

Rising Waters, Difficult Decisions

Findings and Recommendations from
the Calgary Flood Project



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About the Centre for Community Disaster Research

The Centre for Community Disaster Research (CCDR) is a trans-disciplinary hub for research, education, and outreach related to disasters of all types. The Centre is mandated with promoting rigorous academic research that is led by community need, and involves university researchers, students, community groups, government stakeholders, and end-users of research as meaningful partners. Born out of the devastating 2013 Southern Alberta Flood, the CCDR conducts original research, guided by community need, and shares findings widely with diverse stakeholders.

The CCDR is guided by the interests and expertise of our 13 faculty affiliates, and more than 50 student researchers. The CCDR works to fund, support, and promote research projects on disasters, disaster recovery, and post-disaster resilience. We also support initiatives that teach about disasters and crises, including field schools, internships, honours thesis projects, and service-learning projects. Finally, we are a hub for community debate about public policy, resilience initiatives, the needs of first responders, and best practices for communication during times of disaster. We host frequent seminars, brown-bags, guest speakers, symposia, and panels that promote this crucial dialogue.

Through our work, we create knowledge that makes communities in Southern Alberta — and all over Canada — more prepared and more resilient. Our events and initiatives have helped to make both Mount Royal and Calgary the leading Canadian centres for thought, planning, and action related to disasters and risk mitigation.



Executive Summary

Each year thousands of Canadians experience a catastrophic event, such as a flood, wildfire, tornado, or another incident caused by Canada's many hazards. Despite the increasing prevalence of these events, many Canadians do not properly understand their vulnerability to disaster risk, do not trust or follow the municipal governments' evacuation orders, do not know how to use government assistance programs, and have their lives turned upside down by unfortunate — but in many ways preventable — events.

One such event was the 2013 Southern Alberta flood, which inundated Calgary and many surrounding communities. The flood prompted what was, at the time, the largest urban evacuation and the costliest disaster in Canadian history. The flood also exposed the gaps in residents' understanding of their flood risk, their ability to prepare for and engage in flood evacuation, and their capacity to respond to floods.

Based upon a representative sample of Calgary residents affected by the 2013 flood, this report reveals that many Calgarians misunderstood their flood risk prior to the flood. Many residents did not hear the evacuation order, or did not believe that it applied to them, and, even among those who heard the order, a remarkable number of Calgarians failed to evacuate before the flood. This lack of risk awareness and failure to evacuate are troubling, and require action on the part of governmental, non-governmental, private sector, and university partners.

Once evacuated, the residents tended to stay with family members residing in Calgary, only rarely made use of government assistance programs for evacuees, and reported substantial economic losses related to the flood. Those whose homes flooded during the disaster remained evacuated much longer than those whose homes did not flood, incurred significant uninsured financial losses from the flood, and endured disruption to their lives as well as their spatial and social relationships.

Although nearly all residents have returned to their pre-flood homes to live, most continue to worry about future flood events affecting their neighbourhoods and city, and many are contemplating residential moves as a result.

Finally, the disaster has changed the environmental views of some residents, particularly women, by making them more concerned about and more sympathetic to environmental protection. Nonetheless, fewer than half of the affected residents believe that disasters such as the 2013 flood will become more common in the future.

The report provides five concrete policy recommendations for municipal, provincial, and federal government officials, and policymakers.

Key Findings

- » Many Calgarians did not know that their homes or neighbourhoods were at risk of flooding prior to the 2013 flood. Even among those whose homes flooded, more than half were not aware of their risk.
- » Many Calgary residents did not know they were under evacuation order until a public official knocked on their door; many never heard the evacuation order for their neighbourhood, while many among those who had heard it, did not evacuate nonetheless.
- » The evacuated residents used their social networks, specifically family and friends situated within the City of Calgary, to find accommodation during the evacuation.
- » Few affected residents had their losses covered by insurance or by the provincial Disaster Recovery Program.
- » One year after the flood, most evacuated and flooded residents had returned to their pre-flood homes to live, and the flood has had little impact on their attachment to their communities.
- » Many affected residents reported a disruption to their marital or romantic relationships, and to their feelings of security and stability of their surroundings.
- » Most flood-affected residents envisage staying in their pre-flood neighbourhoods, in both the short and long term. However, the fear of future flooding features prominently in a sizable minority's intent to find housing elsewhere.
- » Experiencing the flood has affected the environmental views of many residents, primarily women. Nevertheless, most of the affected residents believe that disasters like the 2013 flood will not become more common in the future.

