Communicating Flood Risk: Best Practices and Recommendations for the Lake Champlain-Richelieu River Basin

International Lake Champlain - Richelieu River Study

A WHITE PAPER TO THE INTERNATIONAL JOINT COMMISSION

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EXECUTIVE SUMMARY

The Lake Champlain-Richelieu River (LCRR) basin is a geographically and culturally diverse region straddling the Canada-US border. The vast drainage area is susceptible to springtime flooding that affects both lakeside and riverside residents of New York, Vermont, and Quebec. The International Joint Commission's Lake Champlain-Richelieu River Basin Study Board has undertaken an extensive evaluation of both structural and non-structural approaches to reduce the impacts of flooding in the LCRR basin.

STUDY FOCUS

As part of this effort, the Study Board adopted a flood mitigation framework centered on four mitigation themes:

1. Reduce extreme water levels on the Richelieu River and by extension, on Lake Champlain
2. Reduce inflows into Lake Champlain or the Richelieu River
3. Improve flood response (emergency preparedness); and
4. Modify floodplain management (adaptation to flooding).

To address Theme 4 (floodplain management), the Study Board convened a group of experts to identify non-structural tools for flood risk management in the LCRR basin. A 2020 expert workshop identified four key areas that the Study Board should focus on in providing floodplain management recommendations to the International Joint Commission:

1. Better flood risk maps are needed.
2. Flood risk should be better communicated and understood.
3. Management of floodplain occupancy should adapt and evolve.
4. Developments in Canadian and US flood insurance should be recognized.

The Study Board subsequently commissioned four White Papers to address these recommendations. This White Paper is the second in that series and addresses the recommendation to increase public awareness of flood risk. The White Paper draws on a review of academic and gray literature, interviews with professionals in relevant fields, and case studies of effective communication practices to provide recommendations for increasing public understanding of flood risk in the LCRR basin.

There is a clear need for enhanced flood risk communication in the LCRR basin, but differences in language, culture, and flood governance across the region present unique challenges for designing and administering effective campaigns. Quebec was more severely affected by the flooding of 2011 and recent flood events in other parts of the province have resulted in rapid developments in flood risk management policy. On the US side of the basin, well-established flood management structures support some preparedness measures, including a developed flood insurance market and land-use planning regulations. Across the border, however, residents have low awareness of their flood risk and have taken minimal action to protect their properties.

Research on risk perception, communication, and behavioral response to environmental threats offers insight for increasing public understanding of flood risk. Simply providing people with information about flood risk will not necessarily increase concern or effect behavioral change. People's risk perception is informed by their science-based knowledge but is also heavily influenced by emotions, experiences, and social context. For example, basin residents who have previously experienced flooding have much greater concern than residents who face similar risks but have no experience with floods. Changing these perceptions is difficult. To be effective, campaigns should be grounded in an understanding of the audience's values and how they conceptualize flood risk.

Flood risk communication can be used to achieve numerous goals related to floodplain management. First, communication fulfills the government's responsibility to inform and engage citizens in flood risk management. Second, it shares some responsibility for risk management with the public and encourages individuals to take action to reduce their flood risk. Third, flood risk communication supports other risk management instruments, such as flood insurance, land-use regulation, and flood risk maps. Some campaigns may go beyond simply informing the public by employing consulting or collaborative approaches that allow for mutual learning and enhance trust between the public and authorities.

RECOMMENDATIONS

While communication objectives may be diverse, certain strategies consistently increase the efficacy of campaigns. The following are recommendations for effective flood risk communication methods based on the research conducted for this paper:

- *Develop a targeted campaign*: Flood risk communication should be designed around a specific set of objectives and tailored to the particular audience and type of flood.

- *Leverage calendar milestones and attention-focusing events*: Time campaigns to correspond with significant dates or seasonal markers to attract attention and make information more salient. Be prepared to act when concern is highest immediately after a flood event.

