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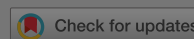
Articles


Public relief and insurance for residential flood losses in Canada: Current status and commentary

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of very high-risk households and improve the quality and accessibility of flood loss data. Furthermore, households will have to become better informed of the specifics of insurance coverage and bear a portion of flood losses through risk-based insurance pricing and conditions.

Les ménages affectés par des inondations au Canada doivent compter sur le support d'un réseau d'assistance complexe, complémenté par une couverture d'assurance partielle, afin de recevoir de l'assistance suite à une inondation. Récemment, une demande s'est fait sentir pour une évaluation du rôle que pourraient avoir les assureurs privés en ce qui a trait aux pertes dues aux inondations résidentielles. De nombreux défis sont cependant associés aux couvertures d'assurances contre les pertes dues aux inondations. Une des façons d'accroître la viabilité de l'assurance contre les inondations est d'inclure des couvertures d'assurance couvrant une variété de types d'inondation, de limiter la couverture pour les ménages à très haut risque et de mettre en œuvre une couverture basée sur les niveaux de risques. Afin d'être efficaces, les couvertures d'assurance contre les inondations devront exiger que les ménages, les assureurs et les gouvernements participent à la réduction des risques d'inondations. Les gouvernements devraient également travailler en partenariat avec les assureurs afin de développer une approche nationale cohérente évaluant les risques d'inondation à l'échelle du pays. Cette évaluation devrait considérer la variété de types d'inondations qui affectent les ménages canadiens, supportant à la fois une approche non structurale

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Introduction
Private insurance and flood disaster recovery
Flood disaster recovery

coverage is available for most natural hazards that present a risk to homeowners in Canada, such as wind, earthquake, tornado, structural and wildland fire, winter storms, hail and lightning. Further, commercial and automobile insurance policies frequently cover damages associated with overland flooding; however, private insurance for damages associated with coastal and riverine flooding is presently excluded from virtually all homeowner insurance policies (Sandink et al. [2010](#); Lamond and Penning-Rowell [2014](#)). By providing financial assistance for losses from uninsurable perils, disaster relief programs provided by provincial and territorial governments are an important component in flood recovery and rebuilding processes across Canada. Further, Shrubsole ([2000](#), 17) stated that “in providing flood relief, we support flood victims...this generosity is often a measure of a caring society.”

Flood insurance is available in most developed countries, including the United States, the United Kingdom, Germany and France. Flood products have been offered in these countries despite considerable technical barriers to flood insurance, including lack of randomness and mutuality of flood losses, resulting in adverse selection and low economic viability of coverage (Paklina [2003](#); Mehlhorn and Hausmann [2012](#); Lamond and Penning-Rowell [2014](#)). Despite the challenges associated with insuring flood, Canada’s federal government (Government of Canada [2014](#)), the Government of Alberta (Government of Alberta [2014](#)) and the National Round Table on Environment and Economy (NRTEE [2011](#)) along with non-government commentators (for example, Alberta [2014](#)) have all called for a review to review the role of flood insurance in the federal budget (Government of Canada [2014](#)).



The provincial governments have also explored the role of flood insurance and damages in

Feltmate [2013](#); Feltmate and Thistlethwaite [2014](#); Lamond and Penning-Rowse [2014](#)). The Insurance Bureau of Canada (IBC) noted that Canadian insurers are also facing significant damages associated with covered flood perils – specifically sewer backup flooding in residential basements in most of Canada (IBC [2014a](#), [2014b](#)). Homeowner losses from groundwater flooding and some types of overland flooding are also frequently insured in Quebec (IBC [2009a](#), [2009b](#)). Thus, the private insurance industry is already a key player in financing recovery following some types of residential flood events in Canada.

There are benefits and drawbacks for both insurance and government relief approaches to financing recovery following a flood. Disaster relief assistance is helpful for those who do not have the resources to recover from disaster events, and spending of financial aid within an affected community can assist in triggering community-wide economic recovery (Tobin and Montz [1997](#)); however, public relief programs have been criticized for shifting individual losses associated with disasters to the wider tax-paying population and limiting incentives for property-level mitigation (Handmer [1990](#); Barnett [1999](#); Anderson [2000](#); Paudel [2012](#)). Moreover, government disaster relief programs are designed to provide relief and do not seek, like insurance, to restore homeowners to a condition similar to that before a flood event. Public misperceptions about the comprehensiveness and adequacy of public disaster relief may deter individuals from adopting mitigation measures (Mileti [1999](#)). Further, the inconsistency of disaster relief

coverage, the high threshold for disaster relief, and the limited amount of relief by disaster

Private insurance exists when the policyholder will engage in mitigation. Longnecker and Barriaguer (2008) is a study that shows that, as a result of the increase in the availability of insurance, the insurance industry

This paper examines the transfer of risk from the insurance industry to the government



programs. The paper concludes with a discussion of challenges and opportunities associated with current approaches to flood disaster assistance and water damage insurance, and challenges and opportunities associated with increasing the role of private insurance in flood recovery. The focus of this paper is on public relief and private insurance for residential flood losses.

Flood disasters and losses

From 1983 to 2013, the Canadian Disaster Database recorded a total of 450 meteorological and hydrological disasters. Flooding was by far the most frequent cause of disasters during this period, resulting in a total of 169 disaster events (Table 1). Flood disasters result in significant losses in Canada. Numerous severe flooding events have exceeded CAD \$40 million in damages since 1996 (Table 2). In 2015, Public Safety Canada (PSC) reported that Disaster Financial Assistance Arrangements (DFAA) payments to provinces totaled approximately CAD \$3.4 billion since program inception in 1970, and that 190 of the 210 events that resulted in DFAA payouts were caused by flood (PSC 2015c, 2015d).

Table 1. Top five causes of hydrological and meteorological disasters in Canada, 1983 to 2013, from the Canadian Disaster Database

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Table 2. Total damages in millions of dollars from 1996 to 2013, by disaster type

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Data available from the Canadian Disaster Database illustrate the growing impact of disasters in Canada. As shown in the DFAA program, the data revealed that

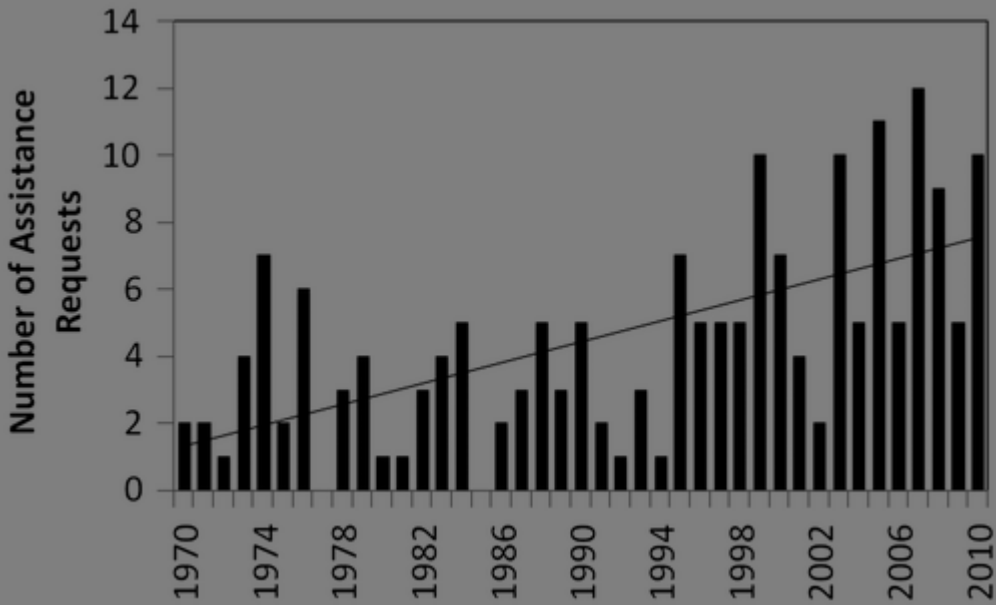
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to 2011, the average annual payment grew to \$118 million, and increased to \$280 million in 2012-2013” (PSC [2015d](#)).