Southern Alberta Underwater

In June 2013, heavy rainfall and rapid mountain snow-melt led to the overtopping of riverbanks on several major rivers in Southern Alberta, including the Bow River and the Elbow River, which converge within the City of Calgary. In the region, more than 100,000 people, most of them from Calgary, were evacuated from their homes; 35,000 people were affected by a power outage for weeks; and downtown Calgary was inaccessible for more than two weeks. In the end, the Southern Alberta flood cost more than \$6 billion in insurable damages—with much of the damage uninsurable — making the event the costliest in Canadian history (Pomeroy et al. 2016; Simonovic 2014).

As the people of Calgary and Southern Alberta struggled to rebuild and recover from this devastating event, numerous questions emerged around risk perceptions, evacuation, and recovery dynamics. Who understood that their properties were at risk, and who did not? Who evacuated, and who did not? When people evacuated, where did they go? How did the flood disrupt people's lives and affect their longer-term plans? This report is a first step in answering many of these questions. Using a unique set of survey data explained below, it probes deeper into Calgarians' understanding of and response to flood risk.

The Calgary Flood Project

After the flood, using funding from the Social Sciences and Humanities Research Council (SSHRC) of Canada, I launched a project that examined the risk awareness, evacuation experiences, and recovery plans of Calgarians affected by this catastrophic event. Along with a team of student research assistants from Mount Royal University, I drew a random sample of households from all twenty-six Calgary neighbourhoods, not all of which had flooded but all of which had been evacuated during the 2013 flood. One year after the flood, in the summer of 2014, we mailed surveys to 1,500 selected households, asking them to participate, and offering a \$25 gift card to thank those who agreed. Subsequently, we visited all the households that had not responded, knocking on the door, and asking the residents to participate. The data collection wrapped up in the early fall of 2014, about fourteen months after the flood.

At the end of the data collection, we accumulated 407 surveys, with a response rate of approximately 26 percent, calculated by the online response rate calculator of the American Association of Public Opinion Research (AAPOR 2017). The resulting data-set, which I call the Calgary Flood Project, provides some of the best data available on the experiences of flood-affected Canadians. We also conducted in-depth interviews with 40 flood-affected Calgarians. In the following section, divided into six sub-sections, I provide an overview of the information that these Calgarians have shared about flood risk, their evacuation decisions and experiences, their economic losses from the flood, their efforts to return and rebuild, their life disruptions, and lastly, their plans and expectations for the future.

Description

Description of Findings:

What Have We Learned About Flood Risk and Response?

How Aware are Calgarians of Flood Risk?

Did the Calgarians affected by the 2013 flood understand that their homes and properties were at risk? This is an extremely important question, as a recent study at the University of Waterloo found that many Canadians were unaware of flood risk. Using a national survey, Thistelwaite et al. (2017) discovered that, among the Canadians living in high-risk flooding areas, 74 percent were unaware of their flood risk, while 78 percent were unaware of the insurance covering them from natural hazards, such as coastal storms, groundwater, riverine flooding, and so on.

Our own survey also asked all participants if, at the time of the flood, they had been aware that their homes might be at risk of flooding. It is important to remember that all the respondents were drawn from the neighborhoods with an evacuation order in place, and had therefore been subject to flood risk, although admittedly some lived on slightly higher ground within these evacuated neighbourhoods. Consistent with Thistlewaite et al.'s (2017) findings, 67 percent of the respondents said that they had not been aware of their home's flood risk prior to the 2013 flood.

An emerging question, then, is what percentage of the flooded Calgarians were aware of this flood risk beforehand. There are two ways to answer this question: by comparing those whose homes flooded with those whose homes did not, or by examining only those whose homes flooded. First, the data indicate that out of all 407 participants, 11.5 percent report not being aware of the

risk, yet flooding anyway. Similarly, 21 percent were aware that their homes were at risk of flooding, but their homes did not flood in 2013. The modal, or most common, answer here was from the 56 percent of residents who report not being aware of risk, and their homes subsequently not flooding. Nevertheless, it is telling that almost 12 percent of the sample was not aware of flood risk but nonetheless experienced flooding. Secondly, when we filter out those residents whose homes did not flood, the answers about risk awareness are split evenly: among those who flooded, half (49.46 percent) were aware and half (50.54 percent) were unaware of the risk beforehand. In other words, among the flooded Calgarians, slightly more residents were unaware of flood risk. The 2013 flood event, quite simply, caught many residents off-guard.