- *Employ multiple mediums*: Harness traditional print sources, online platforms, and in-person methods to increase reach and align the messaging objective with the medium.

- *Use mobile apps to support flood preparedness and response*: Employ apps to achieve instantaneous and wide-reaching communication.

- *Distribute and amplify messages through trusted sources*: Extend messaging through trusted, familiar figures and organizations to increase reach and uptake.

- *Evaluate outcomes*: Assess whether stakeholders were satisfied with the conduct of the communication campaign and whether it had the intended impact.

The literature review and expert interviews also yielded best practices for flood risk messaging:

- *Profile the audience*: Understand audience demographics and characteristics, such as residential versus business property owners, and adapt messaging accordingly.

- *Promote benefits and anticipate barriers to action*: Research what factors will motivate or inhibit people to take the desired action. Promote benefits and address barriers.

- *Keep messages simple*: Avoid overwhelming or confusing the audience by keeping communication materials brief and to the point.

- *Make it understandable*: Use plain, simple language. Avoid technical or mathematical explanations and jargon, such as "fluvial" or "inundation zone".

- *Explain flood risks clearly*: Frame risk in a way that is meaningful to the public (e.g., 26% chance of flooding over a 30-year mortgage, rather than 1% annual probability).

- *Keep the message positive*: Frightening or sad messaging can cause people to discount or ignore the content. Use an optimistic tone to engage audiences and inspire action.

- *Use evocative imagery*: Images that reflect a positive tone and depict individuals engaging in the desired behavior are more effective than scenes of devastation.

- *Make the message memorable*: Where appropriate, use playful, humorous or catchy messaging that will stick in the mind of the target audience.

The paper also highlights three emerging communication strategies that could be used to raise awareness in the LCRR Basin. First, community-based social marketing (CBSM) provides a suite of tools that leverage social norms and behavioral psychology to promote action. Second, real estate disclosure informs buyers about a property's flood risk before they purchase a new home. These strategies have promise for the Basin context. Finally, local weather forecasters are likely effective communication agents for flood risk information because of their large outreach, science communication expertise, and position of trust within local communities.

THE INTERNATIONAL JOINT COMMISSION

Under the Boundary Waters Treaty of 1909 (the Treaty), the governments of the United States and Canada established the basic principles for managing many water-related issues along their shared international boundary. The Treaty established the IJC as a permanent international organization to advise and assist the governments on a range of water management issues. The IJC has two main responsibilities: regulating shared water uses; and investigating transboundary issues and recommending solutions.