Figure 1. Number of requests for Disaster Financial Assistance Arrangements (DFAA) assistance from 1970 to 2010.

Source: Public Safety Canada (PSC [2011](#), 8).



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Due to the proprietary nature of property and casualty (P&C) insurance industry loss data, specific figures on insurance industry losses for insured homeowner water damage associated with flooding are not available. However, the Insurance Institute of Canada (IIC) (2011) report stated:

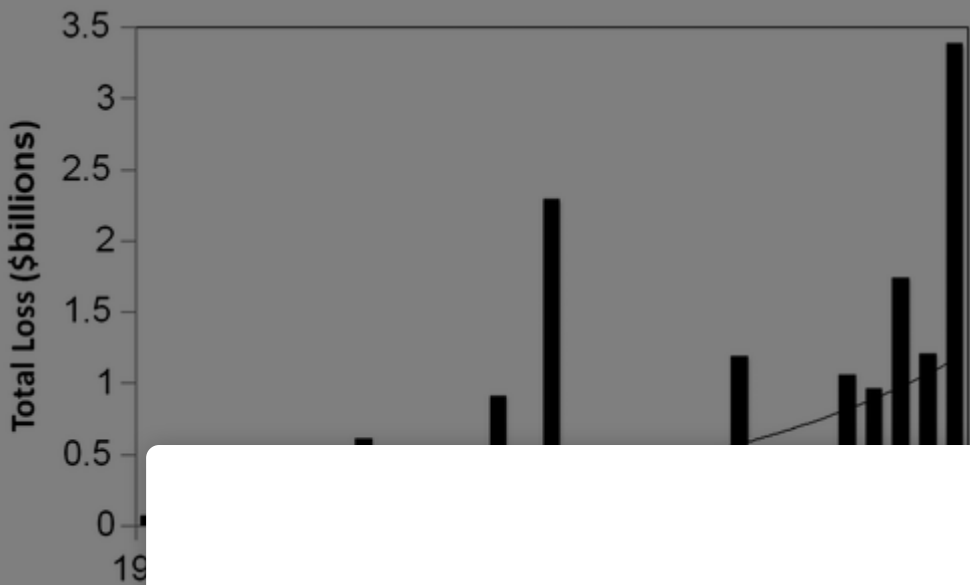


Other insurance industry reports have identified water damage as a driver for increased claims. For example, the Insurance Institute of Canada (IIC) (2014) reported that water damage claims are associated with

natural catastrophe-related payouts in the past decade, much of which has been associated with flooding and extreme rainfall events in large, urban municipalities (Figure 2).

Figure 2. The Insurance Bureau of Canada (IBC) notes a steady increase in the costs of natural catastrophes for the Canadian insurance industry. Overall catastrophic losses recorded by the industry approached or exceeded CAD \$1 billion* in 1998, 2005, 2009, 2010, 2011, 2012 and 2013, though IBC (2014a) notes a change in data collection methods starting in 2009. At over \$3 billion in losses, 2013 saw the greatest amount of natural catastrophe-related damages since the industry began recording figures in 1983. Much of the damage experienced in 2013 was associated with riverine and extreme rainfall related flooding in southern Alberta and southern Ontario.

Source: IBC (2014a).



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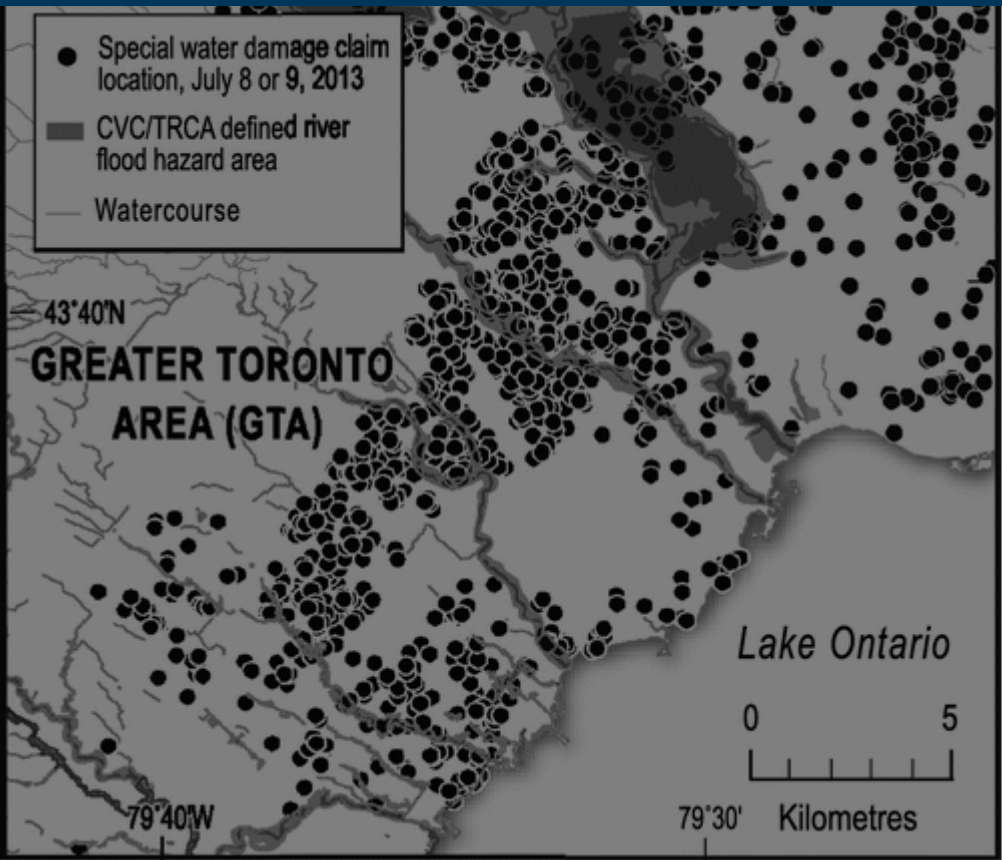
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insured losses, making it the third most expensive insured loss event in Canadian history (IBC [2014a](#)). The insurance industry has also experienced severe losses from recent extreme rainfall events in Thunder Bay and Montreal in 2012 (CAD \$262 million), the GTA in 2005 (\$717.8 million), Edmonton in 2004 (\$194 million) and Peterborough in 2004 (\$102.4 million), amongst several other events across the country (IBC [2014a](#)). Since sewer backup coverage is widely available and overland and groundwater flood losses are uninsured for most Canadian homeowners, a significant portion of the property losses experienced during these events can be attributed to sewer backup. Further, the initial estimate for insured damages associated with the 19 August 2005 GTA extreme rainfall and flood event was CAD \$500 million (IBC [2006](#)). Of this total, approximately \$247 million was associated with sewer backup damages (Sandink [2007](#)). Subsequent surveys of insurance providers revealed that total damages were estimated \$625 million (2005 CAD) (IBC [2014a](#)).

Another important feature of recent large-scale flood loss events has been the geography of damages. A sample of homeowner insurance claim data from the 8 July 2013 extreme rainfall flood in the western GTA indicate that most of the losses that occurred during this event were outside of formally defined riverine flood hazard areas (Figure 3). While the historical emphasis of public flood-prevention programs has been on riverine flooding, the distribution of losses associated with the GTA flood suggest the need for similar prevention programs by public and private agencies to better address sewer backup

Figure 3. Map of the western Greater Toronto Area (GTA) showing the distribution of sewer backup losses (green dots) and approved plumbing casualty (red dots) from the 8 July 2013 extreme rainfall flood event. The map also shows the River flood hazard area (blue line) and the Region of York (grey area).





