Pitt Meadows

2025 Hazard, Risk and Vulnerability Assessment (HRVA)

2025-01-24

Prepared by: Ernie Polsom

FireWise CONSULTING & LEARNING ACADEMY

Contents

1.0 Approach

The approach and tools used in this assessment adhere to the standard practices outlined in Emergency Management British Columbia's (EMBC) Hazard Risk Vulnerability Analysis Toolkit (2020). This toolkit emphasizes integrating scientific data and local knowledge into hazard assessments. With these principles, FireWise conducted the hazard assessments by combining observational data, thorough background research, and insights from local experts.

The risk assessment used the information available at the time of the HRVA. FireWise undertook extensive research and information-gathering efforts to ensure current and relevant data use. Additionally, subject matter experts and community members provided critical input, while Pitt Meadows staff and other identified stakeholders actively contributed, offering valuable context for risk themes and assumptions. However, this project did not include public engagement or outreach.

Including anecdotal evidence in assessing hazard likelihood adds a layer of subjectivity to an already interpretative process. Risk assessments inherently involve judgment to estimate likelihood and consequences, introducing potential bias influenced by analysts' expertise, experiences, and perspectives. This assessment was conducted by a diverse team that collaboratively developed qualitative measures of probability and consequence, drawing on recent Maple Ridge and Mission risk assessments to inform their approach.

The resulting risk ratings should be interpreted as informed estimates rather than definitive conclusions. The BCERMS HRVA Toolkit (2021) emphasizes that "the value of the HRVA lies as much in the conversations among a diverse range of people and groups as in the final results."

1.1 Hazard Identification

FireWise invested significant effort in identifying hazards that could affect the City and those regional hazards that could directly or indirectly affect Pitt Meadows. Definitions for each hazard were reviewed and refined to ensure clarity and relevance. While every effort was made to develop a comprehensive, tailored list of hazards for the City, we recognize that unidentified hazards may still exist.

1.2 Regional Perspective

This HRVA evaluates the hazards that may pose risks to the City of Pitt Meadows. Given Pitt Meadows's location in the Lower Mainland, the City's reliance on Metro Vancouver for critical infrastructure such as water and sewer services, its various agreements and partnerships with neighbouring communities, regional impacts, and risks must also be considered.

Recent climate and weather-related events highlight that many emergencies likely to affect Pitt Meadows have broader regional implications, which are essential to consider when developing effective risk management strategies. Assumptions about the availability of mutual aid or access

to regional resources may not be relevant when multiple jurisdictions are affected. This assessment synthesizes available information and data into pertinent summaries for the city.

The results of this HRVA provide a foundation for further efforts to refine hazard, risk and vulnerability information for the unique needs of individual areas of the City and its residents.

1.3 Engagement

The project terms of reference limited the engagement processes for the HRVA project in Pitt Meadows to senior City leadership and representatives from the Pitt Meadows Airport. While this provided valuable input from key decision-makers and critical infrastructure stakeholders, broader engagement is essential to ensure comprehensive findings reflect community-wide perspectives.

Future efforts should prioritize validating HRVA findings with the broader community through public consultations and interactive engagement sessions. This approach would allow residents to contribute their local knowledge, lived experiences, and unique insights, which are vital for refining hazard assessments and enhancing their relevance to the community's needs.

Additionally, targeted workshops with identified stakeholders—such as local businesses, non-profit organizations, first responders, Indigenous communities, and representatives of vulnerable populations—should be conducted to gather input on specific risks and challenges. These workshops can serve as a platform to address sector-specific concerns, foster collaboration, and build consensus around planning priorities.

By expanding engagement efforts, Pitt Meadows can ensure that future planning processes are informed by diverse perspectives, fostering community buy-in and improving the effectiveness of risk management strategies. This inclusive approach would strengthen stakeholder relationships, enhance resilience, and create a more holistic understanding of regional hazards and vulnerabilities.

1.4 Hazard Identification

The first step in the hazard assessment process was identifying the hazards that could impact the City. A comprehensive list of natural and human-caused hazards was developed by consulting a range of emergency management and risk reduction standards, frameworks, and tools, including those from provincial (Emergency Management British Columbia (EMBC)), federal (Public Safety Canada, and International sources (Sendai Framework).

FireWise further refined this preliminary list to focus on hazards relevant to the City and region. This refinement process involved reviewing historical data, analyzing previous HRVAs, and engaging with City staff and subject matter experts (SMEs). Through this collaborative and data-driven approach, the project team identified 53 hazards relevant to the City.

FireWise categorized the hazards into natural, technological, and conflict-related to ensure clarity and organization. The complete list of hazards and their definitions are in **Appendix 2**.

1.5 Risk Assessment

After completing the hazard list, the next step was to evaluate the relative risk posed by each hazard by calculating a risk score. Risk is "A concept that considers the likelihood that a hazard will occur, as well as the severity of possible impact to health, property, the environment, or other things of value (EMBC, 2021)."

Calculating risk scores is required to assess the likelihood of each hazard occurring and its potential consequences. The calculations were supported by research into historical and significant hazard events and consideration of influencing factors such as climate change.

The risk calculation followed a standard methodology, where risk is determined by multiplying the likelihood score by the total consequence score, expressed as:

Risk = Likelihood x Consequence

This approach systematically quantifies and compares hazards' risks, ensuring consistent and evidence-based evaluation.

1.6 Likelihood Analysis

Likelihood refers to the probability of an event occurring and is expressed as an expected rate of occurrence, such as "once every 15 years". FireWise developed the estimated occurrence rates from published and historical records of notable incidents at the local, regional, provincial and national levels. Additionally, FireWise incorporated hazard likelihood data from previous risk assessments and reports relevant to the City and region.

After collecting and reviewing hazard frequency data, the project team assigned a likelihood rating to each hazard. This rating reflects a 5-point scale (see Table 1), which combines elements from the EMBC HRVA Toolkit (2019) and the UN International Strategy for Disaster Reduction's Resilient Cities Quick Risk Estimation Tool. This blended approach allowed for the inclusion of historical data when specific frequency or return period information was unavailable.

By leveraging a combined scale, the likelihood assessment provides flexibility in accounting for quantitative and qualitative data, ensuring a more comprehensive and contextually relevant evaluation of hazard probability.

Climate change[1] significantly affects the predictability of the frequency and severity of disasters and emergency events. Increasingly volatile weather patterns—prolonged droughts, extreme precipitation, warmer winters, and hotter summers—alter emergencies' likelihood and potential impact. Regions with little history of wildfires are now experiencing highly volatile fire seasons, while phenomena like heat domes, extreme flooding, and severe water scarcity are becoming more frequent and intense.

The term "unprecedented" is frequently used to describe recent events, such as the record-breaking wildfire season of 2023 or the devastating floods caused by the November 2021

[1] https://cleanbc.gov.bc.ca/about-climate-change/impacts-of-climate-change/

atmospheric river that severed the Lower Mainland's access to the rest of Canada. These events underscore the growing unpredictability of future hazards.

When interpreting frequency data, we must recognize that our understanding of future events continually evolves. Climate change introduces new and dynamic threats, making historical data an increasingly limited predictor of future risks. Forecasting must incorporate flexibility and account for the likelihood of emerging and evolving hazards.

Table 1: Likelihood Scale

EMBC				**UNISDR**
Likelihood	Rating	Frequency	Probability (% Chance)	Historical Data
Almost Certain	5	The event will occur once every two years or more	Annual Chance 50% or greater	Occurred three or more times in the last 5 years
Likely	4	The event will happen about once in 3-10 years	Annual chance less than 50%	The event has occurred twice in the last 5 years
Possible	3	The event will happen about once every 11-50 years	Annual chance less than 10%	The event has occurred once in the last 5 years
Unlikely	2	The event will happen about every 51-100 years	Annual Chance less than 2%	It may occur and has occurred in the last 10 years
Rare	1	The event will happen about every 100 years or more	Annual Chance less than 1%	It occurs in exceptional circumstances and has happened in the last 20 years.

1.7 Consequence Analysis

Consequences refer to the physical/environmental, social, economic, and political impacts or adverse effects that may result from a hazardous event (EMBC, 2021). Understanding these

potential impacts is a critical step in assessing risks to a community. A single hazard can have various consequences, varying in severity depending on the context.

EMBC has identified 11 consequence categories to support the evaluation of consequences, grouped into two primary impact areas: Human and Social Impacts and Physical and Economic. Defined impact rating scales accompany each category to standardize the assessment process.

Human and Social Impacts:

- Fatalities
- Injury or illness
- Displacement
- Psychosocial Impact
- Support System Impact
- Cultural Resource Impact

Physical and Economic Impacts:

- Property Damage
- Critical Infrastructure Impact
- Environment Impact
- Reputational Impact

The project team assessed the severity of potential impacts for each hazard using a 5-point scale specific to each consequence category (Tee Tables 2 and 3). Current risk treatments and mitigation activities were carefully considered during the assessment process to ensure realistic and context-sensitive ratings.

Consequence ratings also consider the relative capacity and resources of the evaluated jurisdiction. For example, an incident resulting in four serious injuries would likely be rated as having a higher consequence in a small, remote community with limited volunteer emergency services than a similar event in a large urban center with extensive resources and career personnel readily available.

FireWise totalled the scores for all 11 consequence categories to produce a consequence score out of a potential 44 points for each hazard. This comprehensive scoring approach provided a clear and systematic measure of the overall potential impact of each risk.

Table 2: Consequence Scale Ranking Guide

Consequence Scale Ranking Guide Human and Social Impacts						
Rank	Fatalities	Injury/Illness	Displacement	Psychosocial	Support System Impact	Cultural Impact
None (0)	No directly related fatalities	No directly related illness or injury	No evacuation orders of self-evacuation.	The event is unlikely to result in any short- or long-term trauma.	It is not likely to impact access to supports or networks. Community reciprocity, trust, and cooperation are unaffected.	Little to no impact.
Low (1)	Loss of life that is manageable within the scope of normal operations	Illness or injury that is manageable within the scope of normal operations.	A low percentage of the population evacuated, self-evacuated, or sheltered in place. Supports are provided within the community.	Psychological First Aid can primarily address direct impacts on a few individuals. Additional support to those directly impacted and local mental health professionals can provide for their families.	Hours to days-long disruption to daily life. This is likely to result in reduced localized access to support or networks. Community reciprocity, trust, and cooperation are affected.	Recovery from cultural impacts will take days to weeks.
Med (2)	Loss of life that is beyond the scope of normal operations and may require overtime and/or additional resources.	Illness or injury beyond the scope of normal operations and may require additional capacity and/or resources and/or the activation of response systems and emergency plans.	Enough of the population is evacuated, self-evacuated or sheltering in place to require external support to be brought in.	Localized property loss and/or fatalities or serious injuries. Those directly impacted will likely experience both short- and long-term psychosocial impacts. Local & outside mental health professionals will be needed to provide support and treatment.	Days-long disruption to daily life. This is likely to result in reduced access to support or networks. Community reciprocity, trust, and cooperation are affected.	Recovery from cultural impacts will take months.
High (3)	Loss of life is severe enough for mass fatality procedures to be activated.	Extensive mass illness or injury requiring extra capacity and/or resources across multiple facilities in a health region and potentially specialized care from other health regions. Health authority response systems and emergency plans activated.	10-30% of the population evacuated or displaced.	Widespread loss of property and/or multiple fatalities or persons with serious injuries. Those directly impacted will likely experience both short- and long-term psychosocial impacts. Local and outside mental health professionals will be needed to provide support and treatment.	Weeks or months-long disruption to daily life. Significantly reduced access to supports or networks. Community reciprocity, trust, and cooperation are severely affected.	Recovery from cultural impacts will take years.
Extreme (4)	Fatalities exceed the capacity of existing plans and capabilities. Provincial, Federal or International resources may be required.	Extraordinary mass illness or injury. Provincial, Federal, and International resources may be required. Multiple health region response systems are active.	A high percentage of residents are displaced for years or permanently.	Widespread and long-term psychosocial impacts exceed those directly affected by property loss or fatalities—extensive external support is required.	Months to years-long disruption to daily life. Supports or networks may be permanently changed.	Recovery from cultural impacts will not be possible; destruction is permanent and irreversible (i.e. Destruction of irreplaceable knowledge or artifacts).

Table 3: Consequence Scale Ranking Guide

Consequence Scale Ranking Guide: Physical and Economic Impacts					
Rank	Property Damage	Critical Infrastructure	Environmental	Economic	Reputational
None (0)	It is not likely to result in property damage.	Not likely to disrupt critical infrastructure services.	It is not likely to result in environmental damage.	Not likely to disrupt business or financial activities.	It is not likely to result in political or reputational impacts.
Low (1)	Minor, primarily non-structural damage.	Few service disruptions impact a low percentage of the population—disruptions last hours to days.	Localized and reversible damage. Hours to days-long clean up possible.	Days-long disruptions to a few businesses, financial activities, or livelihoods.	Limited or short-term political or reputational impacts.
Med (2)	Localized severe damage.	A high % of the population is impacted by a few services, OR a low % is affected by significant or multiple service disruptions.	Complete clean-up is possible but may take weeks.	Weeks-long losses to businesses, industry, or livelihoods.	Some significant or long-term political or reputational impacts.
High (3)	Widespread structural damage. Repair may take months to years.	Significant or multiple service disruptions impact a high % of the population.	Significant but reversible damage. Complete cleanup is complex and could take months or years.	Months-long losses to business, industry, or livelihoods.	Significant and long-term political or reputational impacts.
Extreme (4)	Widespread irreparable damage.	Long-term outages impact a high percentage of the population.	Severe or irreversible damage. Complete clean-up is not possible or could take decades.	Widespread or long-term loss of businesses, industry, or livelihoods.	Significant and irreparable political or reputational impacts.

2.0 Executive Summary

The Pitt Meadows 2025 Hazard, Risk, and Vulnerability Assessment (HRVA) comprehensively evaluates the risks and vulnerabilities faced by the City of Pitt Meadows. This assessment aims to enhance the city's preparedness and resilience by identifying potential hazards, assessing their likelihood and consequences, and developing strategies to mitigate these risks. The HRVA adheres to the standard practices outlined in Emergency Management British Columbia's (EMBC) Hazard Risk Vulnerability Analysis Toolkit (2020), integrating scientific data and local knowledge into the hazard assessments1.

Scope of the HRVA

The HRVA covers many natural and human-caused hazards that could impact Pitt Meadows. The assessment includes a thorough hazard identification process, a regional perspective considering the city's reliance on Metro Vancouver for critical infrastructure, and an evaluation of the city's risk profile. The assessment also emphasizes the importance of community engagement and the need for broader public consultations to ensure comprehensive findings.

Overall Risk Profile of the City

Pitt Meadows faces various risks due to its location, climate, and reliance on regional infrastructure. The city's risk profile is influenced by population growth, changes in community development strategies, updated transportation corridors, cyber threats, and climate change. The HRVA highlights the increasingly regional nature of many serious risks, including heat and cold emergencies, extreme rain, wind and snow events, earthquakes, and wildfires. These risks will become more common and extreme due to climate change, requiring regular updates to the HRVA and the city's response systems.

Key Vulnerabilities and Hazards

1. **Flooding**: Pitt Meadows is highly vulnerable to flooding due to its low-lying geography and proximity to the Pitt and Fraser Rivers. Climate change intensifies flood risks by increasing the frequency of extreme rainfall events, rising river levels, and rising sea levels.
2. **Extreme Weather Events**: The city experiences more frequent and severe heatwaves, wildfires, and atmospheric river events. These events can cause significant disruptions to transportation, power supply, and emergency response services.
3. **Critical Infrastructure**: The city's reliance on an extensive network of dikes, pump stations, and regional infrastructure makes it vulnerable to disruptions. Failure of the dike system, power outages, and transportation infrastructure risks are significant concerns.
4. **Social Vulnerabilities**: Certain populations, such as seniors, low-income households, people experiencing homelessness, Indigenous communities, and persons with

disabilities, are more susceptible to the impacts of hazards. Addressing these vulnerabilities requires targeted interventions and community engagement.

5. **Economic Vulnerabilities**: The city's economy is closely tied to agriculture, transportation, and logistics. Disruptions to these sectors due to hazards can have significant economic impacts.

By understanding these risks and vulnerabilities, Pitt Meadows can develop effective risk management strategies to enhance its resilience and ensure the safety and well-being of its residents.

3.0 HRVA Findings

3.1 Defining Risk

Risk is "a situation involving exposure to danger." Understanding the nature of the risks in the community is critical to developing effective risk management strategies, including fire department capacity, organization and optimal service levels. A Hazard, Risk and Vulnerability Assessment (HRVA) is an essential first step in understanding the nature of a community's risks. It informs the development of a risk profile that provides a qualitative and quantitative analysis of an organization's threats, risks and vulnerabilities. The City of Pitt Meadows should view this risk profile from an enterprise perspective involving a "whole city" approach to managing its risk profile that integrates risk management efforts across all affected City departments. Various Pitt Meadows departments are responsible for different [prtions of critical infrastructure, response resources, and mitigation roles critical to successful emergency response outcomes.

Risk is a constantly changing reality. Population growth, changes in community development strategies, updated transportation corridors and associated commodity or passenger traffic, cyber threats, and climate change impact Pitt Meadows's risk profile. The heat dome and atmospheric river in 2021 and the recent interface and wildfires on the Fraser River's north shore in 2024 illustrate the extreme effects of climate change on traditional weather systems. Every production suggests these events will become more common and extreme, requiring regular updates of the HRVA and the City's response systems. These impact the delivery of virtually every City service, so a broad approach to addressing them is essential. An ongoing HRVA process can ensure that the City's risk intelligence identifies trends that allow sustainable and proactive changes to risk management practices within the City and its residents' risk tolerance levels.

A thorough assessment of the internal and external risks should be the basis for developing risk management strategies. The following risk assessment describes community hazards that will require thoughtful consideration.

3.2 Risk Tolerance

Risk tolerance, in the context of municipal government, refers to the level of risk a local government is willing to accept to meet its objectives and provide services to its community. It reflects the balance between an action or decision's potential benefits and negative consequences, including financial, social, and environmental impacts.

Municipal risk tolerance is influenced by several factors, such as:

- **Community Priorities**: What the residents value most (e.g., safety, infrastructure, economic development).
- **Legislative Requirements**: Minimum standards or regulations that must be met.

- **Available Resources**: Financial, human, and technical resources to mitigate or respond to risks.
- **Leadership Philosophy**: The perspectives and decisions of elected officials and senior management.

How Risk Tolerance Varies by Community and Capacity

1. **Community Characteristics**:
    - **Demographics**: A younger, growth-focused community may tolerate more risk, in favour of economic opportunities, whereas an older or more established community may prioritize stability and safety.
    - **Economic Profile**: Communities with robust economic bases may accept more significant financial risks to invest in growth, while those with limited resources may adopt a more conservative approach.
2. **Capacity for Risk Management**:
    - **Financial Resources**: Wealthier municipalities may have greater risk tolerance as they can absorb potential losses or fund mitigation measures. Conversely, municipalities with tight budgets may be risk-averse.
    - **Operational Capacity**: Municipalities with skilled staff and advanced systems are better equipped to manage complex risks, allowing for greater tolerance, whereas smaller communities may lack the resources to address high-risk scenarios effectively.
3. **Geographic and Environmental Factors**:
    - Communities prone to natural hazards (e.g., wildfires and floods) may have a lower risk tolerance in emergency planning. Still, they may accept higher risks in less critical areas to allocate resources effectively.
4. **Public Expectations and Political Landscape**:
    - Public pressure and political priorities often shape risk tolerance. A community with engaged and vocal residents may drive a more conservative approach, while communities with more trust in leadership may support higher-risk initiatives.

In summary, a municipality's risk tolerance is not a fixed measure but a dynamic balance influenced by its unique community characteristics, capacity, and priorities. Tailoring risk management strategies to reflect this variability ensures that risks align with the community's needs and capabilities.

3.3 Community Profile

Pitt Meadows is in the Metro Vancouver region, southwestern British Columbia. Incorporated in 1914, the City spans a land area of 86.34 square kilometres and has an estimated 2024 population of 19,498. Pitt Meadows is named after the Pitt River and Pitt Lake and is one of the municipalities, alongside Electoral Area A, that make up the Metro Vancouver Regional District.

3.3.1 Historical Overview:

The q̓ic̓əy̓ (Katzie) First Nation have lived and thrived in these areas for thousands of years, contributing to the region's rich cultural heritage. European settlement began in 1874 when James McMillan explored the area. The Pitt Meadows area was originally part of the Municipality of Maple Ridge, which was incorporated in the same year. By 1892, residents of Pitt Meadows petitioned to separate from the District of Maple Ridge. 1893, the first dyking district was established to manage the region's flood-prone lands. However, the Fraser River flood of 1894 inundated many acres of farmland, highlighting the area's vulnerability to flooding.

By 1914, Pitt Meadows was a small agricultural community of fewer than 250 people, supplying Vancouver and New Westminster with produce and dairy products. Over time, the community grew and evolved. In 1995, Pitt Meadows became a member municipality of Metro Vancouver, and in 2007, the District of Pitt Meadows was officially incorporated as the City of Pitt Meadows.

3.3.2 Geography

1. Location and Boundaries

- **Coordinates**: 49.2220° N, 122.6893° W
- **Adjacent Municipalities**:
    - **North**: Thompson Mountain Range
    - **East**: Maple Ridge
    - **South**: Surrey and Langley Township (across the Fraser River)
    - **West**: Port Coquitlam
- **Adjacent First Nations:**
    - **q̓ic̓əy̓** (Katzie) **First Nation:** Occupies lands in the City's southeast corner west of the Golden Ears Bridge, east of Bronson Road and south of Airport Way, on the Fraser River.

Pitt Meadows is situated approximately 40 kilometres east of downtown Vancouver, making it part of the commuter belt for the region's urban core. The City covers an area of roughly 86 square kilometres.

2. Topography

- **Flat Terrain**: The majority of Pitt Meadows consists of flat, low-lying terrain due to its location within the floodplain of the Fraser River and Pitt River. This characteristic has made it ideal for agricultural use but susceptible to flooding.
- **Mountains**: To the north, the Thompson Mountain Range provides a dramatic backdrop and recreational opportunities, including hiking and sightseeing.

3. Water Systems

- **Pitt River**: Running along the City's eastern boundary, the Pitt River is a significant geographical feature, connecting Pitt Lake to the Fraser River.
- **Fraser River**: The City's southern boundary is defined by the Fraser River, which plays a crucial role in the region's transportation, trade, and ecological systems.
- **Pitt Lake**: Located to the north, Pitt Lake is one of the largest tidal lakes in the world. It provides critical habitats for wildlife and is a popular destination for boating and fishing.
- **Katzie Slough**: A smaller waterway traversing parts of the City, Katzie Slough supports local biodiversity and irrigation.

4. Land Use

- **Agricultural Land Reserve (ALR)**: Approximately 86% of Pitt Meadows is designated as ALR, preserving its fertile soils for farming. The City is renowned for its agricultural productivity, particularly in blueberries, cranberries, and other crops.
- **Urban Development**: The City's urban core centers around the Pitt Meadows Town Centre in the southeastern corner of the City, offering residential, commercial, and recreational spaces.
- **Industrial Areas**: Small industrial zones near the Fraser River contribute to the local economy and provide logistical access via rail and river transport. The railway and a proposed intermodal and storage facility are planned on the City's west side, south of Highway 7.

5. Infrastructure

- **Transportation**:
    - **Roadways**: Pitt Meadows is accessible via Highway 7 (Lougheed Highway), connecting it to neighbouring communities.
    - **Golden Ears Bridge**: The addition of the Golden Ears Bridge opened the north shore up to commuters and a shortcut for commercial haulers moving products to and from the ports further west. Commercial traffic across the bridge predominantly moves west through the City.

- **Railways**: The Canadian Pacific Railway passes through the City, facilitating freight transport.
- **Airports**: The Pitt Meadows Regional Airport is a hub for private and small commercial aircraft, contributing to the local economy. The airport's flight paths limit development height to 10 storeys in most of the City.
- **Cycling and Trails**: The City boasts extensive cycling routes and walking trails, encouraging sustainable transportation and recreation.

7. Natural and Recreational Features

- **Parks and Trails**: Pitt Meadows offers numerous parks, including the Pitt-Addington Marsh Wildlife Management Area and the dike trail system, which provides scenic views of the rivers and mountains.
- **Wildlife Habitat**: The City's proximity to wetlands and rivers supports diverse ecosystems, including habitats for migratory birds and aquatic species.
- **Golden Ears Provincial Park**: While located in neighbouring Maple Ridge, the park's proximity enhances recreational opportunities for Pitt Meadows residents.

8. Environmental Considerations

- **Floodplain Management**: Given its location in a floodplain, Pitt Meadows has implemented extensive dike systems to protect agricultural land and urban areas from flooding. Over 68% of the City lies within a floodplain.
- **Ecological Preservation**: Efforts to preserve wetlands, riparian zones, and wildlife habitats reflect the City's commitment to environmental stewardship.
- **Agricultural Land Preservation**: The City of Pitt Meadows has committed to safeguarding agricultural lands. 86% of the City is protected farmland under the British Columbia Agricultural Land Reserve (ALR).

9. Population and Urban Growth

While the City remains predominantly rural, its strategic location within Metro Vancouver has attracted urban development. As of 2023, Pitt Meadows has a population of approximately 19,498 residents, with growth focusing on maintaining a balance between urbanization and preserving its natural and agricultural heritage.

Pitt Meadows' geographical features—its rivers, mountains, and fertile plains—make it a distinctive municipality in British Columbia. The City's commitment to sustainable development and environmental stewardship ensures that it remains "The Natural Place," where residents can enjoy a high quality of life amidst stunning natural surroundings.

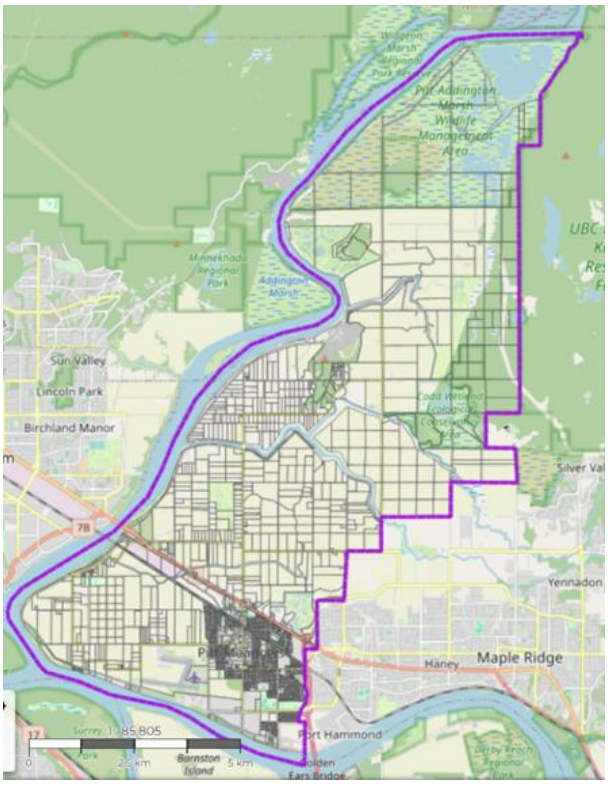

Figure 1: Map of the City of Pitt Meadows.

3.3.3 Demographics

The 2021 Canadian Census provides a comprehensive understanding of the demographic characteristics of Pitt Meadows, a vibrant Metro Vancouver Regional District community. This analysis delves into population trends, age distribution, cultural diversity, education, income, and housing in Pitt Meadows.

Population Growth and Density

- **Population**: The 2021 census indicated 19,146 residents, reflecting a modest 3.1% growth from 2016 (18,573 residents). Recent estimates place the 2024 population at approximately 19,498, maintaining the modest population increases prevalent since growth peaked in 2013. The lack of developable land for housing will likely constrain growth well into the future.
- **Population Density**: 223.6 persons per square kilometre, higher than many rural communities but lower than urban centers in Metro Vancouver due to the exceptional amount of agricultural land. The actual population density of the City's town centre reflects a land density that is more representative of other suburban areas and cities.
- **Land Area**: Approximately 86 square kilometres.

Pitt Meadows' population growth is steady but slower than the provincial average of 7.6%, indicating controlled development and limited urban sprawl.

Age Distribution

The age distribution reveals a balanced community with representation across all age groups:

- **Children and Youth (0–14 years)**: 15.5% of the population (approx. 2,970 individuals).
- **Working-age adults (15–64 years)**: 66.2% of the population (approx. 12,680 individuals).
- **Seniors (65+ years)**: 18.3% of the population (approx. 3,495 individuals)

Pitt Meadows has a slightly younger profile than Canada. Still, the growing proportion of seniors suggests the need for expanded healthcare and senior-oriented services, which will add complexity to demands during emergencies.

Gender Composition

- **Female Residents**: 51.3%
- **Male Residents**: 48.7%

This balance reflects typical trends in Canadian communities, with a slightly higher proportion of females due to longer life expectancy.

Cultural Diversity and Ethnicity

- **Indigenous Population**: Approximately 3% of residents identify as Indigenous (First Nations, Métis, or Inuit).
- **Visible Minorities**: 25% of the population belongs to a visible minority group, with the largest communities being:
    - South Asian: 8.5%
    - Chinese: 5.3%
    - Filipino: 3.2%
    - Black: 1.7%

Pitt Meadows is a diverse community, with multicultural influences contributing to its social and cultural fabric.

Language

- **Official Languages**: 96% of residents primarily speak English, with French spoken by a small minority.
- **Other Languages**: Common non-official languages include Punjabi, Mandarin, and Tagalog, reflecting the cultural diversity of the City.

- **Language Used at Work**: The 2021 census identified 11,375 working-age residents, and 11,310 spoke English most often at work. City programs should be cognizant of the need for programs to have some access to languages other than English or French.

Education

- **Post-Secondary Education**: Over 65% of residents aged 25–64 have completed post-secondary education, including university degrees, college diplomas, and trade certifications.
- **High School Graduates**: Approximately 90% of residents aged 25 and older have at least a high school diploma, slightly above the national average.

The high education levels reflect the community's focus on learning and skill development.

Employment and Income[2]

- **Labour Force Participation**: Around 65% of the working-age population is actively employed or seeking employment.
- **Industries**: The top sectors include retail trade, healthcare, construction, agriculture, and manufacturing.
- **Median Household Income**: $92,000 (2021), higher than the national median, indicating relative affluence
- **Employment Income**: The median employment income for full-time workers was approximately $60,000
- **Industries**: The top industries where residents are employed include retail trade, healthcare and social assistance, construction, and manufacturing
- **Commuting Patterns**: Many residents commute to nearby cities for work, with a notable percentage travelling to Vancouver and other parts of the Metro Vancouver area

Housing

- **Total Private Dwellings**: 7,404, with 96% of dwellings occupied.
- **Housing Types**:
    - Single-detached houses: 53%
    - Apartments/Condos: 27%
    - Townhomes: 15%

[2] https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/details/page.cfm?Lang=E&SearchText=Pitt%20Meadows&DGUIDlist=2021A00055915070&GENDERlist=1,2,3&STATISTIClist=1&HEADERlist=0

- **Homeownership Rate**: 79%, significantly higher than urban centers like Vancouver, reflecting Pitt Meadows' family-oriented nature
- **Median Home Value**: The median home value in Pitt Meadows as of January 2025 is $754,967[3]

Key Demographic Trends

- **Aging Population:** The growing senior demographic suggests increasing demand for healthcare, senior housing, and recreation services tailored to older adults.
- **Cultural Diversity:** The rise in visible minorities and multilingual residents highlights the importance of inclusive community programming and services.
- **Stable Growth:** Controlled population growth and a high homeownership rate reflect the City's family-friendly and commuter-friendly community appeal.

