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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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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 of the role of government in flood insurance (Government of Alberta [2014](#)).



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 thresholds by disaster

Private insurance exists when the policyholder will engage in mitigation measures (Longejan and Barnett [2008](#)). This paper examines the insurance industry



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, 1983–2013, from the Canadian Disaster Database

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Table 2. Total damages in millions of dollars from 1996 to 2013

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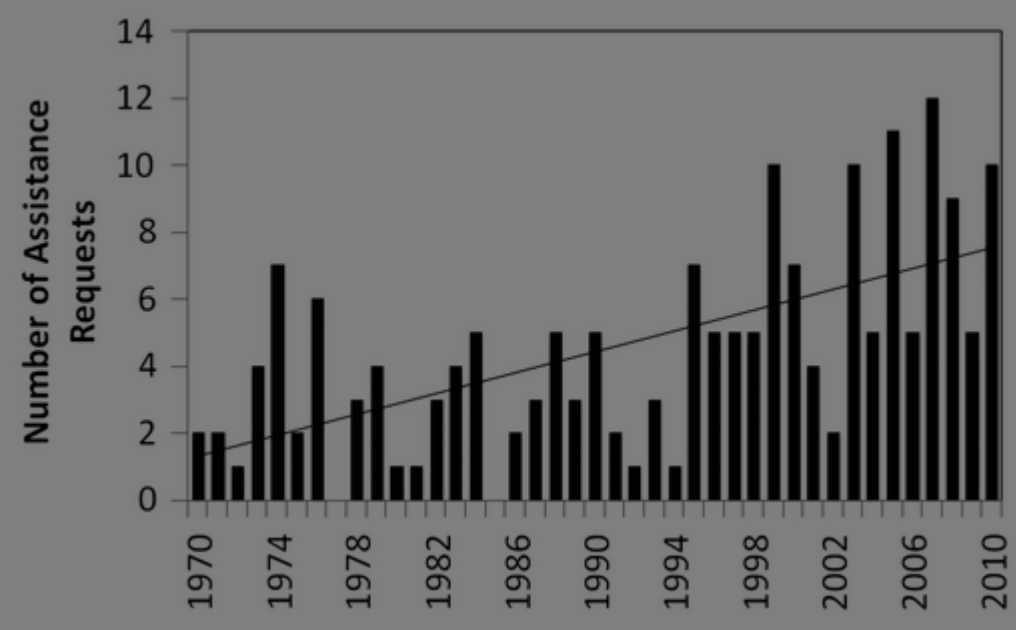
Data available from the Canadian Disaster Database, which is a growing database of disaster events in Canada. As of 2013, the DFAA program has paid out over \$3.4 billion in disaster relief.

illustrate the impact of disasters in Canada. As of 2013, the DFAA program has paid out over \$3.4 billion in disaster relief. This revealed that