Concerning the issue of neighbourhood flood risk, the survey asked Calgarians if, prior to the 2013 flood, they had been aware that their neighbourhood may be at risk of flooding. Although 100 percent of the residents should have answered 'Yes', as each of the surveyed neighbourhoods is indeed prone to flooding, only about half the participants, 49.51 percent, had been aware, while 50.49 percent had been unaware of the risk. In other words, most Calgarians living in an affected neighbourhood did not know, prior to the flood, that their neighbourhood might potentially flood.

Consequently, I became curious about the sources from which the flood-aware Calgarians had learned about their flood risk. Here,



the modal response indicated that many Calgarians — 45.50 percent — had learned about their flood risk from flood maps or from the geographic knowledge of the area (even though the exact source of this geographic knowledge often remained unclear). Alternatively, 21.50 percent had learned about their flood risk from previous floods or evacuation experiences, while 14 percent had learned about it from neighbours. The smallest number of residents — 3.5 percent — had learned about flood risk from real estate agents or previous owners. Naturally, real estate agents and previous owners have an incentive to conceal flood risk information from potential buyers, as acknowledging flood risk may deter buyers and lower property values. Nevertheless, encouraging, incentivizing, or compelling real estate agents, builders, developers, and previous owners to share flood risk information with potential buyers could be an effective strategy for fostering risk awareness and addressing the above-mentioned knowledge gaps (see recommendations below).

Overall, the findings from this section of our survey indicate that many Calgarians, even those living on the most physically

vulnerable properties that were flooded, had been unaware of flood risk prior to the 2013 flood. It is worth noting that while some residents may have truly been unaware of the risk, others were aware of it but, feeling powerless, chose to ignore it due to the “ostrich effect” (Burningham et al. 2008) that compels one to bury one’s head in the sand in the face of danger. Our follow-up interviews

with the flood affected residents also indicate tremendous potential for residents to misinterpret or misunderstand their flood risk. As participants often told us, they believed that, since the 2013 event had been labelled by officials a “1-in-100-year” flood event, they felt a flood of that magnitude would not happen for another 100 years, suggesting a misinterpretation of the annual probability of flood risk. The findings indicate that public authorities have to communicate flood risk to residents in clear

comprehensible terms that would eliminate the possibility of misinterpretation. At the same time, communication that leaves residents feeling empowered to protect their families and communities from flood risk may counter some of the “ostrich effect”, and encourage residents living in at-risk areas to acknowledge their flood risk and take some mitigative steps.

“ Most Calgarians living in an affected neighbourhood did not know, prior to the flood, that their neighbourhood might potentially flood.”

Deciding to Evacuate

When residents are informed about their flood risk, and ordered to evacuate their homes, how do they respond? Our study asked Calgarians several questions about their evacuation decisions. First, we asked the residents whether they had been asked to evacuate. Although the question appears superfluous as all participants have been selected from the evacuated neighbourhoods, where all residents were asked to evacuate regardless of their home elevation, a year later, only 74 percent recall being ordered to evacuate, whereas 26 percent claim that they were not asked to evacuate. This finding indicates that, even when the warning and evacuation order are broadcast widely to all the residents of potentially at-risk areas, many residents do not understand that the order applies to them.



32.83%
did not evacuate*

*among those who heard the order to evacuate

We then asked the residents who had heard the evacuation order how they first learned about it. These results are particularly telling, as the modal response for 35 percent of the participants is learning of the evacuation order from an official, e.g., fire, police, EMS, or emergency manager, knocking on their door. This response is also important because it suggests that municipalities such as Calgary must exert significant effort by going door-to-door in order to make face-to-face contact with thousands of residents,

which makes for a very resource-intensive approach. Although 23.86 percent heard about the evacuation order on television, 9.14 percent on the radio, and 11 percent from neighbours, one particularly interesting finding is that only 8.38 percent first heard about the evacuation order on social media. In contrast to recent claims about the transformative power of social media for risk communication (Veil et al. 2011), my study shows that social media were not a common way to learn about an evacuation order. Instead, face-to-face contact seems to have been most efficacious in conveying the need to evacuate as a necessary, pressing, and immediate task.