Homeowner insurance coverage for flood: current status

The current homeowner insurance regime for water and flood is complex. With more than 300 Canadian Council of Financial Institutions, there is often variation in the conditions of some water damage policies. There is often purchasing intention to offer homeowner insurance, and tenants, the vast majority of the overflow.

There are a number of different flood types that affect residents, notably those who occupy ground-related homes (homes with below-ground foundations and basements). Floodwaters may enter homes via the surface of the ground (overland flooding) through foundation walls and basement floors (seepage or infiltration flooding) or through underground wastewater or stormwater management systems (sewer backup) (Sandink [2014](#)). As described in Table 3, the specifics of available coverage depend on region and flood type.

Display Table

individual households. The nature of a specific insurance policy may be affected by the claims history and location of the household. In some circumstances, homeowners may not be offered optional sewer backup endorsements if they are considered to be at high risk of loss – a determination likely made based on the claims history of the policyholder and the frequency of sewer backup claims in a policyholder's neighbourhood (typically defined by forward sortation area or postal code) or municipality (Applied Systems [2013](#); Friedland et al. [2014](#)), although the high-level of competition in the industry means that high-risk households denied sewer backup coverage by one insurance provider may be able to find coverage from another provider.

The insurance regime for flood and water damage is complicated when contrasted with the availability of coverage for a wide variety of other perils, including wind damage, structural and wildland fire, hail and lightning. Comprehensive automotive coverage typically covers losses associated with overland flooding. Commercial entities in Canada are frequently offered overland flood coverage, and homeowner flood insurance is available in most other developed countries, including Austria, Australia, Belgium, Spain, Switzerland, the United States, the United Kingdom, France and Germany, among many other countries (Sandink et al. [2010](#); Lamond and Penning-Rowsell [2014](#)), potentially leading to the assumption by the general public that flooding is insured. Indeed, national surveys have revealed that anywhere from 21% to 70% of homeowners cited in Sandink et al. (2010) and Lamond and Penning-Rowsell (2014b) revealed that they had flood insurance coverage.

Limited coverage for flood damage was reflected in the results of the June 2013 survey of homeowners. For example, the majority of respondents indicated that they had flood coverage (70%). However, the majority of respondents indicated that they had not read the terms and conditions of their policy (70%). CTV News reported that the majority of respondents indicated that they had not read the terms and conditions of their policy (70%).

The insurance industry has been criticized for its lack of transparency and accountability. The insurance industry has been criticized for its lack of transparency and accountability. The insurance industry has been criticized for its lack of transparency and accountability.



peril to be insurable (Table 4). With respect to flood, the condition of similarity of threat can be easily met, as water is the primary driver of damages during flood events (Hausmann [1998](#); Sandink et al. [2010](#)); however, the conditions of assessability, mutuality, randomness and economic viability are difficult to meet (Hausmann [1998](#); Mehlhorn and Hausmann [2012](#)). A 2013 survey of Canadian insurance leaders found that the primary reason insurance companies do not presently provide residential flood insurance is because of the difficulty of assessing the risk of damage (Thistlethwaite and Feltmate [2013](#)).

Table 4. Five conditions that must typically be met for a peril to become insured. With respect to flood insurance, the conditions of mutuality, assessability, randomness and economic viability make the provision of flood insurance difficult.



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Mutuality has been cited as a particularly difficult condition to meet for flood insurance, as only a relatively small number of households occupy formally defined flood hazard areas (Mehlhorn and Hausmann [2012](#)). Mutuality relates to the economic viability of insurance. If only a small number of households are exposed to flood risk, the community of insured households would be too small to cover losses from a large flood event. E... in area
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An alternative approach to optional flood insurance coverage is to bundle flood coverage with other insured perils. This approach has been adopted in France, Israel, Japan, Portugal, Spain, Switzerland and the United Kingdom (Sandink et al. [2010](#); Paklina [2003](#)). Bundling contributes to economic viability, as it allows insurers to spread losses across time, across a number of different perils and across areas exposed to differing levels of risk (Penning-Rowsell and Pardoe [2012](#)). Bundled coverage also allows for the creation of a large insurance community, overcoming the problem of limited mutuality, and addresses the problem of adverse selection (Crichton [2008](#); Sandink et al. [2010](#)).

International approaches to flood insurance

To highlight several of the challenges and opportunities associated with insuring flood in Canada, international examples of flood insurance programs are briefly reviewed here. The provided examples are classified as private, bundled flood insurance coverage (United Kingdom), public, optional flood coverage (United States), public, compulsory/bundled coverage (France) and private, optional coverage (Germany) (Sandink et al. [2010](#); Mehlhorn and Hausmann [2012](#); Lamond and Penning-Rowsell [2014](#)). These examples illustrate that no single flood insurance arrangement is viewed as ideal.

Private and bundled: the United Kingdom

In the UK, flood insurance is offered by private insurers. The first private flood insurance scheme was established in 1961 between the UK government and private insurers. This scheme was available to homeowners in high-risk areas if they agreed to certain land-use restrictions. The scheme was a reinsurance scheme for private insurers (Priest 2003). The scheme was a risk-based scheme, meaning that the premium was based on the risk of flooding. The scheme was a public-private partnership, meaning that the government and private insurers shared the costs and benefits of the scheme.

While the UK scheme was a public-private partnership, the bundling of flood insurance with other perils was not. The bundling of flood insurance with other perils was a key feature of the UK scheme, as it allowed insurers to spread losses across a number of different perils and across areas exposed to differing levels of risk. The bundling of flood insurance with other perils was a key feature of the UK scheme, as it allowed insurers to spread losses across a number of different perils and across areas exposed to differing levels of risk.

(Crichton [2002, 2005](#); Huber [2004](#)). It has also been argued that premiums often do not correlate well with flood risk, and cross-subsidization occurs for some high-risk insureds with older contracts; however, newer contracts may exclude coverage for high-risk insureds (Mehlhorn and Hausmann [2012](#); Penning-Rowsell and Pardoe [2012](#)). Insurers and the government are currently working toward introducing a risk-sharing pool that subsidizes flood coverage for high-risk properties, called Flood Re. Flood Re will cover an estimated 350,000 homes that are currently facing prohibitively expensive premiums (Association of British Insurers [2014](#)).

Public and optional: United States National Flood Insurance Program

In the United States, federal, state and local governments deliver the National Flood Insurance Program (NFIP) in cooperation with private insurers (Burby [2001](#)). The federal government provides a financial backstop for the program, sets premium rates and identifies flood hazard areas. Local and state governments regulate land use and development in flood hazard areas. Insurers sell policies to homeowners in eligible communities on behalf of the government but do not bear any of the risk (Burby [2001](#); Lamond and Penning-Rowsell [2014](#)).

Since only those living in high-risk, 1-in-100-year Special Flood Hazard Areas (SFHAs) are either required or have an incentive to buy flood insurance, adverse selection is promoted by the NFIP. Further, the risk pool is fragmented through the NFIP for households in different communities. Federally regulated communities that participate in an NFIP are required to sell NFIP policies. Communities that do not sell NFIP policies are considered nonparticipating communities. Estimates of flood damages are based on the Account of Flood Damages and Losses. Adverse selection is a result of the resulting risk pool. Households that are subsidized by the program, the example, is the NFIP program, the



was USD \$24 billion in debt to the US Treasury following recent significant loss events, including Hurricane Katrina (2005) and Superstorm Sandy (2012) (Kousky [2011](#); Government Accountability Office [2014](#)).