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

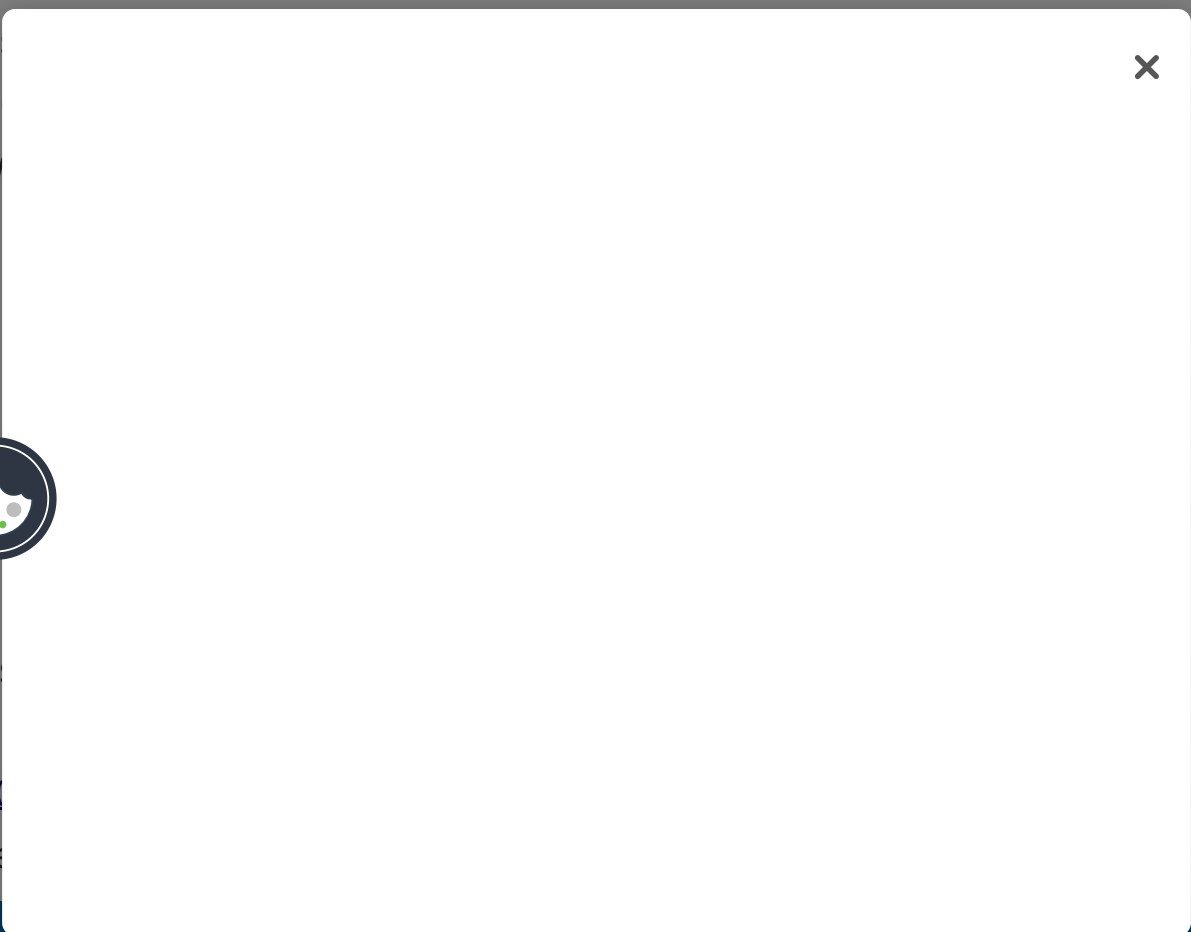
Figure 1. Number of requests for Disaster Financial Assistance Arrangements (DFAA) assistance from 1970 to 2010.

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 the 2011 report stated:



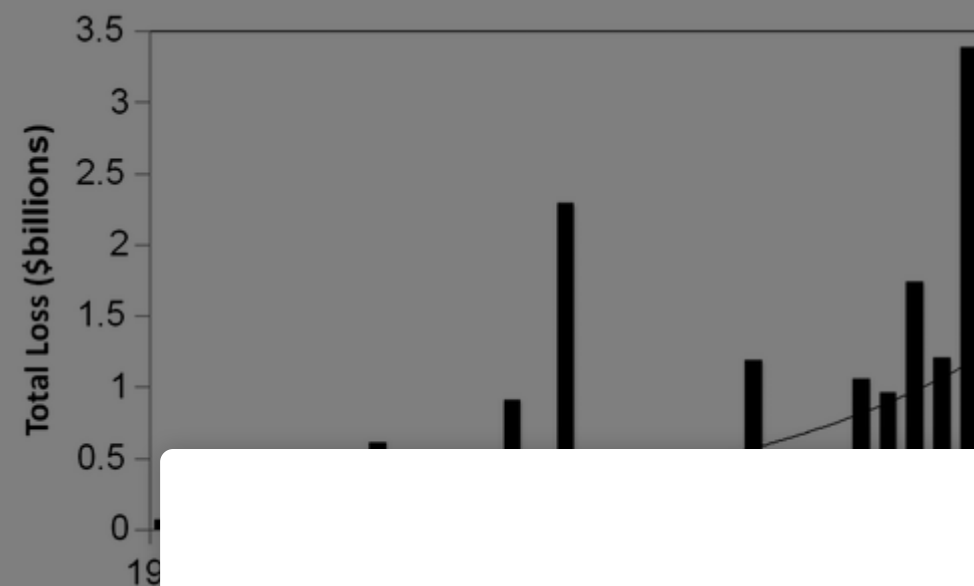
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natural catastrophe-related payouts in the past decade, much of which has been associated with flooding and extreme rainfall events in large, urban municipalities (Figure 2).

