

The road to flood resilience in Canada



Flood poses a risk to individuals, business and the public sector. Severe events in Canada can cause losses exceeding CAD 13 billion, with less than half of these covered by insurance.

This leaves many families without the necessary funds to rebuild their lives if disaster strikes. In addition it delays economic recovery in the affected areas — an effect that hits even those whose homes are still standing.

Concerted action across the risk management chain that involves all key stakeholders — government, the insurance industry and homeowners — can strengthen flood resilience in Canada.



The Calgary flood – a grim reminder of an omnipresent threat

Between June 19 and 24, 2013, the greater Calgary area and parts of Southern Alberta were inundated by widespread flooding following days of torrential rainfall and severe thunderstorms. A state of emergency was declared and 26 neighbourhoods near the Bow and Elbow rivers were placed under a mandatory evacuation order. It was the largest evacuation order in Calgary's history. Three people lost their lives and more than 100 000 people were forced to abandon their homes. The flooding of the Bow and Elbow rivers affected the Calgary city centre along with landmarks such as the Zoo and Stampede Park. Both the Saddledome, home of the NHL Calgary Flames, and the grounds of the famous Calgary Stampede suffered severe damage.

The total economic damage for the province of Alberta was devastating. Economic losses exceeded CAD 5 billion

while insured losses totalled CAD 1.9 billion¹, making this event the costliest disaster in Canadian history, surpassing the 1998 Quebec Ice Storm.

Unfortunately, it was not the only large flood loss in 2013. Toronto also suffered extensive flooding only a few weeks later. The topic of flood was at the forefront of debate among Canadian insurers as well as dominating the social and political arenas. Both losses highlighted the devastating potential of flood perils and exposed the lack of an adequate risk transfer framework to protect homeowners.

Historically, flood is the leading cause of losses among all natural hazards. This is true both around the world and in Canada. No other natural peril has affected more people or caused greater financial strain on economies. The 2013 Calgary flood was only the most recent reminder of this reality.

¹ Natural catastrophes and man-made disasters in 2013: Large losses from floods and hail; Haiyan hits the Philippines, Swiss Re, sigma series, No 1/2014 Swiss Re

Source: Satellite footprint, Calgary Flood, Sertit, Google Earth



Flood risk and the protection gap – multi-billion loss potential in many provinces

A critical risk assessment tool: Probabilistic flood models

A fully probabilistic flood model is an essential tool for an accurate risk assessment of natural perils, and flood is no exception. In the second quarter of 2016, Swiss Re released its first fully probabilistic Canada Flood model. This is an event-based loss tool suitable for both single location and portfolio risk analysis. The model is based on the four-box risk-modelling framework, which combines four distinct components: the hazard, the vulnerability, the value distribution and the insurance conditions.

The hazard model combines Swiss Re's proprietary Global Flood Zones technology (a patented multiple-regression approach) with a state-of-the-art event-set generation method. The event-set generation method consists of four major modules: a rainfall-runoff model, a routing model, a statistical model and an event-set generator. The fluvial component is calibrated to Canada's extensive network of gauged rivers.

The vulnerability component takes advantage of Swiss Re's global flood modelling expertise, which is required in a market with very little detailed flood loss data. Vulnerability factors include occupancy type, coverage type and geographic region. Different combinations of these identifiers yield unique vulnerabilities. Lessons learned in other markets (specifically the US and Europe) are applied to create Canada-specific vulnerabilities.

The value distribution and insurance conditions components use Swiss Re's internal modelling framework. Value distribution locates risks based on input data and geocoding. The Canada Flood model allows for the comprehensive application of insurance conditions – whether basic or complex.

Types of floods in Canada

Flood disasters have been a reality in Canada for more than a century but as a direct result of increasing value concentration in high-risk areas, deteriorating infrastructure and climate change, the frequency and severity of these events are steadily increasing. Approximately 50% of all natural disasters in Canada since 1970 have been caused by floods.² The main types of floods that affect Canada are:

- **Pluvial flood (or torrential rainfall):** Short duration, intense and localised precipitation can equal the rainfall average of one or two months. Torrential downpours trigger flash floods in hilly areas. In flat areas, the local accumulation of water leads to inundation. In built-up areas, the sewer system is often overburdened, resulting in damage from water backing up.
- **Fluvial (or river) floods:** The melting of accumulated winter snowpack (freshet flooding) is the major driver for high water flows in Canada. In combination with days or weeks of continuous rain, rivers can overflow their banks, which can leave thousands of square kilometres of river plains under water for weeks.

