flood types, develop and maintain current floodplain mapping can inform zoning and land use regulations that protect both people and natural corridors.
    a. Integrated stormwater management plans
2. **[CVRD; First Nation and local governments] Land use regulations:** Incorporate stormwater management into zoning and land use regulations to promote better development practices and limit impermeable surfaces to control excess runoff.
3. **[First Nation and local governments] Stormwater infrastructure:** Invest in infrastructure such as retention and detention basins and permeable surfaces can help capture and manage stormwater runoff. Consider integrating best management practices into development and redevelopment.
    b. Green infrastructure practices (Best Management Practices, roofs, and gardens)
    c. Low-impact development
    d. Community-based solutions: Empower the community to develop solutions (e.g., community garden extensions) to reduce runoff and promote sustainable management.
4. **[First Nation and local governments] Monitoring and assessment:** Implement monitoring of mitigation systems to identify successes and areas of improvement.
5. **[EMC] Early warning system:** Create a reliable early warning system for events with rising water levels. Establish clear targets for when these alerts should be issued. Develop situational assessment tools or dashboards.

[78] Cowichan Valley Regional District. (2017). Climate Projections for the Cowichan Valley Regional District. 46 pgs. https://www.cvrd.ca/DocumentCenter/View/81884/Climate-Projections-Report?bidId=#:~:text=As%20our%20climate%20warms%2C%20our,%C2%B0C%20by%20the%202050s.

[79] Emergency Assistance from the Emergency Support Services (ESS) Program. ESS is typically available to any evacuation for up to 72 hours, and due to its limitations, it is considered a response measure not recovery.

Appendix E-9: Landslides/Debris Flows

Landslide/Debris Flow Characteristics

Type	Shock	**Extents**	Local - Regional
Duration	Minutes - Weeks	**Likelihood Trend**	Increasing
Seasonality	Fall - Spring		
Warning Time	Hours - Days		

Terrestrial landslide is any type of slope failure or downward movement of rock and sediment (includes rockfall, debris flows, slumps, and slides, etc.). Excessive rainfall, earthquakes, and certain human activities are some of the factors that commonly trigger landslides (NRCan, 2017).

Potential Landslide/Debris Flow Impacts

Landslides and debris flows can have substantial impacts, especially to people and the environment.

Key impacts:

- Risk to peoples' lives
- Potential impacts to homes; houses built on mountain slopes
- Can shut down major transportation routes – impacts people and economy due to repair costs and supply chain disruptions
- Infrastructure impacts, e.g., gas/power lines
- Can negatively impact waterways and cause environmental issues, e.g., Interrupt salmon runs, long-lasting impacts to streams

Factors affecting resilience:

- Remote areas are becoming more remote, cut-off when road is interrupted
- Rural and remote areas more vulnerable. And larger subdivisions on slopes/below slopes.
- Logging roads have altered slopes, leading to more landslide risks
- How are businesses allowed to increase costs for families stuck due to road closures. How can we ensure families aren't suffering more.
- Unhoused population/seniors are more in urban core. And this is not an urban core issue

ENVIRONMENTAL. Debris flows can deposit large amounts of sediment in waterbodies, affecting aquatic ecosystems and the water quality. With large deposits, the rivers and streams could even backup, leading to or worsening localized flooding. These blockages can also prevent fish passage upstream (i.e., salmon runs). In addition to the accumulation of sediment and debris, landslides can also cause erosion of natural habitats. Debris flows can transport pollutants, along with the rock and sediment, leading to potential contamination.

CRITICAL INFRASTRUCTURE. Landslides can devastate critical infrastructure such as transportation networks and electric or gas grids. Roads may become impassable due to material, causing road closures, isolating communities, and making emergency response more challenging.

HOMES, PROPERTIES. Properties in landslide prone areas are at risk of structural damage that can be costly for owners. Even after a slide has occurred, ongoing slope instability can still pose a threat to homes and communities.

PEOPLE: HEALTH & SAFETY. People living in areas prone to landslides may be required to evacuate, leading to temporary to long-term displacement. The events can also result in injury to people (homeowner, tourists, first responders, etc.) caught in the path of the moving rock, debris, and soil. There is also a risk to life.

ECONOMY. Depending on the proximity, landslides can damage agricultural areas, leading to economic losses.

CULTURE. Landslides can destroy cultural and historical sites, leading to invaluable loss of assets.

Existing Landslide/Debris Flow Risk Reduction and Resilience Measures

With the foundation of key impacts and resilience factors, workshop 3 participants[80] considered the strengths and gaps in current regional preparedness and resilience. Participants reported not feeling prepared for landslides/debris flows and that the hazard needs more attention. The strengths and gaps are informed by reports or initiatives listed in the preparedness and resilience categories in Table 12. A box with less information, like the last category, may indicate a gap.

[80] 18 people attended workshop 3, representing a range of organizations. 15 people participated in the polling at the start of the workshop from local or regional government (40%), First Nations (13%), provincial or federal government (13%), non-profit or service sector (13%), and other (20%).

Table 16: Workshop table of strengths and gaps in landslide/debris flow preparedness and resilience.

1. Understand & Plan *Research, studies, plans, etc.*	2. Mitigate Risk *Keep hazard out, reduce severity, move/adapt*	3. Build Resilience *Strengthen individual/collective capacity*	4. Respond *Actions for effective emergency response*	5. Recover *Actions/investments into recovering functions*
Debris Flow Runout Model: North Shore Cowichan Lake (2021)[81]. **Geohazard Risk Assessment North Slope of Cowichan Lake (Ebbwater Consulting and Palmer Environmental Consulting, 2019)**	DPA 7 – Landslide Hazard[82] for Allenby Road (1982, 2019), North Shore Cowichan Lake (2021), Cowichan River (1989). CVRD Risk Tolerance Policy (2019)[83].	CVRD Mud & Debris Flow webpage[84].	Living the New Normal Education. Early warning system (Cowichan Alert). EM Local Authority Plan. ESS.	

Landslide/Debris Flow Recommendations

Given the potential seriousness of landslide/debris flow events, it is crucial for governments, communities, and organizations to take proactive measures to prepare for and mitigate their impacts. Implementing mitigative measures can help protect lives and reduce risk. Some strategies to consider include:

1. **[CVRD; First Nation and local governments] Hazard mapping:** Maintaining detailed hazard mapping and risk assessments of high-risk areas that already exist (see Table 12 above). This supports the understanding of risk and priorities for emergency management.
2. **[EMC; First Nation and local governments] Land use regulations:** Maintain landslide hazard as part of land use planning and regulations for sustainable development to protect both people and natural corridors and avoid placing new developments in areas of high landslide hazard.
    - Geotechnical Assessments for new development
3. **[EMC; CVRD; jurisdictions] Slope stabilization:** Regularly assess slope conditions and, as necessary, reinforce slopes with appropriate stabilization techniques (e.g., retaining walls, soil nails, vegetation, etc.).
4. **[CVRD; EMC] Debris flow barriers:** Assess best practices and emerging technologies for techniques to deflect debris flows away from critical infrastructure and people.

[81] Stantec and Palmer. (2021). Debris Flow Runout Model: North Shore Cowichan Lake: LABS Model Results 2021 Rev2. https://www.cvrd.ca/DocumentCenter/View/96816/Debris-Flow-Runout-Model-Report
[82] Protection of Development from Hazardous Conditions: DPA 7 – Landslide Hazard. https://www.cvrd.ca/1825/Technical-Reports
[83] CVRD Risk Tolerance Policy (2019). https://www.cvrd.ca/DocumentCenter/View/97457/Natural-Hazard-Risk-Tolerance-Policy
[84] CVRD mud and debris flow information. Contact information. And links to provincial information. https://www.cvrd.ca/3196/Debris-FlowLandslides

Appendix E-10: Dam & Spillways Failure

Dam/Spillway Failure Characteristics

Type	Shock	**Extents**	Local - Regional
Duration	Minutes - Days	**Likelihood Trend**	Increasing
Seasonality	All Year		
Warning Time	Seconds - Days		

Failure of a dam or spillway structure would release water/debris downstream. This can be a 'sunny-day' failure (i.e., a failure occurring outside a storm event as a result of a seismic event or engineering failure) or a 'rainy-day' failure as a result of high-water levels and inflows.

The Cowichan region depends on dams and recognizes their importance and the need to monitor and understand risks associated with them. This is shown through the dam safety reviews and risk assessments for Ashburnham Creek, Stocking Lake, and Youbou Creek Dams as well as the Shawnigan Lake Weir.

Potential Dam/Spillway Failure Impacts

The failure of a dam or spillway can have high consequences to people, the environment, property, and more.

Workshop participants shared how flooding (lake, river, stream flooding, specifically) impacted the environment, culture, and critical infrastructure for emergency response to communities. The lake, river, stream flooding diagram shows a "Medium to High" consequence for five categories, all except for the people indicator. For dam and spillway failure it would be expected that the impact to people could be Extreme. Impacts to low-lying areas extend to vulnerable populations in or adjacent to flood-prone areas. For First Nations, flooding can also mean a loss of cultural activities, sacred medicines, and traditional harvesting sites. This information can be extrapolated to areas at risk of stormwater flooding.

Key impacts:
- Similar to flooding impacts.
- Loss of water that the dam was designed to hold - drinking water, irrigation etc.

ENVIRONMENTAL. The influx of water from dam failure can devastate downstream ecosystems. Additionally, failure can contaminate waterbodies with sediment, debris, and pollutants, harming aquatic ecosystems and leaving water resources unsuitable for drinking, agricultural uses, or recreation. The downstream sediment deposition can even alter the storage capacity of waterways. The environmental impacts can persist for an extended period.

CRITICAL INFRASTRUCTURE. The sudden release of impounded water can cause extensive damage to or destruction of critical infrastructure (roads, bridges, utilities, medical facilities, etc.) that are in the downstream path. Depending on the damages, the disruptions to power or water services that follow an event can be severe and slow to recover.

HOMES, PROPERTIES. The rapid rise of floodwater downstream can destroy homes.