Public and compulsory: France

In France, coverage against flood and other natural hazards is included in standard home insurance policies sold by private insurers. Home insurance is mandatory, making flood insurance penetration nearly universal (Michel-Kerjan [2010](#); Lamond and Penning-RowSELL [2014](#)). Coverage is provided by private insurers, who are offered the option of purchasing reinsurance through a state-owned reinsurer (the Caisse Centrale de Reassurance or CCR), which is in turn supported by a government backstop (IBC [2014b](#)). The government prescribes a single rate, independent of risk, for insurers to charge customers to cover the catastrophe portion of the policy (Michel-Kerjan [2001](#)). While the program has provided flood coverage to a large section of the public, prescription of a single rate limits incentives to mitigate risk by policyholders (Lamond and Penning-RowSELL [2014](#)).

Private and optional: Germany

In Germany, natural hazards insurance, which includes flood coverage, is offered by private insurers as an optional supplement to home insurance policies. While home insurance is compulsory, natural hazards insurance has been optional since 2005 (Hudson [2012](#)). Estimates have been made that only 10% of German households have taken out natural hazards insurance (Hudson [2012](#)). While the proportion of German households with flood insurance has increased since 2005, it remains low (Hudson [2012](#)).



While the example of Germany shows that a public approach can be successful, it also follows the example of the United States in that it is not a public approach. The approach toward returning to a public approach, while not a public approach, is a public approach. The approach toward returning to a public approach, while not a public approach, is a public approach. The approach toward returning to a public approach, while not a public approach, is a public approach.

Despite their similarities, several characteristics of disaster assistance programs add to the complexity of residential flood recovery. These characteristics include differences in total funds that are made available to individual claimants, and determination of conditions for triggering of relief payouts to individuals and communities affected by disaster events.

Federal disaster financial assistance arrangements

Table 1: Summary of the financial and inflation data for the period 1990-2010. The table is divided into two main sections: Financial Data and Inflation Data. The Financial Data section includes columns for Year, GDP (Billion USD), and Inflation Rate (%). The Inflation Data section includes columns for Year, CPI (Index), and Inflation Rate (%). The table is sourced from the Federal Reserve Bank of St. Louis and the Bureau of Economic Analysis.

Provinc

Provincial and territorial (P/T) programs typically provide partial assistance for essential items and primary residences that were damaged by uninsurable perils, such as riverine and coastal flooding. Differences exist with respect to total payout caps, deductibles and the proportion of eligible losses that will be covered by P/T programs (Table 6).

Table 6. Summary of key financial characteristics of provincial/territorial disaster financial assistance programs, individual and family components.



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Available funds

Several provincial programs place limits on total payouts that may be made to individuals and families. These limits vary considerably across the country. For example, total payout amounts range from a high of CAD \$300,000 in British Columbia to \$80,000 in most of the Atlantic Provinces, while other programs, including programs in Alberta and Ontario, do not specify maximum coverage amounts (Table 3). While the Quebec program provides a maximum payout amount for structural damages to homes, coverage is provided for essential items based on an itemized list of pre-set payout amounts. For example, the payout for a living room rug is \$1650 for essential items is \$1650 for Alberta (2012).

While the cap, it does not specify a specific payout for a disaster. The committee are recommended that the committee be composed of local representatives. The committee has been successful in securing CAD \$2 for every individual. (Government of Alberta, 2012). Several individuals



Columbia, New Brunswick, Prince Edward Island and Nova Scotia (Table 3). In situations of “severe hardship,” individual applicants in New Brunswick may apply to have the \$1000 deductible waived (Government of New Brunswick [n.d.](#), 1). Some programs further specify a proportion of eligible losses that will be covered by the programs. Eligible payout proportions range from 80% in British Columbia, Manitoba and the Northwest Territories, to 95% in Saskatchewan (Table 3).

Triggering of disaster relief programs

Triggering thresholds for P/T disaster relief programs differ across the country. For example, Saskatchewan's program allows local authorities to request assistance if an eligible disaster caused "one eligible claimant" to sustain uninsurable losses exceeding CAD \$5000 (Government of Saskatchewan [2014](#), 2), while most other programs trigger as a result of widespread damage (Government of Ontario [2009](#); Government of Prince Edward Island [2011](#); Government of British Columbia [2012](#); Government of Newfoundland and Labrador [2015](#)). For example, the New Brunswick program would apply when the disaster event "caused significant loss to a wide sector of the community as a whole" (Government of New Brunswick [2012](#), 1). Triggering of Newfoundland and Labrador's program occurs on a "case by case basis...in response to abnormal events...in a defined geographical area" resulting in "widespread damage..." (Government of Newfoundland and Labrador [2015](#), 3). Alberta's program guidelines

state that the model is “extraordinary” and that the model is based on loose thresholds. The model is based on extraordinary thresholds.



The lack of empirical evidence on the impact of the program has led to criticism (Anderson [2000](#); Deaton [2009](#)). Deaton and Cartwright (2018) found that the program had a small, but significant, positive impact on

assistance that was provided to affected communities in the United States (Downton and Pielke [2001](#); Garrett and Sobel [2002](#)). While the political economy of disaster assistance programs in Canada remains unstudied, relatively loose triggering thresholds identified in the majority of P/T assistance programs add a further level of uncertainty for individuals who have been affected by flood disaster events.

Government assistance and post-disaster mitigation

The post-disaster/recovery phase is one of the most effective times to implement mitigation measures and reduce vulnerability to future events (Berke et al. [1993](#)). At the same time, it has been argued that disaster relief assistance programs may lead to perpetual states of damage and repair, as these programs are typically aimed at returning affected individuals to “pre-disaster” condition (Park and Miller [1982](#); Tobin and Montz [1997](#); Barnett [1999](#)). It has further been argued that the expectation of government disaster relief creates moral hazard, serving to limit the willingness of individuals to engage in risk-reducing behaviour and increasing the likelihood that they will occupy hazard-prone areas (Shughart II [2011](#)). To counter these arguments, a positive trend in both federal and P/T disaster assistance programs is the incorporation of mitigation clauses, incentives and requirements.

Since 2008, the DFAA may provide an additional disbursement to mitigate disaster risk, on top of disaster relief programs. The program guidelines state that “mitigation enhance vulnerability to future disasters” and “the value of the investment is the estimated cost of replacement of the property for events.” Innovative measures may not exceed the eligible amount (PSC [2007](#), 16). The DFAA also excludes areas if they are not vulnerable to flooding (PSC [2007](#)).



Several provinces have also incorporated post-disaster mitigation assistance into disaster relief programs. For example, additional disbursements of 15% of disaster payouts for mitigation measures are applied in Nova Scotia, and Newfoundland and Labrador (Government of Nova Scotia [2013](#); Government of Newfoundland and Labrador [2015](#)). Incorporation of mitigation into disaster assistance was also applied in Alberta following the June 2013 flooding, where eligible homeowners could receive 15% in additional funding up to CAD \$10,000 (if not more) to incorporate basic flood mitigation measures into properties, including moving electrical panels out of basements and incorporating sewer backflow prevention measures into homes (Government of Alberta [2013a](#), [2013b](#)). Mitigation of future loss is also incorporated in the British Columbia program for claimants who have experienced repeated losses (Government of British Columbia [2012](#)), and flood-affected individuals in the Northwest Territories are “expected to restore their property” to “reasonably protect it against future damage” after receiving a disaster relief payout (Government of the Northwest Territories [2011](#), 5).

A 2011 evaluation of the DFAA program identified some provincial level criticism of the 15% mitigation disbursement. Specifically, the disbursement limited the range of choice for mitigation options as it only applied to damaged infrastructure and provided for only a small portion of the total cost of mitigation projects (PSC [2011](#)). Nevertheless, the evaluation highlighted the need to consider long-term mitigation/prevention considerations (PSC [2011](#)), and the disbursement was seen as a positive step toward supporting flood mitigation.

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confusion amongst the public. Unclear home insurance policy wordings have also resulted in public confusion, including situations where insurers have provided payouts for uninsured overland flood damages (Friedland et al. [2014](#)). Public relief also provides inconsistent payout limits and triggering conditions across the country.