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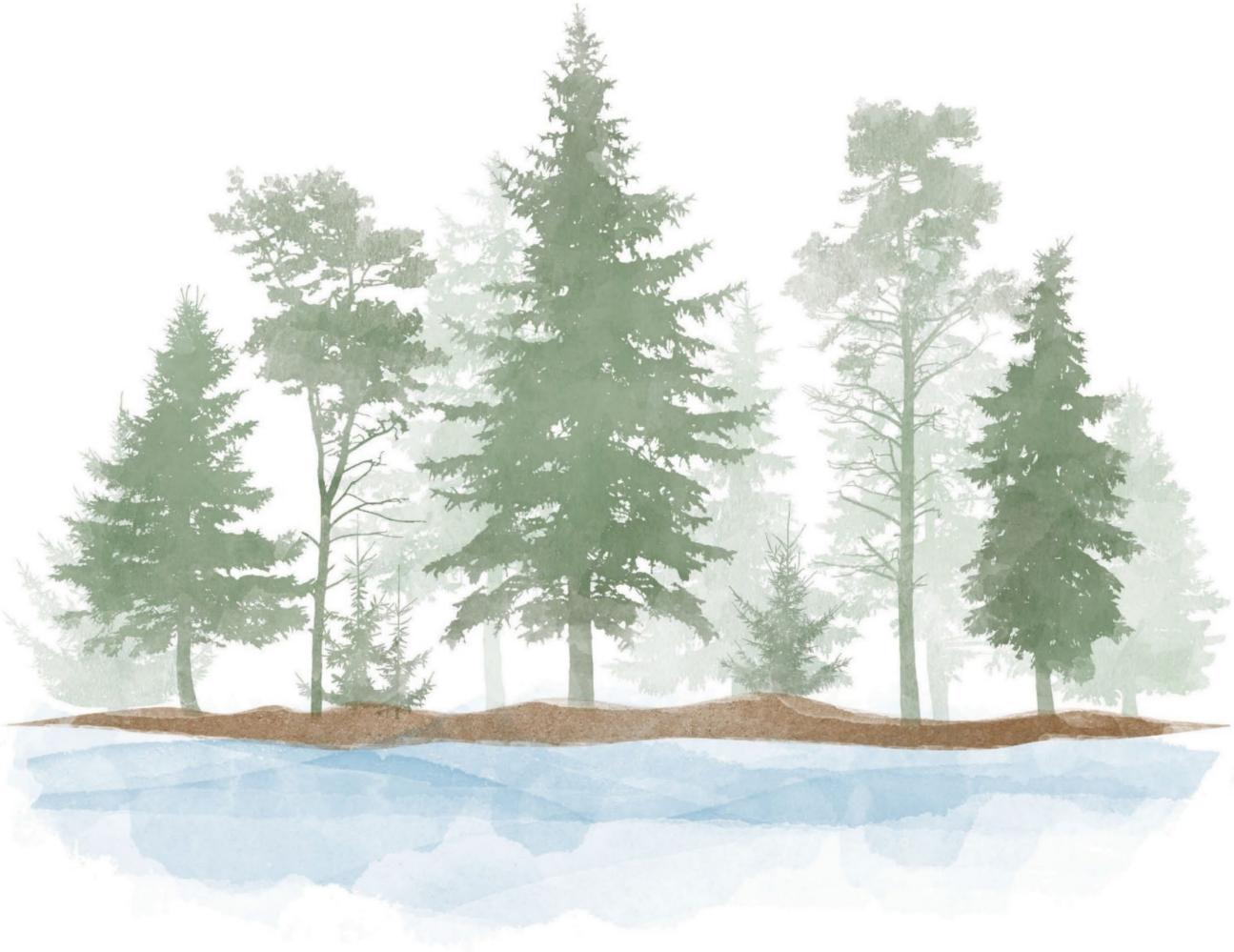

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1 BACKGROUND

The Lake Champlain-Richelieu River (LCRR) basin is a geographically and culturally diverse region straddling the Canada-US border. The vast drainage area is susceptible to springtime flooding that affects both lakeside and riverside residents of New York, Quebec, and Vermont. The International Joint Commission's Lake Champlain-Richelieu River Basin Study Board has undertaken an extensive evaluation of both structural and non-structural approaches to reduce the impacts of flooding in the LCRR basin.

As part of this effort, the Study Board adopted a flood mitigation framework centered on four mitigation themes:

1 Reduce extreme water levels on the Richelieu River and by extension, on Lake Champlain

2 Reduce inflows into Lake Champlain or the Richelieu River

3 Improve flood response (emergency preparedness)

4 Modify floodplain management (adaptation to flooding)

A *Floodplain Management Solutions in the Lake Champlain-Richelieu River (LCRR) Basin* workshop was held February 6-7, 2020 in Montreal, Quebec. The findings from this workshop were synthesized in a report (Henstra and Shabman 2020), which was submitted to the International Lake Champlain- Richelieu River Study Board.