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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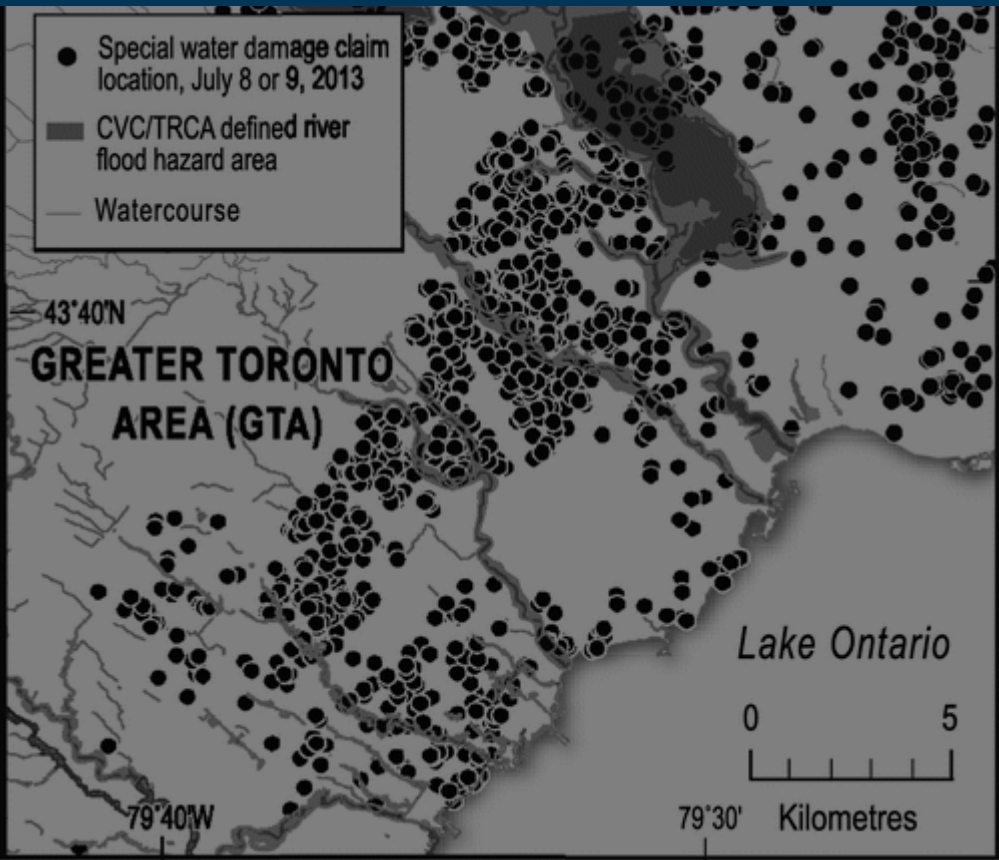
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insured losses, making it the third most expensive insured loss event in Canadian history (IBC [2014a](#)). The insurance industry has also experienced severe losses from recent extreme rainfall events in Thunder Bay and Montreal in 2012 (CAD \$262 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 GTA showing the distribution of insured losses from the 8 July 2013 extreme rainfall flood event. The map displays the location of insured losses (red dots) and compares them to formally defined riverine flood hazard areas (blue shaded regions). The map shows that a significant portion of the losses occurred outside of the defined hazard areas. The map also includes a legend for the hazard areas and a scale bar. The map is titled "Figure 3. Distribution of insured losses from the 8 July 2013 extreme rainfall flood event in the western GTA." The map shows the western GTA area, including the cities of Mississauga, Brampton, and Oakville. The map displays the location of insured losses (red dots) and compares them to formally defined riverine flood hazard areas (blue shaded regions). The map shows that a significant portion of the losses occurred outside of the defined hazard areas. The map also includes a legend for the hazard areas and a scale bar. The map is titled "Figure 3. Distribution of insured losses from the 8 July 2013 extreme rainfall flood event in the western GTA." The map shows the western GTA area, including the cities of Mississauga, Brampton, and Oakville.





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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 policy conditions (see Appendix for some water damage

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be offered commercial flood insurance that covers damage to building structures and other common elements; however, flood coverage for contents and unit upgrades is typically not offered to apartment tenants or individual condominium unit owners.

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.

Table 3. Insured and uninsured flood types in Canada. This table is based on a summary of model wordings for homeowner insurance policies and endorsements produced by the Insurance Bureau of Canada (IBC). While the model wordings are largely optional outside of Quebec, they provide an indicator of the types of water damages that are currently insured by property and casualty (P&C) insurers in Canada.