Pitt Meadows is a dynamic, steadily growing community that balances rural charm with urban convenience. Its diverse population, strong educational attainment, and family-oriented housing market make it an attractive place to live and work. Future planning must address the challenges of an aging population, housing affordability, and preserving agricultural and green spaces while accommodating growth.

3.3.4 Economy

Pitt Meadows, a city in the Metro Vancouver Regional District in British Columbia, boasts a diverse economy that reflects its geographic location, cultural heritage, and infrastructural advantages. Traditionally rooted in agriculture, the City has increasingly diversified its economic base to include commercial, industrial, and service sectors. Its economy is significantly shaped by its relationship with the Greater Vancouver area, enabling the City to leverage regional opportunities while maintaining its rural and community-focused identity.

Pitt Meadows has developed a strong commercial and retail sector that caters to its residents and those in neighbouring communities, including Maple Ridge. These developments provide a variety of goods, services, and amenities that contribute significantly to the local economy while enhancing the City's appeal as a convenient and accessible hub for shopping and business.

Key Commercial and Retail Areas

1. **Meadowtown Shopping Centre**:
   Meadowtown Shopping Centre is the City's primary retail hub, offering a mix of big-box retailers, specialty stores, and dining options. Anchored by major tenants such as Real Canadian Superstore, JYSK, and Staples, the center serves as a one-stop shopping

[3] https://www.bing.com/ck/a?!&&p=cda015d20103261891a9bd1a7a412fd17381c692a46231b93745ccabd563314aJmltdHM9MTczNzY3NjgwMA&ptn=3&ver=2&hsh=4&fclid=18b3f85d-f173-60a4-16ac-eb56f0ca612a&psq=Pitt+Meadows+median+home+price&u=a1aHR0cHM6Ly93d3cuem9sby5jYS9waXR0LW1lYWRvd3MtcmVhbC1lc3RhdGUvdHJlbmRz&ntb=1

destination for Pitt Meadows, Maple Ridge, and surrounding areas. Its convenient location along Lougheed Highway ensures accessibility for shoppers travelling by car or transit.

2. **Osprey Village**:
   Osprey Village is a boutique-style retail and commercial area along the Fraser River. Known for its charming small-town feel, it features locally owned businesses, including cafes, fitness studios, and specialty shops. The village's scenic setting and community-oriented design make it a popular destination for residents and visitors, blending commerce with recreation.

3. **Harris Road Commercial Corridor**:
   Harris Road serves as a central artery for commerce in Pitt Meadows. The corridor includes professional services, restaurants, retail shops, and local businesses, contributing to the City's economic vibrancy. Its accessibility and variety make it an essential part of the local business ecosystem.

4. **Industrial-Commercial Parks**:
   Pitt Meadows also benefits from light industrial and mixed-use commercial zones that house manufacturing, logistics, and warehousing businesses. These areas support the City's economic base while providing opportunities for local job creation and partnerships with regional markets.

Strengths of Pitt Meadows' Commercial and Retail Developments

1. **Proximity to Maple Ridge**:
   Pitt Meadows' retail offerings are well-positioned to attract shoppers from neighbouring Maple Ridge, especially given the shared use of major transportation routes like the Lougheed Highway and the Golden Ears Bridge. This close relationship bolsters customer traffic and provides businesses with a larger market.

2. **Diverse Offerings**:
   The City provides a mix of retail options, from large national chains at Meadowtown Shopping Centre to unique, independently owned businesses in Osprey Village. This diversity ensures that residents and visitors can access various products and services, enhancing customer satisfaction and loyalty.

3. **Accessibility**:
   Pitt Meadows' commercial developments benefit from excellent transportation links, including major highways, commuter rail service via the West Coast Express, and a growing network of cycling and pedestrian-friendly pathways. This accessibility encourages both local and regional shoppers to visit the City.

4. **Support for Local Businesses**:
   The City emphasizes fostering local entrepreneurship and supporting small businesses, particularly in Osprey Village and Harris Road. This approach helps maintain a vibrant and resilient commercial sector while strengthening community ties.

Challenges and Opportunities

1. **Limited Retail Space**:
   Due to its size and significant Agricultural Land Reserve (ALR) areas, Pitt Meadows faces constraints on expanding commercial and retail spaces. Balancing land use priorities while meeting the demands of a growing population presents an ongoing challenge.

2. **Competition with Larger Retail Centers**:
   Pitt Meadows must compete with larger commercial hubs in Metro Vancouver, such as Coquitlam Centre and Guildford Town Centre, which may draw customers away for more extensive shopping options. Maintaining a unique identity and focusing on niche markets will be key to retaining local shoppers.

3. **Tourism Integration**:
   There is an opportunity to better integrate retail and commercial developments with Pitt Meadows' tourism offerings. For instance, enhancing the connection between Osprey Village and recreational activities along the Fraser River could attract more visitors and boost retail spending.

4. **Population Growth**:
   As Pitt Meadows and the surrounding region grow, there is an opportunity to expand and diversify the City's commercial base to meet the evolving needs of its population. This growth can support increased investment in retail and mixed-use developments.

Pitt Meadows' commercial and retail sectors play a vital role in supporting the local economy and meeting the needs of residents and visitors. With well-established hubs like Meadowtown Shopping Centre and unique offerings in areas like Osprey Village, the City successfully caters to a diverse market. By addressing challenges such as space constraints and regional competition while leveraging its strategic location and community-focused approach, Pitt Meadows can continue to thrive as a key commercial destination in the Lower Mainland.

Relationship to the Greater Vancouver Area

Pitt Meadows' economy is closely interconnected with the broader Metro Vancouver region:

- **Commuter Base**: Many Pitt Meadows residents commute to Vancouver, Burnaby, Surrey, and other regional areas for employment in technology, finance, education, and healthcare. The City's access to regional transportation networks, such as the Lougheed Highway (Highway 7) and the West Coast Express commuter train, supports this commuter economy.

- **Transportation and Logistics Hub**: Located along major transportation corridors and served by the CP Rail mainline, Pitt Meadows plays a crucial role in goods movement. Its proximity to Vancouver International Airport (YVR) and the Port of Vancouver enhances its importance in regional logistics and trade.

- **Tourism and Recreation**: Pitt Meadows attracts visitors across Metro Vancouver with its scenic natural features, including Pitt Lake, Golden Ears Provincial Park, dikes, and

extensive trails. Outdoor activities such as hiking, kayaking, and birdwatching contribute to the local tourism economy.

- **Infrastructure Dependency**: Pitt Meadows relies on Metro Vancouver for essential services, including water, sewer, and waste management, making its economy and quality of life dependent on the region's infrastructure and governance.

Agriculture: A Pillar of the Pitt Meadows Economy

Agriculture remains a cornerstone of the Pitt Meadows economy, preserving the City's historical identity as a farming community. With over 86 square kilometres of land, much of it within the Agricultural Land Reserve (ALR), the City is home to a wide range of agricultural activities:

- **Crops and Livestock**: Pitt Meadows is known for producing cranberries, blueberries, and other fruits, as well as dairy farming and livestock. The fertile floodplains of the Fraser River provide ideal conditions for agriculture.
- **Economic Contribution**: Agriculture generates direct financial benefits and supports related industries such as food processing, distribution, and agri-tourism. The City's farmland is a key supplier of produce to Metro Vancouver and beyond, contributing to food security in the region.
- **Agri-Tourism**: Seasonal events, U-pick farms, farmers' markets, and farm tours draw visitors, providing an additional revenue stream for local farmers.

Large Employers in Pitt Meadows

While agriculture forms the backbone of the local economy, Pitt Meadows is also home to notable employers across various sectors:

- **Golden Eagle Group**: A major agricultural company specializing in cranberry and blueberry production, Golden Eagle Group is one of the largest employers in the City.
- **Pacific Rim Aviation Academy**: Located at the Pitt Meadows Regional Airport, this academy contributes to the aviation sector and provides pilot training.
- **Pitt Meadows Regional Airport (YPK)**: A significant economic asset, the airport supports aviation services, flight schools, and light industrial activities.
- **Meadow Gardens Golf Club**: As a popular venue for recreation, events, and tourism, the golf club provides employment opportunities in hospitality and services.
- **Industrial and Commercial Parks**: Several businesses operate in Pitt Meadows' commercial and industrial areas, including manufacturing, warehousing, and logistics firms. Companies like Amazon, Sunwood Building Materials and Innovative Fitness contribute to the local economy.

Economic Strengths

- **Strategic Location**: Pitt Meadows' proximity to Vancouver and regional transportation networks makes it a key player in logistics and commuter employment.

- **Strong Agricultural Base**: The City's rich agricultural lands ensure a steady contribution to the local and regional economy, with a focus on sustainability and food security.
- **Outdoor Tourism and Recreation**: Scenic landscapes and outdoor activities attract visitors, supporting local businesses and enhancing the City's profile as a recreation destination.
- **Diverse Economic Activities**: Pitt Meadows benefits from a diversified economic base that includes agriculture, aviation, and light industrial operations.

Weaknesses and Vulnerabilities

- **Infrastructure Dependency**: The City relies on Metro Vancouver for essential services, creating potential vulnerabilities if regional systems face disruptions.
- **Climate Change Impacts**: As a city on floodplains, Pitt Meadows is particularly vulnerable to flooding, especially with the increasing frequency of extreme weather events such as atmospheric rivers and heat waves. These events also pose risks to agriculture and infrastructure.
- **Limited Local Job Base**: While there are employment opportunities within the City, many residents commute to other parts of Metro Vancouver, which may limit the development of a robust local job market.
- **Land Use Restrictions**: Significant ALR lands limit urban and industrial expansion opportunities, balancing agricultural preservation with economic growth.
- **Economy**: Pitt Meadows depends on strong regional, provincial, national and international economies due to its links to logistics and transportation industries.

Pitt Meadows' economy is shaped by its agricultural heritage, strategic location within Metro Vancouver, and diverse aviation, tourism, and logistics sectors. Its strengths lie in its agricultural productivity, natural beauty, and connectivity to the broader region. At the same time, its vulnerabilities include dependency on regional infrastructure and the growing challenges posed by climate change. Balancing growth and sustainability will be key to the City's future economic resilience.

3.3.4 Climate:

In British Columbia's Lower Mainland, Pitt Meadows experiences a temperate maritime climate characterized by mild, wet winters and warm, relatively dry summers. The City's proximity to the Pacific Ocean and surrounding mountain ranges influences its climate.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	15.5 (59.9)	19.5 (67.1)	23.8 (74.8)	29.8 (85.6)	36 (97)	41.4 (106.5)	37.6 (99.7)	36.6 (97.9)	35.5 (95.9)	30 (86)	20.0 (68.0)	17 (63)	41.4 (106.5)
Mean daily maximum °C (°F)	6.8 (44.2)	8.8 (47.8)	11.3 (52.3)	14.9 (58.8)	19.0 (66.2)	21.3 (70.3)	25.0 (77.0)	25.1 (77.2)	21.5 (70.7)	15.0 (59.0)	9.6 (49.3)	6.1 (43.0)	15.4 (59.7)
Daily mean °C (°F)	3.6 (38.5)	4.6 (40.3)	6.8 (44.2)	9.7 (49.5)	13.5 (56.3)	16.1 (61.0)	18.8 (65.8)	18.8 (65.8)	15.7 (60.3)	10.5 (50.9)	6.0 (42.8)	3.1 (37.6)	10.6 (51.1)
Mean daily minimum °C (°F)	0.5 (32.9)	0.4 (32.7)	2.3 (36.1)	4.5 (40.1)	7.9 (46.2)	10.8 (51.4)	12.6 (54.7)	12.4 (54.3)	9.8 (49.6)	5.9 (42.6)	2.4 (36.3)	0.1 (32.2)	5.8 (42.4)
Record low °C (°F)	−19 (−2)	−14 (7)	−9.4 (15.1)	−5 (23)	−1 (30)	0.6 (33.1)	4.4 (39.9)	5 (41)	−1 (30)	−5.5 (22.1)	−19 (−2)	−18 (0)	−19 (−2)
Average precipitation mm (inches)	252.4 (9.94)	133.6 (5.26)	173.4 (6.83)	104.5 (4.11)	95.3 (3.75)	68.9 (2.71)	47.6 (1.87)	36.3 (1.43)	94.0 (3.70)	180.0 (7.09)	249.0 (9.80)	214.1 (8.43)	1,649.1 (64.92)
Average precipitation days (≥ 0.2 mm)	22.2	17.8	20.3	15.2	13.2	12.8	8.7	7.5	11.3	18.0	21.4	21.8	190.2

Figure 2: Source: Environment Canada

Temperature

- **Winter** (December to February): Average high temperatures range from 6°C to 8°C (43°F to 46°F), while average lows are between 0°C and 2°C (32°F to 36°F). Snowfall is infrequent but can occur during cold spells.
- **Summer** (June to August): Average high temperatures range from 22°C to 25°C (72°F to 77°F), with occasional peaks above 30°C (86°F). Evenings are cooler, with lows around 12°C to 14°C (54°F to 57°F).

Precipitation

- **Annual Rainfall:** Approximately 1,508 mm (59.4 inches) spread over 184 days, mainly between November and March.
- **Snowfall:** On average, Pitt Meadows receives about 340 mm (13.4 inches) of snow annually, typically between November and April.

Sunshine and Daylight

- **Sunshine:** The city experiences varying sunshine hours, with longer days in summer and shorter days in winter.
- **Daylight:** Daylight hours range from about 8 hours in December to over 16 hours in June.

Humidity and Wind

- **Humidity:** The region maintains moderate to high humidity levels year-round due to its maritime influence.
- **Wind:** Prevailing winds are generally light to moderate, with occasional stronger gusts during storm events.

Recent Extreme Weather Events

In recent years, Pitt Meadows has experienced several extreme weather events attributed to climate change:

- **Heatwaves:** In June 2021, a record-breaking heat dome affected the Pacific Northwest, with temperatures in nearby areas reaching unprecedented levels.
- **Atmospheric Rivers:** In November 2021 and again in 2024, atmospheric river events led to significant rainfall, causing widespread flooding in British Columbia, including Pitt Meadows.

Impact of Climate Change on Historical Norms

Climate change has altered historical weather patterns in Pitt Meadows:

- **Temperature:** There is a noticeable increase in average temperatures, leading to milder winters and hotter summers.
- **Precipitation:** Changes in precipitation patterns have resulted in more intense rainfall events and altered snowfall amounts.
- **Extreme Events:** The frequency and severity of extreme weather events, such as heatwaves and heavy rainfall, have increased.
- **Drought:** Increasingly frequent and severe drought cycles place increasing pressure on water supplies for agricultural uses, many of which require large amounts of water for various operations.

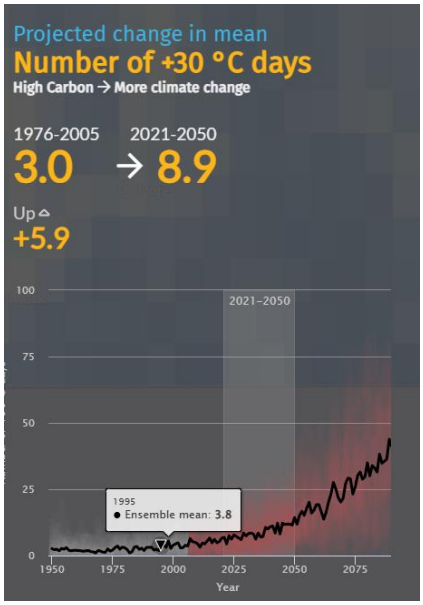

Figure 3: The increasing temperatures will cause extreme heat days to triple[4].

The City of Pitt Meadows is developing a Climate Action Strategy focusing on adaptation and mitigation to build a resilient and sustainable future[5].

Understanding these climatic trends is crucial for residents, policymakers, and businesses to prepare for and adapt to the evolving climate conditions in Pitt Meadows.

[4] https://climateatlas.ca/map/canada/plus30_2030_85#city=486&z=9&lat=49.23&lng=-122.65
[5] Climate Action | City of Pitt Meadows

4.0 Vulnerability

To fully understand how a hazard might impact a community, it is essential to consider the degree of vulnerability to the hazard. While a community's location within a hazardous zone is a primary determinant of risk, vulnerability defines the susceptibility of its people, property, industries, resources, and environment to harm when a hazard event occurs. This susceptibility can significantly influence the severity of impacts, regardless of the hazard's magnitude.

The **UN Office for Disaster Risk Reduction (UNDRR)** defines vulnerability as:
"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." (UNDRR, 2017)

Similarly, the **Government of British Columbia** defines vulnerability as:
"People, property, infrastructure, industry, and resources, or environments that are particularly exposed to adverse impact from a hazard event." (EMBC, 2004, p. 12)

To analyze the complex interplay of factors contributing to vulnerability, this report organizes vulnerabilities into four primary categories:

1. Social Vulnerabilities

Social vulnerabilities refer to community characteristics that affect individuals or groups' ability to prepare for, respond to, and recover from hazard events. Examples include:

- **Age**: Seniors and young children are often more susceptible to harm due to mobility challenges, health conditions, or reliance on caregivers.
- **Language**: Limited proficiency in the primary language spoken in the region can hinder access to emergency information or services.
- **Income Levels**: Low-income households may face more significant challenges in accessing resources such as transportation, housing, or insurance that enhance resilience.

2. Economic Vulnerabilities

Economic vulnerabilities stem from dependencies on industries, resources, or employment sectors that hazards may directly impact. Key considerations include:

- **Economic Dependencies**: Communities reliant on a single industry, such as agriculture or manufacturing, are particularly vulnerable to disruptions caused by hazards.
- **Business Continuity**: Small businesses may lack the resources to recover from physical damage, supply chain disruptions, or loss of customer base.
- **Insurance Coverage**: Low property or business insurance levels increase financial vulnerabilities during recovery.

3. Environmental Vulnerabilities

Environmental vulnerabilities are tied to the community's reliance on and interaction with its natural surroundings. These vulnerabilities include:

- **Sensitive Natural Areas**: Hazards like flooding, wildfires, or storms can disproportionately impact ecologically fragile areas, leading to secondary effects like habitat destruction or biodiversity loss.
- **Resource Dependency**: Communities that depend on natural resources like water, fisheries, or forests are more vulnerable to hazards that threaten these resources.
- **Environmental Degradation**: Pre-existing issues like soil erosion or deforestation can amplify the severity of hazard impacts.

4. Physical Vulnerabilities

Physical vulnerabilities focus on infrastructure, built environments, and assets within the community that may be at risk. Examples include:

- **Critical Infrastructure**: Disruption to systems such as power, water, transportation, and communication can severely hinder a community's response and recovery efforts.
- **Locally Owned Assets**: Damage to key assets like schools, healthcare facilities, or housing can have widespread social and economic repercussions.
- **Urban Development**: Poorly planned development in hazard-prone areas, such as floodplains or unstable slopes, increases physical vulnerability.

Prioritizing Risks through Vulnerability Assessment

By understanding and evaluating these vulnerabilities, communities can gain a clearer picture of where they are most susceptible to the impacts of hazards. This knowledge enables informed decision-making to prioritize risks, direct resources effectively, and develop targeted mitigation strategies that address the most pressing vulnerabilities.

Assessing vulnerabilities identifies weaknesses and highlights opportunities for enhancing resilience, ensuring communities are better prepared to withstand and recover from future hazard events.

4.1 Social Vulnerability

The occurrence of similar hazard events in different communities often reveals significant variations in consequences due to differing levels of **social vulnerability**. Social vulnerability refers to a population's limited capacity to withstand and recover from the adverse impacts of a hazard event. These disparities in vulnerability typically arise from a combination of economic, social, and political factors that create and perpetuate inequalities. As Cutter et al. (2003) explain, social vulnerability is a dynamic condition constantly being shaped, reinforced, or diminished by broader social, economic, and political processes.

In Canada, the inequitable distribution of social, cultural, and economic resources creates distinct social groups that are more susceptible to the impacts of hazards and in greater need of

coping assistance. Vulnerable populations are often defined as those with heightened risk exposure due to systemic barriers, limited access to resources, and reduced capacity to respond and recover from hazard events (Wisner et al., 2004). Such groups include, but are not limited to, seniors, low-income individuals, people experiencing homelessness, Indigenous communities, and persons with disabilities.

4.1.1 Social Vulnerability and Barriers to Resilience

Social vulnerability often amplifies the adverse effects of hazards, as vulnerable populations typically face physical, social, and structural barriers to accessing essential services and support. The following challenges, identified through workshops and census data analysis, highlight some of the critical obstacles encountered by specific populations:

- **Elderly populations**: Aging individuals may experience limited mobility, reliance on caregivers, and health issues, reducing their ability to evacuate or adapt to hazard impacts (EMBC, 2021). The Canadian Institute for Health Information (2011) notes that seniors often face unique vulnerabilities, including isolation, making them disproportionately affected during disasters.
- **Low-income individuals and families**: Financial insecurity reduces access to adequate housing, transportation, insurance, and emergency supplies, leaving low-income households less prepared for hazardous events. Economic inequality also affects recovery, as low-income individuals may lack the resources needed to rebuild or relocate (Mikkonen & Raphael, 2010).
- **People experiencing homelessness**: This group is particularly at risk during hazardous events due to their lack of shelter, inadequate access to healthcare, and limited social networks for support. Their vulnerability is compounded by systemic issues, such as stigmatization and exclusion from disaster response planning (Gaetz et al., 2016).
- **Indigenous communities**: Indigenous populations in Canada often face systemic barriers, including inadequate infrastructure, underfunded services, and geographic isolation. These factors increase their vulnerability to hazards, particularly in remote and rural areas, where emergency response resources may be limited (Truth and Reconciliation Commission of Canada, 2015).
- **Persons with disabilities**: People with disabilities may face challenges related to mobility, communication, and access to information, which can hinder their ability to respond effectively to hazardous events (Government of Canada, 2019).

4.1.2 Dynamic Nature of Vulnerability

Social vulnerability is not static; it is influenced by broader socioeconomic and political contexts that continually shape a community's resilience or susceptibility to hazards. For instance, changes in housing affordability, service accessibility, or demographic shifts can mitigate or exacerbate vulnerability levels. Cutter et al. (2008) emphasize that reducing vulnerability

requires addressing the root causes of inequality and improving the adaptive capacity of at-risk populations.

4.1.3 Identifying Vulnerable Populations in the Region

Through workshops, stakeholder engagement, and analysis of census data, the following vulnerable populations were identified within the region:

1. **Seniors and aging populations**: A growing demographic in the region with distinct health, mobility, and isolation challenges.
2. **Low-income households**: Concentrated in areas with limited access to affordable housing and essential services.
3. **People experiencing homelessness**: A small population particularly at risk due to their reliance on public spaces and shelters, both of which are vulnerable during disasters. Pitt Meadows has limited support services with the larger unhoused populations in Maple Ridge.
4. **Indigenous communities**: Especially in areas where systemic inequities and geographical remoteness compound vulnerability.
5. **Children and youth** may lack the agency or resources to navigate hazardous events effectively.
6. **Persons with disabilities**: Requiring tailored emergency services and communication strategies.

4.1.4 Pathways to Reducing Social Vulnerability

Addressing social vulnerability requires a multi-pronged approach that targets the underlying drivers of inequity. Reducing social vulnerability involves:

- **Improving access to services**: Ensuring vulnerable populations have equitable access to healthcare, housing, and social services.
- **Community engagement**: Incorporating the voices of at-risk populations into emergency planning processes to identify their unique needs.
- **Building resilience**: Investing in community-level resilience programs that reduce dependency on external support and strengthen local capacity to respond and recover.
- **Enhancing social equity**: Addressing systemic inequalities contributing to economic and social vulnerability, such as income inequality and housing insecurity.

Incorporating these considerations into hazard and risk assessments will enable more effective planning, resource allocation, and mitigation strategies, ultimately reducing the adverse impacts of hazard events on the community's most vulnerable members.

4.1.3 Seniors:

The region has a notably high and growing proportion of elderly residents, with 18.2% of the Pitt Meadows population aged 65 or older in 2021, up from 15.7% in 2016. This trend reflects the aging of the baby boomer generation and signals a continuing increase in the senior population in the coming years. This demographic shift is expected to have profound implications for the City's housing, healthcare, support services, and employment.

Seniors are particularly vulnerable to the health impacts associated with natural hazards. For instance, extreme heat events can result in serious illness and even death among older adults (Health Canada, 2011). Physiological factors such as reduced thirst sensation, lower fitness levels, and diminished sweating ability make seniors more prone to dehydration and overheating. Compounding these risks, many older adults face additional challenges such as social isolation, visual, cognitive, or hearing impairments, and limited mobility or agility, all of which heighten their vulnerability during extreme weather events or emergencies (Health Canada, 2011).

In addition to direct health impacts, seniors are disproportionately affected by service disruptions often caused by hazard events, such as windstorms or power outages. Many older adults rely on caregivers, medications, and healthcare services, making interruptions to these supports particularly detrimental. For instance, a prolonged power outage could disrupt refrigeration for temperature-sensitive medications or prevent access to medical equipment like oxygen generators and intravenous pumps. Similarly, challenges in communication and mobility may further isolate seniors during emergencies, delaying their ability to receive assistance or evacuate to safety. Many seniors do not subscribe to social media and may not have access to smartphones or computers, making communications challenging.

This growing demographic presents a significant challenge for emergency management and community planning. Proactive measures are needed to enhance the resilience of senior populations. These include ensuring adequate cooling centers during heat waves, prioritizing seniors in emergency preparedness outreach, and bolstering healthcare and caregiver networks to mitigate the impacts of service disruptions. Addressing these vulnerabilities is critical to reducing risk and improving outcomes for older adults in hazard-prone regions.

4.1.4 Children:

Like the broader region, Pitt Meadows has a relatively low percentage of children and youth, with 14.3% of the population aged 14 years or younger in 2021, compared to the provincial average of 14.9% (Statistics Canada, 2021). While this proportion is not exceptionally high, children remain a critically vulnerable demographic in hazard scenarios due to their dependency on caregivers for access to resources, decision-making, mobility, and emotional support (Sharma, 2016).

Young children are particularly susceptible to the psychological and physical impacts of hazards. Physically, they are more vulnerable to injury, illness, and environmental exposures due to their smaller body size, developing immune systems, and greater respiratory rate relative to body weight. Psychologically, children may experience heightened stress, fear, or trauma

during and after a disaster, especially if they are separated from their parents or guardians. The emotional toll of hazardous events can be long-lasting, particularly for children who experience disruptions to their routines, education, and sense of security.

In Pitt Meadows, the close-knit community and smaller population size offer opportunities to tailor emergency planning and response to the specific needs of children. For instance, schools and childcare centers can play a pivotal role in ensuring the safety of children during emergencies. Collaboration with these institutions to develop evacuation plans, conduct drills, and maintain communication channels with parents is essential. Furthermore, the City's proximity to the natural hazards prevalent in the Lower Mainland, such as flooding or extreme weather events, underscores the importance of integrating child-focused emergency preparedness into broader municipal plans. The large number of parents who work outside of the community means that many school-age children may be particularly vulnerable to sudden onset emergency events, with parents stranded outside of the City. Plans should consider this reality.

Efforts to reduce the vulnerability of children in Pitt Meadows could include creating child-friendly spaces at emergency shelters, prioritizing the reunification of children with their caregivers during disasters, and providing age-appropriate education on emergency preparedness. These measures can enhance resilience and ensure children are not overlooked in emergency response and recovery efforts.

4.1.5 Single Parent Households

Household structure is a significant determinant of social vulnerability, influencing a community's ability to prepare for, respond to, and recover from hazard events (RAND, 2011). In Pitt Meadows, 10.4% of households were headed by a lone parent in 2021, slightly lower than the provincial average of 11.4% (Statistics Canada, 2021). Among these, the majority are led by single mothers, reflecting broader national trends. These households often face unique challenges that heighten their vulnerability to disasters and emergencies.

Single parents, particularly single mothers, are likelier to work in precarious jobs, often characterized by low wages, limited benefits, and irregular hours (Mitchell & Murray, 2017). Balancing employment with childcare responsibilities can further constrain their capacity to accumulate savings or access resources necessary for disaster preparedness. Lower income levels, reduced entitlement to health benefits, and limited social networks exacerbate these challenges, leaving these households with fewer options to cope during and after a hazard event.

The intersection of gender, socioeconomic status, and household structure also plays a critical role in vulnerability. Single mothers are disproportionately impacted by systemic inequities, including lower wages compared to their male counterparts and limited access to resources due to issues of power and privilege (Donner & Rodríguez, 2011). These factors can significantly impede their ability to evacuate, access emergency services, or recover from disasters.

In Pitt Meadows, efforts to support single-parent households should include targeted interventions to enhance their resilience. For example, subsidized childcare, accessible

transportation, and affordable housing can alleviate some of the pressures single parents face, enabling them to better prepare for and respond to emergencies. Community-based programs that strengthen social networks and provide education on disaster preparedness can also reduce isolation and increase adaptive capacity.

Given that Pitt Meadows is situated in a region prone to natural hazards such as flooding and extreme weather events, addressing the vulnerabilities of single-parent households is essential for fostering community resilience. Tailored strategies that recognize these households' unique needs and constraints can help mitigate the disproportionate impacts of disasters on this population.

4.1.6 Indigenous Peoples

FireWise could not interview the Katzie First Nation officials as part of this project. It would be inappropriate to infer or assume to speak for the Nation other than to provide broad information related to general realities on a provincial and national level. Approximately 4% or 780 persons identify as Indigenous in the StatsCan 2021 Pitt Meadows Census.

The impacts of colonial policies, such as residential schools and the Indian Act, have caused intergenerational trauma and persistent social inequities for Indigenous communities (Reading & Wien, 2009). For many First Nations, these systemic barriers manifest in lower income levels, inadequate housing, and limited access to essential services, including culturally appropriate healthcare and emergency support. These factors reduce the community's adaptive capacity and resilience to disasters, making hazard events more devastating in their immediate and long-term impacts.

For Indigenous communities, displacement and evacuation during hazardous events can be especially traumatic. For those with lived experiences of residential schools or whose families were directly impacted, forced relocation can trigger painful memories and compound existing mental health challenges. Indigenous communities often face resource inequalities during evacuations, including insufficient culturally sensitive services or appropriate accommodations, which exacerbate the stress of displacement (Indigenous Corporate Training Inc., 2018).

Addressing these vulnerabilities should include meaningful engagement with the Katzie First Nation to co-develop strategies that enhance community resilience. Investing in robust flood mitigation measures, such as levee improvements and riverbank stabilization, is critical to reducing exposure to flood hazards. Additionally, supporting economic development, improving housing conditions, and ensuring access to culturally appropriate mental health and social services are vital to long-term resilience. Recognizing and respecting Indigenous peoples' sovereignty, knowledge systems, and lived experiences is central to any effective disaster risk reduction strategy.

In the context of Pitt Meadows, fostering partnerships between the municipality and the Katzie First Nation is essential for addressing shared risks, particularly given the geographic interconnectedness and mutual reliance on regional resources. Collaborative approaches that prioritize Indigenous leadership and incorporate traditional ecological knowledge into

emergency management plans will enhance resilience for the Katzie First Nation and contribute to the region's overall preparedness.