Once ordered to evacuate, did the people follow the order and if yes, how quickly? Among those who heard the order, the largest number — 32.83 percent — did not evacuate. In other words, despite their awareness of risk and the evacuation order, a full one-third of the residents opted not to evacuate. Among those who evacuated their homes, only 9.77 percent evacuated immediately, 28.57 percent evacuated within one hour, and 43.86 — almost half — evacuated within two hours. These results are probably quite far from an emergency manager's ideals: it is concerning that 32.83 percent did not evacuate while many more took two hours to evacuate even though flood-waters can rise significantly in two hours. The takeaway point here is that people who hear the evacuation order tend to either evacuate within two hours, or not at all.

When asked why they had not evacuated immediately, 29.51 percent said they needed to collect important belongings, while 11.11 percent wanted to make sure their family members were together and/or safe. Alarming, 19.44 percent wanted to wait and see how bad the flood was going to be, and 3.47 percent did not trust the warnings. The most common reason for not evacuating was selecting the “other reason” category and writing in a personal response, which included the following: “I never believed it could be so bad”; “I didn’t realize how critical it was”; “I lived on an upper floor”; “The power wasn’t out”; “[I] enjoyed seeing the community preparing and evacuating” or stating that they were just “chillin[g]”.

When Calgarians evacuated, where did they go and how did they locate their evacuation accommodation? Concerning evacuation accommodation, the most common response was staying at a family member’s house in Calgary (35.26 percent), followed by staying at a friend’s house in Calgary (22.92 percent). Very few evacuated out of the city (5.25 percent), stayed in a hotel (5.25 percent), or found shelter

When asked about the means by which they evacuated their homes and travelled to their evacuation accommodation, the vast majority — 88.92 percent — utilized their own vehicles, while the remaining 11 percent utilized someone else’s vehicle or public transit, walked, or relied on some other means of evacuation. In contrast to some disasters, such as Hurricane Katrina, the nearly ubiquitous availability of private transportation allowed almost all the residents who wished to evacuate to do so.

During evacuation many disaster-affected residents require material aid, such as money, clothing, or food, so we asked our participants whether they had received financial assistance from any governmental or non-governmental sources. Among those evacuated, the highest percentage — 22.71 percent — received assistance from the provincial government, which indicates that about 77 percent did not rely on the assistance from the Alberta government despite its offer of debit cards to all evacuated residents. Additionally, only 9.89 percent of the evacuated residents reported receiving Red Cross assistance. The number of those who received assistance from family,

“The most common strategy for the residents was to fund their own evacuations, without relying on any financial assistance from family, friends, or governmental/non-governmental sources.”

in a designated evacuation/reception centre (1.26 percent), suggesting that Calgarians mostly relied on local family and friends. When asked whether anyone had helped them find a place to stay during evacuation, most respondents answered “Nobody” (42.26 percent), followed by “A family member living in Calgary” (32.19 percent). Relying on friends living in Calgary, family or friends located outside of the city, neighbours or coworkers all proved extremely rare strategies. By and large, the affected Calgarians took care of themselves, or leaned on locally-situated kin.

friends, coworkers, and religious organizations was even lower. The study reveals that, despite all residents living in flood-affected neighbourhoods with evacuation orders in place, among all respondents, 76.9 percent reported receiving no assistance from any sources, while among those evacuated, 67.3 percent reported receiving no assistance from any sources. This suggests that the most common strategy for the residents was to fund their own evacuations, without relying on any financial assistance from family, friends, or governmental/non-governmental sources.

Flood Losses, Government Assistance, and Insurance Claims

Like many other Albertans, our survey respondents were not immune to the financial effects of the flood — an event in which many losses were not covered by insurance. While 65 percent of our sample reported no uninsured financial losses from the flood, those who had experienced losses reported as much as \$1.7 million in personal losses. The mean losses were \$18,304 for all respondents. However, after filtering out the residents who reported no losses, the mean losses jumped to \$52,000. The average losses for the respondents whose homes flooded were significant - \$78,866. Those respondents with homeowner's or renter's insurance whose homes had flooded estimated that, on average, insurance would cover 39 percent of their losses, although individual estimates ranged from 0 to 100 percent.