- **Coastal flood:** Storm surges are caused by storm-force onshore winds that push the water against a coast for hours at a time. Seaquakes, volcanic eruption or gigantic landslides on the seabed trigger low waves which move in deep waters at a speed of hundreds of kilometres per hour, hurtling onto the shore in the form of enormous breakers.
- **Reservoir flood:** This type of flooding is rare and occurs because of dam failure.

Fluvial and pluvial floods pose the largest loss potential. Often a clear distinction is difficult, as many fluvial floods coincide with local pluvial ones. Large coastal floods are possible in Canada; however, they occur much less frequently.

Swiss Re has just completed the development of a probabilistic, high-resolution Canada Flood model. The model simulates the interaction of fluvial with pluvial loss generation. We use it to assess our accumulation risk and price reinsurance treaties and facultative (or single) risks. We used this new model to assess the large loss potential from pluvial and fluvial flood for both the provinces and the country as a whole. The results are captured on pages 4 and 5.

² The Canadian Disaster Database, Government of Canada, <http://www.publicsafety.gc.ca/cnt/rsrscs/cndn-dsstr-dtbs/index-eng.aspx>

Canada-wide

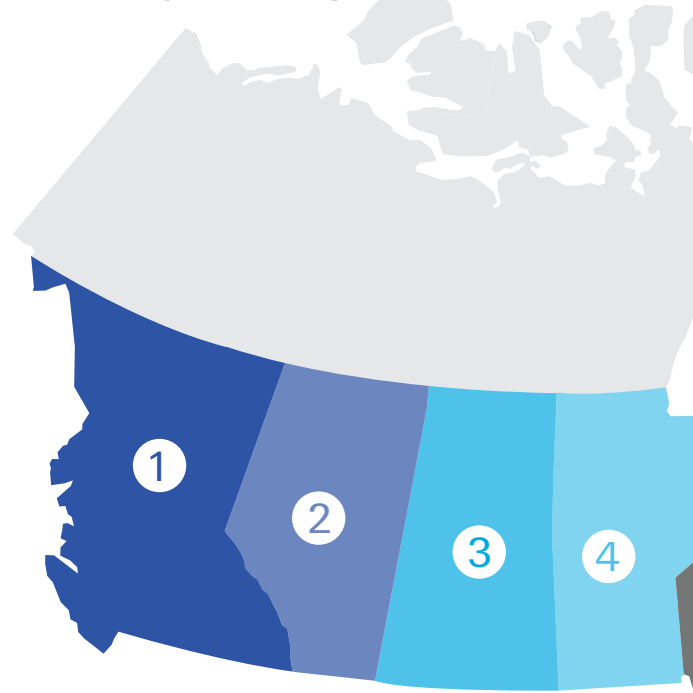
200-year loss scenario

Given the importance of snowmelt in the major rivers of Western Canada, a likely 200-year loss scenario would feature extensive flooding covering multiple western provinces. The majority of river flood events in Western Canada occur during the spring and early summer months, as rainfall combines with snowmelt to create large flows. An analysis of the Canadian Disaster Database shows a clear spike in flooding events during the early spring and summer months.

Economic loss	Insured loss
13.8	5.7

Economic annual expected loss	Insured
1.2	0.5

1 in 200-year loss potentials



all figures in bn CAD

British Columbia 1

The Fraser River is the largest river in the province of British Columbia. The Fraser basin is characterised by substantial development and a large population, including communities within the Lower Fraser Valley. The highest floodwaters occur during the spring snowmelt. Major flood events occurred in 1894 and 1948.

200-year loss scenario

During a high flow event, flood protection is overtopped in various locations along the Lower Fraser River from Hope to Richmond.

Economic loss	Insured loss
5.5	2.6

Alberta 2

The major flood loss potential is in Southern Alberta, specifically the Calgary area. Here, the Elbow River joins the Bow River and both are prone to snowmelt-driven spring and early summer flooding. Major flooding occurred in Southern Alberta in 1995, 2005 and 2013.

