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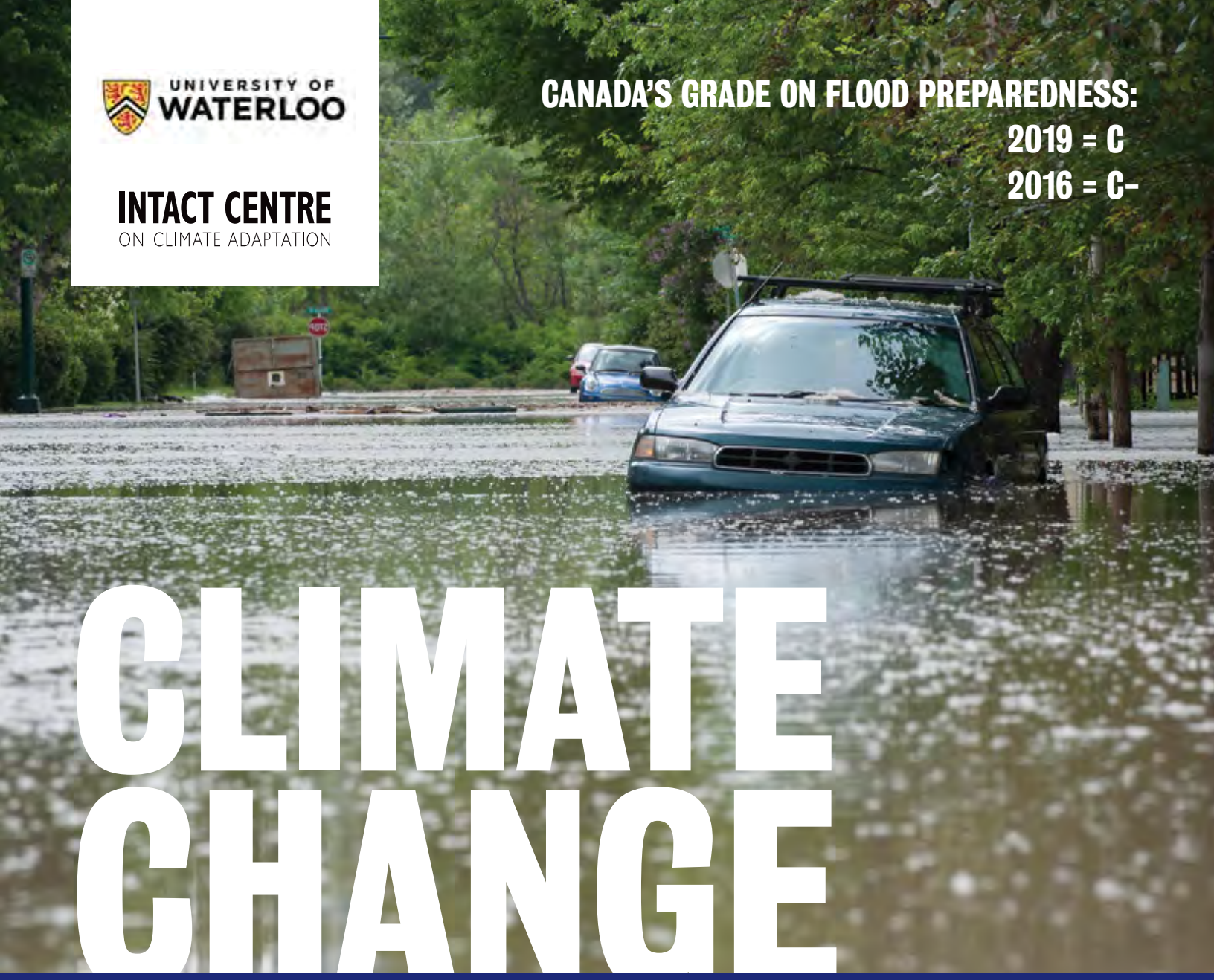
INTACT CENTRE
ON CLIMATE ADAPTATION

CANADA'S GRADE ON FLOOD PREPAREDNESS:
2019 = C
2016 = C–



CLIMATE CHANGE

AND THE PREPAREDNESS OF CANADIAN PROVINCES AND TERRITORIES TO **LIMIT FLOOD RISK**

GENEROUSLY SUPPORTED BY:

[intact]

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Marina Moudrak
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August 2020

"For every single dollar paid out in insurance claims for homes and businesses, IBC estimates that Canadian governments pay out $3 to recover public infrastructure damaged by severe weather.

By analyzing the state of flood preparedness of Canada's provinces and territories, **it is the intent of this report to provide an informed perspective that will contribute to the alleviation of current and future flood and climate-related risks in Canada."**

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MOST SERIOUS

IMPACTS OF CLIMATE CHANGE AND EXTREME WEATHER risk in Canada relate to changes in the intensity, duration and frequency of floods, wildfires, wind, ice storms and permafrost loss (IPCC 2019). Nationally, more than 90 percent of extreme events are handled locally or at the provincial/territorial level and do not require direct federal involvement.

Considering that flooding is currently Canada's costliest natural disaster (IBC 2019c), this report provides a holistic picture of how provincial and territorial governments self-assessed their flood readiness efforts relative to the four pillars of emergency management: mitigation, preparedness, response and recovery.

The flood preparedness of Canada's provinces was evaluated relative to 9 criteria presented in Table 1, and the territories were evaluated relative to 7 criteria (i.e., territories determined that Waterway Management and Sustainable Flood Management were not applicable to northern communities).

Each of the criteria was self-assessed by the jurisdictions using a five-point scale, ranging from 'A' for a high state of flood preparedness, 'E' for a low state of preparedness, and with the good, significant, and incipient states of preparedness denoted as 'B', 'C', and 'D', respectively (see Appendix A for detailed description of the scoring protocol). Scores were determined and recorded based on interviews with representatives of provincial and territorial governments (e.g., Deputy Ministers, Assistant DMs, Directors, Senior Advisors, etc.) who had appropriate expertise relative to the criterion under consideration. From 2018 – 2019, 139 interviews were conducted and recorded.

TABLE 1: Description of criteria utilized to assess the flood preparedness of Canadian provinces and territories.

No.	CRITERIA	DESCRIPTION
1a	Floodplain Mapping	Floodplain maps delineate areas expected to flood, which can provide a basis for land-use planning. The creation and regular update of floodplain maps is vital for reducing the impact of flooding.
1b	Hazard Mapping	Hazard maps, used by the territories, delineate areas predisposed to hazardous events, including permafrost degradation. Maps are used primarily for land-use planning in Northern Canada.
2a	Flood Risk Assessment	Flood risk assessments define the probability that floods occur in a given area and the consequences of flooding for people, properties, and infrastructure.
2b	Hazard Risk Assessment	Hazard risk assessments define the probability that hazards occur in a given area as well as the consequences of such events for people, properties, and infrastructure.
3	Land Use Planning	Land use planning manages development activities to minimize the risk of flooding to life, property, and infrastructure.
4	Waterway Management	Waterway management regulates actions to ensure that waterway modifications such as widening, deepening, realigning or clearing rivers do not increase risk of flooding.
5	Sustainable Flood Management	Sustainable flood management focuses on the protection of the natural features of floodplains, which may include residential relocation.
6	New Development Projects	The assessment of new development projects, with multi-decade service lives, focuses on changing of climatic conditions and the sensitivity of these projects to such changes.
7	Critical Infrastructure (CI) Assessment	CI assessments focus on the vulnerability of existing critical systems to flooding and key measures and actions to enhance their flood resilience.
8	Public Health and Safety	Public Health and Safety assessments focus on flood risks affecting healthcare facilities, dams, flood protection infrastructure and abandoned contaminated sites.
9	Emergency Management	Emergency management assessments focus on flood risks affecting emergency response and recovery operations including contingency planning for businesses and infrastructure owners/operators.

Based on the above criteria, the **Canadian Average Score on Flood Preparedness for 2019 was C**, with the highest score being B-, and the lowest score being C- (**see Figure 1**). An assessment of flood preparedness utilizing virtually the same survey method (excluding the Northwest Territories and Nunavut) was conducted in 2016 – the **Canadian Average Score on Flood Preparedness for 2016 was C-** (**see Figure 2**).

2019 Canadian Average C

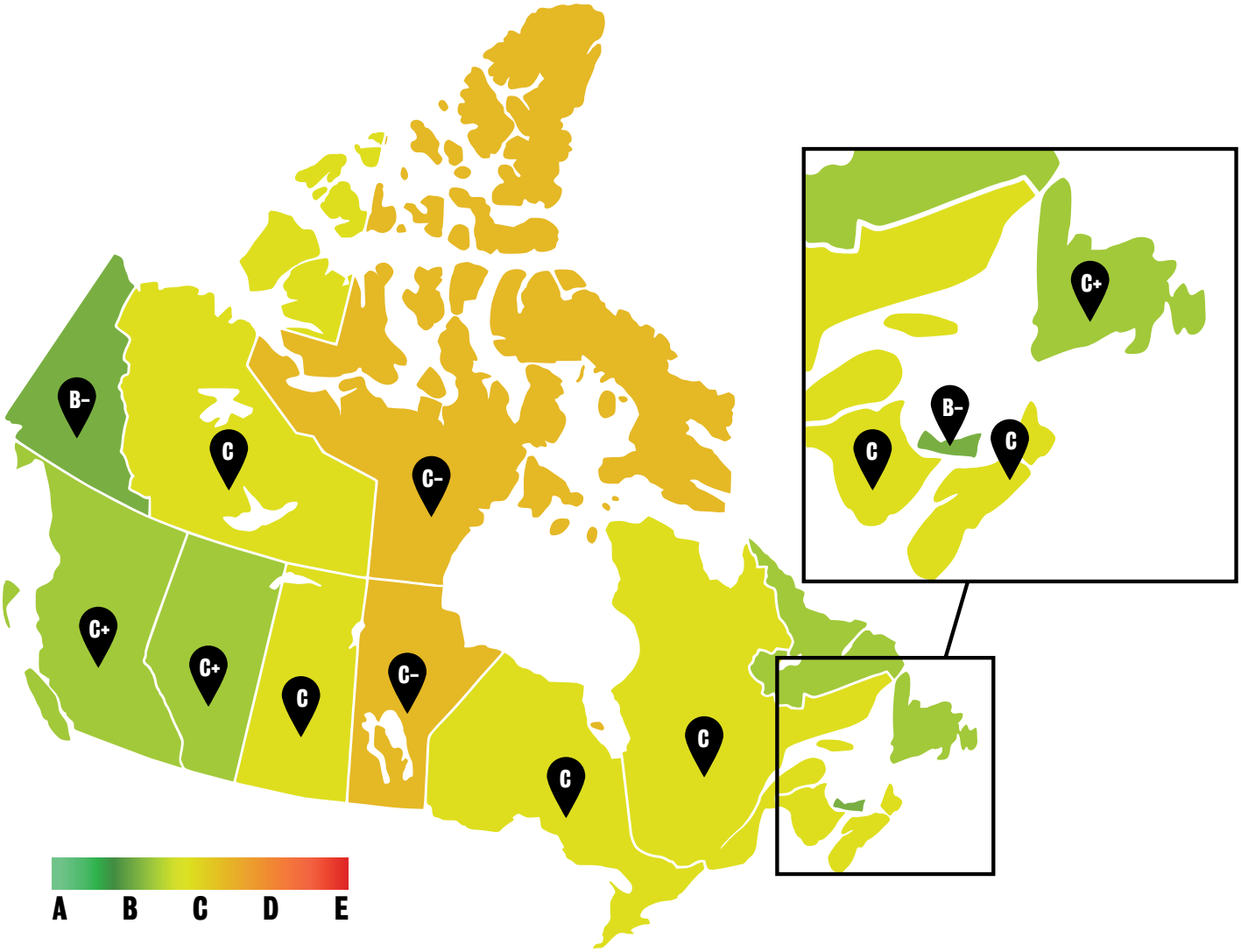


FIGURE 1: Flood Preparedness Scores of Canadian Provinces and Territories, 2019 (A and E reflect high and low scores, respectively)

2016 Canadian Average C–

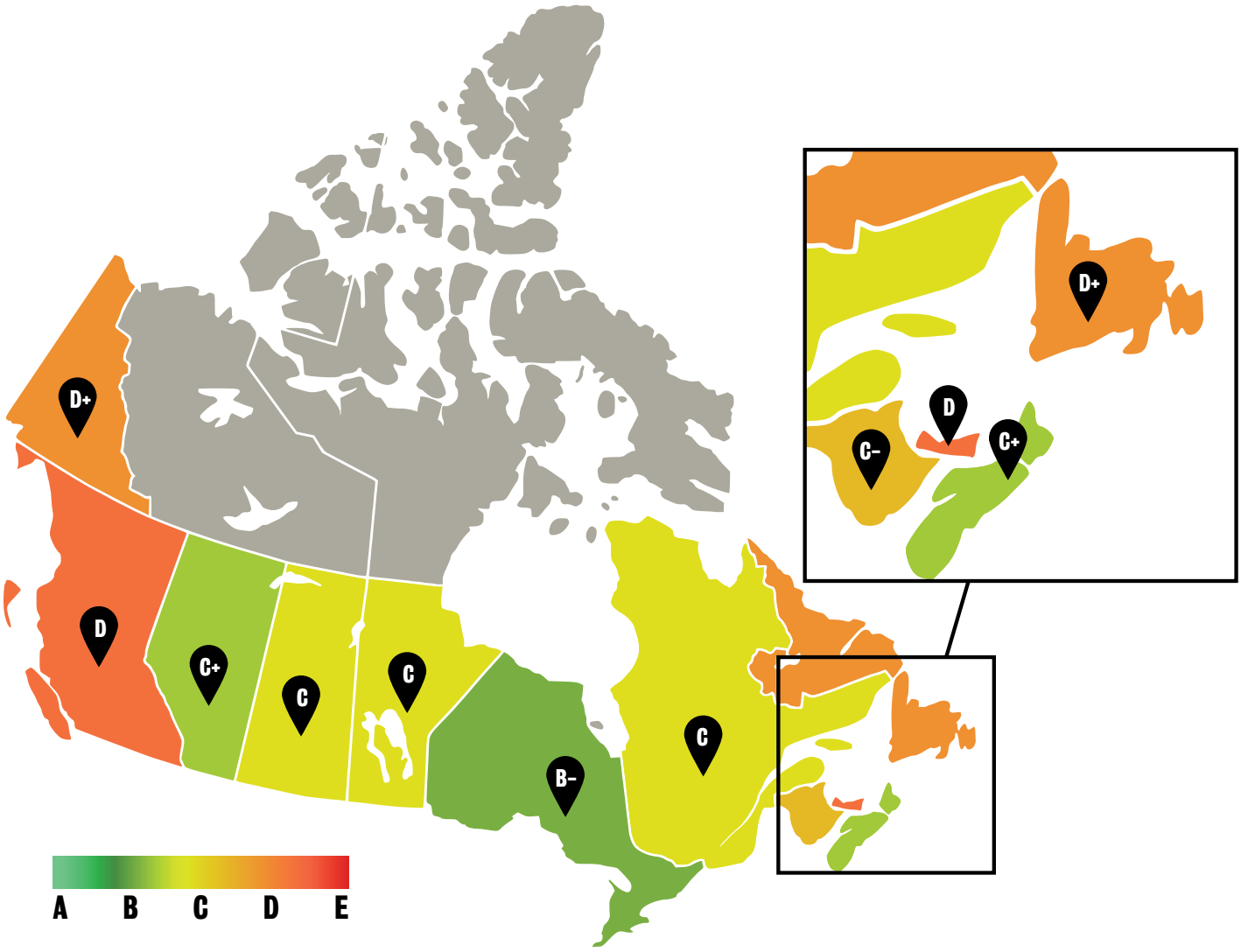


FIGURE 2: **Flood Preparedness Scores of Canadian Provinces and Territories, 2016 (A and E reflect high and low scores, respectively)**

As is evident based on a comparison of Figures 1 and 2, **flood preparedness for Canada has improved marginally over the period 2016 to 2019.**

At the provincial level, average flood preparedness scores were calculated for the western and central provinces (British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec), as distinct from the Atlantic provinces (New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador) and territories (Yukon, Northwest Territories, Nunavut) (Figure 3 a-m). These three distinctions reflected direction primarily from the Atlantic Provinces that considered their flood risk factors to be unique due to their proximity to the Atlantic Ocean.

The most noteworthy uniting factor for the territories is that climate changes, including the warming trend recorded over the past decades in Northern Canada, are already significant and manifest themselves through the reduction of sea ice, the degradation of permafrost, changing precipitation levels and the increasing frequency of ice-jam floods.

FIGURE 3a – m: Flood Preparedness Scores of Canadian Provinces and Territories, 2019