PEOPLE: HEALTH & SAFETY. Dam failure can result in the rapid release of water and debris, posing an immediate and significant danger to people and the downstream affected area. The disruption, asset losses, potential isolation, and long-term recovery can be challenging (mentally, emotionally, socially, etc.) for individuals and communities.

This widespread shock event can overwhelm emergency response, making evacuation and response operations challenging.

ECONOMY. Dam failure can disrupt livelihoods, especially those dependent on water-related activities, for an extended period. Overall, dam failure can translate to significant costs with production losses, extensive emergency response, and recovery and reconstruction.

Existing Dam/Spillway Failure Risk Reduction and Resilience Measures

With the foundation of key impacts and resilience factors, workshop 3 participants[85] considered the strengths and gaps in current regional preparedness and resilience. Participants reported feeling not prepared for dam and spillways failure and that more attention may be needed. This may be elevated slightly considering participants discussed the related hazards, flooding as well as critical infrastructure, as concerns that needed more attention.

The strengths and gaps are informed by reports or initiatives listed in the preparedness and resilience categories in Table 13. A box with less information, like the build resilience and recover boxes, may indicate a gap.

[85] 18 people attended workshop 3, representing a range of organizations. 15 people participated in the polling at the start of the workshop from local or regional government (40%), First Nations (13%), provincial or federal government (13%), non-profit or service sector (13%), and other (20%).

Table 17: Workshop table of strengths and gaps in dam and spillway failure preparedness and resilience.

1. Understand & Plan *Research, studies, plans, etc.*	2. Mitigate Risk *Keep hazard out, reduce severity, move/adapt*	3. Build Resilience *Strengthen individual/collective capacity*	4. Respond *Actions for effective emergency response*	5. Recover *Actions/investments into recovering functions*
Technical Reviews for Floodplain and Dam Mapping for Ashburnham Creek (2019), Shawnigan Lake (2019), Stocking Lake (2018), and Youbou Creek Dams (2019), Cowichan River (2020)[86]. BC Data Catalogue: 28 Active, Regulated Dams with failure consequence of at least significant, high, or very high in CVRD.	OCP Floodplain and Dam Designation Maps (2021)[87].		Dam Emergency Plan (DEP) Lake Cowichan Weir (2021)[88]. EM Local Authority Plan. ESS.	

Dam/Spillway Failure Recommendations

Given the potential seriousness of dam and spillway failure and flood events, it is crucial for governments, communities, and organizations to take proactive measures to prepare for and mitigate their impacts. Some strategies to consider include:

1. **[CVRD; EMC] Regular inspection:** Ensure that the proper authorities have capacity to meet the Dam Safety Act requirements for inspection and monitoring. Comprehensive management programs with structural inspections can identify potential issues early and ensure safety standards are met over the life of the infrastructure.
2. **[CVRD; First Nation and local governments] Hazard and risk assessments:** Maintain comprehensive hazard and risk assessments to inform decision-making and emergency response planning.
3. **[Provincial; CVRD; First Nation and local governments, Dam Owners] Upgrades:** Install timely upgrades or retrofits to ensure that the structure is resilient to potential hazards and climate change conditions.
    a. Monitoring for damage or distress (e.g., beaver activity) can support quickly addressing issues before they increase.
    b. Seismic safety considerations
4. **[CVRD; EMC; Reservoir Operators] Reservoir management plans:** Ensure with reservoir operators that response plans are in line with management plans surrounding releases that reduce risk downstream.
5. **[EMC] Training with planning scenarios:** Consider the emergency response plans under planning scenarios (e.g., different hazard combinations). Organize, exercise, and train with planning scenario round tables between industry, government, and emergency responders.

[86] CVRD Technical Review for Floodplain and Dam Mapping. https://www.cvrd.ca/1825/Technical-Reports
[87] CVRD OCP Schedule O: Flood and Dam Designation Maps. https://www.cvrd.ca/DocumentCenter/View/102789/2021-10-13-Floodplain-and-Dam-Designation-Maps
[88] B. Houle. Dam Emergency Plan (DEP) Lake Cowichan Weir (Dam), Cowichan River. Revised Feb 2021. https://paperexcellence.com/wp-content/uploads/2020/10/DEP-Dam-Emergency-Plan-for-Cowichan-Lake-Weir.pdf

6. *(See also Recommendation #1 above):* **[EMC] Early warning system:** Create an early warning system with clear targets for when alerts should be issued.

Appendix E-11: Severe Winter Conditions

Severe Winter Conditions Characteristics

Type	Shock	**Extents**	Local - Regional
Duration	Days - Weeks	**Likelihood Trend**	Increasing
Seasonality	Winter		
Warning Time	Days - Weeks		

Snowstorms and blizzards are meteorological disturbance that give rise to a heavy fall of snow, often accompanied by strong winds, also referred to as a blizzard or blowing snow event (EMBC, 2021).

Potential Severe Winter Conditions Impacts

Snowstorms and blizzards can have varied impacts on for people and the environment. The severity of the weather events depends on factors such as the duration, wind speed, and overall preparedness.

Participants reported in the workshops that the similar atmospheric hazard, high-wind events, impact several aspects of peoples' lives and pose emergency preparedness challenges, in particular for economy, social/cultural, environment, and critical infrastructure. Of those, critical infrastructure was a repeated concern. Participants indicated that power lines block roads and egress/ emergency response routes, power outages last multiple days, and outages could impact other systems (e.g., medical, drinking water).

Key impacts:

- *Impacts similar to high-wind event (e.g., critical infrastructure)*
- *Heavy snow loads on roofs and powerlines*
- *Dangerous temperatures for vulnerable populations, especially for the unhoused*
- *Isolation*
- *Shutting down roads and businesses, so people can't get supplies*
- *Events in the shoulder season can catch people unaware*

Factors affecting resilience:

- Individual preparedness is improving as people deal with stretches without power and potentially without heating

ENVIRONMENTAL. Snowstorms can disrupt the environment by affecting wildlife, vegetation, and water resources. Additionally, out-of-season or unseasonably cold events contribute to ecological disruptions (such as mismatching the temporal alignment of predator and prey).

CRITICAL INFRASTRUCTURE. With the accumulation of snow and high wind speeds, snowstorms can lead to disruptions in public transportation, including road closures, ferry cancellations, and flight cancellations. Additionally, the forces from snow and wind can weigh on roofs and powerlines, resulting in failures. Disruption to power and communication networks adds challenges for emergency response (e.g., messaging and coordination).

HOMES, PROPERTIES. As with other buildings, home roofs can be impacted by the weight of snow in addition to tree blowdown. Homes that rely on gas lines or have a limited burning supply can also be ill-prepared for the cold conditions, especially for an extended period.

PEOPLE: HEALTH & SAFETY. Exposure to cold temperatures can pose health and safety risks (e.g., hypothermia, frostbite, death, etc.). This is especially true for vulnerable populations. Additionally, isolation following events can have mental health impacts.

Due to the disruptions and closures, people may be unable to restock supplies (e.g., food, medicine, etc.).

ECONOMY. The severe conditions and the triggered infrastructure disruptions can mean business closures, which can disrupt productivity and the economy for a short or extended period. Losses can extend to livestock for farmers.
Costs due to losses, snow removal, or repairs can be underestimated by individuals, cities, and municipalities.

Existing Severe Winter Conditions Risk Reduction and Resilience Measures

With the foundation of key impacts and resilience factors, workshop 3 participants[89] considered the strengths and gaps in current regional preparedness and resilience. Participants reported feeling well prepared for severe winter conditions and that the hazard does not need more attention. However, it should be noted that participants highlighted critical infrastructure disruption, which can be triggered by severe winter conditions, as needing more attention.

The strengths and gaps are informed by reports or initiatives listed in the preparedness and resilience categories in Table 14. An empty box, like the last one, indicates a clear gap.

Table 18: Workshop table of strengths and gaps in severe winter conditions preparedness and resilience.

1. Understand & Plan *Research, studies, plans, etc.*	2. Mitigate Risk *Keep hazard out, reduce severity, move/adapt*	3. Build Resilience *Strengthen individual/collective capacity*	4. Respond *Actions for effective emergency response*	5. Recover *Actions/investments into recovering functions*
BC Data Catalogue: Automated and manual snow weather station locations. Social Vulnerability Data. Meteorological Monitoring. Climate Projections for the CVRD (2017).	Climate Change Adaptation Implementation Plan 2023-2026[90] "Theme 1. Reduce the risk of power outages due to extreme weather events."	Emergency generator, Continuity of operations plans, Critical equipment or utility undergrounding.	Public Works and Engineering department Severe Weather Response Plan; Downed powerline response plan. Extreme weather event shelters.	

[89] 18 people attended workshop 3, representing a range of organizations. 15 people participated in the polling at the start of the workshop from local or regional government (40%), First Nations (13%), provincial or federal government (13%), non-profit or service sector (13%), and other (20%).
[90] CVRD. Climate Change Adaptation Implementation Plan 2023-2026.
https://www.cvrd.ca/DocumentCenter/View/106526/CVRD-Cowichan-Adapts-Implementation-Plan-20230215

Severe Winter Conditions Recommendations

Given the potential seriousness of severe winter conditions, it is crucial for governments, communities, and organizations to take proactive measures to prepare for and mitigate their impacts. Some strategies to consider include:

1. **[CVRD, First Nation and local governments] Winterization:** Ensure critical infrastructure is prepared to withstand the heavy snow and ice that come with snowstorms and blizzards.
    a. Determine the strategies most effective to prevent ice accumulation.
2. **[CVRD, EMC, First Nation and local governments] Assistance:** Ensure plans are in place to assist vulnerable populations that can be greatly impacted during severe weather conditions. This can extend to ensuring that there are clear and established emergency shelters and supplies for displaced residents.
3. **[CVRD, EMC, First Nation and local governments] Community Engagement:** Encourage community engagement for preparedness plans. Use learnings from other communities.
4. **[CVRD, EMC, First Nation and local governments] Partnership:** Identify strategies or collaboration with partners (e.g., Island Health, BC Housing) to acknowledge and plan for vulnerable groups.
5. **[CVRD, EMC, First Nation and local governments] Support neighbourhood preparedness initiatives:** Actively collaborate to promote and support community-based preparedness initiatives, empowering neighborhoods with the resources, training, and tools needed to enhance resilience and effectively respond to emergencies.