200-year loss scenario

Heavy rainfall on saturated soils combined with late snowmelt during May or June, creates high water levels in the Elbow, Highwood, and Bow rivers. The steep mountain landscape of the headwaters does not allow time for the precipitation to be absorbed, which means excess precipitation rapidly accumulates in streams and rivers.

Economic loss	Insured loss
4.3	1.8

Saskatchewan 3

Saskatchewan has several large rivers flowing through the province, including the North and South Saskatchewan Rivers, the Assiniboine River and the Saskatchewan River. The N. and S. Saskatchewan Rivers carry water from the mountains to Cedar Lake and Lake Winnipeg. As with the other western provinces, significant flooding can occur when high rainfall combines with high waters from snowmelt.

200-year loss scenario

As in the 2005 flooding event, where multiple rainstorms saturated the area, the 200-years scenario for Saskatchewan could result from saturated soils and snowmelt. The snowmelt combined with high rainfall would create flooding in much of Southern Saskatchewan. The North and South Saskatchewan rivers would carry water from Alberta and high rainfall would create flooding in the southeastern part of the province.

Economic loss	Insured loss
1.6	0.6



Atlantic Provinces 7

In the Atlantic Provinces, the flooding occurs from multiple sources, including ice jams, snowmelt and heavy rainfall from weakening tropical storms. These provinces have a long history of battling floods, with reported events since 1696. Significant losses have occurred from tropical storms producing heavy rainfall.

200-year loss scenario

A 200-year loss scenario for the combined provinces is a tropical storm travelling through the larger population centers, including Moncton, Saint John, New Glasgow and continuing into Newfoundland. Heavy rainfall would inundate these areas and cause significant damage.

Economic loss	Insured loss
0.8	0.3

Manitoba 4

The Assiniboine River and the Red River converge in Winnipeg, the largest population centre in Manitoba. Due to the significant flood risk, the city has constructed several important flood protection measures, including the Red River floodway, the Portage Diversion and the Shellmouth Reservoir. Significant agricultural and property loss can also occur south of Winnipeg, along the Red River.

200-year loss scenario

Significant snowfall within the Red River basin leads to extensive spring flooding. The Red River floodway would protect Winnipeg from Red River flooding, but agriculture and towns south of the city would be inundated.

Economic loss	Insured loss
1.9	0.7

Ontario 5

The largest flood loss potential is in Southern Ontario, including the Greater Toronto Area. The high population density and the potential for heavy precipitation can create potentially devastating losses, as occurred in 1954 and 2013.

200-year loss scenario

A more severe version of the 1954 Hurricane Hazel event occurs, where heavy precipitation falls on already saturated soils. The flood loss would result from widespread heavy precipitation, creating pluvial flooding in the Greater Toronto Area as well as flooding in the Humber, Etobicoke and Credit rivers. As witnessed in 2013, urban drainage systems would be unable to accommodate the heavy precipitation.

Economic loss	Insured loss
6.4	2.5

Quebec 6

Similar to Ontario, the large flood loss potential in Quebec is due to heavy precipitation in medium-sized catchment areas, especially when combined with snowmelt. Examples include the 1996 Saguenay flood, the 1997 Montreal flood, and the 1972 Richelieu River flood. Given the cold winters and the tendency for rivers to freeze, there is also potential for significant flooding due to ice dams.

200-year loss scenario

A 200-year loss could look like a more severe Saguenay flood of 1996. Quebec rivers are heavily controlled with an extensive network of dams which, if not properly maintained, can aggravate losses. The 200-year loss in Quebec would likely result from long duration, extensive rainfall leading to river floods overtopping and breaching protection measures.

Economic loss	Insured loss
4.2	1.8

Homeowners continue to face a large flood protection gap

Despite the high number of disasters, residential homes have either remained financially unprotected or only marginally protected from the impact of flooding losses. While insurance can be purchased for some water-related perils in Canada, comprehensive residential flood policies were not available until recently and still remain very sparse today. In contrast, sewer back-up covers can be purchased widely, but they exclude losses caused by flooding from water on the premises. This is the result of two realities that have emerged with respect to flood coverage for homeowners over the years.