FIGURE 3a

British Columbia C+

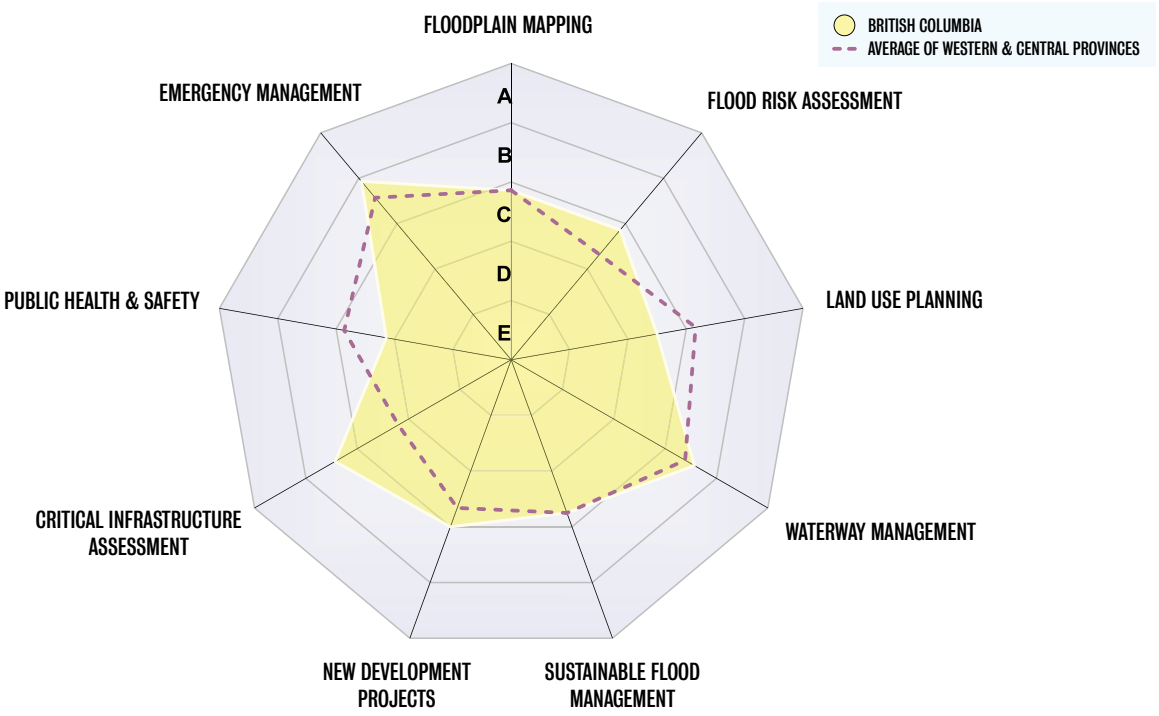


FIGURE 3b

Alberta C+

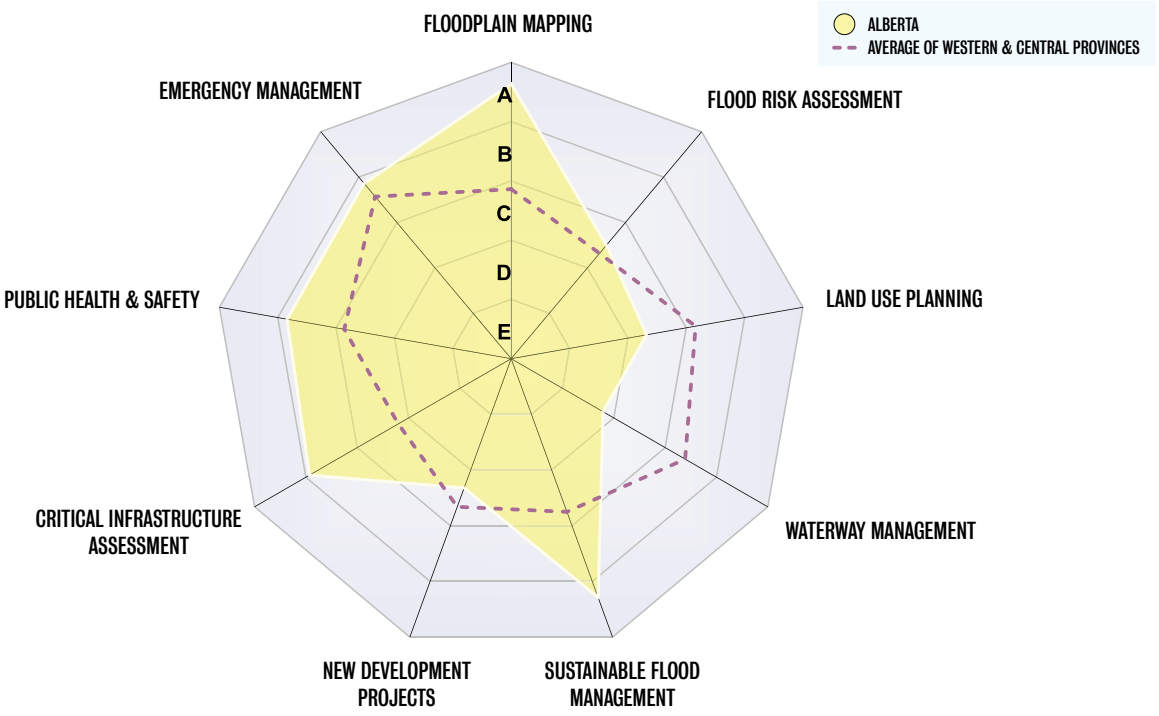


FIGURE 3c

Saskatchewan C

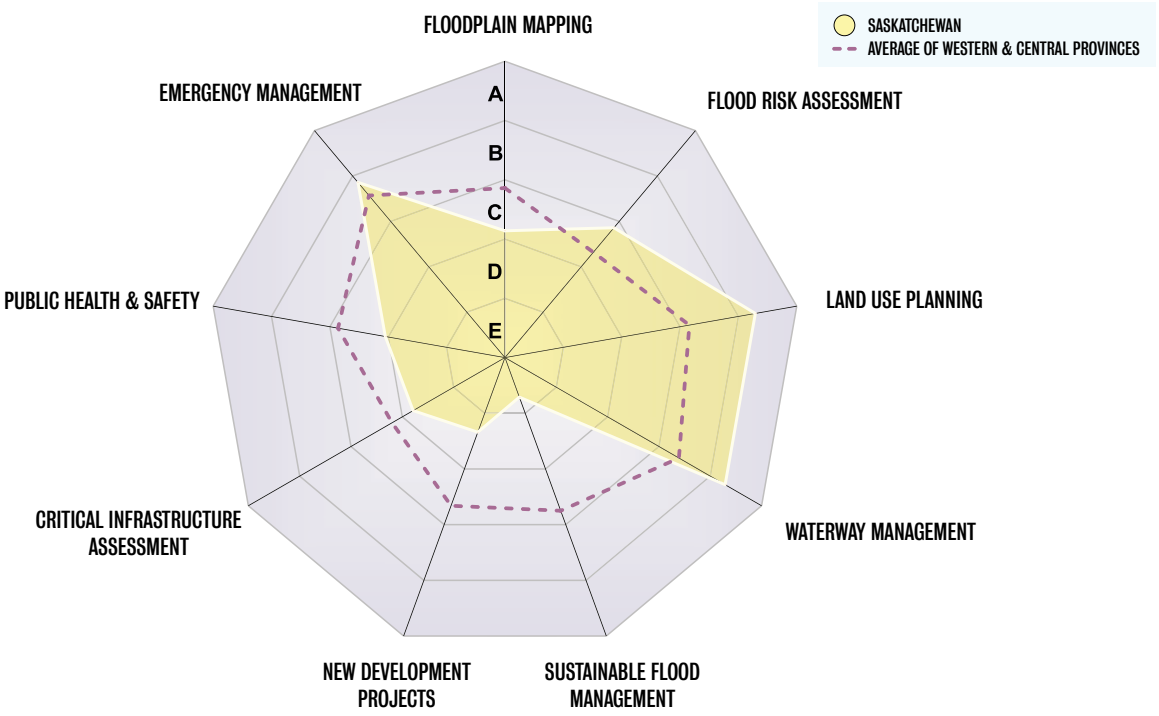


FIGURE 3d

Manitoba C–

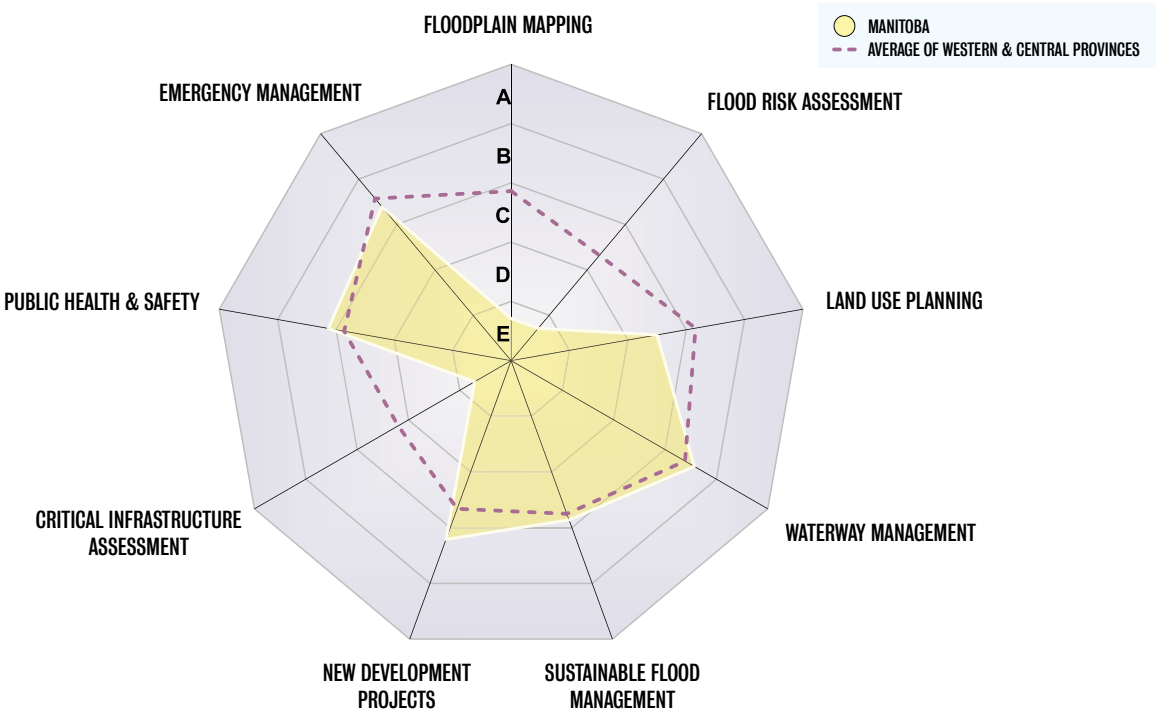


FIGURE 3e

Ontario C

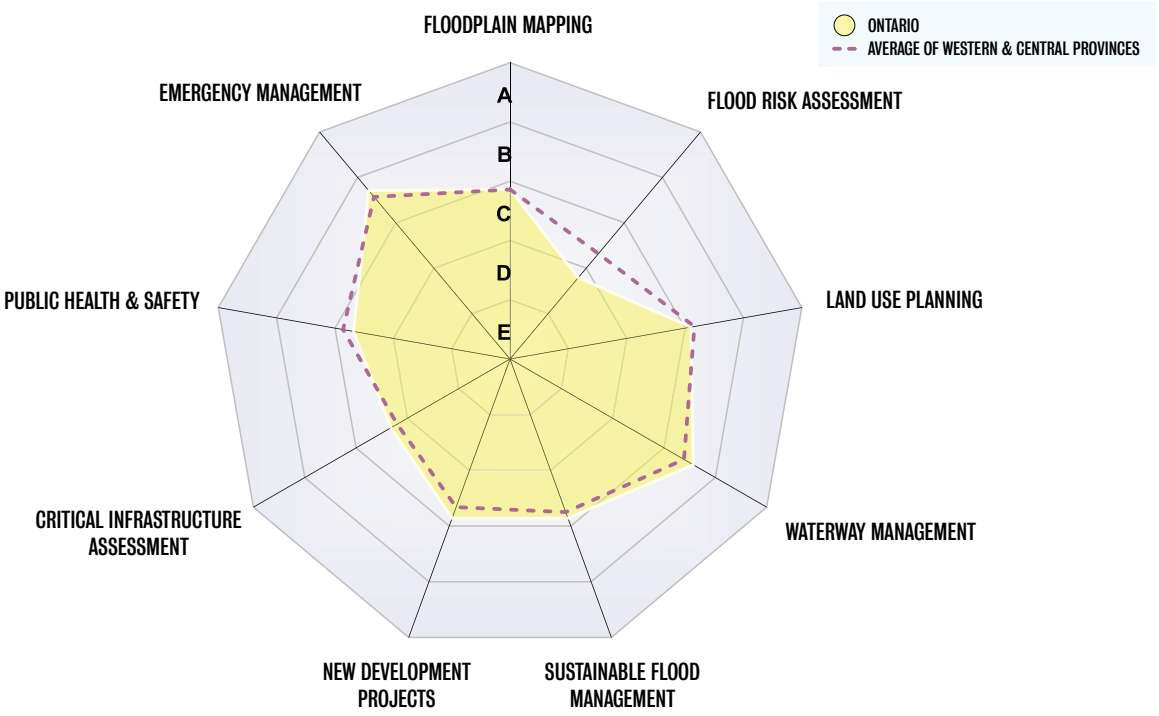


FIGURE 3f

Quebec C

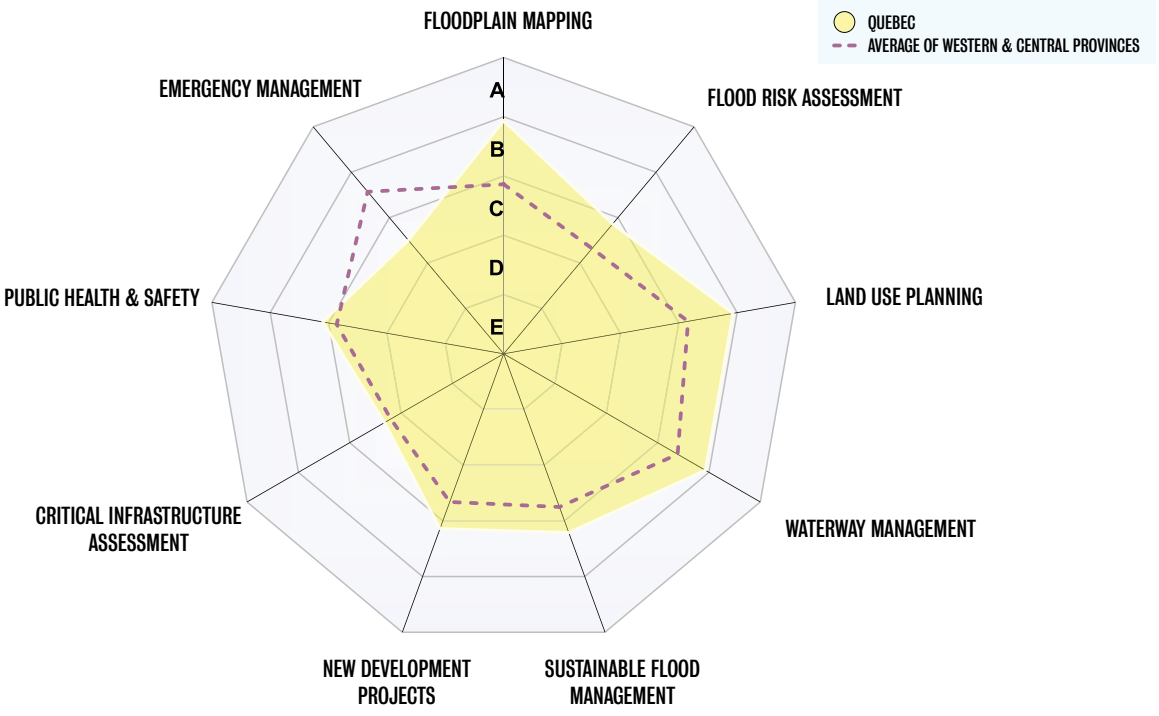


FIGURE 3g

Newfoundland and Labrador C+

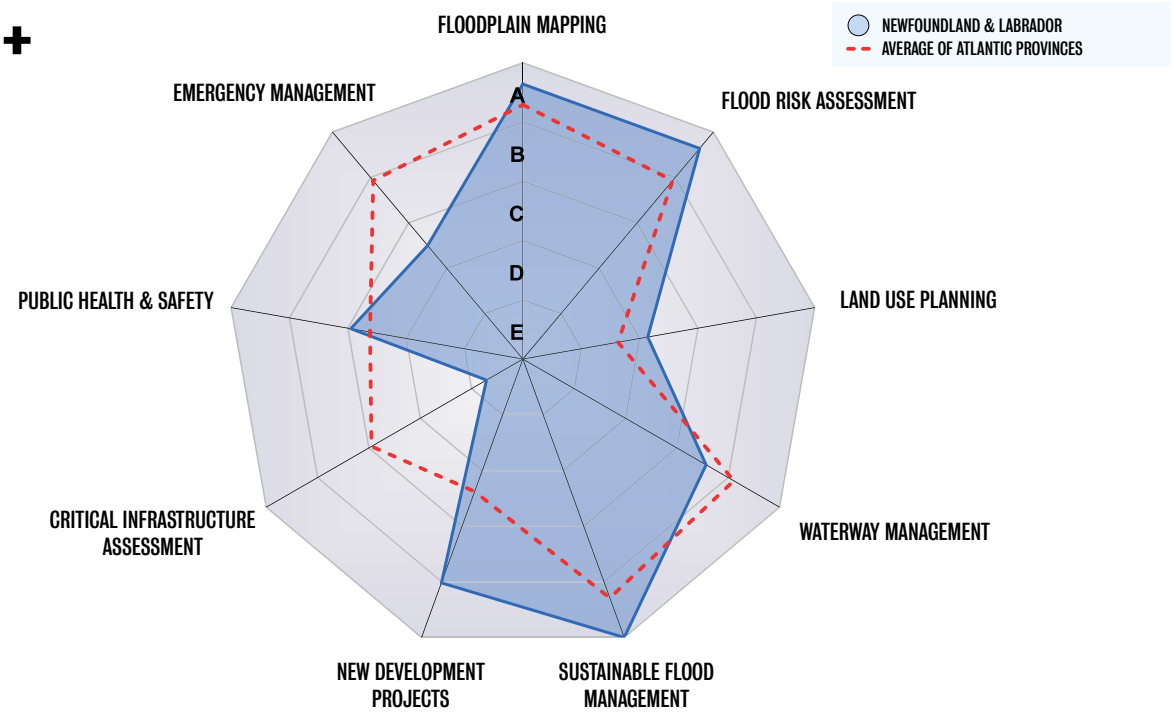


FIGURE 3h

New Brunswick C

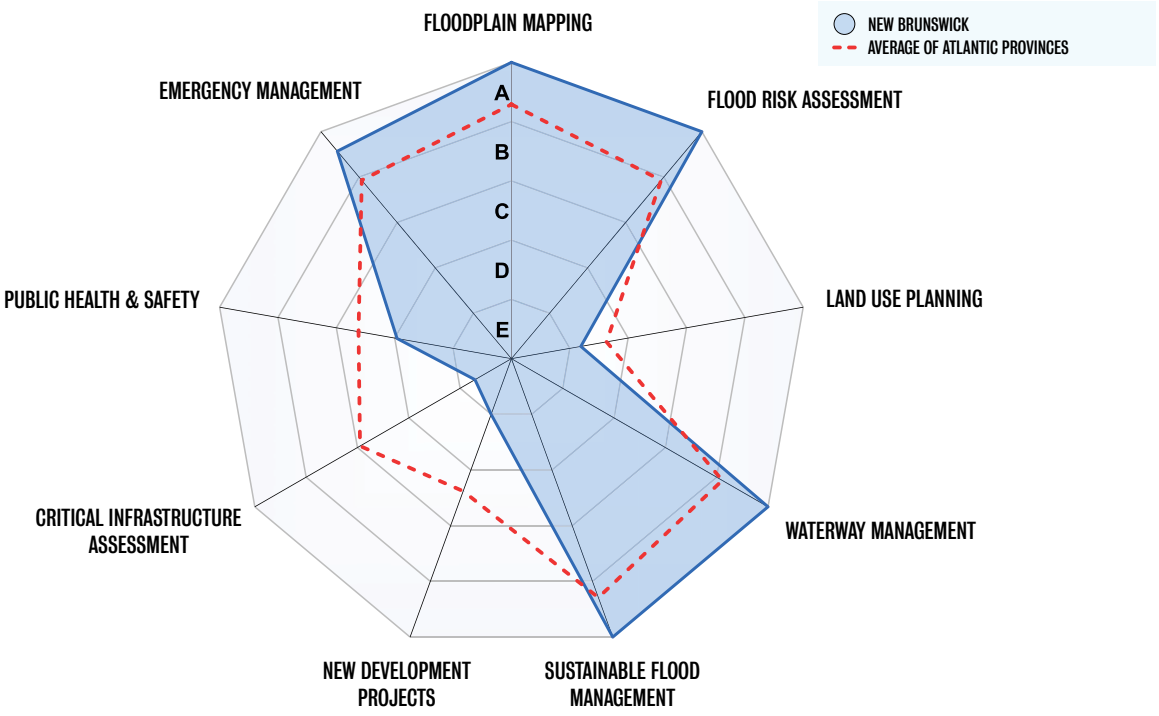


FIGURE 3i

Prince Edward Island B-

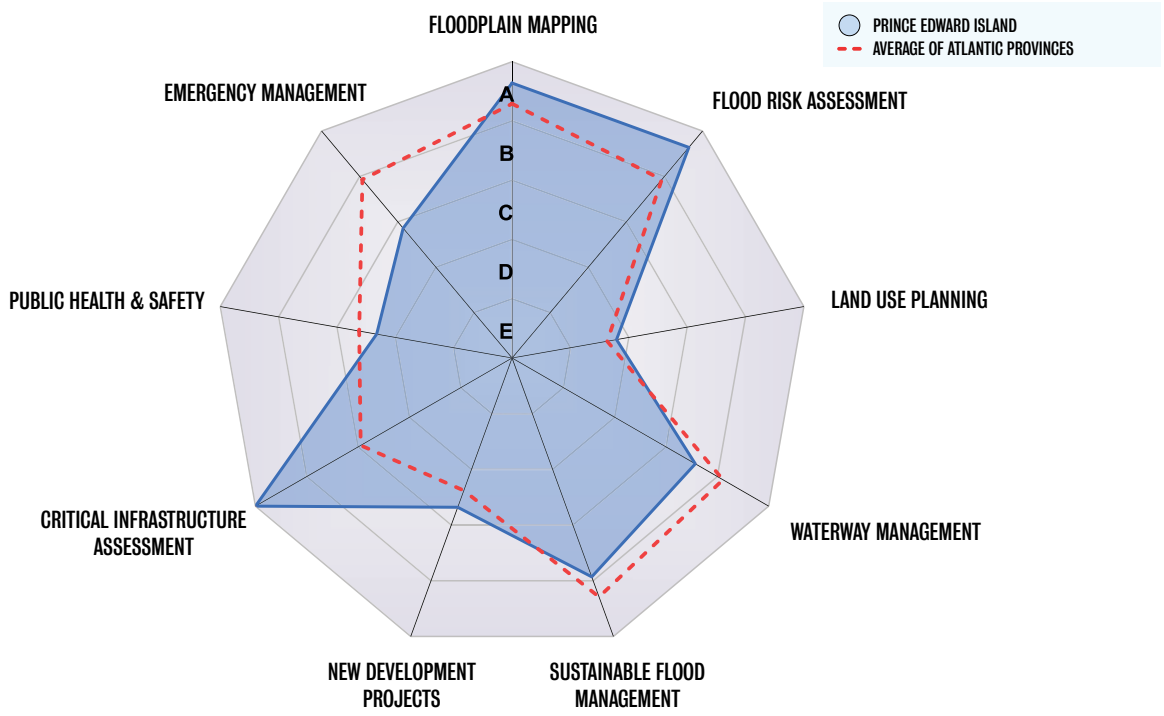


FIGURE 3j

Nova Scotia C

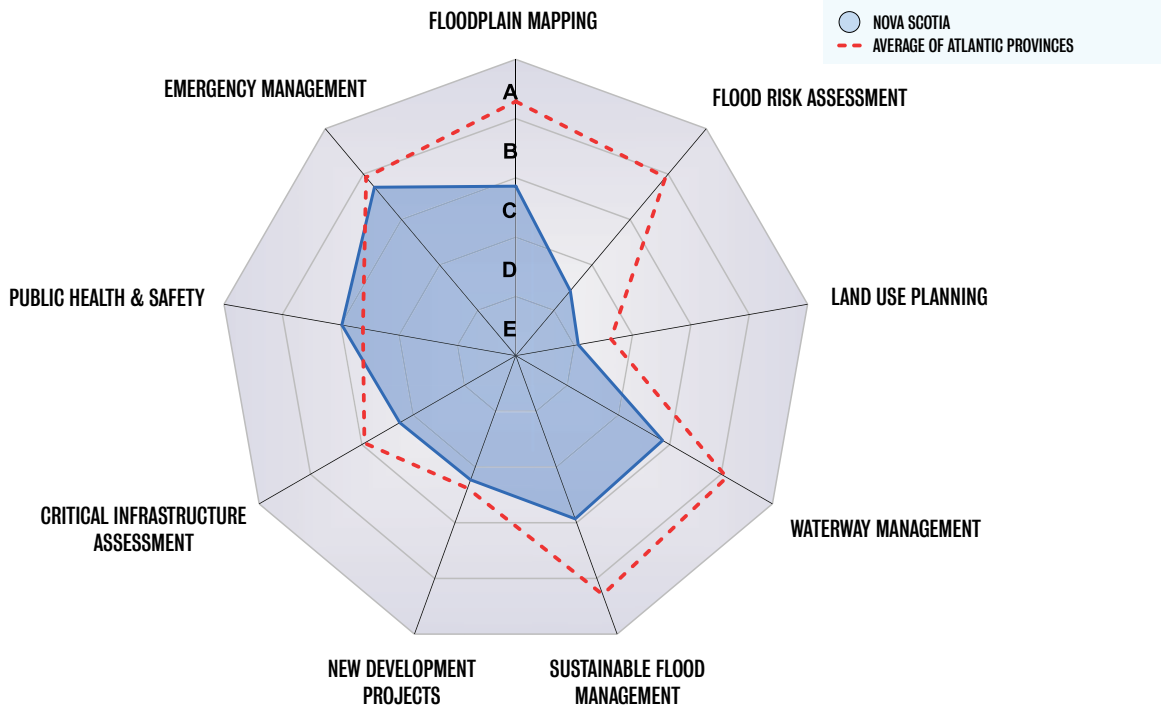


FIGURE 3k

Yukon **B-**

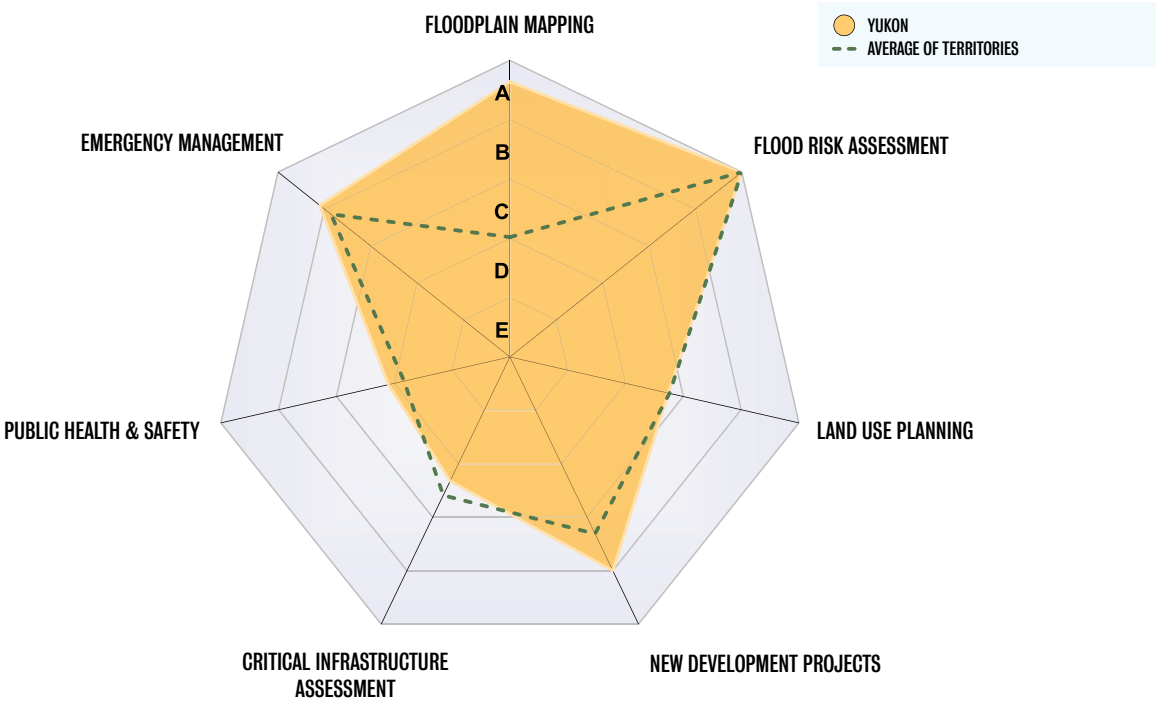


FIGURE 3l

Northwest Territories **C**

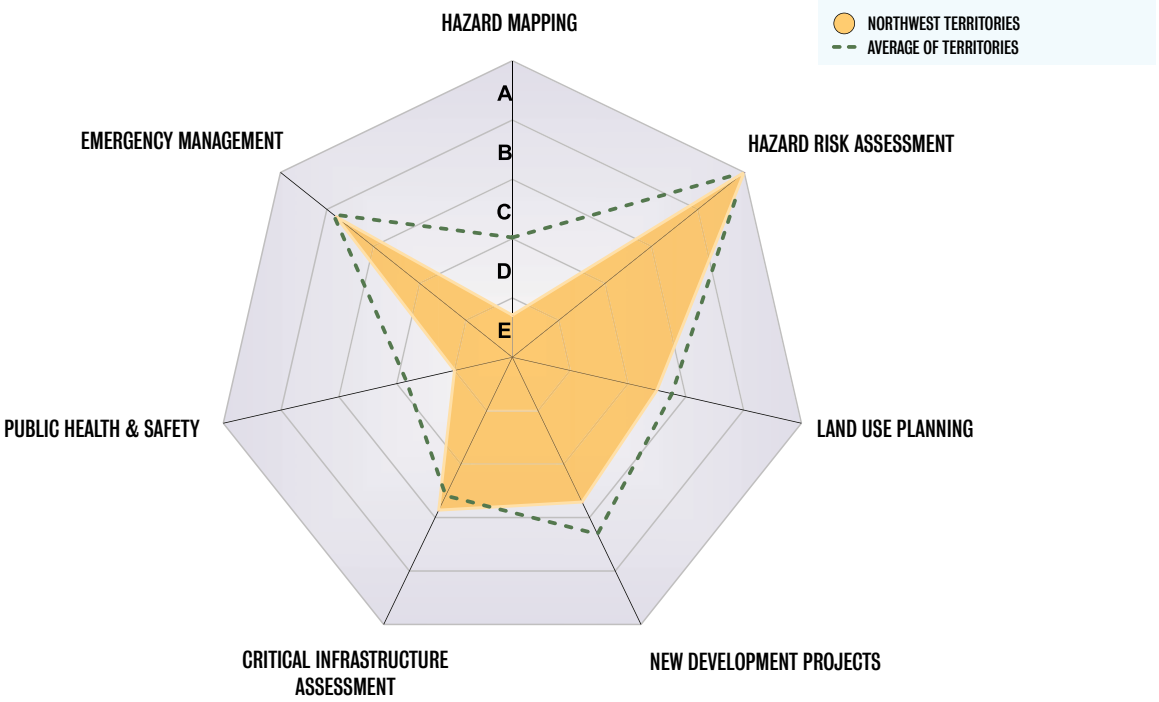
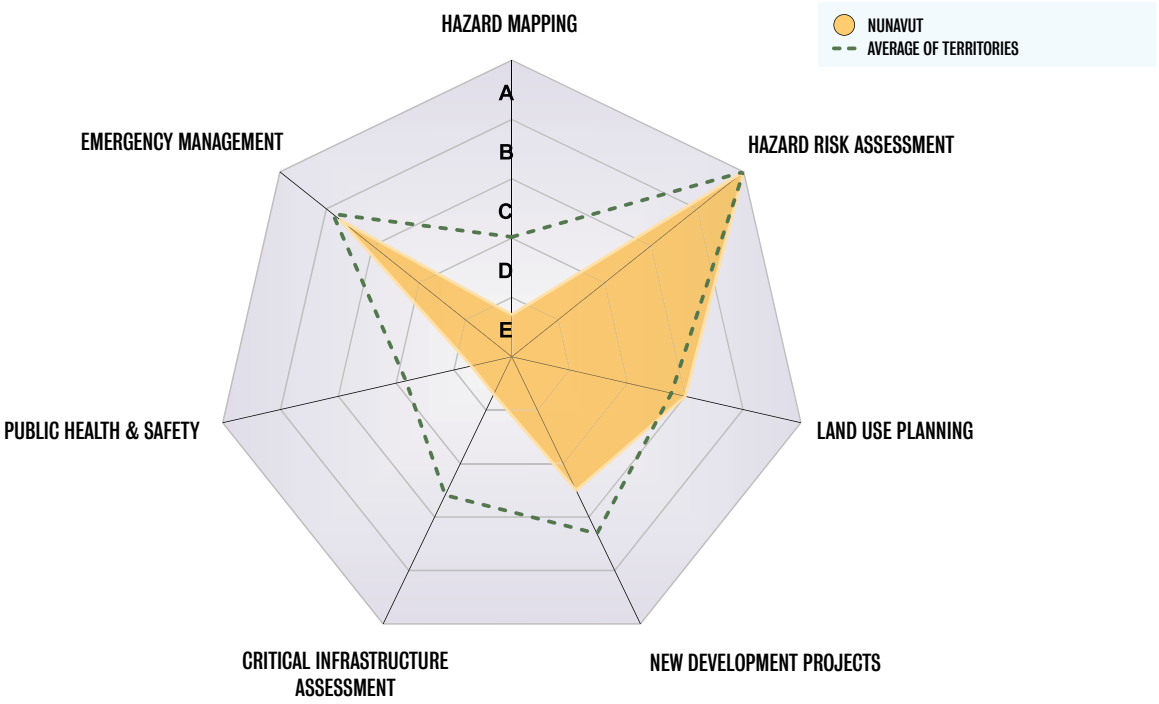


FIGURE 3m

Nunavut C–



Although there was no material difference between the average flood preparedness scores obtained for the provinces and territories, scores did differ sharply within individual provinces and territories. The obtained high level of within group (two groups: the provinces and the territories) variation was partially caused by the perceived lack of flood risk by senior officials, combined with limitations (e.g., technical and financial) to act despite the recognition of risk.

The provinces of Alberta, New Brunswick, Newfoundland and Labrador, and Prince Edward Island each declared that they have incorporated the impacts of climate change into their floodplain mapping initiatives. Conversely, the provinces of British Columbia, Manitoba, Nova Scotia, Ontario, Quebec and Saskatchewan all stated that they are not directly responsible for the development of floodplain mapping, but rather they collaborate with local governments and/or agencies to incorporate the effects of climate change within floodplain maps.

Climate change was reported to have a strong impact on hazards that affect Northern Canada. Accordingly, the territories exhibited strength in relation to incorporating the impacts of climate change pertaining to hazards, and most specifically those associated with waves and storm surges, the degradation of permafrost, sea-level changes and coastal erosion.

Despite the fact that the provinces and Yukon demonstrated strengths in floodplain mapping and flood risk assessments, **many jurisdictions reported a lack of regulations that would prohibit new development within floodplain areas identified as "high risk"**. Although Local Government Acts (or their equivalent) empower municipal governments to enact bylaws that designate floodplain areas, there are limited regulations that explicitly prohibit new development in such areas.

As suggested by many survey respondents, **provinces and territories should consider exercising greater**

enforcement of their land use policies. Although most jurisdictions have some formalized best practices, their implementation is often unrealized. **In this regard, respondents echoed conclusions made by the Parliamentary Budget Office of Canada (2016), highlighting inconsistency in the regulation and enforcement of relevant policies and regulations by provincial governments.**

Provincial and territorial governments reported strength in emergency management relative to flood risk, and more specifically in maintaining the continuity of communications, the operation and maintenance of flood forecasting and alert/warning systems. As well, they exhibited aptitude in the regulation of waterway modifications and in risk assessment of healthcare facilities.

Relative to critical infrastructure, the survey results also indicated strength across the provinces and territories regarding highway and water infrastructure. Alternatively, **as nearly all governments selected the 'non-applicable' option in response to electrical and telecommunications infrastructure questions, this suggests a nationally pervasive gap in these two areas.** Moreover, **nearly all Canadian provinces and territories reported that they do not oversee dam safety reviews nor the update of dam failure inundation maps for non-provincially owned dams. This may pose a potential threat to the safety of Canadians as it may lead to outdated or inaccurate dam safety information.**

A precautionary note emerged from the survey relative to flood risk affecting Critical Infrastructure (CI). CI systems rely on the functional continuity of other systems, a concept commonly referred to as infrastructure interdependency. For example, if communication infrastructure fails during a flood, this may affect emergency response capacity. Despite the importance of assessing infrastructure interdependencies, survey results indicated a prevalent limitation in this area nationwide. Accordingly, many survey respondents suggested that **the provinces and territories might consider forming flood risk task forces to examine interdependencies across multiple aspects of infrastructure resiliency.**

Another key aspect of emergency management is the need to have validated and regularly updated flood risk maps. These maps provide important information about the location and distribution of vulnerable populations and threats to critical infrastructure, including evacuation routes. Table 2 below presents a summary of provincial responses which were collected to address the following question:

"Have the provincial flood risk maps for areas subject to current and future risks of flooding been updated within the last 5 years?"

TABLE 2: State of Provincial Flood Risk Mapping Coverage (2019). Responses to the question: Have the provincial flood risk maps for areas subject to current and future risks of flooding been updated within the last 5 years?

PROVINCE	FLUVIAL	PLUVIAL	COASTAL	ICE JAMS / SEA ICE	GROUNDWATER	WATER RETENTION INFRASTRUCTURE
Alberta	Partially	N/R	N/A	Partially	N/R	N/A
British Columbia	Partially	No	Partially	Partially	No	N/A
Manitoba	Partially	Partially	No	Partially	No	Partially
New Brunswick	Partially	Partially	Partially	Currently Updating	N/A	N/A
Newfoundland and Labrador	Yes	Yes	Yes	Currently Updating	N/A	Yes
Nova Scotia	Partially	No	Yes	Partially	N/A	Partially
Ontario	Partially	Partially	N/A	N/A	N/A	N/A
Prince Edward Island	Partially	No	Yes	N/A	N/A	N/A
Quebec	Partially	No	No	Partially	N/A	Partially
Saskatchewan	Partially	No	N/A	Partially	No	No

Note. N/A = not applicable; N/R = no response; Partially = only some of the territory is covered by mapping.

"The provinces and territories might consider forming flood risk task forces to examine interdependencies across multiple aspects of infrastructure resiliency."

Table 3 presents a summary of territorial responses to the following question: "Have the territorial hazard risk maps been updated within the last 5 years?"

TABLE 3: State of Territorial Hazard Risk Mapping Coverage (2019). Response to question: Have the territorial hazard risk maps been updated within the last 5 years?

PROVINCE	PERMAFROST	FLUVIAL	PLUVIAL	COASTAL	ICE JAMS / SEA ICE	GROUNDWATER	WATER RETENTION INFRASTRUCTURE
Northwest Territories	N/A	N/A	No	N/A	N/A	N/A	N/A
Nunavut	Currently Updating	Partially	N/A	No	Partially	N/A	N/A
Yukon	N/A	N/A	N/A	No	Yes	N/A	Partially

Note. N/A = not applicable; N/R = no response; Partially = only some of the territory is covered by mapping.

In summary, **flood preparedness for Canada in 2019 (Average Score C), juxtaposed to 2016 (Average Score C-), indicates that provinces and territories are moving slowly to address flood risk (with the exception of substantially improved performance for Yukon, British Columbia and PEI).**

The slight improvement in flood risk preparedness, over the 4-year period ending 2019, may explain the discrepancy between the projections made by Canada's Parliamentary Budget Office regarding annual Disaster Financial Assistance Arrangement (DFAA) projected payments of $902 million, with $673 million attributable to flood relief, vs. Canada's funded liability of $100 million (PBOC 2016). **A more aggressive provincial and territorial effort to limit future flood risk could close the gap between projected and funded DFAA expenditures.**

CHAPTER 1
INTRODUCTION

This chapter provides an introduction to the preparedness of Canadian provinces and territories to address the impacts of flooding and climate change risks.

1.1

Background

Climate change effects include increases in the frequency and intensity of hazards such as floods, wildfires, droughts, extreme temperatures, extreme wind, melting permafrost, coastal erosion, and damage to seasonal ice roads. These hazards pose significant risks to communities, the health and well-being of individuals, the economy, and the natural environment (Public Safety Canada 2019). Nationally, flooding is the costliest natural peril (IBC 2019c), and as such it was the imperative for this report – to assess and profile the state of flood preparedness of Canada's provinces and territories.

The escalating costs of extreme weather events are illustrated in **Figure 4**, which profiles insurable loss for Canadian catastrophic (CAT) events between 1983 and 2019. There is a discernable upward trend in losses covering the period, with greater than 50% of growing costs attributable to flooding.

The upward trend in claims in **Figure 4** is not solely a function of extreme weather (CMOS 2018). For example, compounding factors that can affect flood claims include loss of natural infrastructure, aging municipal infrastructure, and housing construction practices that did not incorporate flood-resilience considerations (Moudrak and Feltmate 2019).