Appendix E-12: Human Disease

Human Disease Characteristics

Type	Chronic	**Extents**	Local - Global
Duration	Days - Years	**Likelihood Trend**	Increasing
Seasonality	All Year		
Warning Time	Uncertain		

Diseases that are caused by pathogenic microorganisms and are spread directly, or indirectly, from one person to another. A pandemic is the worldwide spread of a new disease (EMBC, 2021). Unlike many other hazards, human disease requires national and international cooperation for research and control of disease as populations continue to grow.

Potential Human Disease Impacts

The potential impacts of disease can affect many aspects of our society, public health, and the economy. With highly transmissible diseases, the impacts can be severe.

Workshop Results

Key impacts:

- Dramatic impacts on youth, toddlers, teens (staying inside) -- anxiety, depression, social anxiety
- Loss of jobs, businesses
- Cost of living skyrocket
- Many displaced people in Cowichan
- Inconsistent communication
- Nurses, doctors overworked; can't replace them easily
- Minimum staffing levels at local govt – focused on just maintaining water system, sewer system, road infrastructure... (basic services, infrastructure)
- Knock-on impacts (projects not getting completed)
- Long-term impacts: social problems (riffs in families, neighbourhoods, mistrust, miscommunication); hard to quantify
- World-wide factors affect local (e.g., Doctor shortage, housing, workers...) -- has impacts for emergency management

Factors affecting resilience:

- Youth, elderly, vulnerable populations more at risk
- Supply chain - replacing equipment, staff, getting things in timely manner -- still (long term)
- Capacity / resilience of system before the event occurs
- Global conditions affect local situation
- Costs, contracts have doubled in some cases

- Internal capacity & planning affects how many other aspects of society are impacted

CRITICAL INFRASTRUCTURE/SERVICES. The influx of ill patients can overwhelm the healthcare system, resulting in limited hospital capacity, supplies, and staff. Staffing shortages can also widely impact critical service functioning such as public transportation and utilities such as waste management.

GOVERNMENT/REPUTATION. Delayed and inconsistent messaging can spread mistrust and leave room for misinformation.

PEOPLE: HEALTH & SAFETY. Foremost, human diseases can lead to considerable fatalities, causing losses for the affected families and communities and grief. Vulnerable populations like the elderly or immunocompromised are impacted with a range of health and wellness concerns. In addition to the initial illness, there can be long-term implications for individuals, which also impacts community capacity.

- **SOCIAL.** Additional strain on social interactions and mental wellbeing can be triggered by social distancing and quarantine measures. Disease can disproportionately impact marginalized communities. The existing social disparities and discrimination can be worsened.

ECONOMY. As people change behaviour, out-of-office time due to illness or quarantine precautions can impact productivity. Disease can cause economic disruption due to business closures, supply chain interruption, and reduced productivity. The restriction can extend to travel, which can affect the tourism industry in addition to the supply chain trade.

Existing Human Disease Risk Reduction and Resilience Measures

Workshop 3 participants[91] considered the strengths and gaps in current regional preparedness and resilience. Participants reported feeling moderately prepared for human disease events, but that there was also room for more attention. The strengths and gaps are informed by reports or initiatives listed in the preparedness and resilience categories in Table 15. Less filled boxes may indicate gaps.

[91] 18 people attended workshop 3, representing a range of organizations. 15 people participated in the polling at the start of the workshop from local or regional government (40%), First Nations (13%), provincial or federal government (13%), non-profit or service sector (13%), and other (20%).

Table 19: Workshop table of strengths and gaps in human disease preparedness and resilience.

1. Understand & Plan *Research, studies, plans, etc.*	2. Mitigate Risk *Keep hazard out, reduce severity, move/adapt*	3. Build Resilience *Strengthen individual/collective capacity*	4. Respond *Actions for effective emergency response*	5. Recover *Actions/investments into recovering functions*
***Potential* Recent Lessons Learned.**	CVRD Reference Guide[92].	Social Vulnerability Data for sensitivity and resilience. Health messaging for handwashing and staying home.	General community engagement, health infrastructure. EM Local Authority Plan.	Community Recovery Services for various hazard events[93].

Human Disease Recommendations

Given the potential seriousness of human disease and pandemics, it is crucial for governments, communities, and organizations to take proactive measures to prepare for and mitigate their impacts. Many recommendations can only be implemented by Island Health or the federal government (indicated as 'Other' below). Some strategies to consider include:

1. **[Other] Detection, rapid response, and preparedness plans:** Ensure that the necessary plans exist to detect the spread of infectious disease early, respond rapidly with reasonable and adaptable protocol, and understand responsibilities and available resources, all for an effective response.
    a. Vaccination campaigns
2. **[Other] Healthcare infrastructure:** Consider building resilience into existing systems. This may include the following:
    b. Refine overflow plans for influxes in the number of patients.
    c. Stockpile medical supplies for high-demand periods during shortages.
    d. Consider training plans to rapidly bulk the healthcare workforce.
3. **[Other] Equity:** Review guidelines through the lens of equity to ensure fairness in preparedness and response.
4. **[Community; Schools] Adopt flexible school and work policies:** Encourage schools and businesses to adopt flexible policies, such as telecommuting, staggered schedules, and distance learning, to minimize the risk of transmission.
5. **[Community] Build community resilience:** Organizations can foster community resilience by (seasonally?) promoting volunteerism, social cohesion, and support networks that are useful during response. Encourage residents to take responsibility for disease prevention and preparedness, such as practicing good hygiene, staying informed, and following public health guidelines.

[92] CVRD COVID-19 Reference Guide, contact information, and links to provincial information. https://www.cvrd.ca/3270/COVID-19-Reference-Guide

[93] CVRD Community Recovery Services assists people impacted by a disaster to connect with resources. https://www.cvrd.ca/1559/Community-Recovery-Services

Appendix E-13: Security Incident

Security Incident Characteristics

Type	Shock/Chronic	**Extents**	Local
Duration	Days	**Likelihood Trend**	Uncertain
Seasonality	All Year		
Warning Time	Variable		

A security incident is an act or interruption that interferes with the operation of society and the ability of people to function efficiently. Examples include riots, demonstrations, bomb threats, and active shooter disturbances that may be caused by social pressure.

Potential Security Incident Impacts

Modern anthropogenic hazards can have significant impacts on society. Security incidents are disruptive at the very least. The following key impacts and resilience factors were discussed in workshop 3.

Key impacts:

- Personal impact to safety (e.g., active shooter)
- Immediate shutdown of services
- Social and cultural - traumatic for community, fear, mental health
- Riots disruptive to day-to-day access.
- City/Region reputation = drop off in recreation or tourism?
- Potential doubt from community - did government do enough to prepare?
- Damage to critical infrastructure
- Health facilities may be required, in high demand

Factors affecting resilience:

- Police force and fire are trained to respond.
- There are earthquake and fire drills, but nothing for active shooters, just a plan.
- Individuals are not familiar with what to do (but have confidence in police).
- Awareness different than natural hazards; what does public look to (tv, radio?) Would you get the same text alerts?
- Target groups for the unrest/violence are often the most vulnerable.
- Long-term concern for priority population (unhoused)
- What if this occurred on a small island with limited transportation/access?
- Where are the Emergency Management Service crew 'holes'?

CRITICAL INFRASTRUCTURE. Depending on the location and purpose, the incident can result in damage to buildings and other infrastructure. If not to the extent of damage, incidents can cause interruptions in services such as public transportation.

PEOPLE: HEALTH & SAFETY. Security incidents can lead to injury and fatalities, causing losses and grief for the affected families and communities. For the survivors and witnesses of incidents, the mental and emotional trauma can outlast physical injuries, requiring long-term medical or psychological support. For the public, the incidents can strike fear (e.g., doubt in the safety and security of the neighborhood) and impact quality of life daily. This is especially true if the incident is sensationalized in the media. The tensions that arise within the community can pressure divisions.

Security incidents can disrupt education for all students by removing the safe feeling of the learning environment as well as the physical place.

Additionally, people belonging to a diversity of backgrounds (e.g., race, orientation, class, etc.) can face discrimination or retaliation (to themselves, their jobs, or their property) following security incidents.

ECONOMY. The incidents can impact the local businesses and tourism, leading to economic losses. Some events such as riots can cause costly damage to businesses, impacting operations. In addition to building back, adding enhanced security measures can increase business costs.

Existing Security Incident Risk Reduction and Resilience Measures

Workshop 3 participants[94] considered the strengths and gaps in current regional preparedness and resilience. Participants reported feeling not prepared for security incident events and that there was room for more attention. The strengths and gaps are informed by reports or initiatives listed in the preparedness and resilience categories in Table 16. An empty box, like the first one, indicates a clear gap.

Table 20: Workshop table of strengths and gaps in security incident preparedness and resilience.

1. Understand & Plan *Research, studies, plans, etc.*	2. Mitigate Risk *Keep hazard out, reduce severity, move/adapt*	3. Build Resilience *Strengthen individual/collective capacity*	4. Respond *Actions for effective emergency response*	5. Recover *Actions/investments into recovering functions*
		Awareness in schools and lockdown trainings.	BC preparedness and response planning[95]. EM Local Authority Plan.	

[94] 18 people attended workshop 3, representing a range of organizations. 15 people participated in the polling at the start of the workshop from local or regional government (40%), First Nations (13%), provincial or federal government (13%), non-profit or service sector (13%), and other (20%).