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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



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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. It was first introduced in 1961 between the UK and the Netherlands. It is available in high risk areas if the land-use is residential. The policy is based on a risk-based approach (Priestley 2008). The UK has a reinsurance market.

While the UK has a high level of mutuality by bundling flood insurance, significant flood losses are covered under the Genie coverage for



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 (e.g., \$1650 for living room furniture). In Alberta, the maximum payout for essential items is \$1650 (Alberta Government, 2012).

While the maximum payout cap, it does not specify a specific payout for a disaster. The Disaster Relief Committee (DRC) is composed of local representatives and has been successful in securing claims have been submitted for every province. The DRC estimates that the total cost of disaster relief for individuals and families is approximately CAD \$2 billion (Government of Canada, 2012).



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 “extraordinary events...on loose thresholds based on extraordinary events...equivalent of precipitation...es. The lack of...to critical... (Anderson [2000](#); De... found th...ms has led... (Anderson... as been...nd



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.

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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 Canada

Insurers that are not providing coverage for water damage risks that are not covered by standard policies. Insurers lack information on the extent of water damage risks and various types of water damage risks, such as sewer backup, basement flooding, and roof leaks, and rates for

water damage risks. Sustainable water management strategies, such as subsidized water services, are needed to address the concentrated nature of water damage risks in high-risk areas across Canada (Sandink [2009](#)).




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](#); Oulahen [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

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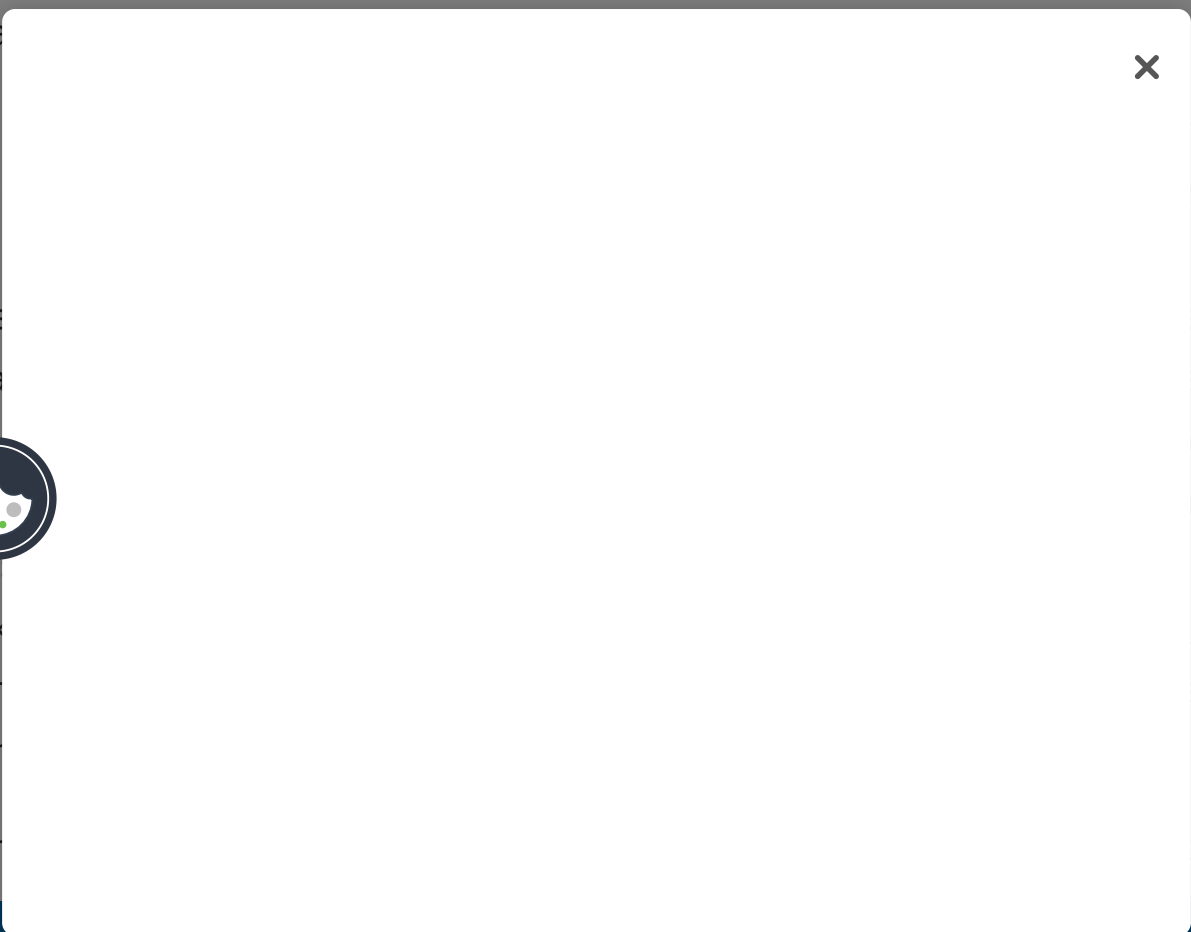


