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# Flood Risk Management: What Is the Role Ahead for the Government of Canada?

Daniel Henstra and Jason Thistlethwaite

## Key Points

- Canadians face increasing flood risk due to climate change, and greater exposure of people and property.
- Canada's traditional approach to flood management lags behind that of other countries that have adopted the principles of flood risk management.
- The Government of Canada is well positioned to offer leadership and capacity to support flood risk management, by:
  - championing a national vision and setting strategic priorities;
  - undertaking flood risk analysis to guide informed dialogue about management options; and
  - leveraging infrastructure spending to incentivize flood resilience.

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## Introduction

Globally, flooding is the most common and most costly natural hazard (United Nations 2015b). In 2016, for example, large-scale flood events in the southern United States, Western Europe and several Asian countries caused economic losses of nearly US\$30 billion<sup>1</sup> (Swiss Re Group 2016). Flood losses are widely expected to increase in the future, due to population growth and the expansion of economic activities in flood-prone areas, as well as more frequent and severe extreme weather triggered by climate change (Casey 2015; Winsemius et al. 2016).

In response, many countries have begun to embrace *flood risk management*, a strategic framework for assessing, evaluating, mitigating and sharing flood risk (Sayers et al. 2013). Flood risk management involves identifying and quantifying potential sources of flooding, engaging stakeholders to determine a socially acceptable level of flood risk, sharing responsibility and financial liability with those whose decisions and actions contribute to flood risk, and implementing a broad portfolio of policy instruments to reduce and manage flood-related impacts (Begum, Stive and Hall 2007; Klijn, Samuels and van Os 2008; Simonovic 2013). States such as the United Kingdom, Germany and the Netherlands are leaders in adopting this approach, driven in part by the European Union's 2007 Flood Directive, which mandated member

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<sup>1</sup> Unless otherwise noted, currency is in Canadian dollars.

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## About the Authors

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countries to design and implement flood risk management plans (Hartmann and Spit 2016).

In Canada, by contrast, flood management remains rooted in a traditional, hazard-based model, focused almost exclusively on the likelihood of flooding, with relatively little attention paid to its possible consequences. The "100-year flood" — a flood magnitude, which, based on historical data, is statistically expected to recur every 100 years on average — is the general design standard for most of Canada, and structural control works such as dikes and dams are intended to reduce risk to the standard flood level (Jakob and Church 2011). This approach fails to account for climate change, which is expected to reduce the return period of extreme weather events that trigger flooding (Kharin et al. 2007; Kharin and Zwiers 2005). Moreover, financial liability for flood management is concentrated: of the \$800 million in average annual uninsured losses attributed to flooding, nearly 75 percent of the burden is borne by property owners (Honegger and Oehy 2016). Finally, a narrow set of policy instruments is used to manage flood risks, which predominantly include expensive structural control works, to separate water from people and property; disaster assistance, to help flood victims recover from impacts; and some limited communications efforts, to raise public awareness.

This policy brief examines flood risk management as a potential alternative strategy, with a specific emphasis on policy priorities for the Government of Canada. It begins by identifying problems associated with Canadian flood management, which suggest the current approach is unsustainable. In the second section, the discussion moves to the principles of flood risk management and presents two examples of their implementation in other states. The third section outlines three recommendations as to how the federal government could enable and support the adoption of flood risk management. The final section offers conclusions and priorities for further policy research.

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## Canada's Outdated Approach to Flood Management

More than 80 significant flood disasters have affected various parts of Canada since the year 2000, and extreme rainfall caused more than \$20 billion in losses in urban areas from 2003 to 2012 (Kovacs and Sandink 2013; Public Safety Canada 2015). In Calgary and surrounding areas, for instance, six days of torrential rain in June 2013 triggered economic losses of more than \$6 billion (*Canadian Underwriter* 2013). The same year, record rainfall in July caused severe flooding in Toronto that inundated city streets, severed power to approximately 300,000 residents, caused more than \$940 million in insured property losses and cost the municipal government more than \$65 million for response and recovery (City of Toronto 2013; Nelson 2014).

