



Source: Jouni Sulim

Mobilizing Flood Adaptation Solutions in Canada

Policy Brief for Canada's Insurance Sector

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Executive Summary

Policy Challenge

This policy brief identifies the actions that the insurance sector can take to mobilize climate adaptation in Canada. Recognizing the broad scope of our challenge, we decided to focus on flooding events because they take lives, disproportionately affect vulnerable populations, disrupt economic activity, and are the costliest extreme weather event in Canada. For instance, in November, flooding in British Columbia (BC) displaced more than 15,000 people and the cost of rebuilding is estimated at over \$9 billion.¹ The British Columbia floods show how a proper policy response requires a multi-level approach among federal, provincial, territorial, Indigenous, and municipal governments across Canada.

While flood adaptation solutions exist, their adoption by governments across Canada has been slow. Guidelines have been developed to mitigate flood risk in new residential communities. Investments in retrofits for existing vulnerable structures and commercial real estate are being made. However, governments have rarely accounted for flood risks in their decision-making. For example, provincial, territorial, Indigenous, and municipal governments have not regularly updated land use planning policies to reflect increasing flood risk in a changing climate. In some municipalities in British Columbia, flood maps have not been updated in 20 years.

The insurance sector policy challenge included understanding government attitudes towards climate adaptation and identifying the barriers impeding action. By exploring what other jurisdictions have done and assessing Canada's adaptation landscape, we have identified a set of barriers to mobilizing climate adaptation solutions and designed a plan to overcome those barriers. This policy brief outlines that plan.

The Policy Window

Canada's federal government is now aware of the need to develop a more comprehensive adaptation policy. In May 2022, the government of Canada published a discussion paper "Preparing for Climate Change: Canada's National Adaptation Strategy (NAS)" that recognizes the "urgent need for adaptation action". The NAS is being debated across Canada by several stakeholders and recently the government set up an online platform called "Let's talk adaptation" to engage more citizens. This process will inform the NAS, which is to be released at the end of the year with guidelines for action over five years. The discussion paper describes the federal government's vision on climate adaptation as aiming to "promote justice, equity, and Indigenous reconciliation, and secure a thriving environment and economy for future generations".

This policy brief reviews actions that can help turn these words into reality. It also identifies how the insurance sector can play a leadership role in mobilizing flooding adaptation policies and programs by partnering with other institutions and advocating for policy change. In concrete terms, we believe government action can be mobilized through our set of recommendations to raise flood risk awareness, increase flood adaptation capacity, and accelerate actions for flood mitigation.

List of Recommendations

Section I: Raise Awareness of Flood Risk.

- 1. The insurance sector should advocate to Eric Loubier, Director General of the Canada Centre for Mapping and Earth Observation at Natural Resources Canada (NRCan) to update flood maps, make them available in an online portal, and create informational resources to raise awareness of flood risk.*
- 2. The insurance sector should advocate to Minister Jonathan Wilkinson of Natural Resources Canada for a centralized adaptation dashboard as a tool for the public servants in municipalities to exchange learnings and best practices.*
- 3. The insurance sector should partner with the University of Waterloo in proposing to Minister Jonathan Wilkinson of Natural Resources Canada to develop innovative data visualization tools relating to flood risks. Together, the partnership should organize a “hackathon” challenge to develop virtual reality simulations using various flood maps.*

Section II: Increase Capacity for Flood Adaptation

- 4. The insurance sector should propose to Minister Steven Guilbeault of Environment and Climate Change Canada, a partnership agreement with the Canadian Center for Climate Services (CCCS) that would result in the development and implementation of a capacity-building training program for relevant public servants regarding climate adaptation.*
- 5. The insurance sector should develop and propose a proof of concept for a ‘one-stop-shop’ for managing adaptation funding programs to Minister Jonathan Wilkinson of Natural Resources Canada.*

Section III: Accelerate Actions for Flood Mitigation

- 6. The insurance sector should advocate for regulations within the proposed National Flood Insurance Program to Minister Bill Blair of Emergency Preparedness and Minister Marco Mendicino of Public Safety Canada.*
- 7. The insurance sector should propose to Laniel Bateman, Director of Climate Change Adaptation and Resilience at Environment and Climate Change Canada a change in the federal evaluation framework of climate adaptation. The proposal should enable the federal government to move from cause-effectiveness to a more flexible perspective based on learning for adapting.*
- 8. The insurance sector should outline to Minister Dominic LeBlanc and Minister Steven Guilbeault how Infrastructure Canada and Environment and Climate Change Canada can best invest in natural infrastructure. The outline should describe implementation criteria and identify how these departments could partner with Indigenous communities.*

Background

Context

November's floods in BC are not an isolated "one in 100 years" event. Rather, they were part of a trend, as global heating increases the severity and frequency of extreme weather events throughout Canada and the world. Canada is warming two times faster than the rest of the world and Northern Canada is warming three times faster.² As a result, studies have shown Canada is facing rising sea levels, loss of snow and ice, and shifting precipitation patterns including increased extreme rainfalls.³ These factors have caused flooding to be more frequent in Canada.⁴

Increasing floods have an impact on our lives, health, livelihoods, economies, environment, and overall wellbeing. These impacts are not evenly distributed. Flooding disproportionately affects the most vulnerable regions and communities. Although socioeconomic vulnerability is often excluded from studies, there is evidence that links it to higher impacts of flooding. For instance, a study by the Canadian Climate Institute revealed that Black households are more exposed to pluvial flood risk than any other population subgroup in Windsor, Ontario.⁵

Furthermore, according to the National Issues Report "Canada in a Changing Climate", socioeconomic status like lack of employment or high poverty rates exacerbate flooding impacts in rural and remote communities, partially because relocation or building protection walls is more accessible to richer communities.⁶ Finally, First Nations, Inuit, and Métis populations in Canada that rely on their land for sustenance, livelihood, culture, and wellbeing, are also more vulnerable to flood impacts. This strong connection with the land is also a source of strength that fosters adaptive capacity.⁷

According to the Insurance Bureau of Canada (IBC), the increased level of flooding, changes in property values, and paving over natural areas have led to insured water catastrophic losses in Canada rising from an average of \$150 million a year until 2007 to an average of \$600 million in 2019.⁸ Flooding is the most expensive peril in Canada, and residential basement flooding is at the top of the list regarding cost implications. There has also been a growing risk of insurability for homeowners to attain full coverage from flood damages, as more insurance companies update their risk assessments to account for the higher risks caused by climate change and slow adaptation.⁹ With two in ten homes in Canada exposed to a risk of flooding,¹⁰ increased extreme weather events caused by climate change, and disproportionate impacts on those more vulnerable, it seems urgent to mobilize flood adaptation actions.

The current status of climate adaptation in Canada is not encouraging. According to a survey conducted by Local Governments for Sustainability (ICLEI) across Canadian municipalities, three per cent do not have adaptation plans, 18 per cent have an adaptation plan but have not started its implementation, 36 per cent have only started implementing actions, and 43 per cent have made "some efforts".¹¹ These efforts are concentrated on conducting risk assessments, identifying possible impacts, or initiating individual action that is not part of a formal adaptation plan.¹² Mobilizing government action on flood adaptation is crucial. We identified a set of barriers

impeding action and possible drivers to address them. We designed the recommendations in this report based on those barriers and drivers, summarised in the following section.

Summary of Key Insights

Following a literature review and stakeholder interview process with experts from the public sector, academia, think tanks, and non-governmental organisations (NGOs) across all levels of government, we developed our key insights to consider when recommending solutions for effective adaptation mobilization.

We asked our stakeholders to identify and prioritize the barriers that are impeding planning and implementing flood adaptation solutions. We found common threads in their responses and categorized the findings into seven themes. Although these themes were differentiated for analytical purposes, some of them overlap and interact. For example, low climate adaptation capacity among public servants relates to challenges in accessing federal funding for the development of climate actions. This overlap is due to the nature of climate adaptation as a “wicked problem,” that is, a problem with several causing variables and no single solution. Nevertheless, it is useful to consider the themes separately to better understand them.

Barriers to Implementing Climate Adaptation

Key Themes	Barriers
Capacity	<ul style="list-style-type: none"> - Small municipalities and Indigenous communities often cannot develop their own flood risk maps or apply for external funding due to capacity constraints. - A significant capacity gap exists between governments in small and large communities. - As a result, large municipalities with better capacity have a disproportionately strong voice at policy discussion tables.
Funding	<ul style="list-style-type: none"> - Lack of access to funding has been mentioned as a key constraint in implementing adaptation solutions by all our municipal level stakeholders. - Municipalities must jump through multiple hoops to get provincial or federal funding. There is a lot of paperwork involved which often discourages small municipalities from applying for funds. - Current approval processes are perceived to be lengthy.
Coordination	<ul style="list-style-type: none"> - Municipal and provincial stakeholders perceive the federal government as “absent” in the climate adaptation space, yet they expect the federal level to lead and provide top-down criteria for adaptation. - There is a lack of coordination between departments tasked with adaptation across the same jurisdiction.
Political Will	<ul style="list-style-type: none"> - A lack of public pressure on politicians about flooding allows them to prioritize recovery over preparedness. Political leaders do not want to spend on “preparedness” where there is little pressure from an electorate that perceives spending on recovery as a political success.

Key Themes	Barriers
	<ul style="list-style-type: none"> - Since elected officials face elections every three to five years, they are more prone to support programming that can be measured as successful within their electoral cycle. - Politicians may hesitate to release the climate impacts and flood risk information about their municipalities since there can be serious consequences for real estate values.
Awareness	<ul style="list-style-type: none"> - The public lacks awareness about where flooding impacts are happening and what the risks are. - Only six per cent of the people living in flood-risk areas are aware. - The costs of the hypothetical impacts of flood-events are not clear to the public.
Flood Mapping	<ul style="list-style-type: none"> - Comprehensive public data on flood risks are not available or accessible in Canada. At least half a million buildings at risk of flooding in Canada are not identified by government-produced flood maps. - Municipal flood maps are outdated, and often municipal governments lack the capacity to update them.
Natural infrastructure	<ul style="list-style-type: none"> - There is a lack of region-specific 'top-down' criteria from the federal government for implementing natural infrastructure. The criteria would help avoid maladaptation, afforestation, and violations of Indigenous land rights. - Coordination is lacking between government commitments of investments in natural infrastructure. For instance, the federal government's tree planting targets need to be communicated and coordinated with municipalities. - Partnerships with Indigenous nations and government is lacking in implementing natural infrastructure. Recognizing Indigenous traditional knowledge and land rights is crucial for the viability of these initiatives.

Key Insights

1. The prioritized recommendations should tackle several barriers at the same time and explore possible co-benefits.
2. Barriers to effective action are reinforced for historically marginalized populations. Indigenous governments, small municipalities, and governments in northern Canada suffer both the effects of climate change and the lack of capacity, funding, political will, and necessary coordination to implement solutions.
3. The level of government best suited to effect change in climate adaptation is the federal government. Several stakeholders agreed that although the federal government was “absent”, it is perceived as the natural leader in climate adaptation. Due to the complex and crosscutting characteristics of climate adaptation, the federal government should be considered a key stakeholder for action mobilization.
4. Although “lack of funding” was brought up by most of our stakeholders, and we confirmed that climate adaptation funding in Canada is low compared to other countries, the inaction in

adaptation is not caused solely by a lack of funding. Rather a lack of allocative efficiency is impeding effective funding processes. Key reasons for allocative inefficiency include lack of capacity and lack of clear criteria for implementing adaptation actions.

Policy Brief Structure

Based on these key insights and our understanding of the barriers to mobilizing climate adaptation, we developed a set of recommendations divided into three sections: Section I, raise awareness of flood risk; Section II, increase capacity for flood adaptation; and Section III, accelerate actions for flood mitigation. In total, we proposed eight recommendations divided into those three sections. In figure 1, the reader can see the summarized titles of the recommendations, the barriers they address, corresponding to colored dots, and the outcome of improving the mobilization of flooding adaptation solutions.

At the end of the report, in the appendices, the reader can find the definitions, acronyms, references, and a complete list of the organisations consulted. They can also find a matrix for conducting an adaptive capacity assessment relevant for Recommendation 4 and a table with the evaluation challenges for climate adaptation relevant for Recommendation 7.

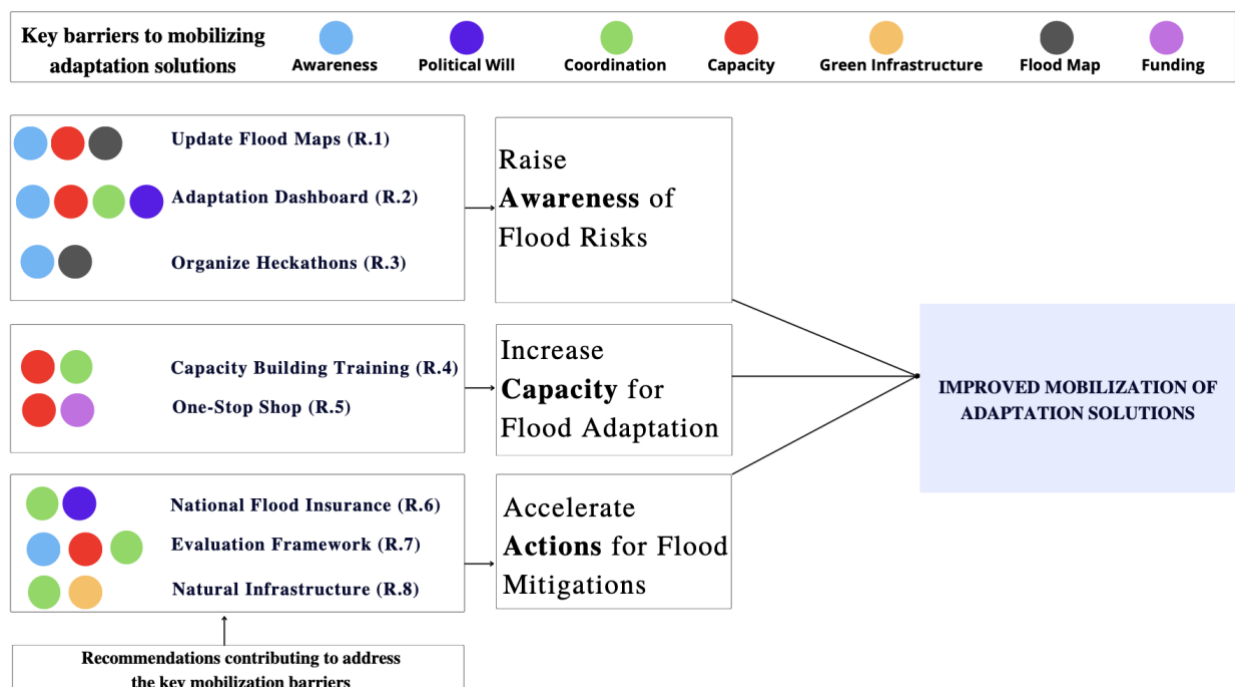


Figure 1: Flow of the recommendations

Recommendations

SECTION I. Raise Awareness of Flood Risk

- 1. The insurance sector should advocate to Eric Loubier, Director General of the Canada Centre for Mapping and Earth Observation at Natural Resources Canada to update flood maps, make them available in an online portal, and create informational resources to raise awareness of flood risk.**

Problem Statement

Broadly, Canadians are not currently aware of their flood risk. In a 2020 survey by Partners for Action, only six per cent of Canadians living in flood-prone areas knew the flood risk they faced.¹³ Two in ten Canadian homes are at risk of flooding.¹⁴ Still, homeowners are unaware.¹⁵ There is a lack of access to information about flood risk and vulnerability for individuals living in high flood risk areas, as the federal government flood maps are outdated. Homebuyers who want to look up their flood risk must wade through incomplete government floodplain maps. In British Columbia, the available flood maps are also 20 years out of date on average and only show existing, not future, flood risk. Available flood maps do not identify the risk of marginalized people facing current or potential flood risks.