opportunities for the introduction of flood insurance. Flood insurance also presents a business opportunity for insurers and creates an opportunity for improved disaster mitigation incentives.

Given the variety of flood hazards that present a risk to Canadian households and the fact that many of these hazards (including stormwater flooding, storm and sanitary sewer backup, infiltration flooding and groundwater) occur outside of formally defined river and coastal flood hazard areas, it is likely that the condition of mutuality can be met if flood coverage is extended for a variety of flood types. This factor also supports the prospect of bundling flood coverage with standard homeowner insurance policies.

While representing a challenge to comprehensive flood coverage, excluding coverage for households in very high-risk areas increases the likelihood that a sustainable flood insurance product can be offered in Canada. A product that covers flood types that occur outside of high-risk areas could still provide coverage for a large number of Canadian households, increasing the viability of bundled coverage, and would act as a disincentive for the development of high-risk areas. This approach could help ensure that flood coverage remains affordable for a large segment of the population while limiting cross-subsidization, and increases the potential for application of risk-based rates for insured households. Bundling would also help reduce risk exposure to private insurers by increasing diversification and sustainability of coverage (Aseervatham et al. [2014](#); La

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et al. [2009](#); Friedland et al. [2014](#); IBC [2014b](#); Paudel 2014; Poussin et al. [2014](#)), helping to offset the limited willingness of property owners to voluntarily participate in risk reduction. While insurers have already engaged in incentivizing measures for sewer backup, the introduction of flood coverage represents an opportunity to incentivize measures for other flood types; however, effective incentives will require policyholders to become aware of the specifics of their insurance coverage, including deductibles, coverage exclusions and sub-limits (Thieken et al. [2006](#); Hudson et al. [2014](#); Sandink [2014](#)).

Conclusion and recommendations

Flood-affected residents in Canada rely on a mix of partial insurance and public relief assistance for flood losses. This system provides limited assistance for flood damages and reduces incentives for mitigating flood risk at the household level. The introduction of private flood insurance has been proposed to improve the current residential flood recovery regime.

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

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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 research was supported by funding from the Natural Sciences and Engineering Research Council of Canada (NSERC) and the Government of Ontario. The authors would like to thank the following individuals for their assistance in the development of this paper: Dr. David Johnston, Director of the Insurance Bureau of Canada (IBC); Dr. John McNeil, Director of the Ontario Ministry of the Environment, Conservation and Forestry; and Dr. Robert Whittaker, Director of the Ontario Ministry of Natural Resources and Forestry. The authors would also like to thank the following individuals for their assistance in the development of this paper: Dr. Robert Whittaker, Director of the Ontario Ministry of Natural Resources and Forestry; Dr. Robert Whittaker, Director of the Ontario Ministry of Natural Resources and Forestry; and Dr. Robert Whittaker, Director of the Ontario Ministry of Natural Resources and Forestry.

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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 Scholar](#)

2. Alberta WaterSMART Solutions Ltd. 2013. The 2013 Great Alberta Flood: Progress report. Calgary: Alberta WaterSMART Solutions Ltd., 10 pp.

