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# Better Flood Maps Are Required to Protect Canadians and Their Property

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## Key Points

- Flood maps are an essential tool with which to communicate flood risk to the public, encourage property owners to purchase insurance and encourage flood preparedness.
- Existing flood maps in Canada are difficult to find, outdated and of poor quality, containing few of the characteristics that experts associate with high-quality maps.
- Canadians are exposed to significant financial risk due to a lack of useful information about flood exposure that could be communicated through maps.

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## Introduction

Flooding is a growing source of financial insecurity for Canadian households. After the 2013 floods in Alberta, for example, flooded homeowners reported average losses of more than \$78,000,<sup>1</sup> more than 60 percent of which, on average, was not covered by government disaster assistance or insurance (Haney 2017, 8). Similarly, the insurance industry indicates that the average cost of repairing a flooded basement is \$43,000 (Evans and Feltmate 2019, 1). For many Canadians — nearly 50 percent of whom are \$200 away from financial insolvency each month — experiencing a flood can have large financial implications (MNP 2019). The unexpected financial burden of post-flood repairs could raise the risk of mortgage default and personal bankruptcy. Canadians need information about flood risk in order to make decisions about flood risk and financial protection.

Flood maps are a potentially valuable resource to inform buyers about flood risk when entering a housing market. Without this information, property buyers are making investments without accounting for a significant risk. Flood maps can also motivate established homeowners to buy flood insurance or implement property-level flood protection measures. In England, for example, residents use flood maps published by the national Environment Agency as part of their research when purchasing a house and negotiating flood insurance (Rollason et al. 2018). Moreover, maps that

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<sup>1</sup> All currency in Canadian dollars.

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insurance, banking, real estate, building and investment industries. His research has been published in a number of academic and industry journals, and he is a frequent speaker and media contributor on Canada's growing vulnerability to extreme weather. Jason holds a Ph.D. in global governance from the Balsillie School of International Affairs.

show vulnerable areas are a critical decision-support tool for planners, property developers, emergency managers, insurance companies and many other stakeholders who need to consider hazards to people and property (Meyer et al. 2012).

Flood maps intended to communicate risk to the public generally seek to raise public awareness about flood impacts, impart flood preparedness advice and increase transparency about government actions for reducing flood risk (Hagemeyer-Klose and Wagner 2009; Kellens et al. 2009; Minano and Peddle 2018). However, flood maps designed for this purpose must ensure that target audiences are able to understand and correctly interpret the information presented (Van Kerkvoorde et al. 2018).

How suitable are Canadian flood maps for communicating risk to the public? This policy brief presents findings from a research study that assessed the quality of flood maps available to the public in 280 municipalities located in designated flood risk areas across Canada. The results indicate that flood maps are difficult to find and generally do not include fundamental design features that experts associate with high-quality maps. Recommendations are offered to improve flood maps and to make them more accessible to public audiences.

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## Background

Flood maps were recognized as an important public policy tool more than 40 years ago in Canada, as exemplified by the launch of the Flood Damage Reduction Program (FDRP) in 1975. The FDRP was initiated as a response to escalating disaster assistance costs and a recognition that structural barriers, such as dams, were too costly and were insufficient to eliminate flood losses (de Loë and Wojtanowski 2001). Through a joint effort of the federal and provincial governments,<sup>2</sup> flood maps were created for more than 900 communities, which were then designated as “flood risk areas” in which future development would be discouraged (Canada 2013). The Government of

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<sup>2</sup> Prince Edward Island and the Yukon were not a part of the FDRP. Nunavut did not become an independent territory until 1999 and was also not part of the FDRP.

Canada also vowed that any new development in these designated areas would not be eligible for disaster assistance, in order to discourage Canadians from settling on these exposed lands.

The program resulted in a series of “engineering maps” and “public information maps” that had different characteristics. The engineering maps were designed to accurately delineate the flood risk areas and were meant for local and provincial government officials. Public information maps depicted the approximate location of the flood risk areas, as well as some local features, such as roads and bridges, in order to share information with the public.