From the government perspective, a coordinated approach to flood management at the federal level started to slowly take shape in the 1950s through various programmes and initiatives.³ This has culminated in the current Disaster Financial Assistance Arrangements (DFAA). The DFAA offer partial financial relief via reimbursement – mostly administered through the provinces – to Canadians for selected expenses and damages resulting from natural disasters, when insurance is unavailable. Since its inception in 1970, the annual cost of the DFAA for weather events has continuously increased from an annual average payout of CAD 54 million (1970 – 1994 period) to CAD 291 million (1995 – 2004), to CAD 410 million over the last ten years or so.⁴ The 220 disasters that triggered payments under the DFAA from 1970 to 2014 resulted in combined total compensation of CAD 6.8 billion, three quarters of which (i.e. CAD 5.2 billion) are attributable to floods.

From an insurance perspective, even though overland flood itself is excluded from residential policies, water claims are amongst the leading causes of home insurance losses in Canada.⁵ This suggests that insurance companies often end up paying for water-related events if the cause of the loss is not absolutely

clear. The most recent example is the 2013 Calgary event, where the largest portion of the insured loss emanated from residential sewers backing up. Ambiguity concerning coverage was a primary source of confusion and frustration for the loss-exposed policyholders and consequently negatively affected the industry's reputation.

Whether warranted or not, today there is a strong belief amongst the Canadian public that they will be protected from flooding losses, either through government relief programmes or under atypical interpretation of their home insurance policy.

The Southern Alberta floods and the Toronto flash flood of 2013 are clear examples of how wide the insurance protection gap actually is in Canada. More specifically, insurance covered only about one-third of the economic losses suffered as a result of the Alberta floods and CAD 1 billion of the almost CAD 1.5 billion in total loss from the Toronto flood.⁶ Uninsured natural catastrophe risk, which has been rising steadily over the past decades, makes up much of the protection gap. In Canada, disaster cost relative to insured assets has tripled since 1970, with 55% of weather-related losses having been uninsured during the 1980 to 2013 period.

According to our assessment, floods cause annual average economic losses of over CAD 1.2 billion. CAD 800 million of these losses are uninsured today, and homeowners bear 75% of the burden. Canada is the only G7 country that leaves homeowners largely unprotected from the financial losses caused by floods. By contrast, countries like the United Kingdom, Australia and Germany are role models of how different levels of government, the insurance industry and the public can work together to strengthen flood resilience (see page 9).

³ Making Flood Insurable for Canadian Homeowners, Swiss Re in collaboration with the Institute for Catastrophic Loss Reduction, November 2010

⁴ Estimate of the Average Annual Cost for Disaster Financial Assistance Arrangements due to Weather Events, Office of the Parliamentary Budget Officer, Government of Canada, February 2016

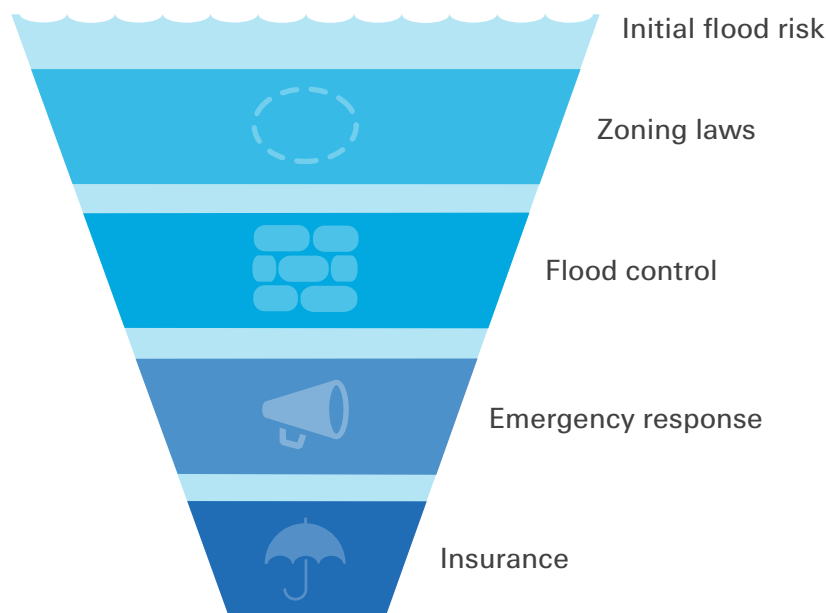
⁵ The financial management of flood risk. An international review: Lessons learned from flood management programs in G8 countries, Insurance Bureau of Canada (IBC/BAC), May 2014