[95] BC emergency response and planning for the BC Public Services. https://www2.gov.bc.ca/gov/content/careers-myhr/managers-supervisors/occupational-health-safety/emergency-response-planning

Security Incident Recommendations

Given the potential seriousness of security incidents, it is crucial for governments, communities, and organizations to take proactive measures to prepare for and mitigate their impacts. Some strategies to consider include:

1. **[EMC; CVRD; First Nation and local governments] Risk assessment:** Conduct or support a modern, threat-specific risk assessment to identify potential threats and vulnerabilities. This will support the continued refinement of response plans and readiness drills.
2. **[EMC; CVRD; First Nation and local governments] Policing:** Encourage positive relationships between the community, first responders, and law enforcement with regular engagement activities. Even support collaboration among the different agencies and emergency management.
3. **[EMC; CVRD; First Nation and local governments] Information share:** Share security incident intel among agencies at the local (and, if possible, national) level for better understanding, planning, and training. This includes information share between RCMP and Emergency Management.
4. **[EMC; CVRD; First Nation and local governments] Stockpile locations and safe spaces:** Establish disaster stockpile locations that can support situations such as quarantine, shelter-in-place, and lockdown to increase community resilience, so individuals are equipped to cope with and recover from incidents.

Appendix E-14 Critical Infrastructure Disruption

Critical Infrastructure Disruption Characteristics

Type	Shock	**Extents**	Local - Regional
Duration	Hours - Months	**Likelihood Trend**	Uncertain
Seasonality	All Year		
Warning Time	Variable (none - hours)		

Critical infrastructure disruption is the interruption of services that are essential for the functioning society that will lead to cascading consequences. Interruptions include electrical, food source, telecommunications, transportation route, wastewater, water service, and fuel source.

Disruptions are triggered by several natural hazards, especially storm/high-wind events, flooding, earthquakes, and severe winter conditions. Critical infrastructure disruptions inhibit or make emergency response more challenging.

Workshop 3 participants considered the strengths and gaps in current regional preparedness and resilience. Participants reported feeling only slightly prepared for critical infrastructure disruption and highlighted that the hazard needs more attention. Recommendations for critical infrastructure disruption are discussed in Appendix F.

Appendix F: Key Steps towards Risk Reduction and Resilience in the Cowichan Region

This section provides recommendations for key steps towards risk reduction and resilience for the Cowichan region, first for all-hazard approaches, and then hazard-specific recommendations, followed by criteria for project prioritization in the future.

1. All-Hazard Recommendations – Big Ideas and Next Wise Actions

One of the key recommendations that heard from the community – and which is becoming more urgent in a world of multi-hazard events, is to use an all-hazards approach towards risk reduction and resilience. Therefore, recommendations for an all-hazards approach (including a big idea, followed by next wise actions) are presented, based on discussions from the workshops. The topics are listed below and further described on the following pages:

1. Multi-jurisdictional Collaboration.
2. Community Building & Preparedness.
3. Understanding & Planning for Risk.
4. Social Resilience & Wellbeing.
5. Emergency Response & Recovery.
6. Critical Infrastructure Resiliency.
7. Participation in Provincial Activities.
8. Healthy Ecosystems.

1.1 Multi-jurisdictional collaboration

Collaboration is one of the key strengths identified by participants that contributes to regional resilience. There is a willingness to collaborate and an abundance of experience and existing relationships to support this: across governments, across community leaders and organizations, and within neighbourhoods. This should be built on to improve disaster resilience and emergency preparedness for the region.

A. Improve coordination and alignment across agencies, departments, and governments

- Build or clarify roles, priorities, and responsibilities at a regional level.
- Hold regular regional meetings, training and other learning opportunities related to Disaster Risk Reduction and Emergency Management.
- Proactively build relationships and capacity across the region to improve regional resilience during events.
- Build on experience, reports, and plans that have been done in the region; ensure institutional memory is maintained in the region.
- Ensure consistent communication before, during, and after emergency events.
- Secure funding for region-wide and targeted initiatives.
- Integrate resilience into all facets of local government operations.

BIG IDEA #1: REGIONAL COLLABORATION

- Bring together a range of organizations and individuals (e.g., municipalities, First Nations, first responders, community / service organizations, volunteer groups).
- Host regular tabletop / scenario-based exercises to build awareness, role clarity and relationships across the region.
- Use this as a basis to work together to better address all phases of disaster management (mitigation, preparedness, response, recovery).
- Specifically, work together to advance a set of shared recommendations relating to risk and hazards to incorporate into OCPs, bylaws and other policies/tools in each community across the region.

Next wise actions…

- *Continue to regionalize efforts by getting partners on board, beginning with participants in these sessions and extending to include leaders, councils, and other community organizations. "Once it starts, it can really take off!".*
- *Regular (monthly) region-wide emergency management meetings (discuss initiatives and plans, hold capacity-building sessions, etc.).*
- *Update the regional response plans and build cross-jurisdictional teams for implementation.*
- *Develop hazard-specific and community-specific information in collaboration with local authorities.*

1.2 Community Building & Preparedness

There is a great opportunity to build on existing systems, plans, and resources by tapping into community capacity and collaboration. In the past, emergency response and preparedness initiatives existed in some communities, such as monthly emergency preparedness meetings in Ladysmith, and volunteer-coordinated emergency response/preparedness zones on Thetis Island. Drawing on local knowledge, strength and self-determination can evoke a sense of ownership and engagement and a greater desire to work together for preparation and response. And, by ensuring that those who can prepare do so, additional services can then go to those whose capacity is overwhelmed or don't have the ability to prepare.

A. Build public awareness of risks and response

- Develop educational and preparedness resources that are accessible across the diversity of communities in the region (e.g., consider cost, language, relevance, distribution, etc.)
- Have difficult conversations with and among community members (e.g., what happens beyond tolerable level of risk?) following good practice for risk communications (e.g., also discuss what people can do to build resilience)

B. Promote neighbourhood and household preparedness

- Revive/continue or develop programs to build awareness and preparedness at a household and neighbourhood level
- Connect people with tools, resources, or workshops to build resilience

- Encourage neighbours to help neighbours before, during and after emergencies

BIG IDEA #2: DEVELOP COMMUNITY RESILIENCE HUBS

- Focus on where capacity/interest exists, or where vulnerability or risks are more pronounced.
- Put out a call for expressions of interest from neighbourhoods / organizations / communities.
- Support groups with resources, information, tools.
- Hold mock disasters, bring neighbours together, make it fun.
- Provide small grants to encourage local / neighbourhood resilience building activities and support basic functions over time.
- Facilitate collaboration across hubs and between hubs and others working on emergency preparedness and response.

Next wise actions…

- *Provide accurate, relevant, useful information and engagement opportunities to empower individuals, groups, and neighbourhoods to build resilience and preparedness.*
- *Get neighbours together: start with a small number of people who can become resources to others.*

1.3 Understanding & Planning for Risks

Participants felt that there has been a lot of work done in the region to understand hazards (e.g., flood modelling and mapping; groundwater supplies) but that gaps exist in linking this to vulnerabilities (e.g., gaps in insurance, priority populations, economic impacts). Similarly, plans exist for some hazards and impacts, but gaps remain for others. In particular, critical infrastructure interruptions, response plans and recovery plans were mentioned as gaps.

A. Strategically advance assessments and plans

- Plan for interactions between hazards such as wildfire, flood, landslides, and drought
- Apply a "multi-solving" lens to disaster risk management – plan for multiple hazards, across FNLG and departments, and considering multiple values and co-benefits.
- Prioritize plans and assessments that will have multiple applications and benefits like recovery, critical infrastructure protection, and business continuity for priority sites.
- Plan as a region for events that overwhelm local or even regional capacity

B. Make use of land use policies and tools to reduce risk

- Align policies across the region to create consistency and support public awareness
  - Update policies and regulations to integrate hazard/risk management considerations
  - Restrict or prevent further development in hazard areas
  - Implement risk tolerance guidance for land use
- Protect or restore natural areas as a hazard mitigation tool

BIG IDEA #3: PLAN THOUGHTFULLY, TAKE ACTION

- Take the time to be thoughtful and make sure this translates into action.
- Build from what already exists – get clear on the big picture so that we can focus on priorities.
- Prioritize hazards, risks, and actions – focus first on hazards we're likely to encounter, build from that to address other hazards.

Next wise actions…

- *Use prioritization from the HRVA process, lessons learned from experience/past plans, and best practices to determine next steps.*
- *Take any idea and just start!*

1.4 Social Resilience and Well-Being

Hazards disproportionately affect already vulnerable populations ("priority populations"), which can include under-housed, low-income, seniors and First Nations people. Vulnerable and isolated people often have fewer resources and/or less physical ability to prepare for and recover from disasters. Disasters and repeated experiences or anticipation of disasters, can also have ongoing impacts on the mental health and wellness of community members. This can exacerbate existing traumas in individuals and communities due to past experiences, including the ongoing impacts of colonization and residential schools for Indigenous people.

A. Pursue equity in planning, response, and recovery

- Ensure the needs of priority populations are identified and included in all planning for hazard events, including evacuations, communications, and recovery plans.
- Address basic needs of priority populations such as safe housing and food security.
- Strengthen relationships and joint planning between government, first responders and service providers to include and support priority populations during response and recovery.

B. Increase supports for mental health and wellness

- Provide education to community and service organizations on trauma-informed approaches to emergency response and recovery – especially for people working with priority populations

- Publicize mental health resources and support available impacts following disaster events

BIG IDEA #4: UNDERSTAND AND INCLUDE PRIORITY POPULATIONS

- Engage with priority populations and those who serve them, to better understand needs and capabilities in relation to emergency preparedness, response, and recovery.
- Work with community organizations, service providers and government services to ensure better integration of tools, resources and supports for priority populations during and after disaster events.
- Share information with the public so that they are better able to include and support priority populations during response efforts.

Next wise actions…

- *Identify groups who face higher / unique risks in relation to hazard events.*
- *Draw on / build relationships with first responder, community, and service organizations to develop targeted communications plans and techniques for reaching and supporting priority populations during hazard events.*
- *Identify specific plans necessary to support priority populations, along with the necessary training and funding for success.*

1.5 Emergency Response & Recovery

There is an ongoing need to ensure that coordination and communication during emergency response is improved, updated, and understood such that response activities can be effective. At a regional level, there are opportunities to build capacity of individual communities and the region as a whole, to ensure effective response options and capacity are available when needed. In addition, recovery is noted as an area that needs additional attention and planning. As all disaster events will require recovery efforts, this type of planning and preparation will have wide application.