4.1.7 Homelessness

In recent years, there has been significant growth in the homeless population within the Pitt Meadows and Maple Ridge region, reflecting a broader trend in Metro Vancouver. This increase in homelessness highlights systemic challenges in housing affordability, access to support services, and economic stability in the area. While point-in-time (PIT) counts provide a snapshot of homelessness, these figures often vastly underestimate the true scale of the issue. The Coalition of the Homeless has emphasized that PIT data typically excludes unsheltered individuals in non-visible locations, such as those staying in vehicles, couch surfing, or finding temporary shelter in isolated areas ("hidden homeless") (Weesjes, 2015).

Furthermore, research indicates that for every person experiencing homelessness in Canada, 23 additional households are vulnerably housed and at significant risk of becoming homeless (Hwang, 2018). In the Pitt Meadows and Maple Ridge area, high rental costs, limited affordable housing stock, and low vacancy rates exacerbate housing insecurity, making it increasingly difficult for vulnerable populations to find stable accommodations. For instance, the Maple Ridge-Pitt Meadows-Katzie Community Network has repeatedly flagged housing affordability as a critical issue in local social planning initiatives.

The lack of secure, adequate housing significantly undermines an individual's ability to endure and recover from hazardous events. Homeless individuals face heightened vulnerability to weather-related hazards, such as extreme heat, severe cold, and flooding, due to their increased exposure and limited access to climate-controlled spaces. In 2021, for example, the extreme heat dome that impacted British Columbia posed severe risks to unsheltered individuals, who had limited options to seek refuge in cooling centers or other safe spaces. Similarly, heavy rainfalls and flooding events in the Fraser Valley region create significant challenges for homeless populations living in makeshift shelters or encampments near the Fraser River and its tributaries.

Homeless populations often experience a "clustering of vulnerability factors" (Settembrino, 2015), which can amplify their susceptibility to the adverse impacts of hazards. Barriers such as high rents, low income, substance-use disorders, disabilities, mental health challenges, trauma, and systemic discrimination limit access to housing and resources. With higher rates of chronic health conditions, including respiratory and cardiovascular issues, many individuals experiencing homelessness are reliant on social and healthcare services that may be disrupted during hazard events. For example, disruptions to emergency shelters, food distribution programs, or medical services during a disaster can disproportionately impact this population.

Additionally, individuals experiencing homelessness may be less likely to evacuate or follow safety precautions during a hazard event due to distrust of authorities and lack of accessible information. This distrust is often rooted in negative past experiences with institutional settings such as hospitals, psychiatric facilities, jails, and, for some Indigenous individuals, residential schools. As a result, many are unwilling to enter emergency shelters or access resources provided by official disaster response agencies (Gin, 2018).

Addressing homelessness and its intersection with disaster vulnerability in Pitt Meadows and Maple Ridge requires a multi-pronged approach. This includes increasing affordable housing options, improving access to mental health and addiction services, and ensuring that emergency plans prioritize the needs of vulnerable populations. Efforts to enhance outreach and build trust with unsheltered individuals are also critical, particularly during disaster preparedness and response. Programs like the Ridge Meadows Ministries and Fraser Health's outreach initiatives are already working toward addressing these challenges but require sustained support and investment to make meaningful progress.

4.2 Economic Vulnerability

Economic resilience is a critical factor in a community's ability to recover from disasters (Public Safety Canada, 2019). Economic vulnerability, in turn, influences a community's capacity to withstand and rebound from hazard events. Communities dependent on a single industry are generally more susceptible to economic shocks than those with a diversified economic base (Conference Board of Canada, 2020). If a community heavily relies on a single major employer or industry, disruptions—such as damage to physical assets (e.g., property damage) or economic flows (e.g., disruptions to production and services)—can significantly impede recovery.

The destruction or impairment of business infrastructure, disruptions to essential services like utilities and transportation networks, and the loss of key suppliers can lead to business closures, resulting in widespread economic consequences. These closures often trigger job losses, increased foreclosures, declining property values, and a shrinking population. Additionally, reduced tax revenues and constrained municipal budgets can further hinder economic recovery and the restoration of public services.

4.2.1 Economic Sectors in Pitt Meadows

Pitt Meadows has a relatively diverse economic foundation that helps mitigate economic vulnerability. Key sectors driving the local economy include:

Agribusiness – Pitt Meadows is part of Fraser Valley's thriving agricultural sector, with extensive berry farms, greenhouses, dairy production, and poultry operations contributing to local and export markets. The Agricultural Land Reserve (ALR) is crucial in preserving farmland, supporting food security, and maintaining rural employment.

Transportation and Logistics – The City is a strategic hub with key roadways such as the Lougheed Highway and the Golden Ears Bridge facilitating regional trade. Pitt Meadows Airport (YPK) is a growing general aviation and commercial transport center. The proposed **CP Logistics Park** would significantly expand the area's role in national and international trade, enhancing freight transport capabilities while raising concerns about environmental and land-use impacts.

Retail Trade – Local businesses, shopping centers, and service industries contribute to employment and economic activity, particularly in the downtown core and along major corridors.

Accommodation and Food Services – The hospitality sector benefits from tourism, local agritourism initiatives, and proximity to regional attractions such as Golden Ears Provincial Park.

Implications for Economic Resilience

Including agribusiness, transportation, and logistics in the local economy provides resilience against disruptions. However, reliance on transportation infrastructure—particularly rail and highway networks—creates vulnerabilities in extreme weather events, supply chain disruptions, or transportation strikes. The proposed CP Logistics Park is expected to enhance economic opportunities but may also introduce new risks, including increased traffic congestion, environmental concerns, and potential displacement of agricultural land.

Ensuring economic resilience in Pitt Meadows will require strategic investments in infrastructure resilience, workforce training, and environmental sustainability. Strengthening local agribusiness networks, supporting transportation infrastructure improvements, and carefully managing the logistics sector's growth will be critical to maintaining long-term economic stability in the face of future challenges.

4.2.2 Economic Vulnerabilities of Pitt Meadows to International Threats

Pitt Meadows' economy is closely tied to regional, national, and international trade, making it particularly vulnerable to the recent threat of substantial U.S. tariffs. Given the city's strong agricultural, transportation, and logistics sectors, as well as its integration with Metro Vancouver's broader economy, shifts in trade policy—especially U.S. tariffs on Canadian goods—could pose significant economic risks.

1) Agricultural Exports and Trade Disruptions

Agriculture is a key economic driver in Pitt Meadows, with significant exports including berries (blueberries, cranberries, and raspberries), greenhouse vegetables, dairy, and poultry. The U.S. is a primary trading partner for Canadian agriculture, and any increase in tariffs on fresh produce, dairy, or processed food products could lead to:

- **Reduced Export Competitiveness** – Higher tariffs would make Pitt Meadows' agricultural products more expensive for U.S. consumers, reducing demand and potentially causing oversupply in domestic markets.
- **Revenue Loss for Farmers** – Increased costs may reduce profit margins for local farmers, who face rising input costs due to inflation, labour shortages, and climate change impacts.
- **Supply Chain Uncertainty** – Tariffs could disrupt established supply chains, affecting cold storage, transportation logistics, and cross-border distribution.

2) Transportation and Logistics Sector Risks

The CP Rail corridor, Pitt Meadows Regional Airport (YPK), and Highway 7 are key transportation and logistics hubs supporting domestic and international trade. A U.S. tariff increase on manufactured goods, forestry products, or agricultural exports could:

- **Reduce Freight Demand** – If Canadian exports decline due to U.S. tariffs, rail and truck shipments through Pitt Meadows could reduce volume, impacting CP Rail's operations and local trucking and logistics businesses.
- **Increase Operational Costs** – Tariffs on goods imported from the U.S. (e.g., farm equipment, fertilizers, or processed foods) could raise costs for local farmers, retailers, and businesses relying on U.S. imports.
- **Slowdown in Infrastructure Growth** – The proposed CP Logistics Park, which aims to expand freight handling capacity, could see delayed investment or reduced demand if cross-border trade weakens.

3) Consumer Goods and Retail Impacts

Pitt Meadows' retail and service sector relies on imports from the U.S., including food products, consumer electronics, and household goods. Tariffs on U.S. imports into Canada could lead to:

- **Prices Higher for Consumers** – Local businesses may pass increased import costs onto consumers, impacting grocery prices, construction materials, and everyday goods.
- **Reduced Retail Spending** – With higher prices and potential job losses in affected industries, consumer spending in local businesses could decline, affecting Pitt Meadows' retail sector.

4) Manufacturing and Small Business Challenges

While Pitt Meadows does not have a large industrial manufacturing base, small businesses and light manufacturing depend on cross-border trade for materials and supply chain stability. U.S. tariffs on Canadian steel, aluminum, or other raw materials could:

- **Increase Production Costs** – If local manufacturers and construction firms face higher material costs, project delays and reduced competitiveness could follow.
- **Create Business Uncertainty** – Smaller firms that rely on U.S. markets for exports may be hesitant to expand or hire workers due to unpredictable trade policies.

Mitigation Strategies and Economic Resilience Measures

To reduce economic vulnerability to U.S. tariff threats, Pitt Meadows can:

- **Diversify Export Markets** – Participate in efforts to strengthen trade relationships with Asia, Europe, and other international partners to reduce reliance on the U.S. market and explore broader Canadian sales opportunities.
- **Enhance Local Processing and Value-Added Agriculture** – Encourage local food processing, branding, and agri-tourism can help increase domestic sales and reduce reliance on exports.
- **Support Logistics Infrastructure Growth** – Expanding **transportation and storage capacity** (e.g., CP Logistics Park, air cargo at YPK) could help adapt to changing trade

routes.

- **Encourage Supply Chain Adaptation** – Businesses should explore alternative suppliers for critical imports, reducing exposure to U.S. trade disruptions.

- **Advocate for Federal Trade Policy Protections** – in collaboration with Metro Vancouver and the BC government, Pitt Meadows can work with Trade Commissioners and federal agencies to ensure local businesses' representation in trade negotiations and potential tariff mitigation measures.

4.3 Environmental Vulnerability

Pitt Meadows is home to diverse sensitive aquatic and terrestrial ecosystems, including expansive wetlands, riparian forests, riverine flats, estuarine vegetation, and critical shoreline habitats along the Fraser River. These ecosystems are ecologically significant and hold deep cultural, economic, and recreational value. They provide essential habitat for numerous species, including bald eagles, osprey, great blue herons, and several red- and blue-listed species, such as the western painted turtle and Pacific water shrew (Government of British Columbia, n.d.).

4.3.1 Ecosystem Services and Environmental Risks

Natural ecosystems in Pitt Meadows contribute significantly to human well-being by providing essential ecological services. These include:

Provisioning services – Supporting agriculture, aquaculture, and freshwater resources, which are crucial for the region's food production and economy.

Regulating services – Mitigating floods, improving water quality, and sequestering carbon, which is particularly important given the increasing risks of climate change.

Cultural services – Offering recreational, aesthetic, and spiritual benefits through nature reserves, parks, and trails. The Pitt River Greenway and nearby Golden Ears Provincial Park attract residents and visitors for hiking, birdwatching, and outdoor activities.

However, these ecosystems face growing pressures from human activity, climate change, and hazard events. Key environmental vulnerabilities in Pitt Meadows include:

4.3.2 Groundwater Contamination and Water Security

Some residents rely on groundwater as a water source for agricultural and other purposes. However, some regional aquifers are highly vulnerable to contamination from surface activities, including improper disposal of hazardous materials, agricultural runoff, and urban development. Hazard events such as hazardous material spills, drought, and saltwater intrusion pose significant risks to groundwater quality and availability.

4.3.3 Flooding and Wetland Degradation

The Pitt River, Alouette River, and Fraser River collectively shape the floodplain landscape of Pitt Meadows, making the region particularly susceptible to seasonal flooding and storm surges. Wetlands and riparian forests serve as natural buffers, absorbing excess floodwaters and reducing erosion. However, land development, dike infrastructure, and habitat loss have reduced these ecosystems' natural flood mitigation capacity. With climate change increasing the frequency of extreme weather events, the risk of flooding—and its impact on homes, businesses, and agriculture—continues to rise.

4.3.4 Biodiversity Loss and Habitat Fragmentation

Agricultural expansion, urbanization, and industrial development, including the proposed CP Logistics Park, can disrupt local ecosystems. Large-scale land alterations can fragment habitats, displace wildlife, and threaten species-at-risk populations. Preserving critical wildlife corridors and integrating green infrastructure into urban planning will be essential to maintaining regional biodiversity.

4.3.5 Climate Change and Extreme Weather Events

Pitt Meadows is experiencing the growing impacts of climate change, including prolonged droughts, extreme heat, and more intense storm events. The December 2021 atmospheric river event, which caused widespread flooding across the Fraser Valley, highlighted the region's vulnerability to extreme rainfall. Rising temperatures also threaten agriculture, with heatwaves and shifting precipitation patterns affecting crop yields and livestock health.

4.3.6 The Role of the Natural Environment in Hazard Mitigation

While Pitt Meadows' natural ecosystems are highly vulnerable to human activity and climate-related hazards, they also provide crucial protective services that can mitigate disaster impacts. For example:

- Wetlands and floodplains act as natural sponges, reducing the severity of flood events. Restoring and maintaining these ecosystems can help reduce flood damage to agricultural lands and residential areas.
- Riparian buffers along the Fraser and Pitt Rivers stabilize shorelines, prevent erosion, and filter pollutants from runoff, safeguarding water quality.
- Forested areas help regulate local temperatures, sequester carbon, and provide windbreaks against extreme weather.

4.3.7 Balancing Economic Development and Environmental Protection

Pitt Meadows' natural resources have long supported local economic activities, including agriculture, fishing, and ecotourism. However, balancing economic growth—such as the expansion of transportation and logistics infrastructure—with environmental sustainability remains a critical challenge. For example, the proposed CP Logistics Park has raised concerns about potential environmental degradation, increased flood risk, and loss of agricultural land. Ensuring that development projects undergo rigorous ecological assessments and incorporate climate resilience strategies will be essential for the region's long-term sustainability.

By prioritizing habitat conservation, responsible land use planning, and climate adaptation measures, Pitt Meadows can protect its invaluable natural assets while enhancing its resilience to environmental hazards. Investing in green infrastructure, sustainable agriculture, and floodplain restoration will safeguard the region's biodiversity and strengthen its ability to withstand future environmental challenges.

4.4 Physical Vulnerability

Physical vulnerability refers to how damage to the built environment affects a community's ability to withstand and recover from hazard events. The built environment includes essential buildings, facilities, and infrastructure—such as transportation networks, electrical grids, telecommunications, and water systems—that sustain economic activity and social well-being.

Critical Infrastructure in Canada and Pitt Meadows

Public Safety Canada defines critical infrastructure (CI) as "services essential to the health, safety, security, or economic well-being of Canadians and the effective functioning of government" (Public Safety Canada, 2019). Canada's ten critical infrastructure sectors include:

- **Health**
- **Food**
- **Finance**
- **Water**
- **Information and Communication Technology**
- **Safety**
- **Energy and Utilities**
- **Manufacturing**
- **Government**
- **Transportation**

Pitt Meadows' infrastructure is part of a more extensive regional network connected to Metro Vancouver, which introduces interdependencies between municipal, provincial, and federal agencies and private stakeholders. This complexity makes it challenging to predict failures and their cascading effects across sectors. Disruptions to one system, such as a highway closure, can severely impact emergency response, supply chains, and the movement of goods and services.

4.4.1 Flooding and Dike Integrity

Pitt Meadows is on a floodplain, making it particularly vulnerable to flooding from the Fraser, Pitt, and Alouette rivers.

The City relies on an extensive network of dikes and pump stations, which require ongoing maintenance and upgrades to withstand extreme weather events and rising water levels due to climate change. Recent episodic rain events termed Atmospheric Rivers have created flash flooding events that have challenged existing infrastructure to protect critical areas of the City.

Failure of the dike system could lead to catastrophic flooding of residential areas, businesses, and farmland, causing long-term economic and environmental damage.

4.4.2 Transportation Infrastructure Risks

Pitt Meadows is a transportation hub with key infrastructure, such as Lougheed Highway (Highway 7), the Golden Ears Bridge, CP Rail lines, and Pitt Meadows Airport (YPK). Disruptions to these routes due to extreme weather, accidents, or infrastructure failures can create significant bottlenecks, affecting commuters, emergency response, and goods movement.

The proposed CP Logistics Park will increase freight traffic in the region, potentially straining local roadways and increasing the risk of transportation-related hazards, including derailments and hazardous material spills. Additional on-site dangerous materials storage facilities will see commodities spend more time and be handled more frequently in Pitt Meadows, where they currently pass through the community to their destination.

Pitt Meadows, located in the Metro Vancouver region of British Columbia, is well-connected through various transportation corridors that support the movement of people, goods, and services. Its transportation network includes highways, railways, waterways, and airways, each playing a crucial role in the City's infrastructure and economy. However, these transportation systems also pose certain risks and threats.

1. Highway and Road Transportation

- **Key Corridors**:
    - **Lougheed Highway (Highway 7)**: The primary east-west route through Pitt Meadows, connecting the City to Maple Ridge to the east and Coquitlam and Vancouver to the west
    - **Golden Ears Bridge Access Routes**: Connects Pitt Meadows to Surrey and Langley across the Fraser River via the Golden Ears Bridge.
    - **Harris Road**: A major north-south arterial road within the City
- **Transportation Modes**:
    - Personal vehicles dominate commuter traffic.
    - Public transit, provided by TransLink, includes buses connecting Pitt Meadows to neighbouring municipalities and SkyTrain services.

2. Rail Transportation

- **Canadian Pacific Railway (CPR)**:
    - A critical freight corridor passes through Pitt Meadows, moving goods such as lumber, grain, and fuel to and from Vancouver's port. The rail bisects the town

centre of Pitt Meadows, impeding critical traffic, including fire, police and ambulance, from accessing the northern sections of the City.

- The West Coast Express, a commuter rail service, also uses this corridor, providing transit to Vancouver and Mission.

3. Air Transportation

- **Pitt Meadows Regional Airport (YPK)**:
  - A general aviation airport serving the region, providing services such as flight training, charter flights, and private aviation
  - Supports emergency services and acts as a base for agricultural and forestry operations.

4. Waterways

- **Fraser River**:
  - The Fraser River borders Pitt Meadows to the south and supports commercial shipping, recreational boating, and fishing.
  - The river also serves as a floodplain, requiring active dike management and flood protection measures.

5. Bicycle and Pedestrian Pathways

- **Pathways**:
  - Pitt Meadows is part of the Metro Vancouver Regional Greenway network, with multi-use trails and bike lanes providing safe routes for cyclists and pedestrians.

6. Public Transit

- **Services**:
  - Bus services connect Pitt Meadows to nearby communities and SkyTrain stations.
  - The West Coast Express provides a commuter rail link to downtown Vancouver.

Key Risks and Threats to Transportation in Pitt Meadows

1. **Flooding and Climate Change**:
   - The City's location in a floodplain makes many transportation corridors vulnerable to flooding, especially during extreme rainfall or Fraser River flooding.
2. **Population Growth and Congestion**:
   - Increased traffic from regional development leads to congestion, particularly along the Lougheed Highway and at railway crossings.

3. **Rail and Hazardous Materials**:
    - The presence of freight trains carrying hazardous goods presents spill and fire risks.
4. **Infrastructure Vulnerabilities**:
    - Aging infrastructure, including dikes and bridges, requires ongoing upgrades to remain resilient to natural and human-made threats.

Pitt Meadows' transportation network is vital to its economy and connectivity, offering various modes for residents and businesses. However, it faces challenges related to climate change, infrastructure limitations, and increasing traffic demands. Addressing these risks through sustainable planning, investments in infrastructure, and collaboration with regional stakeholders will be critical for ensuring the safety and efficiency of Pitt Meadows' transportation system.

4.4.3 Energy and Utilities Disruptions

The region depends on electrical power supplied by BC Hydro, which is vulnerable to extreme weather events such as windstorms, heat waves, and heavy snowfall.

In December 2018, a powerful windstorm caused widespread outages across the Lower Mainland, demonstrating the vulnerability of power infrastructure to natural hazards. Prolonged outages can disrupt water supply systems, communication networks, and emergency response services.

Seismic events or pipeline failures could impact natural gas infrastructure for heating and industrial processes.

4.4.4 Seismic Vulnerability

Although Pitt Meadows is not directly on a major fault line, the region remains at risk from earthquakes due to its proximity to the Cascadia Subduction Zone.

A significant earthquake could damage bridges, roads, pipelines, and buildings, affecting critical services and emergency response capabilities.

Older structures, including some homes and commercial buildings, may not meet modern seismic standards, increasing the risk of structural failure.

4.4.5 Climate Change and Extreme Weather Events

Pitt Meadows is experiencing more frequent and severe heatwaves, wildfires, and atmospheric river events.

The 2021 atmospheric river event caused unprecedented flooding and landslides throughout the Fraser Valley, cutting off transportation routes and impacting supply chains. Similar events could directly impact Pitt Meadows by damaging roads, bridges, and farmland.

While not common in Pitt Meadows, wildfires pose a secondary risk due to smoke-related air quality issues affecting health and visibility, particularly for vulnerable populations.

4.4.6 Enhancing Infrastructure Resilience

Proactively investing in resilient infrastructure and emergency planning is crucial to mitigate physical vulnerabilities. Key strategies include:

Dike upgrades and flood mitigation measures – Strengthening dike infrastructure, improving drainage systems, and investing in natural flood defences like wetlands to absorb excess water.

Transportation resilience planning – Enhancing road networks, improving traffic management systems, and ensuring alternate emergency routes are available.

Seismic retrofits – Encouraging building upgrades to meet modern seismic codes and reinforcing critical infrastructure.

Energy security initiatives – Expanding backup power systems, increasing grid resilience, and promoting decentralized energy solutions (e.g., solar, battery storage).

Climate adaptation policies – Incorporating climate projections into urban planning, upgrading stormwater management systems, and developing emergency response protocols for extreme weather events.

The continued functionality of critical infrastructure during and after a hazard event is a key determinant of a community's ability to recover quickly. Pitt Meadows' ability to withstand future physical threats will depend on proactive investment in resilient infrastructure and coordinated disaster preparedness efforts at all levels of government.

4.4.7 Interruptions to Critical Infrastructure as Hazard Events

While disruptions to critical infrastructure are often secondary impacts of natural hazards, failures within these systems can also be hazard events in their own right, independent of external environmental triggers. For example, an electrical power outage may result from a severe windstorm or vandalism. Still, it can also occur due to aging equipment, system overload, or cyberattacks, leading to cascading effects across other essential services (Public Safety Canada, 2019).

To assess the risks posed by critical infrastructure failures, a comprehensive hazard assessment for Pitt Meadows includes ten distinct hazard events related explicitly to infrastructure disruptions (see Table 4). These hazards reflect regional vulnerabilities and potential emergency scenarios affecting key infrastructure sectors.

Table 4: Hazards related to critical infrastructure failure

Critical Infrastructure Category	Hazard
Health	Health service interruption
Food	Food supply chain interruption

Water	Potable water supply interruption, Wastewater system failure, Loss of agricultural water sources, Loss of regional system connections
Information and Communications Technology	Communications network interruption, Data system compromise, loss of regional system connections
Energy and Utilities	Electrical power outage, Natural gas interruption
Transportation	Aircraft incident Marine vessel incident Motor vehicle incident Rail incident

Among these hazards, Electrical Power Outages, Rail Incidents, and Motor Vehicle Incidents are considered top hazards for the region due to their high probability and potential for widespread disruption.

Key Critical Infrastructure Risks in Pitt Meadows

1) Electrical Power Outage

- **Cause**: Power outages in Pitt Meadows can result from windstorms, equipment failure, cyberattacks, or infrastructure damage. The December 2018 windstorm, for instance, caused massive outages across the Lower Mainland, affecting thousands of residents.
- **Impacts**: Extended outages can disrupt heating, water distribution (due to pump failures), communications, and emergency response services. For businesses, prolonged power loss can lead to significant economic losses, particularly for agriculture and logistics operations.
- **Mitigation**: BC Hydro continues to invest in grid resilience, but backup power solutions, localized microgrids, and alternative energy sources (e.g., solar, battery storage) could enhance local resilience.

2) Water System Failures

- **Cause**: Pitt Meadows relies on Metro Vancouver's regional water system for potable water. Contamination risks include industrial spills, agricultural runoff, and infrastructure failure.
- **Impacts**: Loss of potable water could lead to severe public health issues, particularly for vulnerable populations. Wastewater system failures could also cause environmental contamination, impacting the Fraser River and surrounding ecosystems.
- **Mitigation**: While the system is regional, ongoing investments in local distribution networks to ensure their resilience, emergency water supply plans, and groundwater protection are essential for long-term resilience.

3) Waste Water System Failure

- **Cause:** Pitt Meadows relies on Metro Vancouver's regional waste management systems. Municipal collection infrastructure connects to regionally operated collection and treatment facilities. These are vulnerable to damage from industrial or agricultural contamination, seismic damage, and surges from storm events.
- **Impacts:** Loss of the wastewater system could impact human and animal health, cause contamination of the Fraser River and surrounding ecosystems, and result in expensive repairs and remediation costs. Repeated failures can result in regulatory and reputational damage.
- **Mitigation:** Ongoing infrastructure investments to update and improve the system's resilience. Regional and local emergency management processes to ensure an integrated approach to response. Environmental and climate adaptation strategies linked to effective community and stakeholder engagement.

4) Transportation Infrastructure Disruptions

- **Cause**: Pitt Meadows is a key transportation corridor, with Lougheed Highway (Highway 7), the Golden Ears Bridge, CP Rail, and Pitt Meadows Airport (YPK) playing critical roles. Vehicle collisions, rail accidents, or bridge failures could disrupt regional transportation.
- **Impacts**:
    - A rail incident involving the CP Rail line could have catastrophic consequences, especially with hazardous materials transported through the area, blocked emergency response and access routes through the City, and closure of Highway 7.
    - A motor vehicle incident on Highway 7 or the Golden Ears Bridge could cut off emergency response access and disrupt commuter traffic.
    - The proposed CP Logistics Park may increase freight traffic, raising the risk of transportation-related accidents.
    - Collapse of local drainage infrastructure under municipal roadways could disrupt local traffic.
- **Mitigation**: Strengthening transportation safety protocols, emergency response coordination, and infrastructure investments (e.g., bridge retrofits and intelligent traffic systems) can help reduce these risks.

4) Communications Network Failures

- **Cause**: The increasing reliance on digital infrastructure makes Pitt Meadows vulnerable to cyberattacks, system failures, and extreme weather events that damage telecommunications networks.
- **Impacts**: A major communications failure could affect 911 and dispatch services, emergency alerts, business operations, and public safety coordination.

- **Mitigation**: Enhancing redundant network systems, cyber resilience measures, and emergency backup communication plans is critical.

Enhancing Resilience Against Infrastructure Failures

While it is difficult to predict and prevent all infrastructure failures, Pitt Meadows can strengthen its resilience through:

- **Emergency Preparedness and Redundancy** – Investing in power, water, and communications backup systems to ensure essential services remain operational during outages.
- **Critical Infrastructure Modernization** – Upgrading aging infrastructure, particularly dikes, power lines, and transportation routes, to withstand extreme weather events and seismic activity.
- **Climate Adaptation Measures** – Integrating flood protection, stormwater management, and wildfire resilience into infrastructure planning.
- **Public-Private Collaboration** – Engaging government agencies, private sector stakeholders (e.g., CP Rail, BC Hydro), and local businesses to develop coordinated response strategies.
- **Cybersecurity Enhancements** – Strengthening digital infrastructure protections to guard against cyber threats that could disrupt key systems.

The continued reliability of critical infrastructure is essential for economic stability, public health, and emergency response. By taking a proactive approach, Pitt Meadows can reduce the risks of infrastructure failures while improving its ability to recover quickly from disruptions.

4.4.8 Assessing Hazard-Specific Impacts on Critical Infrastructure

Understanding the impacts of hazard events on critical infrastructure is essential for disaster preparedness and risk mitigation in Pitt Meadows. FireWise used the Consequence Rating Scale (see Tables 2 and 3) to evaluate these impacts as part of the hazard assessment process. Critical Infrastructure is one of five consequence categories under Physical and Economic Impacts, and this scale measures both the severity of disruptions to essential services and the proportion of the population affected.

In Pitt Meadows, where key infrastructure includes dike systems, transportation networks, energy grids, and water systems, the impact of hazards varies significantly depending on the type and scale of the event. For example:

- **A Fraser River flood event** could overwhelm dikes and disrupt water, transportation, and energy infrastructure, impacting thousands of residents and businesses, particularly in low-lying agricultural areas.

- **A significant power outage**, such as one caused by an extreme windstorm or equipment failure, could halt business operations, disrupt emergency services, and affect farm irrigation and refrigeration systems, posing a risk to food security and economic stability.

- **A rail incident involving hazardous materials** could contaminate water sources, disrupt commuter and freight transportation, and require mass evacuations, particularly given the region's proximity to CP Rail's proposed CP Logistics Park.

The **"Critical Infrastructure" consequence score** assigned to each hazard in the All Scores Table provides a standardized measure of risk, allowing decision-makers to prioritize mitigation strategies, emergency response planning, and infrastructure resilience investments. This assessment is particularly crucial as Pitt Meadows continues to grow, with increasing demands on transportation, utilities, and emergency services. By integrating hazard-specific infrastructure assessments into municipal planning and climate adaptation strategies, the city can enhance its ability to withstand and recover from disruptions, ensuring long-term sustainability and public safety.

4.4.9 Identification of Locally Owned Critical Assets and Infrastructure in Pitt Meadows

Though a relatively small municipality within Metro Vancouver, Pitt Meadows is home to key locally owned critical infrastructure essential for public safety, economic stability, and emergency response. While the city spans approximately 86 square kilometres and serves over 20,000 residents (City of Pitt Meadows, 2023), its infrastructure is closely integrated with regional and provincial networks, creating interdependencies that influence disaster resilience and recovery efforts.

Locally Owned Critical Infrastructure in Pitt Meadows

The City of Pitt Meadows owns and operates various critical assets fundamental to the community's sustainability and viability. These include:

- **Dike and Flood Protection Systems** – A network of dikes, pump stations, and stormwater management systems protects residents, businesses, and agricultural lands from Fraser River and Pitt River flooding. The city is responsible for maintaining and upgrading these structures to meet modern flood protection standards in response to climate change and rising water levels (Metro Vancouver, 2021).
- **Municipal Water Supply and Wastewater Systems** – While Pitt Meadows sources potable water from Metro Vancouver's regional water supply, the city operates local distribution infrastructure and stormwater systems. Maintaining water security and wastewater management is crucial, particularly during extreme weather events, drought conditions, or infrastructure failures.
- **Transportation Infrastructure** – The City of Pitt Meadows is responsible for local road networks, bridges, and transit infrastructure, including municipal road maintenance and traffic management. Lougheed Highway (Highway 7) and the Golden Ears Bridge are provincially managed but are crucial transit corridors that impact local mobility and emergency response.
- **Public Safety and Emergency Services** – The Pitt Meadows Fire & Rescue Service provides fire suppression, rescue operations, and emergency medical response. A regional service provider provides fire dispatch services. The city collaborates with the

RCMP Ridge Meadows Detachment for policing services and BC Ambulance Service for emergency medical care.