⁶ Natural catastrophes and man-made disasters in 2013: Large losses from floods and hail; Haiyan hits the Philippines, Swiss Re, sigma series, No 1/2014



Flood resilience – concerted action required from the government, the insurance industry and the homeowner

Holistic flood risk management – multi stakeholder approach



Flood risk can and should be managed using physical, social and economic means. Concerted action across the risk management chain that involves all key stakeholders – government, the insurance industry and homeowners – is crucial.

Zoning laws

Flood risk may vary considerably within short distances. While adjacency to a river means exposure is high, a few metres of elevation can reduce that risk quite materially. These markedly different levels of risk mean zoning laws can effectively mitigate flood risk by restricting construction in the most exposed locations and encouraging it in low-risk areas. This kind of control is contingent upon a strong legal framework at federal, provincial and municipal levels however. Such a framework can also support the avoidance of conflicting priorities, for example over plans to increase real estate assets on which taxes can be levied.

Flood control

Flood risk for existing properties can be reduced by structural and non-structural protection measures. Government investment in structural protection measures should be judged based on the benefits they provide. Ultimately, the social and economic benefit obtained through risk reduction should outweigh the investment cost of dykes, levees or other flood control measures over the lifetime of the measure. One need not look too far – a good example is the floodway in Winnipeg⁷. Here, a protection level of 700 years provides a positive cost benefit ratio for the local economy.

Governments and insurance companies can reduce risk further through temporary and non-structural protection measures, such as raising awareness and promoting preparedness. Moving valuables to higher floors, controlling river flows with temporary sand bag walls and mobile flood barriers have proven effective loss mitigation measures.

Emergency response

Before and during events, early warning systems and pre-agreed emergency plans are key public measures to save lives and reduce property damage. Weather and hydrological models enable early forecasting and provide advance warning to regions at risk. Risk can be reduced materially when those exposed are familiar with the temporary protection measures that can be taken while an event is unfolding.

Insurance

Even with these risk reduction measures in place, residual flood risk remains. And where physical resilience ends, financial resilience starts. Well designed insurance is an economical and effective way to transfer financial risk away from business and homeowners to the insurance industry.

A collaborative effort between all key stakeholders to assess and share the risk and execute pre-and post-event mitigation strategies is – we believe – the solution to community resilience.

⁷ <http://www.floodwayauthority.mb.ca>

Affordability is crucial for sustainable flood insurance schemes

Flood Re in the UK: Innovation to maintain insurability in high-risk areas

The Flood Re scheme in the UK, an insurance programme for residential property, was introduced in April 2016. It substitutes former voluntary agreements between the insurance industry, represented by the Association of British Insurers (ABI) and the British government. The purpose of Flood Re is to provide affordable flood cover for properties in the UK at highest risk of flooding. It is estimated that around 1–2% of domestic households, i.e. between 300 000 and 500 000 homes, might benefit from the premium caps offered through this scheme.

Flood Re is a not-for-profit flood reinsurance fund, owned and managed by the insurance industry. It accepts the transfer of insurance companies' risks above a specified flood-related risk. This risk is very likely to be transferred if the calculated premium is above the Flood Re level. In case of a flood event, insurers will be reimbursed from Flood Re for the claims of the reinsured homeowners.

In addition to premiums ceded by the insurers, Flood Re is funded by a levy raised from insurers based on their residential property market shares; this is a formalised cross-subsidy system put in place prior to Flood Re's inception.

Flood Re is financially independent of the government. Only in the case of an extraordinary loss burden in the set-up phase of the fund, may Flood Re be granted a repayable loan from the UK government. For its part, the UK government has agreed to increase spending on flood defences by GBP 370 million for 2015–16, and increase the budget by the level of inflation for the subsequent five years.

Flood Re will provide transitional support over a 25-year period to the most exposed flood risk areas. During the 25 years, risk management actions will be taken to reduce such risk to an affordable level.