The potential for significant amounts of losses that are not covered either by public relief or private insurance is a further challenge associated with the existing system. For example, private insurance will not provide assistance for river or coastal flooding, or any type of overland or groundwater flooding in Canada, except for Quebec. Further, public relief programs typically exclude coverage for insurable losses, whether or not affected households chose to purchase coverage.

There has been increasing consideration of risk reduction in both public relief programs and private insurance coverage for sewer backup – a positive trend toward sustainable disaster mitigation (Mileti [1999](#)). Notably, insurers have increasingly applied ex-ante and ex-post incentives for mitigation of sewer backup. Ex-post disaster mitigation incentives provided by public relief programs also represent a positive trend, although a system that relies heavily on ex-post disaster payouts and facilitates mitigation only after disasters occur is far from ideal. Transferring substantial costs associated with flooding to Canadian taxpayers represents a further challenge associated with the current system.

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of flood coverage (Sandink et al. [2010](#); Mehlhorn and Hausmann [2012](#)); however, this program has experienced difficulties as a result of a lack of government investment in flood management. It has also been argued that bundling flood coverage into standard home insurance policies may reduce home insurance affordability and may limit the capability of insurance to communicate risk and incentivize risk reduction through price signaling (Thistlethwaite and Feltmate [2013](#)). Optional flood coverage, perhaps bundled with other insured water damage, including sewer backup, provides a potential alternative (Thistlethwaite and Feltmate [2013](#)), but opens up the possibility of adverse selection.

The quality of loss information further challenges the introduction of flood insurance. Insurance loss data are largely proprietary in Canada, limiting their availability to researchers, as well as to policy and decision makers. Insurers may also find that existing loss data, which aggregate various types of flooding along with non-flood related water damages, provide limited utility in the assessment of flood risk at the household level (Friedland et al. [2014](#); Sandink et al. [2014](#)). Loss figures provided by government authorities are also highly aggregated and do not break out flood losses by flood type (for example, see PSC [2014](#)). Further, there are likely significant losses that have been covered by neither private insurers nor public relief programs. Thus, there may be significant, unaccounted-for residential flood losses in Canada, limiting the ability of insurers to fully understand flood risk.

The potential for information asymmetry in Canada is a concern of high quality flood risk information specific to individual households is unreasonable to assume. Thistlethwaite and Feltmate (2013) map coverage of flood prone areas has been mapped rivers are mapped of existing maps did (Friedland et al. [2014](#)). Flood risk is limited by the form of



Flooding outside of formally defined riverine flood hazard areas may account for a significant portion of flood losses, as illustrated in Figure 3. It has also been reported that urban developments constructed before the 1970s were not typically serviced by major stormwater systems (typically designed to handle up to 1-in-100-year flow events) (Hulley et al. [2008](#)), resulting in vulnerability for many Canadian households to stormwater flood hazards. Despite these vulnerabilities, a variety of flood types that are affecting Canadian households, including overland stormwater, storm and sanitary sewer surcharge and groundwater flooding, are largely not addressed in current flood hazard assessments (Sandink et al. [2010](#); Alberta WaterSMART Solutions Ltd. [2013](#), [2014](#); City of Calgary [2014](#)), limiting the ability of governments, insurers and residents to understand flood risk.

Aside from regional-scale exposure information in the form of flood hazard maps, there is also a need to better understand risk reduction at the property or household scale. A variety of flood risk reduction measures are available for riverine flooding (for example, Construction Industry Research and Information Association [2005](#); American Society of Civil Engineers [2006](#); Federal Emergency Management Agency [2012](#)) as well as urban flooding (Sandink [2009](#), [2013](#); Federal Emergency Management Agency [2012](#)), which should be taken into account when assessing risk and implementing risk-based insurance coverage. The difficulty in accessing information on property-level mitigation is reflected in the current situation with respect to water damage pricing experienced by Cana

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The existence of public relief for flood losses may inhibit the purchase of or willingness to pay for flood insurance (Lamond and Penning-Rowse [2014](#)). Previous research indicates that there is a complicated relationship between the provision of public relief funds and the crowding out of insurance (Browne and Hoyt [2000](#); Raschky et al. [2010](#); Kousky et al. [2014](#)). For private flood insurance to be viable in Canada, government relief programs should not discourage the purchase of insurance (Sandink et al. [2010](#); IBC [2014b](#)).

Evidence suggests that there is often limited willingness of property owners to engage in risk-reducing behaviour (Kunreuther [2006](#); Siegrist and Gutscher [2006](#)) and that property owners may not be fully aware of the specific nature of their insurance coverage (Sandink [2007, 2011](#); Hudson et al. [2014](#); Lamond and Penning-Rowse [2014](#); Oulahan [2015](#)). For insurance incentives to be effective, policyholders must be made aware of policy terms and conditions, and how regional and property-scale risk factors affect flood insurance pricing and coverage conditions, and must be appropriately motivated to undertake actions to mitigate risk.

Aside from the challenges noted above, insurers may experience regulatory and reputational risk if risk-based rates become prohibitively expensive. Also, increased exposure of insurers to flood and climate change-related risks through a flood insurance product challenge the introduction of flood insurance (Thistlethwaite and Feltmate [2013](#); La

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Conclusion and recommendations

Challenges to increasing the role of private insurance in flood recovery include technical barriers to insuring flood, including lack of mutuality and adverse selection, inadequate loss and exposure information for a variety of flood types, difficulties in

Related research

impact on households, including riverine, coastal, storm and sanitary sewer backup, stormwater and groundwater flooding.

Improved hazard assessment should support and renew national efforts aimed at mitigating flood risk. If sustainable flood insurance is to be introduced, mitigating risk and reducing the number of households that are in high-risk areas will assist in increasing the number of residents who will be eligible for flood coverage. Improvement of the quality and accessibility of flood loss data by insurers and governments would help increase understanding of flood risk and exposure, and would further support the introduction of flood insurance.

To further support flood insurance, property owners and tenants will have to become better informed of their risk of experiencing damage from a variety of flood types, and will have to participate in both mitigation of risk and in a portion of flood losses (through deductibles and risk-based premiums). Currently, private insurers are applying a combination of risk-based rates, sub-limits, deductibles and availability conditions to promote mitigation for sewer backup. An examination of these approaches would help improve understanding of the role of insurance incentives for promoting risk reduction at the household level.

The introduction of viable flood insurance for households will require continued dialogue between the insurance industry and key federal and provincial agencies involved in flood risk management. This paper is a contribution to the ongoing discussion about flood insurance in Canada. It was prepared for the Insurance Bureau of Canada (IBC) as part of its research on the availability of flood insurance for households.



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Notes

1. Aviva Canada's "Overland Water Protection" product was launched on June 2, 2015 and The Co-operator's launched a "Comprehensive Water" product on May 25, 2015. The products include coverage for fresh-water related overland flooding (for example, flooding associated with stormwater and overflow of lakes and rivers). Offering of the overland flood products depends on whether the insureds have sewer backup coverage in place. Both insurers plan to offer the products across Canada After initial offerings in specific provinces. The Co-operators' product will be offered to high and low-risk policyholders, and will include variable deductibles and coverage limits (Aviva Canada [2015c](#); The Co-operators General Insurance Company [2015](#)).

References

1. Alberta WaterSMART Solutions Ltd. 2013. The 2013 Great Alberta Flood: Actions to mitigate, manage and control future floods. Calgary: Alberta WaterSMART Solutions Ltd., 27 pp.

Google

2. Alberta WaterSMART Solutions Ltd. 2013. The 2013 Great Alberta Flood: Progress report. Calgary: Alberta WaterSMART Solutions Ltd., 27 pp.

Google

3. Anderson, J. and ... and ...
consumers

Google

4. Anderson, J. and ... and ...
potential



5. Anderson, D. R. 2000. Catastrophe insurance and compensation: Remembering basic principles. *Chartered Property and Casualty Underwriters Journal* 53(2): 76–89.