[Goog](#)

3. American Water Works Association. 2013. The 2013 Great Alberta Flood: and

[Goog](#)

4. Anderson, J. 2013. The 2013 Great Alberta Flood: and

[poten](#)



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 Canada. 2015a. Industry first – Aviva Canada launching overland water protection for homeowners.
<https://www.avivacanada.com/press-releases/industry-first-aviva-canada-launching-overland-water-protection-for-homeowners>
(accessed November, 2015).
[Google Scholar](#)
10. Aviva Canada. 2015b. Industry first – Aviva Canada launching overland water protection for homeowners.
<https://www.avivacanada.com/press-releases/industry-first-aviva-canada-launching-overland-water-protection-for-homeowners>
(accessed November, 2015).
[Google Scholar](#)
11. Aviva Canada. 2015c. Industry first – Aviva Canada launching overland water protection for homeowners.
<https://www.avivacanada.com/press-releases/industry-first-aviva-canada-launching-overland-water-protection-for-homeowners>
(accessed November, 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, W., J. Aerts, and J. van den Bergh. 2009. Willingness of homeowners to mitigate climate risk through insurance. *Ecological Economics* 68: 2265-2277.

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

6. Brown... evidence.
Journ...

7. Burby... experience.
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8. Can... sially
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9. Canad... ver sewer

<http://news.nationalpost.com/2013/07/02/calgarians-livid-some-insurance-companies-will-cover-sewer-backup-damage-after-floods-but-others-wont/>

(accessed May, 2014).

[Google Scholar](#)

20. 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](#)

21. Canadian Underwriter. 2014b. Half of Quebec home insurance policyholders think they're covered for overflowing body of water: Survey.

<http://www.canadianunderwriter.ca/news/half-of-quebec-home-insurance-policyholders-think-theyre-covered-for-overflowing-body-of-water/1003018687/?&er=NA>

(accessed April, 2014).

[Google Scholar](#)

22. Carolan, M. S. 2007. One step forward, two steps back: Flood management policy in the United States. *Environmental Claims Journal* 19(1): 22-51.

23. CBC N

<http://www.cbc.ca/news/1.1869111>

(accessed May, 2014).

[Google Scholar](#)

24. CBC N

<http://www.cbc.ca/news/1.1869111>
(accessed May, 2014)

[Google Scholar](#)

25. City of



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 Co-operators General Insurance Company. 2015. The Co-operators launches flood insurance in Alberta.
<http://newsreleases.cooperators.ca/2015-05-25-The-Co-operators-launches-flood-insurance-in-Alberta>
(accessed June, 2015).

Google Scholar

29. Crichton, D. 2002. UK and global insurance responses to flood hazard. *Water International* 27: 119-131.

Web of Science @ Google Scholar

30. Crichton, D. 2002. UK and global insurance responses to flood hazard. *Water International* 27: 119-131.
to be ... 05 pp.

Goog

31. Crichton, D. 2002. UK and global insurance responses to flood hazard. *Water International* 27: 119-131.
papers 33:
117



32. CTV N ...
<http://...>
1.134 ... insurance-
(acce

Goog

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.
[Google Scholar](#)
35. Federal Emergency Management Agency (FEMA). 2012. Engineering principles and practices of retrofitting floodprone residential structures. Washington, DC: FEMA, 507 pp.
[Google Scholar](#)
36. Feltmate, B., and Thistlethwaite, J. 2014. Partners for action: Priorities for Advancing Flood Resilience in Canada. Guelph, ON: The Co-operators, 19 pp.
[Google Scholar](#)
37. Franklin, M. 2013. Insurance company reverses decision on flood claims. CTV News. <http://calgary.ctvnews.ca/insurance-company-reverses-decision-on-flood-claims-1.1356121>
(accessed 10/10/2014)
[Google Scholar](#)
38. Friedlaender, J. 2013. Canadian property owners. *Canadian Journal of Insurance* 19(1): 1-10.
[Google Scholar](#)
39. Gao, Y. 2013. The impact of flood insurance on property damage payments. *Journal of Insurance Economics* 54(1): 1-15.
[Google Scholar](#)
40. Government of Canada. 2013. *Report of the Auditor General of Canada on the Government's Flood Insurance Program*. Ottawa: Auditor General of Canada.



41. Government of Alberta. 2012. Alberta disaster assistance guidelines. Edmonton: Alberta Emergency Management Agency, 28 pp.
[Google Scholar](#)
42. Government of Alberta. 2013a. Disaster recovery program flood mitigation measures. STANDATA Building Code Bulletin. Edmonton: Government of Alberta, 6 pp.
[Google Scholar](#)
43. Government of Alberta. 2013b. Redford government introduces measures to build safer and stronger communities.
<http://alberta.ca/release.cfm?xID=346802662C868-D3E5-DBB4-BCB0B4FA855DDA1D>
(accessed May, 2014).
[Google Scholar](#)
44. Government of Alberta. 2014. Respecting our rivers: Alberta's approach to flood mitigation. Edmonton: Government of Alberta, 8 pp.
[Google Scholar](#)
45. Government of British Columbia. 2012. Disaster financial assistance: Guidelines for private sector. Victoria: Emergency Management BC, 11 pp.
[Goog](#)
46. Govern... 2013: Part 3
of 4. h... (2014).
[Goog](#)
47. Govern... opportunities.
20...
[Go](#)
48. Govern...
<http://>
[Goog](#)