There is mounting evidence to suggest that Canada's traditional, hazard-based approach to flood management (as described above) is no longer technically feasible or socially acceptable. First, whereas flood-related policy and planning is oriented predominantly toward riverine and coastal flooding, a growing proportion of flood-related damages in urban areas stems from sanitary sewer backup and stormwater and groundwater infiltration, which require different solutions (Kovacs and Sandink 2013; Sandink et al. 2015). Second, the capacity to anticipate and mitigate flood damages has diminished, due to outdated flood maps (Noël 2013); deferred investment in flood control structures such as dams, dikes and channels (Conservation Ontario 2013); and infrastructure design standards based on historical meteorological data, which fail to account for future climatic conditions (Auld 2008; Gibbs 2012). Finally, payments under the Disaster Financial Assistance Arrangements — a federal program that reimburses provinces and territories for a portion of disaster response and recovery costs — have increased dramatically, from an average of \$118 million per year in the period 1996–2011 to \$280 million per year in the period 2012–2015, and they are projected to increase to more than \$650 million annually over the next five years (Canada 2016).

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## Flood Risk Management: An Alternative Approach

Flood risk management is a strategic framework for dealing with flooding, which involves analyzing flood risk, appraising options and selecting policies to modify the probability and severity of flooding and to reduce the vulnerability of people, property, systems and other assets subject to potential losses (Sayers et al. 2015). Flood risk management has a number of key characteristics (Sayers et al. 2013):

- **It is informed by risk assessment.** Evaluation of the probability of occurrence and the consequences of flood events serves as the rational basis for developing and comparing alternative risk controls.
- **It incorporates a portfolio of instruments,** combining multiple technological, social, economic and institutional measures to reduce and share responsibility for flood risk.
- **It accepts that absolute protection is impossible.** The framework plans for exceedance of design standards and seeks to build resilience in all aspects of the planning process (for example, development planning, flood control structures, warning systems, building codes and so on).
- **It clarifies and shares responsibilities** and involves property owners, businesses and other stakeholders as active participants, in order to share the responsibility and financial liability.
- **It openly communicates flood risk,** informing decision makers and the public about flood risks facing communities, which enables individuals to undertake and support risk reduction.

Although regional and local authorities have critical roles to play, leadership from national governments is imperative to motivate and enable flood risk management (Traver 2014). A growing number of states around the world are moving away from the traditional, hazard-based model of engineered flood control, with national governments adopting the principles of flood risk management as the foundation for policies to reduce and manage the impacts of flood disasters. This paradigm shift has been driven, in part, by high-level policy mandates such as the European Union's 2007 Flood

Directive,<sup>2</sup> as well as the United Nations Sendai Framework for Disaster Risk Reduction, a strategic agreement that commits the national governments of member states to “prevent and reduce disaster risk” by playing an “enabling, guiding and coordinating role” and by “empower[ing] local authorities...to reduce disaster risk, including through resources, incentives and decision-making responsibilities” (United Nations 2015a, 13).

In England, for example, flood risk management has evolved over the past decade, as national policy makers have sought to decrease reliance on structural controls and adopt a more strategic, long-term approach (Johnson and Priest 2008). In 2005, the national Department for Environment, Food and Rural Affairs (DEFRA) released a 20-year policy vision, which sought to embed flood risk management across government policy and operations and to clarify the roles and responsibilities of relevant stakeholders (DEFRA 2005). Its core objectives included making the public better aware of flood risks, ensuring that the true cost of flood defences are reflected in decision making, facilitating greater local participation and adopting transparent and measurable targets and performance indicators for managing flood risks to people, property and the environment. In this document, DEFRA advocated a coherent strategy to manage all types of flooding, including fluvial (rivers and stream), pluvial (extreme precipitation), sewer backup, groundwater and coastal.

The policy shift has effectively redistributed responsibility for flood risk management among the state, various operating authorities, developers and property owners. For example, *Planning Policy Statement 25*, issued by the Department for Communities and Local Government (DCLG), requires regional and local planning and development control officers to ensure flood risk is considered in the planning process (DCLG 2009). Moreover, developers are responsible for completing a detailed flood risk assessment of proposed development sites and must undertake risk reduction measures where they are deemed necessary by development control officials. Central to the new flood risk management paradigm is the recognition that responsibility must be shared among governments, public and private stakeholders and individual

citizens, and that each of these sets of actors should play a role in both policy decisions and their implementation (Butler and Pidgeon 2011).