Despite the FDRP’s success in mapping flood risk areas and in increasing awareness of flood exposure, the federal government phased out the program in the late 1990s. Experts warned that a lack of federal leadership could mean the “possibility of a return to escalating flood damages and disaster assistance payments” (de Loë 2000, 364). Indeed, since the FDRP’s cancellation, flood losses have increased in Canada, due in part to continued development in flood-prone areas, as well as to population growth and climate change.

Recent floods have been among the costliest disasters on record, such as the Alberta floods in 2013 that were assessed at approximately \$5 billion. New flood risk models produced by the insurance industry estimate that as many as 20 percent of residential properties in Canada have some vulnerability to flood (Insurance Bureau of Canada 2018). To offset flood losses, the federal government is both investing in risk reduction initiatives and supporting the development of a residential flood insurance market (Public Safety Canada 2017). Public access to flood risk information has been identified as a priority to encourage greater responsibility among property owners, particularly given the increasing risk associated with urban flooding in residential areas.

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## Accessing Flood Maps

This study centred on the 957 designated flood risk areas compiled during the FDRP. A random sample of 369 communities was drawn from the total list, which captured communities in all provinces and territories that were part of the FDRP (Table 1). Because some communities had

**Table 1: Number and Percentage of FDRP Communities Analyzed by Province or Territory**

| Province/Territory        | Number of FDRP Communities (Total) | Number of FDRP Communities Analyzed | Percentage Analyzed |
|---------------------------|------------------------------------|-------------------------------------|---------------------|
| Alberta                   | 16                                 | 4                                   | 25%                 |
| British Columbia          | 216                                | 86                                  | 40%                 |
| Manitoba                  | 25                                 | 10                                  | 40%                 |
| New Brunswick             | 84                                 | 35                                  | 42%                 |
| Newfoundland and Labrador | 24                                 | 11                                  | 46%                 |
| Northwest Territories     | 10                                 | 5                                   | 50%                 |
| Nova Scotia               | 24                                 | 9                                   | 38%                 |
| Ontario                   | 273                                | 105                                 | 38%                 |
| Quebec                    | 265                                | 98                                  | 37%                 |
| Saskatchewan              | 20                                 | 6                                   | 30%                 |
| Total                     | 957                                | 369                                 | 39%                 |

Source: Authors.

changed in name or structure since the FDRP, the designated communities were matched with their 280 present-day municipalities.

Unlike many of Canada’s counterparts in the Organisation for Economic Co-operation and Development, such as the United Kingdom and the United States, Canada does not distribute flood maps through a single repository such as an online portal, where citizens across the country could search their postal code to view a flood map with information relevant for their location (Federal Emergency Management Agency [FEMA] 2019; United Kingdom 2019). As such, the authors conducted online searches for each municipality, focusing on the webpages of the individual community, its regional or provincial watershed authority (as applicable), the respective provincial website and an additional Google search using both the municipality name and “flood map” (for example, “Calgary flood map”). The search was completed in July 2018.

Finding a flood map for a community of interest is not an easy task in the Canadian context. Although flood maps were found for 85 percent of communities, locating them was not intuitive and the process varied by province. In New Brunswick, for example, the provincial government maintains an online portal where flood maps are published for multiple municipalities. In Ontario, flood maps are held largely by regional watershed management

agencies called conservation authorities, so a resident would first need to know the conservation authority that governs the territory in which their property is located, and then look up the corresponding flood map. In Nova Scotia, flood maps are part of planning documents located on municipal websites. Even in provinces and regions with online map portals, the search panels were challenging to navigate, requiring a series of steps that could be beyond the capability of a lay user.

Flood maps were not found for 41 municipalities (15 percent) in the study area. Most municipalities lacking available flood maps were in Ontario. In many of those communities, researchers found maps that depicted “development regulated areas,” but these did not meet the operational definition of “flood map” (i.e., the map did not clearly label flood-prone areas).