[Google Scholar](#)

6. Applied Systems. 2013. Sewer backup definitions. Windsor: Applied Systems.

[Google Scholar](#)

7. Aseervatham, V., P. Born, D. Lohmaier, and A. Richter. 2014. Putting everything under the same umbrella – Hazard-specific supply reactions in the aftermath of natural disasters. Malvern PA: American Risk and Insurance Association, 35 pp.

[Google Scholar](#)

8. Association of British Insurers (ABI). 2014. Flood Re explained.
<https://www.abi.org.uk/Insurance-and-savings/Topics-and-issues/Flooding/Government-and-insurance-industry-flood-agreement/Flood-Re-explained>
(accessed November, 2014).

[Google Scholar](#)

9. Aviva. 2014. Flood Re explained. *Aviva*.
protected.
<https://www.aviva.co.uk/press-and-media/press-releases/2014/11/20/flood-re-explained>
launch.
(accessed November, 2014).

[Google Scholar](#)

10. Aviva. 2014. Flood Re explained. *Aviva*.
protected.
<https://www.aviva.co.uk/press-and-media/press-releases/2014/11/20/flood-re-explained>
claims.
(accessed November, 2014).

[Google Scholar](#)



1. Aviva Canada. 2015c. Aviva's overland water protection now available for purchase in Ontario and Alberta.

<https://www.avivacanada.com/article/water-beautiful-until-it-isn%E2%80%99t>
(accessed June, 2015).

[Google Scholar](#)

2. Barnett, B. 1999. US government natural disaster assistance: Historical analysis and prospects for the future. *Disasters* 23(2): 139-155.

[PubMed](#)

[Web of Science ®](#)

[Google Scholar](#)

3. Berke, P., Kartez, J., and Wenger, D. 1993. Recovery after a disaster: Achieving sustainable development, mitigation and equity. *Disasters* 17: 93-109.

[PubMed](#)

[Web of Science ®](#)

[Google Scholar](#)

4. Beynon, C. 2014. Overland flood insurance available in Calgary.

<http://www.cbc.ca/news/canada/calgary/overland-flood-insurance-available-in-calgary-1.2666152>

(accessed June, 2014).

[Google Scholar](#)

5. Botzen et al. 2014. The impact of climate change on the economic costs of natural disasters to mitigation. *Journal of Risk and Insurance* 83(4): 2277.

6. Brown et al. 2014. The impact of climate change on the economic costs of natural disasters to mitigation. *Journal of Risk and Insurance* 83(4): 2277.

7. Burby et al. 2014. The impact of climate change on the economic costs of natural disasters to mitigation. *Journal of Risk and Insurance* 83(4): 2277.



8. Canadian Council of Insurance Regulators (CCIR). 2013. Report on provincially chartered insurers and provincial solvency supervision frameworks. Toronto: Canadian Council of Insurance Regulators, 24 pp.

[Google Scholar](#)

9. Canadian Press. 2013. Calgaryans find some insurance companies will cover sewer backup damage after floods but others won't.
<http://news.nationalpost.com/2013/07/02/calgarians-find-some-insurance-companies-will-cover-sewer-backup-damage-after-floods-but-others-wont/>
(accessed May, 2014).

[Google Scholar](#)

10. Canadian Underwriter. 2014a. Burlington, Ontario flood damage estimated at \$90 million.
<http://www.canadianunderwriter.ca/news/burlington-ontario-flood-damage-estimated-at-90-million/1003233967/?&er=NA>
(accessed March, 2015).

[Google Scholar](#)

11. Canadian Underwriter. 2014b. Half of Quebec home insurance policyholders think they're not getting the best deal.
<http://www.canadianunderwriter.ca/news/quebec-home-insurance-policyholders-think-theyre-not-getting-the-best-deal/1003233967/?&er=NA>
(accessed March, 2015).

[Google Scholar](#)

12. Canadian Underwriter. 2014c. Home insurance policyholders in Quebec want to know if they're getting the best deal.
<http://www.canadianunderwriter.ca/news/quebec-home-insurance-policyholders-want-to-know-if-theyre-getting-the-best-deal/1003233967/?&er=NA>
(accessed March, 2015).

13. CBC News. 2014. Home insurance policyholders in Quebec want to know if they're getting the best deal.
<http://www.cbc.ca/news/canada/quebec/home-insurance-policyholders-want-to-know-if-theyre-getting-the-best-deal-1.1869118>
(accessed March, 2015).

Google Scholar

24. CBC News. 2013b. Insurance frustration for Alberta flood victims.
<http://www.cbc.ca/player/News/Canada/Calgary/ID/2396065659/> (accessed May, 2014).

Google Scholar

25. City of Calgary. 2014. Calgary's flood resilient future: Report from the expert management panel on river flood mitigation. Calgary: City of Calgary, 62 pp.

Google Scholar

26. City of Hamilton. 2013. Binbrook sanitary and stormwater systems performance. Hamilton: City of Hamilton, 70 pp.

Google Scholar

27. Construction Industry Research and Information Association (CIRIA). 2005. Standards for the repair of buildings following flooding. London, UK: Construction Industry Research and Information Association, 132 pp.

Google Scholar

28. The C... unches
flood i...
<http://...> es-flood-
insura...
(acce...



29. Cricht... ater
Intern...

30. Cricht... ere lessons

Google Scholar

31. Crichton, D. 2008. Role of insurance in reducing flood risk. The Geneva Papers 33: 117-132.

Web of Science ® | Google Scholar

32. CTV News. 2013. Why can't Canadians get overland flood insurance?
<http://www.ctvnews.ca/canada/why-can-t-canadians-get-overland-flood-insurance-1.1340172>
(accessed June, 2014).

Google Scholar

33. Dixon, L., N. Clancy, S. Seabury, and A. Overton. 2006. The National Flood Insurance Program's market penetration rate: Estimates and policy implications. Arlington: RAND Corporation, 140 pp.

Google Scholar

34. Downton, M. W., and R. A. Pielke Jr. 2001. Discretion without accountability: Politics, flood damage, and climate. Natural Hazards Review 2(4): 157-166.

35. Federal Emergency Management Agency. 2003. Principles and practices for flood risk reduction: FEMA, 507 pp.

Google

36. Federal Emergency Management Agency. 2003. Advancing Flood Risk Reduction: FEMA, 507 pp.

Google

37. Frankl, R. 2013. CTV News. <http://www.ctvnews.ca/canada/why-can-t-canadians-get-overland-flood-insurance-1.1340172>

38. Friedland, J., H. Cheng, and A. Peleshok. 2014. Water damage risk and Canadian property insurance pricing. Ottawa: Canadian Institute of Actuaries, 62 pp.

39. Garrett, T. A., and R. S. Sobel. 2002. The political economy of FEMA disaster payments. St. Louis: Federal Reserve Bank of St. Louis, 40 pp.

40. Government Accountability Office (GAO). 2014. Flood insurance: Strategies for increasing private sector involvement. Washington, DC: United States Government Accountability Office, 29 pp.

41. Government of Alberta. 2012. Alberta disaster assistance guidelines. Edmonton: Alberta Emergency Management Agency, 28 pp.

42. Government of Alberta. 2012. Alberta disaster assistance guidelines. Edmonton: Alberta Emergency Management Agency, 28 pp.

43. Government of Alberta. 2012. Alberta disaster assistance guidelines. Edmonton: Alberta Emergency Management Agency, 28 pp.

44. Government of Alberta. 2012. Alberta disaster assistance guidelines. Edmonton: Alberta Emergency Management Agency, 28 pp.

45. Government of Alberta. 2012. Alberta disaster assistance guidelines. Edmonton: Alberta Emergency Management Agency, 28 pp.

45. Government of British Columbia. 2012. Disaster financial assistance: Guidelines for private sector. Victoria: Emergency Management BC, 11 pp.