Several stakeholders noted that the responsibility for flood mapping has fallen onto municipalities. There is a lack of coordination between levels of government about whose jurisdiction it is to produce updated flood risk maps. Currently, municipalities are responsible for flood mitigation measures, whereas the federal government has promised to update flood risk maps.¹⁶ According to a stakeholder, insurance companies have up-to-date flood maps but are restricted from releasing this information under privacy and competition laws.

Further, very little information is available regarding climate risks to infrastructure, which leads to terrible infrastructure decisions, according to a stakeholder. Since federal flood maps do not capture many flood risk areas, more flood-prone developments are likely being approved across Canada than the current data reflects. Past land-use planning may also put people at flood risk. At least half a million buildings at risk of flooding in Canada are not identified by government-produced flood maps, shared an interviewed stakeholder. This combination of lack of access to information and awareness about flood risk leaves residents of Canada unprepared for floods.

Description of the Recommendation

The insurance sector should advocate to NRCan to update flood maps into an online portal and create informational resources to support residents of Canada in understanding their flood risk. NRCan provides leadership, technical advice, and expertise in developing flood risk maps. The department has committed to producing a comprehensive national flood map, including data acquisition, management, dissemination, and setting mapping requirements. There are five Government of Canada departments contributing to the production of flood maps in Canada: NRCan, Public Safety Canada, Environment and Climate Change Canada, Crown-Indigenous Relations and Northern Affairs Canada, and Indigenous Services Canada.¹⁷ The online portal would be a new website housing flood maps and informational resources, coordinated by Natural

Resources Canada. Various flood map types would be included, such as inundation maps, flood extent and emergency maps, flood hazard maps, flood risk maps, and flood awareness maps, as defined by the federal government.¹⁸ The portal would provide real-time maps of floods and river ice break-ups with information on emergency response. This portal would allow residents of Canada to look up their risk and flood vulnerability by postal code. Homeowners, renters, businesses, developers, real estate agents, and others would have access to the same updated information and could make informed decisions related to flood risk.

Case Study: The UK has a historic flood map with multiple GIS layers to inform patterns and envision intensity. In England, individuals can type their postal code into ‘Check for flooding’, an open flood risk portal by postal code, hosted by the UK Environmental Agency’s database on exposure to the risk of flooding. The government website has a ‘Sign up for flood warnings’ tool, where homes and businesses can receive flood alerts to their phone or email address. The UK also connects the flood map data to the Lead Local Flood Authority (LLFA) to better prepare residents for flood risk. The flood map identifies who is responsible for managing flood risk and provides resources for flood preparedness.¹⁹

The insurance sector should encourage the government to develop resources such as videos and summaries for homebuyers, renters, real estate agents, and lenders to raise awareness and make information about high flood risk areas more accessible. Currently, Natural Resources Canada provides reference materials, case studies pertaining to flood mapping, and a bibliography of best practices and references for flood mitigation, as part of the Federal Flood Mapping Framework. While flood warnings are embedded in disaster response, the flood map portal would also include a registration feature to sign up for flood warnings. Online accessibility helps keep the public informed, while establishing accountability and transparency. This information could be shared on government social media channels and disseminated through partners and community organizations to raise public awareness.

As part of mapping flood risk, socioeconomic vulnerability assessments of communities must be considered to prioritize scarce resources to protect those at risk. By definition, flood risk maps contain the flood hazard along with socio-economic values to “identify the social, economic and environmental consequences to communities during a potential flood event”. The federal government’s latest flood risk assessments are currently under development, so there is a policy window for advocacy to fill this data gap.²⁰ The insurance sector should advocate to government to conduct spatial representation of socioeconomic exposure of residents of Canada alongside flood risk to understand social vulnerability to flood damages. The insurance sector should use its influence by reaching out to the Task Force on Flood Insurance and Relocation, hosted by Public Safety Canada, to advocate to NRCan to develop a flood map portal, informational resources, and socioeconomic data relating to flood damage.

Intended Outcome

Greater access to flood maps can bring awareness to homeowners, renters, businesses, and developers of their flood risk. Flood risk maps updated by the federal government in a centralized portal will help inform communities of their flood risk and better coordinate flood prevention across jurisdictions. Flood maps can help determine the unsafe areas for development to better regulate flood risk zones. Informational resources can support the usability of the flood map portal

and help equip individuals to further their understanding of current and future risks. The long-term goal is for homeowners, businesses, and developers to better prepare for or avoid living in high-risk areas.

Key Arguments

Update flood maps for homeowners: The exposure of Canadians to flood risk has increased to two in 10 Canadian homes at risk of flooding.²¹ To address this, the federal government is developing a flood risk portal where Canadians would be able to see their property's flood risk on a map of their neighbourhood.²² The federal government can also work with the insurance industry and Indigenous nations, who many have already developed flood maps and are important collaborators. A recent government-funded mapping effort by Western University released Canada-wide maps using 150,000 reference documents.²³ The proposed platform would allow for potential users to search by postal code their neighborhoods to identify flood risk and predictions decades from now. Increased access to flood risk information would equip residents of Canada to understand their risk and act accordingly.

Inform Canadians of their flood risk and the potential costs associated with flood events: Beyond providing access to flood maps, the federal government's flood risk portal must also provide informational resources to raise awareness of Canadians about their flood risk and the costs associated with flood events based on the severity. The cost projections must consider historic flood damage and data, which requires collaboration between the federal government and the insurance sector. The government of Canada must navigate the challenges of spread-out resources across jurisdictions and its diverse topography. These resources can include video tutorials about how to use the flood map and identify their level of risk. The flood map portal should also include a registration feature to sign up for flood warnings. The resources may also be tailored to specific users, including homeowners, renters, business owners, developers, real estate, and lenders. These maps and informational resources should enable people to mitigate future flood risk and take necessary precautions.

Focus on high-risk areas and marginalized populations: The federal government must fill data gaps on flood risk to better support communities disproportionately affected by flooding events. Due to pre-existing socio-economic vulnerability, Indigenous communities are disproportionately impacted by flood risks in Canada.²⁴ Indigenous reserve lands are exposed to flooding, with 22 per cent of residential properties at risk of a 100-year flood.²⁵ In 2013, the Auditor General concluded that flood emergencies occur more often in First Nations Communities.²⁶ A study on the city of Windsor found that residents of lower socioeconomic status are more at risk of flooding impacts.²⁷ Black households are more exposed to surface water flood risk than other populations considered in this study.²⁸ By overlapping maps of flood risk and socio-economic status, researchers found statistically significant correlations showing that these communities with lower socioeconomic status were most at risk.²⁹

A focus on high-risk areas would help identify the increased vulnerability and systemic inequity faced by marginalized people, including Indigenous people, Black people, and people of low socio-economic status. The government of Canada must also recognize that the location and vulnerability of these populations are rooted in colonization, gentrification, systemic oppression, and extraction of fossil fuels, as a leading cause of climate change.³⁰ Marginalized people will also

disproportionately face the impacts of floods on their health, wellbeing, culture, and livelihoods. There are several financial and socio-economic barriers that may prevent residents from taking action to mitigate their flood risk. The flood risk portal, informational resources, and socio-economic assessment outcomes must be made accessible as a first of many steps to enable communities' flood prevention. This flood risk information can also support governments to shift from disaster relief to a disaster prevention approach, especially for those at highest risk.

Cost Considerations

Investment in updating flood maps is critical to provide a baseline understanding of flood risk and vulnerability. The costs of developing a flood map portal, informational resources, and socioeconomic vulnerability assessments by the federal government should be considered as an investment in flood awareness. The insurance sector can invest in staff time for advocacy to the federal government to ensure the development of these resources. The sector may also provide in-kind support to advise and collaborate with the government on flood mapping. Flood maps will contribute to predicting risk transferability and therefore, save costs by reducing time lags in actions and improving flood prevention. For instance, the private sector actors can create coalitions to jointly invest in adaptation actions, if there are sufficient incentives.³¹

- 2. The insurance sector should advocate Minister Jonathan Wilkinson of Natural Resources Canada for a centralized adaptation dashboard as a tool for the public servants in municipalities to exchange learnings and best practices.**

Problem Statement

Different levels of government in Canada are focused on reducing greenhouse gas emissions whereas flood adaptation is still a recent development on their climate agendas. Various non-government stakeholders echoed the lack of political will in climate adaptation, particularly in mobilizing flood adaptation solutions since it is perceived to be costly and therefore, hard to convince taxpayers of its value for money. Both residents and public sector awareness are critical to motivating political will.

Currently, we are witnessing various awareness initiatives taken by various state and non-state actors. For example, NRCan's Climate Change Impact and Adaptation Division (CCIAD) has undertaken a regional adaptation collaboration program to build decision-making capacity by increasing five climate awareness levels;³² the Federation of Canadian Municipalities (FCM) developed a climate adaptation maturity scale for municipalities to self-assess their shortfalls in climate adaptation;³³ the Local Governments for Sustainability (ICLEI) identified more than 1980 adaptation initiatives led by the municipalities.³⁴ However, the lack of interconnectivity among these initiatives reduces the opportunity to maximize benefits. For example, unless there is a critical mass of flood adaptation supporters and accountability from taxpayers, politicians, and government officials will not focus on flood adaptation interventions.

Therefore, there is a need to direct all the initiatives toward a centralized source. It will contribute to creating an information ecosystem where all climate adaptation actors have incentives to provide

or retrieve information for further course of action. Although concurrent awareness campaigns are citizen-centric, there is a parallel need for increased awareness for public sector actors to enhance political will for mobilization of flood adaptation solutions. Only forward-looking strategies can make awareness campaigns effective in addressing individual and collective behaviour of public sector actors for climate adaptation actions. For example, the high density of information gathered in the dashboard can encourage municipal public servants to adopt various adaptation initiatives.

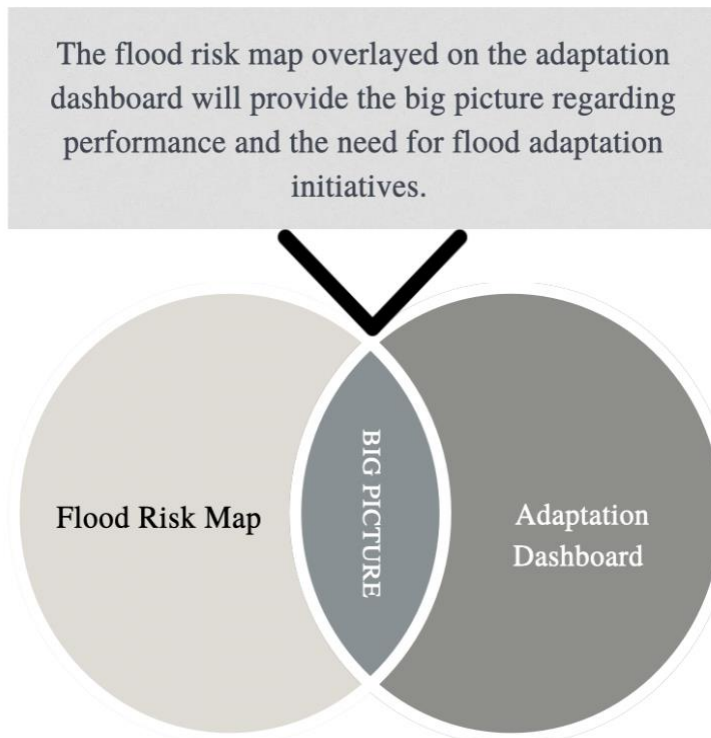
Description of the Recommendation

The insurance sector should advocate to NRCan for developing the centralized dashboard in collaboration with FCM and ICLEI to ameliorate the “map of adaptation” referred to in the NAS discussion paper. The insurance sector should advocate to NRCan to develop a centralized dashboard in collaboration with FCM and ICLEI to ameliorate the “map of adaptation” referred to in the NAS discussion paper. This will enable municipalities to identify flood adaptation practices of other municipalities with similar geospatial or weather characteristics.

The dashboard would include filters that enable municipalities to categorize information according to their climate agenda. For instance, municipalities should be able to filter through the budget, implementation timeline, type of adaptation action, and location data to generate a quick feasibility report. With a centralized dashboard, municipalities would have better opportunities to gain experience and funding and act according to their needs and capacity. The dashboard could also be used as an information source for various non-state actors to design research and advocacy protocols for various climate actions. This will contribute to increasing political will, convincing taxpayers, and unlocking further opportunities to research and adopt best practices.³⁵ For example, taxpayers will have more confidence witnessing initiatives of other municipalities after understanding the performance and risk of their own municipality.

Canadian municipalities own and operate 60 per cent of public infrastructure in Canada and, therefore, play a significant role in mobilizing flood adaptation infrastructure. Municipalities also influence the buildings' location and how they are built. Even if municipalities are the jurisdiction tasked with implementing flood adaptation solutions in Canada, managing public infrastructure separately can cause problems. For instance, a flood protection wall in one municipality can make other municipalities vulnerable to flood risks.³⁶ The dashboard will support municipalities to authorize private and public infrastructures such as housing blocks and roads. This approach will also address the risk concerns of insurers for allowing establishments in risky flood plains.