- **Pitt Meadows Regional Airport (YPK)** – While operated by the Pitt Meadows Airport Society, YPK is a critical regional transportation and emergency response hub. The airport plays a role in disaster response, medical evacuations, and supply chain logistics.

Assessing Risks to Local Critical Infrastructure

Understanding which local infrastructure components are exposed to hazards is essential to evaluating the potential impact of disasters on Pitt Meadows. The city participates in regional emergency management planning through Emergency Management BC (EMBC) and Metro Vancouver, using tools such as the Critical Infrastructure Assessment Tool developed by EMBC, Defence Research and Development Canada, and the Justice Institute of BC.

However, challenges exist in assessing interdependencies with externally controlled infrastructure, such as:

- **CP Rail and the Proposed CP Logistics Park** – This project could increase industrial activity and freight movement risks, potentially straining local and regional transportation infrastructure and emergency response capacity.
- **BC Hydro's Electrical Grid** – Pitt Meadows depends on BC Hydro for power, making it vulnerable to grid failures, extreme weather disruptions, and cyber threats.
- **Metro Vancouver's Water Supply** – While Pitt Meadows manages local distribution, the city relies on Metro Vancouver's regional reservoirs, pipelines, and treatment plants, which could be impacted by seismic activity or contamination incidents.

This project did not include a public or external stakeholder engagement element. Strengthening public-private partnerships and regional collaboration will enhance Pitt Meadows' resilience to hazard events.

By integrating locally owned infrastructure assessments into city planning, emergency response coordination, and climate adaptation initiatives, Pitt Meadows can enhance its ability to withstand and recover from critical infrastructure failures, ensuring continued safety and sustainability for its residents.

Key Terms and Critical Infrastructure Assessment in Pitt Meadows

The **Emergency Management BC (EMBC) Critical Infrastructure Assessment Tool** evaluates locally owned assets and services essential to **community safety, economic stability, and emergency response**. In Pitt Meadows, the tool helps identify key infrastructure, assets, and interdependencies to enhance disaster preparedness and resilience.

Key Definitions in Pitt Meadows' Critical Infrastructure Assessment

- **Asset** – A resource under local government control, including fire engines, emergency vehicles, municipal buildings, trained staff, and public works equipment. Intangible

assets like emergency communication networks (e.g., radio systems and SCADA software for water infrastructure monitoring) also fall into this category.

- **Goods & Services** – Essential resources and services provided by local government, such as drinking water, policing, fire and rescue services, and waste management.
- **Dependency** – A service that cannot be provided without a specific asset. For example, Pitt Meadows Fire & Rescue depends on fire stations, emergency vehicles, and communications infrastructure to operate effectively.

The tool classifies relationships between services and assets as “Critical” or “Important”:

- **Critical Dependencies** – Services that must have a specific asset with no viable alternative (e.g., drinking water supply is critically dependent on Metro Vancouver’s reservoirs and distribution network).
- **Important Dependencies** – Services that rely on a specific asset, but alternatives exist (e.g., solid waste management may have alternative disposal or transfer facilities if a primary site is unavailable).

During the assessment of Pitt Meadows, more “Important” dependencies were identified than “Critical” dependencies, indicating built-in redundancy and greater resilience in some municipal services. However, the assessment highlighted areas where infrastructure weaknesses could pose significant risks, particularly in flood protection, emergency response, and water security.

Locally Owned Critical Infrastructure in Pitt Meadows

Based on the EMBC Critical Infrastructure Assessment Tool, the following locally-owned assets were classified as critical infrastructure for Pitt Meadows:

- **Fire Halls and Emergency Response Assets** – Essential for fire suppression, rescue operations, and disaster response, including Pitt Meadows Fire & Rescue Services and emergency vehicles.
- **Local Government and First Nation Offices** – The City of Pitt Meadows municipal buildings serve as operational centers during emergencies, ensuring continuity of governance and public services.
- **Communication Technology and Infrastructure** – Radio networks, municipal data systems, data backup sites, and SCADA (Supervisory Control and Data Acquisition) software are critical for managing emergency response, water infrastructure, and public safety operations.
- **Water and Wastewater Systems** – Pitt Meadows' local water distribution network, pump stations, and sewage systems are vital for public health, with strong dependencies on Metro Vancouver's regional water supply and treatment facilities.
- **Solid Waste Management Infrastructure** – Waste collection, recycling, and landfill services ensure public health and environmental safety, particularly during emergencies when debris management is crucial.

Enhancing Infrastructure Resilience in Pitt Meadows

Given the city's floodplain geography, reliance on regional infrastructure, and increasing climate risks, Pitt Meadows must prioritize:

- **Flood Protection Investments** – Strengthening dikes, stormwater management, and emergency drainage capacity to protect municipal assets and reduce critical infrastructure vulnerabilities.
- **Redundant Communication Systems** – Expanding backup power solutions, alternative communication networks, and emergency response coordination to minimize disruption risks.
- **Water and Utility Security** – Ensuring backup water supply plans, improving wastewater resilience, and assessing risks from regional infrastructure failures.
- **Interagency Collaboration** – Strengthening partnerships with Metro Vancouver, CP Rail, TransLink, BC Hydro, and Emergency Management BC to address interdependencies and external risks.

By continuously assessing, upgrading, and reinforcing its locally owned assets, Pitt Meadows can enhance its capacity to withstand hazards, protect public services, and ensure long-term sustainability in the face of future challenges.

5.0 Climate Change

Climate change is not a distant or abstract issue—it is an evolving reality already affecting communities across Canada and British Columbia, including Pitt Meadows. The increase in global temperatures, driven by human-caused greenhouse gas emissions, is accelerating environmental changes, affecting weather patterns, water resources, agriculture, infrastructure, and public safety.

Environment and Climate Change Canada (2019a) states Canada's climate is warming at nearly twice the global average. Future projections indicate that by 2081 to 2100, temperatures could increase by 1.8°C if emissions are reduced or by as much as 6.3°C if emissions remain high. The Climate Atlas of Canada further highlights that British Columbia is experiencing rising temperatures, increased frequency of extreme weather events, and shifting precipitation patterns, which will intensify over the coming decades.

Climate-induced emergencies, like atmospheric rivers, have regional impacts. Traditional mutual aid approaches may be inadequate to support Pitt Meadows emergency response agencies because traditional partners will be busy dealing with their emergencies.

Observed and Projected Climate Impacts in British Columbia and Pitt Meadows

1) Rising Temperatures and Heatwaves

The BC Ministry of Environment and Climate Change Strategy (2019) has reported that average temperatures in BC have increased, contributing to longer, hotter summers and more frequent heatwaves. This was evident in the 2021 heat dome event, which resulted in record-breaking temperatures and hundreds of heat-related deaths across the province. In Pitt Meadows, prolonged extreme heat increases risks such as:

- Health emergencies, particularly for vulnerable populations (seniors, children, outdoor workers, and those with pre-existing conditions)
- Increased energy demand is straining BC Hydro's power grid due to higher air conditioning use.
- Reduced agricultural yields, particularly for blueberries, cranberries, and other local crops, are sensitive to heat stress and drought conditions.

2) Increased Flooding and Rising Water Levels

Pitt Meadows is on a floodplain, making it particularly vulnerable to flooding from the Fraser, Pitt, and Alouette rivers and flash flooding from extreme rain events. Climate projections indicate:

- Increased precipitation and extreme rainfall events lead to higher flood risks, as seen in the 2021 atmospheric river event, which caused catastrophic flooding in the Fraser Valley. The lower mainland has seen two significant rain events in 2021 and 2024.

- Rising sea levels and higher river levels are putting additional strain on the city's dike and pump station infrastructure, which must be upgraded to meet future climate conditions (Metro Vancouver, 2021).
- Storm surges are more likely, particularly with high tides, sea level rise, and extreme precipitation events.

3) Seasonal Water Shortages and Drought Conditions

The Preliminary Strategic Climate Risk Assessment for British Columbia (2019) identifies seasonal water shortages as a significant risk by 2050. Pitt Meadows, with its agriculture-dependent economy, faces particular risks due to:

- Reduced summer rainfall and increased evaporation rates, leading to water scarcity for irrigation.
- Lower snowpack levels in the Coast Mountains affect regional water supply for agriculture, industry, and residential use.
- Competition for water resources increases demand as the population grows in Metro Vancouver, while climate change reduces availability.

4) Wildfire Smoke and Air Quality Hazards

Meanwhile, Pitt Meadows is not directly at risk of wildfires and has identified extensive interface areas that are susceptible. The city is impacted by wildfire smoke from Interior BC and the Pacific Northwest. Wildfire seasons are projected to become longer and more severe due to hotter, drier summers (BC Wildfire Service, 2022). The 2017, 2018, and 2023 wildfire seasons saw record-breaking wildfires, resulting in:

- Dangerous air quality levels, affecting public health—especially for children, seniors, and individuals with respiratory conditions.
- Disruptions to outdoor activities and tourism, including agriculture and recreation-based businesses.

5) Transportation and Infrastructure Vulnerabilities

Climate change increases Pitt Meadows' transportation network risks, including Highway 7, the Golden Ears Bridge, CP Rail, and Pitt Meadows Airport (YPK). Hazards include:

- Increased frequency of landslides and road washouts, as seen in the 2021 Fraser Valley flooding, which cut off significant roadways and disrupted supply chains.
- Heat-related damage to infrastructure, including road buckling, rail track warping, and increased maintenance needs.
- More frequent and severe storms increase power outages, disrupting municipal services, emergency response, and business operations.

Integrating Climate Change into Hazard and Risk Planning

The *BC Ministry of Environment and Climate Change Strategy (2019)* states that the likelihood of most risk events increases over time based on climate projections. A large majority of Hazard, Risk, and Vulnerability Assessment (HRVA) participants in British Columbia agree that climate change will amplify natural hazards, including:

- More frequent power outages impacting residential, agricultural, and commercial operations.
- Increased motor vehicle accidents due to more severe weather events like heavy rain, windstorms, and ice storms.

Building Climate Resilience in Pitt Meadows

To mitigate climate risks and enhance resilience, Pitt Meadows must prioritize:

- **Flood Protection Upgrades** – Strengthening dikes, pump stations, and drainage systems to protect against rising water levels and extreme rainfall events.
- **Heat Adaptation Strategies** – Expanding cooling centers, green spaces, and urban tree canopies to mitigate the effects of extreme heat.
- **Water Resource Management** – Improving water conservation, irrigation efficiency, and drought preparedness measures for agriculture and municipal use.
- **Wildfire Smoke Preparedness** – Enhancing air quality monitoring, public health communication, and indoor air filtration measures.
- **Climate-Resilient Infrastructure** – Incorporating climate adaptation into road, energy, and transportation planning to withstand extreme weather impacts.

Climate change already affects Pitt Meadows, and its impacts will intensify in the coming decades. As temperatures rise, extreme weather events become more frequent, and water resources become more stressed, the city must integrate climate science, risk assessments, and adaptation strategies into long-term planning and emergency preparedness efforts.

5.1 Wildfire

Climate change is a major driver behind more prolonged and extreme wildfire seasons in British Columbia, posing increasing risks to communities, infrastructure, and public health. While Pitt Meadows is not within BC's high-risk wildfire zones, it is still vulnerable to interface fires, which occur where urban development meets forested or grassland areas. The City of Pitt Meadows' proximity to forested lands, agricultural areas, and regional parks, combined with increasingly hot, dry summers, raises concerns about smoke-related air quality issues, infrastructure disruptions, and fire spread risks.

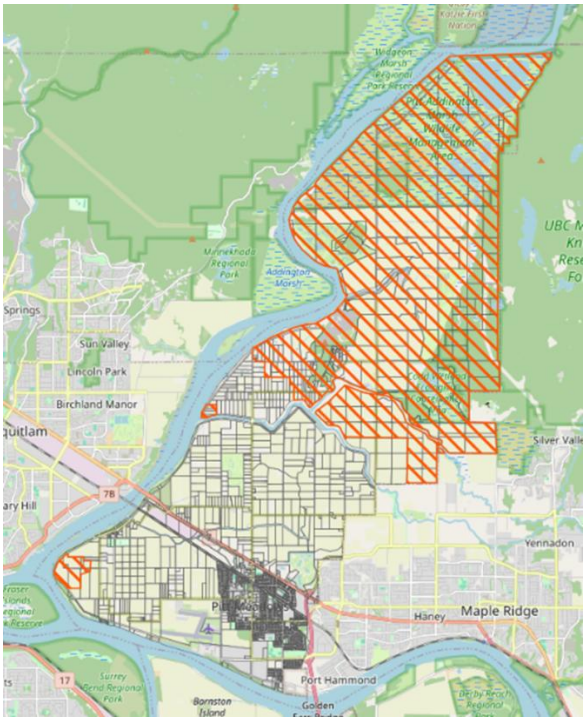

Figure 4: Wildfire hazard zones are mainly restricted to the northern half of Pitt Meadows, with pockets in the west along the Pitt River. Climate change expands potential interface areas outside of traditional threat zones. Source: City of Pitt Meadows

5.1.1 Increasing Wildfire and Interface Fire Risks

According to the *BC Ministry of Environment and Climate Change Strategy (2019),* climate change is increasing the likelihood of extreme wildfire seasons due to:

- **Hotter, drier summers** – Prolonged drought conditions and rising temperatures reduce moisture levels in vegetation, making it more flammable.
- **More frequent and intense wind events** – Winds can spread embers and flames rapidly, increasing the likelihood of fire reaching urban or agricultural areas.
- **Human activity and development pressures** – Urban expansion and recreation in Golden Ears Provincial Park, Pitt Lake, and surrounding forests can increase fire ignition risks.

The Climate Atlas of Canada projects BC will experience more frequent wildfires, with the season lasting longer and fires burning larger areas. These risks directly affect Pitt Meadows through air quality hazards, emergency response challenges, and local infrastructure and economic disruptions.

5.1.2 Public Health and Air Quality Impacts

While Pitt Meadows is not directly at risk of large wildfires, wildfire smoke from Interior BC, Washington State, and the Fraser Valley frequently reduces air quality, posing serious health risks. The 2017, 2018, and 2023 wildfire seasons caused record-breaking smoke levels across Metro Vancouver, leading to:

- **Increased respiratory issues** – Individuals with asthma, chronic obstructive pulmonary disease (COPD), and heart conditions are at higher risk during wildfire smoke events.
- **Reduced outdoor activity and economic impact** – Poor air quality affects tourism, outdoor recreation, and agricultural labourers.
- **Strain on healthcare services** – Increased hospital visits and demand for air filtration systems place additional stress on public health resources.

5.1.3 Infrastructure Disruptions and Economic Losses

Severe wildfires and interface fires can damage critical infrastructure and disrupt services, even if the fires do not directly burn through Pitt Meadows. Potential risks include:

- **Power outages** – Fires affecting BC Hydro transmission lines can cause extended blackouts, impacting businesses, homes, and emergency services.
- **Transportation interruptions** – Highway 7 and CP Rail serve as critical transportation corridors. Smoke, debris, or fire-related closures could disrupt commuter traffic, goods movement, and emergency response access.
- **Water and sewage system vulnerabilities** – Extreme heat and wildfires can affect water treatment plants, reservoirs, and sewage systems, leading to water restrictions or contamination risks.

5.1.4 Property and Agricultural Risks

Although Pitt Meadows does not have dense forest cover, it has expansive agricultural lands, grasslands, and tree-lined urban areas, all susceptible to interface fires.

- **Farm structures, barns, and equipment** – Wildfires spreading through dry grasslands or fields could destroy valuable farm infrastructure and machinery.
- **Livestock and crop losses** – Extreme heat and fire events can stress or displace livestock and damage crops, leading to economic hardship for local farmers.
- **Urban expansion risks** – As Pitt Meadows develops, more properties border natural areas, increasing the need for fire-smart landscaping and fire-resistant building materials.

5.1.5 Strengthening Wildfire and Interface Fire Resilience in Pitt Meadows

To mitigate wildfire and interface fire risks, Pitt Meadows should implement:

- **Wildfire Smoke Preparedness Plans** – Improving air quality monitoring, indoor filtration systems, and public health advisories for residents during severe smoke events.

- **FireSmart Community Strategies** – Encouraging fire-resistant landscaping, defensible space around homes, and updated building codes to reduce the spread of fires in urban areas.

- **Emergency Response Coordination** – Enhancing mutual aid agreements with Metro Vancouver, BC Wildfire Service, and neighbouring municipalities to ensure rapid wildfire suppression and evacuation planning.

- **Public Awareness and Education** – Increase wildfire prevention programs, controlled burn education, and provide fire safety training for residents and recreational users in high-risk areas.

- **Infrastructure Resilience Investments** – Ensuring redundant power sources, transportation backup plans, and water supply security in case of wildfire-related disruptions.

While Pitt Meadows does not face the direct threat of large-scale wildfires, it is highly vulnerable to the secondary impacts of climate-driven wildfires, including interface fires, air quality hazards, infrastructure disruptions, and economic losses. With climate change intensifying fire seasons in BC, proactive fire risk reduction, emergency planning, and resilience-building measures will be essential to protect public health, critical infrastructure, and economic stability in Pitt Meadows.

5.2 Flooding

Pitt Meadows is highly vulnerable to flooding due to its low-lying geography, proximity to the Pitt and Fraser Rivers, and reliance on dike and drainage infrastructure. Climate change intensifies flood risks by increasing the frequency of extreme rainfall events, rising river levels, and rising sea levels, all of which threaten stormwater management systems, agricultural lands, and urban areas.

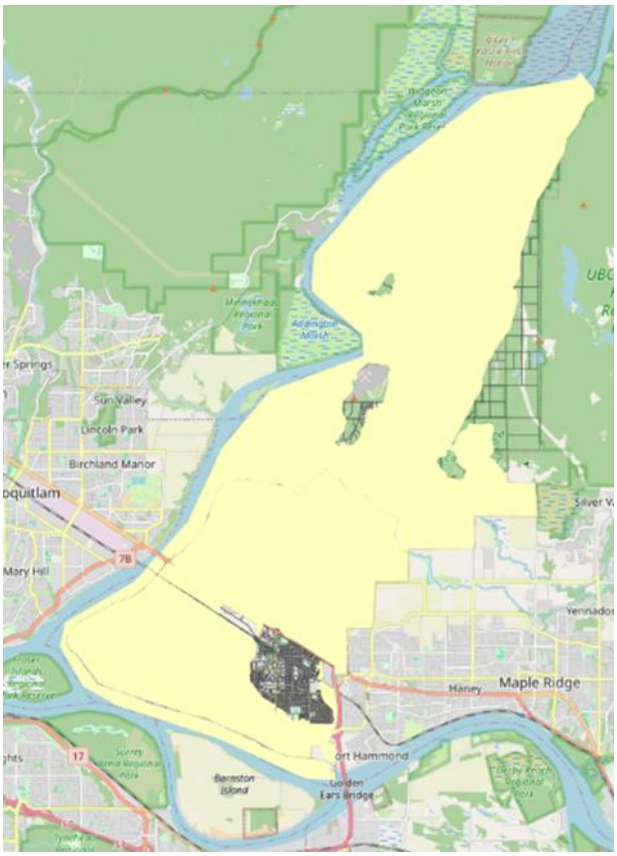

Figure 5: Map Source Pitt Meadows Basemaps: The yellow highlighted area shows that most areas of Pitt Meadows are in the inundation and flood zone, dependent on pumps and dikes for protection.

5.2.1 Overland Flooding (Pluvial Flooding) in Pitt Meadows

Overland flooding occurs when intense rainfall or melting snow overwhelms the land's ability to absorb water, leading to surface water accumulation and flooding in streets, properties, and low-lying areas. Pitt Meadows is particularly susceptible due to:

- High groundwater levels and extensive agricultural lands can become waterlogged after prolonged rainfall.
- Urban development increases impermeable surfaces, such as roads and buildings, reducing natural absorption and increasing stormwater runoff.
- Drainage systems reaching capacity, particularly during back-to-back storm events, prevent proper rainwater dispersal.

As climate change brings more intense rainstorms, pluvial flooding risks will rise, requiring enhanced stormwater management strategies, natural flood absorption zones, and infrastructure upgrades.

5.2.2 River, Lake, and Stream Flooding (Fluvial Flooding)

Flooding from rivers and streams (fluvial flooding) is one of the most significant risks for Pitt Meadows, given its proximity to the Fraser River, Pitt River, and Alouette River. Climate change is altering rainfall patterns, snowmelt timing, and streamflow volumes, leading to:

- Higher peak flows in rivers increase the risk of floodwaters overtopping dikes.
- More significant water level variability makes flood prediction and emergency planning more challenging.
- Increased sediment buildup in water channels reduces their ability to handle high flows and increases the risk of localized flooding.

The Fraser River spring freshet—driven by snowmelt from the Interior—has historically been a significant flood risk for Metro Vancouver communities, including Pitt Meadows. Warmer temperatures and changing precipitation patterns alter snowpack levels, making flood seasons more unpredictable.

5.2.3 Coastal Flooding and the Impact of Sea Level Rise on the Pitt and Fraser Rivers

While Pitt Meadows is not directly on the Pacific Ocean, sea level rise will still significantly affect the city's flood risk due to its connection to the Fraser River Delta and Pitt Lake.

According to the Canadian Climate Atlas and Environment and Climate Change Canada, sea levels along BC's coast will rise by at least 0.8 metres by 2100. This will have cascading impacts on the Pitt and Fraser Rivers:

- Raising baseline water levels makes the region susceptible to tidal flooding, storm surges, and high river flows.
- Reducing the effectiveness of drainage infrastructure, as high tides and rising river levels slow or block natural water outflows, leading to prolonged inland flooding.
- Increasing the risk of saltwater intrusion could affect groundwater supplies and agricultural irrigation.

Additionally, king tides—which already result in water levels over five metres in the region—are expected to become more frequent due to climate change (Hernandez, 2018). If a king tide coincides with a storm surge, flood severity could increase significantly, leading to:

- Overtopping of dikes and drainage systems, flooding farmland, roads, and residential areas.
- Erosion of riverbanks and shorelines, threatening infrastructure and natural habitats.
- Disruptions to transportation corridors, such as Highway 7 and CP Rail, are critical for goods movement and emergency response.

5.2.4 Flood Consequences for Pitt Meadows

Flooding is Canada's costliest natural disaster regarding property damage, economic losses, and infrastructure disruptions (Public Safety Canada, 2015). Major flood events in Pitt Meadows could result in:

- Extensive property and infrastructure damage, particularly in residential areas, farms, and transportation corridors.
- Population displacement and long-term recovery challenges, including psychosocial stress, insurance difficulties, and economic losses for affected individuals and businesses.
- Disruptions to emergency services and utilities, including electricity, telecommunications, and drinking water systems.
- Environmental damage, including contamination of water sources, erosion of riverbanks, and destruction of ecosystems in Pitt Lake, the Fraser River estuary, and wetland areas.

5.2.5 Building Flood Resilience in Pitt Meadows

To mitigate flood risks and sea level rise impacts, Pitt Meadows must prioritize:

- **Dike System Upgrades** – Strengthening and raising existing dikes, pump stations, and floodgates to protect against rising water levels.
- **Stormwater Infrastructure Improvements** – Expanding rainwater drainage capacity, integrating green infrastructure, and maintaining culverts and ditches to reduce overland flooding risks.
- **Climate-Adaptive Land Use Planning** – Restricting development in high-risk flood zones, protecting wetlands as natural flood buffers, and improving agricultural drainage systems.
- **Early Warning Systems and Emergency Preparedness** – Enhancing flood forecasting, emergency response coordination, and public education on flood risks.
- **Regional and Intergovernmental Collaboration** – Working with Metro Vancouver, the Fraser Basin Council, BC's Ministry of Environment and Climate Change Strategy, and the federal government to secure funding for flood mitigation projects and climate adaptation strategies.

As climate change intensifies rainfall, increases sea levels, and alters river systems, Pitt Meadows faces growing flood risks from overland, river, and coastal flooding. By investing in flood resilience, adaptive infrastructure, and emergency preparedness, the city can reduce vulnerabilities and protect residents, businesses, and vital infrastructure from future flood disasters.

5.3 Wind Event

As the climate continues to warm, the frequency and intensity of wind events in British Columbia will increase. According to BC Hydro (2018), there has already been a notable rise in the recurrence and severity of extreme storms, leading to widespread infrastructure damage, prolonged power outages, and rising economic costs.

5.3.1 Recent Wind Events Impacting Pitt Meadows and the Lower Mainland

- **December 2018 Windstorm** – One of the most severe windstorms in BC history battered Metro Vancouver, including Pitt Meadows, with wind gusts exceeding 100 km/h. This storm caused:
    - Widespread power outages affecting over 750,000 BC Hydro customers, some lasting multiple days.
    - Significant tree damage across parks and roadways, leading to blocked transportation routes and commuter disruptions.
    - Infrastructure damage, including downed power lines, damaged homes, and business closures.
- **November 2021 Atmospheric River Event** – While primarily known for historic flooding, this event also included high winds, which compounded storm damage across the Fraser Valley and contributed to critical infrastructure failures, such as road washouts and power grid disruptions.
- **2023 Windstorm Season** – Multiple wind advisories and storm warnings were issued for Metro Vancouver, with several events causing localized power outages and tree damage in Pitt Meadows and surrounding communities.

5.3.2 Impacts of Stronger and More Frequent Wind Events in Pitt Meadows

As climate change fuels more extreme weather patterns, Pitt Meadows can expect:

- **Increased Power Outages** – Strong winds knock down BC Hydro power lines, disrupting electricity supply for homes, businesses, and critical services. Rural areas and older infrastructure networks tend to experience more extended outages, affecting heating, refrigeration, and emergency communication systems.
- **Damage to Homes, Businesses, and Public Infrastructure** – Severe wind events can damage roofs, break windows, and topple fences, leading to costly repairs for residents and businesses. Public infrastructure, such as bus shelters, signage, and roadways, may also suffer damage.
- **Transportation and Commuter Disruptions** – High winds can affect significant transportation corridors, including Highway 7, the Golden Ears Bridge, and CP Rail lines. Downed trees and power lines create hazards, while strong crosswinds can make driving conditions dangerous for commuters and commercial vehicles.

- **Increased Emergency Response Strain** – The Pitt Meadows Fire & Rescue Service and BC Hydro crews often face higher call volumes following severe wind events, responding to fallen power lines, road obstructions, and public safety hazards. Emergency services must also coordinate with Metro Vancouver and provincial agencies to restore essential services.
- **Threats to Trees and Green Spaces** – Parks, natural areas, and tree-lined streets in Pitt Meadows may see increased tree loss and falling branches, causing hazards for pedestrians, vehicles, and properties. Strong winds can also disrupt wildlife habitats and damage crops and greenhouse operations.

5.3.3 Strengthening Windstorm Resilience in Pitt Meadows

To mitigate the **rising risks of extreme wind events**, Pitt Meadows must prioritize:

Infrastructure Upgrades – Collaborating with BC Hydro to strengthen power grid resilience, including undergrounding power lines in high-risk areas and improving storm-hardening measures for municipal infrastructure.

- **Urban Tree Management** – Expanding tree maintenance programs to regularly prune or remove trees posing risks to power lines, roads, and public spaces, reducing potential storm damage.
- **Backup Power Solutions** – Encouraging households, businesses, and critical facilities (e.g., fire halls, emergency shelters, and water treatment plants) to invest in backup power systems and generators.
- **Improved Emergency Planning** – Enhancing storm tracking, early warning systems, and emergency response coordination with Metro Vancouver, BC Emergency Management, and local emergency services to ensure faster power restoration and public safety measures.
- **Public Awareness and Preparedness** – Promoting storm safety education, including securing outdoor furniture, preparing emergency kits, and knowing how to report power outages and hazards.

As windstorms become more frequent and severe, Pitt Meadows must adapt its infrastructure, emergency planning, and community preparedness strategies. By investing in windstorm resilience measures, the city can minimize future disruptions, protect residents, and reduce economic losses caused by extreme wind events.

5.4 Drought

A warming climate and shifting precipitation patterns increase the likelihood and severity of Pitt Meadows and Fraser Valley drought conditions. According to the BC Ministry of Environment and Climate Change Strategy (2019), climate change will reduce snowpack levels, alter seasonal water availability, and extend periods of dry weather, contributing to more significant drought risks.

5.4.1 How Climate Change is Driving Drought Risk in Pitt Meadows

The Fraser Valley's water supply is influenced mainly by snowmelt from the Coast and Cascade Mountain ranges, which feeds local rivers, including the Pitt, Fraser, and Alouette Rivers. However, climate projections indicate that:

- Warmer winters will reduce snowpack, leading to lower summer river flows and less available water for irrigation, drinking water, and hydropower generation.
- Longer, drier summers will increase evaporation rates, reducing water reserves in lakes, streams, and soil.
- More erratic precipitation patterns will create wetter winters and drier summers, worsening seasonal water shortages.

The 2021 and 2022 drought conditions in British Columbia, including record-breaking low river levels in parts of the Fraser Basin, highlighted the growing risk of prolonged dry periods affecting communities, agriculture, and ecosystems.

5.4.2 Cascading Impacts of Drought in Pitt Meadows and the Fraser Valley

As drought conditions become more frequent and severe, Pitt Meadows faces multiple risks across agriculture, forestry, infrastructure, and public health:

- **Agricultural Impacts**
  - Pitt Meadows' economy relies heavily on agriculture, particularly berry farms (blueberries, cranberries, and raspberries), dairy, poultry, and greenhouse production.
  - Drought reduces irrigation water availability, affecting crop yields, livestock health, and farm productivity.
  - Heat and dry conditions increase the risk of soil degradation, impacting long-term agricultural sustainability.
- **Forestry and Tree Health**
  - Drought-stressed trees lose moisture and weaken, making them more vulnerable to pests, disease, and wind damage.
  - Dry conditions increase the likelihood of tree blowdowns during fall and winter windstorms, posing safety risks to homes, roads, and power lines.
  - Increased tree mortality increases the risk of interface wildfires, especially in dry summers.
- **Water Security Challenges**
  - Lower river and groundwater levels reduce the availability of drinking water for Pitt Meadows, which relies on Metro Vancouver's regional water supply and local groundwater wells.
  - Strained municipal water infrastructure may lead to water restrictions for residents and businesses, particularly in the summer months.
  - Increased irrigation and drinking water demand could lead to conflicts between agricultural, industrial, and residential users.

- **Infrastructure and Power Supply Risks**
    - Drought-affected trees are more likely to be uprooted during windstorms, increasing the risk of power outages and transportation disruptions.
    - Hydroelectric power generation, which supplies most of BC's electricity, could be impacted by lower water levels, leading to higher energy costs and increased reliance on alternative power sources.
    - Dust storms from dry soil conditions could impact air quality and road safety, particularly in agricultural areas.

5.4.3 Strengthening Drought Resilience in Pitt Meadows

To mitigate **drought-related risks**, Pitt Meadows should focus on:

- **Water Conservation and Management** – Expand municipal water efficiency programs, improve irrigation practices for farmers, and promote residential water-saving measures.
- **Urban and Agricultural Land Adaptation** – Increasing drought-resistant landscaping, protecting wetlands as natural water storage areas, and supporting climate-resilient farming techniques.
- **Infrastructure Investments** – Strengthen stormwater retention systems, recharge initiatives, and emergency water storage capacity.
- **Wildfire and Tree Management** – Implementing FireSmart strategies, maintaining healthy forests and urban tree canopies, and proactively removing drought-stressed trees near power lines and roadways.
- **Emergency Preparedness and Public Awareness** – Educating residents, farmers, and businesses on drought mitigation strategies and implementing seasonal water restrictions when needed.