Alarmed by a number of major flood events in Central and Western Europe, in 2007 authorities in the Netherlands established a working group of individuals drawn from science, politics, policy and industry (the Delta Committee) to recommend improvements to flood management (Boezeman, Vink and Leroy 2013). The group’s report, *Working Together With Water*, portrayed existing flood protection as outdated and insufficient in light of projected climate change and suggested that a more comprehensive, risk-based approach to flooding was urgently needed (cited in Vink et al. 2013).

In response, a Delta Commissioner was appointed, with a mandate to work with various government ministries, regional and local levels of government, industry and citizens on a long-term program to ensure future flood safety. A first step involved setting out risk-based flood protection standards, based on a combination of cost-benefit analysis and collectively determined levels of acceptable flood-related fatality risk (Klijn et al. 2012). On this basis, a policy mandate issued by the Ministry of Transport, Public Works and Water Management in 2009 set out a three-layered approach to flood risk management, which involved a portfolio of instruments, including flood protection in the form of structural controls; “sustainable spatial planning,” based on flood risk maps, to create room for water during peak flows; and improved emergency response and recovery capacity, to reduce casualties and mitigate economic damage (Zevenbergen et al. 2013). Responsibility for implementation was divided among the national government, which regulates safety norms for primary flood defences; regional water authorities — public bodies that maintain flood defences at the basin-scale; provincial governments, which oversee spatial planning and supervise the water authorities; and municipalities, which are mandated to manage stormwater run-off and groundwater to prevent local flooding (Jong and van den Brink 2013).

These international examples offer important insights. First, flood risk management requires a national policy vision, which sets out objectives, clarifies roles and responsibilities, and identifies priorities for action. Second, responsibility for flood risk reduction must be shared with actors whose behaviour has an influence on exposure

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2 See [http://ec.europa.eu/environment/water/flood\\_risk/](http://ec.europa.eu/environment/water/flood_risk/).

and vulnerability to flooding, such as planners, developers, real estate agents, appraisers, lawyers, lenders and insurers (Treby, Clark and Priest 2006). Finally, a key to effective flood risk management is to make stakeholders and the public aware of flood risks, so that they can take protective action.

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## Policy Recommendations

The adoption of flood risk management in Canada implicates all levels of government, but the Government of Canada must play a central role. Below are three specific courses of action available to the federal government to align Canadian policy with the principles of flood risk management. These are early, foundational steps to set the stage for flood risk management; participatory processes of intergovernmental collaboration and stakeholder engagement will be required to legitimate and implement policy priorities.

### **Set strategic priorities for flood risk management.**

The Government of Canada is uniquely positioned to champion a national vision for flood risk management and to generate buy-in for its implementation across the country. With an operational presence in every region and personnel in virtually every major community, the federal government has the capacity to gather useful intelligence on the number and type of assets at risk,<sup>3</sup> the state of flood preparedness, and flood risk reduction policies and practices. If collected systematically, this information would be invaluable for identifying strategic flood risk management priorities in the national public interest. There is a clear international precedent for this national leadership: for example, in 2000, the Government of Australia published a set of best-practice principles and guidelines for flood risk management, which were influential in motivating state and local governments to adopt risk-based flood policies (Australia 2000).

**Undertake national flood risk analysis.** Effective flood risk management in Canada requires an accepted framework for estimating the likelihood and consequences of flooding, in order

to enable stakeholders to assess its expected frequency of occurrence (for example, very seldom to virtually certain) and the severity of its social, economic and environmental impacts (Black, Bruce and Egener 2010). Key sources of information include community records and media accounts of historical events and their impacts, insurance claims data, climate projections produced by government agencies and university researchers, and expert knowledge held by relevant stakeholders.