According to the government stakeholders interviewed, local governments and public institutions appreciate learning from their peers. Using this centralized dashboard, municipalities can learn about the initiatives, costs, and implementation strategies undertaken by other municipalities across Canada. Though municipalities do not have equal staff capacity and expertise the dashboard can inform on the needs to replicate the initiatives of other municipalities. For instance, the dashboard will help municipalities project their costs, required expertise, and urgency. These municipalities will be equipped to provide a concrete adaptation proposal to the federal government.



The federal government’s flood maps are outdated by 20 to 25 years, and with the current government’s focus on flood mapping, both fluvial and risk maps should be updated to fully utilize this dashboard. For instance, provincial governments can better allocate their budgets and set priorities by evaluating the current status of flood adaptation initiatives and the risk scores of each municipality. Moreover, the dashboard will support municipalities in making evidence-based adaptation proposals and enable federal and provincial governments to make efficient budget allocations. Centralized information will develop common understanding among different levels of governments (municipal, provincial, and federal) expectedly ease time lags of mobilizing adaptation solutions.

Figure 2: Benefit of connecting flood maps within the dashboard

Intended outcomes

Once implemented, the recommendation is expected to contribute to increasing awareness, particularly among state and *non-state* actors. For example, we would see a *looping effect* where non-state actors will advocate for quick actions by evaluating various initiatives listed in the dashboard and thereby, generate pressure on concerned authorities to take proactive actions. Consequently, an increasing number of initiatives in the dashboard will provide opportunities for those advocacy groups to improve their efforts and demand further actions. The process may go on in loops and improve the dashboard over time. The dashboard can generate interactive reports connecting flood risk data with list of initiatives. The dashboard will work as a tool for self-reflections in climate adaptation actions for all the municipalities, as they will quickly be able to evaluate their own performance. This will potentially trigger a competition among municipalities to better perform. It can also act as a digital assessment tool to assess the risk, budgetary requirement, timeline, and other variables, at a given municipality for a given initiative.

Key Arguments

Fulfill information needs of other relevant departments: If NRCan can be convinced to prioritize flood risk maps among the five types of flood maps that the government is currently committed to developing in recent years,³⁷ it is possible to overlay and correlate geo-specific risk maps with the adaptation initiative dashboard. For instance, the map can use algorithms to compare

initiative versus risks, provide autogenerated suggestions by analysing data of different initiatives in different municipalities. This will enable other public and private institutions to make informed decisions. For example, authorities can plan public infrastructure and community home constructions by retrieving interactive climate data from the dashboard.

Initiate network governance: Political decision-making went through significant changes in recent decades. Non-state actors, like FCM, can play a significant role in joint resource mobilization where the federal government still has the prime responsibility for steering policies.³⁸ Horizontal exchanges of knowledge and experience can help to overcome gaps between policy areas or sectors.³⁹ Therefore, a central dashboard can convince policy actors with a common narrative of needs and gaps in flood adaptation.

Influence to take quick actions: Climate scientists have repeatedly raised concerns about how delays in taking climate action may multiply future adversities. Therefore, small actors like municipalities need better tools to analyze capacity and feasibility to act quickly.⁴⁰ ⁴¹ Canadian municipalities are also lagging on adaptation actions, and such a dashboard can outline the concurrent reality in climate adaptation actions and act as a performance evaluation tool for climate adaptation solutions.⁴² There is not much research on Canadian household behaviour towards climate action.⁴³ Overall, Canadian households currently have low effort when it comes to flood adaptation due to lack of awareness. While the flood risk maps can increase residents' concerns, the dashboard will raise awareness to what adaptation actions different jurisdictions have taken and what their respective municipality can do to mitigate such risk.

The incentive for the insurers: Insurers will understand the risks and municipal initiatives accurately to determine whether their insurance products are customized to the different geographies. Moreover, the insurance sector will be able to increase the client count who will subscribe to the flood insurance plans to manage flood risks of insurable properties. Insurance brokers trained on using the dashboard will easily convince potential customers to subscribe to insurance programs. A dashboard created and administered by the central authority will have legitimacy and can effectively address the problem of myopic thinking in realizing risks.⁴⁴

Mainstreaming flood adaptation discussion: Various incremental policy approaches may help mainstream flood adaptation.⁴⁵ The dashboard will attract different interest groups (both private and public) to use data to develop various adaptation initiatives. As per the incremental policy approach, small initiatives will create a critical mass of adaptation initiatives and navigate towards mainstreaming flood adaptation in the climate discussion.

Cost Considerations

The government of Canada developed various digital platforms for increasing awareness among public servants. For example, the Canadian School of Public Servants and the Department of National Defence developed the Indigenous Reconciliation mobile app. Platforms like this are designed to enhance the knowledge of public servants but do not provide interactive learning opportunities nor facilitate opportunities to replicate best practices. This adaptation dashboard will contribute to saving the costs of inactions. Moreover, the dashboard is expected to ease the time and cost of various feasibility analyses for municipalities in mobilizing solutions. Succeeding

implementers of flood solutions can seek preceding municipalities' peer support and engage in various in-kind or skill exchange partnerships to ameliorate adaptation practices. For instance, the dashboard can initiate partnerships among municipalities to jointly implement flood adaptation solutions, which can benefit municipalities with limited financial capacity and expertise. If the dashboard performs as expected, the insurance sector will see improvements in the mobility of flood adaptation solutions. Therefore, the insurance sector should advocate for this dashboard not only to increase awareness among the public sector but also to support their business model.

- 3. The insurance sector should partner with the University of Waterloo in proposing Minister Jonathan Wilkinson of Natural Resources Canada to develop innovative data visualization tools relating to flood risks. Together, the partnership should organize a “hackathon” challenge to develop virtual reality simulations using various flood maps.**

Problem Statement

Most flood adaptation actions in Canada take a structural approach to reinforce the shorelines which entails building infrastructure to mitigate risks. The ability to fund, manage, and maintain flood adaptation initiatives over time determines the feasibility of a protection approach.⁴⁶ A key barrier identified in BC, and corroborated in our literature review, is that conventional public awareness initiatives are not effective. Therefore, decision support tools, like 3D visualization models, precise flood risk analysis, the creation of professional networks, and researcher-practitioner linkages, can help in raising adaptation awareness.

Broadly, people are not talking about flood adaptation solutions since only those affected by flood events can understand the importance of such initiatives. There is also a lack of common consensus among political leaders in setting policy agendas. Currently, Canada has numerous opportunities to develop awareness tools using advanced display technology, processing power, cloud computing, computer vision. One critical reason for lack of awareness is that the latest tools and technologies are not adequately used to raise flood risk awareness among residents of Canada.

The technology industry is expanding in Canada; more youth are engaging in IT services and becoming more capable of technological innovation.⁴⁷ The government has announced the development of flood maps and a National Adaptation Strategy. However, private sector actors like insurance companies are still not considering this as an opportunity to develop future technologies and increased youth engagement for improved flood adaptation. Studies show that exposure to virtual reality enables people to retain messages for the long term and probe to act with an increased sense of urgency.⁴⁸ The insurance sector is currently focused on knowledge management and improving users' experience with online applications.⁴⁹ There is still a lack in using technology for flood risk awareness. This is an opportunity for the insurance sector to take the lead in developing the first-ever virtual reality flood risk visualization platforms in Canada.

Description of the Recommendation

Visualizations are critical in connecting planners, decision-makers, residents, and businesses to information about the potential flood impacts and possible mitigation strategies. The insurance sector is already informed about the knowledge gap among Canadians regarding flood adaptation

and working on different projects to bridge the gap.⁵⁰ The insurance sector highlighted the need for awareness and education to expedite adaptation efforts. However, looking at modern technologies, establishing a data hub for developing awareness is essential.

Research suggests that Canadian youth are technically and contextually equipped to forward with technological solutions for various socio-behavioral problems.⁵¹ The insurance sector can take the opportunity to engage young app developers from Canadian universities in VR app development competitions (Hackathons), where youth can use *Application Programming Interfaces (APIs)* of various open-source platforms and develop virtual reality (VR) based flood adaptation awareness apps. Once ideas are formed through these Hackathons; the insurance sector can incubate the best ideas integrated into a master app to provide an effective and contextually rich representation of flooding impacts that a broad set of stakeholders can understand.

Case Study: In Japan, VR technologies are used to make children aware of flooding events and their possible consequences.⁵² Japan is also developing new tools to prevent and mitigate the effects of extreme weather events. For example, virtual reality disaster preparedness training is gaining popularity. Instead of lectures, schools are utilizing VR to attract students' attention. Trainings are designed with animations and trainees' physical behaviour can be tracked while they experience disasters virtually. Another benefit of preparedness and mitigation VR training is that it can be completed anywhere and by anybody with a computer and a VR headset. The drills happen in the form of “training the trainers” and enable trainees to conduct training in groups of many neighbouring individuals. Japan is also in the process to use digital twin technologies to build a flood simulation. The goal of the simulations is to create a disaster virtually by showing the velocity and depth of flooding, providing evacuation guidance, and using 3D models, then incorporating the results of the simulations into disaster prevention strategies.

Intended Outcomes

Piloting awareness campaigns using virtual reality would encourage the Canadian government to adopt such initiatives and effectively raise awareness. The virtual reality experience can integrate into future developments of technology to disseminate knowledge quickly among target populations. The insurance sector needs these tools more readily available to develop a common consensus on risks and actions. Experience-based awareness can motivate people to avoid buying properties in flood risk zones. Current property owners at the risky zones will be able to seek risk coverage options from the insurance sector. The idea is expected to be welcomed by Canadian youth who will become first-time property buyers in the near future. Their virtual experience of floods could play an important role in decision-making. Therefore, reduced demand for properties on flood plains may lead developers towards flood-free zones, which will save costs for governments, home buyers and insurers.

Key Arguments

Ripple effect through other industries: Recent research strongly supports the effectiveness of virtual reality, especially mixed reality, in developing empathy towards climate change actions.⁵³

For instance, a recent report of Simon Fraser University also endorsed how 3D visualizations can effectively increase flood awareness and actions.⁵⁴ Therefore, more research is expected in this domain in the upcoming days. With developments in the VR industry, visualizations can also be adopted by the gaming industry to design “serious games” on flood adaptation.⁵⁵ This means research on the effects of virtual reality and gaming applications are already gaining momentum in Canada. Further initiatives from the insurance sector to develop VR simulations can encourage other private sector actors to focus on flood adaptation.

Inclined with the federal government strategies: Policies proposed by private sector actors may witness success fast when objectives are inclined with the broad agenda of governments. The government of Canada is also exploring data visualization options, as demonstrated in the National Adaptation Strategy discussion paper.⁵⁶ The paper explores whether conventional versus emerging data visualization platforms can result in different perceptual outcomes for users (i.e., flood risk awareness). Secondary research helped answer this hypothesis that virtual reality works for changing behaviour in climate action.⁵⁷ Therefore, the insurance sector can take a nudge approach to scale up government initiatives in immersive virtual reality to influence public actions.⁵⁸ For example, providing government with evidence-based data from piloting VR initiatives and advocate for governments to scale up the initiatives through government-led awareness campaigns.

Strengthening the network: Among the most viable partnership options for organizing hackathons, we found the University of Waterloo (UofW) as the best positioned partner for the insurance sector. The UofW is a highly recognized university in Canada with a vested interest in technological innovation. For instance, the UofW won the 2020 Major League Hacking (MLH) North America Hackathon Season, which included approximately 175 events, 65,000 hackers, and 10,700 projects.⁵⁹ Different innovation labs run by insurers and hackathons were organized to develop future insurance solutions.⁶⁰ Therefore, this is an opportunity for the insurance sector actors to leverage the government’s ability in public outreach by engaging youth in technological innovations to efficiently communicate flood adaptation solutions.

Accessibility for newcomers and older adults: The number of immigrants is increasing in Canada, and online engagement among recent immigrants is much higher than that of Canadian-born residents and prior immigrants.⁶¹ Survey findings suggest that newcomers buy one in five homes in Canada, and they rush to buy their first home.⁶² Most immigrants landing in Canada are young (from 16 to 28, according to Statistics Canada);⁶³ therefore, the insurance sector will need proper tools to raise awareness of flood risk for these newcomers. Although virtual reality apps may attract youth, there is a valid concern about how older adults can access this virtual reality experience. One strategy can be installing VR kiosks at frequently visited public places, like popular superstores, parks, bus stops, and museums. For instance, JFK airport installed VR kiosks at terminal 4 to provide passengers a virtual experience of New York City.⁶⁴ Similarly in Canada, newcomers and older adults will be able to virtually experience their neighborhood during different scales of flood by selecting locations through postal codes.

Increase capacity of flood alert system and real-time demonstration: The ability to quickly map and demonstrate the potentially flood-affected areas can help first responders accurately locate affected areas, support scientists in better understanding the temporal and spatial evolution of these disasters and create more accurate reference system of sites that may be affected again in

the future.⁶⁵ Currently, Natural Resources Canada relies on RADARSAT satellites that can now retrieve images daily. The current government's "Alert-Ready System" only provides notification but does not necessarily provide any approximate virtual information on how a flood may look at the given alert scale. Previously, Canada's RADARSAT satellite flood perimeters did not accurately estimate water height from 8-12.5 meters, which made it difficult to project overland flooding quickly.⁶⁶ However, the latest development in 2022 suggests increased accuracy of the RADARSAT Constellation mission and may estimate up to 30 meters.⁶⁷

Once the flood maps are updated following Recommendation 1, NRCan can plug in geospatial data of these powerful constellations for ameliorating flood predictions. This will facilitate the development of real-time flood detection and alert systems. NASA uses passive microwave measurements of river surface area to sense river discharge changes. Canada has the same technology but there are no digital visual tools for citizens to simulate real-time flood experiences. A VR app can plug-in satellite data to dynamically evaluate flood scale and demonstrate approximate flood impacts to potentially affected citizens and first responders.⁶⁸

Cost Considerations

Developing platforms for VR-based flood experience is more expensive than conventional dissemination of information, education, and communication materials for raising awareness. However, this one-time cost for establishing the platforms comes with multiple benefits for both private and public sector. For instance, VR-based awareness motivates quick actions or reactions, but conventional tools fail to develop the critical mass of awareness within the same time as immersive VR takes. VR is more adaptive to integrating new information and can communicate target audience in real-time. For example, data depicted through VR can be centrally managed and therefore, any new development in the flood adaptation component can be demonstrated immediately. It will reduce cost and time for updating awareness pamphlets, training materials, and other offline awareness materials. Therefore, it is effective to implement VR, since it broadens the scope of channeling targeted flood information and at the same time reduces time lags without compromising the effectiveness in the outcome of awareness messages and experiences. For example, the neighbourhood with more aged population can take customized approach for visualizing the same information differently to make it relatable by different aged groups.