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## Evaluating the Quality of Flood Maps in Canada

In addition to assessing the availability of flood maps, the quality of publicly accessible flood maps were evaluated according to a set of criteria. The study focused on key characteristics

important for public risk communication, specifically, how a map informs the public about flood risks and motivates individuals to take precautionary actions (Hagemeyer-Klose and Wagner 2009). Based on a scan of international literature, an evaluation framework consisting of nine design criteria was compiled (Table 2). In combination, these characteristics make a flood map effective for risk communication, because they identify an individual property’s flood risk, create relatable depictions of flood impacts on communities (for example, using photographs), assist users in understanding the flood map and its limitations and establish connections between hazards and risk mitigation actions.

The framework was used to evaluate each flood map according to the nine criteria. A flood map was assigned a value of “1” if the criterion was met or “0” if the criterion was not met. If the flood map met all nine criteria, it would receive an overall score of nine out of nine (100 percent). Although the criteria were not weighted by importance, due to limitations in existing scholarship in this area, doing so has been highlighted as a future research priority.

The study’s key finding is that publicly available flood maps in Canada are unsuitable for communicating flood risk to the public. In the sample, 62 percent of flood maps scored less than 50 percent (i.e., they met four or fewer of the nine criteria) (Figure 1). Most critically, less than 50 percent of municipalities had flood maps that would enable users to identify their property, so they are of little use to individuals trying to determine if they are at risk. Similarly, less than half of the maps included advice on what residents could do to reduce or manage their flood risk — and so missed making an important link between risk and actions. Furthermore, by failing to connect property-level flood risk information with advice about risk reduction, the current flood maps do not support the federal government’s objective of facilitating a private flood insurance market.

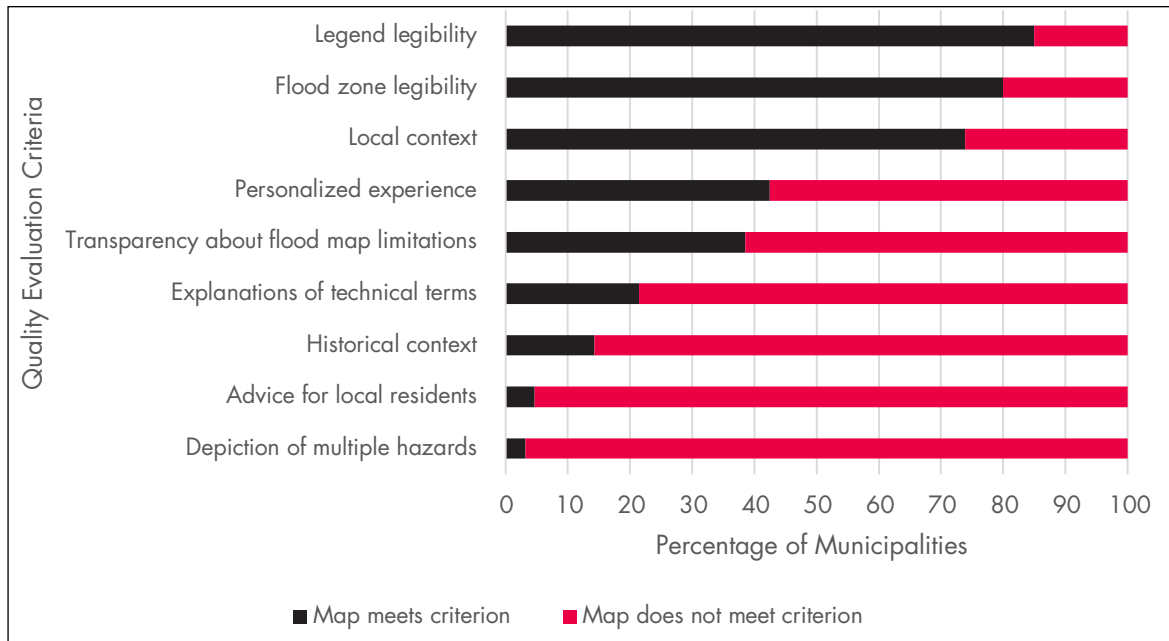
Most maps depicted a limited view of flood risk. Most focused exclusively on riverine flooding, and very few included other types of flooding, such as pluvial flood hazards, that can occur in places far from rivers and coasts. This limitation could instill a false sense of security for users who do not know there are other types of flooding or that flooding can still occur outside of a modelled floodplain. Most maps used technical