As climate change intensifies drought risks in Pitt Meadows and the Fraser Valley, proactive water management, infrastructure planning, and community adaptation will ensure long-term water security, agricultural resilience, and public safety.

5.5 Salt Water Intrusion

Saltwater intrusion is a growing concern for low-lying coastal and river communities, including Pitt Meadows and the Fraser River floodplain. As sea levels rise, storm surges become more frequent, and groundwater demand increases, the risk of saltwater moving into freshwater aquifers threatens drinking water supplies, soil fertility, and agricultural productivity.

5.5.1 Causes of Saltwater Intrusion in the Fraser River Basin

Several climate-related and human-induced factors contribute to saltwater intrusion in Pitt Meadows and the Fraser Valley:

- **Sea Level Rise** – Ocean tides highly influence the Fraser River. As sea levels rise (projected 0.8 m by 2100, according to Environment and Climate Change Canada), the saltwater-freshwater boundary moves further inland. This increases the risk of salinity reaching groundwater sources, particularly during periods of low river flow.

- **Storm Surges and Flooding** – Extreme storm events and king tides can push saltwater further upstream into the Fraser River and its tributaries, impacting Pitt Lake and surrounding wetlands. If this saltwater infiltrates drinking water aquifers, it can permanently degrade groundwater quality.
- **Coastal Erosion and Land Subsidence** – As dike-protected areas like Pitt Meadows experience gradual land subsidence, the saltwater interface moves closer inland. This can lead to long-term soil degradation in farmland and increased difficulty in managing freshwater resources.
- **Increased Groundwater Demand** – Population growth, agricultural expansion, and climate-driven droughts increase the stress on local groundwater supplies, making aquifers more vulnerable to saltwater contamination. Higher water extraction rates in dry summers create a hydraulic imbalance, allowing saltwater to seep further into freshwater reserves.

5.5.2 Potential Impacts on Pitt Meadows

- **Drinking Water Contamination** – Pitt Meadows primarily relies on Metro Vancouver's regional water supply. However, some private wells and local groundwater sources could become vulnerable to saltwater intrusion, increasing water treatment costs and supply challenges.
- **Agricultural and Soil Degradation** – Pitt Meadows is a major agricultural hub that produces berries, dairy, poultry, and greenhouse crops. Salinization of farmland due to saltwater intrusion could:
    - Reduce soil fertility, making it harder to grow crops.
    - Damage irrigation systems requiring more costly water filtration and treatment.
    - This leads to economic losses for farmers, affecting yields and long-term agricultural viability.
- **Infrastructure and Drainage Challenges** – The Pitt River and Fraser River drainage systems rely on dikes, pump stations, and culverts to manage water levels and prevent flooding. Higher salinity in floodwaters could lead to:
    - Corrosion of infrastructure, increasing maintenance and repair costs.
    - Reduced effectiveness of drainage systems, as salt-laden water impacts soil permeability.

5.5.3 Addressing Saltwater Intrusion Risks in Pitt Meadows

To mitigate the risks of saltwater intrusion, Pitt Meadows must prioritize:

- **Dike and Flood Protection Upgrades** – Strengthening the Pitt River and Fraser River dike systems to prevent tidal flooding and storm surges from pushing saltwater inland.
- **Sustainable Water Management** – Implementing water conservation strategies and groundwater monitoring programs and regulating well usage to prevent over-extraction of freshwater reserves.

- **Soil and Agricultural Resilience Measures** – Supporting salt-tolerant crop research, soil restoration programs, and agricultural drainage improvements to protect farmland productivity.
- **Collaboration with regional and federal agencies –** Working with Metro Vancouver, Environment and Climate Change Canada, and BC's Ministry of Environment and Climate Change Strategy to monitor sea-level rise impacts and secure funding for adaptive infrastructure projects.

As sea levels rise and climate patterns shift, Pitt Meadows and the Fraser River basin face an increasing risk of saltwater intrusion. Proactive infrastructure investments, water management strategies, and agricultural adaptation measures will protect drinking water sources, sustain local farms, and maintain regional resilience in climate change.

5.6 Heat Event

Climate change drives a measurable increase in extreme heat events, with hotter summers and more frequent heat waves expected in Pitt Meadows and the Fraser Valley. According to *Environment and Climate Change Canada (Bush & Lemmen, 2019)*, Canada's climate has already warmed significantly and will continue to do so. The *BC Ministry of Environment and Climate Change Strategy (2019)* projects that:

- Days with temperatures exceeding 32°C will become more common in British Columbia.
- Heat waves—extended periods of extreme heat—are expected to occur every 3 to 10 years, increasing risks to human health, infrastructure, and ecosystems.
- The intensity and duration of extreme heat events will continue to rise, particularly in urban and agricultural areas where heat exposure is amplified.

5.6.1 Heatwave Trends and Recent Examples in BC

- **2021 Heat Dome** – One of the most catastrophic heat events in Canadian history, the June 2021 heat dome resulted in:
    - Temperatures reaching 49.6°C in Lytton, BC (Canada's highest recorded temperature).
    - Over 600 heat-related deaths in BC, primarily affecting seniors and vulnerable populations (BC Coroners Service, 2022).
    - Increased hospitalizations and emergency service strain due to heat exhaustion, dehydration, and respiratory complications.
- **2023 Summer Heat Alerts** – The Fraser Valley experienced multiple heat warnings, leading to record-breaking temperature spikes and poor air quality from wildfire smoke.

5.6.2 Impacts of Increasing Heat on Pitt Meadows

- **Human Health Risks**

- Vulnerable populations—including seniors, children, outdoor workers, and individuals with pre-existing conditions—face a higher risk of heat-related illnesses such as heatstroke, dehydration, and cardiovascular stress.
- Increased hospital visits and demand for cooling centers and medical services during extreme heat events.
- Exacerbation of respiratory conditions, particularly for individuals exposed to heat combined with wildfire smoke.

- **Infrastructure and Transportation Stress**
  - Roads, bridges, and rail infrastructure may experience thermal expansion, leading to asphalt damage, rail track warping, and increased maintenance costs.
  - Increased electricity demand for air conditioning strains BC Hydro's power grid, raising the risk of brownouts and localized power outages.
  - Public transit and active transportation (walking, cycling) may become less accessible as extreme heat discourages outdoor movement.
- **Agricultural and Economic Impacts**
  - Higher temperatures and prolonged drought conditions threaten crop yields, particularly for berries, dairy farms, and greenhouse production, which are critical to Pitt Meadows' economy.
  - Heat stress in livestock can reduce dairy and poultry production, leading to economic losses for farmers.
  - Outdoor labour productivity declines, affecting construction, landscaping, and agricultural workforces.
- **Ecosystem and Environmental Consequences**
  - Increased drought and wildfire risk impacts forests, wetlands, and urban green spaces.
  - Reduced water levels in rivers and lakes, stressing aquatic life, fisheries, and drinking water supplies.
  - Higher rates of tree mortality, reducing the natural cooling effects of urban greenery and increasing the urban heat island effect.

5.6.3 Strengthening Heat Resilience in Pitt Meadows

To address rising extreme heat risks, Pitt Meadows should prioritize:

- **Cooling Infrastructure and Public Health Measures**
  - Expanding cooling centers in libraries, community centers, and public spaces.

    - Implementing urban tree planting and shade structures reduces the urban heat island effect.
    - Improving public communication strategies for heat warnings and emergency response plans.

- **Energy and Infrastructure Adaptation**
    - Strengthening power grid resilience to prevent outages during high-demand heat events.
    - Encouraging green building designs with heat-reflective materials, cool roofs, and energy-efficient air conditioning systems.
    - Upgrading road and rail infrastructure to withstand extreme temperature fluctuations.

- **Climate-Resilient Agriculture and Water Management**
    - Supporting drought-resistant crop research and efficient irrigation techniques for local farms.
    - Protecting wetlands and groundwater sources to maintain water availability during heatwaves.
    - Implementing fire-smart practices in agricultural and forested areas to reduce wildfire risks.

As Pitt Meadows faces more frequent and severe heat waves, investing in climate adaptation measures, public health preparedness, and infrastructure resilience is essential. By strengthening heat mitigation strategies, the city can protect vulnerable populations, maintain economic stability, and reduce the long-term impacts of climate change on public health and infrastructure.

5.7 Rainfall Event

Climate change will increase the severity, frequency, and intensity of rainfall events in Pitt Meadows and the Fraser Valley, leading to a higher risk of localized and regional flooding. According to the *BC Ministry of Environment and Climate Change Strategy (2019)*, annual precipitation levels in BC will increase, with a greater concentration of rainfall occurring in high-intensity storm events. These trends align with research from *Environment and Climate Change Canada (Bush & Lemmen, 2019)*, which predicts that extreme rainfall events will become more frequent and severe over the next 30 years.

5.7.1 How Climate Change is Increasing Rainfall and Flood Risks in Pitt Meadows

The Fraser Valley's weather patterns are shaped by its coastal and mountainous geography, making it highly sensitive to changing precipitation trends. Climate projections indicate that:

- More rain will fall in intense, short bursts, overwhelming stormwater drainage systems, dikes, and pump stations.
- The overall volume of annual precipitation will increase, but more of it will fall as rain instead of snow, altering seasonal water flow patterns in the Fraser and Pitt Rivers.
- Rivers, lakes, and urban areas will experience more frequent and intense flooding, particularly in low-lying floodplain communities like Pitt Meadows.

5.7.2 Recent Extreme Rainfall and Flood Events in the Fraser Valley

November 2021 Atmospheric River Event

- It was one of BC's most destructive flood events, bringing over 300 mm of rain to parts of the Fraser Valley within days.
- This resulted in massive road washouts, bridge failures, and evacuations, cutting off communities from emergency services and supply chains.
- While Pitt Meadows was not as severely affected as Abbotsford and Chilliwack, the event underscored the city’s vulnerability to extreme precipitation and Fraser River flooding.

Winter 2023 Rainstorm Series

- Back-to-back storms in January and February 2023 led to localized flooding along Highway 7 and saturated agricultural fields in Pitt Meadows.
- High water levels in the Fraser and Pitt Rivers placed pressure on dikes and drainage systems, highlighting the need for ongoing flood protection upgrades.

5.7.3 Impacts of Increased Rainfall and Flooding in Pitt Meadows

Property and Infrastructure Damage

- High-intensity rainfall events can cause urban and overland flooding, damaging homes, businesses, roads, and public facilities.
- Dike and pump station infrastructure will face increasing pressure, requiring continuous maintenance and upgrades.
- Roads and highways, including Lougheed Highway (Highway 7) and the Golden Ears Bridge, may experience flooding, washouts, and increased congestion due to road closures.

Agricultural Flooding and Economic Losses

- Pitt Meadows’ fertile farmlands, known for berries, dairy, and greenhouse crops, are particularly vulnerable to extreme rainfall and prolonged flooding.

- Excessive rainfall can cause soil erosion, crop loss, and delayed planting seasons, impacting farmers' livelihoods and regional food security.
- Flooding in livestock operations can lead to animal displacement, contamination risks, and economic hardships for farmers.

Water Quality and Public Health Risks

- Heavy rainfall can overwhelm stormwater and wastewater treatment systems, increasing the risk of water contamination and infrastructure failure.
- Floodwaters may contain urban and agricultural runoff pollutants, leading to long-term environmental degradation in the Fraser River, Pitt River, and local wetlands.

5.7.4 Strengthening Flood Resilience in Pitt Meadows

To mitigate the increasing risks of extreme rainfall and flooding, Pitt Meadows should focus on:

- **Upgrading Dikes and Pump Stations** – Investing in flood control infrastructure, stormwater management improvements, and emergency drainage systems to handle higher water volumes.
- **Enhancing Agricultural Drainage Systems** – Supporting farmers with improved water management practices, soil retention measures, and climate-adaptive crop planning.
- **Strengthening Emergency Preparedness and Response** – Expanding flood forecasting, early warning systems, and community evacuation planning to minimize risks to residents and businesses.
- **Implementing Green Infrastructure Solutions** – Increasing urban green spaces, wetland restoration projects, and permeable surface designs to reduce stormwater runoff and enhance natural flood absorption.
- **Advocating for Regional and Federal Support** – Collaborating with Metro Vancouver, BC's Ministry of Environment and Climate Change Strategy, and the federal government to secure funding for long-term flood adaptation strategies.

As climate change intensifies rainfall patterns, Pitt Meadows faces rising flood risks that threaten homes, businesses, and farmlands. By investing in infrastructure resilience, water management, and climate adaptation, the city can reduce flood impacts, protect critical assets, and enhance long-term community safety in an era of changing climate conditions.

5.8 In Summary

Climate change significantly influences the **City of Pitt Meadows'** emergency planning, mitigation, and preparedness approach. Extreme weather events' increasing frequency and severity necessitate comprehensive strategies to safeguard the community's well-being and infrastructure.

5.8.1 Climate Change Impacts in Pitt Meadows

The **Official Community Plan (OCP)** identifies several climate-related challenges:

- **Temperature Variations**: Anticipated hotter, drier summers and warmer, wetter winters.
- **Precipitation Changes**: An increase in intense rainfall events, elevating the risk of localized flooding.
- **Sea-Level Rise**: Potential impacts on low-lying areas, affecting drainage and increasing flood susceptibility.
- **Extreme Weather Events**: A higher likelihood of heatwaves, storms, and wildfires, posing threats to public health and safety.

5.8.2 Emergency Program Preparations

In response to these challenges, Pitt Meadows has implemented several initiatives:

1. **Climate Action Strategy**: The city is developing a strategy focusing on:
    - **Climate Adaptation**: Preparing the community and infrastructure for anticipated climate impacts.
    - **Climate Mitigation**: Reducing greenhouse gas emissions to lessen future climate change effects.
2. **Heat Preparedness**: Recognizing the dangers of rising temperatures, the city has:
    - Established cooling centers for residents during extreme heat events.
    - Provided resources to help the community prepare for heat waves.
3. **Flood Management**: Given the city's floodplain location, efforts include:
    - Regular maintenance and assessment of dikes and pump stations.
    - Public education on flood preparedness and response strategies.
4. **Agricultural Viability Strategy**: To support local farmers facing climate challenges, the city has endorsed a strategy focusing on:
    - Protecting farmland.
    - Enhancing infrastructure to support agricultural resilience.

The City of Pitt Meadows is proactively addressing the multifaceted impacts of climate change through strategic planning and community engagement. By implementing these initiatives, the city aims to enhance its resilience against extreme weather events and ensure the safety and well-being of its residents.

6.0 Hazard Assessment Results and Risk Scores

Risk assessment is a crucial component of Pitt Meadows' emergency planning and climate adaptation efforts, helping to prioritize hazards and develop mitigation strategies. Risk is generally calculated using the formula:

Risk = Likelihood × Consequence

This equation provides a structured measure of risk for each identified hazard in the city. However, it is essential to recognize that risk scores serve as best estimates rather than absolutes, given the inherent uncertainties in qualitative hazard assessments.

While the Official Community Plan (OCP) and Climate Action Strategy outline a commitment to risk-based decision-making, the risk assessment process remains dynamic, influenced by:

- Changing climate conditions (e.g., more frequent extreme weather events).
- Evolving land-use patterns (e.g., urban expansion and infrastructure growth).
- Community feedback and expert input may shift priorities over time.

The subjectivity of qualitative assessments means that results could vary if a different group of stakeholders conducted the hazard evaluation. Despite these limitations, qualitative assessments provide a valuable framework for proactive planning, ensuring preparedness efforts align with evolving risks.

While the likelihood-consequence risk equation provides a valuable tool for assessing hazards in Pitt Meadows, its results must be interpreted within the broader context of climate change, urban development, and emergency preparedness strategies. By integrating scientific data, community engagement, and adaptive planning, Pitt Meadows can ensure its risk assessments remain relevant, actionable, and practical in protecting residents and infrastructure.

6.1 Reputational Risk

Municipalities face significant reputational risks during emergencies in today's rapidly evolving media landscape. The rise of social media, instant news cycles, and public scrutiny has made crisis communication a critical aspect of emergency management. How a municipality responds, communicates, and manages public perception during an emergency can reinforce public trust or lead to lasting reputational damage.

6.1.1 The Role of Reputational Risk in Emergency Scoring and Response

In this report, reputational risk is integral to the risk scoring framework. Regardless of the event type or jurisdiction, reputational risks should be assessed alongside operational and logistical risks to ensure municipalities are prepared for physical and public relations challenges. This means that every emergency—whether a flood, wildfire, infrastructure failure, or heat wave—requires assessing how residents, businesses, and external stakeholders will perceive municipal actions and communications.

If public confidence is eroded due to poor communication, misinformation, or perceived inaction, a municipality may face long-term challenges such as:

- Decreased public trust in local government and emergency response agencies
- Increased difficulty in securing future funding and resources for emergency preparedness
- Greater scrutiny from media, advocacy groups, and higher levels of government
- Economic consequences, including reduced investment and business confidence

6.1.2 Recent Reputational Risks in British Columbia Emergency Responses

- **2021 Lytton Wildfire** – The rapid destruction of Lytton underscored the need for coordinated emergency messaging. Residents and media questioned whether evacuation warnings and emergency alerts had been issued quickly enough.
- **2023 BC Wildfires (Shuswap & Okanagan Fires)** – Social media criticism highlighted perceived gaps in emergency coordination, evacuation planning, and transparency, leading to public frustration and challenges in controlling narratives.
- **2021 Fraser Valley Floods (Atmospheric River Event)** – Extensive flooding led to road closures, mass evacuations, and widespread damage. While officials provided emergency updates, confusion over evacuation orders and road conditions created reputational challenges for various municipalities and provincial agencies.

6.1.3 Strategies for Managing Reputational Risk in Pitt Meadows

To mitigate reputational risks and maintain public trust, Pitt Meadows should focus on:

- **Integrating Reputational Risk into Emergency Planning** – Ensuring that all emergency preparedness strategies include public relations and communication protocols.
- **Transparent and Consistent Communication** – Regular updates, fact-based messaging, and pre-established communication channels help prevent misinformation.
- **Social Media Monitoring and Rapid Response** – Tracking real-time public sentiment and media coverage allows for quick corrections and proactive engagement.
- **Training and Crisis Communication Drills** – Public officials, first responders, and municipal staff should receive media training to ensure unified messaging during crises.
- **Public Engagement and Community Collaboration** – Involving local leaders, businesses, and community organizations in emergency planning can help build public confidence and shared responsibility.

Reputational risk directly impacts the potential perception of the success of the jurisdiction's preparations, mitigation, response and recovery from emergencies – whether they are in direct control of the issue. While difficult to quantify accurately, it deserves specific consideration through all aspects of risk identification and management processes.

6.2 Hazard Assessment and Risk Scores

Risk assessment is fundamental for evaluating a jurisdiction's hazard threats and vulnerabilities. The calculation of risk is commonly expressed as:

Risk=Likelihood X Consequence

This formula provides a structured approach to measuring risk by considering the probability of an event occurring (likelihood) and the severity of its impacts (consequence).

While this method helps prioritize hazards and inform decision-making, it is essential to recognize that risk scores are estimates rather than definitive values. The assessment's qualitative nature introduces subjectivity, as evaluations of likelihood and consequence reflect expert judgment, historical data, and climate projections.

6.2.1 Limitations and Variability in Risk Scoring

- **Subjectivity in Assessments** – Determining likelihood and consequence scores relies on expert analysis, community input, and existing data, all of which can introduce variability.
- **Evolving Climate and Hazard Conditions** – As climate change intensifies extreme weather events, past trends may no longer fully indicate future risks.
- **Different Stakeholder Perspectives** – Risk assessments conducted by various groups or at other times may result in variations in scoring, reflecting changes in local conditions, new hazard data, or shifts in community priorities.

6.2.2 Rating Confidence:

FireWise has assigned a rating confidence level of Moderate to high to the rating assessments in this report. The limited nature of the risk owner engagements and lack of previous HRVAs are limiting factors that will be addressed through future updates of the HRVA assessments.

Enhancing Risk Assessment Accuracy

To improve the reliability and applicability of risk scores, the future assessment maintenance process should:

Incorporate Up-to-Date Climate and Hazard Data – Utilize real-time monitoring, predictive modelling, and historical event analysis to refine likelihood assessments.

Engage Multi-Stakeholder Input – Involving emergency management professionals, climate scientists, local government, and community members ensures a comprehensive and balanced evaluation of risks.

Conduct Regular Updates and Reviews – The City should revisit its risk assessments to reflect new data, emerging hazards, and lessons learned from past events.

Recognize Uncertainty and Adaptability – Understanding that dynamic risk assessments encourage flexible and proactive emergency planning rather than rigid reliance on static scores.

The likelihood-consequence risk equation is valuable for prioritizing hazards and guiding emergency preparedness efforts. However, due to the subjective nature of risk assessments and evolving climate conditions, municipalities must remain adaptable, continuously update risk data, and engage diverse perspectives to ensure accurate, informed, and effective hazard mitigation strategies.

The Hazard, Risk, and Vulnerability Analysis (HRVA) for Pitt Meadows conducted a comprehensive assessment across various hazard categories, including natural, technological, and conflict-related hazards. The analysis identified various risks pertinent to the city, emphasizing transportation-related and natural hazards.

6.2.3 Transportation-Related Hazards

The **Canadian Pacific (CP) rail line**, which traverses the town center of Pitt Meadows, presents a significant risk due to:

- **Hazardous Materials Handling**: The presence of intermodal facilities and the transportation of hazardous materials increases the potential for incidents.
- **Level Crossings**: Numerous level crossings within the city exacerbate the risk of accidents.
- **Evolving Rail Operations**: Changes in rail operations may introduce new risks or amplify existing ones.

These factors collectively contribute to transportation-related hazards being among the top-tier risks for Pitt Meadows.

6.2.4 Natural Hazards

Climate change has heightened the City's frequency and severity of natural hazards. The HRVA identified the following natural hazards as having the highest risk scores:

1. **Wildfire and Urban Interface Fire**: The proximity of urban areas to forested regions increases the risk of wildfires impacting the community. While agricultural and irrigated lands buffer more developed areas of the City, extended periods of drought can make it easier for interface fires to occur at great distances from the actual wildfire.
2. **Overland Flooding**: Heavy rainfall events can lead to surface water accumulation, overwhelming drainage systems, and localized flooding.
3. **Wind Events**: Severe windstorms can result in property damage and power outages and pose safety risks to residents.
4. **Drought**: Extended periods of low precipitation can affect water supplies for the City and agriculture businesses and increase the risk of wildfires.

Notably, while a **Megathrust Earthquake** is considered to have a lower likelihood, it possesses the highest consequence score due to the potential for widespread devastation.

6.2.5 Technological Hazards

Among technological hazards, the HRVA highlighted:

- **Rail Incidents**: With a high-risk score of 132, rail incidents are a primary concern due to previously mentioned factors.
- **Structure Fires**: Scoring 130, structure fires remain a significant risk, necessitating ongoing fire prevention and response efforts.
- **Hazardous Materials Incidents**: With a score of 111, incidents involving hazardous materials, whether during transportation or at fixed facilities, pose substantial risks to public health and safety.

6.2.6 Conflict-Related Hazards

While specific conflict-related hazards, such as Intentional Acts involving Chemical, Biological, Radiological, Nuclear, and Explosive (CBRNE) materials, Active Threats, and Hijackings, have high consequence scores, their lower likelihood results in comparatively lower overall risk scores.

The evolving tariff issues with the United States borders on conflict-related

6.2.7 Alignment with Regional Assessments

The findings of Pitt Meadows' HRVA are consistent with regional assessments conducted by Metro Vancouver. For instance, Metro Vancouver's **Regional Multi-Hazard Mapping Project** identified that approximately 63% of the region's land base is susceptible to one to three hazard types, including coastal flooding, river flooding, earthquakes, and wildfires.

6.2.8 Benchmark for Future Analysis

This HRVA is a benchmark for future analyses, providing a foundational understanding of the city's risk profile. It underscores the importance of continuous monitoring, assessment, and mitigation efforts to enhance community resilience against identified hazards.

6.2.9 Human Disease Considerations

The HRVA also identified human diseases as posing very high consequences to the region. However, due to the assigned likelihood, the overall risk score for this category was lower, highlighting the need for public health preparedness and monitoring to address potential disease outbreaks.

In summary, the HRVA comprehensively evaluates the various hazards facing Pitt Meadows, aligning with regional assessments and serving as a critical tool for future emergency planning and risk mitigation efforts.

Incident Type	Likelihood (1-5)	Human and Social Impacts (0-24)	Physical and Economic Impacts (0-20)	Overall Consequence (0-44)	Risk (0-220)
Rail Incident	4	18	15	33	132
Structure Fire	5	12	14	26	130
Hazardous Materials Release- Land	3	21	16	37	111
Aircraft Incident	5	10	9	19	95
Rainfall Event	4	11	10	21	82
Overland flooding	4	9	11	20	80
Motor Vehicle Incident	5	10	6	16	80
Drought	4	6	13	19	76
Fires (Wildfire and Wildland-Urban Interface)	3	11	14	25	75
Potable Water Supply Interruption	4	5	13	18	72
Building Collapse	4	9	9	18	72
Wind Event	5	7	7	14	70
Thunderstorm	5	8	6	14	70
Heat Event	4	9	8	17	68
Active Threat	4	9	8	17	68
Waste Water Interruption	4	7	10	17	68
Hazardous Materials Release - Marine	3	10	12	22	66
Cyber Security Threat	5	4	9	13	65
Public Disturbance	4	7	9	16	64
Rivers, Lakes, and Stream Flooding	3	8	13	21	63
Marine Vessel Incident	4	6	8	14	56
Land Subsidence and Sinkholes	4	6	8	14	56
Cold Event	4	7	7	14	56
Health Interruption	3	11	5	16	48
Electrical Power Outage	5	3	5	8	40
Air Quality	4	7	3	10	40
Human Disease	2	12	8	20	40
Snow Event	4	4	6	10	40
Megathrust Earthquake	1	22	18	40	40
Coastal Flooding	3	2	11	13	39
Dam Failure	2	11	7	18	36
Avalanche	3	7	5	12	36
Earthquake	1	18	17	35	35
Animal Disease	3	2	9	11	33
Bridge Collapse	3	3	8	11	33
Intentional Acts of CBRNE	1	14	16	30	30
Freeze Event	4	2	5	7	28
Communications Interruption	4	4	3	7	28
Food Supply Chain Interruption	3	5	4	9	27
Landslide	2	8	4	12	24
Geomagnetic Storm	3	3	5	8	24
Hail	4	2	4	6	24
Saltwater Intrusion	3	0	7	7	21
Fog	5	3	1	4	20
Tsunami	1	10	9	19	19
Coastal Erosion and Sedimintation	2	5	4	9	18
Fuel Supply Interruption	3	3	3	6	16
Hijacking	1	8	7	15	15
Volcanic Ash Fallout	1	5	9	14	14
Insect Infestation and Plan disease	2	1	6	6	12
Extraterrestrial Debris	1	6	4	10	10
Sieche	1	3	0	3	3

Figure 6: Pitt Meadows Risk Scores

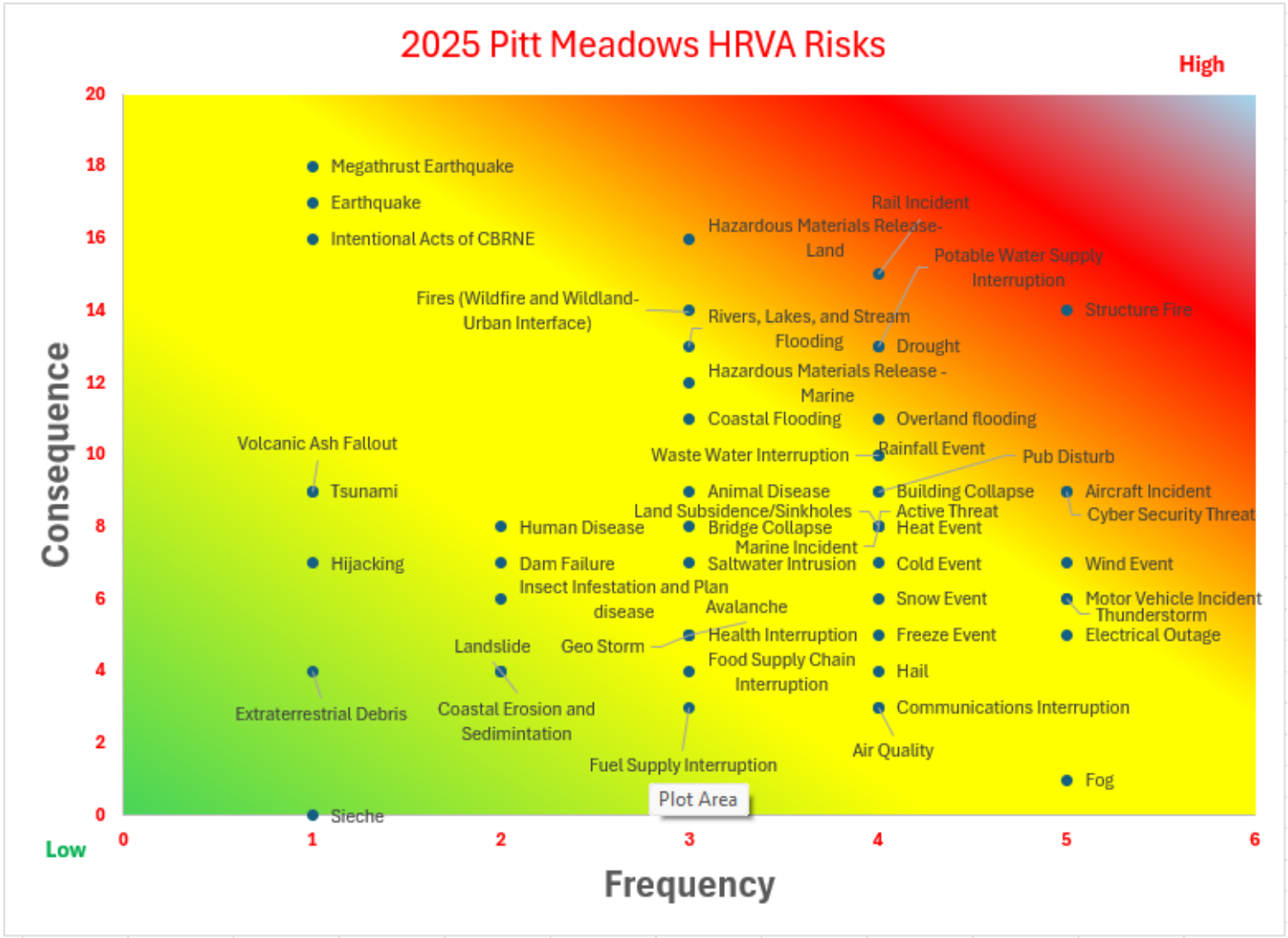

Figure 7: Distribution and prioritization of risks reflect a combination of frequency, consequence, and the City of Pitt Meadows's ability to manage or eliminate the risk.