A. Improve Coordination & Communication

- Communicate proactively with the public, using a range of formats to ensure accessibility (e.g., language, access to technology). Cater to groups like seniors who may lack smart phones or internet.

B. Provide Training Regionally

- Use Shakeout drills as a model to build awareness and preparedness across the population.
- Develop and practice evacuation strategies with the public. Include strategies for remote and isolated areas, critical infrastructure interruptions (e.g., cellphone service, ferries, bridges, single egress routes), and unique situations (people in the backcountry; large events; mass care).
- Train volunteers, service agencies, and neighbourhood groups to actively support during response.
- Train response teams and ensure they have sufficient depth to accommodate for illnesses and attrition.

C. Plan for Recovery

- Develop recovery plans for common hazard events and adapt those plans for other hazard events as needed.
- Develop re-entry plans that ensure areas are safe for residents to return as well as long-term recovery plans that help restore stability and security.

1.6 Critical Infrastructure Resiliency

Understanding and addressing critical infrastructure (CI) resiliency is another area with widespread application, as so many hazards can have critical infrastructure impacts.

A. Bring people together and remove silo'ing

There is the potential for substantial role confusion and silo'ing with respect to critical infrastructure resilience. Under EDMA, it is now required as part of Emergency Management planning. However, historically, critical infrastructure management has been very siloed and inconsistent between different FNLG. EMC could play a convener role in this space.

- Bring FNLG and critical infrastructure operators together to develop a new strategy towards managing CI resilience jointly.
- Identify roles and responsibilities for mitigation efforts and recovery.

B. Prioritize and enhance infrastructure resilience

- Reference and enforce codes, standards, and regulations that promote resilience in infrastructure design, construction, and maintenance.
- Build back to higher standards, following disaster events, or opportunistically during upgrades, to enhance regional infrastructure resilience over time.
- Conduct a comprehensive critical infrastructure risk assessment to identify vulnerabilities to natural and anthropogenic threats as well as climate change.
- Prioritize critical infrastructure based on their function for society and public safety.
- Allocate sufficient funding to upgrade infrastructure. This can include implementing innovative technologies or pilot projects.
- Improve power infrastructure resilience to wildfires, storm/high-wind events, and other hazards.

C. Plan for interruptions and failures of critical infrastructure

- Integrate resilience considerations into urban planning, land use zoning, and development regulations to ensure that new infrastructure projects are resilient to future hazards and climate impacts (e.g., multi-hazards like drought, fire, and flood).
- Generate strategies to address:
    - remote communities
    - transportation routes
    - supply lines
    - business continuity
    - essential services (medical, communications, food, fuel, etc.)
- Diversify electricity sources, both individually and regionally

- Plan for water scarcity and drought resilience

D. Participate in Provincial activities

- Ensure that the EMC voice is heard at provincial and broader regional tables related to the Provincial Climate Risk Assessment
- Foster collaboration among all levels of government (agencies, private sector entities, community organizations, and other stakeholders) to coordinate efforts, share information, and implement resilience measures effectively.
- Understand the implications of *EDMA* changes and provide feedback towards regulation development.

1.7 Healthy Ecosystems

- Work should be explored with community partners to preserve and restore ecosystems: Ecosystems that have high biodiversity and functioning are more resilient to natural hazards, such as wildfires, floods, landslides.

2. All-Hazards Recommendations Summary

The 44 all-hazard recommendations from this section are summarized in this section (**Table 4**). The recommendations are grouped according to the estimated action timeframe and the cost and effort. The timeframe, or high-level priority (**Table 1**) and cost rankings (**Table 2**) have been assigned to aid in action prioritization.

Table 3 defines the fields for the recommendation tables. The complete list of recommendations is also provided in Attachment B – Recommendations Overview Spreadsheet, organized by sequence in the report.

Table 21: High-level priority rankings.

Priority	Approximate
Short-term	Within the next 1-2 years.
Mid-term	2-5 years
Longer-term	5-10 years

Table 22: Cost/effort rankings.

Cost/Effort	Approximate Cost
High	> 1M$
Medium	$100,000-1M$
Low	<$100,000

Table 23: Fields defined for the recommendation tables.

Field	Definition
Code	Hazard number as it appears in the report - recommendation count/order (e.g., All-hazards, first recommendation is A-1)
Priority	Assigned low to high based on estimated timeframe.
Cost/Effort	Assigned low to high based on estimated cost/effort.
Hazard	Hazard name. Only shown for specific hazards, not all-hazards.
Actor	Organization responsible for the recommended action.
Recommended Action	Recommendation.
Sendai-Priority	Sendai-Priority abbreviation A. Understand and Reduce Risk C. Invest in Resilience B. Strengthen Governance D. Enhance Response and Recovery

Table 24: All-hazard recommendations, listed by priority and cost/effort.

Code	Priority	Cost/Effort	Actor	Recommended Action	Sendai-Priority
A-1	Short-term	Low	EMC	Multi-jurisdictional collaboration· Hold regular regional meetings, trainings and other learning opportunities related to Disaster Risk Reduction and Emergency Management.	D
A-2	Short-term	Low	EMC; CVRD; FNLG	Multi-jurisdictional collaboration· Proactively build relationships and capacity across the region to improve regional resilience during events.	D
A-3	Short-term	Low	EMC; CVRD; FNLG	Multi-jurisdictional collaboration· Build or clarify of roles, priorities, and responsibilities at a regional level.	B
A-4	Short-term	Low	EMC; CVRD; FNLG	Multi-jurisdictional collaboration· Ensure consistent communication before, during, and after emergency events.	A
A-5	Short-term	Low	EMC; CVRD; FNLG	Multi-jurisdictional collaboration· Integrate resilience into all facets of local government operations.	B
A-6	Short-term	Low	EMC	Community Building & Preparedness· Revive or develop programs to build awareness and preparedness at a household and neighbourhood level	D
A-7	Short-term	Low	EMC	Community Building & Preparedness· Connect people with tools, resources, or workshops to build resilience.	A
A-8	Short-term	Low	EMC	Community Building & Preparedness· Encourage neighbours to help neighbours before, during and after emergencies	D
A-9	Short-term	Low	EMC	Social Resilience and Well-Being· Ensure the needs of priority populations are identified and included in all planning for hazard events, including evacuations, communications, and recovery plans.	D
A-10	Short-term	Low	EMC	Social Resilience and Well-Being· Strengthen relationships and joint planning between government, first responders, and service providers to include and support priority populations during response and recovery.	C
A-11	Short-term	Low	EMC	Social Resilience and Well-Being· Provide education to community and service organizations on trauma-informed approaches to emergency response and recovery – especially for people working with priority populations.	A
A-12	Short-term	Low	EMC	Social Resilience and Well-Being· Publicize mental health resources and support available to address impacts following disaster events.	C
A-13	Short-term	Low	EMC	Emergency Response & Recovery· Communicate proactively with the public, using a range of formats to ensure accessibility (e.g., language, access to technology). Cater to groups like seniors who may lack smart phones or internet.	A
A-14	Short-term	Low	EMC	Emergency Response & Recovery· Use Shakeout drills as a model to build awareness and preparedness across the population.	A
A-15	Short-term	Low	EMC	Emergency Response & Recovery· Develop and practice evacuation strategies with the public. Include strategies for remote and isolated areas, critical infrastructure interruptions (e.g., cellphone service, ferries, bridges, single egress routes), and unique situations (people in the backcountry; large events; mass care).	A
A-16	Short-term	Low	EMC	Emergency Response & Recovery· Train response teams and ensure they have sufficient depth to accommodate for illnesses and attrition.	D

Code	Priority	Cost/Effort	Actor	Recommended Action	Sendai-Priority
A-17	Short-term	Low	EMC	Emergency Response & Recovery· Develop re-entry plans that ensure areas are safe for residents to return as well as long-term recovery plans that help restore stability and security.	C
A-18	Short-term	Low	EMC	Critical Infrastructure Resiliency· Reference and enforce codes, standards, and regulations that promote resilience in infrastructure design, construction, and maintenance.	B
A-19	Short-term	Low	EMC	Critical Infrastructure Resiliency· Build back to higher standards, following disaster events, or opportunistically during upgrades, to enhance regional infrastructure resilience over time.	B
A-20	Short-term	Low	EMC; CVRD; FNLG	Critical Infrastructure Resiliency· Ensure that the EMC voice is heard at provincial and broader regional tables related to the Provincial Climate Risk Assessment	B
A-21	Short-term	Low	EMC; CVRD; FNLG	Critical Infrastructure Resiliency· Foster collaboration among all levels of government (agencies, private sector entities, community organizations, and other stakeholders) to coordinate efforts, share information, and implement resilience measures effectively.	B
A-22	Short-term	Low	EMC; CVRD; FNLG	Critical Infrastructure Resiliency· Understand the implications of EDMA changes.	B
A-23	Short-term	Low	EMC	Critical Infrastructure Resiliency· Bring people together and remove silo'ing	B
A-24	Short-term	Medium	EMC	Understanding & Planning for Risks· Protect or restore natural areas as a hazard mitigation tool	C
A-25	Short-term	Medium	EMC	Emergency Response & Recovery· Continue to develop, test, and promote Cowichan Alert for advance notice of hazard events. Specific hazard details include: 1) Storm/High-wind: Impending high-wind events, allowing communities to take precautions or evacuate. 2) Coastal Storm Flooding: Create a reliable early warning system. This system should include automated alerts for events with rising water levels, including king tides. Establish clear targets for when these alerts should be issued. Develop situational assessment tools or dashboards that consolidate real-time flood data to aid in making informed safety decisions. 3) Stormwater flooding (see also #45): Create a reliable early warning system for events with rising water levels. Establish clear targets for when these alerts should be issued. Develop situational assessment tools or dashboards. 4) Dam and Spillway Failure: Create an early warning system with clear targets for when alerts should be issued.	D
A-26	Mid-term	Low	EMC; CVRD; FNLG	Multi-jurisdictional collaboration· Secure funding for region-wide and targeted initiatives.	A
A-27	Mid-term	Low	EMC	Community Building & Preparedness· Develop educational and preparedness resources that are accessible across the diversity of communities in the region (e.g., consider cost, language, relevance, distribution, etc.)	A
A-28	Mid-term	Low	EMC	Community Building & Preparedness· Have difficult conversations with and among community members (e.g., what happens beyond tolerable level of risk?) following good practice for risk communications (e.g., also discuss what people can do to build resilience).	A
A-29	Mid-term	Low	EMC	Understanding & Planning for Risks· Apply a "multi-solving" lens to disaster risk management – plan for multiple hazards, across FNLG and their departments, and considering multiple values and co-benefits.	D