SECTION II. Increase Capacity for Flood Adaptation

- 4. The insurance sector should propose to Steven Guilbeault, Minister of Environment and Climate Change Canada, a partnership agreement with the Canadian Center for Climate Services (CCCS) that would result in the development and implementation of a capacity-building training program for relevant public servants regarding climate adaptation.**

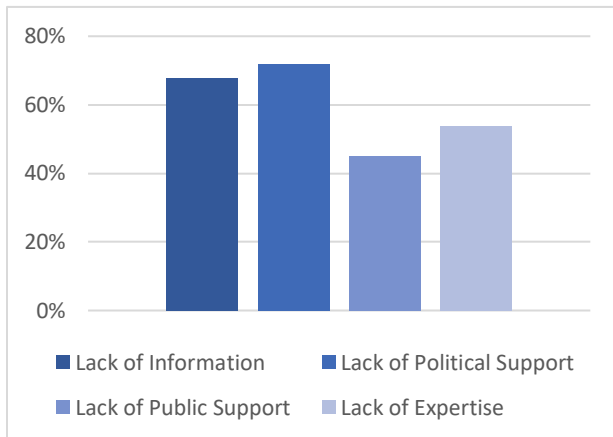
Problem Statement

Adaptive capacity is considered as a function of several determinants that, when present in a system, strengthen the system's capacity to respond to climate change.⁶⁹ In particular, key factors

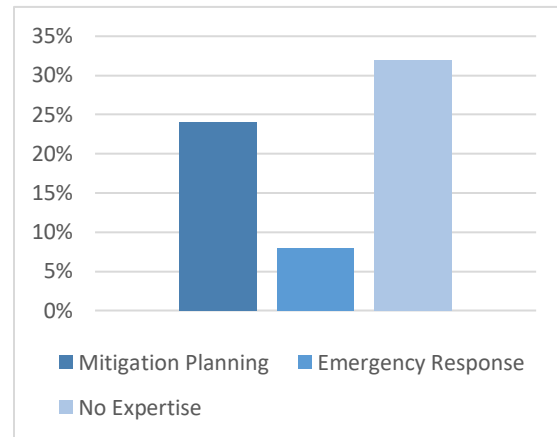
that affect adaptive capacity include social, political, human, financial, and environmental capital. When a country has enhanced adaptive capacity at all levels of government, it can design and implement effective adaptation strategies in the face of evolving hazards and stresses. The country can effectively reduce the likelihood of the occurrence and/or the magnitude of harmful outcomes resulting from climate-related hazards.⁷⁰

Over the years, Canada has made some progress in mobilizing resources and building the capacity to adapt to climate change through various adaptation plans, consortiums, and collaborative efforts. Despite these efforts, Canada is still lagging in terms of building adaptation expertise among public servants across levels of government. The capacity gap is especially prominent in smaller municipalities, Indigenous governments, and northern governments. It has pervasive consequences such as the possibility of maladaptation, inaction, slow mobilization of climate adaptation solutions, lack of learning and improving climate adaptation solutions, and difficulties accessing funding.

According to a nationally representative survey of professional planners conducted by the Canadian Institute of Planners in 2019, 32 per cent of respondents working as adaptation specialists at different levels of government stated that they had no experience or skills around climate change (Graph 2). Similarly, when respondents were asked about the barriers, they face in incorporating climate change adaptation into their planning work, more than 50 per cent mentioned their lack of adaptation expertise (Graph 1) These findings indicate a perceived need from planners for further training on adaptation planning.



Graph 1: Barriers to include adaptation in planners' work
Source: 2019 survey of Canadian planners, CIP



Graph 2: Area of climate change experience and skills
Source: 2019 survey of Canadian planners, CIP

Description of the Recommendation

a. Capacity Needs Assessment

To mobilize climate adaptation policy within different levels of Canadian government, public servants must have the capacity to do so. The first step in developing capacity is to conduct a capacity needs assessment. This would take stock of the existing skills and capabilities at both organisational and individual levels.

Moreover, designing a training plan would be contingent upon the findings of this assessment. The training contents will depend on the existing skills of public servants. Since adaptation knowledge is often context-specific, there is no one-size-fits-all solution to adaptation training. The needs assessment would serve a dual purpose. It would identify the target group who need capacity building and the adaptation champions within the institution. In addition, the assessment would segment the public servants into four categories (Figure 3) based on their influence in adaptation planning and their level of capacity. While the potential changemakers and adopters would be the key recipients of the capacity-building activities, the champions and influencers would help create an internal learning ecosystem.

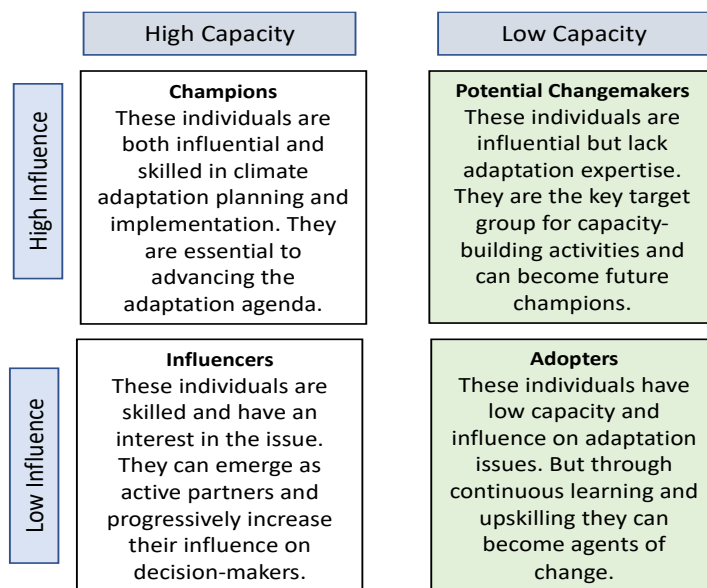


Figure 3: Influence & Capacity Matrix on climate adaptation

A complete matrix for this capacity needs assessment for public servants, including dimensions, categories, modules, definitions of each module, and example hypotheses for the survey, can be found in Appendix A.

b. Capacity Building

In this brief, “capacity” is referred to as the ability of relevant public servants to utilize the available climate adaptation tools and incorporate an adaptation lens in their day-to-day work. “Capacity Building” is the process through which an individual’s or organisation’s technical, operational, systemic, and adaptive skills are enhanced for better climate adaptation. The Canadian Centre for Climate Services (CCCS) established under the Department of Environment and Climate Change Canada (ECCC) is well-positioned to take the lead in designing and implementing a capacity development program for public servants. CCCS is mandated to provide government officials with reliable information and support to consider climate change in their decision-making.

Once capacity gaps are identified and contents are developed through a needs assessment, the next step is to design training methods. Two proposed overarching and interlinked methods are highlighted below.

Customized and Short-term Training: This type of training is often more desirable since its impacts are more readily observable and immediately tangible. This training can be either supply-driven—pre-existing contents that are regularly scheduled—or demand-driven, developed following a particular event. Research shows that short-term adaptation-related training is most effective when customized to the participant's needs, participatory in nature, and tailored using context-specific examples.⁷¹ Training could take different forms based on the needs of the target groups. For example, in a workshop setting, participants could bring the projects they are working on to generate intentional, documented, and actionable flood adaptation tactics. Conversely, online courses could teach public servants how to use flood risk maps at their own pace.

Continuous Training: This method would complement the short-term training and give public servants the opportunity to enhance their adaptation skills and knowledge on an ongoing basis. Staff with low capacity would be matched horizontally or vertically with the champions and influencers identified within their institution, or from other institutions. This would enable public servants to learn from their peers over a longer time period and facilitate cross-organisational learning. However, the need for individuals' commitment to lead the process of their capacity development would be substantial, as opposed to it being externally driven. Increased awareness explained in the previous sections (Recommendation 1, 2, and 3) will contribute to building the individual commitment.

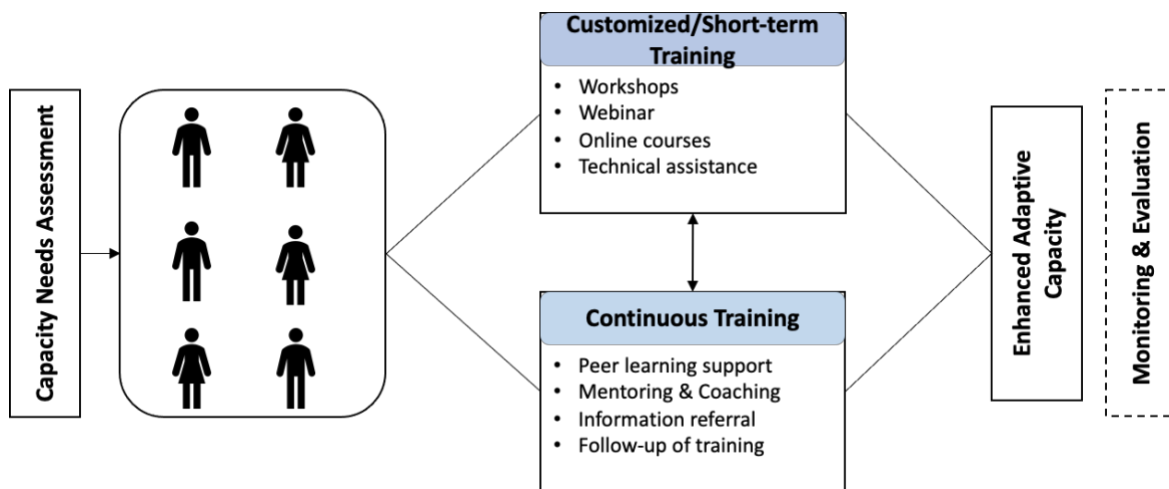


Figure 4: Proposed Capacity Building Model

The capacity-building activities aim to help public servants integrate adaptation strategies into their everyday planning. There is a need for a comprehensive evaluation of the resulting outcomes and impacts of the training initiatives on adaptation-related decision-making. This would give valuable insights into what methods work best and why. The effectiveness could be assessed in several ways, including formal and informal participant feedback or the ability to incorporate adaptive features into project implementation following the training.

Intended Outcome

Increase public servants' knowledge of climate adaptation and the jurisdictions' capacity to plan, implement, and evaluate climate adaptation solutions, including areas and communities disproportionately facing flood risk.

Key Arguments

Stakeholder views on the capacity constraints: On a similar note, many of the stakeholders interviewed also highlighted the lack of capacity of public servants as a key barrier to mobilizing climate adaptation. At the provincial level, there is a lack of adaptation experts who can engage with municipalities or Indigenous communities and who can identify local adaptation concerns and solutions to inform policies. Larger municipalities have the capacity to design and implement adaptation-related projects, but often lack the expertise to integrate climate adaptation in their decision-making processes. A considerable capacity gap exists at the smaller municipality level, for instance, they do not have enough human resources to prioritize climate adaptation policy. In the interviews, several stakeholders mentioned that public servants across federal government departments are not aligned in their understanding of climate adaptation and what effective flood adaptation solutions are available.

Effectiveness of the proposed training methods: Aligning training to adaptation practices enables participants to meet their aims and experience tangible benefits. In addition, training in climate adaptation tools often involves a substantial time commitment by public servants, requiring time away from existing obligations and creating a perceived increase in their workload. Designing active training connected to their work instead of passive or theoretical exercises would minimize the opportunity costs to some extent. Research shows engaging public servants with training that balances their needs and time constraints translates into more intentional on-the-ground adaptation projects.⁷²

A window of opportunity for a new capacity-building program: NRCan is leading a program—Building Regional Adaptation Capacity and Expertise Program (BRACE)—which invests in training, and knowledge-exchange activities to increase the capacity of organisations, professionals, communities, and small-to-medium sized businesses to undertake climate change adaptation actions.⁷³ BRACE is a five-year initiative under the Pan-Canadian Framework on Clean Growth and Climate Change plan. The program is scheduled to phase out in 2022, opening a window of opportunity for a new capacity development program.

Cost Considerations

The proposed capacity development program is for relevant public servants across all levels of government in Canada. Considering the broad scope of the program, the initial costs would be high. For instance, the capacity needs assessment may require hiring an external agency. While analyzing the assessment results, identifying specific capacity gaps, and designing region-specific training contents would require significant CCCS staff time. However, once all the components of

the program are established, it would entail only recurrent costs in terms of staff time both in providing and receiving training.

5. **The insurance sector should develop and propose a proof of concept for a ‘one-stop-shop’ for managing adaptation funding programs to Jonathan Wilkinson, Minister of Natural Resources Canada.**

Problem Statement

Climate adaptation funding programs are fragmented: Due to insufficient internal funds, small municipal governments, Indigenous governments, and northern governments rely on federal and provincial funding programs for their adaptation-related projects. However, these funding programs are highly fragmented and come with different objectives. This fragmentation stems from the cross-cutting nature of climate adaptation and diffusion of responsibilities, especially flood-risk management, across several federal departments and ministries.⁷⁴ A quick scan of the adaptation governance structure shows that at least five ministries, including Environment and Climate Change, Indigenous and Northern Affairs, Infrastructure, Natural Resources, and Public Safety, work in this space. This makes it harder for municipalities and Indigenous communities to identify suitable funding programs to support their climate adaptation initiatives. Furthermore, some stakeholders mentioned that due to overreliance on public funds, local governments are often unaware of the private-sector grants and contributions available at the local level.^{1*}

Capacity constraints of local governments: Even when the most suitable funding programs are identified, preparing applications, and securing financing can be challenging. Applications for programs like Disaster Mitigation and Adaptation Fund (DMAF) and National Disaster Mitigation Program (NDMP) usually require collecting technical information, risk assessment, and preparation of detailed analyses for projects. While large and relatively well-resourced municipalities can fulfill the requirements, small municipalities and Indigenous communities lack sufficient human resources or skills to prepare such applications.⁷⁵ Hence, insufficient administrative capacity is one of the most significant obstacles in accessing adaptation funding at the local level.

Description of the Recommendation

A one-stop-shop (OSS) model could be utilized for managing all the federal adaptation funding programs. This would help bring the programs under a single platform and streamline the application processes. The OSS platform can mitigate fragmentation, enhance local governments’ accessibility to adaptation funding, and be used as a medium for increasing interdepartmental coordination.