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

[Google Scholar](#)

60. Government of New Brunswick. n.d. Frequently asked questions: Disaster Financial Assistance Program. Fredericton: Government of New Brunswick, 2 pp.

[Google Scholar](#)

61. Government of Newfoundland and Labrador. 2015. Disaster Financial Assistance Program policy statement, March 2015. St. John's: Government of Newfoundland and Labrador, 7 pp.

[Google Scholar](#)

62. Government of Nova Scotia. 2013. Disaster financial assistance. http://novascotia.ca/just/EMO/disaster_financial_assistance/ (accessed May, 2014).

[Google Scholar](#)

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

[Google Scholar](#)

64. Govern

[\[Goog\]\(#\)](http://</p></div><div data-bbox=)

65. Govern

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66. Govern

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[Goog](#)

67. Govern

(DDA)

Saskatchewan, 50 pp.

[Google Scholar](#)

58. Government of the Northwest Territories. 2005. Disaster assistance policy. Yellowknife: Government of Northwest Territories, 13 pp.

[Google Scholar](#)

59. Government of the Northwest Territories. 2011. Disaster financial assistance questions and answers. Yellowknife: Government of Northwest Territories, 6 pp.

[Google Scholar](#)

60. Government of the Yukon. 2009. Recovery information.

<http://www.community.gov.yk.ca/emo/recovery.html> (accessed May, 2014).

[Google Scholar](#)

61. 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](#)

62. Harris
<http://> (accessed
June, 2
[Goog](#)

63. Hausn
[Goog](#)

64. Hu
gentle
22 pp.
[Goog](#)

65. Hudso
tion and



Germany and the United States. Malvern, PA: American Risk and Insurance Association, 38 pp.

[Google Scholar](#)

66. Hulley, M., E. Watt, and G. Zukovs. 2008. Potential impacts of climate change on stormwater management. XCG Consultants Ltd. WaterTech2008 Conference, Lake Louise, Alberta, 10 pp.

[Google Scholar](#)

67. Insurance Bureau of Canada (IBC). 2003. Homeowners comprehensive form: A guide to your policy. IBC 1155 04.03. Toronto: Insurance Bureau of Canada, 13 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 and sewers. IBC 1561R 2009. Montreal: Insurance Bureau of Canada.

[Google Scholar](#)

71. Insurance Bureau of Canada (IBC). 2009c. Water damage endorsement: Flood insurance industry. IBC 1561S 2009. Montreal: Insurance Bureau of Canada.

[Google Scholar](#)

72. Insurance Bureau of Canada (IBC). 2009d. Water damage endorsement: Flood risk. Toronto: Insurance Bureau of Canada.

[Google Scholar](#)

73. Insurance Bureau of Canada (IBC). 2009e. Water damage endorsement: Flood risk. Toronto: Insurance Bureau of Canada.

[Google Scholar](#)



Google Scholar

74. Insurance Business. 2013. Manitoba brokers empathize with Alberta counterparts. <http://www.insurancebusiness.ca/news/manitoba-brokers-empathize-with-alberta-counterparts-174371.aspx>

(accessed May, 2014).

Google Scholar

75. Jardine, C., M. Wallace, and P. Kovacs. 2012. A strategy for reducing hazard damages. Toronto: Institute for Catastrophic Loss Reduction, 49 pp.

Google Scholar

76. 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

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

78. Kousk
Review

Hazards

79. Kousk
Th

ropic risks.

80. Kousk
out pr

ance crowd

ance

Assoc

Goog



31. Kunreuther, H. 1996. Mitigating disaster losses through insurance. *Journal of Risk and Uncertainty* 12: 171-187.

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

32. Kunreuther, H. 2006. Disaster mitigation and insurance: Learning from Katrina. *The ANNALS of the American Academy of Political and Social Science* 604: 208-227.