Insured Catastrophic Losses in Canada

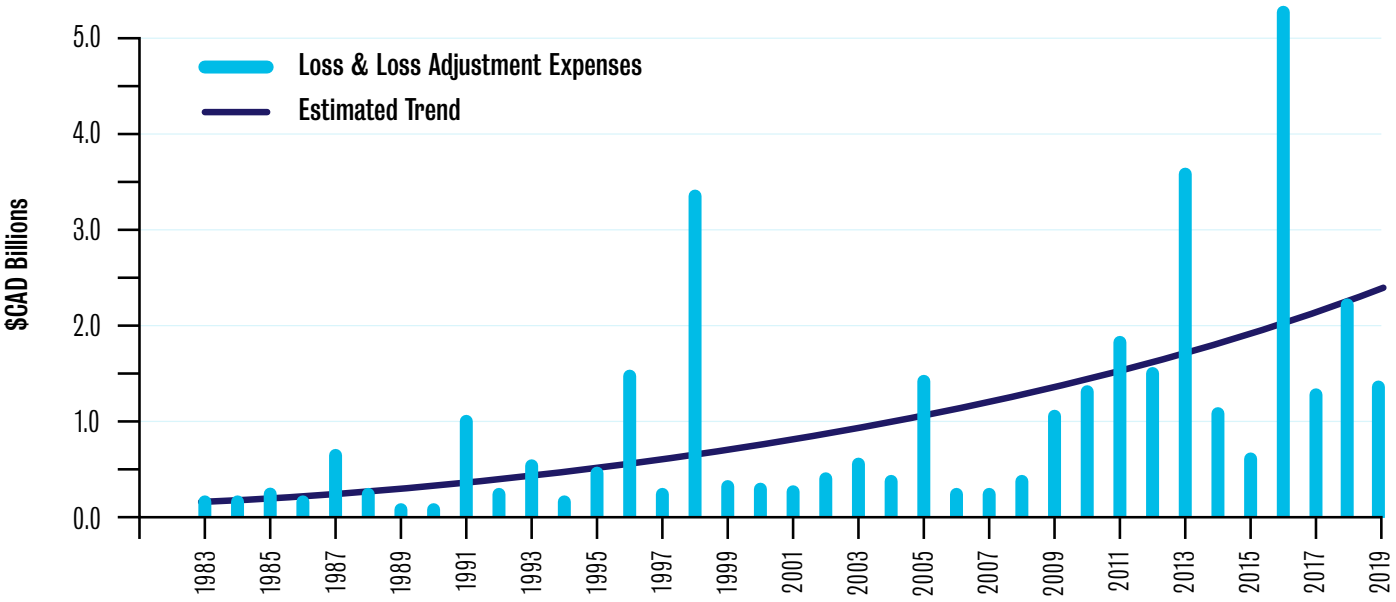


FIGURE 4: Catastrophic insured loss payments, Canada, 1983 – 2019. Total losses are normalized for inflation ($2019 CAN) and per-capita wealth accumulation. Source: CatIQ, PCS, IBC Facts Book.

Determining the state of flood preparedness of the provinces and territories – and by extension, identifying the means to correct deficiencies – bears financial relevance to the federal government of Canada. More specifically, in the event of a large-scale natural disaster, the federal government may provide financial assistance to provincial and territorial governments through Disaster Financial Assistance Arrangements (DFAA) administered by Public Safety Canada. Although the provincial and territorial governments design, develop and deliver disaster financial assistance, DFAA defines what costs will be eligible for cost sharing with the federal government (cost sharing varies depending on such factors as the population density of the affected region and total financial burden impact).

The Parliamentary Budget Office estimated that over the five-year period beginning in 2016, DFAA demands could reach $673 million per year due to flooding (PBOC 2016) – this figure reflects a marked jump over the previously budgeted $100 million per year. Implementation of means to limit flood risk could help to redress this funding gap.

Substantially costly floods are appearing across the Canadian landscape in a pattern consistent with Parliamentary Budget Office projections. For example, during July of 2019, the Insurance Bureau of Canada released the Eastern Canada Spring Flooding Review, indicating that spring flooding across Ontario, Quebec and New Brunswick caused close to $208 million in insured damage that year alone, suggesting that the trend of increasing flood damage costs shows no sight of abatement (IBC 2019a).

Historically, the Canadian government has tried to limit residential and commercial flood risk through federally directed programs. For example, in recognition of the rising costs of flooding, the federal government initiated the Flood Damage Reduction Program (FDRP) in 1975, in an attempt to discourage future development in areas at high risk of flooding. According to the declared aim of the program, following the designation of a floodplain, both federal and provincial governments would agree to avoid building any future "flood vulnerable developments" in flood prone areas (ECCC 2013). **Generally, this agreement was not enforced in any meaningful way and development continued to take place in hazardous areas throughout the span of the program. Multiple studies documented that weak enforcement of the FDRP meant that the program had no significant impact on occupancy rates within floodplain areas, no reduction in the cost of flood damages, and failed to halt development in flood prone areas** (Christin 1997, Roy and Lacroix 1997, Morris-Oswald et al. 1998, Shrubsole et al. 1997). The program ended in 1997.

Just as insurable losses/costs associated with flooding are on the rise, uninsurable losses are likewise increasing. For instance, "for every single dollar paid out in insurance claims for homes and businesses, IBC estimates that Canadian governments pay out $3 to recover public infrastructure damaged by severe weather" (IBC 2019c).

By analyzing the state of flood preparedness of Canada's provinces and territories, **it is the intent of this report to provide an informed perspective that will contribute to the alleviation of current and future flood and climate-related risks in Canada.** With this purpose in mind, the structure of this report is as follows:

- **Chapter 2** defines the scope of the study;
- **Chapter 3** presents an overview of the major findings and trends across provincial and territorial jurisdictions, broken down by region:
  - 3.1 presents an overview of the data collected from the representatives of the six western and central provinces – British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Quebec;
  - 3.2 presents an overview of the data collected from the representatives of the four Atlantic provinces – Newfoundland and Labrador, New Brunswick, Prince Edward Island and Nova Scotia; and
  - 3.3 presents an overview of the data collected from the representatives of the three territories – Yukon, Northwest Territories and Nunavut.
- **Chapter 4** profiles emerging trends and conclusions; and
- **Appendix A** provides study questionnaires.

CHAPTER 2
PURPOSE AND SCOPE

In Canada, provincial, territorial and municipal governments all share the responsibility for emergency management. Across the nation, more than 90 percent of emergencies are handled locally or at the provincial/territorial level and do not require direct federal involvement (PSC 2019).

In recognition of this distribution of responsibility, **this study examined the preparedness of provincial and territorial governments to minimize the negative consequences of current and future floods.** The field component of research ran from January – September 2019. Research consisted of interviews with representatives from provincial and territorial governments who were responsible for the management of flood and climate-related risks as well as with emergency management personnel.

The areas of focus of the study reflected the core themes of the United Nations Sendai Framework for Disaster Risk Reduction (DRR), to which Canada is a signatory. DRR is a systematic, whole-of-society approach to identifying, assessing, and analyzing the causal effects of disasters and reducing the resultant risks and impacts based on risk assessments. The framework highlights the need for an integrated, all-hazard, multi-sectoral approach to disaster risk management (PSC 2017) relative to four key pillars:

1) Understanding disaster risk;

2) Strengthening disaster risk governance to manage disaster risk;

3) Investing in disaster risk reduction for resilience; and

4) Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction (Canada 2017).

The criteria utilized within this study were not exclusive to DRR, but also drew upon the Canadian Emergency Management Framework (PSC 2017), which outlines the roles and responsibilities of Canadian governments.

"This study examined the preparedness of provincial and territorial governments to minimize the negative consequences of current and future floods."

2.1

Study Design and Methodology

Flood preparedness criteria utilized in the current study were informed, in part, based on a 2016 study of the flood preparedness of Canadian provinces and Yukon Territory (Feltmate and Moudrak 2016). To reflect the evolution toward proactive prevention and mitigation efforts in emergency management practices, and to incorporate efforts to adapt to climate change, some of the criteria and their components were redesigned for the present study.

The criteria designed to assess the flood-related commitments of provincial governments are presented in Table 4. Some criteria consisted of a single dimension (e.g., Floodplain Mapping), whereas other factors consisted of sub-components (e.g., Land Use Planning).

TABLE 4: Key Assessment Criteria for Provincial Governments

No.	CRITERIA	IDENTIFIER	SUB-COMPONENTS
1	Floodplain Mapping	1	NA
2	Flood Risk Assessment	2	NA
3	Flood Risk Maps	3	NA
4	Land Use Planning	4a	Unincorporated Areas/Communities
		4b	Municipal Planning Areas
		4c	Provincial Crown Lands
5	Waterway Management	5	NA
6	Sustainable Flood Management	6a	Riverine
		6b	Coastal
7	New Development Projects	7a	New Provincial Highways
		7b	New Natural Resource Developments
		7c	New Oil and Gas Pipelines
		7d	New Hydrogeneration Projects
		7e	New Solid Waste Landfills
8	Critical Infrastructure Assessment	8a	Electrical Infrastructure
		8b	Telecommunications Infrastructure
		8c	Provincial Highway Infrastructure
		8d	Pipeline Infrastructure
		8e	Drinking and Wastewater Infrastructure
9	Public Health and Safety	9a	Healthcare Facilities
		9b	Structural Flood Protection Infrastructure
		9c	Dam Safety
		9d	Abandoned Contaminated Sites
10	Emergency Management	10a	Emergency Response Operations
		10b	Continuity of Electricity Supply
		10c	Continuity of Fuel Supply
		10d	Continuity of Communications
		10e	Flood Forecasting and Warnings

Note. N/A indicates that the specific criterion is standalone and therefore does not have any components.

The criteria designed to assess the hazard-related commitments of territorial governments are presented in Table 5.

TABLE 5: Key Assessment Criteria for Territorial Governments

No.	CRITERIA	IDENTIFIER	SUB-COMPONENTS
1	Floodplain (Hazard) Mapping	1	NA
2	Hazard Risk Assessments	2	NA
3	Hazard Risk Maps	3	NA
4	Land Use Planning	4a	Unincorporated Areas/Communities
		4b	Municipal Planning Areas
		4c	Territorial Crown Lands
5	Waterway Management	5	NA
6	Sustainable Risk Management	6a	Riverine
		6b	Coastal
7	New Development Projects	7a	New Territorial Highways
		7b	New Natural Resource Developments
		7c	New Oil and Gas Pipelines
		7d	New Hydrogeneration Projects
		7e	New Solid Waste Landfills
8	Critical Infrastructure Assessment	8a	Electrical Infrastructure
		8b	Telecommunications Infrastructure
		8c	Territorial Highway Infrastructure
		8d	Pipeline Infrastructure
		8e	Drinking and Wastewater Infrastructure
9	Public Health and Safety	9a	Healthcare Facilities
		9b	Structural Flood Protection Infrastructure
		9c	Dam Safety
		9d	Abandoned Contaminated Sites
10	Emergency Management	10a	Emergency Response Planning
		10b	Continuity of Electricity Supply
		10c	Continuity of Fuel Supply
		10d	Continuity of Communications
		10e	Flood Forecasting and Warnings

Data/information regarding the criteria identified in Tables 4 and 5 was collected in a similar manner as in a prior flood preparedness study (Feltmate and Moudrak 2016). Specifically, the data was primarily collected by means of telephone interviews with key government officials. Prior to the initiation of each phone interview, all study participants were informed that their personal judgements or opinions were not sought in regard to the adequacy of the flood preparedness efforts of their respective jurisdictions. Instead, the stated goal of the phone interviews was to collect information on the specific measures, practices, and policies that were in place within each jurisdiction. Moreover, **all study participants confirmed the responses that they provided, wherein the data was recorded and analyzed only following written confirmation of its accuracy by the study participants.**

2.2

Survey Questionnaires

Survey questions presented to provinces and territories were formulated relative to the criteria specified in Tables 4 and 5. Moreover, to enable relative continuity and comparison of outcomes, between the current study and one conducted in 2016 (Feltmate and Moudrak 2016), the questions and response options were consistent in design.

Several pilot interviews were conducted with provincial and territorial officials to ensure interview questions were unambiguous.

Similar to the prior study conducted in 2016 (Feltmate and Moudrak 2016), the present survey was designed using questions that were primarily quantitative in nature. The provincial and territorial questionnaires each consisted of 28 questions. These questions were categorized relative to the flood preparedness criteria to which they corresponded.

All 28 survey questions presented to the provinces and the territories are presented in Appendix A. A sample survey question is presented below (see Data Analysis, Section 2.4).

2.3

Sample Population

Participants in this study represented governmental departments with responsibilities to manage and respond to flooding and to coordinate response to other climate-related risks.

For territorial governments, the initial list of departments included those actively involved in territory-wide climate risk management, including flood risk management for the Yukon and the Northwest Territories. Nunavut, as it was not found to be at a significant risk to flooding, was only assessed from the perspective of climate risk.

Researchers on this project established a data base of 806 provincial/territorial contacts, all of whom held responsibilities related to flood or climate change preparedness. Following the process of identification, the researchers sent invitations to those contacts who were designated by provincial and territorial documents as being responsible for climate change and flood risk adaptation efforts, including emergency management.

Following conveyance of initial invitations, some government officials appointed representatives to collect information from within their departments. However, in many cases, it was also necessary for the researchers to send additional invitations at the Assistant/Associate Deputy Ministerial level.

The total number of transmitted invitations was 305 to the provinces and territories. **Interviews were conducted with 139 jurisdictionally designated representatives** (see Table 6 for breakdown of the number of interviewees per province and territory).

"Researchers on this project established a data base of 806 provincial/territorial contacts, all of whom held responsibilities related to flood or climate change preparedness."

TABLE 6: Number of Governmental Officials Interviewed, by Province and Territory (2019)

Province/Territory	Number of Conducted Interviews
Alberta	14
British Columbia	17
Manitoba	12
New Brunswick	7
Newfoundland and Labrador	9
Northwest Territories	9
Nova Scotia	7
Nunavut	6
Ontario	18
Prince Edward Island	6
Quebec	11
Saskatchewan	12
Yukon	11
TOTAL	**139**

Note. The Ministry of Municipal Affairs from Quebec declined to participate. Therefore, the ratio of ministries that chose to participate in the study vs. the total number of ministries contacted was 66/67or 98.5%.

2.4

Data Analysis

To enable comparability between provincial/territorial flood preparedness survey data obtained in 2019 vs. 2016, identical methods were applied to data collection and analysis in both studies.

The survey utilized closed-form questions, each of which had five response options ranging from 'optimal' ('A') to the low ('E'), with the good, significant, and incipient options in between, respectively. During interviews, respondents self-reported which option out of the five response options best captured the level of preparedness of their jurisdiction. For example, to gauge the level of involvement of provincial governments in the creation, maintenance, and update of floodplain maps, participants were asked to select the most appropriate option (or combination of options) in response to the following survey question:

What is the level of provincial engagement relating to the development and update of floodplain maps, including coastal and riverine maps? (select between the following options):

- A - The province is responsible for the development and regular (every 5 years) update of floodplain maps. This includes incorporating changes in floodplain hydrology and hydraulics as well as the impacts of climate change on identified flood hazards, including flood hazards associated with storm surges and sea-level rise.
- B - The province is responsible for developing floodplain mapping tools and guidelines, and delegates responsibility for the development and update of floodplain maps to local governments. The province subsequently validates the accuracy of these maps.
- C - The province sets standards, policies, and provides guidelines for the development of floodplain maps, and delegates responsibility for the development and update of floodplain maps to local governments or conservation/watershed authorities.
- D - The province delegates the responsibility for the development and update of floodplain maps to local governments or conservation/watershed authorities. While the province regularly updates provincial guidelines for floodplain mapping, it does not supervise the production of floodplain maps.
- E - The province updates floodplain maps on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

For data analysis, the selected response options were codified through the assignment of a numerical value for each respective option: A=5, B=4, C=3, D=2, and E=1. In some instances, respondents chose to utilize the non-applicable option instead of any of the above letter grades. In such cases, no numeric value was assigned to those responses. Data analyses were then performed by calculating means for each participating jurisdiction. Criteria means were calculated by summing the response options selected for each component divided by the number of component questions considered.

These means were subsequently recoded into letter scores by converting the numeric values to letter grades. However, no data transformation was performed and consequently **the resultant values represent the judgement of each jurisdiction in reference to their respective levels of preparedness.** Finally, average scores for geographical groupings of jurisdictions were calculated, including for all of Canada, by summing the individual preparedness values and dividing by the number of jurisdictions in each respective geographical category.

To enable additional insight regarding the efforts of the provinces and territories to address flood and climate change preparedness, the study incorporated several open-ended questions, not predisposed to quantification, but that nonetheless could aid in the interpretation of overall preparedness – this information is presented in Chapter 3.

CHAPTER 3
PROVINCIAL AND TERRITORIAL FINDINGS

This chapter provides an overview of major findings pertaining to the state of preparedness of provinces and territories relative to flood and climate-related risk.

To effectively present the performance of provincial and territorial governments, the report made use of the following three designations of jurisdictions:

Western and Central Canada, encompassing the provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Quebec;

Atlantic Canada, encompassing the provinces of Newfoundland and Labrador, New Brunswick, Prince Edward Island and Nova Scotia; and

Northern Canada, encompassing the territories of the Yukon, Northwest Territories and Nunavut.

The following uniting factors explain each combination of provinces and territories.

Namely, the provinces of Western and Central Canada all have an important similarity in that most of their population lives and works within the southern portions of each respective province. In addition, all of these provinces demonstrate a trend of continual transformation of the natural environment into the built environment in their southern regions. This trend negatively impacts hydrological and ecological systems and thereby exacerbates their pre-existing flood vulnerability.

Similarly, the provinces of Atlantic Canada share unique geographical specifics which makes all of them susceptible to two primary mechanisms of flooding – namely, coastal flooding and inland flooding.

Finally, the most noteworthy uniting factor for the territories is that climate changes, including the warming trend recorded over the past decades in Northern Canada, are already significant and manifest themselves through the reduction of sea ice, the degradation of permafrost, changing precipitation levels, and the increasing frequency of ice-jam floods.

Due to the use of this approach, the major findings of the study are presented in the following three subsections:

Subsection 3.1 profiles the findings for Western and Central Canada;

Subsection 3.2 profiles the findings for Atlantic Canada; and

Subsection 3.3 profiles the findings for Northern Canada.

3.1

Western and Central Canada Flood Preparedness

Each province of Western and Central Canada has a large population (relative to the Maritimes or Territories) of over 1 million people (Statistics Canada 2019). Moreover, most of their population lives and works within the respective southern portions of each province, whereas the northern areas of each province are generally underdeveloped, sparsely populated, remote and difficult to access.

This region is also highly susceptible to the impacts of flooding. Specifically, four of the worst floods in Canadian history have occurred in Manitoba, and the most financially costly flood took place in Alberta (Mortillaro 2014).

One of the contributing factors that leads to the intensified risks of flooding in this region is the steady trend of the transformation of the natural environment. This is taking place due to the rapid rate of intensifying urbanization, the expansion of the built environment, and the continued growth and spread of transportation infrastructure networks. This transformation also significantly increases the ecological, social and economic costs of extreme weather events.

The forecasted impacts of climate change are similar for the southern parts of these provinces in that daily extreme precipitation (that is, changes in extreme precipitation amounts accumulated over a day or less) is projected to increase throughout the region. Thus, there is the resultant potential for a higher incidence of local flooding due to rainfall events, particularly within urban areas. "An increasing shift toward snowmelt-related floods occurring earlier in the year, including floods associated with spring snowmelt, ice jams, and rain-on-snow events, is also anticipated." (Cohen et al. 2019)

Although floods take place frequently throughout the Western and Central Canada, there are regional differences in the causes that give rise to them taking place:

- In British Columbia, the mountainous and varied terrain creates a unique flood regime. Heavy rainfall combined with light snow in coastal mountain areas can create peak flows greater than those during the spring freshet, and in mountainous regions heavy rainfall

can cause torrents of debris. The Province also has more than 27,200 km of coastline, and experiences coastal flooding when storms arrive during King Tide events, with this projected to increase in frequency and intensity;

- In Alberta, snowmelt from plains and mountains, heavy rainfall and ice jams are the primary causes of flooding;
- In Saskatchewan, the low topographical relief and poorly developed surface drainage system means that the southern parts of this Province are particularly susceptible to flood events (Pattison-Williams et al. 2018). The extensive coverage of the landscape by water from either snowmelt or extreme rainfall is one of the most serious causes of flooding in the Province;
- In Manitoba, the vast majority of incidents stem from spring flooding caused by exceptionally fast snowmelt or large amounts of precipitation coinciding with melting temperatures. Large inundations occur mainly within the Red River watershed because of its level topography and diminished slope;
- In Ontario, floods result from snowmelt, spring rainfall storms, summer thunderstorms, tropical storms or hurricanes, or ice jams, depending on the region of the Province. The major cause of flooding throughout the Province, however, is spring snowmelt combined with short term high intensity precipitation events; and
- In Quebec, spring snowmelt accompanied by rainfall and ice jams are the major causes of flooding. The coastal communities of Quebec, many of which are extremely remote, are prone to submersion floods that are the result of a set of marine phenomena (tides, storms, winds and low atmospheric pressure conditions).

This section provides an overview of the responses provided by the government officials of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, and Quebec.

The following six diagrams (3.1.1 – 3.1.6) illustrate the flood preparedness of the individual provinces within Western and Central Canada, assessed against nine criteria, and benchmarked relative to the average score for all six provinces. The components of the criteria were aggregated into a single score per jurisdiction in order to demonstrate the overall preparedness level of each province. The presentation of provinces is geographic, from west to east.

British Columbia C+

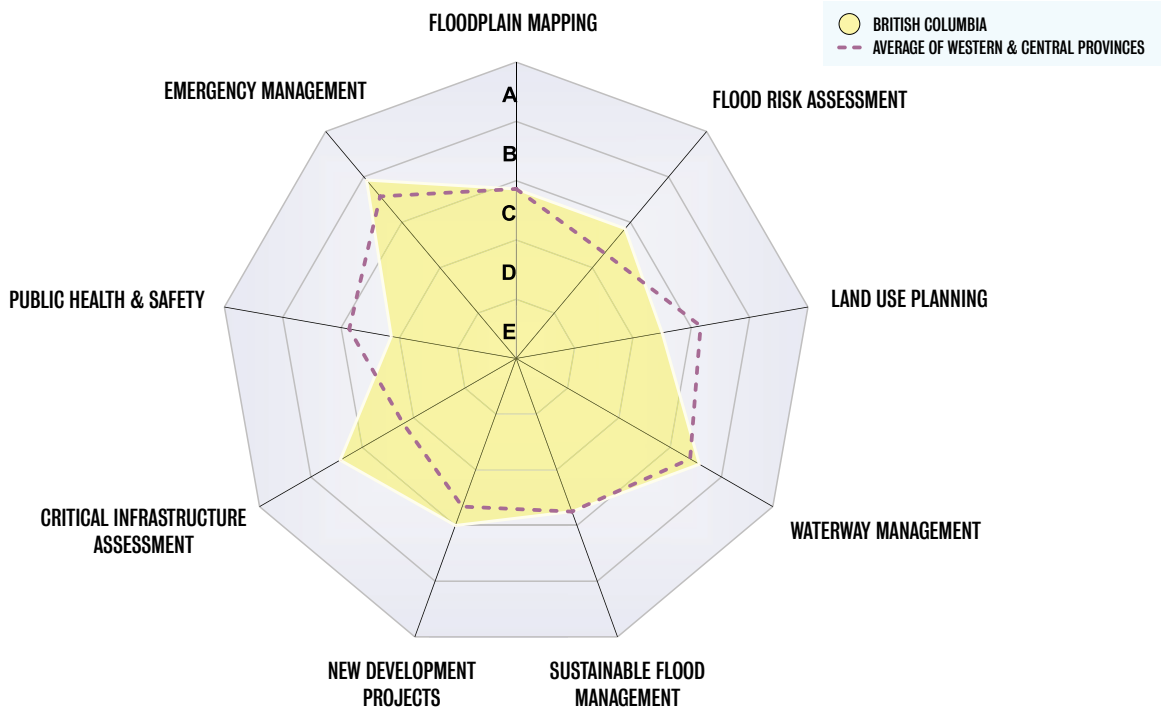


Figure 3.1.1. Flood Preparedness for British Columbia. The benchmark score calculated as the average of the results of all Western and Central Canada provinces (viz. British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec) is outlined by the dashed line. The yellow area depicts the preparedness score of British Columbia.

Areas of strength regarding flood preparedness for British Columbia were in the areas of Flood Risk Assessment, New Development Projects, Critical Infrastructure and Emergency Management.

The province stated that while it does not undertake assessments on its own, and does not validate flood risk assessments, it provides guidelines and administers the funding for the development and update of flood risk assessments.

Regarding New Development Projects, the Province stated that its Flood Hazard Area Land Use Management Guidelines must be considered for all new developments on provincial Crown land. As well, the Province prohibits landfills to be located within its provincially designated floodplain areas and requires the proponents of new landfills to complete siting assessments prior to initiating development.

In reference to Critical Infrastructure, the province reported that it actively engages with electrical utilities to discuss the vulnerability of their systems. Electrical utilities are also required to have their own emergency plans in place. British Columbia has also conducted several vulnerability studies on its highway system and has developed and released a guideline document for highway designers. The province has also developed a tool for the analysis of risks to its water infrastructure and has regulations in place that require regional and municipal governments to have emergency plans prepared that assess the potential impacts on people and property. Moreover, the province has funded risk assessments, flood mapping, as well as various methods of mitigation for this sector.

In terms of its emergency management initiatives, the province reported that it takes responsibility for ensuring that critical flood risk information is transmitted relative to all the streams and rivers that are monitored by its River Forecast Centre. The province also takes responsibility for the accurate and timely dissemination of early flood warnings to the public, including flash flood alerts.

Conversely, the province reported certain areas of weakness, specifically in terms of its land use planning policy as well as its initiatives in the field of public health and safety.

Notably, the Province reported that most of its floodplain mapping is at least 20 years old (as of 2019). **The Province also reported that municipalities largely develop flood hazard area bylaws without provincial involvement, and may also independently grant exemptions to said bylaws.** Therefore, the Province stated that **flood hazard assessments in British Columbia are rather 'patchwork'** and that **land use planning within British Columbia is "sporadic at best."**

The Province reported that there is no requirement that local governments designate floodplains within their jurisdiction. Therefore, local governments can develop flood hazard areas without provincial approval, can grant flood hazard area land development exceptions, and may independently establish the subdivision requirements for their flood prone areas.

Regarding public health and safety initiatives, British Columbia reported that the flooding of healthcare facilities is not a risk that is currently being addressed by the province. Similarly, **British Columbia stated that its Dam Safety Section does not require dam owners to undertake flood risk assessments whatsoever.** Moreover, and perhaps **most concurringly, the Province stated that it is the "role of the downstream communities to ensure they plan for all hazards including potential dam incidents."** The extent to which the provincial government of British Columbia would get involved, if at all, in such cases was not explicitly specified.

Finally, regarding ice-related flooding, the Province indicated that it does not presently operate an ice-jam flood forecasting system.

"Local governments can develop flood hazard areas without provincial approval, can grant flood hazard area land development exceptions, and may independently establish the subdivision requirements for their flood prone areas."

Alberta C+

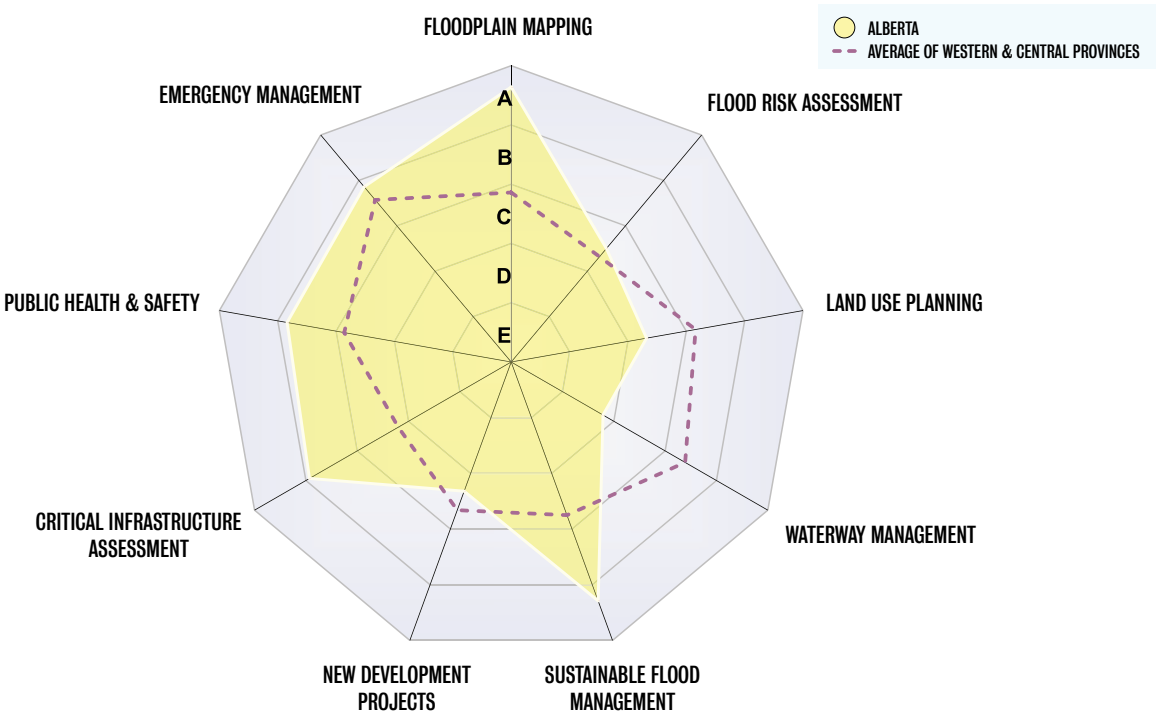


Figure 3.1.2. Flood Preparedness for the Province of Alberta. The benchmark score calculated as the average of the results of all Western and Central Canada provinces (viz. British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec) is outlined by the dashed line. The yellow area depicts the preparedness score of Alberta.

It is notable that Alberta is the only province in both Western and Central Canada that takes responsibility for floodplain mapping and that is consequently the sole producer of flood hazard maps for its entire territory. The Province also stated that its flood mapping update schedule is on a 10-year update cycle.