Code	Priority	Cost/Effort	Actor	Recommended Action	Sendai-Priority
A-30	Mid-term	Low	EMC	Understanding & Planning for Risks· Prioritize plans and assessments that will have multiple applications and benefits like recovery, critical infrastructure protection, and business continuity for priority sites.	D
A-31	Mid-term	Low	EMC	Emergency Response & Recovery· Train volunteers, service agencies, and neighbourhood groups to actively support during response.	D
A-32	Mid-term	Low	EMC	Critical Infrastructure Resiliency· Prioritize critical infrastructure based on their function for society and public safety.	C
A-33	Mid-term	Low	EMC	Critical Infrastructure Resiliency· Integrate resilience considerations into urban planning, land use zoning, and development regulations to ensure that new infrastructure projects are resilient to future hazards and climate impacts (e.g., multi-hazards like drought, fire, flood).	B
A-34	Mid-term	Medium	EMC; CVRD; FNLG	Multi-jurisdictional collaboration· Build on experience, reports, and plans that have been done in the region; ensure institutional memory is maintained in the region.	A
A-35	Mid-term	Medium	EMC	Understanding & Planning for Risks· Plan for interactions between hazards such as wildfire, flood, landslides, and drought.	A
A-36	Mid-term	Medium	EMC	Understanding & Planning for Risks· Plan as a region for events that overwhelm local or even regional capacity.	D
A-37	Mid-term	Medium	EMC	Understanding & Planning for Risks· Align policies across the region to create consistency and support public awareness: Update policies and regulations to integrate hazard/risk management considerations; Restrict or prevent further development in hazard areas; Implement risk tolerance guidance for land use.	B
A-38	Mid-term	Medium	EMC	Social Resilience and Well-Being· Address basic needs of priority populations such as safe housing and food security.	D
A-39	Mid-term	Medium	EMC	Emergency Response & Recovery· Develop recovery plans for common hazard events and adapt those plans for other hazard events as needed.	A
A-40	Mid-term	Medium	EMC	Critical Infrastructure Resiliency· Conduct a comprehensive critical infrastructure risk assessment to identify vulnerabilities to natural and anthropogenic threats as well as climate change.	A
A-41	Mid-term	Medium	EMC	Critical Infrastructure Resiliency· Allocate sufficient funding to upgrade infrastructure. This can include implementing innovative technologies or pilot projects.	C
A-42	Mid-term	Medium	EMC	Critical Infrastructure Resiliency· Generate strategies to address remote communities, transportation routes, supply lines, business continuity, essential services (medical, communications, food, fuel, etc.).	C
A-43	Mid-term	Medium	EMC	Healthy Ecosystems· Work with community partners to preserve and restore ecosystems: Ecosystems that have high biodiversity and functioning are more resilient to natural hazards, such as wildfires, floods, landslides.	C
A-44	Longer-term	High	EMC	Critical Infrastructure Resiliency· Improve power infrastructure resilience to wildfires, storm/high-wind events, and other hazards.	C

Code	Priority	Cost/Effort	Actor	Recommended Action	Sendai-Priority
A-45	Longer-term	High	EMC	Critical Infrastructure Resiliency· Diversify electricity sources, both individually and regionally.	C
A-46	Longer-term	High	EMC	Critical Infrastructure Resiliency· Plan for water scarcity and drought resilience.	C

3. Hazard-Specific Recommendations

While the section above provides recommendations that are applicable across all hazards and support general risk reduction and resilience for the Cowichan region, this section provides hazard-specific recommendations. To get in the mindset of preparedness, **Table 5** provides an overview of likelihood trends, risk, and current preparedness for the priority hazards in the Cowichan region. Hazards of higher risk (sorted to appear higher in the table) should be the focus, especially if current preparedness is relatively low. Further, priority hazards that currently have lower preparedness should also be the focus for risk reduction and resilience strategies. The right most columns show the hazards that Workshop 3 participants identified as needing more work or being best prepared for. This risk and preparedness information as well as the overarching all-hazard recommendations, informed the following hazard-specific recommendations. Recommendations are grouped according to the estimated action timeframe and cost and effort (**Table 6**, **Table 7**, **Table 8**).

Table 25: Overview of likelihood trends, risk, and current preparedness for priority hazards in the Cowichan region.

Hazard	Risk Method	Likelihood Trend	Risk	Preparedness	Workshop 3	
					Needs work	*Best prepared*
Drought	*Planning Scenario*	Increasing	High	Med	54%	
Extreme Heat		Increasing	High	High		64%
Storm / High-Wind Event		Increasing	High	Med		
Wildfire		Increasing	High	Med		
Lake, River, Stream Flooding		Increasing	Med	Med		29%
Earthquake		Uncertain	Med	Med		
Hazardous Material Release		Uncertain	Low	Low		
Human Disease	*General (High-level)*	Increasing	Very High	Med	23%	29%
Coastal Storm Flooding		Increasing	High	Med		
Critical Infrastructure Disruption		Uncertain	High	Low		
Stormwater Flooding		Increasing	High	Low		
Landslides / Debris Flows		Increasing	High	Med		
Severe Winter Conditions		Increasing	Med	Med		43%
Security Incident		Uncertain	Med	Low	46%	
Dams and Spillways Failure		Increasing	Low	Med		

Note: Risk Method – The planning scenarios were an exercise implemented at Workshop 2. Learnings from these illustrative hazards were then applied to all priority hazards for Workshop 3, as suggested by the right most columns. Only the top two results in the two categories (planning scenario and general) are shown; hazards with small percentages are not shown, so the percentages do not sum to 100%.

3.1 Short-term Action Items (1-2 years)

Table 26: Short-term hazard-specific recommendations.

Code	Priority	Cost/Effort	Hazard	Actor	Recommended Action	Sendai-Priority
1-1	Short-term	Low	Storm/High-wind	EMC & partnerships	Community Education and Preparedness: Educate the public about risks and promoting preparedness to increase safety and reduce damage. Examples includes promoting family and community emergency plans, identifying safe shelters, and securing loose objects.	C
2-1	Short-term	Low	Lake,River Flood	EMC; community groups	Public awareness: Educate the public about flood hazards and risk, preparedness, and response to empower individuals or groups to respond effectively. This potentially reduces the strain on emergency management resources.	C
3-1	Short-term	Low	Drought	EMC; CVRD; community groups	Collaboration: Collaborate among sectors (agriculture, environmental groups, first nations, municipalities, etc.) to optimize water use, allocation, and planning.	B
4-1	Short-term	Low	Wildfire	EMC	Water conservation: Continue or extend water use restrictions during dry seasons or drought conditions to help conserve water resources for wildfire control.	D
4-2	Short-term	Low	Wildfire	EMC encourages CVRD, FNLG, private homeowners	Public education programs: Continue implementation of FireSmart principles, assessments, incentives, and education in all communities.	A
4-3	Short-term	Low	Wildfire	EMC encourages CVRD, FNLG, private homeowners	Critical infrastructure fuel management: Establish ongoing strategy and implementation of FireSmart fuel management practices for critical assets.	C
4-4	Short-term	Low	Wildfire	EMC	Consistent communications: Ensure regular meetings (e.g., monthly) to discuss initiatives, plans, and exercises with the emergency management team, in full or portions, enhances the meetings that are already occurring, supports a proactive approach, and connects different specialists.	D
4-5	Short-term	Low	Wildfire	EMC	Consistent communications: Plan meetings and opportunities to engage with vulnerable communities supports conversations around emergency management plans, progress on current initiatives (e.g., Regional Cowichan Wildfire Committee), and resources (i.e., identifying where help can be given and is needed).	C
4-6	Short-term	Low	Wildfire	EMC	Consistent Communications: Meet with organized groups such as farmers associations to leverage capacity and extend planning to specific needs such as plans for livestock in case of a wildfire.	C

Code	Priority	Cost/Effort	Hazard	Actor	Recommended Action	Sendai-Priority
4-7	Short-term	Medium	Wildfire	EMC encourages CVRD, FNLG, private homeowners	Training: Continuously train firefighters on techniques and response strategies to optimize water use and the overall effectiveness. This also includes local and First Nations training.	D
4-15	Short-term	Low	Wildfire	EMC; CVRD, FNLG, private homeowners	Wildfire smoke mitigation strategies: Develop, publicize, and implement strategies to mitigate the impact of wildfire smoke on indoor air quality, such as installing high-efficiency particulate air (HEPA) filters in buildings, sealing windows and doors, and creating clean air shelters in vulnerable communities.	A
5-1	Short-term	Low	HazMat	EMC	Communication: Determine how to communicate with the public for timely and accurate updates that support community trust.	D
5-2	Short-term	Low	HazMat	EMC; Regional	Aid agreements: Establish aid agreements with neighbouring regions or industries can increase support and resources during a large-scale event.	B
5-3	Short-term	Medium	HazMat	EMC and others	Additional planning scenarios: Consider the emergency response plans under various planning scenarios (e.g., different hazard combinations). Organize, exercise, and train with planning scenario round tables between industry, government, and emergency responders.	D
6-1	Short-term	Low	Earthquake	EMC; other EM	Aid agreements: Establish aid agreements with neighbouring regions, emergency response agencies, and private organizations to increase support and resources for an effective response to an event. Neighboring communities can consider agreements to have support when one falls outside the impacted area.	B
6-2	Short-term	Medium	Earthquake	CVRD; EMC; FNLG; community	Community preparedness: In addition to public awareness, communities can establish community-based preparedness initiatives (e.g., at neighbourhood level) to support each other during and after events. This may also take pressure off of first responders.	C
10-1	Short-term	Medium	Dam/Spillway Failures	Provincial	Regular inspections: Ensure that the proper authorities have capacity to meet the Dam Satiety Act requirements for inspection and monitoring. Comprehensive management programs with structural inspections can identify potential issues early and ensure safety standards are met over the life of the infrastructure.	A
11-1	Short-term	Low	Severe Winter Conditions	CVRD, EMC, FNLG	Community Engagement: Encourage community engagement for preparedness plans. Use learnings from other communities.	C
11-2	Short-term	Low	Severe Winter Conditions	CVRD, EMC, FNLG	Partnership: Identify strategies or collaboration with partners (e.g., Island Health, BC Housing) to acknowledge and plan for vulnerable groups.	B
11-3	Short-term	Low	Severe Winter Conditions	CVRD, EMC, FNLG	Support neighborhood preparedness initiatives: Actively collaborate to promote and support community-based preparedness initiatives, empowering neighborhoods with the resources, training, and tools needed to enhance resilience and effectively respond to emergencies.	A