A single platform would allow local governments to choose from multiple funding programs the most suitable one for their adaptation project and apply. The proposed platform should take the form of a website, designed in a phased approach. In the initial phase, the website would be

^{1*} Upon further verification we found there are 32 funding programs available only in BC including federal, provincial, and private sector grants. <https://retooling.ca/tools-resources/Funding-Opportunities>

informational, offering details about compliance with the program requirements. There should be opportunities for interaction with the departments to help answer questions and support local governments to complete required procedures online. Information could be pooled from different agencies by a central institution.⁷⁶ When the platform is established, and all the relevant federal departments are on board, it would act as a coordination model. The platform would coordinate with the ministries and departments to manage the adaptation funding space and gradually incorporate provincial and private sector grants and contributions.

Some key considerations for developing the proposed OSS platform are highlighted below.

Central planning institution: A federal department with solid communication and feedback channels with other departments should take the lead in developing and managing the platform. On that note, Natural Resources Canada is better positioned to be that central planning institution considering its mandate of advancing the climate adaptation agenda in Canada.⁷⁷

Regulatory changes: To ensure cooperation with other departments and maximize the platform's potential benefits, necessary adjustments to the regulatory framework should be made before designing the technical specifications.

Clustering of programs: A mapping exercise should be conducted across all the departments and levels of government to identify an exhaustive list of available programs. Programs with similar eligibility requirements and target groups should be clustered. For each cluster of the programs, application process should also be streamlined to achieve administrative simplification.

User-friendly interface: The platform's interface should be user centered and consider the local governments' capacity constraints. A pilot should be planned and executed to test the services before going live, ensuring that they meet users' expectations.

Service Standard: A service standard should be developed in collaboration with all the relevant departments to clearly outline other program modalities, including the time required from application to approval and evaluation process to be used.

The below diagram shows the transition from the current status where local governments need to go through a complex web of application processes to the proposed single platform. The OSS platform would simplify the process by housing all funding programs and facilitating applications through a single interface.

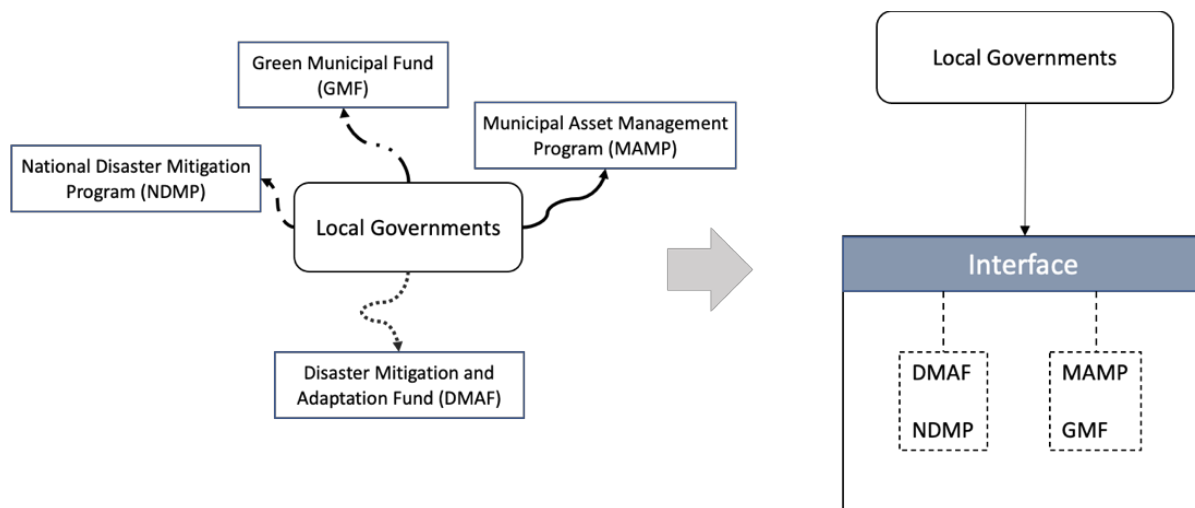


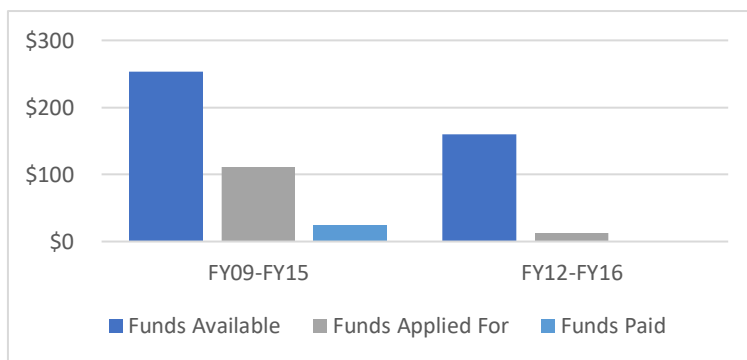
Figure 5: Simplification of the funding program management

Intended Outcomes

In addition to addressing the fragmentation and the inaccessibility of funding, the one-stop-shop platform is expected to enhance coordination across and within levels of government promoting a whole-of-government approach. The OSS platform would reduce administrative burdens and transaction costs for smaller municipalities and Indigenous communities through process simplification. In the long-term, the platform is expected to bring provincial and other private sector funds under the platform to help increase Canada’s adaptive capacity.

Key Arguments

Low usage of funds: The current approach to climate adaptation funding is inefficient in reaching the local governments and supporting up-front measures that would help communities avoid or reduce potential climate-related damages. According to a report from the office of the auditor general of Canada in 2016, only a fraction of the available federal government mitigation funds was dispensed during the audit period (FY 2009- FY 2016).



Graph 3: Utilization of federal flood mitigation funds

Source: Reports of the Commissioner of the Environment and Sustainable Development, 2016

It is high time to shift the pattern of how the public sector funds are being managed. In this regard, the one-stop-shop platform would better match of supply and demand for funds. Moreover, due to increased bandwidth from the administrative simplification, governments could make policies to identify and act on their adaptation priorities, with specific support for the most at-risk communities and regions, including Indigenous nations.

Experience in developing single platforms: Canada has experience developing citizen-centric one-stop-shop platforms for public service delivery. For example, Service Canada serves as a single point of access to citizens for many government services, delivering some of the Government’s largest and most well-known programs and services, such as Employment Insurance and the Canada Pension Plan. Service Canada presents a menu of integrated public services to the citizens regardless of their jurisdiction or central government responsible for service delivery.⁷⁸ The program maintains agreements with other government departments or levels of government, which set out partnership frameworks, including roles and responsibilities, privacy considerations, cost recovery, and more.⁷⁹

Reduced transaction costs for local governments: One-stop shops are established to reduce regulatory and administrative burdens. From an economic perspective, the primary rationale for introducing the proposed one-stop-shop platform would be to achieve allocative efficiency via reduced transaction costs. Transaction costs tend to be disproportionately greater for smaller municipalities and Indigenous communities impeding the implementation of adaptation projects at the local level.⁸⁰ Since municipalities would not have to interact with different agencies separately, their transaction costs would be lower. Separately, there are also costs associated with fragmented, challenging to navigate funding programs. These difficulties justify managing of adaptation funding programs from a single point.

Cost Considerations

The one-stop-shop being an online platform would be less resource-intensive compared to a brick-and-mortar form. Once the system is developed and all the funding programs are integrated, operational costs would be low. The key cost components for the platform could be divided into two broad categories: “non-personnel” and “personnel”. Non-personnel costs are necessary for developing the architecture and general operation of the platform, which may include website development; hardware; software licenses; reviewing the options for integration of the available IT systems; securing broadband connectivity to enable data exchange across agencies; and ensuring interoperability among databases. These costs can be identified as infrastructure costs for the platform and would include service contracts with vendors or contractors, equipment, and supplies. Whereas personnel costs would include salaries and wages of the employees who would provide support in managing the platform on a day-to-day basis.

SECTION III. Accelerate Actions for Flood Mitigation

- 6. The insurance sector should advocate for regulations within the proposed National Flood Insurance Program to Minister Bill Blair of Emergency Preparedness and Minister Marco Mendicino of Public Safety of Canada.**

Problem Statement

Residents of Canada are not adequately covered by flood insurance and could face significant monetary and social costs due to flood damages. Twenty per cent of Canadian households face some vulnerability to floods, and 10 per cent are at high risk of flooding. Up to 10 per cent of homes in Canada are uninsurable due to flood risks, according to the Insurance Bureau of Canada (IBC). A lack of political will in coordinating more effective flood insurance has left the greatest burden on individual homeowners and renters during floods. Furthermore, the lack of coordination across jurisdictions has created a patchwork of flood insurance providers and has left people behind, unprepared, and uninsured.⁸¹ While several countries coordinate flood insurance nationally, Canada is the only G7 country with no national flood insurance program.⁸²

Real estate agents and lenders are not required to disclose flood risk information. In several cities across Canada, flooding has caused an eight per cent reduction in the sale price of a home and a 44 per cent reduction in the number of homes listed for sale.⁸³ A moral hazard exists when real estate agents and lenders have little incentive to reveal data on flood risks that would devalue properties, reduce competitive advantage, and affect potential profits. Coastal and riverside properties are often high value yet are most prone to flooding and sea-level rise impacts. As a result, homeowners, renters, and business owners are unaware of their flood risk due to a lack of access to flood risk information. A moral hazard problem also exists in the development of new homes and buildings. Currently, development in flood-risk areas is not sufficiently regulated and puts people at a higher risk. The Canadian Climate Institute forecasts that, by mid-century, Canadians will experience a fivefold increase in flood damage to homes and buildings.

Description of the Recommendation

The insurance sector can advocate to the federal government for specific regulations to better mandate, regulate, and oversee the use of flood insurance through the National Flood Insurance Program. These regulations would improve the National Flood Insurance Program promised by the federal government, which currently plans to develop a low-cost program to protect homeowners at high risk of flooding with flood insurance. This information would help buyers and renters make informed decisions regarding the flood risk of their home. This program would act as a federal backstop to ensure minimum flood protection for homeowners. The insurance sector should advocate for a suite of regulations to include in creating the National Flood Insurance Program. These include pushing for:

1) Mandatory flood risk disclosure by real estate agents, lenders, and landlords: A requirement for home sellers to disclose information can help inform prospective home buyers and renters of the property's flood history, previous flood damage and flood risk. The federal government is best positioned to oversee the mandatory flood risk disclosure to ensure uniformity and adequacy of disclosures across all provinces and territories. Flood risk disclosures also require updated flood maps by the federal government, as discussed in Recommendation 1. Federal standards are needed to determine how real estate agents and lenders disclose flood risk to potential buyers.

2) Default opt-out insurance coverage: Default opt-out is part of a ‘choice architecture’ prompting individuals to participate in flood insurance coverage and allowing the freedom of choice to opt-out.⁸⁴ The automatic enrollment would be especially critical for those within flood-risk areas, but could prove critical for those in surrounding areas, as flooding events become increasingly frequent. Insurers should advocate to the federal government to use default opt-out insurance coverage, rather than the current opt-in participation. This would encourage broader enrolment in the coverage, as individuals are less motivated to opt-out.

3) Regulation of the development of new housing in high-risk flood areas: The federal government must prohibit and regulate the development of new housing in high-risk flood areas. Currently, the federal government “discourages” development in floodplains and encourages land use controls. Land use regulations recognize that hazard areas will continue to be flooded.⁸⁵ Stronger regulation is required to work with municipalities to limit development in areas prone to flooding.

4) Collaboration with Canada Mortgage and Housing Corporation (CMHC) on assessing flood risk: CMHC currently supports the dissemination of information on flood risk in partnership with the Intact Centre on Climate Adaptation. Public Safety Canada should collaborate with its crown corporation, the Canadian Mortgage and Housing Corporation (CMHC), to conduct outreach and determine flood risk for homeowners.

Case Study: Looking to other jurisdictions, the government of the United States implemented the National Flood Insurance Act and program in 1968. This program could also restrict building infrastructure in floodplains to reduce the flood risk of new development. This effort has helped governments shift from a disaster relief to a disaster prevention approach. Some US states have flood risk disclosure requirements mandating sellers to disclose whether or how frequently a property has flooded, if it is in a flood zone, and if the previous owner received aid which would require flood insurance.⁸⁶

Intended Outcome

Better coordination of flood insurance through a National Flood Insurance Program will ensure greater access to coverage for individuals in high-risk areas. The federal jurisdiction in charge of flood insurance will help improve access to information for those promoting and purchasing flood insurance. Stronger regulation of flood insurance programs, such as mandatory flood risk disclosure, will ensure that real estate agents and lenders disclosing the flood risk to homeowners for improved flood protection. A default opt-out insurance coverage for high-risk flood areas would increase the uptake of flood coverage, as people are likely to stay covered rather than opt-out. Regulation of new development in high-risk flood areas prevents potential flood damage. Coordination with CMHC will ensure the management of flood insurance is collaborative between housing agencies, insurance companies, and the federal government.

Key Arguments

Motivate implementation: The government of Canada must release its plan for a National Flood Insurance Program. In 2019, Prime Minister Justin Trudeau made an election promise of creating

a national flood insurance program if re-elected but has delayed its implementation.⁸⁷ In the last federal election, the Liberal and Conservative parties' campaign platforms included developing a low-cost insurance program for high-risk homes, which the Insurance Bureau of Canada largely designed. The federal government allocated \$6.3M from 2020 to 2021 to work on flood insurance and relocation and launched the Task Force on Flood Insurance and Relocation to recommend its next steps. It plans to release a report on a flood insurance program at some point in the future, but as of June 2022, there are still no details on such a program. Meanwhile, flood risk and damage increasingly affecting insurance coverage.

Improve coordination across jurisdictions: Based on our stakeholder interviews, the Climate Risk Research Group and the Partners for Action at the University of Waterloo are better positioned to inform the federal government about how to better coordinate and oversee an overarching flood insurance program. Canada's current approach to flooding insurance is a patchwork of regulations on insurance policies spread across different jurisdictions.⁸⁸ Ahead of and during pluvial or fluvial flood events, the government of Canada needs to address the lack of coordination about where the responsibility for flood management lies. A national flood insurance plan will act as a federal backstop if any other jurisdiction does not meet the federal benchmark for flood insurance coverage. This measure would ensure that residents of Canada in flood areas have flood insurance to protect themselves against flooding impacts. The government of Canada needs to work closely with insurance companies to establish a network of insurance providers with operating standards. Collaborating with the Canadian Mortgage and Housing Corporation (CMHC) would also help disclose flood risk and ensure insurance coverage of homeowners.