The workshop report identified four key areas that the Study Board should focus on in providing floodplain management recommendations to the International Joint Commission:

1 Better flood risk maps are needed.

2 Flood risk should be better communicated and understood.

3 Management of floodplain occupancy should adapt and evolve.

4 Developments in Canadian and US flood insurance should be recognized.

The Study Board agreed with the proposed framework to examine these four areas in more detail. Experts in floodplain management were subsequently contracted to explore best management practices and provide recommendations for each of these specific areas. The result was four White Papers, each of which focused on one of these topics. Better communication of flood risk helps assure that decisions about floodplain use are based on facts. The first and second white papers are closely connected because flood maps help communicate an accurate assessment of risks. Throughout the study area, floodplain management has already reduced the vulnerability to flooding since 1976. Quebec is in the process of revisiting its floodplain management techniques in its Normative Framework, and the United States will be instituting a new approach called Risk Rating 2.0. The third white paper explores these developments, including new ideas that may or may not be part of any new policies. The fourth paper explores the potential of universal flood insurance to both reduce personal financial hazard and drive improvements in floodplain management. The fourth paper is closely connected to the third, in that it discusses a specific and novel floodplain management measure.

The unifying focus in developing these four White Papers is improving floodplain management. The goal is to ensure the wise use of floodplains. The principal characteristic of wise use is that it is sustainable; i.e., property owners understand flood risks but feel that benefits justify or outweigh these risks without the need for an external subsidy. Each of the white papers in this series focused on compiling best management practices based on interviews with experts and a literature review. The goal was to identify those practices that may apply to the basin, while also considering existing jurisdictional efforts. This White Paper focuses on key area # 2: Flood Risk should be better communicated and understood.

1.1 POLICY CONTEXT

The Lake Champlain-Richelieu River Basin is a socially, politically, and geographically diverse region. This diversity presents unique challenges for flood risk communication. Governance of the Basin involves two national governments (Canada and the United States), three regional governments (Quebec, New York, and Vermont), and dozens of local governments. Variation in topography, flood experience, and exposure to flood hazards makes understanding flooding especially difficult for Basin inhabitants.

The severity of the flood threat also varies considerably across the region. The floods in the spring of 2011, the worst in recorded history, affected residents in Quebec more severely than Basin residents in New York and Vermont. Quebec sustained nearly 80% of the total damages from the flood, and twice as many primary residences were flooded in the province than on the US side of the border.

Quebec

In Canada, the federal, provincial, and municipal governments are all involved to some extent in managing flood risk. The government of Canada plays a role by providing forecasts of weather conditions that could lead to flooding, monitoring flood hazards through the Government Operations Centre, funding small flood mitigation projects, and contributing to post-flood disaster assistance.

The Quebec government has a more direct role in flood risk management. The Ministère de la Sécurité Publique (Ministry of Public Security) sets regulatory standards for development, funds structural mitigation projects, and administers disaster relief. The province has recently created a network of experts to improve flood preparedness and has made changes to land use policies in floodplains. Provincial flood maps, which were notoriously outdated, inaccessible, and esoteric, are in the process of being updated (Valois, Tessier et al. 2020). The major flooding of 2017 prompted the adoption of a Civil Protection Flood Action Plan, consisting of 24 actions to strengthen flood risk management, such as inter-municipal aid, financial support to improve municipal flood preparedness, and better flood risk communication. The Quebec government has also bought out properties severely damaged by flooding.

Municipal governments serve several key flood risk management functions, including applying zoning by-laws to control or prevent development in flood-prone areas, issuing flood warnings when an event seems imminent, and subsidizing property-level flood protection measures (MELCC 2021).

New York and Vermont

In the United States, flood risk management is executed primarily through local government regulatory and spending decisions, which are influenced by incentives and deterrents embedded in the federal system. The Federal Emergency Management Agency (FEMA) provides grants that aim to encourage pre-flood planning to reduce hazard exposure and

vulnerability, and that support post-flood recovery and resilience-building. Annual appropriations are limited and there is intense competition among states and localities to access these funds. FEMA recovery grants are initiated after a flood emergency is formalized through a Presidential disaster declaration.