Code	Priority	Cost/Effort	Hazard	Actor	Recommended Action	Sendai-Priority
11-4	Short-term	Medium	Severe Winter Conditions	CVRD, FNLG	Winterization: Ensure critical infrastructure is prepared to withstand the heavy snow and ice that come with snowstorms and blizzards. Determine the strategies most effective to prevent ice accumulation.	A
11-5	Short-term	Medium	Severe Winter Conditions	CVRD, EMC, FNLG	Assistance: Ensure plans are in place to assist vulnerable populations that can be greatly impacted during severe weather conditions. This can extend to ensuring that there are clear and established emergency shelters and supplies for displaced residents.	D
12-1	Short-term	Low	Human Disease	Community, Schools	Adopt flexible school and work policies: Encourage schools and businesses to adopt flexible policies, such as telecommuting, staggered schedules, and distance learning, to minimize the risk of transmission.	B
12-2	Short-term	Low	Human Disease	Community	Build community resilience: Foster community resilience by promoting volunteerism, social cohesion, and support networks that are useful during response. Encourage residents to take responsibility for disease prevention and preparedness, such as practicing good hygiene, staying informed, and following public health guidelines.	A
12-3	Short-term	Medium	Human Disease	Other	Equity: Review guidelines through the lens of equity to ensure fairness in preparedness and response.	C
13-1	Short-term	Medium	Security Incident	EMC; CVRD; FNLG	Policing: Encourage positive relationships between the community, first responders, and law enforcement with regular engagement activities. Even support collaboration among the different agencies and emergency management.	D
13-2	Short-term	Medium	Security Incident	EMC; CVRD; FNLG	Information share: Share security incident intel among agencies at the local (and, if possible, national) level for better understanding, planning, and training.	D
13-3	Short-term	Medium	Security Incident	EMC; CVRD; FNLG	Stockpile locations and safe spaces: Establish disaster stockpile locations that can support situations such as quarantine, shelter-in-place, and lockdown to increase community resilience, so individuals are equipped to cope with and recover from incidents.	D

3.2 Mid-term Actions (2-5 years)

Table 27: Mid-term hazard-specific recommendations.

Code	Priority	Cost/Effort	Hazard	Actor	Recommended Action	Sendai-Priority
1-2	Mid-term	Low	Storm/High-wind	EMC in cooperation with FNLG	Establish, review, or update response plans and resources for recovery that help communities bounce back faster.	D
1-3	Mid-term	Low	Storm/High-wind	EMC	Collaboration: Work with BC Hydro to improve recovery.	D
1-4	Mid-term	Medium	Storm/High-wind	EMC; CVRD; BC Hydro	Vegetation Management: Manage trees and vegetation in urban and select rural areas can reduce damage from blow-down during high-wind events. Work with BC Hydro to improve preparedness.	C
2-2	Mid-term	Medium	Lake,River Flood	EMC; FNLG	Floodplain management: Implement and enforce standard regulations on buildings in flood-prone areas.	A
2-3	Mid-term	Medium	Lake,River Flood	CVRD; FNLG	Floodplain management: Control development to reduce property damage and protect human safety.	A
2-4	Mid-term	Medium	Lake,River Flood	CVRD; FNLG	Infrastructure resilience: Working with property owners and communities to make septic systems flood-resilient to reduce potential contamination of flood waters.	A
2-5	Mid-term	High	Lake,River Flood	CVRD; FNLG	Infrastructure resilience: Design critical infrastructure to be more resilient to flood impacts to minimize service disruptions and accelerate recovery after events. This includes critical infrastructure such as drinking water and wastewater treatment system.	A
3-2	Mid-term	Low	Drought	CVRD; EMC	Conservation: Promote water conservation (e.g., behavior, water-efficient technologies) at the individual and community level for responsible water use.	C
3-3	Mid-term	Low	Drought	CVRD; EMC; FNLG	Drought contingency plan: Maintain and implement the drought contingency plan developed by the CVRD (e.g., water restrictions, emergency water supply plans, water allocation strategies, etc.) at local and regional levels.	C
3-4	Mid-term	Medium	Drought	CVRD; FNLG	Sustainable agriculture practices: Support the adoption of water-efficient techniques (e.g., drip irrigation, moisture sensors). Encourage drought-resistant and, therefore, water-efficient crop varieties.	C
4-8	Mid-term	Low	Wildfire	EMC	Emergency management plans: Update Local Authority Plans regularly and add community-specific hazard plans.	B
4-9	Mid-term	Medium	Wildfire	BC Wildfire Service; Jurisdiction; CVRD	Firefighting resources - Water sources: A water source is necessary in all areas of the communities for a timely response. Where hydrants are limited or non-existent, site strategically located water storage (e.g., water tanks) to provide a reliable source for firefighting.	D

Code	Priority	Cost/Effort	Hazard	Actor	Recommended Action	Sendai-Priority
4-10	Mid-term	Medium	Wildfire	BC Wildfire Service; Jurisdiction; CVRD	Firefighting resources: Maintain and test resources such as hydrants to ensure working condition during an emergency.	D
4-11	Mid-term	Medium	Wildfire	EMC encourages CVRD, FNLG, private homeowners	Defensible space: Establish defensible spaces in and around the wildland urban interface to create fire-resistant areas.	A
4-12	Mid-term	High	Wildfire	BC Wildfire Service; Jurisdiction; CVRD	Firefighting resources - Water recycling: Implement systems for grey water reuse and recycling to save water resources for other uses such as firefighting.	C
4-13	Mid-term	High	Wildfire	EMC; CVRD, FNLG, private homeowners	Prescribed burns: Managed controlled or prescribed burns to reduce fuel loads and prevent larger, hotter fires. Work with Knowledge Keepers to identify the suitability, location, and frequency of prescribed burns.	A
5-4	Mid-term	Low	HazMat	EMC	Communication: Establish communication protocol between industries, emergency responders, and other necessary parties to facilitate response coordination.	D
5-5	Mid-term	Medium	HazMat	EMC; MoTI	Hazard and risk assessment for materials release: Identify, document (in a readily available location) and communicate areas at higher risk based on proximity to industrial sites and transportation routes (i.e., air, rail, ship, or truck hubs). Additionally, outside of these high-risk areas, consider existing codes or guidelines for restricting the transportation of materials through densely populated as well as environmentally sensitive areas.	A
5-6	Mid-term	Medium	HazMat	Provincial	Regulatory compliance: Identify the pathways of inspections or audits. Determine how to highlight the importance of strict enforcement and adherence.	A
6-3	Mid-term	Low	Earthquake	CVRD, FNLG	Risk assessment: Undertake seismic risk assessments to identify areas at higher risk of damage based on both the hazard and exposure (e.g., building age, type, subsurface, critical infrastructure condition, etc.). (a) Review the Natural Resources Canada (NRCan) Risk Profiler for the Cowichan Region. (b) Research: Support research to increase hazard understanding and improve mitigation technologies.	A
6-4	Mid-term	High	Earthquake	FNLG	Building codes: Enforce conservative building codes that encompass seismic hazards to ensure new construction is safer. Retrofit existing structure (e.g., schools) to, at the minimum, meet current seismic safety standards.	A