6.3 Rail Incident

Rail incidents pose a critical threat to the City of Pitt Meadows. The risks are multifaceted—ranging from hazardous materials releases to disruptions in emergency response—and are compounded by the city's unique geography and ongoing development patterns. With a significant CP Rail line bisecting the town center and plans for expanding intermodal, dangerous goods storage, and distribution facilities, the potential impacts on public safety, transportation, and local businesses are significant.

Rail Incidents have a Risk Rating of 132.

6.3.1 Hazard Description

Hazardous Materials Releases:
Rail lines in Pitt Meadows transport a range of hazardous materials. In an accident or derailment, a spill of chemicals or flammable substances could lead to immediate public health risks, environmental contamination, and costly cleanup operations.

Reference: *Transport Canada provides guidelines on hazardous materials transport and incident response (Transport Canada, 2020).*

Transportation Blockage and Emergency Response Disruption:
Rail incidents can lead to significant blockage of critical roadways. Level crossings near the CP Rail line could be obstructed, hindering the regular flow of traffic and delaying emergency response vehicles, thereby exacerbating the incident's overall impact.

Reference: *Metro Vancouver's Regional Multi-Hazard Mapping Project emphasizes the interconnectedness of transportation networks and the cascading impacts of infrastructure failures (Metro Vancouver, 2019).*

Proximity to Residential and Commercial Areas:
The rail line runs through densely populated areas of Pitt Meadows, placing homes, schools, and businesses at heightened risk. A rail accident close to these areas could result in significant casualties, property damage, and long-term disruption to community life.

Reference: *The City of Pitt Meadows Official Community Plan (OCP) highlights the risks associated with urban development near critical infrastructure (City of Pitt Meadows, 2022).*

Changing Risk Profile Due to Development:
Ongoing development of intermodal facilities and dangerous goods storage/distribution sites near the rail corridor alters the risk landscape. Increased rail traffic, higher volumes of hazardous materials, and more concentrated populations near these facilities all contribute to a higher overall risk.

Reference: Regional planning documents and assessments by Metro Vancouver note that urban expansion near rail corridors requires updated risk management strategies (Metro Vancouver, 2020).

6.3.2 Risk Factors

- **Frequency and Volume of Rail Traffic**: An increase in rail traffic—primarily focusing on dangerous goods—raises the probability of incidents.
- **Infrastructure Age and Maintenance**: Aging rail infrastructure and the complexity of maintaining critical assets like level crossings and rail bridges can increase the likelihood of an incident and the severity of its consequences.
- **Population Density and Land Use**: The proximity of the rail corridor to densely populated residential and commercial zones magnifies the potential impacts.
- **Emergency Response Limitations**: Limited on-site resources and the potential for blocked road access can delay critical emergency response, increasing casualty and damage outcomes.

6.3.3 Consequence Analysis

- **Human Health and Safety**: Potential mass casualties, injuries, or toxic exposures from hazardous material releases.
- **Infrastructure and Economic Impacts**:
  - Disruption of essential services due to blocked transportation corridors.
  - High costs associated with emergency response, cleanup, and long-term reconstruction.
  - Losses for local businesses and interruption of supply chains.
- **Environmental Consequences**:
  - Chemical spills and contamination could impact soil, water, and local ecosystems, with long-term remediation costs.
- **Reputational Impacts**:
  - A rail incident's handling (or mishandling) can significantly affect public trust in municipal governance and emergency management. This risk is integrated into the city's overall risk-scoring and planning processes.

6.3.4 Vulnerability Analysis

Several local and regional factors shape Pitt Meadows' vulnerabilities:

- **Geographic Exposure**: The rail line's course through the city center increases exposure.
- **Development Patterns**: Rapid urbanization and the planned expansion of industrial facilities contribute to heightened risk.
- **Interdependencies with Regional Networks**: Pitt Meadows is part of the larger Metro Vancouver region, meaning that rail incidents have broader implications for transportation and emergency response across multiple jurisdictions.
- Preparedness Gaps: Although emergency plans are in place, evolving risks—such as increased rail traffic and hazardous materials transport—require continuous updates to emergency response protocols.

6.3.5 Mitigation and Preparedness Measures

To reduce the risk and potential impacts of rail-related incidents, the following strategies are recommended:

- **Enhanced Infrastructure Monitoring and Maintenance**:
  - Regular inspections and modernization of rail infrastructure and level crossings.
  - Upgrading signalling and safety systems along critical corridors.

Reference: *BC Ministry of Transportation and Infrastructure provides guidelines for rail systems' maintenance and risk mitigation (BC Ministry of Transportation, 2021).*

- **Robust Emergency Response Planning**:
  - Develop and regularly update comprehensive emergency response plans that specifically address rail incidents.
  - Conduct joint exercises with CP Rail, local emergency services, and regional partners.

Reference: *Public Safety Canada's emergency management guidelines emphasize the importance of coordinated response efforts (Public Safety Canada, 2019).*

- **Public Communication and Reputational Management**:
  - Integrate reputational risk into the overall risk-scoring framework to ensure proactive communication strategies are in place.
  - Leverage social media and traditional channels to provide timely and accurate emergency updates.

Reference: *Metro Vancouver and the City of Pitt Meadows both recognize the role of effective communication in mitigating reputational risk (Metro Vancouver, 2020).*

- **Risk-Informed Land Use Planning**:
  - Ensure that future developments near the rail corridor incorporate risk reduction measures, such as adequate buffer zones and enhanced safety standards.
  - Align municipal planning policies with regional hazard assessments to minimize exposure.

Reference: *The City of Pitt Meadows Official Community Plan (OCP) outlines land use strategies to mitigate risks from nearby rail operations (City of Pitt Meadows, 2022).*

- **Collaboration and Continuous Improvement**:
  - Establish regular communication channels between municipal authorities, CP Rail, regional emergency management, and other stakeholders.
  - Utilize lessons learned from past incidents and ongoing risk assessments (such as the HRVA) to continuously refine risk profiles and response strategies.

Rail incidents represent a critical and evolving risk for Pitt Meadows, with far-reaching implications for public safety, infrastructure integrity, and the region's economic stability. By integrating data from local, regional, provincial, and national sources, Pitt Meadows' risk profile for rail-related incidents underscores the necessity for enhanced monitoring, robust emergency

planning, and proactive land use and reputational management strategies. These efforts, informed by ongoing assessments such as the HRVA and aligned with the City's Official Community Plan, are essential to safeguard the community in an increasingly complex risk environment.

6.4 Structure Fires

Structure fires represent a significant threat to the City of Pitt Meadows, given its diverse mix of residential, commercial, light industrial, large logistics and distribution facilities, and agricultural establishments. This varied landscape introduces a complex array of fire risks that necessitate comprehensive understanding and proactive management.

6.4.1 Hazard Description

- **Residential Properties**: The city's residential areas, comprising single-family homes, townhouses, and multi-family units, are susceptible to fires from cooking incidents, heating equipment malfunctions, electrical faults, and human negligence.
- **Commercial and Light Industrial Facilities**: These establishments often house flammable materials and complex electrical systems, increasing the potential for fires due to equipment failures, improper storage practices, or operational errors.
- **Logistics and Distribution Centers**: The presence of large warehouses and distribution hubs introduces risks associated with high storage densities, extensive packaging materials, and the operation of heavy machinery, all of which can contribute to fire outbreaks.
- **Agricultural Facilities**: Farms and related structures are prone to fires from equipment use, combustible materials like hay storage, complex agri-business facilities in otherwise traditional farms, and potential exposure to open flames during activities such as welding or controlled burns.

6.4.2 Risk Factors

- **Aging Infrastructure**: Older buildings may lack modern fire suppression systems or have outdated electrical installations, elevating fire risks.
- **High Occupancy Levels**: Buildings with significant human traffic, such as shopping centers or event venues, face increased fire hazards due to potential evacuation challenges and higher chances of ignition sources.
- **Proximity of Structures**: Densely built areas can facilitate the rapid spread of fires between adjacent buildings, complicating containment efforts.
- **Storage of Hazardous Materials**: Both industrial and agricultural sites may store flammable or reactive substances, which can exacerbate fire severity and pose additional dangers to responders.

6.4.3 Consequence Analysis

- **Human Impact**: Fires can result in injuries or fatalities among residents, workers, and emergency personnel.

- **Property Damage**: Significant destruction of buildings, equipment, and inventory can occur, leading to substantial financial losses.
- **Operational Disruption**: Fires may halt business operations, cause supply chain interruptions, and lead to job losses, affecting the local economy.
- **Environmental Harm**: Releasing hazardous substances during fires can contaminate air, soil, and water sources, necessitating extensive remediation efforts.

6.4.4 Vulnerability Analysis

- **Community Preparedness**: The level of public awareness and readiness to respond to fire emergencies influences overall vulnerability.
- **Emergency Response Capacity**: The effectiveness of the Pitt Meadows Fire & Rescue Service (PMFRS) in terms of staffing, equipment, and training is crucial in mitigating fire impacts.
- **Building Code Compliance**: Adherence to fire safety regulations and implementing fire-resistant construction practices are vital in reducing vulnerabilities.

6.4.5 Mitigation and Preparedness Measures

- **Fire Safety Plans**: The City mandates that buildings develop comprehensive fire safety plans per Section 2.8.2 of the British Columbia Fire Code. These plans should detail emergency procedures, maintenance schedules for fire protection systems, and evacuation protocols.
- **Regular Inspections and Maintenance**: Conducting routine inspections of electrical systems, heating equipment, and fire suppression installations can identify potential hazards before they result in fires.
- **Public Education Initiatives**: PMFRS engages in community outreach to educate residents and businesses on fire prevention strategies, the importance of smoke detectors, and the development of home evacuation plans.
- **Enhanced Emergency Response**: Transitioning to a 24-hour shift model, as implemented by PMFRS in January 2025, aims to improve response times and operational efficiency during emergencies.
- **Investment in Infrastructure**: Completing the new Fire Hall and Emergency Operations Centre in 2023 reflects the city's commitment to bolstering its emergency response capabilities.

By addressing these risk factors through comprehensive planning, community engagement, and continuous investment in emergency services, Pitt Meadows aims to mitigate the threat of structure fires and enhance overall public safety.

6.5 Hazardous Materials – Land

Hazardous materials incidents—whether from industrial facilities, vehicles, or rail transport—pose a critical threat to the City of Pitt Meadows. These incidents can lead to toxic exposure, explosions, fires, environmental contamination, and long-term remediation challenges, significantly impacting public safety, municipal operations, and regional trust. Given the city's limited capacity for handling large-scale hazardous materials incidents, coordination with regional, industry, and provincial response agencies is essential.

6.5.1 Hazard Description

Sources of Hazardous Materials Incidents:

- **Facility-Originated Incidents**
  - Industrial, agricultural, and commercial sites within Pitt Meadows store, process, and handle chemicals, fuels, and hazardous waste.
  - Equipment failures, human error, fires, or structural issues can lead to leaks, spills, or explosions.
- **Vehicle-Related Incidents**
  - The city's major transportation corridors (Highway 7, Lougheed Highway, and arterial road networks) are used to transport hazardous goods.
  - Traffic collisions, improper loading, or vehicle malfunctions can result in spills, leaks, or fire hazards.
- **Rail-Related Incidents**
  - The CP Rail line bisecting the city carries hazardous materials, including flammable liquids, corrosive substances, and compressed gases.
  - Derailments, track failures, or collisions can lead to significant large-scale emergencies.

6.5.2 Risk Factors in Pitt Meadows

- **Limited Local Emergency Response Capacity**
  - Pitt Meadows Fire & Rescue Service (PMFRS) has limited hazardous materials response capabilities.
  - The department does not have a dedicated hazardous materials response team and relies on mutual aid agreements for large-scale incidents.
- **Dependence on Regional, Provincial, and Industry Response Teams**
  - Metro Vancouver hazardous materials teams may assist but require time for deployment.
- **Industry-specific emergency response units** (e.g., CP Rail and industrial partners) are primary responders for rail-related hazmat events.
  - Emergency Management BC (EMBC) and Provincial Spill Response Teams may coordinate efforts in catastrophic hazardous materials releases.
- **Proximity to High-Risk Areas**
  - Industrial and agricultural facilities near residential neighbourhoods elevate human exposure risks.

    - Rail corridors pass through the urban center, increasing potential evacuation complexities in case of an incident.
- Aging Infrastructure & Increased Transport Volumes
    - Older industrial sites may have legacy storage tanks or pipelines at risk of failure.
    - Higher rail traffic and growing logistics operations increase the likelihood of hazardous materials transport incidents.

6.5.3 Consequence Analysis

- Health and Safety Risks
    - Exposure to toxic substances can lead to acute respiratory distress, burns, poisoning, or fatalities.
    - Fire and explosion hazards from volatile chemicals can impact residents and responders.
- Evacuation and Emergency Response Challenges
    - Major hazmat events may require large-scale evacuations of residential neighbourhoods and businesses.
    - Blocked rail crossings or damaged roadways can hamper emergency response and medical transport.
- Environmental Contamination and Long-Term Remediation
    - Spills into the Fraser River, Pitt River, or agricultural lands can cause widespread water and soil contamination.
    - Remediation efforts may take years, affecting local ecosystems, drinking water sources, and agricultural productivity.
- Economic and Reputational Damage
    - Business closures, agricultural losses, and property damage can create long-term economic instability.
    - A poorly managed response could erode public trust in municipal leadership and emergency management.

6.5.4 Emergency Response Capacity in Pitt Meadows

- **Local Response Limitations**
    - The Pitt Meadows Fire & Rescue Service (PMFRS) has limited hazardous materials incident management capabilities.
        - No dedicated hazmat unit exists within the fire department, requiring reliance on:
    - **Mutual aid agreements with Metro Vancouver fire services.**
        - Provincial emergency response units (EMBC & BC Environmental Emergency Program).
        - Private industry hazmat teams (e.g., CP Rail Emergency Response, local industrial facilities).
        - Regional and Provincial Response Coordination
    - Metro Vancouver Regional Hazardous Materials Teams

        - These teams specialize in containment, decontamination, and public safety measures.
        - Deployment time may vary depending on incident location and severity.
    - **Emergency Management BC (EMBC) & BC Environmental Emergency Program**
        - Manages large-scale hazardous materials incidents affecting multiple jurisdictions
        - Provides coordination between municipal, provincial, and federal agencies
    - **CP Rail and Industrial Emergency Response Teams**
        - CP Rail has a dedicated emergency hazmat team to respond to rail-related incidents.
        - Industrial partners may be responsible for site-based hazardous materials response and cleanup.

6.5.5 Mitigation and Preparedness Strategies

- **Municipal Planning and Land Use Policies**
    - Strengthen land use regulations to ensure sufficient buffer zones between hazardous materials sites and residential areas.
    - Enhance industrial facility oversight by requiring regular hazardous materials safety audits and compliance checks.
- **Infrastructure and Response Enhancements**
    - Improve transportation safety measures, including hazmat routing restrictions and vehicle inspections.
    - Upgrade emergency response capabilities, including specialized hazmat training for Pitt Meadows Fire & Rescue personnel.
- **Public Awareness and Evacuation Readiness**
    - Increase public education on shelter-in-place and evacuation procedures for hazardous materials incidents.
    - Develop real-time emergency notification systems to alert residents of chemical spills, fires, or evacuation orders.
- Regional and Industry Coordination
    - Formalize response agreements with Metro Vancouver hazmat teams, provincial agencies, and industry partners.
    - Conduct multi-agency training drills simulating large-scale hazardous materials emergencies.

Hazardous materials incidents present a significant and evolving risk to Pitt Meadows, with potential consequences for public safety, environmental sustainability, and municipal operations. Given the city's limited emergency response capacity, a coordinated regional, provincial, and industry-led approach is essential.

By investing in emergency response training, land use planning, public education, and interagency collaboration, Pitt Meadows can strengthen its resilience against hazardous materials events and ensure community safety.

6.6 Aircraft Incident

Aircraft-related incidents at and around Pitt Meadows Regional Airport (YPK) pose a significant threat to the City of Pitt Meadows. The airport's high traffic volume, primarily comprising small aircraft, combined with the limited advanced training of local firefighters and minimal on-site firefighting facilities, exacerbates this risk.

6.6.1 Hazard Description

- **High Traffic Volume**: YPK is a bustling hub for general aviation, hosting numerous flight training schools and recreational pilots. This high air traffic density increases the potential for mid-air collisions and other in-flight emergencies.
- **Small Aircraft Operations**: The prevalence of small aircraft, which often have less advanced avionics and safety features than larger commercial planes, can lead to a higher incidence of operational mishaps.

6.6.2 Recent Incidents

- **Near-Miss Events**: In July 2024, a privately registered Cessna aircraft was involved in three near-miss incidents at YPK. The pilot deviated from instructed flight paths, cutting off multiple aircraft and causing significant disruptions. Fortunately, no collisions occurred, and the aircraft returned safely to its departure point.
- **Landing Gear Malfunction**: In August 2024, a small Cessna-style aircraft experienced a landing gear issue, resulting in a hard, nose-down landing at YPK. There were no injuries, but the incident highlighted potential vulnerabilities in aircraft maintenance and emergency response.

6.6.3 Risk Factors

- **Limited Firefighting Resources**: The Pitt Meadows Fire & Rescue Service (PMFRS) provides fire suppression and rescue services but lacks specialized training and equipment for aircraft-specific incidents. The absence of a dedicated Aircraft Rescue and Firefighting (ARFF) unit on-site means response times and effectiveness may be compromised during aviation emergencies.
- **Training Gaps**: While PMFRS personnel undergo regular training, advanced ARFF training is not standard. Specialized programs, such as those offered by Firemedix Fire Academy, are available but may not be routinely accessible to all local firefighters.
- **Proximity to Urban Areas**: YPK's location near residential and commercial zones increases the potential impact radius of any aircraft incident, posing risks to both people and property on the ground.

6.6.4 Consequence Analysis

- **Human Impact**: Potential for injuries or fatalities among passengers, crew, and residents near an incident.

- **Property Damage**: Aircraft accidents can significantly damage airport infrastructure, nearby buildings, and other assets. Buildings under or adjacent to glide paths are particularly at risk.
- **Environmental Concerns**: Fuel spills and hazardous material releases can result in environmental contamination, affecting local ecosystems.
- **Operational Disruption**: Incidents can cause temporary airport closures, leading to economic losses and logistical challenges.

6.6.5 Mitigation and Preparedness Measures

- **Enhanced Training**: Investing in specialized ARFF training for PMFRS personnel can improve readiness and response capabilities. Collaborations with training centers like Firemedix Fire Academy could be beneficial.
- **Infrastructure Development**: Establishing on-site firefighting facilities equipped to handle aircraft emergencies can significantly reduce response times and improve outcomes.
- **Community Awareness**: Educating the public about aviation safety and emergency procedures can enhance community resilience and preparedness.
- **Policy and Planning**: Developing comprehensive emergency response plans that include coordination with regional and national aviation authorities ensures a unified approach during incidents.

By addressing these risk factors through targeted training, infrastructure improvements, and strategic planning, Pitt Meadows can enhance its preparedness for aircraft-related incidents, safeguarding its residents and assets.

6.6 Rain Event

Climate change is increasing the frequency and intensity of extreme rain events, posing a growing threat to communities in the Fraser Valley. Pitt Meadows is particularly vulnerable with its low-lying lands between the Pitt, Fraser, and Alouette Rivers. The city's dependence on dikes and pump stations to manage floodwaters, combined with urban and agricultural development, creates a complex risk environment for rain-related incidents.

6.6.1 Hazard Description

- **Intense Rainfall and Atmospheric River Events**: Extreme rain events, often driven by atmospheric river systems, are becoming more common in British Columbia (BC Ministry of Environment and Climate Change Strategy, 2019). These events can produce short, intense periods of precipitation that overwhelm natural and engineered drainage systems.
- **Riverine Flooding**: As heavy rainfall increases, so do river levels in the Pitt, Fraser, and Alouette Rivers. This can result in riverine flooding, particularly when peak flows coincide with high tides or storm surges, leading to elevated flood levels in downstream communities.
- **Overland (Pluvial) Flooding**: Urbanization has increased the number of impermeable surfaces in Pitt Meadows, reducing natural water absorption and increasing surface runoff. This can cause localized flooding even in areas not directly adjacent to significant water bodies.

6.6.2 Risk Factors

- **Geographic Vulnerability**: Pitt Meadows is located on low-lying land between multiple rivers, which makes it highly susceptible to flooding. Historical flood events in the Fraser Valley underscore the region’s sensitivity to heavy rain (Environment and Climate Change Canada, 2019).
- **Dependence on Flood Protection Infrastructure**: The city relies on a network of dikes, pump stations, and drainage systems to control floodwaters. Aging infrastructure and the potential for increased demand during extreme weather events may reduce system effectiveness (City of Pitt Meadows Official Community Plan, 2022).
- **Urbanization and Land Use Change**: Continued development has increased impermeable surfaces, reducing the natural capacity for water infiltration. The rapid urban growth projected in the region (up to 12% population increase over the next decade) intensifies the risk of overland flooding (City of Pitt Meadows OCP, 2022).
- **Climate Change Impacts**: Projections indicate that BC will experience more extreme rainfall as temperatures rise, leading to altered precipitation patterns and an increased likelihood of severe flood events (BC Ministry of Environment and Climate Change Strategy, 2019).

6.6.3 Consequence Analysis

- **Public Safety and Health**: Flooding can endanger lives by trapping residents, causing injuries, or leading to waterborne diseases. Rapid-onset floods also complicate emergency evacuations, potentially delaying response times.
- **Infrastructure Damage**: Floodwaters can compromise roads, bridges, and public utilities. Overwhelmed pump stations and dikes may fail during prolonged events, leading to widespread structural damage in residential and commercial areas.
- **Economic and Agricultural Impacts**: Flooding can disrupt local businesses and damage agricultural lands, affecting livelihoods and food security. Damage to farmlands not only impacts crop yields but may also lead to long-term soil degradation.
- **Environmental Degradation**: Excess water can cause erosion, sedimentation, and contamination of water bodies, affecting local ecosystems. Urban runoff and industrial site contaminants may be carried into the rivers, impacting aquatic life and water quality.
- **Reputational and Operational Impacts**: Inadequate flood response or infrastructure failures may erode public trust in municipal governance. Effective management of these risks is critical for maintaining community confidence.

6.6.4 Vulnerability Analysis

- **Infrastructure Limitations**: The effectiveness of current flood protection measures, including dikes and pump stations, is a key vulnerability. Aging infrastructure and limited capacity to handle increased runoff during extreme rain events amplify risk.
- **Interconnected Regional Systems**: Pitt Meadows is part of the larger Metro Vancouver and Fraser Valley region. Flooding upstream or in adjacent communities can have cascading effects, further challenging local emergency response efforts through limited regional response capabilities.
- **Emergency Response Preparedness**: The local emergency management framework must coordinate with regional and provincial agencies to manage flood events. However, resource constraints and infrastructure limitations can impede rapid response.

6.6.5 Mitigation and Preparedness Measures

- **Infrastructure Upgrades**:
    - **Dike and Pump Station Enhancements**: Prioritize investment in modernizing and expanding flood protection infrastructure to handle higher water volumes.
    - **Green Infrastructure**: Integrate permeable pavements, green roofs, and increased urban green spaces to reduce surface runoff and enhance natural water absorption.
- **Enhanced Flood Forecasting and Early Warning Systems**:

    - Utilize data from Environment and Climate Change Canada and regional monitoring networks to improve flood prediction and public alert systems.

- **Land Use and Development Controls**:
    - Implement strict zoning regulations to limit new developments in high-risk flood zones.
    - Encourage developments that incorporate flood-resilient designs.
- **Regional Coordination and Emergency Planning**:
    - Work closely with Metro Vancouver, Emergency Management BC, and provincial authorities to ensure a coordinated response to flood events.
    - Conduct regular multi-agency training exercises and update emergency response plans to reflect evolving risks.
- **Community Engagement and Public Awareness**:
    - Increase public education on flood preparedness, including evacuation procedures and the importance of emergency supplies.
    - Develop clear communication channels to provide timely updates during extreme weather events.

As climate change drives more extreme rainfall events, Pitt Meadows faces a heightened risk of flood-related incidents. The city's unique geographic location, reliance on aging flood protection infrastructure, and urban development make it particularly susceptible to the consequences of extreme rain events. By investing in infrastructure upgrades, enhancing regional coordination, and promoting community preparedness, Pitt Meadows can mitigate the risks and strengthen its resilience against future flood events.

6.7 Overland Flooding

Overland flooding—often called pluvial flooding—has become an increasing threat to Pitt Meadows due to climate change, rapid urban development, and its unique geographical setting. The city’s location on low-lying lands between the Pitt, Fraser, and Alouette Rivers and its dependence on aging dikes and pump stations make it particularly vulnerable to these events.

6.7.1 Hazard Description

- **Definition of Overland Flooding:**
  Overland flooding occurs when intense rainfall overwhelms natural and engineered drainage systems, accumulating surface water on roads, properties, and public spaces—even in areas not adjacent to major rivers.
    - *Reference*: Maksimovic, 2015.

- **Climate Change Connection:**
  Climate change is increasing the intensity and frequency of extreme rain events, as Environment and Climate Change Canada (2019) and the BC Ministry of Environment and Climate Change Strategy (2019) noted. Warmer temperatures increase atmospheric moisture capacity, resulting in more intense and concentrated rainfall events that can trigger overland flooding.

6.7.2 Risk Factors

- **Geographical Vulnerability:**
  - **Low-Lying Lands:** Pitt Meadows is situated on flat, low-lying terrain between multiple rivers, making it susceptible to riverine and overland flooding.
  - **Proximity to Water Bodies:** The city's closeness to the Pitt, Fraser, and Alouette Rivers increases the likelihood that extreme rain events can result in rapid surface runoff and inundation.
- **Dependence on Flood Protection Infrastructure:**
  - **Dikes and Pump Stations:** Pitt Meadows relies on a dikes and pump stations network to control floodwaters. Aging infrastructure and capacity limitations mean that during extreme rainfall events, these systems may become overwhelmed, leading to localized flooding.
  - **Urbanization:** Increased impervious surfaces from residential, commercial, and industrial development reduce the land's natural ability to absorb rainwater, further exacerbating runoff and flood risk.
  - *Reference*: the City of Pitt Meadows Official Community Plan (OCP, 2022).
- **Regional and Climatic Factors:**
  - **Atmospheric Rivers:** Weather systems known as atmospheric rivers can deliver intense rainfall over short periods. For example, the November 2021 atmospheric river event in the Fraser Valley led to widespread flooding and overwhelmed drainage systems in several communities.
  - *Reference*: Environment and Climate Change Canada (2019); Metro Vancouver Regional Multi-Hazard Mapping Project (2019).

6.7.3 Consequence Analysis

- **Public Safety and Health:**
  - Rapid-onset flooding can trap residents, damage property, and increase the risk of waterborne diseases.
  - Evacuation challenges may arise if roads are impassable due to standing water.

- **Infrastructure Damage:**
    - Floodwaters can damage roads, bridges, and utility networks, leading to long-term disruptions and high repair costs.
    - Failure of dike and pump station systems during extreme events can lead to cascading failures across the city's infrastructure.
- **Economic Impacts:**
    - Business interruptions, agricultural losses, and property damage can have severe economic repercussions.
    - Long-term recovery efforts and remediation add to municipal financial burdens.
- **Environmental Consequences:**
    - Overland flooding can lead to soil erosion, water quality degradation, and contamination from urban runoff, affecting local ecosystems and agricultural productivity.
- **Reputational and Operational Impacts:**
    - Ineffective response to flooding can erode public trust in municipal governance and emergency management, impacting future resilience initiatives.

6.7.4 Vulnerability Analysis

- **Aging Flood Protection Systems:**
    - Critical for flood management, the current dikes and pump stations may not be adequately sized or maintained to handle future extreme rainfall events.
- **Urbanization and Land Use Changes:**
    - Continued development in Pitt Meadows increases impermeable surfaces, reducing natural water absorption and worsening runoff during storms.
- **Interconnected Regional Systems:**
    - Pitt Meadows is part of the larger Metro Vancouver and Fraser Valley network, meaning that upstream events and regional climate impacts can have cascading effects on the city.
- **Emergency Response Limitations:**
    - Resource constraints and capacity limits in local emergency services can delay flood response efforts, increasing the overall impact on the community.
    - *Reference*: City of Pitt Meadows Emergency Management Reports; Metro Vancouver Emergency Preparedness Guidelines.

6.7.5 Mitigation and Preparedness Strategies

- **Infrastructure Upgrades:**
    - Modernize and expand the capacity of dikes and pump stations to manage increased water volumes. Recent updates to pumps and emergency power are helpful.
    - Incorporate green infrastructure solutions such as permeable pavements, rain gardens, and restored wetlands to enhance natural water absorption.
    - *Reference*: BC Ministry of Environment and Climate Change Strategy (2019).
- **Enhanced Flood Forecasting and Early Warning Systems:**
    - Utilize improved meteorological data from Environment and Climate Change Canada and regional monitoring networks to provide timely alerts to residents.
    - Invest in technology and communication systems that rapidly disseminate warnings and evacuation orders.
- **Land Use Planning and Zoning:**
    - Implement zoning restrictions to limit new developments in high-risk flood zones.
    - Encourage developments incorporating flood-resilient design principles, such as elevated structures and water-resistant materials.
    - *Reference*: the City of Pitt Meadows Official Community Plan (OCP, 2022).
- **Regional Coordination and Emergency Preparedness:**
    - Foster collaboration with Metro Vancouver, Emergency Management BC, and provincial agencies to ensure a coordinated response to flood events.
    - Conduct regular multi-agency drills and review emergency plans to adapt to evolving flood risks.
- **Community Engagement and Public Education:**
    - Increase public awareness of flood preparedness, evacuation procedures, and the importance of emergency kits.
    - Establish clear communication channels to keep residents informed before, during, and after flood events.
    - *Reference*: Local community education initiatives; Metro Vancouver Public Safety Communications.

As climate change drives more extreme rainfall events, Pitt Meadows faces a heightened risk of overland flooding. The city's low-lying geography, reliance on aging flood protection infrastructure, and ongoing urbanization significantly contribute to its vulnerability. By prioritizing

infrastructure upgrades, enhanced forecasting, robust land use planning, and coordinated emergency response, Pitt Meadows can improve its resilience to overland flooding events and protect its residents, infrastructure, and environment from future impacts.

6.8 Vehicle Collision

Motor vehicle incidents represent an increasing threat to the City of Pitt Meadows. Growing commuter volumes, increased commercial vehicle movement, and volatile weather conditions driven by climate change contribute to a rising frequency of collisions. These incidents significantly affect public safety, infrastructure integrity, and local economic stability.

6.8.1 Hazard Description

- **Increased Traffic Volumes**: Pitt Meadows experiences a steady increase in daily traffic due to commuter flows and commercial transportation. The city's proximity to major routes like Highway 7 and the Golden Ears Bridge makes it a key transit corridor within the Metro Vancouver region.
- **Weather-Related Risks**: Climate change contributes to more extreme and variable weather conditions. Intense rainfall, fog, and icy conditions during winter can degrade road conditions, reduce visibility, and increase braking distances, leading to a higher incidence of collisions.
    - *Reference*: *BC Ministry of Environment and Climate Change Strategy (2019) reports that extreme weather events are becoming more frequent in the region.*
- **Commercial Vehicle Movement**: The growth of intermodal facilities and distribution centers in and around Pitt Meadows has increased heavy truck and commercial vehicle traffic. These vehicles have different handling characteristics and longer stopping distances, which can elevate collision risks, especially in adverse weather.