Most post-flood funding is (a) intended for immediate emergency relief, (b) directed to rebuilding public infrastructure (not supporting individuals), and (c) designed to reduce flood hazard exposure and vulnerability in anticipation of future events (Kousky and Shabman 2015). In sum, post-flood aid to individuals is limited, its distribution is delayed by the Congressional appropriation and then grant approval processes, and it is tied to the random nature of storms large enough to warrant a Presidential disaster declaration. Federal assistance often requires monetary or in-kind cost sharing from the recipient and/or undertaking some flood risk management actions as a condition of its receipt.

Flood insurance is significantly further developed in the United States than in Canada (see White Paper #4). The main source of coverage is the National Flood Insurance Program (NFIP), which is offered to properties in Special Flood Hazard Areas that are bounded by the elevation of the 1% (or 100-year) flood. To enroll, a community must first adopt an NFIP-specified land-use plan designed to limit flood risk.

Within the LCRR basin, there are notable differences in the administration of flood risk management between New York and Vermont. In New York, state emergency management is organized at the regional level, so hazard mitigation plans are developed at this scale. These plans do not differentiate between lake and tributary flooding. New York also has a strong county administrative system. When floods occur, the counties and municipalities work together on mitigation. Vermont, by contrast, has strong state support for hazard mitigation planning, but weak county administration. There is a great deal of diversity in how counties across the state integrate flooding into their hazard mitigation planning. In both New York and Vermont, there was a strong push for hazard mitigation and defense planning following the 2011 floods, but the priority may have waned since there has not been any significant flooding since that event.

1.2 THE NEED FOR ENHANCED FLOOD RISK COMMUNICATION IN THE LCRR BASIN

This section presents available information about current flood risk awareness on the Canadian and American sides of the LCRR Basin. Drawing on recent survey research, it asserts that greater risk communication efforts are required to increase public awareness of flood risk.

Quebec

Research on flood awareness and risk perception demonstrates a need for improved and expanded communication across the LCRR Basin. Canadians generally lack awareness of their exposure to flood risk. In a 2020 survey of homeowners living in designated flood risk areas, only 6 percent of respondents knew they were at risk, and nearly half of all respondents reported they were not at all concerned about flooding (Ziolecki et al. 2020). Recent survey data from flood-prone regions of Quebec indicate that the same trend holds in the province: about one-quarter of those living in flood-prone parts of the province did not know they were at risk (Valois et al. 2020). Moreover, despite the widely publicized floods of 2017 and 2019, the number of at-risk residents who did not know they lived in a flood-prone area grew between 2015 and 2019 (Valois et al. 2020). This suggests that recent communication efforts have not increased flood risk awareness.

Low awareness of flood risk in Quebec explains in part why many Canadian residents of the basin have not taken action to protect their properties from flooding. Quebec households with no previous flood experience have engaged in very few adaptive behaviors, comparable to those living in low-risk flood areas of the province (Valois et al. 2020). Evidence

suggests that some residents on the Quebec side of the basin who experienced the 2011 floods perceived the event as an anomalous, once-in-a-lifetime event and therefore did not see the need to prepare for future flooding (Gervich and Spett 2021). Residents who perceive future flood risk are typically older, so they might face other barriers to action, such as limited resources and restricted mobility.

Understanding how people perceive flood risk and protective measures is critical for designing effective communication strategies. Research underway by the Social, Political, and Economic (SPE) Analysis Group will be essential for understanding the attitudes and beliefs of stakeholders (e.g., first responders; community organizations) and the public across the LCRR basin and will help to prioritize flood risk management solutions. From its work to date, we know that residents of Quebec, Vermont, and New York prioritize similar decision-making criteria for flood risk management. Specifically, human health and safety (especially among vulnerable residents) ranks first; medium priority is assigned to protecting environmental health and preventing structural damages; and the lowest priority is preventing harm to the economy, historical/cultural sites, and infrastructure. We also know residents of the Quebec side of the basin rely on and trust municipal websites as their primary source of flood-related information. Local television is also used, though it is less trusted than the government (Gervich and Spett 2021). These data from the SPE Analysis Group are valuable for ensuring that messaging around flood risk reaches LCRR residents and resonates with their values and priorities.