[Google Scholar](#)

46. Government of Canada. 2013. Update – Economic and fiscal projections 2013: Part 3 of 4. <http://www.fin.gc.ca/efp-pef/2013/efp-pef-03-eng.asp> (accessed May, 2014).

[Google Scholar](#)

47. Government of Canada. 2014. The road to balance: Creating jobs and opportunities. 2014 Federal Budget. Ottawa: Government of Canada, 427 pp.

[Google Scholar](#)

48. Government of Manitoba. n.d. Disaster financial assistance. <http://www.gov.mb.ca/emo/home/dfa/index.html> (accessed May, 2014).

[Google Scholar](#)

49. Government of New Brunswick. 2012. Disaster financial assistance policy guidelines. Fredericton: Government of New Brunswick, 2 pp.

[Google](#)

50. Government of New Brunswick. 2012. Disaster financial assistance policy guidelines. Fredericton: Government of New Brunswick, 2 pp.

[Google](#)

51. Government of New Brunswick. 2012. Disaster financial assistance policy guidelines. Fredericton: Government of New Brunswick, 2 pp.

[Google](#)

52. Government of New Brunswick. 2012. Disaster financial assistance policy guidelines. Fredericton: Government of New Brunswick, 2 pp.

[Google](#)



53. Government of Ontario. 2009. Ontario Disaster Relief Assistance Program. Toronto: Queen's Printer for Ontario, 26 pp.

[Google Scholar](#)

54. Government of Ontario. 2013. Assistance to private individuals. <http://www.mah.gov.on.ca/Page240.aspx> (accessed May, 2014).

[Google Scholar](#)

55. Government of Prince Edward Island. 2011. Disaster Assistance Program guide. Charlottetown: Government of Prince Edward Island, Justice and Public Safety.

[Google Scholar](#)

56. Government of Quebec. n.d. Programme général d'aide financière lors de sinistres réels ou imminents. Quebec: Government of Quebec, 34 pp.

[Google Scholar](#)

57. Government of Saskatchewan. 2014. The Provincial Disaster Assistance Program (PDAP) general claim guidelines – Effective April 1, 2014. Regina: Government of Saskatchewan, 50 pp.

[Google Scholar](#)

58. Government of Saskatchewan. 2014. The Provincial Disaster Assistance Program (PDAP) general claim guidelines – Effective April 1, 2014. Regina: Government of Saskatchewan, 50 pp.

[Google Scholar](#)

59. Government of Quebec. n.d. Programme général d'aide financière lors de sinistres réels ou imminents. Quebec: Government of Quebec, 34 pp.

[Google Scholar](#)

60. Government of Saskatchewan. 2014. The Provincial Disaster Assistance Program (PDAP) general claim guidelines – Effective April 1, 2014. Regina: Government of Saskatchewan, 50 pp.

[Google Scholar](#)



51. Handmer, J. 1990. Flood insurance and relief in the US and Britain. Boulder, CO: Natural Hazards and Applications Information Center, Institute of Behavioral Science, University of Colorado, 43 pp.

[Google Scholar](#)

52. Harris, C. 2014. The problem with property. Claims Canada.
<http://www.claimscanada.ca/issues/article.aspx?aid=1003150185&er=NA> (accessed June, 2015).

[Google Scholar](#)

53. Hausmann, P. 1998. Floods – An insurable risk? Zurich: Swiss Re, 48 pp.

[Google Scholar](#)

54. Huber, M. 2004. Reforming the UK flood insurance regime: The breakdown of a gentleman's agreement. London: London School of Economics and Political Science, 22 pp.

[Google Scholar](#)

55. Hudson, P. W. Botzen, J. Czaikowski, and H. Kreibich. 2014. Adverse selection and moral hazard in flood insurance: Evidence from Germany. Working Paper, European Association of Economic Statisticians.

[Google Scholar](#)

56. Hulley, M. 2014. The impact of climate change on flood risk: A case study of the Lake District, Cumbria, UK.

[Google Scholar](#)

57. Insurance Association of Australia. 2014. Flood insurance: A guide for homeowners. Canberra: Australian Government, 10 pp.

[Google Scholar](#)



68. Insurance Bureau of Canada (IBC). 2006. Facts of the general insurance industry. Toronto: Insurance Bureau of Canada, 44 pp.

[Google Scholar](#)

69. Insurance Bureau of Canada (IBC). 2009a. Water damage endorsement: Ground water and sewers. IBC 1561Q 2009. Montreal: Insurance Bureau of Canada.

[Google Scholar](#)

70. Insurance Bureau of Canada (IBC). 2009b. Water damage endorsement: Above ground water. IBC 1562Q 2009. Montreal: Insurance Bureau of Canada.

[Google Scholar](#)

71. Insurance Bureau of Canada (IBC). 2014a. Facts of the property & casualty insurance industry in Canada: 2014. Toronto: Insurance Bureau of Canada, 65 pp.

[Google Scholar](#)

72. Insurance Bureau of Canada (IBC). 2014b. The financial management of flood risk. Toronto: Insurance Bureau of Canada, 24 pp.

[Google](#)

73. Insurance Bureau of Canada (IBC). 2015. Water damage endorsement. IBC115Q 2015. Montreal: Insurance Bureau of Canada.

[Google](#)

74. Insurance Bureau of Canada (IBC). 2016. Water damage endorsement: Interparts. <https://www.alberta.ca/insurance-bureau-of-canada-16062016> (accessed 16 June 2016).

[Google](#)

75. Jardine, J. 2015. Water damage endorsement: Interparts. Toronto: Insurance Bureau of Canada.

6. J.D. Power. 2014. BCAA, the personal and SSQ general each rank highest in home insurance satisfaction in their respective region.

<http://www.jdpower.com/press-releases/2014-canadian-home-insurance-study#sthash.NXRCNFVO.dpuf>

(accessed June, 2014).

[Google Scholar](#)

7. Jongejan, R., and P. Barrieu. 2008. Insuring large-scale floods in the Netherlands. *The Geneva Papers* 33: 250–268.

[Web of Science ®](#) | [Google Scholar](#)

8. Kousky, C. 2011. Understanding the demand for flood insurance. *Natural Hazards Review* 12: 96–110.

[Web of Science ®](#) | [Google Scholar](#)

9. Kousky, C., and R. Cooke. 2012. Explaining the failure to insure catastrophic risks. *The Geneva Papers* 37: 206–227.

[Web of Science ®](#) | [Google Scholar](#)

30. Kousky, C., and R. Cooke. 2012. Explaining the failure to insure catastrophic risks. *The Geneva Papers* 37: 206–227.

[Google Scholar](#)

31. Kunreuther, H., and P. Barrieu. 2008. Insuring large-scale floods in the Netherlands. *The Geneva Papers* 33: 250–268.



32. Kunreuther, H., and P. Barrieu. 2008. Insuring large-scale floods in the Netherlands. *The Geneva Papers* 33: 250–268.

33. Kunreuther, H. C., and G. F. White. 1994. The role of the National Flood Insurance Program in reducing losses and promoting wise use of floodplains. *Water Resources Update* 95: 31–35.

[Google Scholar](#)

34. Lamond, J. E., and E. Penning-Rowell. 2014. The robustness of flood insurance regimes given changing risk resulting from climate change. *Climate Risk Management* 2: 1–10.

[Google Scholar](#)

35. Lamond, J. E., and D. G. Proverbs. 2008. Flood insurance in the UK – A survey of the experience of floodplain residents. *WIT Transactions on Ecology and the Environment* 118: 325–334.

[Google Scholar](#)

36. Lasalle, L. 2013. Not all flooding covered by insurance, policies need to be checked: Experts.

<http://www.theglobeandmail.com/news/national/not-all-flooding-covered-by-insurance-policies-need-to-be-checked-experts/article12754762/>

(accessed 11/11/2013)

[Google](#)

37. McLennan, S. 2013. Flood insurance and risks: Crop and livestock.

38. McLennan, S. 2013. Flood insurance and risks: Crop and livestock. *WIT Transactions on Ecology and the Environment* 118: 325–334.