As a result of improvements in flood modelling, the Canadian insurance industry is, for the first time, in a strong position to offer a suite of fully private flood insurance solutions to the vast majority of Canadians. This is both viable and sustainable today. Most residential properties in Canada could be insured against the flood peril through regular insurance on a private and voluntary basis.

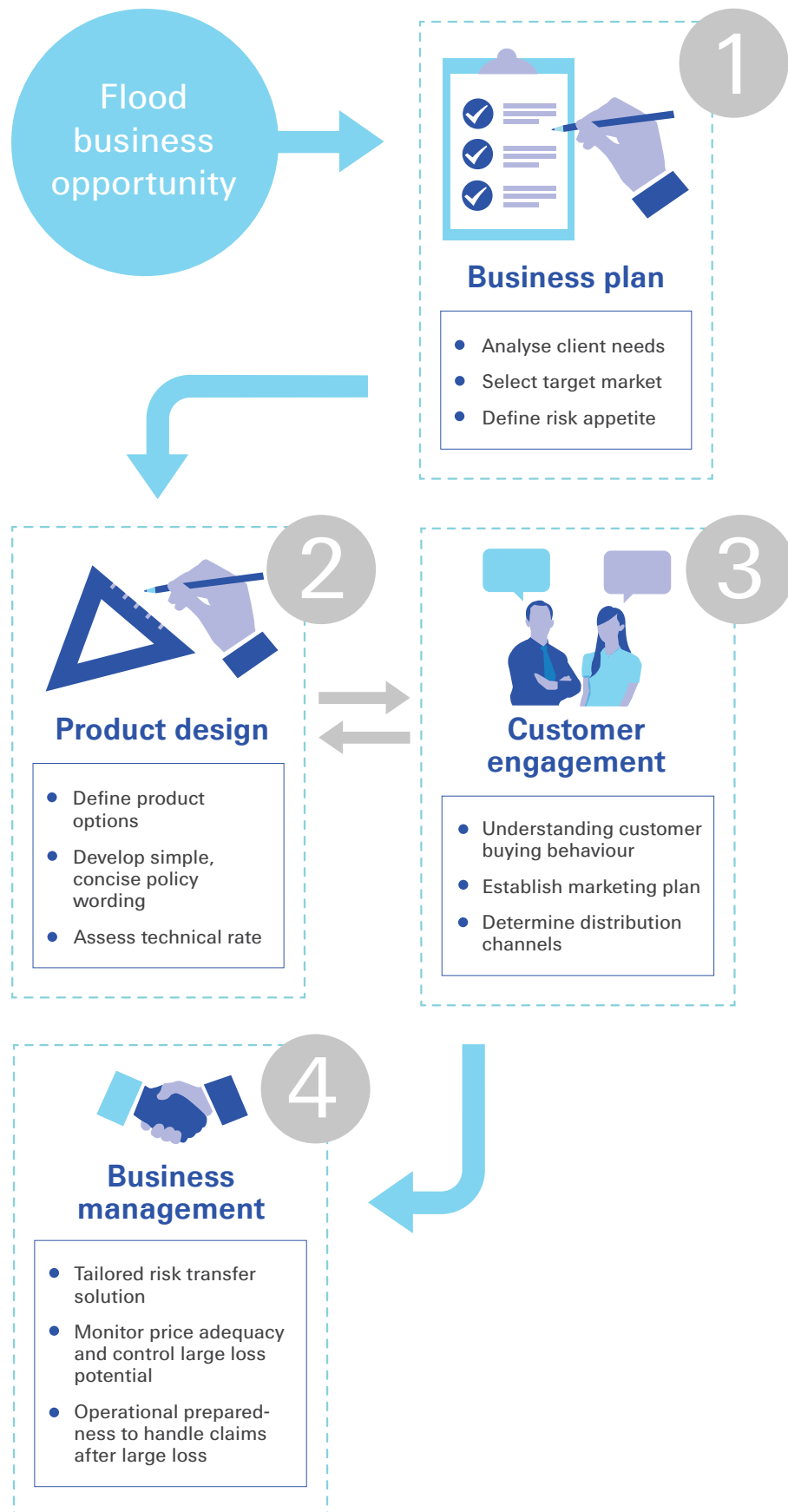
Insurers' product offerings are based on sound risk assessment, thus ensuring economic sustainability. Products can also be tailored to the needs of the end-consumer. As part of their value proposition, insurers bring their expertise in disaster claim handling to enable timely service and compensation to claimants following catastrophic events.