Address the moral hazard: A mandatory flood risk disclosure by real estate agents, mortgage lenders, and insurance brokers would help address Canadians' current gap in awareness of their flood risk. Access to information, such as flood maps and flood risk disclosure, raises awareness for better decision-making. Potential homeowners can purchase flood insurance or decide not to buy the home. When entering into development agreements, flood protection measures may differ from the current and future flood risk reality. The federal, provincial, territorial, municipal, and Indigenous governments must also collaborate in their approach to regulating new developments of housing in high-risk flood areas. The government should regulate new development in high-risk areas as part of the National Flood Insurance Program.

Set default opt-out for greater coverage: Aside from mandatory disclosure, a “default opt-out” would encourage broader insurance coverage across Canada. Default opt-out rules have clear advantages instead of ‘active choosing’ of flood insurance coverage. Studies have shown significantly higher participation rates in an opt-out programs than in an opt-in.⁸⁹ Default option for high-risk flood areas would not require homeowners to dedicate additional time and research, which can be barriers for opting into flood insurance.⁹⁰ Several successful example of default opt-out programs are the automatic enrollment in green energy, savings programs, rental car insurance, and health insurance for students on university campuses across Canada.⁹¹ For flood insurance, an opt-out strategy could encourage greater awareness of flood risk and greater enrolment into the flood insurance programs.

Cost Considerations

The insurance sector would advocate to the federal government to develop a framework with regulations for the National Flood Insurance Program. The regulations for mandatory flood risk disclosure, default opt-out insurance coverage, regulation of new development and collaborating with CMHC are efforts to encourage greater uptake of flood insurance in high-risk areas. This framework for a National Flood Insurance Program would require staff time for advocacy for the insurance sector. The government will likely require a stakeholder engagement process to collaborate with advisors for the national program. The primary cost of the flood insurance program would be on the residents of homes and building owners in high-risk areas. The National Flood Insurance Program in the United States has an average cost of \$771USD per year per household.⁹² Flood insurance can provide valuable coverage and financial protection from greater economic loss. The average cost of claims for flood damage to a property is approximately \$43,000 in Canada. Floods in Canada currently cause over \$1 billion in direct damages to homes and other infrastructure annually. The costs of inaction in flood prevention are predicted to lead to flood damage to homes and buildings that could increase fivefold in the next few decades and by a factor of ten by the end of the century, with costs as high as \$13.6 billion annually.

- 7. The insurance sector should propose to Laniel Bateman, Director of Climate Change Adaptation and Resilience at Environment and Climate Change Canada a change in the federal evaluation framework on climate adaptation. The proposal should enable the federal government to move from cause-effectiveness to a more flexible perspective based on learning for adapting.**

Problem Statement

Currently, there is no clear adaptation evaluation framework, and the few guidelines provided by the federal government are not helping to mobilize action. For instance, the Pan Canadian Framework on Clean Growth and Climate Change or the Federal Adaptation Policy Framework are either too vague or too narrowly focused on measuring the effectiveness of climate adaptation. However, measuring the effectiveness of adaptation actions is complex. It imposes an unnecessary burden on public servants to calculate unobservable variables in contexts of high uncertainty with no adequate counterfactual.⁹³ For example, avoided damages due to flood prevention in a specific geography.

Furthermore, focusing on effectiveness complicates funding climate adaptation actions because provinces have a hard time justifying the effect of their actions on resiliency to the federal government. The strong focus on the attribution of cause-effectiveness is due to the policy inertia toward causality and cost-benefit analyses. These frameworks might not be well suited for all policy issues. Based on our research, we described the challenges of evaluating climate adaptation in Appendix B.

Description of the Recommendation

The insurance sector should advocate for a change in the federal adaptation evaluation framework. Instead of emphasizing on effectiveness, this framework should combine outcome indicators with progress indicators, quantitative and qualitative data, and focus on evaluation as a learning tool for improving climate adaptation solutions and mobilizing government action.

a. Utilization-focused evaluation (UFE):

We believe the best theoretical approach for evaluating flood and climate adaptation in Canada is *utilization-focused evaluation*, a theory pioneered by Michael Patton. In this theory, evaluators should understand who the users of the evaluation results will be and focus on understanding their needs, actively engaging them in the evaluation process, and getting their buy-in for the use of the evaluation results for learning and adapting.⁹⁴

This approach is flexible and encourages adaptation because it focuses on learning. According to Patton, an evaluation must be active in identifying intended users and focusing on evaluation questions, reactive in continuing to learn about the evaluative situation, and “adaptive in altering the evaluation questions and designs in light of their increased understanding of the situation and changing conditions.”⁹⁵

Adaptive evaluation allows for indicators and determinations of success to change through a learning and iteration process. Since flood adaptation is a moving target depending on constantly changing socioecological and environmental systems, quantitative indicators should be balanced with qualitative indicators to describe these system changes and understand data, like public spending on flood prevention, in a broader context.

b. Evaluation guidelines for adaptation:

This adaptation evaluation framework is aligned with the Treasury Board’s “Policy on Results” which provides goals and requirements for any government-led evaluation initiative while also being applicable to the evaluation adaptation actions.^{2*}

Evaluation Purpose: The framework should provide insights to the government about what additional efforts are required to adapt and inform all Canadians on whether Canada is adapting to the impacts of climate change.⁹⁶

Flexibility: An adequate framework for adaptation evaluation should not be definitive. Immovable frameworks for wicked problems with high uncertainty contexts are doomed to failure. Instead, the government should be willing to improve indicators and methods over time to capture scientific progress and changes in climate and socioeconomic conditions.

^{2*} The evaluation purpose aligns with Policy on Results objectives 3.1.1 and 3.1.2 (Improve the achievement of results and enhance the understanding of the results government seeks to achieve, does achieve, and the resources used to achieve them). The flexibility guideline fosters objectives 3.2.1 and 3.2.2 (Clarity on what departments are trying to achieve and how they assess success and measure and evaluate their performance, using the resulting information to manage and improve programs, policies and services). The proposed evaluation framework may resolve the current tension with 3.2.3 (resources allocation based on performance) reported by stakeholders consulted because the indicators created based on the framework should balance effectiveness with other variables such as preparedness or readiness based on the proposed process.

Inclusion: Respectfully working with Indigenous Peoples, and other relevant stakeholders, is necessary to design monitoring and evaluation (M&E) systems and improve adaptive capacity and resilience together. Only if the evaluation results are useful to them, will the evaluation mobilize action.⁹⁷ This is important for climate adaptation in general, but especially relevant for flooding since it disproportionately affects Indigenous Communities.

Governance: A leading entity in the federal government should centralize municipal and provincial evaluations and provide the evaluation framework to be applied nationally. Data gathered locally should be funnelled to this institution annually. Since Natural Resources Canada is conducting the evaluation of the national climate change policy and the Climate Adaptation Sub-Program, they are the best-positioned agency to effect changes in the evaluation framework. They have had issues calculating costs and benefits and are focused on determining the effectiveness of actions on outcomes they cannot causally establish. Climate Change Adaptation and Resilience at ECCC can help them navigate the changes in the evaluation framework based on this recommendation and their ongoing consultation process.

Indicators: The indicators must be developed through a process of stakeholder consultation. This process should aim at getting buy-in from the stakeholders to increase the use of evaluation results. Indicator development is done locally, but the federal government must provide a framework for national comparison. For instance, the government could track readiness for flood adaptation by measuring resources devoted to flood adaptation as a share of a jurisdiction's budget, staff capacity in terms of hours of work, the connections the jurisdiction has to other sectors to implement this work, and legislative constraints to implementing adaptation measures. Combining quantitative data with qualitative data is important to provide context and complexity to the results analysis.

c. Evaluation steps

Finally, the government should follow these steps based on the Center for Disease Control and Prevention (CDC) evaluation framework.⁹⁸ It is an iterative cycle that could start anywhere depending on a jurisdiction's current situation. A crucial step is assessing (or reassessing) the context, which includes changes in flooding data and predictions, technology, evaluative capacity, and changes in users. Then, engage the stakeholders to understand the uses of the evaluation and align them with the guidelines and theoretical framework for adaptation. Next, develop evaluation questions and indicators to answer those stakeholders' needs and intended uses. Gather the data, analyze it, and produce results reports to be communicated differently depending on the stakeholders. Collect their feedback on the process and results, focusing on the results' usefulness in mobilizing adaptation solutions, and finally reassess the context, including previous evaluation performance.

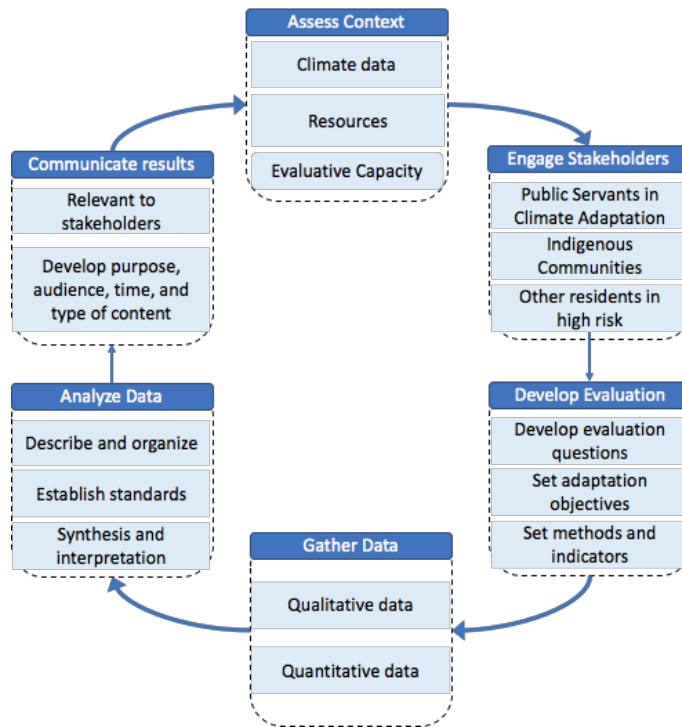


Figure 6: Evaluation Process for Climate Adaptation, based on enhanced CDCs framework.⁹⁹

Intended Outcome

Focusing more on measuring readiness and preparedness for climate adaptation and having an evaluation framework centred on learning will make it easier to see visible progress. The federal government’s current persistence in measuring unobservable variables frustrates public servants. Adaptation is a moving target, non-reducible to a single variable, and effective adaptation prevents flooding events from happening, which makes adaptation actions hard to evaluate. A more flexible evaluation would mobilize public servants and jurisdictions by removing these barriers. In the long run, clearer and more useful evaluation frameworks can make the funding process more accessible. The federal government funding would not rely on the effectiveness of adaptation actions on unobservable variables, but on progress in variables we can observe, such as increased capacity.

Key Arguments

Useful and meaningful evaluation for public servants: According to a public servant in BC working on the climate adaptation space, the federal government asks British Columbia about the effectiveness of the money allocated in climate adaptation. Assessing the effectiveness of climate adaptation measures is, in their experience, a burden. The indicators that public servants are asked to deliver on are, for example, lives saved, economic damage avoided, risk avoided, that is, events that did not happen. These are difficult to measure. In turn, the accountability solely based on these indicators is ineffective because they are not capturing with precision the efforts and actions undertaken by provincial governments. A flexible utilization-focused evaluation would allow

public servants to adapt by removing existing barriers. These meaningful evaluation practices foster flood adaptation implementation.

Focusing only on effectiveness hampers funding: The federal government is reluctant to provide further funding based on the efficacy of previous adaptation actions. In the words of a public servant: “getting further funding is hamstrung by this need for understanding effectiveness, and that’s not a good thing to look at for adaptation.” Another stakeholder from academia agreed that effectiveness should not be prioritized in the evaluation framework for adaptation because it contributes to the lack of governance in the adaptation space. This is not a one-person or one local government problem. The federal government’s need to evaluate effectiveness is causing issues across Canada. According to the Expert Panel on Climate Change Adaptation, “the ability to measure avoided impacts is another challenge of adaptation monitoring and evaluation”.¹⁰⁰ With a utilization-focused evaluation framework and a process of iterating indicators, the provincial, municipal, Indigenous, and territorial governments could access federal government funding based on process indicators, not only outcome indicators, and qualitative data instead of only quantitative data.

The timing for an evaluation framework shift is right: The timing is good for making the case for a change in adaptation evaluation because the Liberal government made commitments to set “clear targets and indicators to measure progress and strengthen the case for adaptation”¹⁰¹ by the end of 2022.¹⁰² Furthermore, the federal government is hosting a consultation platform called Let’s Talk Adaptation¹⁰³, asking the general public about the goals of the National Adaptation Strategy. NRCan will carry on public consultations until the summer’s end and begin the strategy’s development in the fall. The NAS will be released at the end of 2022.

In the BC government, the federal government plans, the Liberal platform plans, and in the United Nations’ framework, there is an understanding of the need to develop an evaluation framework for adaptation. It would be wise to take advantage of this policy window to advocate for an evaluation framework for adaptation that allows public servants to mobilize actions in climate adaptation.

Cost Considerations

Changing the evaluation framework, and updating it iteratively, is an action to support long-term adaptation. This new framework supports the creation of a suitable policy environment to ensure that future actions respond to changes in the socio-environmental context. Its potential to both mobilize and improve adaptation action on flooding and other adaptation contexts across Canada is considerable and could have benefits over the long term. Therefore, measuring and including those potential benefits in economic analyses is more challenging.

According to Insurance Bureau of Canada, the average insured costs of climate events have gone from \$0.4billion per year until 2007 to \$1.9 billion by 2019.¹⁰⁴ The Canadian government interprets this documented rise in long-term losses as indicative of the adaptation gap. This gap includes policy issues such as unclear evaluation.¹⁰⁵ Advocating for this change does not require capital costs, nor annual recurring costs that the Canadian government is not already considering since they are rebuilding their climate adaptation evaluation framework through consultations in

the NAS. There are no negative co-impacts of this particular action, and in terms of feasibility, since there is a policy window for it, there is considerable ease for its implementation.

- 8. The insurance sector should outline to Minister Dominic LeBlanc and Minister Steven Guilbeault how Infrastructure Canada and Environment and Climate Change Canada can best invest in natural infrastructure. The outline should describe implementation criteria and identify how these departments could partner with Indigenous communities.**

Problem Statement

The federal government currently invests in ‘nature-based solutions’ but does not yet implement ‘natural infrastructure’ with flood adaptation in mind. Natural infrastructure for flood adaptation must include stronger restoration practices of marshes and wetlands. Preserving wetlands can reduce flood damage costs by up to 40 per cent.¹⁰⁶ In urban areas, there is a lack of investment and criteria for effective implementation of rain gardens and green roofs to absorb excess water and divert floodwaters. There is a greater need for natural infrastructure to divert floodwaters from grey infrastructure to green infrastructure. The federal government must also recognize that clear-cutting, logging, and land-use changes exacerbate flooding impacts. These actions remove nature as a first line of defence from flooding.