Moreover, as Figure 3.1.2 demonstrates, the Province reported certain areas of strength in its flood preparedness, particularly in terms of Sustainable Flood Management, Critical Infrastructure Assessment, and Public Health and Safety.

Under its Watershed Resiliency and Restoration Program, the **Province created a $35M project that funded NGOs focusing on the restoration and resilience of wetlands and riparian areas in order to reduce the intensity, magnitude, duration and effects of floods and droughts.** With that said, however, the province noted that its provincial policies are better defined as "best practices" rather than as mandates.

With regard to its water infrastructure, the Alberta Government has funded a variety of different initiatives, including Alberta Innovates, to identify the risks of floods and droughts to 50 of its drinking water systems and to construct new flood barriers, conduct drainage improvements, create new stormwater outfalls and establish urban constructed wetlands.

Regarding public health and safety, Alberta stated that it has developed a Dam Safety Framework that regulates all dams within the province. Alberta has also recently undertaken an initiative to update and confirm the level of safety of the abandoned contaminated sites throughout its territory.

Pertaining to flood vulnerability of healthcare facilities, the province reported that it takes an all-hazards approach to reviewing facility vulnerability and undergoes planning and mitigation actions to protect such facilities from hazards, with risk assessments conducted at the facility level.

Conversely, Alberta reported that it falls beneath the regional average with respect to certain domains of flood preparedness. Specifically, its performance was found to be below average in terms of Land Use Planning, Waterway Management and New Project Development policies.

The province indicated that its Floodway Development Regulation is currently under development but not completed (2019). In addition, oil and gas wells, transmission lines and pipelines are all exempt from the requirements of the planning provisions of the Province's Municipal Government Act (MGA). The Province also stated that while it coordinates responses regarding the continuity of electrical supply, it does not take responsibility for the emergency supply of power. Instead, the independent agency AESO (Alberta Electric System Operator) assumes leadership on this topic.

In terms of emergency response operations in general, Alberta reported that it steps in only when States of Emergency are formally declared.

Finally, regarding ice-related flooding, the province indicated that flood hazard studies are conducted only in those parts of Alberta that have a known history of ice-related issues, and that such studies include ice modelling and mapping scenarios. These studies are conducted by the River Forecast Centre which maintains situational awareness of river ice conditions using forecasting and specialized data collection models. Alberta stated that the risk of ice-related flooding varies across its territory and reported that some of its communities are at a greater risk of ice-related flooding than other causes of flooding.

Saskatchewan C

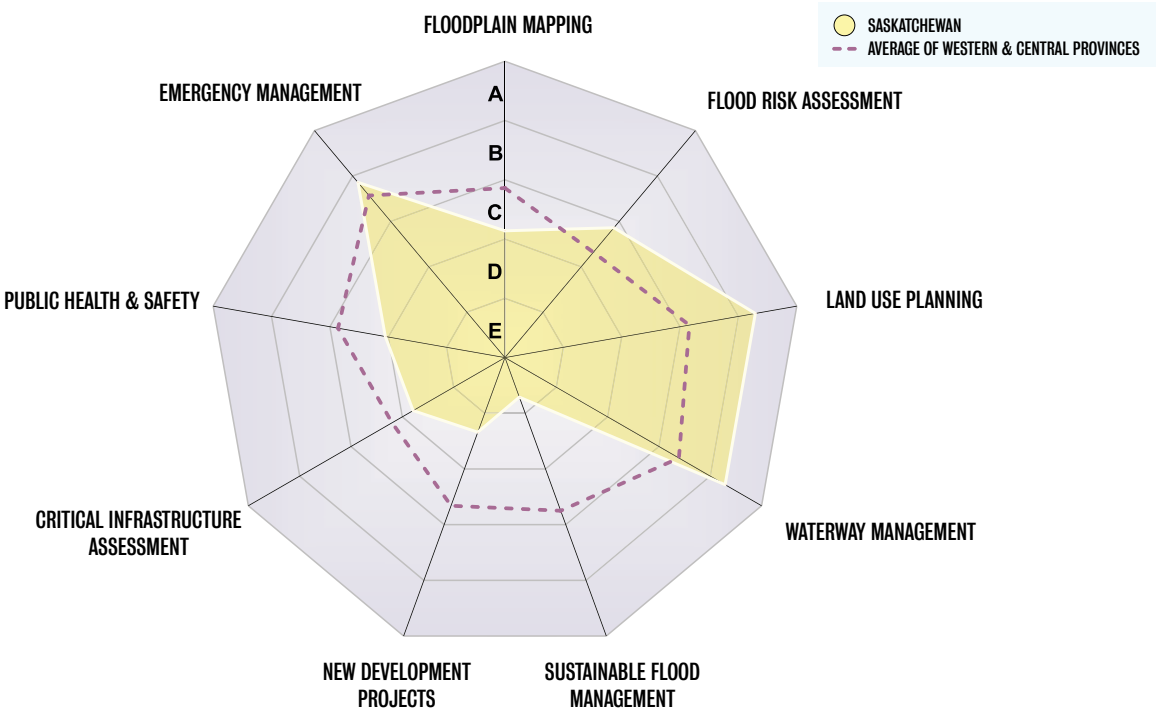


Figure 3.1.3. Flood Preparedness for the Province of Saskatchewan. The benchmark score calculated as the average of the results of all Western and Central Canada provinces (viz. British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec) is outlined by the dashed line. The yellow area depicts the preparedness score of Saskatchewan.

It is important to note that Saskatchewan is unique in that it has a dedicated **Water Security Agency** (WSA) responsible for flood-related issues, including flood forecasting and the dissemination of information to provincial and municipal emergency management officials. **The existence of an agency that takes a central responsibility for flood forecasting on a province-wide basis is unique not only for this region of Canada but even nationwide.**

As Figure 3.1.3 demonstrates, Saskatchewan reported strength in its flood preparedness initiatives in Flood Risk Assessment, Land Use Planning and Emergency Management.

Flood Risk Assessment is a well-developed sector in Saskatchewan when compared to the rest of the region. Flood risk assessments are updated annually.

The province leads the region in Land Use Planning for its unincorporated communities and municipal planning areas. Specifically, in parts of the province, such as in northern Saskatchewan, it takes direct responsibility for conducting environmental impact assessments. **Saskatchewan is also unique in that it maintains a database of all historical flood events that have taken place near its road network.**

With respect to Emergency Management, Saskatchewan stated that it is responsible for provincial flood mapping and monitoring but described itself generally as "**a super-planning cell with a bit of responsibility.**" The province elaborated that it is focused on ensuring that local authorities have all the information that they need and assists them with planning, focusing on the use of established local resources.

The province also operates a public alerting system called SaskAlert, an AlertReady product, which it uses to issue alerts and advisories for various emergencies. In addition to this, Saskatchewan makes use of a province-wide alerting protocol called the Provincial Public Safety Telecommunications Network with all local EMS services, as well as the RCMP, utilizing this system throughout Saskatchewan. The Province also has flood monitors operated by the aforementioned WSA.

Alternatively, the areas of weakness for Saskatchewan were reported to be in a few domains of flood preparedness, specifically, Floodplain Mapping, Sustainable Flood Management, New Development Projects, Critical Infrastructure Assessment and Public Health and Safety.

Regarding Floodplain Mapping, **Saskatchewan stated that it had not updated its flood mapping since 1996.** Moreover, riverine flood maps or models spanning the entire riverine watershed have not yet been developed in Saskatchewan. However, the province presently (2019) has a pilot project that is being funded through the NDMP, focused on updating and creating floodplain maps for Saskatchewan. The province also reported that it lacks both legislation and policy in terms of protecting its natural floodplains. Moreover, **the province entirely lacks a wetland policy** which is a fact that provincial authorities had admitted has been criticized in prior literature. Saskatchewan also does not have a mitigation policy regarding agricultural drainage. Instead, the province merely delegates the implementation of certain limited policies, and has no significant enforcement mechanisms in relation to these subjects.

A stark situation was reported regarding New Development Projects, with decisions being made at the municipal rather than the provincial level. Essentially, this means that although provincial regulations state that planning must consider flood risk, the extent to which this is practiced is up to the municipalities. Additionally, most pipelines within Saskatchewan are not reviewed with comprehensive Environmental Impact Assessments (EIAs), and **the province reported that only a small subset of pipeline projects had ever been comprehensively reviewed relative to the impact of flooding.**

In terms of Critical Infrastructure, the province noted that its highway system had suffered significant damage in recent decades due to flooding, and therefore Saskatchewan has expended effort to mitigate ongoing risk in this area. In addition, Saskatchewan reported that it does not fund mitigation initiatives in terms of drinking water and wastewater infrastructure. The province also stated that individual community flood maps and hydraulic models have either been recently updated or are currently being developed or updated for some communities which have a history of ice-influenced flood damages. The province also reported that it lacks a river ice monitoring system and does not forecast river ice breakups. Generally, the province reported that ice-jam flooding is "fairly unlikely" to occur in comparison to other causes of flooding.

Manitoba C–

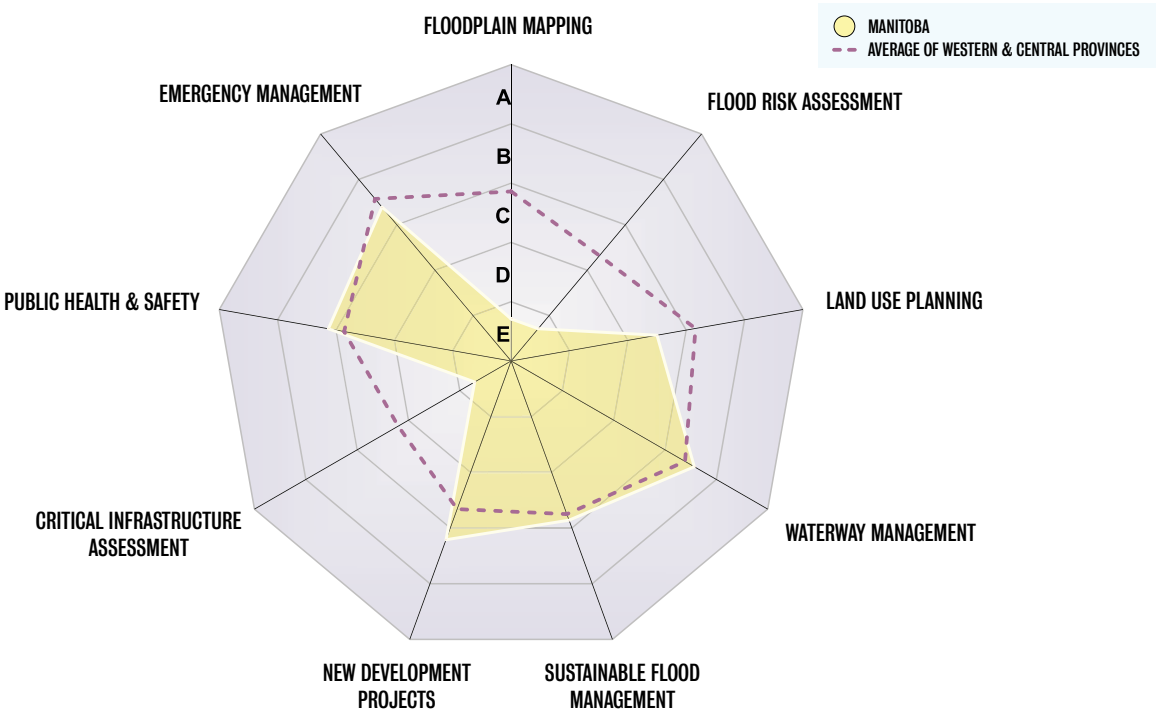


Figure 3.1.4. Flood Preparedness for the Province of Manitoba. The benchmark score calculated as the average of the results of all Western and Central Canada provinces (viz. British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec) is outlined by the dashed line. The yellow area depicts the preparedness score of Manitoba.

As Figure 3.1.4 demonstrates, Manitoba reported areas of strength with respect to its flood preparedness regarding New Development Projects and Public Health and Safety. Notably, **Manitoba is the only province in the region that takes direct responsibility for the analysis of abandoned contaminated sites to determine whether such sites may be affected by flooding**, although this is currently performed on a case-by-case basis. The province has changed its flood protection standard from 1-in-100-year to 1-in-200-year in order to account for the effects of climate change.

Flood hazards for New Development Projects are assessed directly by the province – if flood risk is identified during the technical review related to licensing or permit applications, the applicant is then required to provide additional information on flood risk mitigation for the project.

With regard to its Public Health and Safety initiatives, Manitoba reported that its regional health authorities conduct general hazard assessments, and that the provincial healthcare sector has comprehensive health emergency management programs in place. In terms of its Structural Flood Protection Infrastructure, Manitoba is directly responsible for addressing, maintaining and upgrading the flood related infrastructure that it owns. The province is also responsible for updating dam failure inundation maps. However, conservation/watershed authorities, utility operators and local governments take responsibility for some dam infrastructure not operated by the province.

Manitoba was found to score lower that the regional average in certain domains of flood preparedness. Specifically, its performance was found to be below average in terms of its Land Use Planning efforts as well as Emergency Management policies.

The province reported that up to two-thirds of its land area remains unincorporated, a comparably high figure, and therefore land use regulations do not cover all flood prone areas of the province.

With respect to Emergency Management initiatives, **Manitoba reported that the provincial government was not aware of any efforts by their government to require back-up emergency power within provincial health facilities. Therefore, only some health facilities in Manitoba have back-up generators, indicating that planning in this area is primarily ad hoc.**

On a similar note, the province reported that it does not directly engage in issues pertaining to the continuity of fuel supply. Therefore, local governments and organizations within the province are independently responsible for ensuring that they have all processes in place to ensure the adequate supply of fuel and distribution capability during emergencies. The province would only address continuity of fuel supply if a flood event reached a certain scope and scale, the exact specifics of which were not specified.

Manitoba also reported that the provincial telecommunications utility provider has its own emergency management program and takes the lead on the issue of communications continuity. However, local governments within Manitoba are also independently responsible for ensuring the operable continuity of their own individually owned and operated communications equipment to ensure their ability to communicate information to their citizens during floods and other emergency events.

Regarding ice-related flooding, Manitoba reported that ice jams had caused severe flooding along the Red River north of Winnipeg in 2009. The province is presently working on developing ice-jam flood mapping, and while it stated that it does monitor ice on an annual basis, it does not forecast the formation of river ice. The province also attempts to account for ice-induced flooding in flood risk mapping, and it stated that ice-jam flooding is a concern in some regions, with evacuations taking place as a response to that threat. However, the province declared that ice jams are not a primary hazard for Manitoba.

Ontario C

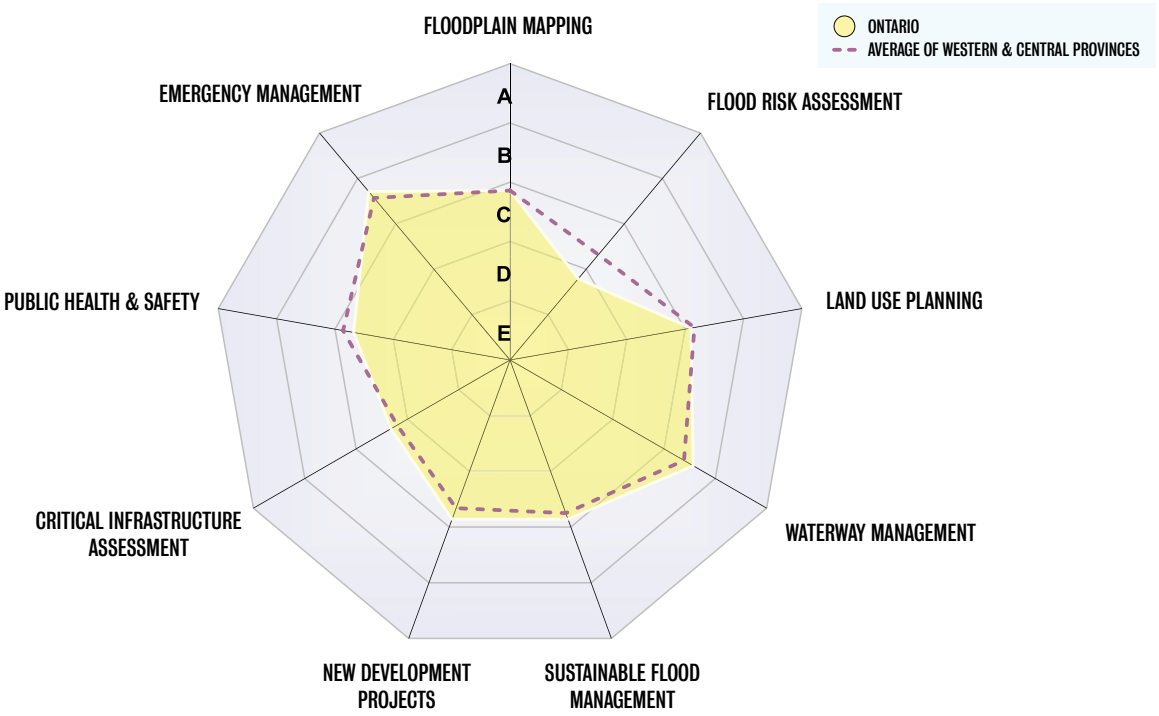


Figure 3.1.5. Flood Preparedness for the Province of Ontario. The benchmark score calculated as the average of the results of all Western and Central Canada provinces (viz. British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec) is outlined by the dashed line. The yellow area depicts the preparedness of score of Ontario.

The Province of Ontario is unique in all of Canada, in that it has established a network of Conservation Authorities (CAs) that play a central role in planning for and mitigating the consequences of flood events throughout their respective watersheds. Notably, not all municipalities of Ontario are covered by CAs, and this results in certain gaps in terms of preparedness for the significant parts of Ontario that lack local Conservation Authorities.

As Figure 3.1.5 demonstrates, Ontario reported areas of strength in its flood preparedness in terms of Sustainable Flood Management, New Development Projects, Critical Infrastructure Assessment and Emergency Management.

Regarding Ontario policies pertaining to Sustainable Flood Management, the province stated that any development activities within 120 m of Provincially Significant Wetlands (PSWs) and 30m of non-PSWs are regulated by CAs to ensure that such activities do not negatively impact the hydrological function of those areas. These standards are well above regional and national averages.

For New Development Projects in Ontario, oil and gas pipeline projects are subject to regulatory reviews by the National Energy Board (NEB) and/or the Ontario Energy Board (OEB). Similarly, new hydrogeneration projects are subject to Ministry of Natural Resources and Forestry (MNRF) approval, with such approvals requiring flood risk assessment. Additionally, the inundation mapping created through this process is publicly available.

In terms of Critical Infrastructure assessments, Ontario reported that an assessment was conducted in 2015 on the climate vulnerability of its electrical transmission sector. The Canadian Nuclear Safety Commission (CNSC) has mandated action for all nuclear utilities to ensure that they mitigate against all external hazards, including flooding. Nuclear facilities are also required to have Emergency Mitigation Equipment and some have installed flood barriers.

With respect to the construction of new telecommunication infrastructure in Ontario, this is subject to development restrictions and some CA regulations. Similarly, the province reported that the development of new water infrastructure would likewise be subject to certain development restrictions.

Regarding Emergency Management, Ontario reported that its MNRF provides notifications to municipalities in areas where no CAs exist and is generally responsible for all areas that lack municipal oversight. However, municipalities and CAs rely on provincial flood forecasting and warning systems and the province provides some funding to CAs to support their forecasting and warning activities. Throughout Ontario, the Surface Water Monitoring Centre (SWMC) within MNRF monitors water flows and levels, and issues Provincial Flood Advisories. The MNRF also conducts flood risk assessments for First Nations communities within Ontario.

Ontario was found to be below the regional average in terms of some of its flood preparedness efforts, specifically in its Flood Risk Assessment efforts and in the Public Health and Safety sector.

The primary reason why Ontario was found to be below average in Flood Risk Assessment pertained to the province not always making assessments publicly available, and frequently passing the responsibility for the development of assessments to local governments.

In reference to Public Health and Safety, there is no provincial legislation or regulation applicable to assessing the flood vulnerability of healthcare facilities, thus these facilities largely self-regulate relative to this issue. Additionally, the province also reported that it was not certain whether its Ministry of Health and Long-Term Care had conducted a risk assessment on Ontario healthcare facilities within the past 5-7 years. Regarding Structural Flood Protection, Ontario reported that local governments (or individual citizens) are responsible for their protection and noted that it commonly lacks access to the risk assessments. Finally, the province reported that it has no proactive monitoring or inspection program for SFPs, and that there are no mandatory provincial requirements for SFPs.

In addition, the provincial **Technical Guide, River and Stream Systems: Flooding Hazard Limit** (2002) provides the provincial standard for defining flood hazards through mapping, and includes a section on ice jams and computational methods. The province also has an **Ice Management Manual** (1988) which outlines the guiding procedures for preventing and addressing ice jams. Although Ontario does not have a dedicated ice-jam flood forecasting system, it does use gauges and monitors and responds to flooding caused by ice jams. Ontario reported that while floods caused by ice jams may be relatively frequent in some areas, such floods are not as common or as widespread as other forms of flooding. **The most common form of flooding in Ontario is urban, wherein stormwater exceeds infrastructure capacities and capabilities.** For example, 2013 Toronto floods caused $1 to $1.4 billion in damages that constituted the greatest flood-related losses in Ontario's history.

Ontario reported that it assists James Bay First Nations to address the impacts of flooding, as ice-related flooding is a major concern in this remote area, and has historically had severe impacts, including the complete destruction of the community of Winisk in 1986, which was once located on the Winisk River, close to Hudson Bay.

"The most common form of flooding in Ontario is urban, wherein stormwater exceeds infrastructure capacities and capabilities."

Quebec C

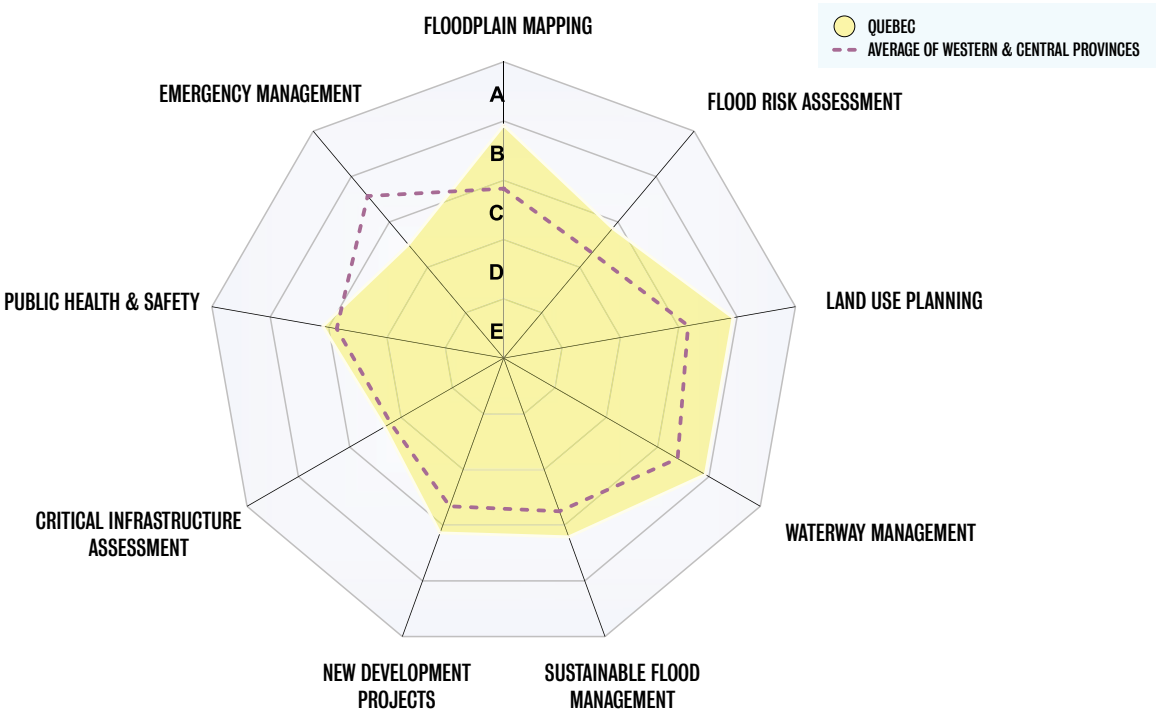


Figure 3.1.6. Flood Preparedness for the Province of Quebec. The benchmark score calculated as the average of the results of all Western and Central Canada provinces (viz. British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec) is outlined by the dashed line. The yellow area depicts the preparedness score of Quebec.

As Figure 3.1.6 demonstrates, Quebec reported areas of strength in its flood preparedness relative to Sustainable Flood Management, New Development Projects and Public Health and Safety. The Ministry of Municipal Affairs declined to participate in the study and therefore, the Land Use Planning score on Figure 3.1.6 applies only to developments on Crown Land. Questions pertaining to Municipal Planning Areas and the unincorporated parts of the province were not addressed.

Regarding Sustainable Flood Management policies, the province reported that responsibility for this issue is shared between provincial and municipal governments, whereas provincial legislation applies universally for isolated wetlands. **Quebec has recently developed a compensation system that will make it possible to finance a prospective wetland and waterway restoration program.**

In reference to New Development Projects, project proponents are required to model the impacts of their projects on watersheds accounting for climate change with a horizon of 2050-2080. For flood zones identified prior to the initiation of a particular project, the proponents of the project must conduct hydrologic and hydraulic modelling analyses. Alternatively, if flood zones are not identified prior to the initiation of a project, project proponents are required to identify them. Relative to hydroelectric dams, such projects are subject to the provincial Dam Safety Regulations. At the same time, the dams owned by the Province are assessed by provincial authorities.

Quebec also reported that the risk of flooding to healthcare facilities is addressed by the Province, in conjunction with municipal authorities in terms of mapping, mitigation and evacuation, as applicable.

Conversely, Quebec reported that it was beneath the regional average primarily with respect to Emergency Management. The province stated that municipalities in Quebec are independently responsible for the spring

flood preparation, although they are supported by provincial expertise in this process. The Province stated that **municipalities are responsible for ensuring the continuity of fuel supply during emergencies** – however, they can request assistance from regional bodies as well as directly from the Quebec government.

Regarding ice-related flooding, the province indicated that Regional County Municipalities must consider the risks of flooding caused by ice jams.

3.2

Atlantic Canada Flood Preparedness

The Atlantic provinces were among the first settled and consequently were the first developed provinces in Canada, including the significant historic land transformations that took place in New Brunswick and Nova Scotia. The unique geographical specifics of this region make it susceptible to two primary mechanisms of flooding – coastal and inland.

Since approximately 2000 onwards, storm surges have resulted in property destruction in all four Atlantic provinces (Natural Resources Canada 2015). Sections of the Atlantic coast are amongst the areas in Canada that are most threatened by sea level rise. Additionally, the majority of Atlantic Canada is now subsiding with the exception of the northernmost parts of Labrador as well as its Lake Melville area. The coastal areas of southern Atlantic Canada are sinking, and localized sea-level rise is estimated to be significantly greater than projected global sea-level rise (Bush and Lemmen 2019). This continued trend of sea-level rise will amplify the impacts of storm surges and flooding throughout Atlantic Canada.

The changing climate is also affecting the duration and extent of sea ice coverage, with the resultant effects differing throughout Atlantic Canada. Reduced ice cover (or no ice cover at all) is resulting in enhanced coastal erosion in northern and eastern Prince Edward Island and southeastern New Brunswick, and the instability of its non-vegetated coastal sand dunes, amongst other effects (Natural Resources Canada 2015).

Although inland flooding is also a common occurrence throughout Atlantic Canada (ACASA 2011), there are idiosyncratic regional differences behind the causes:

- Newfoundland and Labrador - inland floods are primarily caused by rain combined with snowmelt and ice jamming;
- New Brunswick - inland flooding is primarily the result of rainfall, rain-on-snow events, ice jamming, or a combination of those factors;
- Prince Edward Island - inland flooding is primarily the result of heavy precipitation, often as a result of extra-tropical storms (in other words, hurricane remnants); and
- Nova Scotia - inland flooding is caused by torrential rainfalls, sudden thaws and infrastructure failure.

Ice jams are another cause of flooding across Canada, including the Atlantic region – to illustrate, "data for the Saint John River basin… indicate[s] that over two thirds of total flood damage costs incurred by New Brunswick are due to ice-related events (Canada 2013)." Similarly, ice jams also lead to pervasive flooding in Labrador (Government of Newfoundland and Labrador).

The following four diagrams (3.2.1 – 3.2.4) illustrate the flood preparedness of the individual provinces within Atlantic Canada, assessed against nine criteria, and benchmarked relative to the average score for all four provinces. The components of the criteria were aggregated into a single score per jurisdiction in order to demonstrate the overall preparedness level of each province. The presentation of provinces is geographic, from west to east.

"Sections of the Atlantic coast are amongst the areas in Canada that are most threatened by sea level rise."