**Table 2: Characteristics of Effective Flood Maps**

| Characteristic                                      | Description  |
|---|--|
| Personalized experience                             | Users can find information specific to their property (for example, searchable by postal code)                               |
| Local context                                       | Identifiable places or landmarks that help users visualize the likely spatial extent of flooding                             |
| Historical context                                  | Depictions of past floods (for example, photographs; victim testimonials) to help users understand potential impacts         |
| Legend  | Clear explanation of lines, symbols, colours and terminology   |
| Legible   | Easy for the user to distinguish the extents of the flood zone   |
| Explanation of scientific and technical terminology | Meaning of terms (for example, 100-year flood zone) is understandable to a lay audience                                      |
| Transparent about the limitations and uncertainty   | Exposure of adjacent areas and potential expansion of inundation zone due to climate change or other factors is acknowledged |
| Holistic view                                       | All forms of flooding (for example, coastal, riverine and pluvial) are depicted  |
| Risk reduction advice                               | Information provided on subjects such as evacuation, property-level protection and insurance                                 |

Source: Authors.

**Figure 1: Characteristics of Publicly Accessible Flood Maps**



Source: Authors.

terminology (for example, 100-year floodplain), which can be useful for sharing information between informed parties, such as conservation authorities, municipal planning departments and land developers, but can be easily misinterpreted by a non-expert (for example, a 100-year flood is not necessarily a “once in a lifetime” event).

## Policy Recommendations

The study presented here highlights the limitations of Canada’s publicly accessible flood maps for communicating risk to the public. Flood maps are difficult to find, outdated and generally lack the characteristics that experts associate with high-quality maps, including personalized experience, local context, historical context, legend legibility, flood zone legibility, explanation of technical terms, risk reduction advice, transparency about flood modelling limitations and depiction of multiple flood hazards. Considering these findings, the following recommendations are offered:

**Establish an intergovernmental partnership to produce high-quality, publicly accessible flood risk maps.** Canadians are exposed to significant financial risk due to a lack of useful information

about flood exposure that could be communicated through maps. Canada needs a renewed effort to produce maps that inform the public about flood risks and motivate individuals to take precautionary actions, particularly in light of scientific predictions that flooding will increase in a changing climate (Burn and Whitfield 2018; Gaur, Gaur and Simonovic 2018). Flood maps should depict various types of flood hazards (for example, fluvial and pluvial flooding) and flood risk categories (for example, high risk). Risk information and advice on what a homeowner can do should be tailored to individual properties (for example, via a postal code search).

An intergovernmental partnership is desirable for several reasons. First, provinces clearly vary in their willingness and capacity to create flood risk maps, so a joint federal-provincial-territorial effort would harmonize the content and quality of maps nationwide. Second, a joint national mapping initiative would enable the systematic collection of metrics about the maps, such as their age, geographic extents and information limitations, which would be useful for making improvements to flood maps in the future. Finally, establishing which level of government is responsible for publishing flood maps for public use (for example, federal or provincial websites) would make it easier for property



owners and many other stakeholders to locate maps and integrate them into decision making.

**Better integrate flood maps into decision-making.** High-quality, publicly accessible flood risk maps are a starting point for a more comprehensive and holistic approach to flood risk management. To be effective, however, they must be used to inform decision processes that affect flood exposure and vulnerability, such as land use planning, real estate transactions, home improvements and mortgage lending.

In the United States, for instance, those purchasing a home in a designated flood risk area with a federally backed mortgage are required to purchase flood insurance. The federal government distributes official Flood Insurance Rate Maps that determine which properties are subject to mandatory flood insurance and at what premium rate. The result is a transparent system of risk zones that enables buyers to make more informed choices.

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