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

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-Rowsell. 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: 3

36. Lasalle
Exper
<http://>
insura



37. McLer
Crop a
and risks:

8. Mehlhorn, J., and P. Hausmann. 2012. Flood – An underestimated risk: Insure, inform, insure. Zurich: Swiss Re, 25 pp.

[Google Scholar](#)

9. Michel-Kerjan, E. O. 2001. Insurance against natural disasters: Do the French have the answer? Strengths and limitations. Cahier no. 2001-007. Paris: Laboratoire d'économétrie, Ecole Polytechnique, 22 pp.

[Google Scholar](#)

10. 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](#)

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

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

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

[Google Scholar](#)

13. MMM (2013) *Disaster Risk Reduction: A Global Report*. Ottawa: [Google Scholar](#)

14. National Commission on the Causes and Prevention of Disasters. *Disasters by Design: The Economics of Disasters*. Washington, DC: National Academies Press, 2000. [Google Scholar](#)

15. Nelson, J. (2013) "Disaster Risk Reduction: A Global Report" and shame" [http://www.nationalacademies.org/~/media/Files/2013/08/20130820-Disaster-Risk-Reduction-Report-Pr-headers.pdf](#) (accessed 10/10/2013)

06. Nelson, J. 2015. Severe flooding prompts new insurance offering. <http://www.theglobeandmail.com/report-on-business/severe-flooding-prompts-new-insurance-offering/article23134088/> (accessed March, 2015).
[Google Scholar](#)

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).
[Google Scholar](#)

08. Oulahen, G. 2015. Flood insurance in Canada: Implications for flood management and residential vulnerability to flood hazards. *Environmental Management* 55(3): 603-615.
[PubMed](#) | [Web of Science ®](#) | [Google Scholar](#)

09. Paklina, N. 2003. Flood insurance. Paris: OECD, 26 pp.
[Google Scholar](#)

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

11. Paude...nce
system...5.

12. Pawlo...ecting
inf...study in
Co...105-114.

13. Pennir...ced: Should
we be



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04. Platt, R. H. 1999. From changing control to flood insurance: Changing approaches to floods in the United States. *Environments* 27: 67-78.

[Google Scholar](#)

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

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10. Public

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

(accessed March, 2015).

[Google Scholar](#)

3. 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](#)

4. 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](#)

5. Richardson, G. R. A. 2010. Adapting to climate change: An introduction for Canadian municipalities. Ottawa: Natural Resources Canada, 48 pp.

[Google Scholar](#)

6. Sandink, D. 2007. Sewer backup: Homeowner perception and mitigation behaviour in Edmonton. *Journal of Environmental Planning and Management*, 50(1), 68 pp.

[Google Scholar](#)

7. Sandink, D. 2007. Sewer backup: Homeowner perception and mitigation behaviour in Edmonton. *Journal of Environmental Planning and Management*, 50(1), 68 pp. Institute for

[Google Scholar](#)

8. Sandink, D. 2007. Sewer backup: Homeowner perception and mitigation behaviour in Edmonton. *Journal of Environmental Planning and Management*, 50(1), 68 pp. case study of the

[Google Scholar](#)

9. Sandink, D. 2007. Sewer backup: Homeowner perception and mitigation behaviour in Edmonton. *Journal of Environmental Planning and Management*, 50(1), 68 pp. high voluntary retrofits. *Catastrophic*



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. Oulahen, and G. McGillivray. 2010. Making flood insurable for Canadian homeowners: A discussion paper. Zurich: Swiss Re, 72 pp.

[Google Scholar](#)

23. Shrubsole, D. 2000. Flood management in Canada at the crossroads. Toronto: Institute for Catastrophic Loss Reduction, 30 pp.

[Google Scholar](#)

24. Shrubsole, D. 2000. Flood management in Canada at the crossroads. Toronto: Institute for Catastrophic Loss Reduction, 30 pp. [revisited. In](#) *Climate Change and Catastrophic Loss Reduction: Proceedings of the 2000 International Conference on Catastrophic Loss Reduction*, ed. D. Shrubsole, 1-10. London: Edward Elgar.

25. Shrubsole, D. 2000. Flood management in Canada at the crossroads. *Journal of Catastrophic Loss Reduction* 15(4): 1-10.



26. Siegrist, H. 2000. People's perception of flood risk. *Journal of Catastrophic Loss Reduction* 15(4): 71-979.

27. Thieke, M. 2000. Investigation of

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: 237-247.

[Google Scholar](#)

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