Newfoundland and Labrador C+

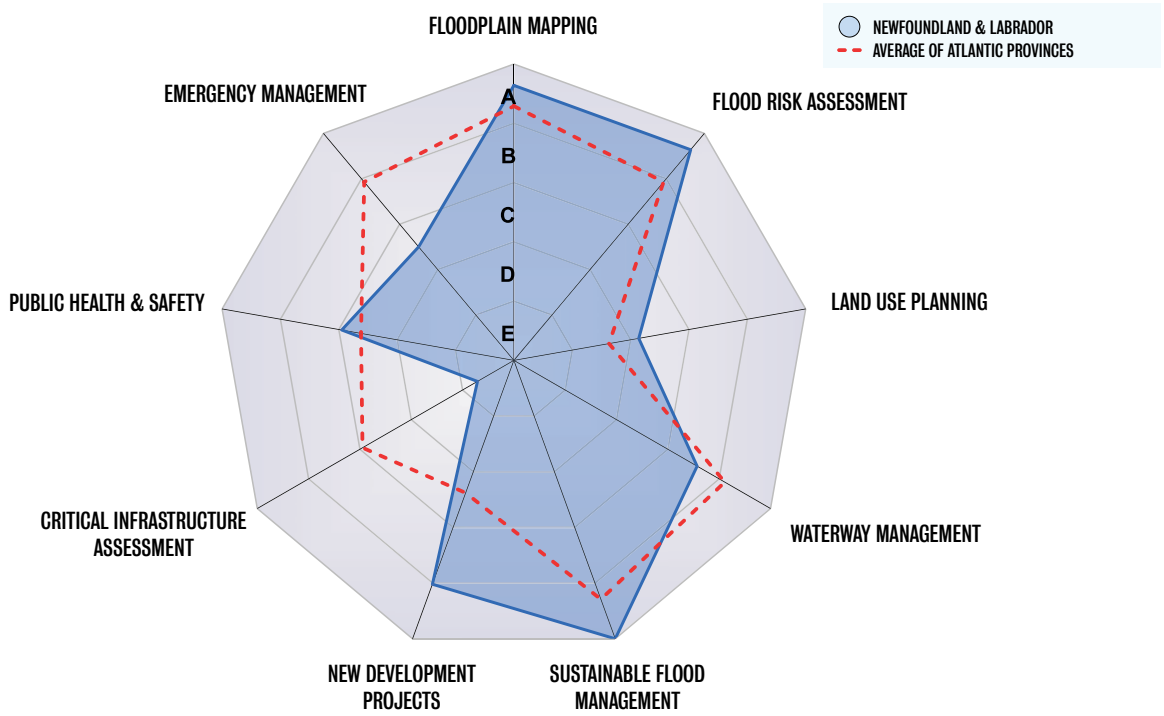


Figure 3.2.1. Flood Preparedness for the Province of Newfoundland and Labrador. The benchmark score calculated as the average of the results of all Atlantic provinces (viz. Newfoundland and Labrador, New Brunswick, Prince Edward Island, Nova Scotia) is outlined by the dashed line. The blue area depicts the preparedness score of Newfoundland and Labrador.

As demonstrated in Figure 3.2.1, Newfoundland and Labrador reported strength in flood preparedness in the domains of Floodplain Mapping, Flood Risk Assessment, Sustainable Flood Management, New Development Projects and Public Health and Safety. Notably, since 2009, **the province has updated its flood risk mapping study standard to include climate change factors, inundation mapping, LiDAR and land-cover analyses using high-resolution satellite imagery. In 2018, the Newfoundland and Labrador commissioned a Climate Projections Study that identifies how the province's climate is projected to change by mid and late century.**

Current land titles within the province must maintain a minimum 15-meter buffer between the shoreline and the boundary of the issued title. This is a relatively small buffer relative to other Canadian jurisdictions that require at least a 30-meter buffer.

Moreover, **the province stipulates that any developments within flood prone areas require hydraulic or environmental assessments, whereas dam break inundation mapping is required for new hydroelectric projects.**

In addition, there are four Regional Health Authorities in Newfoundland and Labrador that have each completed site-specific flood planning for the facilities located within their respective areas. The Province conducts flood risk mapping for such facilities and shares the results of these studies with local governments and infrastructure owners. The province also incorporates a climate change component, calculated to the year 2050, in its flood risk mapping to assist with planning and mitigation initiatives.

Conversely, Newfoundland and Labrador reported that it was beneath the Atlantic regional average in certain aspects of flood preparedness. For example, the

province lacks a regulatory flood risk framework for unincorporated areas, and therefore developments in those areas are not subject to any regulatory restrictions.

Additionally, **the province reported that some regions are at a high risk of flooding, the threat of which is exacerbated by inadequate health emergency resources in these areas.**

Newfoundland and Labrador also noted that it had suffered a province-wide power outage in January 2014 due to inadequate power supply. A project, sanctioned at Muskrat Falls to help remedy this issue, has seen extreme cost and schedule overruns. In the interim, backup capacity is required for all provincial Critical Infrastructure facilities in order to prevent extensive and extended losses of power. However, the province reported issues with local owners and operators in the fuel supply sector who are often reluctant to provide auxiliary power to their fuel stations, as they are concerned that this might void their pump warranties. Therefore, **the province has stated that it has experienced significant difficulties in mandating planning in relation to the continuity of fuel supply.**

Finally, the Newfoundland and Labrador is conducting studies to incorporate the consideration of the risk of ice jamming relative to flood risk. The province stated that it **operates river ice flood forecasting systems on the Badger and Churchill Rivers, and reported that these systems are "amongst the most advanced in the country."** Newfoundland and Labrador stated that ice-jam flooding is the most dramatic and extensively damaging type of flooding within the province although only 5% of its flood events are the result of ice jams.

New Brunswick C

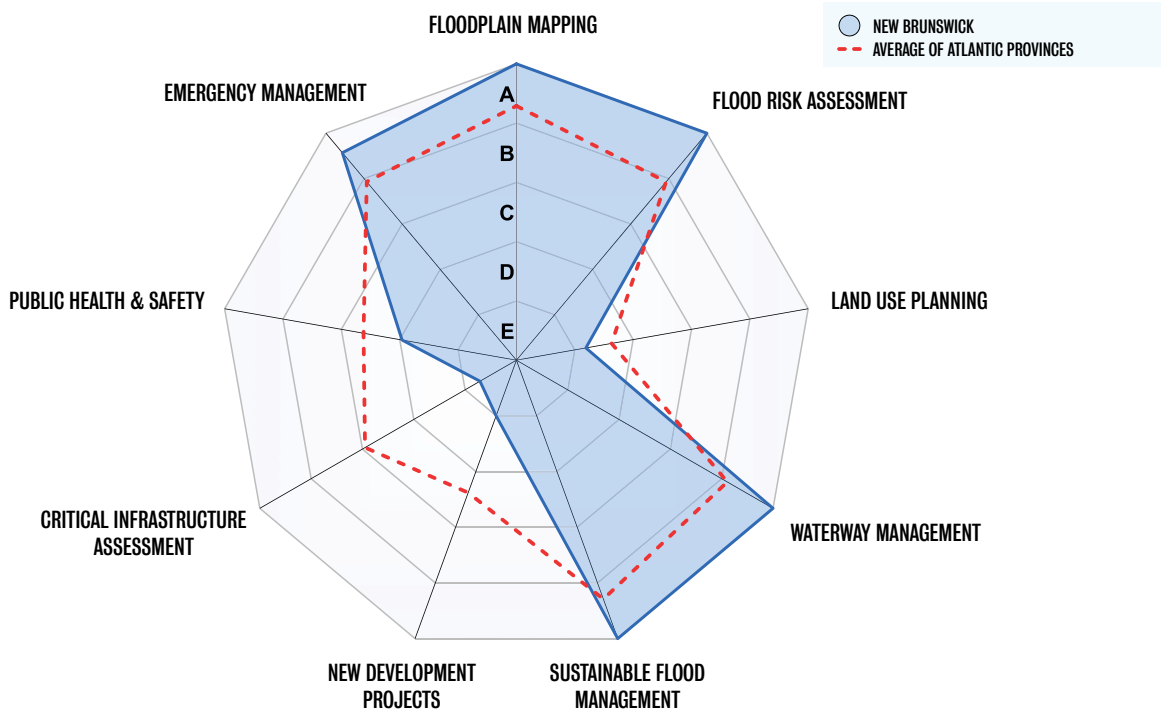


Figure 3.2.2. Flood Preparedness for the Province of New Brunswick. The benchmark score calculated as the average of the results of all Atlantic provinces (viz. Newfoundland and Labrador, New Brunswick, Prince Edward Island, Nova Scotia) is outlined by the dashed line. The blue area depicts the preparedness score for New Brunswick.

As demonstrated in Figure 3.2.2, New Brunswick reported areas of strength in flood preparedness in the domains of Floodplain Mapping, Flood Risk Assessment, Waterway Management and Sustainable Flood Management. Notably, the province has two policies that protect provincial streams, rivers, wetlands, and lakes – The Watercourse and Wetland Alteration Regulation and the Clean Water Act. Moreover, all in-channel alterations within the province require permitting and **all waterway modifications are prohibited province-wide unless a project serves a necessary public function.**

Regarding Emergency Management, the province also exceeds the regional average. The province has a contingency plan that assigns preparedness and response tasks to all government departments and response agencies. **During the annual flooding season in the Saint John River, there is a provincial program that is focused on river surveillance and flood forecasting. This program informs the public about potential flood risks and assists communities with planning.**

Alternatively, New Brunswick reported that it was beneath the regional average in some areas of flood preparedness. Specifically, land use plans are optional and entirely un-mandated within unincorporated areas. Therefore, residents living in unincorporated settlements are particularly vulnerable to the effects of flooding due to their tendency of residing in high-risk areas and in low-quality shelters, due to the lack of regulation applicable to these areas. Moreover, there are no specific regulations regarding highways and basic Environmental Impact Assessments are not consistently conducted for all new developments within the Province.

Regarding Critical Infrastructure, including electrical and telecommunication networks, the Province takes a reactive rather than a proactive approach wherein the provincial authorities are consulted only after such infrastructure is impacted, which can lead to inefficiencies in emergency operations. The Province described a hospital in Perth-Andover had been identified as particularly vulnerable to flooding, and has sustained damage in multiple prior floods, forcing evacuations. In response, **the Province is conducting a pilot project focused on assessing the vulnerability of the Horizon Health network located in the northern section of New Brunswick. All hospitals in New Brunswick have conducted ad-hoc all-hazard assessments and a formal health system hazard vulnerability risk assessment was conducted in 2018.**

Finally, regarding ice-related flooding, **the province plans to include areas susceptible to ice jamming on its flooding maps, including the aforementioned Perth-Andover region.** The Province also operates a river ice-monitoring program but does not forecast river ice coverage. **New Brunswick reported that ice-jam flooding is an extremely high priority and therefore it works with several agencies such as the Emergency Measures Organization (EMO) and the Department of Transportation and Infrastructure (DTI) on communicating ice jam risk and safety and security information to its citizens.**

Prince Edward Island B-

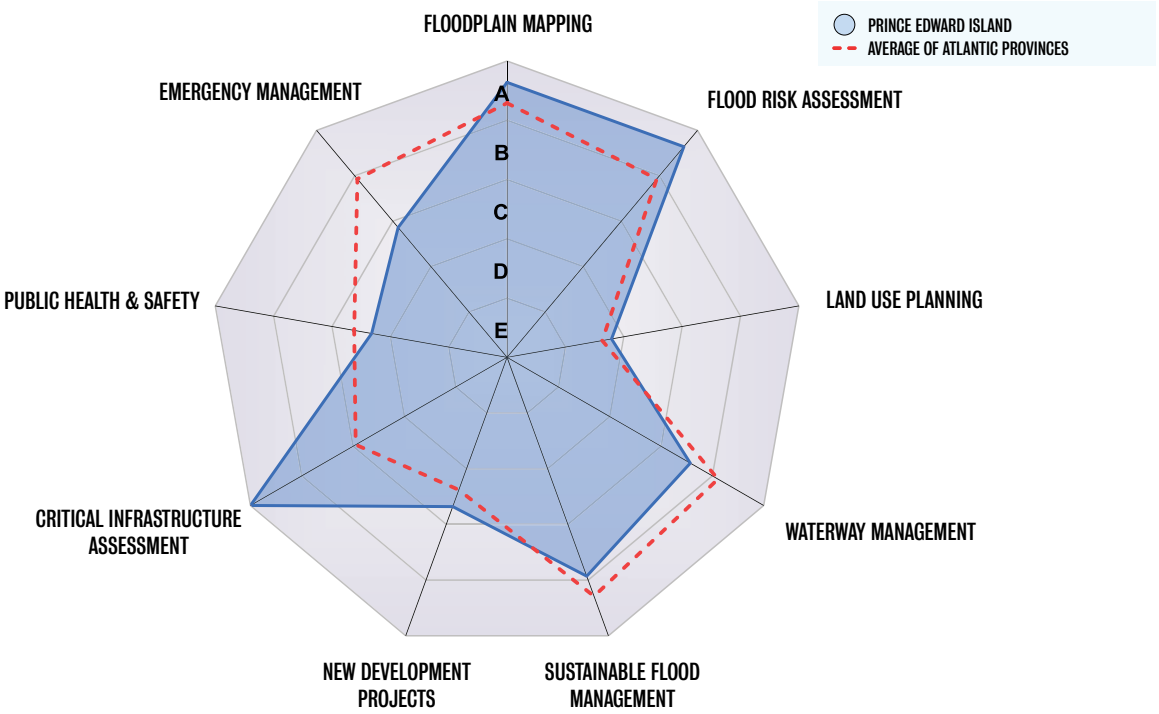


Figure 3.2.3. Flood Preparedness for the Province of Prince Edward Island. The benchmark score calculated as the average of the results of all Atlantic provinces (viz. Newfoundland and Labrador, New Brunswick, Prince Edward Island, Nova Scotia) is outlined by the dashed line. The blue area depicts the preparedness score of Prince Edward Island.

Prince Edward Island is geographically the smallest province in Canada – as such, infrastructure present in most, if not all, other provinces is absent. Specifically, **there are no appreciable pipelines, dams or Structural Flood Protection facilities (SFPs) within Prince Edward Island.**

As demonstrated in Figure 3.2.3, Prince Edward Island reported areas of strength in terms of flood preparedness, especially in the areas of Floodplain Mapping, Flood Risk Assessment, New Development Projects and Critical Infrastructure Assessment. **The province also noted that it is currently producing province-wide flood maps for the first time.**

Uniquely for Prince Edward Island, **the province has the authority to establish minimum development standards and binding land use regulations that apply throughout the entire province.**

The province also has legislative protections in place for its riparian zones and wetlands and provides incentives for their protection. However, the wetland buffer zone within the province is 15-meters (as compared to the neighboring New Brunswick standard of 30-metres). As well, the province lacks incentive programs for the restoration of natural floodplain areas and **does not provide any incentives to move or relocate developments from floodplain zones.**

The province has conducted vulnerability assessments of its water facilities, covering a total of six communities, and reported that it was able to successfully relocate some of its water infrastructure to mitigate risks, utilizing a combination of provincial and federal funding.

All healthcare facilities within Prince Edward Island have completed full hazard risk assessments, although the province has not yet secured funding to mitigate the risks

to some of its healthcare facilities found to be located in flood-vulnerable areas.

The province reported that in recognition of its electrical and telecommunications systems being managed by privately-owned entities, flood risk mitigation actions in relation to their operation are isolated and are not known to the provincial government.

Relative to fuel supply, Prince Edward Island reported that it is not formally involved in ensuring the continuity of fuel supply, but does have an informal plan with Irving Oil.

The province reported reliance on federally operated tide gauges which measure water levels. Therefore, related alerts are issued from the federal government rather than from the province, which the province highlighted as an ongoing area of concern.

> " The province has the authority to establish minimum development standards and binding land use regulations that apply throughout the entire province."

Nova Scotia C

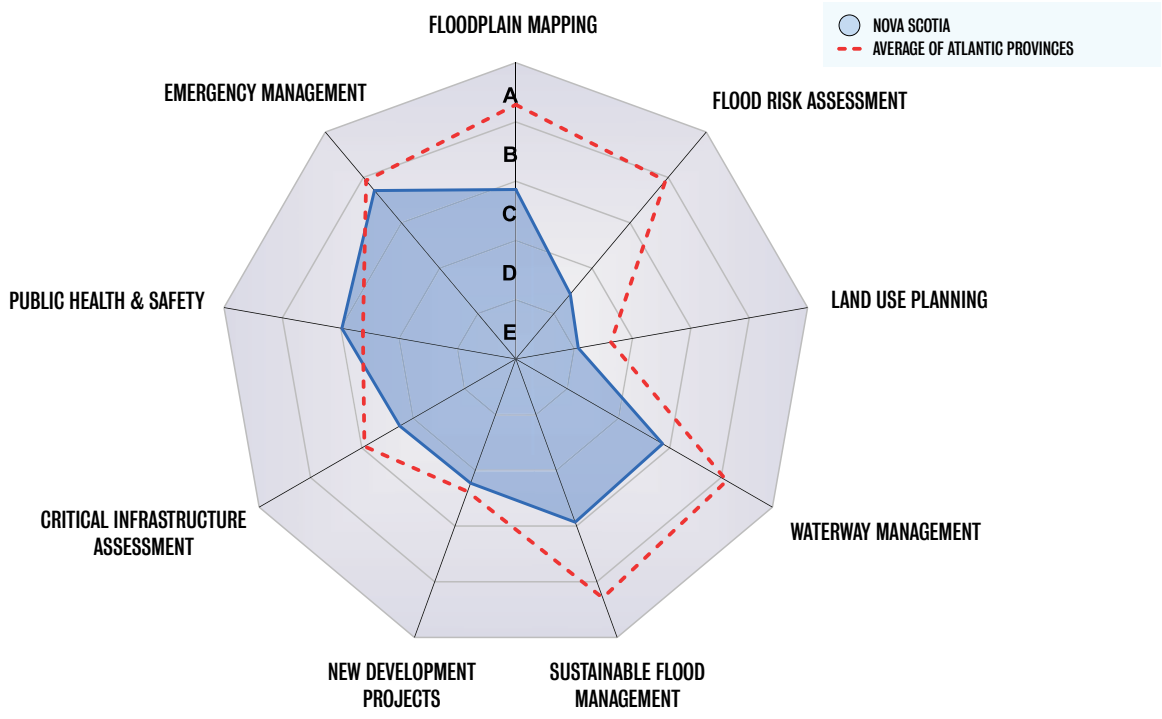


Figure 3.2.4. Flood Preparedness for the Province of Nova Scotia. The benchmark score calculated as the average of the results of all Atlantic provinces (viz. Newfoundland and Labrador, New Brunswick, Prince Edward Island, Nova Scotia) is outlined by the dashed line. The blue area depicts the preparedness score of Nova Scotia.

Nova Scotia is the only province in Atlantic Canada that delegates responsibility for floodplain mapping, among other responsibilities, to its local governments. The province is creating provincial guidelines for floodplain mapping, that factor in the effects of climate change, storm surge and sea level rise. Updated floodplain maps have been, or are being, developed for some areas that were originally covered under the Federal Damage Reduction Program (FDRP). Notably, dykes play a particularly significant role within Nova Scotia, and the Province stated that it has recently updated its dyke vulnerability assessments incorporating impacts of climate change.

As demonstrated in Figure 3.2.4, the province reported strength in terms of its flood preparedness in the domain of Public Health and Safety.

Relative to Public Health and Safety, the province is undertaking assessments of several provincially owned dam structures and is working to develop a 10-year plan for effectively managing those structures, including the development of updated flood inundation mapping. The province is responsible for assessing the vulnerability of dykes – as such, an operation and maintenance program is in place. Dykes protect not only agricultural lands but also significant pieces of public infrastructure such as roads, railways, sewage treatment plants, utility corridors, historical sites and entire communities (e.g., Wolfville, Grand Pre, Windsor, parts of Truro and Colchester County, Annapolis Royal, Chignectou Isthmus, and the Village of Advocate).

All health facilities within the Province have been strategically located away from flood plains and tidal surge areas. Moreover, the Department of Health and Wellness has committed to a three-year climate assessment project for the continuing care sector to identify climate change risks and mitigating strategies for profit-based, non-profit, as well as governmental health facilities.

The province mandates municipalities to create Municipal Climate Change Adaptation Plans in order to be eligible for Gas Tax funding from the Province. These plans include infrastructure assessments, the incorporation of flooding impacts within designs, and funding infrastructure upgrades.

Conversely, the province reported that it lacks incentive programs for the restoration of natural floodplain areas and does not provide any incentives for the relocation of developments from floodplain zones. In reference to risk of flooding to highway infrastructure, the province reported that they have only focused on areas of known vulnerability, rather than assessing the highways system as a whole.

The province is developing a program that will include monitoring of river ice patterns. Nova Scotia stated that ice jam flooding is an issue, but it considers the likelihood of such events to be lower than other types of flooding influenced by such forces as hurricanes, tropical storms and intense short-duration rainfall that typically occurs during the winter season.

3.3

Northern Canada Flood Preparedness

Northern Canada is comprised of three territories – the Northwest Territories, Nunavut, and the Yukon. The risk exposure of all three territories to the impacts of climate change is significant (CCA 2019). However, the climate change risks faced by Northern Canadian jurisdictions are not always directly related to flooding, as opposed to the rest of Canada. Another differentiator for the territories, as relative to the provinces, has to do with the unique challenges that are faced by emergency management personnel due to extreme weather conditions, the lack of established infrastructure, and the remoteness of many communities.

As natural resource development projects are becoming more prevalent in northern Canada, emergency planners must take in account evolving challenges pertaining to climate risk. Territorial governments must establish an open dialogue with businesses operating within the region, to ensure they understand and plan for potential risks exacerbated by a changing climate.

Table 7 profiles some climate change and extreme weather-related effects projected to be most problematic across territories (CCA 2019).

TABLE 7: Primary Climate Change Hazards Across Canadian Territories (CCA 2019)

Territory	Key Areas of Impact
Yukon	• Increased average winter temperature • Changes in rain and snowfall volume • More frequent and extreme weather events including lightning strikes, strong winds, flooding and fires • Melting glaciers and sea ice • Thawing permafrost
Northwest Territories	• Thawing permafrost • Increased rain and snowfall across many regions • Lower water levels in some lakes and rivers • Rising sea levels
Nunavut	• Thawing permafrost • Melting sea ice • More extreme weather events such as ice storms, strong winds and storm surges • Rising sea levels

Permafrost is an important physical component of Northern Canada, and has a profound effect on the hydrology, landscape and ecology of northern environments – as such, changing conditions of permafrost must factor into the planning and management of virtually all infrastructure in the northern regions of Canada.

The following three diagrams (3.3.1 – 3.3.3) illustrate the flood/climate change preparedness of each of the territories of northern Canada, assessed against seven criteria, and benchmarked relative to the average score for all three territories. These criteria were aggregated into a single score per jurisdiction in order to demonstrate the overall preparedness level of each territory. The territories are presented in geographical order, from west to east.

Yukon B–

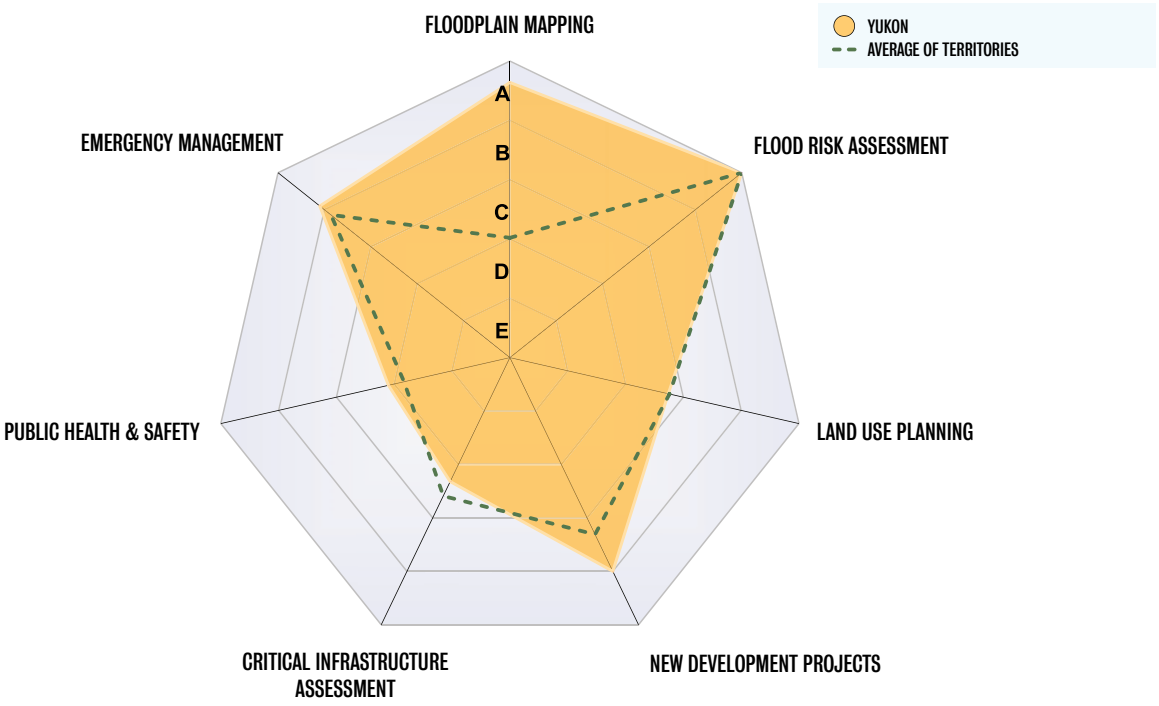


Figure 3.3.1. Flood Preparedness for the Territory of Yukon. The benchmark score, calculated as the average of the results of all Northern Territories (viz. Yukon, Northwest Territories, Nunavut) is outlined by the dashed line. The orange area depicts the preparedness score of Yukon.

Yukon is more 'province-like' in all aspects of its climate change preparedness initiatives relative to other territories. For example, Yukon conducts Floodplain Mapping and Flood Risk Assessments instead of the Hazard Mapping and Hazard Risk Assessments that are common in Northwest Territories and Nunavut. The rationale for this difference resides in Yukon being at significant risk of flooding, whereas the other territories regard this threat as insignificant.

Notably, the Yukon demonstrates leadership regarding land use planning as under its Environmental and Socio-economic Assessment Act, and project proponents must conduct risk and vulnerability assessments that address land-use changes. The results of these assessments are validated by the territorial government and/or the Yukon Environmental and Socio-economic Assessment Board.

As Figure 3.3.1 demonstrates, Yukon reported strong performance in flood preparedness relative to Floodplain Mapping, New Development Projects, Public Health and Safety and Emergency Management.

Relative to Floodplain Mapping, the territory reported that it is planning to have flood maps in place, territory-wide, with updates scheduled to take place more frequently than every five years.

In reference to New Development Projects, the Yukon has comprehensive regulations that make the territory a leader in this respect not only relative to other territories, but also arguably in all of Canada. Stewardship relative to new projects is due to an environmental assessment process, which involves the Yukon Water Board and the general public. An environmental assessment emphasizes whether a project proponent has documented and simulated surface and road drainage, as well as groundwater challenges, amongst other issues. The territory itself takes responsibility for preventing development projects from

interfering with water balances and quantities for both the duration of a project and following its termination.

All new projects that take place within the territory are required to include preliminary flood risk assessments. This applies to all highway, electrical, water, residential and federal development projects. **The assessment process for projects includes a 3-level review lead by a local office, an executive committee or a panel, and for major projects, a full joint panel.**

Regarding Public Health and Safety initiatives, the territory reported that it has jurisdiction over highway connections territory-wide, and that flood risk mitigation applies to culverts and related infrastructure. The territory also reported that Yukon Energy has risk assessments on file regarding the possibility of dam failures and their consequences. Yukon reported that it became the first territory in Canada to take over land and resource management responsibilities from the federal government – as such, Yukon is responsible for some abandoned mines located within its territory. The territory reported that it addresses climate change related vulnerability of sites on an ad-hoc basis.

Yukon also demonstrated strengths regarding Emergency Management efforts. The territory reported that it is responsible for all crown lands, municipalities, unincorporated lands and non-municipal areas. Yukon conducts forecasting activities territory-wide and does not devolve this responsibility to its municipalities, in contrast to most provinces and territories in Canada. Moreover, the territory coordinates emergency preparedness activities from a central office that has a designated role for all types of emergency management initiatives. There are also business continuity plans in place for various facilities including hospitals. Hospitals also cooperate with one another on coordinating emergency efforts.

Yukon reported that it, in conjunction with the federal government, funded establishment of the Public Safety Broadband Network (PSBN), and that the Territory has an active AlertReady system in addition to 9-1-1 service. The latter fact is notable because basic 9-1-1 service is not universally available throughout the Canadian North, particularly in some of its remote communities.

Yukon has a monitoring system in place for some of its key watersheds. All water level monitoring efforts, as well as the identification of at-risk areas, is the responsibility of its Water Resources Branch. However, the territory remarked that most of its watersheds that are prone to flooding are not associated with any significant consequences. Therefore, the primary flood-related issue for the territory relates to ice break-up, and even if uncharacteristically heavy rains did take place within the territory, Yukon reported that this would not have an impact on most of its communities.

Alternatively, Yukon performs beneath the regional average in reference to some domains, primarily in relation to Critical Infrastructure assessments.

Specifically, the territory stated that more work is required on mitigating the vulnerability of its power grid to flooding. Yukon reported that there is no mechanism for ensuring that risk assessments are performed and that mitigation efforts remain under development. In short, the vulnerability of the electrical system remains largely unassessed. Yukon also stated that while risk assessments should be under the direction of a central managing body, no such body yet exists.

Additionally, Yukon reported that it does not have adequate funding to address the impacts of climate change on its road network. Similarly, the territory has also never assessed water infrastructure. Territorial municipalities are responsible for their own water infrastructure, and it is their responsibility to manage it. The territory stated that it has no standards for the review or assessment of such infrastructure.

Finally, **the territory indicated that ice-related flooding is likely the second most significant cause of flooding in Yukon**, as well as throughout Canada (excluding Prince Edward Island, Nova Scotia, and Nunavut).

> "Yukon has comprehensive regulations that make the territory a leader in the assessment of New Development Projects, not only relative to other territories, but also arguably in all of Canada."