There are several terms used to describe natural infrastructure and various approaches to implementation. ‘Nature-based solutions’ have garnered international support in recent years, but are criticized to do its potential malpractice, including a lack of free, prior, and informed consent, and leading to human rights violations.¹⁰⁷ While nature-based solutions have a transformative potential, they can reproduce “power dynamics that restrict the participation of historically excluded actors”, such as Indigenous peoples.¹⁰⁸ Similarly, there is also a lack of ‘top-down’ criteria for best practices of using natural infrastructure for flood adaptation to avoid counterproductive and harmful practices, such as maladaptation, afforestation, and violations of Indigenous land rights. The implementation of natural infrastructure currently lacks partnership with Indigenous nations, due to historic and ongoing exclusion, extraction, and colonization. Natural infrastructure projects take place on the unceded territory of Indigenous peoples and require consent and partnership in its implementation.

Description of the Recommendation

The insurance sector should advocate to the federal government to invest in natural infrastructure pilot projects, such as restoring wetlands and marshes and expanding rain gardens and green roofs. Wetlands and marshes are a first line of defence from floods and must be protected. In urban areas, rain gardens and green roofs absorb excess rainwater and strengthen climate resilience. These projects are aimed to help build resilience to flood damage, extreme weather events, and other climate change impacts. The government of Canada must invest in nature for the co-benefits of climate adaptation and mitigation. Natural infrastructure can be used for climate mitigation through its ability for nature sequester carbon from the atmosphere but cannot replace the

necessary decarbonization required with emissions reductions in Canada. Natural infrastructure can absorb excess precipitation and divert floodwaters from affecting critical infrastructure and homes. The co-benefits must also include equitable outcomes for surrounding communities.

The federal government needs to set “top down” criteria for the implementation of natural infrastructure, according to a politician in municipal government. To avoid maladaptation, the government of Canada can set criteria to ensure the implementation of natural infrastructure is place-based, context-dependent, and rooted in local and/or traditional knowledge. The criteria must consider the local, environmental, economic, and social contexts, including traditions and culture, which can provide more sustainable support for these initiatives.¹⁰⁹ The criteria must also provide safeguards that respect biodiversity science, uphold Indigenous rights to the land, ensure good governance, and promote gender equality in the implementation of natural infrastructure. Without social inclusion, these initiatives risk public opposition in their implementation.¹¹⁰ Stronger criteria and coordination with all levels of government is crucial for the long-term success of natural infrastructure.

Both the government of Canada and insurers investing in natural infrastructure should partner with Indigenous nations in the implementation of natural infrastructure initiatives. Building meaningful relationships with Indigenous nations is important, as these initiatives typically take place on unceded territory and require consent. Partnering with Indigenous Peoples is critical in designing nature-based solutions and avoiding maladaptation. Partnerships can help the government strive towards reconciliation, since generating knowledge about the land is a goal shared with Indigenous peoples and possible collaboration will result in better outcomes for all involved.¹¹¹ The federal government needs these criteria to ensure they uphold the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP). Indigenous leadership must be recognized by the government and supported through financial and formalized partnerships. Several models are possible, including co-managing protected areas, partnering on natural infrastructure projects, and collaborating with Indigenous knowledge-holders.

Case study: In the city of Philadelphia, instead of expanding grey infrastructure with an old sewage system, the expansion of natural infrastructure projects created co-benefits. These include enhancing climate adaptation, beautifying the city, supporting equity for those disproportionately affected by flooding, and diverting rainwater into managed rain gardens and green roofs. Natural infrastructure was seen to support equity dimensions such as wellbeing, health, community safety, and resistance to heat waves. Philadelphia has invested over US\$2 billion into green infrastructure, successfully relieving pressure on grey infrastructure, its sewage system.¹¹²

Intended Outcome

Greater investment in natural infrastructure would support community resilience to flooding impacts. By absorbing excess water from grey infrastructure, natural infrastructure could help prevent flooding events and reduce flood damages in the longer term. Using nature for climate mitigation and adaptation would also produce key co-benefits, including greater protection from heatwaves, community safety, and the beautification of the city. Partnering with Indigenous nations in the implementation of the natural infrastructure projects would ensure more effective

stewardship and governance, ensure the integration of local and/or traditional knowledge, provide appropriate community-specific recommendations, and support reconciliation efforts by ensuring consent on unceded territory in Canada.

Key Arguments

Invest in nature as a first line of defence: The government of Canada can increase its investments in nature for flood adaptation. The federal government has grown its attention to natural infrastructure and nature-based solutions. In 2018, the federal government dedicated \$2 billion over 10 years for a Disaster Mitigation and Adaptation Fund for large-scale built and natural infrastructure projects.¹¹³ The government of Canada also committed to planting two billion trees for climate action. Greater alignment on natural infrastructure-related federal commitments and funding opportunities would be beneficial. To compare with Philadelphia's \$2 billion investment in natural infrastructure projects, the province of British Columbia invested only half of what Philadelphia invested. This lack of funding towards new projects has limited the province to strengthen its first line of defense. Greater support from the federal government is needed to fund sustainable, natural infrastructure.

Develop criteria for the co-benefits of natural infrastructure: Alongside the investments for nature, the federal government must set criteria for best practices to support provinces, territories, municipalities, and Indigenous governments, as they aim to divert excess water from grey infrastructure to green infrastructure. Natural infrastructure presents important co-benefits for the government of Canada's climate mitigation and adaptation efforts. As they mature, plants can absorb and store greenhouse gases, vegetation helps prevent floodwaters from reaching homes, and trees provide shade and lower air temperatures during heatwaves. Wetlands can hold massive amounts of carbon, absorb heavy precipitation, and reduce overall flooding in our communities. Disturbing this natural infrastructure reduces its potential for climate mitigation and adaptation. The co-benefits of natural infrastructure must also consider the equity dimensions. For instance, a study by the Canadian Climate Institute revealed that Black households are more exposed to pluvial flood risk than any other population subgroup in Windsor, Ontario, due to the absence of natural infrastructure.¹¹⁴ The presence of natural infrastructure can reduce the vulnerability of populations to heatwaves and flood impacts.

In terms of implementation, natural infrastructure and nature-based solutions are region-specific. There are best practices depending on microclimates and ecosystems. Otherwise, there are risks of afforestation, planting trees where they may not have previously been and may not survive. This may result in increased emissions and further degradation of land, rather than its purpose for climate mitigation and adaptation. Nature-based solutions such as tree planting also risk becoming monoculture and preventing natural biodiversity from thriving. To avoid these maladaptation practices, the federal government can set criteria for implementation and partner with local knowledge-holders, such as Indigenous nations.

Partner with Indigenous Peoples: Indigenous Peoples have been stewarding this land for millennia and have important traditional knowledge. Indigenous governments are currently applying traditional knowledge on flood mitigation passed on through generations. A University of Alberta study with Kashechewan First Nation demonstrated how collaboration and partnership

between Indigenous knowledge holders and governments helps promote effective adaptation action.¹¹⁵ Participatory mapping is used for flood monitoring and disaster risk reduction near James Bay. Another successful example is the partnership and integration of Coastal First Nations in the forest management of the Great Bear Rainforest.¹¹⁶ There is a greater need to collaborate across jurisdictions, especially with Indigenous nations, to effectively implement flood adaptation initiatives.

Cost Considerations

Greater investment in nature-based solutions will help divert the costs of flood damages. As mentioned, preserving wetlands can reduce flood damage costs by up to 40 per cent.¹¹⁷ The federal government is currently investing in nature-based solutions for mitigation but should consider how to maximize the co-benefits with climate adaptation as a cost-effective measure. The insurance sector can invest in advocacy efforts to ask the government to set criteria for the implementation of natural infrastructure. Without criteria and safeguards for nature, there is the risk of maladaptation, ineffective, or a loss of investments in plants, trees, and restoration efforts, due to the varied climates, contexts, and topography of Canada. The criteria and safeguards will help ensure the sustainability and viability of the investments in natural infrastructure. Partnerships with Indigenous peoples would help the longevity of the government-funded national infrastructure but should not be transactional for cost savings. Indigenous partners must be meaningfully compensated by the federal government. Instead, investing in building meaningful relationships with Indigenous people would further the government's current commitments to reconciliation and the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).

Action Plan

In the short-term, the insurance sector can advocate for updated flood maps and informational resources to raise awareness of Canadians about their flood risk (Recommendation 1). These flood maps would set the foundation for developing a centralized adaptation dashboard (Recommendation 2) and a National Flood Insurance Program (Recommendation 6). The Hackathon challenge (Recommendation 3) and the development of the virtual reality app can take place in the background while the flood maps are developed.

In the short-term, the insurance sector can also advocate for an adaptation capacity-building program for the relevant public servants (Recommendation 4). The insurance sector can advocate for setting up a 'one-stop-shop' for better management of adaptation funding programs (Recommendation 5). There is a policy window with current National Adaptation Strategy consultations for the insurance sector to advocate for a change in the federal evaluation framework, so it is better suited to the complexities of climate adaptation and does not impede public servants' action in this area (Recommendation 7). Finally, the insurance sector can advocate for investing in natural infrastructure, set criteria, and partner with Indigenous peoples in their implementation (Recommendation 8). All these recommendations can be initiated, and some completed, within the next two years.

In the medium-to-long term, to improve public sector awareness the insurance sector should organize public-private dialogues among relevant stakeholders to create a broad consensus about the opportunities of using the initiatives dashboard (Recommendation 2). Meanwhile, as the VR tools were developed in the short run, the insurance sector can take a step forward to convince various private and public sector actors in installing kiosks to increase the virtual flood experience (Recommendation 3). While providing technical assistance in implementing the capacity-building program, the sector should also participate in results presentations and further consultation about the adequacy of the evaluation framework for adaptation.

Actions for the Insurance Sector	Short-term (0-2 years)	Mid-term (2-5 years)	Long-term (5+ years)
Recommendation 1: Update flood maps in a portal and create informational resources			
Advocate to Natural Resources Canada to update flood maps in a portal.	x		
Advocate to NRCan to create informational resources to raise awareness of flood risk.	x		
Advocate to NRCan to develop socioeconomic status assessments to better understand vulnerability to flood damage.	x		
Advocate to NRCan to put forward these recommendations on the Task Force on Flood Insurance and Relocation.	x		
Recommendation 2: Creating a centralized adaptation dashboard			
Advocate to NRCan to partner with the Federation of Canadian Municipalities (FCM) and Local Governments for Sustainability (ICLEI) to develop a framework for mapping adaptation initiatives	x		
Organize Public Private Dialogues to develop common consensus on adaptation dashboard		x	
Collectively advocate to NRCan to adopt the dashboard and create overlays with flood risk maps.		x	
Support to mobilize risk reports and best practices across Canada		x	
Recommendation 3: “Hackathon” challenge to develop virtual reality simulations using flood maps			
Establish partnership with University of Waterloo to organize hackathons	x		
Create internal working group to develop virtual reality apps and design dissemination protocol.	x		
Organize Hackathons and formulate a master VR app.	x		
Partner with various likeminded organisations to install VR kiosks across Canada for flood awareness.		x	
Recommendation 4: Design a capacity-building training program for relevant public servants			
Advocate to the Environment and Climate Change Canada (ECCC) for taking a leadership role in building adaptation capacity of the relevant public servants	x		

Advocate to the Canadian Center for Climate Services (CCCS) to design and conduct a capacity needs assessment survey of all relevant public servants across all levels of governments	x		
Provide technical assistance in designing and conducting the needs assessment	x		
Provide technical assistance in designing the training contents informed by the capacity needs assessment		x	
Provide technical assistance in designing a learning outcome evaluation framework		x	
Provide technical assistance during the implementation phase of the capacity-building program			x
Recommendation 5: Setting up a 'one-stop-shop' for adaptation funding programs.			
Advocate to NRCan for taking a leadership role in coordinating with relevant ministries and departments for their buy-in	x		
Advocate for a funding program mapping exercise and clustering of similar programs with streamlined application process	x		
Provide technical or financial assistance in assessing feasibility of the platform		x	
Recommendation 6: Specific regulations to the federal government in the creation of the National Flood Insurance Program.			
Advocate to NRCan to add regulations within the National Flood Insurance Program, including:	x		
o Mandatory flood risk disclosure by real estate agents and lenders.	x		
o Default opt-out insurance coverage.	x		
o Regulation of new development in high-risk flood areas.	x		
Collaborate with the Canadian Mortgage and Housing Corporation (CMHC) for implementation.		x	
Recommendation 7: Change in the federal evaluation framework of climate adaptation			
Advocate for a change in the federal evaluation framework during the NAS consultation process following the principles and processes of the recommendation.	x		
Align the resulting evaluation framework with federal legislation on evaluation (Policy on Results).	x		
Participate as a stakeholder in the constant learning process to see the results and periodically propose changes in the evaluation framework if necessary.	x	x	
Recommendation 8: Invest in natural infrastructure, set criteria and partner with Indigenous Peoples			
Advocate to ECCC and Infrastructure Canada (INFC) to invest in natural infrastructure.	x		
Advocate to ECCC and INFC to develop criteria for natural infrastructure.	x		
Advocate to ECCC and INFC to build partnerships with Indigenous Peoples through meaningful relationships in the implementation of natural infrastructure.	x	x	

Conclusion

This policy brief outlines eight recommendations that the insurance sector can undertake to mobilize flood adaptation solutions in Canada. We identify the critical policy opportunities based on a multi-level approach of adaptation governance. We focus on the federal government as it is best suited to lead the changes we recommend, and it is planning to publish a National Adaptation Strategy (NAS) by the end of 2022. There is an opportunity for the insurance sector to advocate for change within the NAS framework. To limit the scope of our research, we focused on flooding, the costliest weather event with impacts on the wellbeing of the residents of Canada.

The insurance sector should advocate for updated flood maps within the next two years to bring awareness to homeowners, renters, businesses, and developers of their flood risk. With a centralized flood map portal, the government will better coordinate flood prevention across jurisdictions and better regulate flood risk zones. Recognizing information is necessary, but can be insufficient to change behavior, we recommend partnering with the University of Waterloo to organize hackathons for the development of innovative visualization tools that provide an experience of flood to nudge civilians and decision-makers into action. With updated flood maps, the government should create an adaptation dashboard to share flood initiatives and best practices across Canada.