For high-risk residential properties, however, access to affordable insurance may be best achieved through partnership with the government. In such cases risk-based prices remain beyond the pocketbooks of most homeowners. The government could subsidise part of the premium for such high-risk properties; however, the monetary quantification of the actual flood risk needs to be made transparent to the homeowner as a way of building more robust risk awareness and shifting the onus to individuals over time.

Pre-financing through insurance will also help minimise and stabilise flood-related costs for the government. A clear separation of roles and responsibilities and an explicit pre-funding mechanism also open the door to targeted investments on physical flood protection measures where these are preferable to a subsidised financial risk transfer. The prevention of new development in flood plains through effective flood plain management and through investment in public infrastructure could be strengthened.

Both the insurance industry and the government would keep consumers abreast of risk prevention strategies and encourage them to take responsibility for risk-mitigation action through incentives as well as education.

Flood insurance – from opportunity to solution



No product launch is the same

Swiss Re wants to support and collaborate with insurance companies to close the protection gap for flood risk in Canada. A partnership with Swiss Re can bring:

- Insights based on our in-house probabilistic flood model – ranging from location level risk views to portfolio level large loss assessments.
- Our global reach, which allows us to apply learnings and best practices from other markets. Policy wordings and tailored structured solutions are a prime example of where we can provide valuable insights.
- Ways to engage with customers that lead to action. Launched in 2013 and with 95 insurance specific pilots around the world, our Behavioural Research Unit has quickly established a strong track record of helping insurers increase take-up of their products by applying the latest insights from behavioural economics.
- Feedback on existing catastrophe claims management and business continuity plans. Insight into international best practice and lessons learned from large loss events.
- Access to our global network of technology partners who can help design an engaging customer experience, where regular communication, rewards and incentives encourage clients to lead safer lives and secure better protected assets.

There are different ways of offering flood coverage: for example, one comprehensive water coverage that protects against all water-related losses. Alternatively, clear distinction between sewer back-up and overland flood coverage can be made with separate coverages. The key element to consider is that the product is simple for the consumer to understand and for the insurance company to communicate. It is also important that coverage is transparent and without any ambiguity to prevent reputational issues.

To give the insured flexibility and to respond to their coverage needs, a meaningful choice of deductibles and limits needs to be provided. A strong communication plan that guides the consumer in his or her purchasing decision is also important for a successful product selection.

In terms of pricing, affordability of property insurance is a critical factor in insurance buying decisions. Global consumer surveys reveal that one-half of insurance buyers make final policy decisions based on price⁸.

In Canada, for a home that is within river flood zones, annual premiums are in the several hundreds of dollars, depending on their risk level. This translates for these high risk locations to one or two dollars per day. For the majority of risks, which are only exposed to pluvial hazard, the risk premiums are significantly lower.

In the buying context of flood insurance, it is not only rational decision-making factors, such as affordability, but also the irrational ones such as behavioural barriers or simply lack of awareness that sway people's attitudes. Recent advances in behaviour economics can help to materially improve the perception of existing products' value proposition, and to create new concepts on how to offer insurance more effectively.

Survey evidence indicates that ease of purchase and continued service may also be an important factor in insurance buying behaviour. In a recent global survey, while 50% of consumers report buying insurance policies based on cost, nearly 30% reported that frequency of communication with their insurer was an important factor, while 30% highly valued the service they received⁸.

As an abstract and intangible concept, insurance requires customised explanation. Key measures include improving risk awareness, better explaining the value of insurance and its affordability and developing simpler products that consumers can understand.

Protecting Canadians against flood requires the collaboration of governments, primary insurers and all other stakeholders concerned. At Swiss Re we are willing to provide our know-how and expertise to make it happen. Let's start now.

⁸ Reimagining customer relationships. Key findings from the EY Global Insurance Survey 2014, Ernst & Young, 2014

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Title:

The road to flood resilience in Canada

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