Northwest Territories C

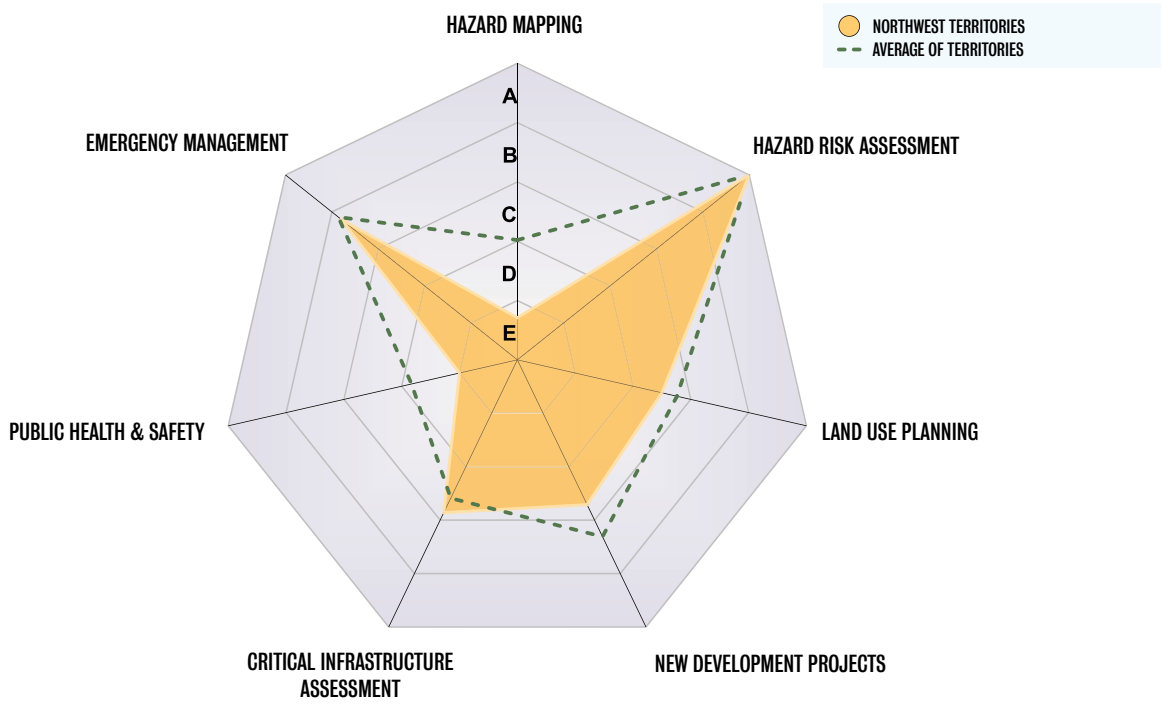


Figure 3.3.2. Climate Change Preparedness for Northwest Territories. The benchmark score, calculated as the average of the results of all Northern Territories (viz. the Yukon, Northwest Territories, Nunavut) is outlined by the dashed line. The orange area depicts the preparedness score of Northwest Territories.

As Figure 3.3.2 demonstrates, Northwest Territories reported strength in climate change preparedness in terms of Hazard Risk Assessment, Critical Infrastructure Assessment and Emergency Management.

Regarding Hazard Risk Assessments, the territory created the Northwest Territories Hazard Identification Risk Assessment (HIRA) in 2014, which outlined the overall risk exposure of the territory to natural and manmade hazards. This assessment also incorporated regional reviews for subareas of the territory. The Emergency Management Organization (EMO) of the territory has committed to updating the HIRA every five years. In addition, when communities within the territory create or update community emergency plans, local HIRAs are mandated and are included within resultant master plans.

Regarding Critical Infrastructure, the territory reported that it has initiatives in place for its electrical, telecommunications, highway and water infrastructure. For pipeline infrastructure, the territory stated that the federal National Energy Board (NEB) would remain the regulator for all oil and gas developments in Northwest Territories until at least 2040.

In reference to electrical infrastructure, the territory stated that it is the responsibility of the Northwest Territories Power Corporation (NTPC) to establish plans that deal with potential emergencies and to address vulnerabilities of the electrical system. The NTPC is also responsible for the protection of critical community electrical systems.

For telecommunications, Northwest Territories reported that it works with the regional provider, NorthwesTel, to ensure the protection of telecom critical infrastructure

and to mitigate the impacts of the loss of telecom services, which was noted as a common occurrence.

Relative to highway infrastructure, Northwest Territories reported that every five years a highway risk assessment determines the vulnerability of highways to climate change. The territory has two management systems to monitor road systems: The Highway Surface Management System (HSMS) and the Bridge Management System (BMS). Highways are inspected annually, and as are 75% of all bridges and culverts.

Regarding the management of water infrastructure, the territory reported that water treatment facilities and wastewater management infrastructure are mandated to be planned with flood risk considerations incorporated into their initial design. Moreover, all territorial communities are mandated to have emergency plans that address the protection of key infrastructure. Community governments also receive annual funding from the Territory, directed to the replacement, operation, and maintenance of capital infrastructure.

For emergency response operations, the Northwest Territories reported that its territorial Emergency Management Office (EMO) collaborates with individual communities, and that they together "do their best to monitor river and flood conditions." Additionally, the Territory works with communities to ensure that local emergency plans are updated and validated and to maximize the limited capacity of its emergency management systems. All communities must establish a local EMO, appoint local coordinators, and have emergency plans in place.

The Northwest Territories stated that Environment Canada provides severe weather and high-water alerts and warnings. Moreover, **communities designated as at-risk to the threat of flooding have formed flood watch committees that report on conditions during ice break-up and high-water periods.** The territorial EMO advises communities and stakeholders when issuing high-water reports. The territory also has water quantity monitoring sensors that can provide real-time data on water flows and levels. This information is available to the public.

The territory's performance was found to be below average in terms of Hazard Mapping, New Development Projects, and Public Health and Safety policies.

Hazard Mapping is in preliminary stages with a working group that will guide mapping design. The group includes representatives from the territorial government as well as from the Northwest Territories Association of Communities.

Regarding New Development Projects, the territory follows best practices in undergoing climate change risk planning rather than enforcing strict guidelines. Therefore, while some projects are subject to formal environmental assessments, other projects may only go through pre-screening. Moreover, the territory reported that flood hazard assessments are not mandated and are done "out of principle." Notably, the Canadian Environmental Assessment Act (2012) does not apply within the Mackenzie Valley region.

The territory also reported that there has not been a hazard risk assessment conducted on its healthcare sector within the last five years (relative to 2019).

Finally, the territory has no mitigation strategy in reference to assessing its Structural Flood Protection infrastructure. The territory noted that the federal National Disaster Mitigation Program (NDMP) offered a significant opportunity to obtain funding to develop a community mitigation plan – however, with the NDMP ending in 2019, and no suggestion of follow-up funding, the territory expressed concern that it may not have the opportunity to implement any flood protection measures recommended under NDMP.

"The territory reported that water treatment facilities and wastewater management infrastructure are mandated to be planned with flood risk considerations incorporated into their initial design."

Nunavut C–

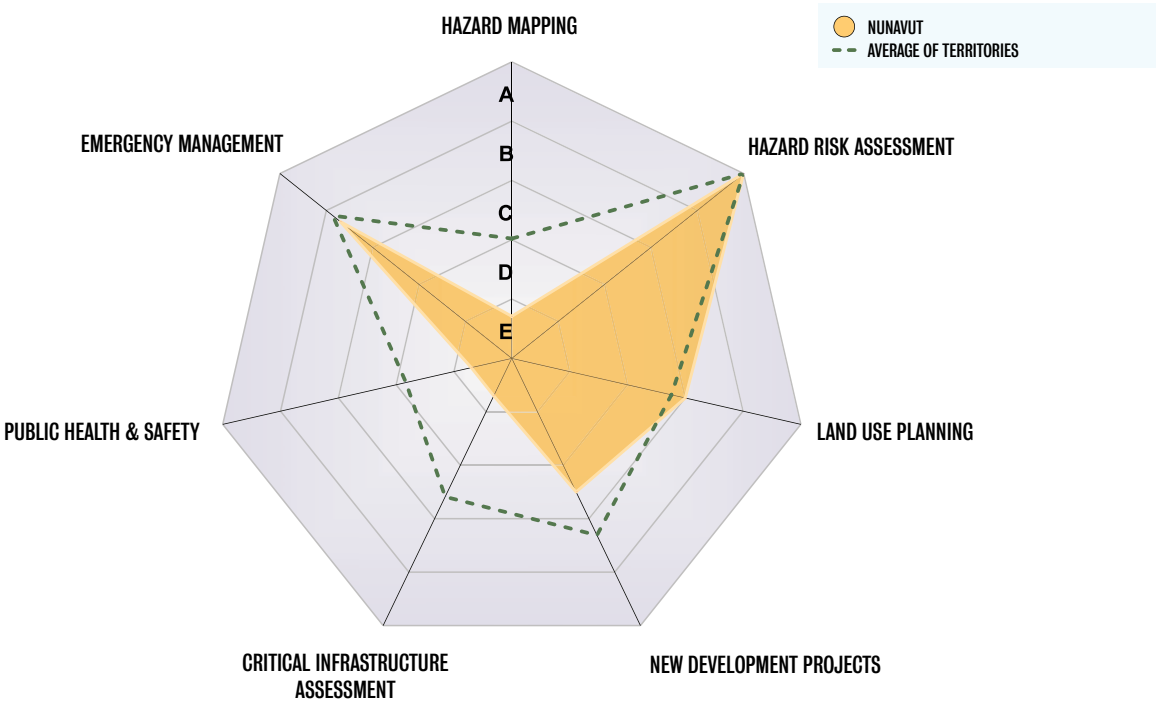


Figure 3.3.3. Climate Change Preparedness for the Territory of Nunavut. The benchmark score calculated as the average of the results of all Northern Territories (viz. the Yukon, Northwest Territories, Nunavut) is outlined by the dashed line. The orange area depicts the preparedness score of Nunavut.

As Figure 3.3.3 demonstrates, Nunavut reported strength in climate change preparedness regarding Hazard Risk Assessment and Land Use Planning.

The Territory stated that its Impact Review Board conducts on-going revisions to its Environmental Impact Statement. Nunavut also reported that its communities have plans and bylaws that dictate how land use is to be regulated within the Territory's Municipal Planning Areas. However, Nunavut also remarked that the mere existence of such plans does not in itself enforce municipal adherence to these practices.

The Territory stated that it has generated various maps related to climate risk assessment, used to rank priority areas across Nunavut by risk. Nunavut also reported that it has completed seven permafrost (loss) maps, driven by the perception that **permafrost degradation is the greatest climate change related threat affecting Nunavut.** The territory also conducted a project on the mining sector, assessing how climate change may convey risk.

Nunavut generally conducts land use planning when designing/building subdivisions. Furthermore, **the Impact Review Board engages on-going reviews of its Environmental Impact Statement requirements.** Although these practices are laudable, Nunavut remarked that the mere existence of such practices does not necessarily translate into on the ground practice.

Nunavut was below average in terms of its Hazard Mapping, New Development Projects, Critical Infrastructure Assessment, and Public Health and Safety initiatives.

Regarding Hazard Mapping, Nunavut reported that it has completed permafrost mapping for just seven of its 25 major communities.

With respect to New Development Projects, the territory stated that roads that lead out of communities typically serve to connect to mines, thus with roads being managed privately their condition is often unknown.

In reference to Critical Infrastructure, the territory lacks a central electricity grid, thus each community within Nunavut receives its electricity from individual diesel power generation. With communities being largely "off grid" and isolated, a system failure due to extreme weather would be isolated. Conversely, by being off grid, the potential for back-up power benefitting communities would be limited.

The territory remarked that there are no roads that connect any of its communities, and that all communities are disconnected from the rest of Canada. In the event of extreme weather, road capacity to serve isolated communities would be limited.

Regarding the assessment of healthcare facilities, Nunavut assists individual healthcare facilities with decision making related to various hazard scenarios. The territory stated that their approach to this issue is "very ad hoc."

Nunavut reported that it has an ongoing non-profit program that performs sea-ice hazard mapping, monitors depths, and maps hazard areas, supported by federal funding in partnership with the territorial government.

"Nunavut also reported that it has completed seven permafrost (loss) maps, driven by the perception that permafrost degradation is the greatest climate change related threat affecting Nunavut."

CHAPTER 4
EMERGING TRENDS AND CONCLUSIONS

The purpose of this study, and its 2016 complement, was to determine the state of flood and climate related efforts of Canada's provincial and territorial governments.

Findings indicate that **there has been no significant progress in flood preparedness of Canadian provinces and territories over the period 2016 vs. 2019.** The Canadian average score on flood preparedness migrated from C- in 2016, to C in 2019. There were material improvements in the flood preparedness scores of some Canadian jurisdictions, notably Yukon, British Columbia and Prince Edward Island.

Areas of strength in the flood preparedness of the provinces and territories included Emergency Management (and more specifically Emergency Preparedness and Response), Waterway Management, Sustainable Flood Management, Public Health and Safety (particularly Healthcare Systems), Emergency Response Operations, Flood Forecasting and Emergency Warning Systems.

Areas of weakness in flood preparedness included Land Use Planning, New Development Projects and Critical Infrastructure Assessments (particularly Structural Flood Protection Infrastructure, Dam Safety and Abandoned Contaminated Sites).

Regarding floodplain mapping, Alberta, New Brunswick, Newfoundland and Labrador, and Prince Edward Island reported that they anticipate and incorporate the impacts of climate change into flood hazard assessment. Despite differences in flood management regulatory regimes, British Columbia, Manitoba, Nova Scotia, Ontario, Quebec and Saskatchewan stated that they were not directly responsible for the development of floodplain mapping within their provinces. However, they all stated that they collaborate with local governments and/or other parties in their efforts to incorporate the effects of climate change within their floodplain mapping.

Although the three territories differed in terms of the extent of their current hazard mapping projects, they all made significant efforts towards incorporating the impacts of climate change on identified hazards, including those associated with waves and storm surges, sea-level changes, coastal erosion, and significantly, the degradation of permafrost.

In reference to new developments, most Canadian jurisdictions lack regulations that would restrict residential, commercial, industrial and infrastructure development within designated floodplains. Due to this ongoing allowance, the upgrade and development of accurate floodplain maps does not consistently led to real reductions in flood damages. To limit ongoing flood damage, Canadian provinces and territories need to make significant improvements in the following aspects of flood and climate change preparedness:

- Land Use Planning;
- Critical Infrastructure (CI) Assessment; and
- Public Health and Safety.

Land Use Planning

The Canadian Emergency Management Framework (PSC 2017) outlines the importance of non-structural measures, such as land use planning, in preventing and reducing disaster risk. Despite this, for all components of land use planning applicable to flood risk – i.e., for unincorporated communities, municipal planning areas, and for Crown Lands – provincial and territorial governments scored poorly. As reported by multiple jurisdictions, provincial and territorial governments commonly do not require municipalities to designate floodplains within their respective areas. Additionally, provinces and territories often do not conduct studies to identify flood hazard areas within their unincorporated areas or communities.

However, the most significant limitation in relation to land use planning is that Canadian provinces and territories lack the legislative power to enforce their own established land use standards within their municipal areas. This fact is one of the most crucial causative factors as to why flood damages continue to be endemic throughout Canada.

Like many resource-based countries, Canada faces challenges in relation to natural resource development projects that may affect local hydrology, natural land-cover change, water contamination, extensive water consumption, and various forms of pollution. Resource development activities often have a large topographic footprint and that can often influence local drainage systems. Activities may require the diversion of rivers and creeks, and at times increase the risk of localized flooding due to the loss of natural floodplain storage. Despite these types of influence, the study found that only Quebec, Newfoundland and Labrador, and Yukon require and practice risk-based land use evaluations that incorporate the impacts of climate change for natural resource projects.

Regarding resource development, under its Environmental and Socio-economic Assessment Act, Yukon project proponents must conduct risk and vulnerability assessments pertaining to land-use change. The territory and/or Yukon Environmental and Socio-economic Assessment validate these findings.

It is also notable that many survey respondents indicated the need to integrate hazard risk management into existing land-use management instruments, to ensure the safe development of land, not only during natural resource projects, but also for any new developments.

Critical Infrastructure (CI) Assessment

The loss of Critical Infrastructure (CI) components such as those within transportation networks and within energy, telecommunication, water supply, and wastewater systems can have significant negative impacts on emergency response and recovery efforts. Provinces and territories reported limited effort in the area of flood risk and CI assessment – this may explain cases with 70% of Disaster Financial Assistance (DFAA) directed to restoration of critical infrastructure.

Additionally, most Canadian jurisdictions specified that CI assessment does not fall within their area of responsibility, and they therefore opted to select the non-applicable response option relative to CI. Furthermore, **nearly all Canadian provinces and territories reported a near complete failure to address infrastructure interdependencies. Study respondents indicated that they typically address infrastructure interdependencies following disasters** (e.g., such as following Northeast North American blackout of 2003).

Most respondents also volunteered that they were uncertain regarding whether climate change impacts had entered into planning and permitting decisions. Some respondents also indicated that they are highly concerned that power outages frequently lead to disruptions in the continuity of telecommunication services which are critically important for emergency response and recovery operations.

Public Health and Safety

Regarding flood preparedness, almost all provinces addressed the vulnerability assessment of healthcare facilities, whereas for the three territories this was an area of comparatively weak performance.

Under the flood dimension of public health and safety that addressed assessment of abandoned contaminated sites and dams, provinces and territories both documented weak performance. There are tens of thousands contaminated sites across Canada, for which the impacts of flooding are analyzed on an ad hoc basis. On a positive note, some respondents indicated that they are considering incorporating the impacts of climate change on abandoned contaminated sites, including mine tailings.

In reference to safety of people living upstream and downstream from dams, and the potential threat of climate change induced flood risk, dam owners are not required to undertake flood risk assessments in most provinces and territories. Most provinces have transferred the responsibility for the assessment of dams to municipal governments, who in turn, frequently make only limited efforts with respect to this domain of preparedness. Dam safety is further complicated by a diverse ownership structure in Canada – some dams are owned directly by the provinces and territories, others by municipalities, and the remainder by a third parties including private companies, electrical utilities and even individual citizens.

Conclusions

Survey respondents, from provinces and territories, referenced the need for Canada to provide – **in timely fashion** – user-friendly and publicly accessible up-to-date flood risk maps. Amongst an array of benefits, flood (or hazard) risk maps provide crucial information regarding the location and distribution of vulnerable populations, threats to Critical Infrastructure, and safe evacuation routes during times of flood inundation. For communities with increasing population densities subject to pressure to continue developing in high-risk flood areas, flood risk maps can promote public awareness, thereby enabling people to make informed decisions on safe places to live and to ensure assignment of appropriate flood preparedness measures.

The main types of flooding to which Canadian jurisdictions are exposed are fluvial, pluvial, coastal, ice jam, and groundwater flooding, as well as flooding due to the failure of artificial water retention infrastructure. This study presented a question related to the development and regular update of flood risk (or in Northern Canada, hazard) maps, with the following finding – of the primary types of flooding, only fluvial mapping had been developed by all provinces for some land areas. With respect to the other aforementioned types of flooding, mapping efforts remain either underdeveloped, incomplete or nonexistent.

Study respondents also reported the need for significant improvements regarding the communication and dissemination of critical information before, during and following flood events. This direction included pre-flood actions by homeowners to limit flood risk, during-flood safety and flood mitigation efforts at the community level, and post-flood protocols to restore community and business normalcy. In remote and/or unincorporated communities and in northern Canada, respondents emphasized that the timely dissemination of emergency information often proved especially difficult during flood events.

A pervasive theme conveyed by nearly all (139) survey respondents was complacency by provinces and territories relative to the timely mobilization of flood risk mitigation policies and procedures. This study supported this perception – namely, from 2016 to 2019, the overall flood preparedness score for Canada moved from C- to C, respectively.

Recognizing that climate change is irreversible (ECCC 2019), and that the financial and social costs of flooding are increasing for Canada, fiduciary duty mandates the near-term resolve of provinces and territories to mitigate flood risk. If Canada continues on its current path of business as usual, the 2024 flood preparedness score will be C+, which survey respondents identified as "too little too late". **Provinces and territories must fast-track flood risk mitigation to avoid predictable and costly disasters before they strike.** Additionally, many respondents suggested that **the Federal Government of Canada should support the provinces and territories to create and disseminate combined fluvial/pluvial flood risk maps, and to make them publicly available on or before year-end 2021.**

APPENDIX A

This appendix provides a description of criteria used to assess the flood-related commitments of provincial and territorial governments, along with provincial and territorial questionnaires.

A.1 Floodplain Mapping

There is a growing awareness that the incorporation of climate change projections into floodplain maps is crucially important. However, just incorporating climate change considerations into existing flood mapping is not sufficient, as this does not eliminate the need for the regular update of mapping. Such updates are necessary due to land-use alterations and river channel changes, amongst many other dynamic factors. (e.g., new tools, better data).

In sum, the creation and the regular update of flood mapping products and encouraging their active utilization in land use planning and emergency response efforts is vital to managing flood risk. It is equally important that such flood mapping products are made readily available to the public to allow the public-at-large to recognize and understand their exposure to the risk of flooding.

To address this criterion, participants from provincial governments were asked to select the most appropriate option (or combination of options) in response to the following question:

1 What is the level of provincial engagement relating to the development and update of floodplain maps, including coastal and riverine maps?

ANSWER KEY	
A	The province is responsible for the development and regular (every 5 years) update of floodplain maps. This includes incorporating changes in floodplain hydrology and hydraulics as well as the impacts of climate change on identified flood hazards, including flood hazards associated with storm surges and sea-level rise.
B	The province is responsible for developing floodplain mapping tools and guidelines, and delegates responsibility for the development and update of floodplain maps to local governments. The province subsequently validates the accuracy of these maps.
C	The province sets standards, policies, and provides guidelines for the development of floodplain maps, and delegates responsibility for the development and update of floodplain maps to local governments or conservation/watershed authorities.
D	The province delegates the responsibility for the development and update of floodplain maps to local governments or conservation/watershed authorities. While the province regularly updates provincial guidelines for floodplain mapping, it does not supervise the production of floodplain maps.
E	The province updates floodplain maps on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

In order to reflect the unique climate-related aspects of the Canadian North, the territories were asked a slightly modified version of Question 1, indicated as Question 1*, which focused primarily on permafrost-related hazards, and also on waves, storm surges, sea-level changes, and coastal erosion.

Therefore, participants from the territories were asked to select the most appropriate option (or combination of options) in response to the following question:

1* What is the level of territorial engagement relating to the development and update of climate change-related hazard mapping, including permafrost hazard mapping?

ANSWER KEY	
A	The territory is responsible for the development and regular (every 5-7 years) update of hazard maps. This includes incorporating impacts of climate change on identified hazards, including hazards associated with waves and storm surges, permafrost degradation, sea-level change, and coastal erosion.
B	The territory develops hazard mapping tools and guidelines in collaboration with the federal government, delegating responsibility for the development and update of hazard maps to local communities. The territory subsequently validates the accuracy of these maps.
C	The territory sets standards, policies, and provides guidelines for the development of hazard maps, and delegates responsibility for the development and update of hazard maps to local communities.
D	The territory delegates the responsibility for the development and update of hazard maps to local communities. While the territory regularly updates territorial guidelines for hazard mapping, it does not supervise the production of hazard maps.
E	The territory updates hazard maps on an ad-hoc basis, but not on a regular basis.

A.2 Flood Risk Assessment

Flood risk assessments, incorporating the impacts of climate and land use changes on people, assets, infrastructure, and the environment are an invaluable instrument for decision makers, policy makers, and planners. They can be used to understand and mitigate present and future damages, to create risk management strategies that are both cost effective and community supported, and to help plan for long-term financial investments in risk mitigation.

To address this criterion, participants from provincial governments were asked to select the most appropriate option (or combination of options) in response to the following question:

2 What is the level of provincial engagement relating to the development and update of flood risk assessments (including watershed and coastal risk assessments, as applicable)?

ANSWER KEY	
A	The province is responsible for the development and update of flood risk assessments, incorporating the impacts of climate and land use changes on people, assets, infrastructure, and the environment.
B	The province is responsible for developing tools and guidelines for flood risk assessments, incorporating the impacts of climate and land use changes on people, assets, infrastructure, and the environment. While the province delegates the responsibility for flood risk assessment to local governments or conservation/watershed authorities, it validates the accuracy of these assessments.
C	The province sets standards, policies, and provides guidelines for the development and update of flood risk assessments and delegates the responsibility for flood risk assessment to local governments or conservation/watershed authorities.
D	The province delegates the responsibility for the development and update of flood risk assessments to local governments or conservation/watershed authorities. While the province regularly updates provincial guidelines for flood risk assessments, it neither validates nor supervises their development.
E	The province conducts flood risk assessments on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

To reflect the unique climate-related aspects of the Canadian North, the territories were asked a slightly modified version of Question 2, indicated below as Question 2*, which was focused on climate-related hazards, such as floods, snow loads, ice hazards, extreme weather events, and the degradation of permafrost.

Therefore, participants from the territories were asked to select the most appropriate option (or combination of options) in response to the following question:

2* What is the level of territorial engagement relating to the development and update of climate change-related hazard risk assessments (such as floods, snow loads, ice hazards, extreme weather events, and permafrost degradation)?

ANSWER KEY	
A	The territory is responsible for the development and update of hazard risk assessments, incorporating the impacts of climate and land use changes on people, assets, infrastructure, and the environment.
B	The territory develops tools and guidelines for hazard risk assessments in collaboration with the federal government, incorporating the impacts of climate and land use changes on people, assets, infrastructure, and the environment. While the territory delegates the responsibility for hazard risk assessment to local communities, it does validate the accuracy of these assessments.
C	The territory sets standards, policies, and provides guidelines for the development and update of hazard risk assessments and delegates the responsibility for hazard risk assessment to local communities.
D	The territory delegates the responsibility for the development and update of hazard risk assessments to local communities. While the territory regularly updates territorial guidelines for hazard risk assessments, it neither validates nor supervises their development.
E	The territory conducts hazard risk assessments on an ad-hoc basis, but not on a regular basis.

A.3 Flood Risk Maps

For communities with increasing population densities which are also subject to pressure to continue developing in high-risk areas, flood risk maps play an important role in helping to promote public awareness, thereby enabling people to make informed decisions on where to live and which preventive actions to take.

Flood risk maps also serve the purpose of providing crucial intelligence for emergency management professionals about the location and concentration of vulnerable populations and help with identifying potential threats to critical evacuation routes.

To gauge the level of involvement of provincial governments in the update of flood risk maps, participants were asked to select the most appropriate option in response to the following question: "Have the provincial flood risk maps for areas subject to current and future risks of flooding been updated within the last 5 years?"

To gauge the level of involvement of territorial governments in the update of flood risk maps, participants were asked to select the most appropriate option in response to the following question: "Have the territorial hazard risk maps been updated within the last 5 years?"

A.4 Land Use Planning

Land use planning is one of the fundamental components of flood management. Managing development activities to effectively minimize the risk of flooding to life, property, and infrastructure is a major objective of land use planning. Since some hazard areas will continue to be occasionally flooded, land use regulations must be directed at prohibiting development within the highest-risk areas as well as restricting development in lower risk areas.

The present study assesses the declared commitments of provincial and territorial governments pertaining to the following components of Land Use Planning criteria:

- Unincorporated Communities;
- Municipal Planning Areas; and
- Provincial / Territorial Crown Lands.

To address these criteria, participants from provincial governments were asked to select the most appropriate option (or combination of options) in response to the following questions:

4a Relative to land use planning for unincorporated areas/communities, how does the province regulate new development (including new residential development)?

ANSWER KEY	
A	The provincial regulations explicitly prohibit new development within flood hazard areas. These areas are identified using recent province-run studies (conducted within the past 5-7 years) which designated flood hazard areas and floodplains.
B	The provincial policies restrict or regulate new development within flood hazard areas. These areas are identified using recent province-run studies (conducted within the past 5-7 years) which designated flood hazard areas and floodplains.
C	The provincial regulations stipulate that new developments within flood hazard areas identified using recent province-run studies (conducted within the past 5-7 years) are required to obtain written approval from the provincial government or conservation/watershed authorities prior to development.
D	The province is currently considering developing a regulatory framework to address development in unincorporated areas/communities.
E	The province does not have a regulatory framework addressing development in unincorporated areas/communities and has no plans to develop such a framework.

4b Relative to land use planning within Municipal Planning Areas (MPA), how does the province regulate floodplain and/or coastal encroachment through infill, intensification, and redevelopment?

ANSWER KEY	
A	The provincial regulations explicitly prohibit new development within flood hazard areas. These areas are identified using recent studies (conducted within the past 5-7 years) which designated flood hazard areas and floodplains.
B	The provincial regulations stipulate that community plans and local zoning bylaws shall designate lands identified as flood hazard areas during recent studies (conducted within the past 5-7 years) as floodplains and prohibit new development and redevelopment within these areas.
C	The provincial regulations stipulate that new developments within flood hazard areas identified using recent studies (conducted within the past 5-7 years) require written approval from the provincial government or conservation/watershed authorities.
D	The provincial policies stipulate that community plans and local zoning bylaws may restrict new development and redevelopment within flood hazard areas identified using studies conducted within the past 10-15 years.
E	While the province requires consideration of provincial policies and land use guidelines, the province does not have the legal power to enforce municipal adherence to provincial land use guidelines.

4c How does the province engage in risk-based land use planning for new development on provincial crown lands?

ANSWER KEY	
A	The provincial regulations stipulate that flood risk and vulnerability assessments (incorporating the impacts of climate and land-use change) shall be conducted by the province and used as part of the process for developing recommendations for land-use change plans or development proposals.
B	The provincial regulations stipulate that flood risk and vulnerability assessments (incorporating the impacts of climate and land-use change) shall be conducted by the proponent as part of the permit application for development.
C	The provincial policies stipulate that flood risk and vulnerability assessments (incorporating the impacts of climate and land-use change) may be conducted by the proponent as part of the permit application for development.
D	The provincial policies stipulate that flood risk and vulnerability assessments may be conducted by local governments or conservation/watershed authorities as part of the permit application for development.
E	The province does not have an established regulatory framework regarding new development on provincial lands.