The lack of adaptive capacity across Canada is impeding the effective implementation of flood adaptation solutions. To increase the adaptive capacity of governments, the insurance sector should advocate for a capacity-building training program of public servants. The participants should include areas and communities disproportionately facing flood risk. Currently, there is fragmentation and inaccessibility of funding. We recommend establishing a one-stop-shop platform in the next two years to enhance coordination across and within levels of government promoting a whole-of-government approach. This platform would reduce administrative burdens and transaction costs for smaller municipalities and Indigenous communities through process simplification.

Even with awareness of flood risk and adaptive capacity, jurisdictions encounter barriers in the current climate adaptation structure and governance. A National Flood Insurance Program will provide better coordination of flood insurance and ensure greater access to coverage for individuals in high-risk areas. Stronger regulation of flood insurance programs will ensure information disclosure and uptake of flood coverage. These overdue needs must be advanced in the next two years. In the same timeframe, climate adaptation's evaluation framework must change to respond to the nature of climate adaptation. It should be more flexible and centered on learning and adapting outcomes and indicators instead of focusing only on effectiveness.

Finally, greater investment in natural infrastructure would support community resilience to flooding impacts while producing key co-benefits in mitigation, safety, and urban beautification. The insurance sector must propose to partner with Indigenous nations in the implementation of the natural infrastructure projects to ensure better stewardship and governance of flood adaptation.

In conclusion, the key points made in this report are as follows:

- Raising awareness is the first step to protecting residents from climate threats. In general, Canadians are unaware of their flood risk. Within the next five years, centralized mapping and visualization efforts can address that knowledge gap.
- Despite some efforts to increase capacity, smaller municipalities and Indigenous governments are not adequately equipped to act on climate adaptation. Increasing capacity through training programs and simpler funding processes can help avoid maladaptation and mobilize action.
- Within the next two years, designing an evaluation framework in tune with the evolving nature of climate adaptation can improve actions and motivate public servants to implement solutions.
- Canada is leaving its most vulnerable residents unprotected from flood risk. Setting regulations for a National Flood Insurance Program and investing more in natural infrastructure can enhance flood resilience.

We started writing this report in November 2021 when atmospheric rivers devastated British Columbia. The frequency of these events is increasing faster than the government's reaction to them. Canada's insurance sector can advocate to governments across Canada, particularly the federal government, to raise awareness, increase capacity, and take flooding adaptation actions outlined in this policy brief. Together, they can save lives, protect infrastructure, and improve the well-being of current and future generations if the eight recommendations outlined in this brief are implemented.

Appendices

Appendix A: Matrix for an Adaptive Capacity Assessment for Public Servants

There is a gap in the literature about mobilizing the implementation of climate adaptation measures in Canada. Beyond structural barriers, like the lack of sufficient funding for adaptation policies, there is an interest in understanding Canada’s public servants’ knowledge, attitudes, beliefs, and behaviors (KABB) about climate adaptation. These are known as KAP frameworks (knowledge, attitudes, practices). They have been used to understand citizens’ knowledge, attitude, and beliefs towards climate adaptation, but currently, there is no instrument to understand public servants’ KABBs. We recommend filling this gap by designing and implementing a survey.

According to a survey of public servants conducted by the University of British Columbia, the Federation of Canadian Municipalities, and the University of Waterloo, almost half of respondents with adaptation plans (46 per cent) identified their Planning or Environment departments as the leaders in adaptation implementation; Engineering / Public Works was the third department with 17 per cent. Besides these units, Public Safety was identified as a popular support department.¹¹⁸ Recognizing the cross-sectoral nature of adaptation and the identified lack of horizontal coordination, a public servants KABB survey of public servants would have to consider at least those departments.

Based on our research, ICLEI’s report on Local Adaptation (2010), the Climate Adaptation Maturity Scale (FCM), and a KABB survey of public servants conducted in Florida, we identified possible modules for this survey.¹¹⁹ There are two dimensions of adaptive capacity: personal and institutional. The personal dimension seeks to understand public servants’ demographic characteristics, adaptation knowledge, beliefs, emotions, and behaviors. The institutional dimension aims to understand the institutional capacities through their government unit’s material resources, human resources, governance landscape, and technical ability. The CCCS should take responsibility for this task. We propose a biennial survey to understand the capacity improvements through time.

Adaptive Capacity Assessment for Public Servants				
Dimension	Category	Module	Definition	Example Hypothesis
Personal	Demographic	Demographic	This module will allow for further disaggregation and understanding of public servants’ needs and adaptive capacity by age, gender, level of education, profession, income bracket, affiliation (level of government), jurisdiction, and Department.	Male decision makers on average underestimate the impacts of climate change compared with their female colleagues. ¹²⁰
	Beliefs	Climate change	Beliefs about climate change, risk aversion, adaptation	Believing adaptation is second best policy to

Adaptive Capacity Assessment for Public Servants				
Dimension	Category	Module	Definition	Example Hypothesis
		Adaptation barriers	barriers and drivers may impede or foster adaptation implementation.	mitigation might impede planning and implementing on adaptation.
		Adaptation drivers		
	Emotions and values	Emotions	Assesses the concerns, fears, and anxieties, optimism, relating to climate adaptation, climate change and their work environment.	Adaptation cannot work on silos. Healthy work environments that foster teamwork may foster the successful planning and implementing of adaptation policies.
		Values	Assesses value judgements and prioritization of climate events consequences in human lives, health, culture, economy	There is no clarity about the criteria to make value judgements on which action (with the same risk level) to prioritize because value judgement is not aligned.
	Knowledge	Knowledge	Assesses the understanding of basic concepts, best practices, and maladaptation avoidance and gaps in specific areas.	A lack of a common understanding of adaptation might impede successful planning and implementation.
	Behaviours	Behaviours	Self-reported individual adaptive behaviours.	Sometimes knowledge and awareness does not translate into adaptive behaviour. For instance, people may know their homes' flood risks, but not acquire flood insurance.
Institutional	Material resources	Funding	This module aims at understanding public servants' beliefs and knowledge about funding streams and the application processes.	Adaptive capacity is greater when governments have policies or mechanisms in place to allow for equitable access to resources.
		Equity		
		Technology and innovation	Assesses the perceived technological capacity	Lacking adequate technology (dashboards, websites, spreadsheets,

Adaptive Capacity Assessment for Public Servants

Dimension	Category	Module	Definition	Example Hypothesis
			(hardware and software) of a jurisdiction.	risk assessment software, and mapping software), for example, to create flood maps, impedes adaptation.
	Human resources	Individual Skills	Describes the human resources and skills necessary to assess, plan and implement adaptation actions, the presence of adaptation teams.	Apparently, some teams lack personnel with enough years of experience in adaptation which hampers successful implementation.
		Teamwork		
	Governance	Internal	Assesses the inclusion of adaptation in roles and responsibilities across internal organisational charts, the level of professional connections, trust, and collaboration across different departments (horizontal), levels of government (vertical), and other organisations like Civil Society Organizations, Academia, private sector (external)	A good governance structure with clear roles and communication channels improves the capacity to prepare for and react to climate events. Isolated governments have a harder time successfully mobilizing adaptation actions.
		Horizontal		
		Vertical		
		External		
	Technical capacity	Technical capacity	Assesses the absence or the quality of current adaptation practices like hiring consultants, evaluating practices, data gathering practices, adaptation policies and plans.	Jurisdictions with low capacities don't have adaptation policies in place or adaptation plans, medium capacity jurisdictions have them but are not progressing in implementing them, high-capacity jurisdictions are evaluating their plans and policies, learning, and continuously improving them.

Appendix B: Climate Adaptation Evaluation Challenges and Solutions

Climate Adaptation Evaluation Challenges		
Challenge	Definition	Proposed Solution
Adaptation is not an end point	There is no single benchmark determining what is successful adaptation. In mitigation, we have the reduction of GHG emissions as a comprehensive indicator of progress, but there is no clear end state in adaptation.	Conducting evaluation from an adaptive framework , that is, allowing the adaptation actions and measures of success to be adjusted iteratively based on experience. <u>Key question:</u> Are we learning how to adapt our policies and monitoring and evaluation (M&E) systems?
Adaptation is “a moving target” (the shifting baseline problem).	Building a baseline in climate adaptation is difficult because environmental and socio-ecological systems continuously change. Therefore, a fixed baseline may only be a valid reference for a few years.	Consider updating baseline data every three years and complementing climate adaptation metrics with qualitative indicators across variables of interest to have a broader grasp of the policies’ effects on adaptation. <u>Key question:</u> Are the current evaluation goals and indicators still appropriate?
Measuring “avoided impacts” is difficult	Since adaptation is intended to reduce climate impacts, but climate events may or may not occur, it is hard to measure how much worse the consequences would have been in the absence of the adaptation actions.	In the absence of a good counterfactual, climate adaptation evaluation could focus on measuring progress along the theory of change of the policy (including environmental, social, economic conditions). Instead of attribution, we should focus on contribution . <u>Key question:</u> To what extent does the policy contribute to adaptation goals?
Higher uncertainty levels in adaptation	Since adaptation is intended to reduce <i>future</i> impacts across very specific geographies and social contexts, there is a high level of uncertainty regarding adaptation actions, especially when the probability of an event is unknown or difficult to forecast.	Adaptation should be regarded as an ever-changing process to capture updated data and forecasts. Flexibility should be a success measure for climate adaptation policy, along with a culture of constant pivoting, examining assumptions, and asking evaluation questions.

Climate Adaptation Evaluation Challenges		
Challenge	Definition	Proposed Solution
		<p><u>Key question:</u> What kind of future do we want and what actions do we need to get there?</p>
Multiplicity of geographies, scales and sectors	Adaptation measures may have impact across a large diversity of sectors and scales, so there is no one-size-fits-all set of indicators to match these different circumstances.	<p>Indicators must be tailored to local contexts and types of adaptation interventions. For larger scale comparison it might be better to focus on process indicators and change in adaptive capacity.</p> <p><u>Key question:</u> What are the scope reach of the evaluation?</p>
Capacity constraints	A lack of human, financial, or technical capacity in evaluation can impair a jurisdiction's ability to monitor and evaluate adaptation progress.	<p>An evaluation framework for climate adaptation focused on learning can help identify capacity gaps. This evaluation could help demand funds, personnel, or technical capacity training programs across levels of government.</p> <p><u>Key question:</u> What are the current capacities for conducting evaluation and do they meet our needs?</p>

Appendix C: Organisations Consulted

1. Adaptation to Climate Change Team (ACT) at Simon Fraser University
2. British Columbia Assembly of First Nations, Climate Change Strategy
3. Canadian Climate Institute
4. City of Vancouver Sustainability Group
5. City of Vancouver Council
6. Environment and Climate Change Canada, Climate Change Adaptation Directorate
7. Globe and Mail, Climate Adaptation
8. ICLEI – Local Governments for Sustainability
9. Insurance Bureau of Canada (IBC)
10. Intact Centre on Climate Adaptation
11. Ministry of Environment and Climate Change Strategy of BC, Climate Risk Programs and Implementation
12. Ministry of Environment and Climate Change Strategy of BC, Emergency Management
13. Ministry of Environment and Climate Change Strategy of BC, Forest Carbon and Climate Services Branch
14. Ministry of Environment and Climate Change Strategy of BC, Resilience and Clean Government
15. Pacific Climate Impacts Consortium (PICS)
16. Ouranos, Vulnerability, Impacts and Adaptation team
17. University of Waterloo, School of Environment, Enterprise and Development

Appendix D: Definitions

- **Adaptive capacity:** refers to the properties of a system which enable it to expand its coping range under existing climate variability or future climate conditions. It is the ability of systems, institutions, humans, and other organisms to adjust to potential damage, take advantage of opportunities, or respond to consequences.¹²²
- **Application Programming Interface:** Application Programming Interface, which is a software intermediary that allows two applications to talk to each other. Each time you use an app like Facebook, send an instant message, or check the weather on your phone, you're using an API.
- **Climate adaptation:** actions that reduce the negative impact of climate change. It involves adjusting policies and actions because of observed or expected changes in climate. Adaptation can be reactive, occurring in response to climate impacts, or anticipatory, occurring before impacts of climate change are observed. In most circumstances, anticipatory adaptations will result in lower long-term costs and be more effective than reactive adaptations.¹²³
- **Flood Insurance:** Although there are four types of flood insurance commonly understood by the insurance sector, overland flooding, sewer backup, plumbing issues, and leaking roof; in this report, “flood insurance” means the insurance only for overland flooding since other flood insurance types are not associated with flood disasters.
- **Hackathon:** it is an event to create functioning software or hardware. Hackathons tend to have a specific focus, which can include the programming language used, the operating system, an application, an API, or the subject and the demographic group of the programmers.
- **Insurance sector:** In this report, the insurance sector means insurers individually or collectively in Canada, who have the urgency, interest, and incentive to invest in or support mobilizing flood adaptation solutions. This also includes insurers struggling with their capacity to cover costs for floods and receive more than 20 per cent of claims due to flood events out of their total portfolio.
- **Looping Effect:** The looping effect describes the interaction between classifications and the targeted “kinds of people” or humankind that purportedly share behaviour and traits. The idea is that classificatory practices induce reactions in the members of the humankind by enabling new intentional ways of being and acting.
- **Mitigation:** In the context of climate change, mitigation is an anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhance greenhouse gas sinks.¹²⁴
- **Resilience:** The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the same capacity for self-organisation and the same capacity to adapt to stress and change.¹²⁵
- **Natural infrastructure** was also referred to interchangeably as green infrastructure and nature-based solutions.
- **Nature-based solutions** are actions to protect, sustainably manage, and restore natural or modified ecosystems. These solutions address societal challenges effectively while providing human wellbeing and biodiversity benefits.¹²⁶

- **Maladaptation** is actions that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future.¹²⁷
- **Non-State Actor:** An individual or organisation that has significant political influence but is not allied to any particular country or state.
- **Socioeconomic vulnerability** “refers to characteristics of a person or group that influence their capacity to prepare for, respond to, and recover from a flood hazard event.¹²⁸

Appendix E: List of Acronyms

BRACE: Building Regional Adaptation Capacity and Expertise Program

CMHC: Canadian Mortgage and Housing Corporation

CCCS: Canadian Center for Climate Services

ECCC: Environment and Climate Change Canada

FCM: Federation of Canadian Municipalities

GIS: Geographic Information System

IBC: Insurance Bureau of Canada

ICLEI: Local Governments for Sustainability

INFC: Infrastructure Canada

NAS: National Adaptation Strategy

NRCan: Natural Resources Canada

OSS: One-stop-shop

VR: Virtual Reality

Appendix F: Endnotes

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