6.8.2 Risk Factors

- **Volatile Weather Conditions**:
    - **Intense Rainfall and Thunderstorms** can lead to hydroplaning and reduced road traction.
    - **Fog and Low Visibility**: In early mornings and late evenings, contributing to multi-vehicle collisions.
    - **Icy Roads in Winter**: Fluctuating temperatures increase the likelihood of black ice formation.
    - *Reference*: Environment and Climate Change Canada (2019) and local weather service data confirm rising trends in extreme weather events.
- **Traffic Congestion and Infrastructure Limitations**:
    - **High Volume on Major Corridors**: The heavy use of Highway 7, a critical artery through Pitt Meadows, can lead to congestion that increases collision risk.

    - **Aging Road Infrastructure**: Some roadways may not have been upgraded to current safety standards, exacerbating the risk during high traffic volumes and adverse weather.
    - **Rail Crossings**: Pitt Meadows's dependence on level crossings results in frequent congestion due to traffic disruptions from train operations. Driver fatigue, frustration, and traffic volumes increase the risk of incidents.
- **Driver Behavior and Commercial Pressures**:
    - **Increased Commercial Traffic**: Tight delivery schedules and driver fatigue can contribute to accidents.
    - **Distracted Driving**: A growing concern nationally, affecting commuter safety.
    - *Reference*: National Highway Traffic Safety Administration (NHTSA) and provincial reports highlight the impact of driver behaviour on collision rates.

6.8.3 Consequence Analysis

- **Human Impact**:
    - **Injuries and Fatalities**: Collisions may result in serious injuries or deaths, placing stress on local healthcare and emergency services.
    - **Public Safety Concerns**: Repeated incidents can reduce community confidence in transportation safety.
- **Economic and Infrastructure Impacts**:
    - **Road and Bridge Damage**: Frequent collisions can lead to costly repairs and traffic disruptions.
    - **Business Disruptions**: Accidents may interrupt commercial activity, delay deliveries, and affect local supply chains.
    - **Emergency Response Delays**: Traffic congestion and blocked roadways hinder the ability of first responders to reach incident sites quickly.
- **Reputational Effects**:
    - A pattern of frequent accidents can damage the municipal reputation, affect public trust, and influence future transportation planning decisions.
- **Recent Incident Examples**:
    - In 2023, **Maple Ridge News** reported a series of collisions on Highway 7 near Pitt Meadows during heavy rainfall, resulting in temporary road closures and significant commuter delays.

- Local media have highlighted incidents where adverse weather conditions contributed to multi-vehicle accidents, emphasizing the urgent need for enhanced safety measures.

6.8.4 Vulnerability Analysis

- **Geographic Vulnerability**: Pitt Meadows' location as a key transit corridor exposes it to high traffic volumes, particularly on major routes where accidents can have cascading effects throughout the region.
- **Infrastructure and Roadway Conditions**: Aging or inadequately maintained road infrastructure increases vulnerability during extreme weather events. Limited roadway capacity and insufficient drainage exacerbate the risk of hydroplaning and accidents.
- **Emergency Response Limitations**: While local emergency services are active, increased traffic congestion, rail disruptions to emergency response routes, and accident frequency can overwhelm response capacities, leading to delays in medical care and traffic management during peak periods.

6.8.5 Mitigation and Preparedness Strategies

- **Infrastructure Improvements**:
  - **Road Upgrades**: Invest in resurfacing, enhanced drainage systems, and widening key corridors like Highway 7.
  - **Rail Crossing Upgrades**: Work with other orders of government and industry to evaluate crossing solutions for key emergency response and traffic corridors.
  - **Smart Traffic Management**: Implement real-time monitoring systems and adaptive traffic signal controls to manage congestion during adverse weather.
- **Enhanced Weather Monitoring and Public Alerts**:
  - **Early Warning Systems**: Utilize advanced weather forecasting data from Environment and Climate Change Canada to issue timely alerts to drivers.
  - **Public Education Campaigns**: Inform the community about the risks of driving in extreme weather and promote safe driving practices.
- **Driver Training and Enforcement**:
  - **Commercial Driver Programs**: Lobby provincial and national governments to strengthen commercial vehicle operators' training and fatigue management protocols.
  - **Increased Traffic Enforcement**: Deploy additional patrols and use automated systems to deter distracted driving and speeding, especially during inclement weather.

- **Regional Coordination**:
    - **Collaboration with Metro Vancouver and Provincial Authorities**: Ensure emergency response plans are integrated and coordinated across jurisdictions.
    - **Multi-Agency Drills**: Conduct joint exercises involving local police, fire services, and transportation departments to test and improve response strategies.

The threat of motor vehicle collisions in Pitt Meadows is amplified by increased traffic volumes, volatile weather conditions driven by climate change, and aging infrastructure. Addressing these risks requires a multi-faceted approach that includes infrastructure upgrades, enhanced weather monitoring, public education, and coordinated regional emergency response. By implementing these strategies, Pitt Meadows can mitigate the impacts of motor vehicle incidents and improve safety for its residents and commuters.

6.9 Drought

Drought is emerging as an increasing threat to the City of Pitt Meadows due to the impacts of climate change. Reduced precipitation, higher temperatures, and altered seasonal water patterns will decrease water availability for potable use and agriculture. Pitt Meadows' reliance on regional water sources and its significant agricultural sector—especially water-dependent crops—makes the city particularly vulnerable to drought.

6.9.1 Hazard Description

- **Definition of Drought**:
  Drought is a prolonged period of below-average precipitation resulting in water shortages that affect ecosystems, agriculture, and municipal water supplies. Unlike flash floods, drought develops slowly and can persist over multiple seasons.
- **Climate Change Connection**:
  Climate change is projected to intensify drought risk across British Columbia. According to Environment and Climate Change Canada (2019) and the BC Ministry of Environment and Climate Change Strategy (2019), rising temperatures and shifting precipitation patterns contribute to reduced snowpack and lower summer flows, increasing the severity and frequency of drought events.
- **Local Context**:
  Pitt Meadows' location in the Fraser Valley—where water supply is closely linked to snowmelt and rainfall—places it at risk when these natural water sources become scarce. This is compounded by increased water demand due to population growth and agricultural expansion.

6.9.2 Risk Factors

- **Increased Temperatures and Evaporation**: Rising temperatures accelerate soil and surface water evaporation, reducing available water for human consumption and agriculture.
  - *Reference*: Environment and Climate Change Canada (2019).
- **Reduced Snowpack and Altered Hydrology**: Warmer winters lead to diminished snowpack in the Coast Mountains, a critical source of runoff for the Fraser and Pitt Rivers. Lower snowpack translates to reduced water flow during the summer months.
  - *Reference*: BC Ministry of Environment and Climate Change Strategy (2019).
- **Dependence on Regional Water Supply**:
  Pitt Meadows relies significantly on regional water sources managed by Metro Vancouver and local agencies. Drought in the Fraser Valley can compromise these supplies, affecting potable water and irrigation systems.
  - *Reference*: the City of Pitt Meadows Official Community Plan (OCP, 2022).

- **Agricultural Vulnerability**: A substantial portion of Pitt Meadows' economy is based on agriculture, including water-dependent crops such as berries and greenhouse produce. Prolonged drought can lead to reduced crop yields, soil degradation, and increased competition for water between urban and agricultural users.

6.9.3 Analysis

- **Potable Water Shortages**: Reduced water inflows can strain municipal water supplies, leading to water restrictions, increased treatment costs, and potential public health risks if alternative sources are unavailable.
- **Agricultural Impacts**: Lower water availability can significantly affect crop irrigation, reducing yields and causing economic losses for farmers. Drought can also stress livestock operations and damage soil health, affecting long-term agricultural productivity.
- **Economic and Social Disruptions**: Water scarcity can increase water infrastructure upgrades and emergency management costs. Additionally, prolonged droughts may have broader economic repercussions, including impacts on local businesses and reduced investor confidence.
- **Environmental Degradation**: Drought conditions contribute to habitat loss, increased wildfire risk, and diminished water quality in local rivers and streams, further impacting the ecosystem services critical to the region.
- **Reputational Risk**: Poor management of drought impacts can erode public trust in municipal authorities and complicate future planning efforts, especially if water scarcity leads to prolonged disruptions in daily life.

6.9.4 Vulnerability Analysis

- **Infrastructure Constraints**: Pitt Meadows' water infrastructure may not be fully adapted to prolonged low-flow conditions, highlighting the need for investment in water conservation and storage upgrades.
- **Population Growth and Demand**: While population growth in Pitt Meadows is forecasted to be low over the next decade (City of Pitt Meadows OCP, 2022), regional demands for water must be factored into the City's vulnerability. The demand for potable water is expected to rise, increasing competition between urban and agricultural users.
- **Agricultural Dependency**:
  The local economy's reliance on agriculture—particularly water-dependent crops—amplifies vulnerability, as drought conditions can directly impact food production and economic stability.
- **Regional Interdependence**:
  As part of the larger Fraser Valley and Metro Vancouver region, Pitt Meadows is affected by broader hydrological changes and water management policies. Drought conditions in neighbouring communities can have cascading effects on local water availability.

6.9.5 Mitigation and Preparedness Measures

- **Infrastructure Upgrades and Water Conservation**:
    - Invest in modernizing water storage, distribution systems, and pump stations to increase capacity during low-flow periods.
    - Promote water conservation initiatives among residents and businesses.
    - *Reference*: BC Ministry of Environment and Climate Change Strategy (2019).
- **Climate-Resilient Agricultural Practices**:
    - Support farmers in adopting efficient irrigation systems and drought-resistant crop varieties.
    - Encourage soil conservation techniques to maintain water retention.
    - *Reference*: Agriculture and Agri-Food Canada provides guidelines for drought management in agriculture.
- **Enhanced Monitoring and Early Warning Systems**:
    - To forecast drought conditions, utilize advanced meteorological and hydrological data from Environment and Climate Change Canada.
    - Implement early warning systems to alert residents and farmers of impending water shortages.
- **Regional Coordination and Policy Development**:
    - Collaborate with Metro Vancouver and Fraser Valley water management agencies to develop coordinated drought response strategies.
    - Update municipal policies to incorporate climate change projections and water scarcity scenarios.
    - *Reference*: the City of Pitt Meadows Official Community Plan (OCP, 2022).
- **Public Education and Community Engagement**:
    - Launch educational campaigns about water conservation and efficient irrigation practices.
    - Engage community stakeholders in developing local drought response plans and resilience strategies.

Drought represents an increasing threat to Pitt Meadows, driven by climate change and compounded by the city's geographical and infrastructural vulnerabilities. With significant impacts on potable water supplies, agriculture, and the local economy, proactive measures—such as infrastructure upgrades, regional coordination, and community engagement—are essential to enhancing the city's resilience. By integrating these strategies into local planning

and emergency preparedness efforts, Pitt Meadows can better navigate the challenges posed by future drought events.

6.10 Wildland and Interface Fires

Wildland and interface fires represent a growing threat for lower mainland jurisdictions, including Pitt Meadows. The city's extensive interface area—where urban development meets wildland—combined with the region's exposure to intense heat events, prolonged drought cycles, and increased human activity, creates a high-risk environment for wildfires. Climate change further exacerbates these conditions, altering fire weather patterns and intensifying fire behaviour.

6.10.1 Hazard Description

- **Wildland and Interface Fires Defined**:
  Wildland fires occur in naturally vegetated areas, while interface fires ignite at the boundary between wildland and human development. Pitt Meadows faces both types of fire threats with its mix of residential, agricultural, and undeveloped lands.
    - *Reference*: BC Wildfire Service and Natural Resources Canada provide definitions and fire behaviour analyses for wildland and interface fires.
- **Climate Change Impact**:
  Rising temperatures and altered precipitation patterns have led to more frequent and severe heat events and prolonged drought cycles. These climatic shifts reduce fuel moisture in vegetation and extend the fire season, increasing the likelihood and intensity of fires.
    - *Reference*: Environment and Climate Change Canada (2019) and BC Ministry of Environment and Climate Change Strategy (2019) document these trends.
- **Human Activity**:
  Increased development, recreational activities, and improper land management practices contribute to ignition sources. Urban expansion into fire-prone areas heightens the potential for accidental ignitions and complicates fire suppression efforts.
    - *Reference*: The City of Pitt Meadows Official Community Plan (OCP, 2022) highlights the challenges of balancing growth with environmental risk management.

6.10.2 Risk Factors

- **Geographical Vulnerability**:
    - Pitt Meadows is in the Fraser Valley, characterized by low-lying terrain interspersed with forested and agricultural lands. This setting creates extensive interface zones where fires can spread rapidly from wildlands into urban areas.

- **Climatic Conditions**:
    - **Heat Events & Drought Cycles**: Extended periods of high temperatures and low precipitation dry out vegetation and soils, reducing natural fire resistance and increasing the likelihood of ignition.
    - **Seasonal Variability**: Environment and Climate Change Canada noted that warming trends result in longer, more unpredictable fire seasons.
- **Urbanization and Land Use**:
    - Ongoing development in Pitt Meadows increases impervious surfaces and fragments of natural vegetation, altering fire behaviour. Urban encroachment into wildland areas expands the interface zone and complicates fire management.
- **Infrastructure and Response Limitations**:
    - Limited firefighting resources and specialized training for wildland and interface fire suppression in Pitt Meadows constrain the city's ability to respond quickly and effectively to fire incidents.
    - *Reference*: Local fire department reports and municipal emergency management documents note challenges in response capacity.

6.10.3 Consequence Analysis

- **Human Health and Safety**:
    - Wildfires pose direct threats to life, with risks of injury, smoke inhalation, and evacuation-related hazards.
- **Property and Economic Damage**:
    - Fires can destroy homes, agricultural infrastructure, and critical community assets, leading to significant economic losses. The reconstruction and long-term recovery process can further strain municipal budgets.
- **Environmental Impacts**:
    - Fires contribute to habitat loss, air and water pollution, and soil degradation, with effects that can persist for years.
- **Reputational and Social Consequences**:
    - A poorly managed fire event can erode public trust in local governance and emergency services, affecting community morale and future planning efforts.

6.10.4 Vulnerability Analysis

- **Extent of Interface Areas**:
    - Much of Pitt Meadows lies within or near the wildland-urban interface, where fire spread can occur rapidly and unpredictably.
- **Infrastructure Limitations**:
    - The city's current firefighting resources, including personnel and equipment, may be inadequate for large-scale fires, particularly during extreme climatic conditions.
    - *Reference*: Pitt Meadows Fire & Rescue Service Annual Report (2023) notes challenges in advanced wildland fire training and equipment availability.
- **Interdependency with Regional Fire Dynamics**:
    - Regional fire activity in the Fraser Valley, such as the severe wildfires experienced in recent years in nearby areas like Abbotsford and Chilliwack, increases the risk of embers or spot fires igniting within Pitt Meadows.
    - *Reference*: Recent Metro Vancouver and BC Wildfire Service incident reports provide context for regional fire threats.

6.10.5 Mitigation and Preparedness Strategies

- **Enhanced Fire Prevention and Land Management**:
    - Implement fuel reduction programs, including controlled burns and vegetation management, especially in interface zones.
    - Encourage property owners to adopt FireSmart practices, such as creating defensible space and using fire-resistant building materials.
    - *Reference*: BC Wildfire Service guidelines and FireSmart programs available through Natural Resources Canada.
- **Infrastructure and Capacity Building**:
    - Upgrade firefighting equipment and invest in advanced training programs focused on wildland and interface fire suppression.
    - Expand collaboration with regional and provincial agencies to bolster response capabilities during peak fire seasons.
    - *Reference*: Emergency Management BC and Metro Vancouver Hazard Mapping reports.
- **Improved Early Warning and Communication Systems**:

    - Leverage technology to enhance fire detection, real-time monitoring, and public alert systems.
    - Conduct regular community drills and public education campaigns to ensure preparedness.
    - *Reference*: Environment and Climate Change Canada and regional emergency management protocols.
- **Policy and Zoning Measures**:
    - Update land use policies to limit new developments in high-risk areas and encourage designs that mitigate fire spread.
    - Integrate climate change projections into local planning and zoning regulations.
    - *Reference*: The *City of Pitt Meadows Official Community Plan (OCP, 2022).*

Wildland and interface fires represent a growing threat to Pitt Meadows, driven by climate change, extended drought cycles, and increased human activity. The city's extensive interface areas, limited wildland firefighting resources, and evolving climatic conditions necessitate a robust, multi-layered approach to risk mitigation. By enhancing land management practices, upgrading infrastructure, improving emergency response capabilities, and integrating climate resilience into urban planning, Pitt Meadows can reduce the potential impacts of wildland and interface fires on public safety, property, and the environment.

6.11 Potable Water Interruption

Potable water supply interruptions are a critical risk for Pitt Meadows, with potential causes ranging from infrastructure degradation and seismic events to reduced water availability driven by climate change and drought. These disruptions affect public health and quality of life and have broader regional economic and environmental implications.

6.11.1 Hazard Description

- **Infrastructure Wear and Tear**:
  Over time, water mains, pipelines, and treatment facilities are subject to normal wear and tear. Aging infrastructure can experience leaks, bursts, or system failures, leading to service interruptions.
    - *Reference*: The City of Pitt Meadows Annual Infrastructure Report (2023) notes that several components of the municipal water network are reaching the end of their designed lifespan.
- **Seismic Risks**:
  The region is prone to seismic activity, and even moderate earthquakes can damage underground water pipes—especially those running under rivers and other critical conduits. Seismic-induced ground shifts may lead to pipeline ruptures or misalignments, causing widespread water loss and service disruption.
    - *Reference*: BC Ministry of Transportation and Infrastructure (2021) highlights seismic vulnerabilities in water distribution systems in the Lower Mainland.
- **Climate Change and Drought**:
  Climate change is contributing to longer and more severe drought cycles. Lower water levels in the Fraser and Pitt Rivers, reduced snowpack, and increased evaporation rates limit the regional water supply available for municipal and agricultural use.
    - *Reference*: Environment and Climate Change Canada (2019) and BC Ministry of Environment and Climate Change Strategy (2019) have reported that reduced precipitation and warming trends impact water availability in the region.

6.11.2 Risk Factors

- **Aging Infrastructure and Maintenance Challenges**:
    - Many Pitt Meadows water pipes and related facilities are aging and may not have been updated to current standards, making them more susceptible to failure.
    - Regular maintenance and upgrade programs are essential but can be limited by budget constraints.
- **Seismic Activity**:

    - The Lower Mainland's proximity to active fault lines increases the risk of earthquake-induced damage. Historical seismic events, such as the 2010 Maule earthquake in Chile (as a reference for potential impacts) and local simulated scenarios, underscore the vulnerability of underground systems.

- **Water Supply Variability**:
    - Drought conditions, intensified by climate change, reduce reservoir levels and river flows, which can stress the water supply system during peak demand periods.
    - Increased water demand due to population growth (projected at 12% over the next decade) compounds the risk of shortages.
- **Operational and Emergency Response Constraints**:
    - The city's ability to quickly repair or reroute water supply during a disruption is critical. Limited on-site emergency resources and dependency on regional support may delay recovery.
    - *Reference*: *Recent incident analyses from Metro Vancouver indicate that water main breaks during peak times have led to multi-day service interruptions.*

6.11.3 Consequence Analysis

- **Public Health Risks**:
    - Interruptions in potable water supply can lead to compromised hygiene, increased risk of waterborne diseases, and general public health emergencies.
    - Vulnerable populations, including seniors and families with young children, are at increased risk during prolonged outages.
- **Economic and Social Disruptions**:
    - Businesses, particularly those in food service, manufacturing, and agriculture, rely on continuous water supply. Interruptions can result in production losses, spoilage, and revenue declines.
    - Municipal and regional economies suffer due to the costs associated with emergency repairs, infrastructure replacement, and potential legal liabilities.
- **Environmental Impact**:
    - Water contamination events resulting from pipeline failures or stress can lead to long-term environmental remediation issues and damage local ecosystems.
    - Reduced water levels may also affect riverine and wetland ecosystems critical to the region's biodiversity.
- **Reputational Damage**:

- Repeated or prolonged water supply interruptions can erode public trust in municipal governance and emergency management, impacting community confidence and future investments.

6.11.4 Vulnerability Analysis

- **Geographical Exposure**:
  Pitt Meadows' location along the Fraser and Pitt Rivers and in a low-lying area increases its exposure to water supply limitations and seismic hazards.
- **Interconnected Regional Systems**:
  The city is part of a larger regional water network managed by Metro Vancouver. Interruptions upstream or in adjacent jurisdictions can have cascading effects on Pitt Meadows' water supply.
- **Infrastructure Age and Investment Gaps**:
  A significant portion of the municipal water system is aging, with some components approaching or exceeding their design life, thereby increasing the probability of failure during stress events.
- **Resource and Response Capacity**:
  Limited local emergency response capabilities for repairing critical water infrastructure can delay recovery during significant incidents, necessitating reliance on regional and provincial support.

6.11.5 Mitigation and Preparedness Measures

- **Infrastructure Upgrades and Modernization**:
  - Invest in replacing and upgrading aging water mains, pipelines, and treatment facilities to improve resilience against wear, seismic shocks, and extreme weather.
  - Lobby Metro Vancouver will prioritize hardening pipes and systems to address seismic vulnerabilities.
  - Implement smart monitoring systems to detect leaks and stress in real time.
  - *Reference*: *Recommendations from the BC Ministry of Transportation and Infrastructure (2021).*
- **Enhanced Seismic Retrofitting**:
  - Apply seismic retrofitting techniques to critical water infrastructure, particularly those segments running under rivers and in high-risk areas.
  - Conduct regular seismic risk assessments in collaboration with provincial engineering bodies.
- **Water Conservation and Demand Management**:

    - Promote water-saving measures among residents and businesses to reduce overall demand, especially during drought conditions.
    - Implement tiered water pricing and conservation incentives.
    - *Reference*: Environment and Climate Change Canada (2019) highlights the importance of demand management in drought conditions.
- **Regional Coordination and Emergency Planning**:
    - Establish robust emergency response protocols that integrate municipal, regional, and provincial resources for rapid repair and rerouting of water supply during disruptions.
    - Conduct multi-agency drills and update emergency management plans to reflect current climate change projections and infrastructure vulnerabilities.
    - *Reference*: Metro Vancouver Emergency Management Guidelines (2019).
- **Public Communication and Education**:
    - Develop and disseminate clear communication strategies to inform residents of potential water shortages, conservation measures, and emergency procedures.
    - Use local media and digital platforms for timely updates during incidents.

6.11.6 Recent Incident Examples

- **Metro Vancouver Water Main Breaks**: Several incidents in nearby communities, reported by local media (e.g., Maple Ridge News, 2023), have led to extended water outages during peak demand periods, highlighting vulnerabilities in the regional water network.
- **Seismic-Triggered Pipeline Failures**: Simulation exercises and historical data (e.g., from the 2010 seismic risk assessments by the BC Ministry of Transportation) underscore the potential for seismic events to disrupt water supply in the Lower Mainland.

Drought and related potable water supply interruptions pose a multifaceted risk to Pitt Meadows, driven by aging infrastructure, seismic vulnerabilities, and climate change-induced reductions in water availability. Through strategic investments in infrastructure modernization, enhanced seismic retrofitting, effective demand management, and coordinated emergency response planning, Pitt Meadows can bolster its resilience against these threats. By integrating local, regional, provincial, and national insights into planning and response efforts, the city can better safeguard its water supply and protect the health and well-being of its residents.

Appendix 1: Glossary of Key Terms

FireWise uses standard definitions for terms in this report that comply with the following:

- Emergency Management British Columbia standard definitions
- Emergency Preparedness Canada
- National Fire Protection Association
- Other British Columbia legislation

Asset: Equipment or personnel used to deliver a service. People, structures, facilities, buildings, materials, and processes can all be Assets. (EMBC)

Consequence/Impact: The physical/environmental, social, economic, and political impact or adverse effects that may occur due to a hazardous event. (EMBC)

Critical Infrastructure: The processes, systems, facilities, technologies, networks, assets and services essential to the health, safety, security or economic well-being of a community. Critical infrastructure can be stand-alone, interconnected, and interdependent within and across provinces, territories, and national borders. Disruptions of critical infrastructure could result in catastrophic loss of life, adverse economic effects and significant harm to public confidence (Public Safety Canada).

Frequency: The number of occurrences of an event in a defined period (Public Safety Canada).

Hazard: 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).

Likelihood: The chance of an event or an incident happening, whether defined, measured or determined objectively or subjectively (Public Safety Canada).

Mitigation: Mitigation measures eliminate or reduce the impacts and risks of hazards through proactive measures taken before an emergency or disaster occurs (Public Safety Canada).

Preparedness: The phase of emergency management during which action is taken to ensure that individuals, businesses, and the jurisdiction/ organization are ready to undertake emergency response and recovery (EMBC).

Recovery: The restoring or improving livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities of a disaster-affected community or society, aligning with the principles of sustainable development and “building back better,” to avoid or reduce future disaster risk (UN Office for Disaster Risk Reduction).

Resilience: 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 Office for Disaster Risk Reduction).

Vulnerability: 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 (UN Office for Disaster Risk Reduction, 2017).

Appendix 2: Hazard Definitions

The following list of hazards has been specifically compiled to capture the diverse threats relevant to the City of Pitt Meadows. Drawing on historical data, previous Hazard, Risk, and Vulnerability Analyses (HRVAs), and authoritative hazard lists from provincial (EMBC), federal (Public Safety Canada), and international sources, as well as extensive engagement with community members and subject matter experts, a total of 53 hazards have been identified that could affect the region.

For clarity, the hazards are arranged alphabetically—first by hazard category (Conflict, Natural, and Technological) and then by sub-category (e.g., Security/Threat, Biological, Climatological, etc.). FireWise surveyed various emergency management and risk reduction standards, frameworks, and tools to tailor these hazards' classification and grouping to the unique Pitt Meadows context.

This structured approach has resulted in defining three broad hazard categories—Conflict, Natural, and Technological—with each further broken down into relevant sub-categories. This comprehensive hazard inventory provides a critical foundation for local emergency planning, risk assessment, and resilience-building efforts in Pitt Meadows.

Conflict Hazards	Natural Hazards	Technological Hazards
Human-caused hazards originating from intentional human actions.	***Environmental processes that have the potential to interact with humans and infrastructure.***	***Hazards stemming from technological or industrial conditions and the consequences of an event related to a natural hazard.***
Security/Threat	Biological	Hazardous Materials
	Climatological	Infrastructure Failure
	Extraterrestrial	Communications
	Geological	Energy
	Hydrological – Flooding	Food
	Hydrological – other	Health
	Meteorological	Water
		Other Incidents
		Transportation Incidents

A-2.1 Conflict Hazards

Security/Threat

A hazard originating from intentional human actions.

Active Threat	An active threat is when an individual is actively engaged in killing or attempting to kill people in a confined and populated area, including active shooters in both public and industrial spaces.
Cyber Security Threat	A circumstance or event with the potential to interrupt or adversely impact organizational operations, assets, or individuals (including mission, functions, image or reputation). Cyber threats occur through information systems via unauthorized access, destruction, disclosure, modification of information, and/or denial of service.
Hijacking	The unexpected, unlawful and forceful seizure of control aboard an aircraft, boat or ship, wheeled or tracked vehicle by an individual or group of individuals resulting in passenger and crew endangerment, injury or death, and/or the redirection of flight destination. This definition also includes forceful seizure of control of public buildings resulting in endangerment, injury or death.
Intentional Acts of CBRNE	An event involving a potential, perceived, or actual act with chemical or biological, radiological, nuclear or explosive materials that are, or are suspected to be, used deliberately or intentionally to cause harm.
Public Disturbance	An act or interruption that interferes with society's operation and people's ability to function efficiently. Examples include mass gatherings, riots and demonstrations.

A-2.2 Natural Hazards

A-2.2.1 Biological

A hazard caused by exposure to living organisms and their toxic substances.

Animal Disease	Animal diseases or sicknesses can be spread from animals to animals and from animals to humans. They can be classified as noninfectious diseases, infectious diseases, and diseases caused by parasites.
Human Disease	Diseases caused by pathogenic microorganisms that are spread directly or indirectly from one person to another. Epidemic refers to an increase, often sudden, in the number of cases of a disease above what is typically expected in that population in that area (Pandemic is the worldwide spread of a new disease. The total number of people who get severely ill can vary. However, the impact or severity tends to be higher in pandemics partly because of the much larger number of people who lack pre-existing immunity to the new virus, as evidenced by the 2020 Covid-19 pandemic.
Plant Infestation and Plant Disease	An event involving invasive pests such as insects and mites or plant pathogens, including fungi, bacteria and viruses.

A-2.2.2 Climatological

A hazard caused by long-lived atmospheric processes and climate variability.

Air Quality	Air pollution occurs when the air contains harmful gases, dust, fumes, or odours. These substances—known as pollutants—can be liquid, solid, or gaseous. An air quality advisory is issued when pollutant levels approach or exceed established limits or when poor air quality is expected to persist or worsen (Government of British Columbia, n.d.-a). In British Columbia, the Air Quality Health Index (AQHI) is used to communicate health risks on a scale from 1 to 10: • **1–3:** Low health risk • **4–6:** Moderate health risk • **7–10:** High health risk • **10+:** Very high health risk
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. In British Columbia (BC), combinations of insufficient snow accumulation, hot and dry weather, or a delay in rainfall may cause drought.
Fires (Wildfire and Wildland-Urban Interface	**Wildfire**: An unplanned fire – including unauthorized human-caused fires – occurring on forest or range lands, burning forest vegetation, grass, brush, shrub, peat lands, or a prescribed fire set under a regulation which spreads beyond the area authorized for burning. **Wildland Urban Interface (WUI):** Any area where combustible forest fuel is found adjacent to homes, farm structures, or other outbuildings. This may occur at the interface, where development and forest fuel (vegetation) meet at a well-defined boundary, or in the intermix, where development and forest fuel intermingle without a defined boundary.

A-2.2.3 Extraterrestrial

A hazard originating outside of the earth's atmosphere.

Extraterrestrial Debris	A type of extraterrestrial hazard caused by a natural object (e.g. meteoroid, asteroid, comet, etc.) or human-made object (e.g. satellite, space vehicle, etc.) entering the earth's atmosphere and the resulting debris colliding with the earth.
Geomagnetic Storm	A type of extraterrestrial hazard caused by solar wind shockwaves (solar flare) that temporarily disturb the Earth's magnetosphere.

A-2.2.4 Geological

A hazard originating from solid earth.

Avalanche	The movement of snow and ice in response to the force of gravity down a mountainside.
Coastal Erosion and Sedimentation	The temporary or permanent loss of sediments or landmass in coastal margins is due to waves, winds, tides, or human activities.
Landslide	A landslide is any slope failure or downward movement of rock and/or sediment (includes rock-fall, debris flows, slumps and slides, etc.). Excessive rainfall, earthquakes and certain human activities are some of the factors that commonly trigger landslides.
Earthquake	An earthquake is the shaking of the ground due to movement along a fault rupture (EMBC, 2019). For this definition, an earthquake is considered to have a magnitude of 5 to 8.4 (Note: “Megathrust earthquakes,” those with a magnitude of 8.5 and above, are defined separately).
Land Subsidence and Sinkholes	The sinking or caving in of the ground due to groundwater removal, mining, dissolution of limestone (e.g., karst, sinkholes), extraction of natural gas, and earthquakes.
Megathrust Earthquake	A megathrust earthquake is a massive earthquake in a subduction zone, where one of the earth's tectonic plates is thrust under another. The Cascadia subduction zone is located off the west coast of North America. From mid-Vancouver Island to northern California, the Juan de Fuca Plate is subducted beneath the North American Plate. The two plates continually move towards one another yet become "stuck" where they are in contact. Eventually, the build-up of strain exceeds the friction between the two plates, and a vast megathrust earthquake occurs. For this definition, megathrust earthquakes have a magnitude of 8.5 or greater.
Volcanic Ash Fallout	Ash falls occur when fine volcanic ash has been ejected from a volcanic vent into the atmosphere, possibly transported by upper-level winds, and deposited on the earth.