\$78,866

Average losses for respondents
whose homes flooded

To help the affected homeowners rebuild after the flood, the Government of Alberta launched the Disaster Recovery Program (DRP). We were curious whether our affected participants had applied for coverage, and if so, how much they had received. Only 13 percent of all respondents and 42.24 percent of those whose homes had flooded applied for DRP assistance one year after the flood. Revealing the reasons for not applying, 57.69 percent of those who had flooded felt their losses were not large enough, while the remainder either believed that they would not qualify, or found the process very confusing. When asked what percentage of their losses had been or was expected to be covered by the DRP, the respondents who had applied for it estimated a mean of 34 percent. While the economic losses were common and significant, other economic disruptions, such as job loss, were far less common. In fact, only seven participants (1.74 percent), far fewer than in some other disasters, reported losing their job because of the flood. The results from this section indicate that many Calgarians have incurred significant economic losses as a result of the flood. In most cases, the losses have not been covered by either insurance or the Province of Alberta's Disaster Recovery Program to any significant degree.



Returning and Rebuilding

Previous research has demonstrated that disaster-affected communities nearly always return and rebuild, with the most affected communities regaining at least their pre-disaster population years after a disaster. How did the recovery take place in Calgary? Our survey asked Calgarians how many days they had been evacuated until they returned to their properties for the first time, at least to visit. The mean length of evacuation was 12.5 days, or nearly two weeks away from home. This number, though, depended heavily on the flood severity near one's home: for those whose homes flooded, the mean length of evacuation was nearly a month, 29.4 days, while for those whose homes did not flood, the mean length of evacuation, though still disruptive, was only 5.23 days.

By the time of the survey in the summer of 2014, virtually all respondents (96.80 percent), including the flooded residents (92.39 percent) and the non-flooded residents (98.94 percent), had returned to their pre-flood homes to live.

For most residents, the flood did not disrupt their emotional attachment to their neighborhoods. When asked how attached they felt to their neighborhoods before and after the flood, 67.57 percent reported being "strongly" (rather than "somewhat", or "not very") attached before the flood, and 68.47 percent reported being "strongly" attached after the flood. Although a few people have changed their level of attachment, it appears, that the majority have not changed their place attachment due to the flood. In another study using multivariate regression analysis (results available upon request), I demonstrate that, while home flooding and a longer evacuation did exert some negative influence on neighborhood attachment, the strongest predictor of post-flood attachment was pre-flood attachment, even controlling for various indicators of flood experience.

This section demonstrates that virtually all residents returned and rebuilt, although these tasks took much longer for those whose homes flooded. Despite the flood and its economic ramifications, the affected Calgarians remain emotionally attached to their communities.

Disruption and the New Normal

After disasters, many people report feeling disrupted and insecure in ways that they often struggle to explain. Social scientists have called this phenomenon a disruption of “ontological security” (Hawkins and Maurer 2011). This disruption can follow a change in family dynamics, daily routines and life patterns as well as a change in or disappearance of familiar local landmarks. To what extent did the 2013 flood disrupt Calgarians’ ontological security, and, more broadly, how did it impact the social relationships of the affected people?

Concerning ontological security, the survey asked whether the participants had experienced disruptions to or changes in their usual routines since the flood. Among all participants, 20 percent answered “Yes”, while among those whose homes had flooded, 45.65 percent answered “Yes”. In addition, the survey asked

“ These findings indicate that a significant number of Calgarians, especially among those whose homes flooded, report a disruption to the patterns and routines that constitute their ontological security.”

whether the participants found it upsetting or disrupting that familiar landmarks, such as houses, schools, or stores, had either disappeared or had been empty since the flood, to which a larger percentage — 46.27 percent of all participants and 55.91 percent of those whose homes had flooded — responded in the affirmative. These findings indicate that a significant number of Calgarians, especially among those whose homes flooded, report a disruption to the patterns and routines that constitute their ontological security.

When asked if the flood had negatively impacted their marriage or relationship, 20 percent of all participants responded that it had, while 80 percent responded that it

had not. However, among those whose properties had flooded, nearly half (42.47 percent) reported that their relationships had been affected by the flood. When parents were asked if they had seen any negative changes in their children’s behaviour since the flood, only 14.68 percent of participants answered “Yes”. When asked how their kids had been coping since the flood, 54.55 percent answered “Very well”, while only 4.55 percent reported their children having a very difficult time.