The Government of Canada has the technical capacity and policy legitimacy to undertake flood risk analysis on a national scale, and scenarios generated through this risk analysis would provide a valuable, tangible object to guide national, regional and local dialogue about management options. By setting out a standardized methodology, the federal government could reduce debate over how risk should be estimated, in order to focus attention on making coherent policy decisions and ensuring scarce resources are targeted toward areas and assets at greatest risk. Furthermore, a publicly available database of flood risk information would be useful to inform individual risk decisions and motivate property-level protection measures.

**Leverage federal spending to support flood risk management.** One of the federal government's greatest policy resources is its superior fiscal capacity and legitimacy to spend public funds to support national priorities in all parts of Canada. This "spending power" should be leveraged to enable and encourage flood resilience. For instance, the 2014 New Building Canada Fund<sup>4</sup> finances infrastructure projects in communities all across the country. Over their long life cycle, these infrastructure assets are vulnerable to stress from extreme weather, posing risks ranging from temporary interruption of services to permanent damage and destruction of exposed facilities (Chang et al. 2014; Public Safety Canada 2003). The fund's \$4 billion National Infrastructure Component — an objective of which is to reduce potential economic disruptions — requires provincial, regional and municipal applicants to confirm that a proposed project provides appropriate access for persons with disabilities and meets or exceeds energy-efficiency requirements of the Model National Energy Code. Adding a requirement to

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3 Municipalities in several provinces are required to develop infrastructure asset management plans, which could provide a valuable source of data for this purpose.

4 See [www.infrastructure.gc.ca/plan/nbcf-nfcc-eng.html](http://www.infrastructure.gc.ca/plan/nbcf-nfcc-eng.html).

assess the project's vulnerability to flooding and produce a plan for risk reduction would not be onerous and would, at a minimum, call attention to flood risk management as a development priority.

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## Conclusions

Flooding is a major global problem, and its impacts are expected to get much worse due to increasing exposure of people and property and more frequent and severe extreme weather events associated with climate change. Flood risk management offers an alternative paradigm to the traditional, hazard-based model's reliance on structural mitigation to meet static protection standards drawn from historical experience. National governments are uniquely positioned to provide leadership in crafting a shared vision of flood-resilient communities and in engaging stakeholders who have resources and responsibilities to contribute to this policy goal.

The recommendations here offer some first steps the Government of Canada can take to enable and support the adoption of flood risk management principles. However, there are many outstanding policy issues to resolve, such as the appropriate intergovernmental distribution of flood management responsibilities, the attribution of financial liability for flood losses and the risk reduction behaviour that can be reasonably expected of individual property owners. Moreover, although risk analysis offers a valuable foundation of knowledge, reducing flood risk may require contentious response strategies, such as prohibiting development in flood-prone areas or relocating people and property outside of coastal zones. These thorny matters demand open dialogue and stakeholder engagement, and important lessons can be drawn from governance models adopted by other states in the international community.

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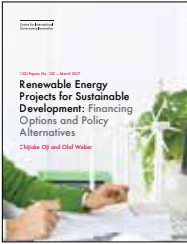
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# CIGI Publications

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### Renewable Energy Projects for Sustainable Development: Financing Options and Policy Alternatives

*CIGI Paper No. 122*  
*Chijioko Oji and Olaf Weber*

To further the dissemination of decentralized renewable energy in order to address climate change and access to energy in developing countries, finance is needed. This paper presents a summary of available options for financing renewable energy development and alternatives for policy implementation to support this process.



### Sustainability Innovation in Canadian Small Businesses: What We Need to Know

*CIGI Policy Brief No. 96*  
*Sarah Burch*

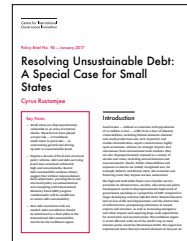
Canada has pledged to reduce its greenhouse gas (GHG) emissions by 30 percent below 2005 levels by 2030, and has developed a Pan-Canadian Framework on Clean Growth and Climate Change. Canada must seek to reduce GHG emissions while enhancing economic and environmental resilience. This policy brief examines what is known about sustainability entrepreneurship in small and medium-sized enterprises and elaborates on knowledge gaps that have stymied effective policy making.