Code	Priority	Cost/Effort	Hazard	Actor	Recommended Action	Sendai-Priority
7-1	Mid-term	Low	Coastal Flood	EMC	Early warning system: Create a reliable early warning system. This system should include automated alerts for events with rising water levels, including king tides. Establish clear targets for when these alerts should be issued. Develop situational assessment tools or dashboards that consolidate real-time flood data to aid in making informed safety decisions.	C
7-2	Mid-term	Medium	Coastal Flood	CVRD; FNLG	Coastal hazard mapping: Maintain coastal hazard mapping to highlight high hazard areas and risks. Identify areas lacking assessments (e.g., First Nations Reserves) and pathways forward. Ensure that assessments are applied for planning purposes (e.g., Chemainus FCLs).	A
7-3	Mid-term	Medium	Coastal Flood	CVRD; FNLG	Coastal hazard mapping: Implement conservative flood construction levels for coastal high hazard zones. This can extend to new construction by retrofitting infrastructure with smart designs to withstand events (e.g., storm surge).	A
7-4	Mid-term	Medium	Coastal Flood	CVRD; FNLG	Land use regulations and management: Implement and enforce regulations in coastal hazard areas as well as control development to reduce damages, especially repeat losses, and protect human safety.	A
7-5	Mid-term	Medium	Coastal Flood	EMC; FNLG	All-water management: Consider interactions between different flood types. To prevent excess water from entering the coastal areas during a storm, manage urban stormwater runoff.	A
7-6	Mid-term	High	Coastal Flood	Provincial; MoTI; FNLG	Infrastructure resilience: Design or adapt critical infrastructure to be resilient to flood impacts can minimize service disruptions and accelerate recovery after events.	C
8-1	Mid-term	Low	Stormwater Flooding	EMC; FNLG	Empower the community to develop solutions (e.g. community garden extensions) to reduce runoff and promote sustainable management.	C
8-2	Mid-term	Low	Stormwater Flooding	EMC	Early warning system: Create a reliable early warning system for events with rising water levels. Establish clear targets for when these alerts should be issued. Develop situational assessment tools or dashboards.	C
8-3	Mid-term	Medium	Stormwater Flooding	CVRD; FNLG	Pluvial floodplain mapping: As with other flood types, develop and maintain current floodplain mapping to inform zoning and land use regulations that protect both people and natural corridors.	A
8-4	Mid-term	Medium	Stormwater Flooding	CVRD; FNLG	Land use regulations: Incorporate stormwater management into zoning and land use regulations to promote better development practices and limit impermeable surfaces to control excess runoff.	A
9-1	Mid-term	Medium	Landslides/Debris Flows	CVRD; FNLG	Hazard mapping: Maintain detailed hazard mapping and risk assessments of high-risk areas that already exist. This supports the understanding of risk and priorities for emergency management.	A
9-2	Mid-term	Medium	Landslides/Debris Flows	EMC; FNLG	Land use regulations: Maintain landslide hazard as part of land use planning and regulations for sustainable development to protect both people and natural corridors and avoid placing new developments in areas of high landslide hazard. See: Geotechnical Assessments for new development.	A

Code	Priority	Cost/Effort	Hazard	Actor	Recommended Action	Sendai-Priority
10-2	Mid-term	Low	Dam/Spillway Failures	CVRD; EMC; Reservoir Operators	Reservoir management plans: Ensure with reservoir operators that response plans are in line with management plans surrounding releases that reduce risk downstream.	D
10-3	Mid-term	Low	Dam/Spillway Failures	EMC	Training with planning scenarios: Consider the emergency response plans under planning scenarios (e.g., different hazard combinations). Organize, exercise, and train with planning scenario round tables between industry, government, and emergency responders.	D
10-4	Mid-term	Low	Dam/Spillway Failures	EMC	Early warning system: Create an early warning system with clear targets for when alerts should be issued.	C
10-5	Mid-term	Medium	Dam/Spillway Failures	CVRD; FNLG	Hazard and risk assessments: Maintain comprehensive hazard and risk assessments to inform decision-making and emergency response planning.	A
10-6	Mid-term	High	Dam/Spillway Failures	Provincial; CVRD; FNLG	Upgrades: Install timely upgrades or retrofits to ensure that the structure is more resilient to potential hazards and climate change conditions. Considerations extend to monitoring for damage or distress (e.g., beaver activity) and seismic safety considerations.	A
12-4	Mid-term	Medium	Human Disease	Other	Detection, rapid response, and preparedness plans: Ensure that the necessary plans exist to detect the spread of infectious disease early, respond rapidly with reasonable and adaptable protocol, and understand responsibilities and available resources, all for an effective response.	D
12-5	Mid-term	High	Human Disease	Other	Healthcare infrastructure: Consider building resilience into existing systems. This may include refining overflow plans for influxes in the number of patients; stockpiling medical supplies for high-demand periods during shortages; and considering training plans to rapidly bulk the healthcare workforce.	C
13-4	Mid-term	Medium	Security Incident	EMC; CVRD; FNLG	Risk assessment: Conduct or support a modern, threat-specific risk assessment to identify potential threats and vulnerabilities. This will support the continued refinement of response plans and readiness drills.	A

3.3 Longer-term Actions (5-10 years)

Table 28: Long-term hazard-specific recommendations.

Code	Priority	Cost/Effort	Hazard	Actor	Recommended Action	Sendai-Priority
2-6	Longer-term	High	Lake,River Flood	CVRD; FNLG	Natural flood management: Implement nature-based solutions, such as restoring natural wetlands and creating modern retention ponds (sized for climate projections), to slow and retain excess water, potentially reducing the flood hazard.	A
2-7	Longer-term	High	Lake,River Flood	CVRD; FNLG	Natural flood management: For highly-managed lands, such as agricultural areas, extend solutions to afforestation or flood-resilient crops for areas that regularly flood.	A
3-5	Longer-term	Medium	Drought	CVRD; FNLG; community groups	Rainwater harvesting: Implement systems to capture rainwater that can be beneficial on many scales, from individuals to the city.	A
3-6	Longer-term	High	Drought	CVRD; FNLG	Water recycling: Implement and normalize (grey) water recycling and reuse, notably for non-potable uses such as irrigation and industrial processes. This practice reduces the overall water demand.	A
3-7	Longer-term	High	Drought	CVRD; FNLG	Ecosystem restoration: Restore natural ecosystems that play crucial roles in regulating water, such as wetlands and forests.	A
3-8	Longer-term	High	Drought	CVRD; MoTI; FNLG	Water infrastructure: Upgrade or retrofit water infrastructure to optimize supply and distribution. This may include decommissioning select groundwater wells.	C
4-14	Longer-term	High	Wildfire	BC Wildfire Service; Jurisdiction; CVRD	Firefighting resources - Water infrastructure: Maintain, inspect, and retrofit underground water infrastructure (e.g., pipelines, water treatment and distribution facilities) to limit unnecessary losses and ensure a reliable supply.	C
6-5	Longer-term	Medium	Earthquake	FNLG	Land use planning: Support land use planning that considers seismic hazards such as avoiding developments in high-risk earthquake areas.	A
6-6	Longer-term	High	Earthquake	Provincial	Infrastructure resilience: Construct critical infrastructure, especially infrastructure that is entirely under the authority of local FNLG (utility plants, transportation networks, etc.), with the consideration of seismic hazards to ensure functionality following events. To minimize disruption, resilient designs or retrofits include underground utilities. Key services such as water and emergency services/operations centres must be supported through seismic construction.	A
7-7	Longer-term	High	Coastal Flood	FNLG; community groups	Nature-Based Solutions: Implement nature-based solutions, such as restoring natural wetlands and sand dunes/gravel spits, to potentially reduce flood hazards.	A
8-5	Longer-term	Low	Stormwater Flooding	FNLG	Monitoring and assessment: Implement monitoring of mitigation systems to identify successes and areas of improvement.	A
8-6	Longer-term	High	Stormwater Flooding	FNLG	Stormwater infrastructure: Invest in infrastructure such as retention and detention basins and permeable surfaces can help capture and manage stormwater runoff.	A

Code	Priority	Cost/Effort	Hazard	Actor	Recommended Action	Sendai-Priority
9-3	Longer-term	High	Landslides/Debris Flows	EMC; CVRD; FNLG	Slope stabilization: Regularly assess slope conditions and, as necessary, reinforce slopes with appropriate stabilization techniques (e.g., retaining walls, soil nails, vegetation, etc.).	A
9-4	Longer-term	High	Landslides/Debris Flows	CVRD; EMC	Debris flow barriers: Assess best practices and emerging technologies for techniques to deflect debris flows away from critical infrastructure and people.	A

4. Project Prioritization and Evaluation Criteria

Throughout this report, many recommendations for risk reduction and resilience measures have been provided. While concrete examples of next steps have been provided in Section 1.1, there may also be the need to prioritize between projects, hazards, and communities, and support allocation of available funding, as opportunities and external funding availabilities arise. To guide these decisions and strategic planning for the regional emergency management service (EMC), a range of evaluation criteria has been proposed below.

Project Prioritization and Evaluation Criteria:

- **Multi-hazard approach:** Can this project reduce risk and increase resilience for multiple (or all) hazards? A multi-hazard or all-hazard approach aims at generally reducing risk (e.g., by working with vulnerable populations) and increasing resilience (e.g., by establishing community resilience hubs), and thus allows a bigger return on investment.
- **Risk-based approach:** Is the focus of the project on the hazards/areas of highest risk?
    a. Priority Hazards in the Cowichan region: Storm/High-Wind Events; Lake, River, Stream Flooding; Drought; Extreme Heat; Wildfire; Hazardous Materials Release; Coastal Storm Flooding; Stormwater Flooding; Landslides/Debris Flows; Dam & Spillway Failure; Severe Winter Conditions; Human Disease; Security Incident; and Critical Infrastructure Disruption.
    b. Out of these priority hazards, regionally, drought and extreme heat, as well as wildfire, high-wind events and flooding have been identified as having particularly high risk, followed by earthquakes, landslides/debris flows, and hazardous material releases.
- **Resilience-based approach:** Does the project consider current resilience measures and will it increase community resilience into the future?
    a. Workshop participants indicated that they felt best prepared for these hazards:
        - Extreme Heat (64%); Wildfire (57%); Severe Winter Conditions (43%); Human disease & Lake, River Stream Flooding (29%)
    b. In contrast, workshop participants also indicated that these hazards needed more attention:
        - Critical Infrastructure Interruption (69%); Drought (54%); Security Incident (46%); Human Disease (23%)
    c. The existing risk reduction and resilience measures table (see Attachment C) also provides a good overview of strengths and gaps.
    d. Lastly, Section 1.1.2 above provides strategies and framings to increase community resilience.
- **Reconciliation (DRIPA)-focused approach:** Does the project actively implement the principles of DRIPA (e.g., include Indigenous partners or leadership)?
- **Equity-focused approach:** Does the project account for social vulnerabilities, disproportionately affected populations, and other equity-related aspects?
- **Climate change approach:** Does the project acknowledge climate change (if relevant for the hazard), and will provide recommendations into the future that allow adapting to a 'New Normal'?
- **Co-benefits approach:** Does the project provide co-benefits to the community or ecosystems?

- **Opportunistic approach:** While this project has originally not been planned as a risk reduction and resilience project, could a planned project be opportunistically used to serve such a purpose (along with its original intend)? Examples are upgrades/repairs to critical infrastructure systems, properties in hazardous areas that are up for purchase/new development, etc.

Appendix G: References

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