Our results indicate that a significant number of the affected Calgary residents experienced a disruption to their routines, surroundings, or human relationships. This disruption, I argue, makes it difficult for these residents to establish a “new normal” after the disaster, and to otherwise recover and flourish. However, with proper resources available, it would be entirely possible to reduce the amount of turmoil and disruption experienced by those in disaster-affected communities, such as Calgary.



Looking Ahead

As Calgarians returned to their flooded homes and neighbourhoods, and began the laborious process of rebuilding, many naturally considered whether to remain in their neighbourhoods, or seek housing elsewhere. To capture these dynamics, we asked the survey participants whether they envisaged themselves living in their pre-flood neighbourhood one year later, which would be the summer of 2015. Most respondents — 82 percent — envisaged themselves remaining, while 10.32 percent were uncertain, and only 7.62 percent answered “No”. Among those whose homes had flooded, 78.49 percent thought they would remain in their pre-flood neighbourhood after a year, while 13.98 percent were uncertain, and only 7.53 percent answered “No”.

In multivariate analyses (available upon request), the strongest predictors of residents’ intention to remain in the neighbourhood were the variables related to the strength of social ties, or social capital, in the neighbourhood. The residents who were more attached to the place, who were more active in their community, and who knew more of their neighbours, were also more likely to intend to stay in their neighbourhood, even controlling for the usual demographic predictors and home flooding. In short, it is not income or flood-related economic losses that predict whether people intend to stay or to sell and depart, but the closeness they feel to their community. As a follow-up, we asked whether the participants envisaged themselves living in

their pre-flood neighbourhood five years later. Here, only 55.53 percent were certain about staying, while 29.24 percent were uncertain, and 15.23 percent said “No”. The percentage distribution was similar among those who had flooded: 51.61 percent intended to remain over five years, 32.26 percent were uncertain, and 16.13 percent thought that they would likely leave. Among the participants planning to leave, the most common rationale was the fear of future flooding, or, as some residents put it, wanting to “get out while [the] house still has value”. In addition to fear of future flooding, other reasons included a high cost of living in the neighbourhood, and wanting to downsize.



74.57%

**stated the 2013 floods did not change
their views about the environment**

Social science research seems split on whether disasters induce attitudinal and behavioural changes related to the environment in the affected people. When asked whether the 2013 flood had changed their views about the environment, 25.43 percent answered “Yes”, while 74.57 percent answered “No”. However, as I show in a paper with Travis Milnes, these results depend heavily on gender: all else equal, women were almost three times as likely as men to say that their environmental views had changed because of the flood. While women almost always discussed environmentalism and expressed a greater environmental concern, men often discussed the need to protect Alberta’s economic base, the oil sands, and were reticent about environmental change, lest it should threaten their livelihoods (Miles and Haney 2017). Besides gender, changing environmental views did not depend upon any other factor, such as one’s home flooding, or one’s evacuation experience, income, age, parenthood, homeownership, and education. In a paper with Caroline McDonald-Harker, we also show that the Southern Alberta Flood has led people to appreciate the power of nature, to spend more time in nature, but also to worry about the contamination and environmental toxicity induced by the flood (Haney and McDonald-Harker 2017).

Finally, we asked our participants whether they viewed the Calgary flood as an isolated event, or as a larger trend in increased disaster losses. Both governmental and non-governmental agencies, including Public Safety Canada (2016), and the United Nations (2015), take the position that disaster risk is increasing, and that in the future catastrophic events will take more lives, cause more economic losses, and inflict more property damage. Among the participants, 40.25 percent believed that such events as the Calgary flood would become more common in the future, while 41.98 percent believed they would be about as common as before, and 7.16 percent believed they would become less common. The remainder, 10.62 percent, were unsure. Although it is positive that almost half the respondents understand that the events such as the flood will become more common, it is nevertheless odd that, even in a community just affected by the costliest disaster in Canada's history, most residents feel that such disasters will either remain the same or become less common. As I argue below, we would benefit from education and public outreach programs that can convey the information about the trend of increased disasters to the public in ways that motivate and inspire action.