New York and Vermont

Many Americans in the LCRR Basin are also unaware of flood risk and unprepared for flood events that might affect their property. In New York and Vermont, public flood risk perception is more contingent on experience with flooding than in Quebec, where general flood awareness has remained higher because of other serious flooding events in the province since 2011 (Gervich and Spett 2021). New York and Vermont residents who experienced flooding directly in 2011 have higher risk perception than those who are also at risk but did not previously experience flooding on their property.

Survey research from the SPE Analysis Group also compared flood risk perceptions of first responders and general residents of the LCRR Basin in New York and Vermont. When asked about the likelihood of experiencing river or lake flooding in the next 10 years, 68% of first responders reported the likelihood to be high or very high. This contrasts with only 10% of residents who believed they were likely to experience flooding over the same period. Concern about flooding also varied across the United States side of the LCRR Basin, where stakeholders prioritized the impacts of tributary flooding over lake flooding, typically because those impacts are more severe.

Residents of Vermont and New York prioritized human health and safety as their top priority for decision-making around flood response (Gervich and Spett 2021). They listed environmental protection and minimizing damage to structures as medium priorities and ranked protecting historical/cultural sites and preventing economic harm as the lowest priority. Regarding sources of flood risk information, police and fire departments were identified as the most trusted, though not the most utilized, authority among New York and Vermont residents.

2 RISK PERCEPTION, RISK COMMUNICATION, AND BEHAVIORAL RESPONSES

In this section, we draw on scholarly literature to present highlights of the current state of knowledge about risk perception, risk communication, and human behavior.

Risk perception

Understanding how people perceive risks is valuable for directing risk communication efforts. Risk is commonly understood as containing two elements: a hazard and the probability of its occurrence. Individuals manage risks daily, such as whether to make a new investment, bring an umbrella to work, or undergo a medical procedure. Human perception of risk is related to the objective or quantifiable reality of risk but is also strongly influenced by emotional, social, and contextual factors. Although two people can be exposed to the same risk, the way they comprehend, assess, and make decisions about that risk can diverge considerably (Fischhoff et al. 1993). For many decades, scholars from diverse disciplines have explored how humans process risk, why they are more concerned about some risks than others, and the processes by which people make decisions regarding risk (Meyer and Kunreuther 2017; Morgan et al. 2002; Slovic et al. 1982; Slovic 2000).

Findings from our expert interviews strongly supported the notion of divergent perceptions of the same risk in the LCRR basin. For example, the scientifically calculable risk of a 100-year flood is perceived differently by different stakeholders. From an economic perspective, the damage incurred from such a flood might be considered insignificant when averaged out over such a long period. Conversely, a property owner who lives in the same residence for 30 years has a 26% chance of experiencing that flood, and for them, the trauma and personal loss of that event could be incalculable.

The psychometric paradigm

The psychometric paradigm explains why people have an extreme aversion to some hazards and are relatively indifferent to others, and why the layperson's perception of risk differs from that of an expert (Slovic et al. 1984). According to the psychometric paradigm, individuals are more concerned about unfamiliar and involuntary risks (i.e., those they cannot control). Familiar and controllable risks, such as driving a vehicle despite the risk of an accident, are more manageable and acceptable. The second dimension of the psychometric paradigm is dread: people have the highest aversion to risks that elicit visceral feelings of terror and have catastrophic potential. Examples of high dread risks are terrorist attacks and nuclear accidents; low dread risks are exemplified by illnesses and household accidents (Krimsky and Golding 1992).

Cognitive biases

Research in cognitive science and psychology has generated insights into common thought patterns that influence the processing and responses to risk (Meyer and Kunreuther 2017). For example, myopia is the human tendency to focus on short future time horizons when considering the costs and benefits of taking measures to protect against risks. Inertia refers to a systematic bias towards maintaining the status quo when there is uncertainty about the efficacy of investing in protective measures. When confronted with complex risks, people also tend to simplify their decision tasks by attending to only a subset of relevant information.