A-2.2.5 Hydrological – Flooding

A flood is a general term for the overflow of water from a lake, river, or stream channel onto ordinarily dry land (rivers, lakes and stream flooding), higher-than-normal levels along the coast (coastal flooding), as well as ponding of water at or near the point where the rain fell (overland flooding).

Coastal Flooding	Higher-than-normal water levels along the coast are caused by tidal changes or thunderstorms, resulting in flooding lasting days to weeks. High winds from tropical cyclones or other storms push water onshore to create a storm surge, the leading cause of coastal flooding and representing the most significant threat associated with such storms. Coastal flooding can be amplified or dampened by daily tides and periodic king tides, which are much larger tides that occur monthly or yearly due to the interaction of the earth, moon, and sun in their orbits. Storm Surge: A storm surge consists of very high waves and water levels caused by the wind and air pressure "pushing" the water onto the shore, often resulting in high waves and flooding. Storm surges can occur along all coastal areas of Canada. It can also occur in large lakes, such as the Great Lakes. **King Tide**: King Tides (also known as perigean spring tides) are extreme high tide events that occur when the sun and moon's gravitation forces reinforce one another at times of the year when the moon is closest to the earth. They happen twice a year but are typically more dramatic during the winter.
Rivers, Lakes and Streams Flooding	Flooding results from the overflow of natural lake shorelines or water from a stream or river channel onto normally dry land in the floodplain adjacent to the channel. These floods can be caused by intense rainfall, rapid snowmelt (including freshet events), and ice jams blocking the rivers. **Freshet**: The movement of water associated with the thawing of ice and snow each spring. This runoff can result in high water levels in streams, lakes and other waterways. **Ice Jams**: The accumulation of floating ice restricting or blocking a river's flow and drainage. Ice jams develop near river bends and obstructions (e.g., bridges).

Overland Flooding	Overland flooding (“pluvial flooding”) results from rainfall-generated overland flow. This type of flooding is usually associated with high-intensity rainfall events (typically >30mm/h) but can also occur with lower-intensity rainfall or melting snow where the ground is saturated, frozen, developed or otherwise has low permeability, resulting in overland flow and ponding in depressions in the topography. High-intensity ‘extreme’ rainfall events (atmospheric rivers) in urban environments may cause sewerage/drainage systems to be completely overwhelmed and result in flooding.

A-2.2.6 Hydrological – Other

A hazard originating from surface or subsurface freshwater or saltwater.

Saltwater Intrusion	When saline (salty) water is drawn into a freshwater aquifer, rendering the water unpotable. Natural processes or human activities can affect one or multiple wells in an aquifer.
Seiche	A standing wave of water in a large semi- or fully-enclosed body of water (lakes or bays) created by strong winds and /or a significant difference in atmospheric pressure.
Tsunami	A series of waves (with long wavelengths when travelling across the deep ocean) are generated by a displacement of massive amounts of water through underwater earthquakes, volcanic eruptions or landslides. Tsunamis travel at very high speeds across the ocean but slow down and grow steeper as they begin to reach shallow water. This definition includes the effects caused by both remote source (telegenic) tsunamis and those caused by terrestrial and submarine landslides (terrestrial).

A-2.2.7 Meteorological

A hazard caused by short-lived extreme weather and atmospheric conditions.

Cold Event	A cold wave is a period of abnormally cold weather, typically characterized by temperatures at or below –15°C for two or more consecutive days. In the BC Lower Mainland, such events are often exacerbated by high winds, which further reduce the effective temperature through wind chill and increase the risk of hazardous conditions.
Fog	Fog is a cloud at the Earth's surface composed of tiny water droplets—or, in very cold conditions, ice crystals or ice fog—that forms under calm or light wind conditions and can reduce visibility to less than 1 kilometre. A fog advisory is issued when fog is expected to persist for at least six hours, significantly reducing visibility.
Freeze Event (Frost, Freezing Rain, Flash Freeze)	An event involving the deposit or coating of ice on an object, e.g.: **Frost**: A deposit of ice crystals that forms through sublimation, which occurs when the temperature of surfaces is below freezing and water vapour from humid air forms solid deposits on the cold surface. **Freezing Rain**: Rain that freezes on impact to form a coating of clear ice (glaze) on the ground and exposed objects. A freezing rain warning is issued when freezing rain may pose a hazard to transportation or property or when freezing rain is expected for at least 2 hours. **Flash Freeze**: When significant ice may form on roads, sidewalks or other surfaces over much of a region because of a rapid drop in temperature resulting in the freezing of residual water from either melted snow or falling/fallen rain.
Hail	Hail is a type of precipitation consisting of ice lumps forming in a thunderstorm's core. Typically, hailstones begin at a minimum diameter of 5 mm and can grow to exceed 10 cm—roughly the size of a grapefruit. These hailstones can impact the ground at up to 130 kilometres per hour, posing significant risks to property, crops, and public safety.
Heat Event	A heat wave is a period of abnormally hot and/or unusually humid weather lasting two or more consecutive days. Under current criteria, a heat warning is issued when forecast models indicate that daytime maximum temperatures will reach 29°C or above and nighttime minimum temperatures will remain at or above 16°C for at least two consecutive days.

Rainfall Event	Emergency Management BC (EMBC) defines a rainfall event as a period during which precipitation accumulates to levels that can overwhelm drainage and flood protection systems, posing a risk to public safety and infrastructure. In the BC Lower Mainland, for example, EMBC guidance is used to issue rainfall warnings when forecasted precipitation exceeds thresholds—such as 100 mm in 24 hours for inland communities like Pitt Meadows—indicating that the accumulated rainfall could lead to flooding or other hazardous conditions.
Snow Event	Meteorological disturbance gives rise to a heavy fall of snow, often accompanied by strong winds (also referred to as a blizzard or blowing snow event). A snowfall warning is issued when 10 cm or more of snow falls within 12 hours or less or when 5 cm or more falls within 6 hours. A blowing snow advisory is issued when blowing snow, caused by winds of at least 30 km/h, is expected to reduce visibility to 800 m or less for at least 3 hours.
Thunderstorm	A local storm usually produced by a cumulonimbus cloud and is always accompanied by thunder and lightning.
Wind Event	Differences in air pressure drive the horizontal movement of air, with larger pressure gradients resulting in stronger winds as air flows from areas of high pressure toward low pressure. A warning is issued when sustained winds reach 70 km/h or higher or when 90 km/h or more gusts are expected.

A-2.3 Technological Hazards

A-2.3.1 Hazardous Materials

A hazardous material is any agent which has the potential to cause harm either by itself or through the interaction with outer factors.

Hazardous Materials Release - Land	A spill on site or along a transport route is any uncontrolled release of material that poses a risk to health, safety, or property. This definition applies to incidents occurring while the material is in transit or stationary, including motor vehicles, rail, pipelines, or industrial facilities.
Hazardous Materials Release - Marine	An accidental leak, spill, or release of a chemical into the marine environment that poses a threat to human or ecosystem health. This definition encompasses both tidal and non-tidal scenarios and applies to incidents that occur during transit and those that happen while the material is stationary.

A-2.3.2 Infrastructure Failure – Communications

A hazard arising from the disruption of communication and technology services, including the provision of networks, data lines, and internet service by the local government or other service providers. Information and communications technology includes voice-over-internet service, data services, first responder communications, etc.

Communications Interruption	The unavailability of services the communications infrastructure provides is caused by human error, equipment malfunction, or breakdown. This definition includes interruptions to landlines, cellphones, internet, commercial radio, satellites, etc.

A-2.3.3 Infrastructure Failure – Energy

A hazard arising from the inability to provide energy to the community. Energy and utilities include electrical power provision and municipally owned infrastructure (power lines, transmission stations), natural gas provision and externally owned infrastructure, and the supply and distribution of gasoline.

Dam Failure	Dam failure is a breach in the dam itself, its foundations, abutments, or spillway, which results in significant or rapidly increasing uncontrolled water releases from the reservoir. **Dam**: A barrier constructed to enable the storage or diversion of water from a stream, aquifer, or both. **Spillway**: Structures constructed to safely release flood waters from a dam to a downstream area, usually the river on which the dam has been built.
Electrical Power Outage	A power outage is a short or long-term loss of electric power to an area.
Fuel Supply Interruption	A fuel supply disruption is any deficit, interruption, or failure in fuel systems, services, supplies, or resources. This includes pipeline damage, transportation delays caused by severe weather or shipping infrastructure issues, market-induced shortages, and panic fuel hoarding during emergencies.

A-2.3.4 Infrastructure Failure – Food

A hazard arising due to the inability to safely produce and distribute food.

Food Supply Chain Interruption	A disruption to the food supply or delivery system may result in food shortages in a community.

A-2.3.5 Infrastructure Failure – Health

A hazard arising due to the interruption of community health services.

Health Interruption	An interruption to basic health services. This includes the reduction or loss of access to healthcare systems and/or medical resources, e.g., prescription supplies, health workers, health facilities and services, and specialized health technology.

A-2.3.6 Infrastructure Failure – Water

A hazard arising due to the failure of the provision of safe drinking water and removal & processing of wastewater by the local government. Examples include the provision of drinking water, removal and processing of sewer and wastewater, inspection and maintenance of wells and reservoirs, etc.

Potable Water Supply Interruption	A water supply disruption is any deficit, interruption, or failure of water systems, services, supplies, or resources. This definition encompasses various water sources and infrastructure issues, including well water, treatment facilities, storage systems, and water supply contamination.
Waste Eater Interruption	A wastewater or sewer system disruption is defined as any deficit, interruption, or failure in the systems, services, supplies, or resources related to wastewater management. This definition includes issues affecting sanitary facilities, pump stations, septic fields, runoff, leaks, and contamination.

A-2.3.7 Other Technological Incidents

A category to capture other incidents such as an explosion, building collapse, etc.

Bridge Collapse	A bridge failure occurs when a bridge or any structural component loses its integrity or load-bearing capacity, compromising its safety and functionality.
Building Collapse	A building failure occurs when a structure or one of its components loses its structural integrity or load-carrying capacity. Structural collapse can result from engineering or construction flaws, metal fatigue, changes in load-bearing capacity, human error, or external factors such as earthquakes, floods, fires, explosions, and the accumulation of snow or ice.
Structure Fire	A fire occurring in industrial, commercial, or residential structures. This includes, but is not limited to, fires in factories, storage facilities, office buildings, homes, apartment complexes, schools, hotels, and retail establishments.

A-2.3.8 Transportation Incidents

Transportation incidents include motor vehicles, aircraft, marine, and rail.

Aircraft Incident	An air crash is an incident involving one or more aircraft that damages aircraft, property or human injury or death. Most crashes occur near airports; however, they can occur anywhere in the rugged terrain of British Columbia.
Motor Vehicle Incident	A vehicle incident occurs whenever any motorized or non-motorized vehicle—such as a truck, passenger car, bus, farm vehicle, or other conveyance—collides with another vehicle, train, or obstruction or loses control and sustains damage.
Marine Vessel Incident	An event involving a boat or ship that poses a threat to human life, property, and natural resources. This may include scenarios where a vessel submerges, sustains damage, causes bodily injury or death, or disrupts transportation services.
Rail Incident	When a train derails or collides with another train, motor vehicle, or obstruction on the rail tracks. Rail accidents have potential for a severe human or environmental impact.

Appendix 3: Full Hazard Assessment Scores

A-3.1 Human and Social Impacts

Hazard	Fatalities	Injury/Illness	Displacement	Psychosocial	Support System Impact	Cultural Impact	Total
Megathrust Earthquake	4	4	4	4	3	3	22
Hazardous Materials Release- Land	4	3	3	4	4	3	21
Earthquake	3	3	3	3	3	3	18
Rail Incident	3	3	3	3	3	3	18
Intentional Acts of CBRNE	2	3	2	3	2	2	14
Structure Fire	2	2	2	2	2	2	12
Human Disease	2	3	0	2	3	2	12
Fires (Wildfire and Wildland-Urban Interface)	1	1	1	2	3	3	11
Dam Failure	2	2	1	2	1	3	11
Rainfall Event	1	1	3	2	2	2	11
Health Interruption	2	2	1	3	3	0	11
Motor Vehicle Incident	3	3	1	2	1	0	10
Hazardous Materials Release - Marine	1	1	2	1	1	4	10
Aircraft Incident	2	2	2	2	2	0	10
Tsunami	1	2	1	2	1	3	10
Overland flooding	0	1	1	1	3	3	9
Heat Event	1	2	1	2	2	1	9
Active Threat	2	2	1	3	1	0	9
Building Collapse	2	2	1	2	2	0	9
Rivers, Lakes, and Stream Flooding	1	1	1	2	1	2	8
Landslide	1	1	0	2	1	3	8
Thunderstorm	2	2	1	2	1	0	8
Hijacking	1	2	1	3	1	0	8

Hazard	Fatalities	Injury/Illness	Displacement	Psychosocial	Support System Impact	Cultural Impact	Total
Wind Event	1	1	1	2	2	0	7
Air Quality	1	2	1	1	2	0	7
Cold Event	1	1	1	2	2	0	7
Public Disturbance	2	2	1	1	1	0	7
Waste Water Interruption	0	0	3	2	2	0	7
Avalanche	1	1	0	2	0	3	7
Drought	0	0	0	3	1	2	6
Marine Vessel Incident	1	1	1	1	0	2	6
Land Subsidence and Sinkholes	1	1	1	1	1	1	6
Extraterrestrial Debris	1	1	2	2	0	0	6
Coastal Erosion and Sedimintation	0	0	0	1	0	4	5
Food Supply Chain Interruption	0	0	0	2	3	0	5
Potable Water Supply Interruption	0	1	0	2	2	0	5
Volcanic Ash Fallout	1	2	0	2	0	0	5
Snow Event	1	1	0	1	1	0	4
Cyber Security Threat	0	0	1	1	2	0	4
Communications Interruption	0	0	0	2	2	0	4
Electrical Power Outage	1	1	0	0	1	0	3
Fog	1	1	0	0	1	0	3
Fuel Supply Interruption	0	0	0	2	1	0	3
Geomagnetic Storm	0	0	0	1	2	0	3
Bridge Collapse	0	0	0	1	2	0	3
Sieche	1	1	0	0	1	0	3
Coastal Flooding	0	0	0	0	0	2	2
Freeze Event	0	0	0	1	1	0	2
Animal Disease	0	0	0	1	1	0	2
Hail	0	1	0	0	1	0	2
Insect Infestation and Plant disease	0	0	0	0	1	0	1
Saltwater Intrusion	0	0	0	0	0	0	0

A-3.2 Physical and Economic Impacts

Hazard	Property Damage	Critical Infrastructure	Environmental	Economic	Reputational	Total
Megathrust Earthquake	4	3	4	4	3	18
Earthquake	3	3	4	4	3	17
Hazardous Materials Release- Land	3	3	4	3	3	16
Intentional Acts of CBRNE	2	3	3	4	4	16
Rail Incident	3	2	3	4	3	15
Fires (Wildfire and Wildland-Urban Interface)	3	3	3	3	2	14
Structure Fire	2	2	3	4	3	14
Drought	2	2	3	4	2	13
Rivers, Lakes, and Stream Flooding	2	2	3	3	3	13
Potable Water Supply Interruption	2	2	2	4	3	13
Hazardous Materials Release - Marine	2	2	3	3	2	12
Overland flooding	2	1	2	3	3	11
Coastal Flooding	2	2	4	2	1	11
Rainfall Event	2	2	1	2	3	10
Waste Water Interruption	0	3	2	2	3	10
Animal Disease	1	0	2	3	3	9
Cyber Security Threat	1	2	1	1	4	9
Aircraft Incident	2	1	2	2	2	9
Building Collapse	2	0	2	3	2	9
Public Disturbance	2	1	2	2	2	9
Volcanic Ash Fallout	1	0	3	3	2	9
Tsunami	2	1	3	2	1	9
Human Disease	0	3	0	3	2	8
Marine Vessel Incident	2	2	2	1	1	8

Hazard	Property Damage	Critical Infrastructure	Environmental	Economic	Reputational	Total
Land Subsidence and Sinkholes	1	1	2	2	2	8
Heat Event	1	1	2	1	3	8
Active Threat	2	2	1	1	2	8
Bridge Collapse	2	1	1	2	2	8
Wind Event	1	1	2	1	2	7
Saltwater Intrusion	1	0	4	2	0	7
Cold Event	1	2	1	2	1	7
Dam Failure	2	1	2	2	0	7
Hijacking	2	2	0	1	2	7
Motor Vehicle Incident	2	0	1	1	2	6
Insect Infestation and Plan disease	1	0	1	3	1	6
Snow Event	1	2	0	1	2	6
Thunderstorm	1	1	2	1	1	6
Electrical Power Outage	1	2	1	1	0	5
Freeze Event	1	1	1	2	0	5
Geomagnetic Storm	1	1	0	1	2	5
Health Interruption	0	2	0	1	2	5
Avalanche	2	0	0	2	1	5
Landslide	1	0	1	1	1	4
Coastal Erosion and Sedimintation	2	1	1	0	0	4
Food Supply Chain Interruption	0	0	0	3	1	4
Hail	1	0	0	2	1	4
Extraterrestrial Debris	2	0	1	1	0	4
Air Quality	0	0	0	2	1	3
Fuel Supply Interruption	0	0	0	2	1	3
Communications Interruption	0	1	0	0	2	3
Fog	1	0	0	0	0	1
Sieche	0	0	0	0	0	0

Appendix 4 The City's Critical Assets Owned and Operated by the City

Critical Assets and Facilities Owned and Operated by the City of Pitt Meadows, British Columbia

Based on the City's Official Community Plan, recent Hazard, Risk, and Vulnerability Analyses (HRVA), and municipal annual reports, the following is a list of critical assets and facilities that are owned and operated by the City of Pitt Meadows:

1. **Municipal Administration and Governance**
    - **City Hall and Administrative Offices:** Central hub for municipal governance, service delivery, and community engagement.
    - **Customer Service Centers:** Facilities that manage public inquiries and administrative functions.
2. **Public Safety and Emergency Response**
    - **Pitt Meadows Fire & Rescue Service Building:**
        - Fire Hall and associated emergency response infrastructure.
        - Firefighting fleets and equipment critical for rapid response.
    - **Emergency Operations Centre (EOC):**
        - A coordination center for municipal emergency management during significant incidents is located at the fire hall.
    - **Local Policing Support:**
        - Community policing provided by the RCMP will transition from a community policing station to a stand-alone detachment in 2025.
3. **Water and Wastewater Systems**
    - **Drinking Water Distribution Network:**
        - Local water storage tanks, pump stations, and distribution pipelines that ensure potable water delivery (in coordination with Metro Vancouver's regional water system).
    - **Wastewater Collection and Treatment Facilities:**
        - Infrastructure for sewage collection, treatment plants, and supporting pump stations that protect public health and the environment.
4. **Public Works and Infrastructure Management**

- **Road Maintenance and Transportation Infrastructure:**
    - Vehicle fleets and maintenance depots dedicated to the upkeep of municipal roads, bridges, and drainage systems.
- **Utility and Infrastructure Systems:**
    - Public lighting, drainage, and other utility management systems essential for community functioning.
    - Dikes, pumping stations and other flood control structures and systems

5. **Communication and Information Technology Infrastructure**
    - **Municipal Communication Systems:**
        - Dispatch centers and emergency alert systems that support coordinated response efforts.
    - **SCADA and IT Systems:**
        - Systems used to monitor and control water, wastewater, and other critical municipal services

Appendix 5 References

- **Cutter, S. L., Boruff, B. J., & Shirley, W. L. (2003)**. *Social vulnerability to environmental hazards.*
- **Cutter, S. L., et al. (2008).** *The vulnerability of global cities to climate hazards.*
- **EMBC (2021).** *Hazard, Risk, and Vulnerability Analysis Toolkit.*
- **Gaetz, S., Donaldson, J., Richter, T., & Gulliver, T. (2016).** *The state of homelessness in Canada.*
- **Mikkonen, J., & Raphael, D. (2010).** *Social determinants of health: The Canadian facts*
- **Truth and Reconciliation Commission of Canada. (2015)**. *Honouring the truth, reconciling for the future.*
- **UNDRR (2017)**. *Terminology on disaster risk reduction.*
- **Health Canada. (2011).** *Heat alert and response systems to protect health: Best practices guidebook.*
- **Sharma, U. *(2016).*** *Children's vulnerability and resilience in disasters: A review of research and practice.*
- **Statistics Canada*. (2021).*** *Population and age demographics: Pitt Meadows and British Columbia.*
- **Donner, W., & Rodríguez, H. (2011)**. *Disaster risk and vulnerability: The role of social structures.*
- **Mitchell, T., & Murray, V. (2017).** *The impact of disasters on health: Precarious employment and its implications for vulnerable populations.*
- **RAND. (2011).** *Social vulnerability and disasters: Key considerations for reducing risks.*
- **Statistics Canada. (2021).** *Pitt Meadows demographic and household data.*
- **Reading, C., & Wien, F. (2009).** *Health inequalities and social determinants of Aboriginal people's health. National Collaborating Centre for Aboriginal Health.*
- **Indigenous Corporate Training Inc. (2018).** *The importance of cultural safety in emergency management for Indigenous communities.*
- **Statistics Canada. (2021).** *Demographic and socioeconomic data for Pitt Meadows and the Katzie First Nation.*
- **Gin, J. (2018).** *Vulnerabilities of Homeless Populations During Disasters.*
- **Hwang, S. W. (2018).** *Homelessness and Health. Canadian Medical Association Journal.*

- **Maple Ridge-Pitt Meadows Katzie Community Network (2021).** *Community Report on Housing and Social Issues.*
- **Settembrino, M. R.** (2015). *Vulnerability and Resilience Among Homeless Populations.*
- **Weesjes, G.** (2015). *Hidden Homelessness: Addressing the Invisibility of the Problem.*
- **Statistics Canada** (2021). *Housing and Demographics Data for Pitt Meadows and Maple Ridge.*
- **City of Pitt Meadows Flood Hazard Risk Assessment** (2018)
- **Metro Vancouver**: *[PDF] Metro Vancouver Electoral Area A Community Wildfire Resiliency Plan*
- ***City of Vancouver Council**: [PDF] Hazard, Risk and Vulnerability Analysis - City of Vancouver*
- *https://www.fvrd.ca [PDF] Hazard Report - Fraser Valley Regional District*
- **Metro Vancouver** *[PDF] Metro Vancouver Natural Hazard Data Inventory for the Region Final ...*
- **Coquitlam** *[PDF] Hazards, Risk and Vulnerability Assessment - Coquitlam.ca*
- **Pitt Meadows** *[PDF] Pitt Meadows Flood Hazard Risk Assessment*
- **Pitt Meadows** *[PDF] The Flood Mitigation Plan - City of Pitt Meadows*
- **Government of British Columbia** *[PDF] hazard, risk and vulnerability analysis (HRVA) - Gov.bc.ca*
- **Government of British Columbia** *[PDF] hazard, risk and vulnerability analysis (HRVA) - Gov.bc.ca*
- **Metro Vancouver** *[XLS] Metro Vancouver Natural Hazard Data Inventory*
- **Retooling for Climate Change** *Community Health and Climate Change Vulnerability Maps*
- **BC Ministry of Transportation and Infrastructure** (2021). Rail Safety and Maintenance Guidelines.
- **City of Pitt Meadows** (2022). Official Community Plan. Available online.
- **Metro Vancouver** (2019). Regional Multi-Hazard Mapping Project. Available online
- ***Metro Vancouver.** (2020). Regional Planning and Risk Assessment Reports.*
- ***Public Safety Canada** (2019) Emergency Management Guidelines.*

- **Transport Canada. (2020).** Hazardous Materials Transportation Regulations.
- **The City of Pitt Meadows** (2023) Annual Report.
- **The City of Pitt Meadows. (n.d.).** Fire Safety Plans.
- **Corbett, N. (2025, January 16).** Pitt Meadows Fire Department goes to 24-hour shifts. Maple Ridge News
- **City of Pitt Meadows (2023)**. *Official Community Plan – Emergency and Hazard Planning*.
- **Metro Vancouver (2020).** *Regional Hazardous Materials Response Planning Report*.
- **Emergency Management BC (EMBC) (2022)**. *British Columbia Environmental Emergency Program Guidelines*. Retrieved from gov.bc.ca.
- **Transport Canada (2023)**. *Rail Safety and Dangerous Goods Transport Regulations*. Retrieved from tc.gc.ca.
- **CP Rail Emergency Response Team (2022).** *Hazmat Transportation Safety Program*. Retrieved from cpr.ca.
- **Pitt Meadows Fire & Rescue Service.** (n.d.). Fire & Rescue Service. The City of Pitt Meadows.
- **Tucker, B. (2024, August 6).** Plane involved in three near misses above Pitt Meadows airport. Maple Ridge News.
- **Maple Ridge - Pitt Meadows News Staff**. (2024, August 28). Plane crash reported at Pitt Meadows Airport on Wednesday. Maple Ridge News.
- **Firemedix Fire Academy. (2024, August 28).** Great job @pittmeadowsiaff4810 in... [Facebook post].
- **BC Ministry of Environment and Climate Change Strategy**. (2019). *Climate Change and Flooding in British Columbia*. Retrieved from gov.bc.ca.
- **Environment and Climate Change Canada**. (2019). *Canada's Changing Climate Report*. Retrieved from canada.ca.
- **The City of Pitt Meadows Official Community Plan (OCP)**. (2022). Retrieved from pittmeadows.ca.
- **Metro Vancouver**. (2019). *Regional Multi-Hazard Mapping Project*. Retrieved from metrovancouver.org.
- **BC Ministry of Environment and Climate Change Strategy. (2019).** *Climate Change and Flooding in British Columbia*. Retrieved from gov.bc.ca.
- **The City of Pitt Meadows. (2022).** ***Official Community Plan***. Retrieved from pittmeadows.ca.

- **Environment and Climate Change Canada. (2019).** *Canada's Changing Climate Report*. Retrieved from canada.ca.
- **Metro Vancouver. (2019).** *Regional Multi-Hazard Mapping Project*. Retrieved from metrovancouver.org.
- **BC Ministry of Environment and Climate Change Strategy. (2019).** *Climate Change and Extreme Weather in British Columbia*. Retrieved from gov.bc.ca.
- **Environment and Climate Change Canada. (2019).** *Canada's Changing Climate Report*. Retrieved from canada.ca.
- **The City of Pitt Meadows. (2022)**. *Official Community Plan*. Retrieved from pittmeadows.ca.
- **Metro Vancouver. (2019).** *Regional Multi-Hazard Mapping Project*. Retrieved from metrovancouver.org.
- **National Highway Traffic Safety Administration. (2023)**. *Traffic Safety Facts*. Retrieved from nhtsa.gov.
- **Maple Ridge News. (2023)**. *Series of Collisions on Highway 7 During Heavy Rainfall in Pitt Meadows*. Retrieved from mapleridgenews.com.
- **BC Ministry of Environment and Climate Change Strategy. (2019)**. *Climate Change and Water Management in British Columbia*. Retrieved from gov.bc.ca.
- **Environment and Climate Change Canada. (2019)**. *Canada's Changing Climate Report*. Retrieved from canada.ca.
- **The City of Pitt Meadows. (2022)**. *Official Community Plan*. Retrieved from pittmeadows.ca.
- **Agriculture and Agri-Food Canada. (2020)**. *Drought Management in Agriculture*. Retrieved from agr.gc.ca.
- **Metro Vancouver. (2019).** *Regional Water Supply and Climate Impact Reports*. Retrieved from metrovancouver.org.
- **BC Ministry of Environment and Climate Change Strategy. (2019).** *Climate Change and Wildfire Trends in British Columbia*. Retrieved from gov.bc.ca.
- **Environment and Climate Change Canada. (2019)**. *Canada's Changing Climate Report*. Retrieved from canada.ca.
- **The City of Pitt Meadows. (2022).** *Official Community Plan*. Retrieved from pittmeadows.ca.
- **BC Wildfire Service. (2023)**. *Annual Fire Management Report*. Retrieved from gov.bc.ca/fire.

- **Metro Vancouver. (2019).** *Regional Multi-Hazard Mapping Project*. Retrieved from metrovancouver.org.
- **Pitt Meadows Fire & Rescue Service. (2023)**. *Annual Report*. Retrieved from pittmeadows.ca/fire-rescue.
- **BC Ministry of Environment and Climate Change Strategy. (2019).** *Climate Change and Wildfire Trends in British Columbia*. Retrieved from gov.bc.ca.
- **Environment and Climate Change Canada. (2019)**. *Canada's Changing Climate Report*. Retrieved from canada.ca.
- **The City of Pitt Meadows. (2022)**. *Official Community Plan*. Retrieved from pittmeadows.ca.
- **BC Wildfire Service. (2023).** *Annual Fire Management Report*. Retrieved from gov.bc.ca/fire.
- **Metro Vancouver. (2019)**. *Regional Multi-Hazard Mapping Project*. Retrieved from metrovancouver.org.
- **Pitt Meadows Fire & Rescue Service. (2023).** *Annual Report*. Retrieved from pittmeadows.ca/fire-rescue.
- **BC Ministry of Environment and Climate Change Strategy. (2019).** *Climate Change and Water Management in British Columbia*. Retrieved from gov.bc.ca
- **BC Ministry of Transportation and Infrastructure. (2021)**. *Seismic Retrofitting Guidelines for Water Infrastructure*. Retrieved from gov.bc.ca
- **Environment and Climate Change Canada. (2019)**. *Canada's Changing Climate Report*. Retrieved from canada.ca
- **The City of Pitt Meadows. (2022).** *Official Community Plan*. Retrieved from pittmeadows.ca
- **Metro Vancouver. (2019).** *Regional Multi-Hazard Mapping Project and Emergency Management Guidelines*. Retrieved from metrovancouver.org
- **National Research Council Canada. (2020).** Water Infrastructure and Drought Preparedness Report. Retrieved from NRC-cnrc.gc.ca
- **BC Ministry of Environment and Climate Change Strategy. (2019)**. *Climate Change and Water Management in British Columbia*. Retrieved from gov.bc.ca
- **BC Ministry of Transportation and Infrastructure. (2021).** *Seismic Retrofitting Guidelines for Water Infrastructure*. Retrieved from gov.bc.ca
- **Environment and Climate Change Canada. (2019).** *Canada's Changing Climate Report*. Retrieved from canada.ca

- **The City of Pitt Meadows. (2022).** *Official Community Plan*. Retrieved from pittmeadows.ca
- **Metro Vancouver. (2019).** *Regional Multi-Hazard Mapping Project and Emergency Management Guidelines*. Retrieved from metrovancouver.org
- **National Research Council Canada. (2020).** *Water Infrastructure and Drought Preparedness Report*. Retrieved from NRC-cnrc.gc.ca