Recommendations

Based upon these findings from the Calgary Flood Project, there are several steps that should be taken to enhance residents' knowledge about risk, ensure a more timely and complete evacuation, facilitate a more efficient, and equitable recovery from future floods, and increase community resilience:

- » Emergency managers and university partners must better educate the public about disaster risk, the trends in increasing disaster frequency, and the importance of heeding evacuation orders. To do so, it is necessary to build more trust and create more open lines of communication between government agencies and the public not only during, but also before declared disasters. To accomplish this, the government may consider utilizing trusted community members as purveyors of information, such as risk estimates, plans for evacuation, and so on, during normal times. These community-embedded liaisons could then be used to effectively communicate evacuation orders—and the importance of heeding them — once an evacuation is called.
- » When building or selling a home, the development and real estate industries should be compelled to disclose flood map locations, including a property's location within a designated floodway or flood-fringe area. The explanation of flood risk should be presented in terms that residents are most likely to understand. My results indicate that many residents do not understand "1-in-100-year" flood risk correctly, as they think that a flood will occur predictably every 100 years. Therefore, flood risk should be communicated to potential home-buyers as an annual probability of flooding (i.e., a 1 percent annual probability).
- » Provincial governments must ensure that the evacuated residents are aware of the programs providing financial assistance during evacuation and the rebuilding phase as well as the procedures involved in applying for them. The under-utilization of these programs, including the DRP, by the flood affected Calgarians indicates that better communication about assistance availability, eligibility criteria, and timelines should increase application numbers. The increase in applications should naturally be accompanied by an increase in funding for assistance programs both during and after a disaster. This recommendation, although neither cheap, nor politically expedient, is nonetheless necessary to help Canadians regain their financial footing after disaster strikes.
- » Following a disaster, government agencies should ensure that free mental health services are available for the affected residents. Our participants reported a disruption to their security and sense of stability in their surroundings (ontological security) as well as a disruption to their marriages or romantic relationships. These issues, common in many post-disaster communities, may be addressed by more widely available and accessible mental healthcare.
- » Canadians would benefit from education and outreach programs providing the official estimates of increasing disaster frequency and severity that stem from the main drivers, climate change and demographic growth in risky areas, presented in ways that will inspire action. This includes covering potential solutions, both structural mitigation approaches and community building approaches to enhancing local social capital, and creating more resilient communities.

endations



As I often point out to my students, and to the public when speaking in disaster-affected communities, there is no single magic-bullet solution for disaster risk reduction. Better protecting Canadians from natural hazards will be a long, politically contentious, and expensive process. Disasters are “wicked problems” (Perry 2015; Gertha-Taylor 2007): they are constituted by a series of interlocking, interdependent problems spanning multiple systems (environmental, social, economic, and political). Often, when dealing with wicked problems, implementing a devised solution to one aspect of the problem induces an entirely new set of problems. For instance, implementing a disaster recovery program in an area may induce gentrification, attracting wealthier residents to the area while driving away the original lower-income residents due to the increasing costs, thereby exacerbating existing inequalities. Despite occasionally falling victim to pessimism when grappling with these wicked problems, I nevertheless feel optimistic. Thanks to the findings generated by the Calgary Flood Project and similar projects, I hope that Calgarians and Canadians can be better informed about risk, become more proactive about mitigating that risk, and will transform into global leaders in thinking about, and planning for disasters.

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Acknowledgements

The Calgary Flood Project was made possible by a grant from the Social Sciences and Humanities Research Council (SSHRC) of Canada, under the Insight Grant program (#435-2014-1008). Thanks are also owed to the Centre for Community Disaster Research at Mount Royal, the Calgary Foundation, the City of Calgary, the Institute for Environmental Sustainability, the MRU Faculty of Arts, the MRU Office of Research, Scholarship, and Community Engagement, and MRU Marketing and Communications.

In particular, thanks are owed to Jeff Keshen, Dean of the Faculty of Arts, Tom Buchanan, Chair of the Department of Sociology & Anthropology, Caroline McDonald-Harker, faculty member in sociology and faculty affiliate of the CCDR, as well as Kristen Barber of Southern Illinois University and faculty affiliate of the CCDR, for helpful comments on an earlier version of this report. This report also benefited from the useful feedback provided by the staff of the Calgary Emergency Management Agency (CEMA) and the Emergency Social Services Network of Alberta (ESSNA), both of which invited me to present these findings to their organizations, and helped me think through their significance and ability to inform policy and practice.

The Calgary Flood Project would not have been possible without the work of several bright and dedicated student research assistants. They are, in no particular order, Travis Milnes, Angela Laughton, Victoria Stamper, Isabelle Sinclair, Priya Kaila, Morah Mackinnon, Grace Ajele, and Daran Gray.