To address Land Use Planning criteria, participants from territorial governments were asked to select the most appropriate option (or combination of options) in response to the following questions:

4a* Relative to land use planning for unincorporated areas/communities, how does the territory regulate new development (including new residential development)?

ANSWER KEY	
A	The territorial regulations explicitly prohibit new development within hazard risk areas. These areas are identified using recent territory-run studies (conducted within the past 5-7 years) which designated hazard areas.
B	The territorial policies restrict or regulate new development within hazard risk areas. These areas are identified using recent territory-run studies (conducted within the past 5-7 years) which designated hazard areas.
C	The territorial regulations stipulate that new developments within hazard risk areas identified using recent territory-run studies (conducted within the past 5-7 years) are required to obtain written approval from the territorial government prior to development.
D	The territory is currently considering developing a regulatory framework to address development in unincorporated areas/communities.
E	The territory does not have a regulatory framework addressing development in unincorporated areas/communities and has no plans to develop such a framework.

4b* Relative to land use planning within municipal planning areas (mpas), how does the territory regulate hazard risk zone and/or coastal encroachment through infill, intensification, and redevelopment?

ANSWER KEY	
A	The territorial regulations explicitly prohibit new development within hazard risk areas. These areas are identified using recent studies (conducted within the past 5-7 years) which designated hazard areas.
B	The territorial regulations stipulate that community plans and local zoning bylaws shall designate lands identified as hazard risk areas during recent studies (conducted within the past 5-7 years) and prohibit new development and redevelopment within these areas.
C	The territorial regulations stipulate that new developments within hazard risk areas identified using recent studies (conducted within the past 5-7 years) require written approval from the territorial government.
D	The territorial policies stipulate that community plans and local zoning bylaws may restrict new development and redevelopment within hazard risk areas identified using studies conducted within the past 10-15 years.
E	While the territory requires consideration of territorial policies and land use guidelines, the territory does not have the legal power to enforce municipal adherence to territorial land use guidelines.

4c* How does the territory engage in risk-based land use planning for new development on crown lands?

ANSWER KEY	
A	The territorial regulations stipulate that hazard risk and vulnerability assessments (incorporating the impacts of climate and land-use changes) shall be conducted by the territory and used as part of the process for developing recommendations for land-use change plans or development proposals.
B	The territorial regulations stipulate that hazard risk and vulnerability assessments (incorporating the impacts of climate and land-use change) shall be conducted by the proponent as part of the permit application for development.
C	The territorial policies stipulate that hazard risk and vulnerability assessments (incorporating the impacts of climate and land-use change) may be conducted by the proponent as part of the permit application for development.
D	The territorial policies stipulate that hazard risk and vulnerability assessments may be conducted by local communities as part of the permit application for development.
E	The territory does not have an established regulatory framework regarding new development on Crown lands.

A.5 Waterway Management

Any work to be completed within water bodies, floodplains, or wetlands requires a review of the relevant approvals and permits under existing provincial and/or territorial regulations. Failure to adequately manage waterway modifications could have major consequences with respect to the potential loss of life, the risk of personal injury, and the possibility of large socio-economic impacts on populations and infrastructure located in close proximity to the waterways.

To address this criterion, participants from provincial governments were asked to select the most appropriate option (or combination of options) in response to the following question:

5 In regard to waterway modifications such as widening, deepening, realigning, clearing, or cleaning rivers and flowpaths, what policy does the province have in place?

ANSWER KEY	
A	The provincial regulations stipulate that prior to any waterway modification, an alteration impact analysis considering the impacts of climate change shall be submitted for the approval/rejection of a particular project. The province delegates the responsibility for alteration impact analyses to local governments or conservation/watershed authorities and validates the accuracy of these analyses.
B	The provincial regulations stipulate that prior to any waterway modification, an alteration impact analysis considering the impacts of climate change shall be submitted for the approval/rejection of a particular project. The province delegates the responsibility for alteration impact analyses to the project proponents and validates the accuracy of these analyses.
C	The province sets standards and guidelines for alteration impact analyses of waterway modification projects, and delegates responsibility for conducting such analyses to local governments or conservation/watershed authorities.
D	The province sets standards and guidelines for alteration impact analyses of waterway modification projects, and delegates responsibility for conducting such analyses to the to the project proponents. The province delegates responsibility for validating these analyses to local governments or conservation/watershed authorities.
E	The province defines policy regarding waterway modifications, and delegates responsibility for their implementation and enforcement to local governments or conservation/watershed authorities.

To address this criterion, participants from territorial governments were asked to select the most appropriate option (or combination of options) in response to the following question:

5* In regard to waterway modifications such as widening, deepening, realigning, clearing, or cleaning rivers and flowpaths, what policy does the territory have in place?

ANSWER KEY	
A	The territorial regulations stipulate that prior to any waterway modification, an alteration impact analysis considering the impacts of climate change shall be submitted for the approval/rejection of a particular project. The territory delegates the responsibility for alteration impact analyses to local communities and validates the accuracy of these analyses.
B	The territorial regulations stipulate that prior to any waterway modification, an alteration impact analysis considering the impacts of climate change shall be submitted for the approval/rejection of a particular project. The territory delegates the responsibility for alteration impact analyses to the project proponents and validates the accuracy of these analyses.
C	The territory sets standards and guidelines for alteration impact analyses of waterway modification projects, and delegates responsibility for conducting such analyses to local communities.
D	The territory sets standards and guidelines for alteration impact analyses of waterway modification projects, and delegates responsibility for conducting such analyses to the project proponents. The territory delegates responsibility for validating these analyses to local communities.
E	The territory defines policy regarding waterway modifications, and delegates responsibility for their implementation and enforcement to local communities.

A.6 Sustainable Flood Management

Despite the established value of natural ecosystems, including their role as a flood protective element, Canada to-date continues to experience significant and extensive losses of its wetlands, forests, and intact grassland areas. The transformation of the natural environment has been most extreme in the southern parts of Canada, including the Great Plains region of Canada that stretches across southern Manitoba, Saskatchewan, and Alberta, and the grasslands in British Columbia's interior.

Although floodplain regulations require the protection of natural floodplains, stream channels, and natural protective barriers such as wetlands, Canada continues to lose its unique natural capital: namely its wetlands, riparian forests, and coastal marches.

The present study assesses the declared commitments of provincial and territorial governments pertaining to the following components of the Sustainable Flood Management criterion:

- Protection and Restoration of Riverine Floodplains, Wetlands, and Riparian Buffers; and
- Protection and Restoration of Coastal Floodplains, Salt Marshes, and Sand Dunes.

To address these criteria, participants from provincial governments were asked to select the most appropriate option (or combination of options) in response to the following questions:

6a In regard to the capacity of natural features such as floodplains, wetlands, and riparian buffers to mitigate flooding, how does the province engage in the protection and restoration of these features?

ANSWER KEY	
A	The provincial regulations protect natural features and provide direction for their restoration, including the protection, management, and restoration of wetlands and riparian areas. Provincial initiatives include financial incentives for the gradual relocation of existing residential developments out of the floodplain.
B	The provincial regulations protect natural features and provide direction for their restoration. Provincial initiatives include financial incentives for the gradual restoration of natural watercourses.
C	The province sets the framework for regulating the protection and restoration of natural features, and delegates responsibility for their maintenance to local governments or conservation/watershed authorities.
D	The province sets standards and develops guidelines regarding the protection and restoration of natural features and delegates responsibility for their implementation and enforcement to local governments or conservation/watershed authorities.
E	The province sets policies regarding the protection and restoration of natural features and delegates responsibility for their implementation and enforcement to local governments or conservation/watershed authorities.

6b In regard to the capacity of natural coastal features such as coastal floodplains, salt marshes, and sand dunes to mitigate coastal flooding, how does the province engage in the protection and restoration of these features?

ANSWER KEY	
A	The provincial regulations protect natural coastal areas and provide direction for their restoration. Provincial initiatives include financial incentives for the gradual relocation of existing development out of coastal flood risk areas.
B	The provincial regulations protect natural coastal areas and provide direction for their restoration. Provincial initiatives include financial incentives for the natural development of coastal salt marshes and sand dunes.
C	The province sets the framework for regulating the protection and restoration of natural coastal areas, and delegates responsibility for their maintenance to local governments or conservation/watershed authorities.
D	The province sets standards and develops guidelines regarding the protection and restoration of natural coastal areas and delegates responsibility for their implementation and enforcement to local governments or conservation/watershed authorities.
E	The province defines policies regarding the protection and restoration of natural coastal areas and delegates responsibility for their implementation and enforcement to local governments or conservation/watershed authorities.

To address Sustainable Flood Management criteria, participants from territorial governments were asked to select the most appropriate option (or combination of options) in response to the following questions:

6a* In regard to the capacity of natural features such as floodplains, wetlands, and riparian buffers to mitigate flooding, how does the territory engage in the protection and restoration of these features?

ANSWER KEY	
A	The territorial regulations protect natural features and provide direction for their restoration, including the protection, management, and restoration of wetlands and riparian areas. Territorial initiatives include financial incentives for the gradual relocation of existing residential developments out of the floodplain.
B	The territorial regulations protect natural features and provide direction for their restoration. Territorial initiatives include financial incentives for the gradual restoration of natural watercourses.
C	The territory sets the framework for regulating the protection and restoration of natural features, and delegates responsibility for their maintenance to local governments.
D	The territory sets standards and develops guidelines regarding the protection and restoration of natural features and delegates responsibility for their implementation and enforcement to local governments.
E	The territory sets policies regarding the protection and restoration of natural features and delegates responsibility for their implementation and enforcement to local governments.

6b* In regard to the capacity of natural coastal features such as coastal floodplains, salt marshes, and sand dunes to mitigate coastal flooding, how does the territory engage in the protection and restoration of these features?

ANSWER KEY	
A	The territorial regulations protect natural coastal areas and provide direction for their restoration. Territorial initiatives include financial incentives for the gradual relocation of existing development out of coastal flood risk areas.
B	The territorial regulations protect natural coastal areas and provide direction for their restoration. Territorial initiatives include financial incentives for the natural development of coastal salt marshes and sand dunes.
C	The territory sets the framework for regulating the protection and restoration of natural coastal areas, and delegates responsibility for their maintenance to local governments.
D	The territory sets standards and develops guidelines regarding the protection and restoration of natural coastal areas and delegates responsibility for their implementation and enforcement to local governments.
E	The territory defines policies regarding the protection and restoration of natural coastal areas and delegates responsibility for their implementation and enforcement to local governments.

A.7 Vulnerability Assessment for New Development Projects

The term, new development projects, refers to the design and construction of infrastructure assets that may have very long service lives; dams, for instance, are commonly in use for 80-100 years, or even longer. It is therefore critical that the planning and design phases of new development projects include the assessment of the type, extent, and rate of change of the climatic conditions to which such infrastructure is predicted to be exposed and the level of the sensitivity of the infrastructure to such changes.

The assessment of vulnerability from an engineering standpoint as well as general risk assessments are the primary methods through which climate change can be considered in the design, operation, and maintenance of physical infrastructure systems infrastructure.

The present study assesses the declared commitments of provincial and territorial governments pertaining to the following components of the New Development Projects criterion:

- New Highways;
- Natural Resource Development;
- Oil and Gas Pipelines;
- Hydrogeneration; and
- Solid Waste Landfills.

To address these criteria, participants from provincial governments were asked to select the most appropriate option (or combination of options) in response to the following questions:

7a In regard to the development of new provincial highways, how does the province engage in the assessment of flood risk?

ANSWER KEY	
A	The provincial regulations mandate that flood risk assessments considering the impacts of climate change on identified flood hazards be submitted as part of the approval process for highway projects located within or in close proximity to flood-prone areas. These areas are identified using recent studies (conducted within the past 5-7 years) which designated flood hazard areas and floodplains.
B	The province develops tools, protocols, and guidelines for flood risk assessments and delegates the responsibility for conducting these assessments for new highway projects to local governments or conservation/watershed authorities. These flood risk assessments are subsequently approved by the provincial government.
C	The provincial regulations stipulate that an Environmental Impact Assessment (including hydrologic and hydraulic modelling) must be included in the recommendation for an approval/rejection of a particular highway development project.
D	The province develops tools, protocols, and guidelines for flood risk assessments and delegates the responsibility for conducting these assessments for new highway projects to local governments or conservation/watershed authorities.
E	Provincial regulations do not specifically require that flood risk assessments be carried out prior to the development of new highways, but provincial technical requirements specify mitigation measures which inherently provide some protection against the effects of flooding.

7b How does the province engage in the pre-development assessment of flood risk in regard to new natural resource development projects on provincially owned crown lands?

ANSWER KEY	
A	The provincial regulations mandate that flood risk assessments considering the impacts of climate change on identified flood hazards be submitted by the applicant for new projects located within or in close proximity to flood-prone areas. These areas are identified using recent studies (conducted within the past 5-7 years) which designated flood hazard areas and floodplains.
B	The province develops tools, protocols, and guidelines for flood risk assessments and delegates the responsibility for conducting these assessments to local governments or conservation/watershed authorities. These flood risk assessments are subsequently approved by the provincial government.
C	The provincial regulations stipulate that an Environmental Impact Assessment (including hydrologic and hydraulic modelling) must be included in the recommendation for an approval/rejection of a particular new development project.
D	The province develops tools, protocols, and guidelines for flood risk assessments and delegates the responsibility for conducting these assessments for new development projects to local governments or conservation/watershed authorities.
E	Provincial regulations do not specifically require that flood risk assessments be carried out prior to the development of new projects, but provincial technical requirements specify mitigation measures which inherently provide some protection against the effects of flooding.

7c In regard to the development of new oil and gas pipeline projects, how does the province engage in the assessment of flood risk?

ANSWER KEY	
A	The provincial regulations legally mandate that flood risk assessments considering the impacts of climate change on identified flood hazards be submitted by the applicant for new pipeline projects crossing flood-prone areas. These areas are identified using recent studies (conducted within the past 5-7 years) which designated flood hazard areas and floodplains. The results of these risk assessments are consequently validated by the regulator.
B	The province develops tools, protocols, and guidelines for flood risk assessments and delegates the responsibility for conducting these assessments for new pipeline projects to local governments or conservation/watershed authorities. The results of flood risk assessments are validated by the regulator.
C	The provincial regulations stipulate that an Environmental Impact Assessment (including hydrologic and hydraulic modelling) must be included in the recommendation for an approval/rejection of a particular new pipeline project.
D	The province develops tools, protocols, and guidelines for flood risk assessments and delegates the responsibility for conducting these assessments for new pipeline projects to local governments or conservation/watershed authorities.
E	Provincial regulations do not specifically require that flood risk assessments be carried out prior to the development of new pipeline projects, but provincial technical requirements specify mitigation measures which inherently provide some protection against the effects of flooding.

7d In regard to the development of new hydrogeneration projects, how does the province engage in the assessment of flood risk as related to controlled releases and/or dam failures?

ANSWER KEY	
A	The province mandates that permit applications submitted for hydrogeneration projects contain flood risk assessments considering the impacts of climate change. Such assessments are performed by the applicant and are made available to the public prior to the issuance of development licenses.
B	The province mandates that permit applications submitted for hydrogeneration projects contain flood risk assessments considering the impacts of climate change. Such assessments are performed by the applicant and are subsequently validated prior to the issuance of development licenses. No public posting of such assessments is required.
C	The province mandates that permit applications submitted for hydrogeneration projects include flood risk assessments. These risk assessments do not include climate change impacts but are validated by the water Comptroller prior to the issuance of development licenses. No public posting of these assessment is required.
D	The provincial regulations do not specifically require that flood risk assessments be submitted; however, the province negotiates agreements to compensate affected groups if flooding occurs due to controlled releases or dam failures.
E	The province delegates the responsibility for flood risk assessments to local governments and provides technical guidance to local planning authorities for flood risk assessments pertaining to hydrogeneration projects.

7e In regard to the development of new solid waste landfills, how does the province regulate flood risk management?

ANSWER KEY	
A	The provincial regulations mandate that flood risk assessments considering the impacts of climate change on identified flood hazards be submitted as part of the approval process for new solid waste landfill projects located within or in close proximity to flood-prone areas. These areas are identified using recent studies (conducted within the past 5-7 years) which designated flood hazard areas and floodplains.
B	The province develops tools, protocols, and guidelines for flood risk assessments and delegates the responsibility for conducting these assessments for new solid waste landfill projects to local governments or conservation/watershed authorities. These flood risk assessments are subsequently approved by the provincial government.
C	The provincial regulations stipulate that an Environmental Impact Assessment (including hydrologic and hydraulic modelling) must be included in the recommendation for an approval/rejection of a particular solid waste landfill project.
D	The province develops tools, protocols, and guidelines for flood risk assessments and delegates the responsibility for conducting these assessments for new solid waste landfill projects to local governments or conservation/watershed authorities.
E	Provincial regulations do not specifically require that flood risk assessments be carried out prior to the development of new solid waste landfill projects, but provincial technical requirements specify mitigation measures which inherently provide some protection against the effects of flooding.

To address New Development Projects criteria, participants from territorial governments were asked to select the most appropriate option (or combination of options) in response to the following questions:

7a* In regard to the development of new territorial highways, how does the territory engage in the assessment of hazard risk?

ANSWER KEY	
A	The territorial regulations mandate that hazard risk assessments considering the impacts of climate change be submitted as part of the approval process for highway projects located within or in close proximity to hazard risk areas. These areas are identified using recent studies (conducted within the past 5-7 years) which designated hazard risk areas.
B	The territory develops tools, protocols, and guidelines for hazard risk assessments and delegates the responsibility for conducting these assessments for new highway projects to local communities. These hazard risk assessments are subsequently approved by the territorial government.
C	The territorial regulations stipulate that an Environmental Impact Assessment must be included in the recommendation for an approval/rejection of a particular highway development project.
D	The territory develops tools, protocols, and guidelines for hazard risk assessments and delegates the responsibility for conducting these assessments for new highway projects to local communities.
E	Territorial regulations do not specifically require that hazard risk assessments be carried out prior to the development of new highways, but territorial technical requirements specify mitigation measures which inherently provide some protection.

7b* How does the territory engage in the pre-development assessment of hazard risk in regard to new natural resource development projects?

ANSWER KEY	
A	The territorial regulations mandate that hazard risk assessments considering the impacts of climate change be submitted by the applicant for new projects located within or in close proximity to hazard risk areas. These areas are identified using recent studies (conducted within the past 5-7 years) which designated hazard risk areas.
B	The territory develops tools, protocols, and guidelines for hazard risk assessments and delegates the responsibility for conducting these assessments to local communities. These hazard risk assessments are subsequently approved by the territorial government.
C	The territorial regulations stipulate that an Environmental Impact Assessment must be included in the recommendation for an approval/rejection of a particular new development project.
D	The territory develops tools, protocols, and guidelines for hazard risk assessments and delegates the responsibility for conducting these assessments for new development projects to local communities.
E	Territorial regulations do not specifically require that hazard risk assessments be carried out prior to the development of new projects, but territorial technical requirements specify mitigation measures which inherently provide some protection.

7c* In regard to the development of new oil and gas pipeline projects, how does the territory engage in the assessment of hazard risk?

ANSWER KEY	
A	The territorial regulations legally mandate that hazard risk assessments considering the impacts of climate change be submitted by the applicant for new pipeline projects crossing hazard risk areas. These areas are identified using recent studies (conducted within the past 5-7 years) which designated hazard risk areas. The results of these risk assessments are consequently validated by the regulator.
B	The territory develops tools, protocols, and guidelines for hazard risk assessments and delegates the responsibility for conducting these assessments for new pipeline projects to local communities. The results of hazard risk assessments are validated by the regulator.
C	The territorial regulations stipulate that an Environmental Impact Assessment must be included in the recommendation for an approval/rejection of a particular new pipeline project.
D	The territory develops tools, protocols, and guidelines for hazard risk assessments and delegates the responsibility for conducting these assessments for new pipeline projects to local communities.
E	Territorial regulations do not specifically require that hazard risk assessments be carried out prior to the development of new pipeline projects, but territorial technical requirements specify mitigation measures which inherently provide some protection.

7d* In regard to the development of new hydrogeneration projects, how does the territory engage in the assessment of flood risk as related to controlled releases and/or dam failures?

ANSWER KEY	
A	The territory mandates that permit applications submitted for hydrogeneration projects contain flood risk assessments considering the impacts of climate change. Such assessments are performed by the applicant and are made available to the public prior to the issuance of development licenses.
B	The territory mandates that permit applications submitted for hydrogeneration projects contain flood risk assessments considering the impacts of climate change. Such assessments are performed by the applicant and are subsequently validated prior to the issuance of development licenses. No public posting of such assessments is required.
C	The territory mandates that permit applications submitted for hydrogeneration projects include flood risk assessments. These risk assessments do not include climate change impacts but are validated by the water Comptroller prior to the issuance of development licenses. No public posting of these assessment is required.
D	The territorial regulations do not specifically require that flood risk assessments be submitted; however, the territory negotiates agreements to compensate affected groups if flooding occurs due to controlled releases or dam failures.
E	The territory delegates the responsibility for flood risk assessments to local communities and provides technical guidance to local planning authorities for flood risk assessments pertaining to hydrogeneration projects.

7e* In regard to the development of new solid waste landfills, how does the territory regulate hazard risk management?

ANSWER KEY	
A	The territorial regulations mandate that hazard risk assessments considering the impacts of climate change be submitted as part of the approval process for new solid waste landfill projects located within or in close proximity to hazard risk areas. These areas are identified using recent studies (conducted within the past 5-7 years) which designated hazard risk areas.
B	The territory develops tools, protocols, and guidelines for hazard risk assessments and delegates the responsibility for conducting these assessments for new solid waste landfill projects to local communities. These hazard risk assessments are subsequently approved by the territorial government.
C	The territorial regulations stipulate that an Environmental Impact Assessment must be included in the recommendation for an approval/rejection of a particular solid waste landfill project.
D	The territory develops tools, protocols, and guidelines for hazard risk assessments and delegates the responsibility for conducting these assessments for new solid waste landfill projects to local communities.
E	Territorial regulations do not specifically require that hazard risk assessments be carried out prior to the development of new solid waste landfill projects, but territorial technical requirements specify mitigation measures which inherently provide some protection.

A.8 Risk Mitigation for Critical Infrastructure

Concerns over climate change and rising sea levels bring into question the vulnerability of Critical Infrastructure to flooding and to the adverse effects of climate change. The loss of Critical Infrastructure components such as those within energy systems, transportation networks, telecommunication systems, water supply and wastewater systems, as well as other lifeline infrastructure systems can have far-reaching societal impacts, and damage to these critical assets may well have significant impacts on emergency response and recovery efforts.

The first step in determining which adaptation or mitigation strategies are appropriate for a given piece of existing Critical Infrastructure is to assess the present status of said infrastructure with a comprehensive vulnerability assessment. On this basis, the process of planning mitigation measures can be initiated.

The present study assesses the declared commitments of provincial and territorial governments pertaining to the assessment of vulnerability and mitigation of risk for the following types of Critical Infrastructure that were identified as the five components of the composite criterion:

- Electrical Infrastructure;
- Telecom Infrastructure;
- Provincial Highway Infrastructure and Highway Drainage Structures;
- Pipeline Infrastructure; and
- Water Infrastructure.

To address these criteria, participants from provincial governments were asked to select the most appropriate option (or combination of options) in response to the following questions:

8a How does the province mitigate the vulnerability of its existing electrical infrastructure to flooding?

ANSWER KEY	
A	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of the existing electrical system to flooding incorporating the impacts of climate change on identified flood hazards. The province is presently engaged with the owners/operators of electrical infrastructure in implementing mitigation actions to enhance the flood resilience of electrical infrastructure, if deemed necessary.
B	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of the existing electrical system to flooding incorporating the impacts of climate change on identified flood hazards. The province is presently engaged with the owners/operators of electrical infrastructure in developing plans to protect electrical infrastructure to a desired level.
C	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of the existing electrical system to flooding incorporating the impacts of climate change on identified flood hazards. The province is presently engaged with the owners/operators of electrical infrastructure in evaluating and prioritizing adaptation initiatives.
D	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of the existing electrical system to flooding incorporating the impacts of climate change on identified flood hazards. The province is presently engaged with the owners/operators of electrical infrastructure in developing a detailed risk assessment of the rural and remote segments of the electrical system.
E	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of the existing electrical system to flooding incorporating the impacts of climate change on identified flood hazards. Engagement with the owners/operators of electrical infrastructure is currently limited to preliminary discussions.

8b How does the province mitigate the vulnerability of telecommunications infrastructure to flooding?

ANSWER KEY	
A	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of existing telecom infrastructure to flooding incorporating the impacts of climate change on identified flood hazards. The province is presently engaged with the owners/operators of telecom infrastructure in implementing mitigation actions to enhance the flood resilience of telecom infrastructure, if deemed necessary.
B	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of existing telecom infrastructure to flooding incorporating the impacts of climate change on identified flood hazards. The province is presently engaged with the owners/operators of telecom infrastructure in developing plans to protect infrastructure to a desired level.
C	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of existing telecom infrastructure to flooding incorporating the impacts of climate change on identified flood hazards. The province is presently engaged with the owners/operators of telecom infrastructure in evaluating and prioritizing adaptation initiatives.
D	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of existing telecom infrastructure to flooding incorporating the impacts of climate change on identified flood hazards. The province is presently engaged with the owners/operators of telecom infrastructure in developing a detailed risk assessment of the rural and remote segments of telecom networks.
E	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of existing telecom infrastructure to flooding incorporating the impacts of climate change on identified flood hazards. Engagement with the owners/operators of telecom infrastructure is currently limited to preliminary discussions.

8c How does the province mitigate the vulnerability of existing provincial highway infrastructure and highway drainage structures to flooding?

ANSWER KEY	
A	The province has recently (within the past 5 years) conducted assessments to identify the vulnerability of its highways to flooding incorporating the impacts of climate change on identified flood hazards. The province has subsequently secured funding and developed plans to protect its highway infrastructure (including highway drainage infrastructure) to a desired level, if deemed necessary.
B	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of its highways to flooding incorporating the impacts of climate change on identified flood hazards. The province has subsequently engaged with stakeholders to secure funding in order to protect its highway infrastructure (including highway drainage infrastructure) to a desired level.
C	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of its highways to flooding incorporating the impacts of climate change on identified flood hazards. The province has subsequently engaged with stakeholders to develop plans in order to protect its highway infrastructure (including highway drainage infrastructure) to a desired level.
D	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of its highways to flooding incorporating the impacts of climate change on identified flood hazards. The province is currently engaged with stakeholders to develop a framework in order to assess and prioritize flood adaptation measures for highway infrastructure components.
E	The province addresses the vulnerability of highway infrastructure (including highway drainage structures) to flooding on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

8d How does the province mitigate the vulnerability of existing pipeline infrastructure to flooding?

ANSWER KEY	
A	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of its existing pipeline infrastructure to flooding incorporating the impacts of climate change on identified flood hazards. The province is engaged with the owners/operators of gas and oil pipelines in implementing mitigation actions to enhance the flood resilience of pipelines, if deemed necessary.
B	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of its existing pipeline infrastructure to flooding incorporating the impacts of climate change on identified flood hazards. The province is engaged with the owners/operators of gas and oil pipelines in developing a framework in order to assess and prioritize mitigation initiatives.
C	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of its existing pipeline infrastructure to flooding incorporating the impacts of climate change on identified flood hazards. Engagement with the owners/operators of gas and oil pipelines is currently limited to preliminary discussions.
D	The province provides risk assessment tools to the owners/operators of gas and oil pipelines. However, the development of flood risk assessments and mitigation initiatives is the responsibility of the owners/operators of gas and oil pipelines.
E	The province has no regulations nor policies regarding the flood risk assessment of existing pipelines, passing on all flood-related responsibilities to the regulator.

8e How does the province engage in assessing the vulnerability of drinking water and wastewater infrastructure to flooding?

ANSWER KEY	
A	The province mandates the owners/operators of water infrastructure to develop and regularly update flood vulnerability assessments incorporating the impacts of climate change on identified flood hazards. The province approves the results of such assessments and is engaged in developing and funding mitigation initiatives.
B	The province sets standards, policies, and provides guidelines for flood vulnerability assessments and delegates the responsibility for their development and regular update to local governments or conservation/watershed authorities. The province approves the results of such assessments, secures long-term funding, and collaborates with local governments in developing flood mitigation strategies and initiatives.
C	The province sets policies and provides guidelines for flood vulnerability assessments and delegates the responsibility for their development and regular update to local governments or conservation/watershed authorities. The province collaborates with local governments in developing flood mitigation strategies, and from time-to-time, offers funding for projects related to the review and upgrade of existing water infrastructure.
D	The province sets policies and provides guidelines for flood vulnerability assessments and delegates the responsibility for their development and regular update to local governments or conservation/watershed authorities.
E	The province addresses the vulnerability of drinking water and wastewater infrastructure to flooding on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

To address Critical Infrastructure criteria, participants from territorial governments were asked to select the most appropriate option (or combination of options) in response to the following questions:

8a* How does the territory mitigate the climate change-related vulnerability of its existing electrical infrastructure?

ANSWER KEY	
A	The territory has recently (within the past 5 years) conducted climate change-related assessments to identify the vulnerability of the existing electrical system. The territory is presently engaged with the owners/operators of electrical infrastructure in implementing mitigation actions to enhance the resilience of electrical infrastructure, if deemed necessary.
B	The territory has recently (within the past 5 years) conducted climate change-related assessments to identify the vulnerability of the existing electrical system. The territory is presently engaged with the owners/operators of electrical infrastructure in developing plans to protect electrical infrastructure to a desired level.
C	The territory has recently (within the past 5 years) conducted climate change-related assessments to identify the vulnerability of the existing electrical system. The territory is presently engaged with the owners/operators of electrical infrastructure in evaluating and prioritizing adaptation initiatives.
D	The territory has recently (within the past 5 years) conducted climate change-related assessments to identify the vulnerability of the existing electrical system. The territory is presently engaged with the owners/operators of electrical infrastructure in developing a detailed risk assessment of the rural and remote segments of the electrical system.
E	The territory has recently (within the past 5 years) conducted climate change-related assessments to identify the vulnerability of the existing electrical system. Engagement with the owners/operators of electrical infrastructure is currently limited to preliminary discussions.