[Google](#)

39. Michel, J. 2013. Flood insurance and risks: Crop and livestock. *WIT Transactions on Ecology and the Environment* 118: 325–334.

00. Michel-Kerjan, E. O. 2010. Catastrophe economics: The National Flood Insurance Program. *Journal of Economic Perspectives* 24(4): 399–422.

Web of Science ® Google Scholar

01. Michel-Kerjan, E., and H. Kunreuther. 2011. Redesigning flood insurance. *Science* 333: 408–409.

PubMed Web of Science ® Google Scholar

02. Mileti, D., ed. 1999. *Disasters by design*. Washington, DC: Joseph Henry Press, 351 pp.

Google Scholar

03. MMM Group Limited. 2014. *National Floodplain Mapping Assessment – Final report*. Ottawa: Public Safety Canada, 68 pp.

Google Scholar

04. National Board of Technical Engineering and Fire Insurance (NBTFE). 2011. *Setting the price: The economic impact of flood insurance on the environment*. Round Table on Environment and the Economy.

Google

05. Nelson, J. 2011. "Flood insurance: A case of 'too good to be true' and shame" *http://www.floodinsurance.ca/2011/05/20/flood-insurance-a-case-of-too-good-to-be-true-and-shame/* (accessed 2011-05-20).

Google

06. Nelson, J. 2011. *Flood insurance: A case of 'too good to be true' and shame* <http://www.floodinsurance.ca/2011/05/20/flood-insurance-a-case-of-too-good-to-be-true-and-shame/>

07. Office of the Superintendent of Financial Institutions (OSFI). 2014. Who we regulate. <http://www.osfi-bsif.gc.ca/Eng/wt-ow/Pages/wwr-er.aspx?sAll=1> (accessed May, 2014).

08. Oulahen, G. 2015. Flood insurance in Canada: Implications for flood management and residential vulnerability to flood hazards. *Environmental Management* 55(3): 603-615.

09. Paklina, N. 2003. Flood insurance. Paris: OECD, 26 pp.

00. Park, W., and W. Miller. 1982. Flood risk perceptions and overdevelopment in the floodplain. *Water Resources Bulletin* 18(1): 89-94.

01. Paudel, Y. 2012. A comparative study of public-private catastrophe insurance system. *Journal of Risk Management* 5.

02. Pawlowicz, J. 2013. The impact of flood risk perception on flood insurance purchasing inflow: A study in the Columbia River Basin. *Journal of Risk Management* 105-114.

03. Pennin, J. 2013. Flood risk perception: Should we be more concerned? *Journal of Risk Management* 105-114.

04. Platt, R. 2013. Flood risk perception: Should we be more concerned? *Journal of Risk Management* 105-114.

05. Poussin, J., W. Botzen, and J. Aerts. 2014. Factors of influence on flood damage mitigation behaviour by households. *Environmental Science and Policy* 40: 69–77.

[Web of Science ®](#) | [Google Scholar](#)

06. Priest, S. J., J. M. Clark, and E. J. Treby. 2005. Flood insurance: The challenge of the uninsured. *Area* 37(3): 295–302.

[Web of Science ®](#) | [Google Scholar](#)

07. Public Safety Canada (PSC). 2007. Revised DFAA guidelines. Ottawa: Public Safety Canada, 34 pp.

[Google Scholar](#)

08. Public Safety Canada (PSC). 2011. 2011–2012 Evaluation of the Disaster Financial Assistance Arrangements Program: Final report. Ottawa: Public Safety Canada, 22 pp.

[Google Scholar](#)

09. Public Safety Canada (PSC). 2014. *Canadian Disaster Database*.

http://www.scc.gc.ca/publications/other_publications/2014/cdd/cdd-eng.asp (accessed May, 2015).

[Google Scholar](#)

10. Public Safety Canada (PSC). 2014. *Canadian Disaster Database*.

http://www.scc.gc.ca/publications/other_publications/2014/cdd/cdd-eng.asp (accessed May, 2015).

[Google Scholar](#)

11. Public Safety Canada (PSC). 2014. *Canadian Disaster Database*.

http://www.scc.gc.ca/publications/other_publications/2014/cdd/cdd-eng.asp (accessed May, 2015).

Google Scholar

12. Public Safety Canada (PSC). 2015c. Disaster Financial Assistance Arrangements. <http://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/rcvr-dsstrs/dsstr-fnncl-ssstnc-rrngmnts/index-eng.aspx#a05> (accessed March, 2015).

Google Scholar

13. Public Safety Canada (PSC). 2015d. The government of Canada announces disaster mitigation investments and modernizes disaster financial assistance arrangements. <http://news.gc.ca/web/article-en.do?nid=922139> (accessed March, 2015).

Google Scholar

14. Raschky, P. A., R. Schwarze, M. Schwindt, and F. Zahn. 2010. Uncertainty of governmental relief and the crowding out of insurance. Innsbruck: Institute of Public Finance, University of Innsbruck, 29 pp.

Google Scholar

15. Richardson, G. R. A. 2010. Adapting to climate change: An introduction for Canadian municipalities.

Google Scholar

16. Sandin, P. 2004. Risk perception and risk behaviour in the 21st century. *Risk Analysis* 24(1): 68 pp.

Google Scholar

17. Sandin, P. 2005. Risk perception and risk behaviour in the 21st century. *Risk Analysis* 25(1): 68 pp. Institute for

Google Scholar

18. Sandin, P. 2005. Risk perception and risk behaviour in the 21st century. *Risk Analysis* 25(1): 68 pp. case study of the

[Google Scholar](#)

19. Sandink, D. 2013. Urban flooding in Canada: Lot-side risk reduction through voluntary retrofit programs, Code interpretation and by-laws. Toronto: Institute for Catastrophic Loss Reduction, 80 pp.

[Google Scholar](#)

20. Sandink, D. 2014. Urban flooding and ground-related homes in Canada: An overview. Paper presented at the 6th International Conference on Flood Management, Sao Paulo, Brazil, September 17, 2014.

[Google Scholar](#)

21. Sandink, D., C. D'Souza, and H. Ledra. 2014. Improving industry loss data: Refining personal and commercial kind of loss codes for water damage, flood, fire, wind and hail. Toronto: CGI, 52 pp.

[Google Scholar](#)

22. Sandink, D., P. Kovacs, G. Oulahan, and G. McGillivray. 2010. Making flood insurable for Canadian homeowners: A discussion paper. Zurich: Swiss Re, 72 pp.

[Google](#)

23. Shrub...
Institu...
Google

24. Sh...
Clim...
local I...
revisited. In
ents at the
ward Elgar.

25. Shugh...
15(4):...
t Review

26. Siegrist, M., and H. Gutscher. 2006. Flooding risks: A comparison of laypeople's perceptions and expert's assessments in Switzerland. *Risk Analysis* 26: 971-979.

[PubMed](#)

[Web of Science ®](#)

[Google Scholar](#)

27. Thieken, A., T. Petrow, H. Kreibich, and B. Merz. 2006. Insurability and mitigation of flood losses in private households in Germany. *Risk Analysis* 26(2): 383-395.

[PubMed](#)

[Web of Science ®](#)

[Google Scholar](#)

28. Thistlethwaite, J., and B. Feltmate. 2013. Assessing the viability of overland flood insurance: The Canadian residential property market. Guelph, ON: The Co-operators, 52 pp.

[Google Scholar](#)

29. Tobin, G. A., and B. E. Montz. 1997. Natural hazards: Explanation and integration. New York: The Guilford Press.

[Google Scholar](#)

30. Watt, W. E. 1995. The national flood damage reduction program: 1976-1995. *Canadian Water Resources Journal* 20: 227-247.

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