### Economic Opportunities from a Changing Climate

*CIGI Paper No. 118*  
*Jeff Rubin*

Few countries have seen their economic aspirations frustrated by the imperatives of mitigating climate change as much as Canada, which once dreamt of parlaying its vast oil sands resource into becoming an energy superpower. However, global climate change, in conjunction with the national and international policies designed to mitigate it, will present some unique opportunities for the Canadian economy over the next several decades.



### Resolving Unsustainable Debt: A Special Case for Small States

*CIGI Policy Brief No. 94*  
*Cyrus Rustomjee*

Small states are disproportionately vulnerable to an array of external shocks, which have played a major role — in Caribbean small states in particular — in constraining growth and driving up debt to unsustainable levels. Despite policy reforms, debt and debt-servicing levels remain stubbornly high. New debt resolution tools are needed. Debt cancellation should be introduced as a third pillar in the international debt sustainability tool kit for the Caribbean region.



### Generating Growth from Innovation for the Low-carbon Economy: Exploring Safeguards in Finance and Regulation

*CIGI Paper No. 117*  
*Céline Bak*

The Paris Agreement heralded a new level of engagement on energy innovation with a commitment by 21 member countries to doubling the investment in energy innovation by 2020. Public investment in innovations related to energy and to carbon and business environment enablers that reduce barriers to the emergence of new firms have resulted in the creation of many firms whose business models are founded on innovation and whose markets are global, but whose customers and competitors are much larger incumbents.



### Managing Climate Change Risk in Coastal Canadian Communities through Sustainable Insurance

*CIGI Policy Brief No. 93*  
*Jason Thistlethwaite and Andrea Minano*

The objective of this policy brief is to assess the viability of private flood insurance in Canadian coastal communities and to identify measures necessary to expand the role of insurance as a source of disaster management in the era of climate change. The findings from this brief can be used to inform policy supporting insurability in other vulnerable communities.



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## About the Global Economy Program

Addressing limitations in the ways nations tackle shared economic challenges, the Global Economy Program at CIGI strives to inform and guide policy debates through world-leading research and sustained stakeholder engagement.

With experts from academia, national agencies, international institutions and the private sector, the Global Economy Program supports research in the following areas: management of severe sovereign debt crises; central banking and international financial regulation; China's role in the global economy; governance and policies of the Bretton Woods institutions; the Group of Twenty; global, plurilateral and regional trade agreements; and financing sustainable development. Each year, the Global Economy Program hosts, co-hosts and participates in many events worldwide, working with trusted international partners, which allows the program to disseminate policy recommendations to an international audience of policy makers.

Through its research, collaboration and publications, the Global Economy Program informs decision makers, fosters dialogue and debate on policy-relevant ideas and strengthens multilateral responses to the most pressing international governance issues.

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## About CIGI

We are the Centre for International Governance Innovation: an independent, non-partisan think tank with an objective and uniquely global perspective. Our research, opinions and public voice make a difference in today's world by bringing clarity and innovative thinking to global policy making. By working across disciplines and in partnership with the best peers and experts, we are the benchmark for influential research and trusted analysis.

Our research programs focus on governance of the global economy, global security and politics, and international law in collaboration with a range of strategic partners and support from the Government of Canada, the Government of Ontario, as well as founder Jim Balsillie.

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## À propos du CIGI

Au Centre pour l'innovation dans la gouvernance internationale (CIGI), nous formons un groupe de réflexion indépendant et non partisan qui formule des points de vue objectifs dont la portée est notamment mondiale. Nos recherches, nos avis et l'opinion publique ont des effets réels sur le monde d'aujourd'hui en apportant autant de la clarté qu'une réflexion novatrice dans l'élaboration des politiques à l'échelle internationale. En raison des travaux accomplis en collaboration et en partenariat avec des pairs et des spécialistes interdisciplinaires des plus compétents, nous sommes devenus une référence grâce à l'influence de nos recherches et à la fiabilité de nos analyses.

Nos programmes de recherche ont trait à la gouvernance dans les domaines suivants : l'économie mondiale, la sécurité et les politiques mondiales, et le droit international, et nous les exécutons avec la collaboration de nombreux partenaires stratégiques et le soutien des gouvernements du Canada et de l'Ontario ainsi que du fondateur du CIGI, Jim Balsillie.

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