8b* How does the territory mitigate the climate change-related vulnerability of its telecommunications infrastructure?

ANSWER KEY	
A	The territory has recently (within the past 5 years) conducted climate change-related assessments to identify the vulnerability of existing telecom infrastructure. The territory is presently engaged with the owners/operators of telecom infrastructure in implementing mitigation actions to enhance the resilience of telecom infrastructure, if deemed necessary.
B	The territory has recently (within the past 5 years) conducted climate change-related assessments to identify the vulnerability of existing telecom infrastructure. The territory is presently engaged with the owners/operators of telecom infrastructure in developing plans to protect infrastructure to a desired level.
C	The territory has recently (within the past 5 years) conducted climate change-related assessments to identify the vulnerability of existing telecom infrastructure. The territory is presently engaged with the owners/operators of telecom infrastructure in evaluating and prioritizing adaptation initiatives.
D	The territory has recently (within the past 5 years) conducted climate change-related assessments to identify the vulnerability of existing telecom infrastructure. The territory is presently engaged with the owners/operators of telecom infrastructure in developing a detailed risk assessment of the rural and remote segments of telecom networks.
E	The territory has recently (within the past 5 years) conducted climate change-related assessments to identify the vulnerability of existing telecom infrastructure. Engagement with the owners/operators of telecom infrastructure is currently limited to preliminary discussions.

8c* How does the territory mitigate the climate change-related vulnerability of its existing territorial highway infrastructure and highway drainage structures?

ANSWER KEY	
A	The territory has recently (within the past 5 years) conducted assessments to identify the vulnerability of its highways to the impacts of climate change on identified hazards. The territory has subsequently secured funding and developed plans to protect its highway infrastructure (including highway drainage infrastructure) to a desired level, if deemed necessary.
B	The territory has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of its highways to the impacts of climate change on identified hazards. The territory has subsequently engaged with stakeholders to secure funding in order to protect its highway infrastructure (including highway drainage infrastructure) to a desired level.
C	The territory has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of its highways to the impacts of climate change on identified hazards. The territory has subsequently engaged with stakeholders to develop plans in order to protect its highway infrastructure (including highway drainage infrastructure) to a desired level.
D	The territory has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of its highways to the impacts of climate change on identified hazards. The territory is currently engaged with stakeholders to develop a framework in order to assess and prioritize adaptation measures for highway infrastructure components.
E	The territory addresses the vulnerability of highway infrastructure (including highway drainage structures) to the impacts of climate change on identified hazards on an ad-hoc basis, but not on a regular basis.

8d* How does the territory mitigate the climate change-related vulnerability of its existing pipeline infrastructure?

ANSWER KEY	
A	The territory has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of its existing pipeline infrastructure to the impacts of climate change on identified hazards. The territory is engaged with the owners/operators of gas and oil pipelines in implementing mitigation actions to enhance the resilience of pipelines, if deemed necessary.
B	The territory has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of its existing pipeline infrastructure to the impacts of climate change on identified hazards. The territory is engaged with the owners/operators of gas and oil pipelines in developing a framework in order to assess and prioritize mitigation initiatives.
C	The territory has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of its existing pipeline infrastructure to the impacts of climate change on identified hazards. Engagement with the owners/operators of gas and oil pipelines is currently limited to preliminary discussions.
D	The territory provides risk assessment tools to the owners/operators of gas and oil pipelines. However, the development of hazard risk assessments and mitigation initiatives is the responsibility of the owners/operators of gas and oil pipelines.
E	The territory has no regulations nor policies regarding the hazard risk assessment of existing pipelines, passing on all related responsibilities to the regulator.

8e* How Does The Territory Engage In Assessing The Climate Change-Related Vulnerability Of Its Drinking Water And Wastewater Infrastructure?

ANSWER KEY	
A	The territory mandates the owners/operators of water infrastructure to develop and regularly update climate change-related vulnerability assessments incorporating the impacts of climate change on identified hazards. The territory approves the results of such assessments and is engaged in developing and funding mitigation initiatives.
B	The territory sets standards, policies, and provides guidelines for climate change-related vulnerability assessments and delegates the responsibility for their development and regular update to local communities. The territory approves the results of such assessments, secures long-term funding, and collaborates with local communities in developing climate change-related mitigation strategies and initiatives.
C	The territory sets policies and provides guidelines for climate change-related vulnerability assessments and delegates the responsibility for their development and regular update to local communities. The territory collaborates with local communities in developing mitigation strategies, and from time-to-time, offers funding for projects related to the review and upgrade of existing water infrastructure.
D	The territory sets policies and provides guidelines for climate change-related vulnerability assessments and delegates the responsibility for their development and regular update to local communities.
E	The territory addresses the vulnerability of drinking water and wastewater infrastructure to climate change-related hazards on an ad-hoc basis, but not on a regular basis.

A.9 Public Health and Safety

Disasters resulting from natural hazards such as floods can directly affect human health through injuries, death, and disease outbreaks, and their longer-term impacts may include further health issues such as illnesses, psychiatric issues, and disabilities (World Health Organization 2018). Floods can also trigger dam incidents, the failure of structural flood protection infrastructure (SFP), as well as the release of contaminants from abandoned sites into the environment, resulting in immense property and environmental damages and the possible loss of human life.

The present study assesses the declared commitments of provincial and territorial governments in relation to the assessment of vulnerability and the mitigation of risk in the following domains of Public Health & Safety that were identified as the four components of the composite criterion:

- Healthcare System;
- Structural Flood Protection Infrastructure;
- Dams Safety; and
- Abandoned Contaminated Sites.

To address these criteria, participants from provincial governments were asked to select the most appropriate option (or combination of options) in response to the following questions:

9a How does the province mitigate the vulnerability of existing healthcare facilities to flooding (such as hospitals, extended care facilities, retirement homes, hospices, and assisted living facilities)?

ANSWER KEY	
A	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of existing healthcare facilities and their dependencies to flooding. The province has subsequently secured funding and developed plans to protect existing healthcare facilities and services to a desired level, if deemed necessary.
B	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of existing healthcare facilities and their dependencies to flooding. The province has subsequently engaged with stakeholders to develop resilience plans and to secure funding in order to protect healthcare facilities to a desired level.
C	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of existing healthcare facilities to flooding. In collaboration with the relevant stakeholders, the province plans to assess flood vulnerabilities related to the dependency of healthcare facilities on other critical infrastructure systems.
D	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of existing healthcare facilities and their dependencies to flooding. Engagement with the owners/operators of healthcare facilities is currently limited to preliminary discussions.
E	The province addresses the vulnerability of existing healthcare facilities to flooding on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

9b How does the province engage in assessing the vulnerability of existing Structural Flood Protection (SFP) infrastructure to flooding?

ANSWER KEY	
A	The province is responsible for the regular (every 5 years) update of the vulnerability assessments of its existing SFP infrastructure to flooding incorporating the impacts of climate change on identified flood hazards. The province provides funding for any necessary upgrades in order to protect SFP infrastructure to a desired level.
B	The province mandates the owners/operators of SFPs to identify the impacts of climate change on identified flood hazards. The province validates the results of flood vulnerability assessments and oversees required reviews and upgrades.
C	The province sets policies and develops guidelines for flood risk assessments of SFPs, which include consideration of impacts of climate change on identified flood hazards. The province delegates the responsibility for flood risk assessment and mitigation to local governments or conservation/watershed authorities.
D	The province sets policies and provides guidelines for flood risk assessments of SFPs, which include consideration of the impacts of climate change on identified flood hazards. The province delegates the responsibility for flood risk assessment and mitigation to the owners of these SFPs.
E	The province addresses the vulnerability of existing structural flood protection infrastructure to flooding on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

9c In regard to the safety of communities upstream and downstream from dams, how does the province engage in flood risk management?

ANSWER KEY	
A	The province is responsible for conducting flood risk assessments on province-owned dams, incorporating the impacts of climate change and local flood hazards on dam safety. The province secures funding for reviews of dam safety and updates of dam failure inundation maps.
B	The province mandates the owners/operators of dams to identify the impacts of climate change and local flood hazards on the safety of their dams. The province oversees regular dam safety reviews, and updates of dam failure inundation maps.
C	The province sets policies and develops guidelines for flood risk assessments and dam safety reviews. The province delegates the responsibility for flood risk assessments, regular dam safety reviews and updates of dam failure inundation maps to local government or conservation/watershed authorities.
D	The province sets policies and develops guidelines for flood risk assessments and dam safety reviews. The province delegates the responsibility for flood risk assessments, regular dam safety reviews and updates of dam failure inundation maps to the owners/operators of dams.
E	The province addresses the vulnerability of existing dam infrastructure to flooding on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

9d How does the province mitigate the vulnerability of abandoned contaminated sites to flooding?

ANSWER KEY	
A	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of abandoned contaminated sites to flooding incorporating the impacts of climate change on identified flood hazards. It has subsequently secured funding and developed plans to protect abandoned contaminated sites to a desired level, if deemed necessary.
B	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of abandoned contaminated sites to flooding incorporating the impacts of climate change on identified flood hazards. It has subsequently engaged with stakeholders to develop plans and to secure funding in order to protect abandoned contaminated sites to a desired level.
C	The province has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of abandoned contaminated sites to flooding incorporating the impacts of climate change on identified flood hazards. The province is presently engaged with stakeholders to develop a framework in order to assess and prioritize flood adaptation measures for abandoned contaminated sites.
D	The province defines policies regarding abandoned contaminated sites and delegates the responsibility for their flood risk management to conservation/watershed authorities or local governments.
E	The province addresses the vulnerability of abandoned contaminated sites to flooding on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

To address Public Health and Safety criteria, participants from territorial governments were asked to select the most appropriate option (or combination of options) in response to the following questions:

9a* How does the territory mitigate the climate change related vulnerability of existing healthcare facilities (such as hospitals, extended care facilities, retirement homes, hospices, and assisted living facilities)?

ANSWER KEY	
A	The territory has recently (within the past 5 years) conducted climate change-related vulnerability assessments of existing healthcare facilities and their dependencies. The territory has subsequently secured funding and developed plans to protect existing healthcare facilities and services to a desired level, if deemed necessary.
B	The territory has recently (within the past 5 years) conducted climate change-related vulnerability assessments of existing healthcare facilities and their dependencies. The territory has subsequently engaged with stakeholders to develop resilience plans and to secure funding in order to protect healthcare facilities to a desired level.
C	The territory has recently (within the past 5 years) conducted climate change-related vulnerability assessments of existing healthcare facilities and their dependencies. In collaboration with the relevant stakeholders, the territory plans to assess climate change-related vulnerabilities related to the dependency of healthcare facilities on other critical infrastructure systems.
D	The territory has recently (within the past 5 years) conducted climate change-related vulnerability assessments of existing healthcare facilities and their dependencies. Engagement with the owners/operators of healthcare facilities is currently limited to preliminary discussions.
E	The territory addresses the climate change-related vulnerability of existing healthcare facilities on an ad-hoc basis, but not on a regular basis.

9b* How does the territory engage in assessing the vulnerability of existing Structural Flood Protection (SFP) infrastructure (including dykes, levees, flood walls, sea walls, flood damage mitigation reservoirs, etc.) to flooding?

ANSWER KEY	
A	The territory is responsible for the regular (every 5 years) update of the vulnerability assessments of its existing SFP infrastructure to flooding incorporating the impacts of climate change on identified flood hazards. The territory provides funding for any necessary upgrades in order to protect SFP infrastructure to a desired level.
B	The territory mandates the owners/operators of SFPs to identify the impacts of climate change on identified flood hazards. The territory validates the results of flood vulnerability assessments and oversees required reviews and upgrades.
C	The territory sets policies and develops guidelines for flood risk assessments of SFPs, which include consideration of the impacts of climate change on identified flood hazards. The territory delegates the responsibility for flood risk assessment and mitigation to local governments.
D	The territory sets policies and provides guidelines for flood risk assessments of SFPs, which include consideration of the impacts of climate change on identified flood hazards. The territory delegates the responsibility for flood risk assessment and mitigation to the owners of these SFPs.
E	The territory addresses the vulnerability of existing structural flood protection infrastructure to flooding on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

9c* In regard to the safety of communities upstream and downstream from dams, how does the territory engage in flood risk management?

ANSWER KEY	
A	The territory is responsible for conducting flood risk assessments on dams, incorporating the impacts of climate change and local flood hazards on dam safety. The territory secures funding for reviews of dam safety and updates of dam failure inundation maps.
B	The territory mandates the owners/operators of dams to identify the impacts of climate change and local flood hazards on the safety of their dams. The territory oversees regular dam safety reviews and updates of dam failure inundation maps.
C	The territory sets policies and develops guidelines for flood risk assessments and dam safety reviews. The territory delegates the responsibility for flood risk assessments, regular dam safety reviews, and updates of dam failure inundation to local governments.
D	The territory sets policies and develops guidelines for flood risk assessments and dam safety reviews. The territory delegates the responsibility for flood risk assessments, regular dam safety reviews, and updates of dam failure inundation maps to the owners/operators of dams.
E	The territory addresses the vulnerability of existing dam infrastructure to flooding on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

9d* How does the territory mitigate the vulnerability of abandoned contaminated sites to flooding?

ANSWER KEY	
A	The territory has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of abandoned contaminated sites to flooding incorporating impacts of climate change on identified flood hazards. It has subsequently secured funding and developed plans to protect abandoned contaminated sites to a desired level, if deemed necessary.
B	The territory has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of abandoned contaminated sites to flooding incorporating impacts of climate change on identified flood hazards. It has subsequently engaged with stakeholders to develop plans and to secure funding in order to protect abandoned contaminated sites to a desired level.
C	The territory has recently (within the past 5 years) conducted risk assessments to identify the vulnerability of abandoned contaminated sites to flooding incorporating impacts of climate change on identified flood hazards. The territory is presently engaged with stakeholders to develop a framework in order to assess and prioritize flood adaptation measures for abandoned contaminated sites.
D	The territory defines policies regarding abandoned contaminated sites and delegates the responsibility for their flood risk management to local governments.
E	The territory addresses the vulnerability of abandoned contaminated sites to flooding on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

A.10 Emergency Management

Despite the efforts of governments and other groups to establish and enforce various types of protective and adaptation measures, floods do still occur. While mitigation and preparedness actions are undertaken prior to emergency events, response and recovery efforts are initiated after an emergency event has already begun. In Canada, emergency management is a shared responsibility between individuals and the various levels of government.

Collaboration with business and infrastructure owners and operators which have the primary responsibility for managing their systems in emergencies, and the coordination of their objectives, strategies, and tactics during major flooding events is critically important in order to ensure the robustness of emergency response and recovery operations.

The present study assesses the declared commitments of provincial and territorial governments in relation to the following domains of Emergency Management that were identified as the five components of the composite criterion:

- Emergency Response Operations;
- Continuity of Electricity Supply;
- Continuity of Fuel Supply;
- Continuity of Communications; and
- Flood Forecasting and Emergency Warning Systems.

To address these criteria, participants from provincial governments were asked to select the most appropriate option (or combination of options) in response to the following questions:

10a How does the province manage emergency response operations?

ANSWER KEY	
A	The province is legally responsible for planning and managing flood emergency response operations for the entire province including rural and unincorporated communities. It sets provincial flood emergency response requirements and maintains provincial flood forecasting and warning systems.
B	The province delegates responsibility for planning and managing flood emergency response operations to conservation/watershed authorities. These authorities are responsible for the operation of flood forecasting/warning systems and the regular update of hazard risk and vulnerability assessments of their emergency response operations.
C	The province delegates the responsibility for planning and managing flood emergency response operations to local/regional governments. While these governments rely on provincial flood forecasting and warning systems, they are responsible for the regular update of the hazard risk and vulnerability assessments of their emergency operations. The province financially supports and validates these assessments.
D	The province delegates the responsibility for planning and managing flood emergency response operations to local/regional governments. While these governments rely on provincial flood forecasting and warning systems, they are responsible for the regular update of hazard risk and vulnerability assessments of their emergency operations.
E	The province delegates the responsibility for emergency planning to local/regional governments. The province addresses the vulnerability of local/regional emergency response operations to flooding on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

10b How does the province manage flood preparedness and response planning as it relates to the continuity of electricity supply, including power supply for emergency coordination centres, emergency first response operations, and hospitals?

ANSWER KEY	
A	The province is responsible for the planning and implementation of an emergency power supply strategy to facilitate emergency energy distribution and secures funding for emergency operations.
B	The province mandates that local power utilities (or the independent electricity system operator) develop emergency energy distribution plans to ensure the continuity of electricity supply during emergency events. The province subsequently validates these plans.
C	The province mandates that local governments, in collaboration with power utilities, develop emergency energy distribution plans to ensure power supply to critical infrastructure and emergency coordination centres. The province subsequently validates these plans.
D	The province mandates that local governments develop emergency energy distribution plans to ensure power supply to critical infrastructure and emergency coordination centres.
E	The province provides tools and guidelines for emergency electricity planning and assists local governments in the development and implementation of emergency energy distribution plans.

10c How does the province engage in flood preparedness and response planning as it relates to the continuity of fuel supply (gas, oil, and diesel), including fuel supply for emergency coordination centres, emergency first response operations, and hospitals?

ANSWER KEY	
A	The province is responsible for the planning and implementation of an emergency fuel strategy to facilitate emergency fuel distribution and secures funding for the emergency supply of fuel.
B	The province delegates responsibility for the planning and implementation of emergency fuel strategy to local governments or conservation/watershed authorities. The province collaborates with local governments to mitigate the effects of fuel shortages during emergency events.
C	The provincial regulations stipulate that local governments are responsible for the operation and maintenance of designated emergency fuel depots and for the development of emergency fuel distribution plans which are subsequently validated by the province.
D	The provincial regulations stipulate that local governments are responsible for the operation and maintenance of designated emergency fuel depots and for the development of emergency fuel distribution plans.
E	The province provides tools and guidelines for emergency fuel distribution planning to assist local governments in the development and implementation of emergency fuel plans.

10d How does the province ensure the continuity of communications between emergency response providers during flood events?

ANSWER KEY	
A	The province is responsible for communicating critical information during emergency events and provides funding for the implementation of a public safety broadband network.
B	The province is responsible for communicating critical information during emergency events and is considering sub-contracting the implementation of a public safety broadband network to local providers.
C	The province is responsible for communicating critical information during emergency events and works closely with telecom providers to enable emergency responders to coordinate their activities and communicate during telecommunication network outages.
D	The province has policies that specify that local governments develop agreements with local telecom providers. Local governments are required to maintain and operate networks that enable responders to communicate directly during emergency events.
E	The province delegates the responsibility for communicating critical information during emergency events to local governments.

10e How does the province engage in the Operation and Maintenance (O&M) of flood forecasting and alert/warning systems?

ANSWER KEY	
A	The province is responsible for the O&M and regular upgrade of province-wide flood forecasting systems and emergency alert/warning systems. The province is responsible for the accurate and timely dissemination of early flood warnings, including flash flood alerts, to the public.
B	The province is responsible for the O&M and regular upgrade of province-wide flood forecasting systems and emergency alert/warning systems. The province delegates the responsibility for the accurate and timely dissemination of early flood warnings, including flash flood alerts, to the public to local governments or conservation/watershed authorities.
C	The province is responsible for the O&M and regular upgrade of flood forecasting systems, delegating the responsibility for emergency alert/warning systems to local governments or conservation/watershed authorities. These authorities are responsible for the accurately and timely dissemination of early flood warnings, including flash flood alerts, to the public.
D	The province, in collaboration with local governments, is currently engaged in the testing of new emergency alert/warning systems in order to improve communication and dissemination mechanisms.
E	The province, in collaboration with local governments, is currently engaged in the upgrade of existing flood forecasting and emergency alert/warning systems to improve communication and dissemination mechanisms.

To address Emergency Management criteria, participants from territorial governments were asked to select the most appropriate option (or combination of options) in response to the following questions:

10a* How does the territory manage emergency response operations?

ANSWER KEY	
A	The territory is legally responsible for planning and managing flood emergency response operations for the entire territory including rural and unincorporated communities. It sets territorial flood emergency response requirements and maintains territorial flood forecasting and warning systems.
B	The territory delegates the responsibility for planning and managing flood emergency response operations to local governments. These authorities are responsible for the operation of flood forecasting/warning systems and the regular update of hazard risk and vulnerability assessments of their emergency response operations.
C	The territory delegates the responsibility for planning and managing flood emergency response operations to local/regional governments. While these governments rely on territorial flood forecasting and warning systems, they are responsible for the regular update of the hazard risk and vulnerability assessments of their emergency operations. The territory financially supports and validates these assessments.
D	The territory delegates the responsibility for planning and managing flood emergency response operations to local/regional governments. While these governments rely on territorial flood forecasting and warning systems, they are responsible for the regular update of hazard risk and vulnerability assessments of their emergency operations.
E	The territory delegates the responsibility for emergency planning to local/regional governments. The territory addresses the vulnerability of local/regional emergency response operations to flooding on an ad-hoc basis (e.g. following large flood events), but not on a regular basis.

10b* How does the territory manage emergency preparedness and response planning as it relates to the continuity of electricity supply, including power supply for emergency coordination centres, emergency first response operations, and hospitals?

ANSWER KEY	
A	The territory is responsible for the planning and implementation of an emergency power supply strategy to facilitate emergency energy distribution and secures funding for emergency operations.
B	The territory mandates that local power utilities develop emergency energy distribution plans to ensure the continuity of electricity supply during emergency events. The territory subsequently validates these plans.
C	The territory mandates that local communities, in collaboration with power utilities, develop emergency energy distribution plans to ensure power supply to critical infrastructure and emergency coordination centres. The territory subsequently validates these plans.
D	The territory mandates that local communities develop emergency energy distribution plans to ensure power supply to critical infrastructure and emergency coordination centres.
E	The territory provides tools and guidelines for emergency electricity planning and assists local communities in the development and implementation of emergency energy distribution plans.

10c* How does the territory engage in flood preparedness and response planning as it relates to the continuity of fuel supply (gas, oil, and diesel), including fuel supply for emergency coordination centres, emergency first response operations, and hospitals?

ANSWER KEY	
A	The territory is responsible for the planning and implementation of an emergency fuel strategy to facilitate emergency fuel distribution and secures funding for the emergency supply of fuel.
B	The territory delegates responsibility for the planning and implementation of emergency fuel strategy to local governments. The territory collaborates with local governments to mitigate the effects of fuel shortages during emergency events.
C	The territorial regulations stipulate that local governments are responsible for the operation and maintenance of designated emergency fuel depots and for the development of emergency fuel distribution plans which are subsequently validated by the territory.
D	The territorial regulations stipulate that local governments are responsible for the operation and maintenance of designated emergency fuel depots and for the development of emergency fuel distribution plans.
E	The territory provides tools and guidelines for emergency fuel distribution planning to assist local governments in the development and implementation of emergency fuel plans.

10d* How does the territory ensure the continuity of communications between emergency response providers during flood events?

ANSWER KEY	
A	The territory is responsible for communicating critical information during emergency events and provides funding for the implementation of a public safety broadband network.
B	The territory is responsible for communicating critical information during emergency events and is considering sub-contracting the implementation of a public safety broadband network to local providers.
C	The territory is responsible for communicating critical information during emergency events and works closely with telecom providers to enable emergency responders to coordinate their activities and communicate during telecommunication network outages.
D	The territory has policies that specify that local governments develop agreements with local telecom providers. Local governments are required to maintain and operate networks that enable responders to communicate directly during emergency events.
E	The territory delegates the responsibility for communicating critical information during emergency events to local governments.

10e* How does the territory engage in the Operation and Maintenance (O&M) of flood forecasting and alert/warning systems?

ANSWER KEY	
A	The territory, in collaboration with the federal government, is responsible for the O&M and regular upgrade of territory-wide flood forecasting systems and emergency alert/warning systems. The territory is responsible for the accurate and timely dissemination of early flood warnings, including flash flood alerts, to the public.
B	The territory, in collaboration with the federal government, is responsible for the O&M and regular upgrade of territory-wide flood forecasting systems and emergency alert/warning systems. The territory collaborates with federal and local governments in the developing of flood forecasts for selected key locations.
C	The territory relies solely on the flood forecasting and emergency alert/warning systems provided by the federal government. The territory is currently engaged in the upgrade of existing flood forecasting and emergency alert/warning systems to improve communication and dissemination mechanisms.
D	The territory relies solely on the flood forecasting and emergency alert/warning systems provided by the federal government. The territory is currently considering the upgrade of existing flood forecasting and emergency alert/warning systems to improve communication and dissemination mechanisms.
E	The territory, in collaboration with local governments, is responsible for the maintenance and upgrade of existing emergency alert/warning systems. No comprehensive flood forecasting systems presently exist but are under consideration.

Definitions

Catastrophic Event (CAT): an event that affects multiple policies and causes more than $25 million of insured damage.

Climate: the average weather, usually expressed in terms of the parameters temperature, precipitation, and wind.

Climate Change: a change in the mean and/or the variability of climate parameters over time ranging from months to thousands or millions of years

Coastal Flooding: flooding associated with a defined shoreline along an ocean or a lake. Can occur due to a combination of high water levels, high tides, storm surges, waves, tsunamis, rising sea levels.

Contaminated Site: a site at which substances occur at concentrations: (1) above background levels and pose or are likely to pose an immediate or long-term hazard to human health or the environment, or (2) exceeding levels specified in policies and regulations.

Floodplain: an area adjacent to a lake, river or coast, which can be expected to be regularly inundated or covered with water. It typically includes two zones:

- **Floodway:** the channel of the river or stream and the adjacent land that must remain free from obstruction so that the regulatory flood can be safely conveyed downstream
- **Flood Fringe:** the remaining portion of the floodplain, where flood depths, flow velocities, or wave energies are relatively lower and some development may be permitted, if adequate levels of flood protection are provided. Flood Mechanisms: the condition, which causes a specific type of flood (e.g., blocked culvert leading to overland flooding).

Flood Mitigation: a sustained action taken to reduce or eliminate long-term risk to people and property from flood hazards and their effects. Mitigation distinguishes actions that have a long-term impact from those that are more closely associated with preparedness for, immediate response to, and short-term recovery from specific events.

Flood Risk: flood risk is a combination of the likelihood of occurrence of a flood event and the social or economic consequences of that event when it occurs.

Flood Risk Maps: maps that contain the flood hazard or inundation delineations along with additional socio-economic values, such as potential loss or property vulnerability levels. These maps serve to identify the social, economic and environmental consequences to communities during a potential flood event.

Flood Protection: any combination of structural and non-structural improvements, additions, changes, or adjustments to structures, which reduce or eliminate risk of flood damage to real estate or improved real property, water and sanitation facilities, or structures with their contents.

Fluvial Flooding: excess stream flow in a watercourse, such that land outside the normal banks is submerged or inundated. Riverine flooding can be caused or exacerbated by extreme rainfall, snowmelt, physical conditions (e.g., ice, sediment and debris jams, watercourse configuration and capacity limitations), as well as elevated water levels in receiving waterbodies.

Infill: development within urban boundaries not related to large-scale development plans, but rather smaller scale development in remnant vacant parcels.

Intensity-Duration-Frequency (IDF) curve: a graphical representation of the probability that a given depth of rainfall will occur, shown in rainfall intensity (e.g., in millimeters per hour) with respect to rainfall duration (e.g., hour). Lateral: any pipe from a building connected to the main sewer.

Peak Flow: the maximum flow rate occurring during a specified flood event measured at a given point in a river, overland, or in a pipe system.

Permafrost: rock or soil that remains below 0°C for at least two consecutive years. Surface conditions including vegetation, organic cover and snow thickness can influence permafrost temperatures. Permafrost thickness is related to the air temperature, soil characteristics and the geothermal gradient as well as the geological history of the area.

Pluvial Flooding: the inundation of the built environment by rainfall, overwhelming the capacity of stormwater management systems.

Re-development: conversion of existing urban uses of lower value and significance to other preferred uses per a community plan (e.g. brownfield redevelopment to residential uses).

Regulatory Flood: the defined flood event used to delineate areas prone to flooding for the purposes of regulating land use. The minimum regulatory flood criteria standard in Canada is the 100-year return period flood, which is the peak flood flow with a one percent chance of occurring in any given year. Some regions, provinces, and territories implement standards that are more stringent.

Resilience: capacity of people and systems to absorb negative impacts and respond to changing climate conditions.

Riparian Areas: the ecosystems that are located adjacent to streams, rivers, wetlands, and lakes wherein both soil and vegetation are strongly influenced by the presence of water.

Risk: a combination of the likelihood (probability of occurrence) and the consequences of an event.

Risk Management: a systematic approach to setting the course of action under conditions of uncertainty, by applying management policies, procedures, and practices to the analysis, evaluation, control, and communication about risk issues.

Runoff: the amount of water deriving from precipitation/ snowmelt, not otherwise evapotranspirated or stored, that flows across the landscape.

Sanitary Sewer: part of the public sewage works for the transmission of sanitary sewage (includes human and industrial waste, and septic waste, but not typically stormwater).

Stormwater: precipitation that washes off driveways, parking lots, roads, yards, rooftops, and other surfaces.

Stormwater Management: the planning, design and implementation of systems that mitigate and control the impacts of man-made changes to runoff and other components of the hydrologic cycle. Stormwater management is also referred to as "rainwater management" in much of the world.

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