Risk perceptions and responses are also strongly influenced by observations of others. For instance, herding refers to the human bias towards choices that mirror the actions of peers. These cognitive biases are often useful for assessing situations and making decisions quickly, but they can also lead to poor decision-making concerning risk.

More than knowledge deficit

The psychometric paradigm and cognitive biases help to explain why communication of environmental risks is difficult: simply providing people with information will not lead to the desired action. Historically, when the public failed to respond to risks in the ways advised by experts, their inaction was attributed to ignorance (Nisbet and Scheufele 2009). Science communicators assumed that if the public was presented with the same set of facts, then they would come to agree with the experts and pursue a rational course of action. This 'deficit model' led to one-sided science communication strategies, which prioritized simply providing more information about science topics. Further, when the public failed to agree with scientists, the deficit model justified condescending claims of "public ignorance" and "denial", rather than identifying inadequacies in the communication efforts of scientists and organizations (Nisbet and Scheufele 2009). In recent decades, research has identified the failings of the deficit model: we are not passive, rational consumers of science information, but rather our understanding of science topics is mediated by our ideology, experiences, and social context.

Thinking fast and thinking slow

People's seeming lack of comprehension and failure to respond rationally to risk information can be partially explained by research on human information processing. Cognitive scientists have identified two parallel modes of information processing, only one of which is responsive to the abstract, technical information that often characterizes technical or scientific messaging about environmental risks. Kahneman (2011) described these systems as "thinking fast"—our emotional/experiential processing system, and "thinking slow"—our rational/analytic processing system. "Thinking fast" is an automatic response to experience, which encodes reality in concrete images, narratives, and metaphors.

In contrast, "thinking slow" requires deliberate effort, but enables us to process abstract ideas, words, and statistics about complex topics like flood risk. Various studies have demonstrated that "experientially derived knowledge is often more compelling and more likely to influence behavior than is abstract knowledge" (Epstein 1994). "Thinking fast" is also more closely associated with risk response (Weber 2006). Accordingly, vivid, concrete, and experiential information is more likely to influence people's perceptions and behaviors around flood risk than abstract, technical information.

In the context of flood risk communication, practitioners can use fast thinking to their advantage by using vivid language, narrative, and evocative imagery. Relying on numbers and charts alone is less likely to shift perceptions and inspire people to take action, because flood risk may be processed as a distant and abstract threat (Slovic 2000). More creative strategies such as displaying historical inundation lines or offering themed, guided tours may do a better job of tapping into people's emotions and making flooding a more salient problem.

Framing effects

The framing of risk affects how the audience perceives it and their willingness to act to manage it. Framing refers to highlighting certain aspects of an issue to promote a particular interpretation. Framing is an unavoidable element of communication because events must always be edited or simplified in some manner to be understood (Halffman 2019). Flood events, for example, allow for numerous possible frames: as a chaotic natural phenomenon, a story of personal trauma or resilience, a failure of urban planning, a preordained act of God, a symptom of a changing climate, or an opportunity for community growth and solidarity.

When communicating about flood risk, therefore, the actions for dealing with or managing the risk must be framed as feasible for the intended audience (Meyer and Smith 2019). Although the event itself might be described as dangerous, the messaging should instill a high sense of self-efficacy, which makes individuals more likely to take action and seek out additional information. Target recipients must also feel empowered to engage in personal risk reduction, which increases their intention to act.

Insights from behavioral economics and marketing

Risk messaging often fails to produce behavioral change because it does not outline clear actions and effectively convey how the benefits of taking those actions exceed the costs. Experts in behavioral economics emphasize the importance of identifying specific actions, targeted to the audience, to avoid information overload, which may cause the audience to tune out or fail to prioritize the most important actions (Ziolecki and Thistlethwaite 2019). Communication with the intent of inducing action should emphasize the target behavior (e.g., purchasing flood insurance) while making the competing behavior (e.g., delaying purchasing flood insurance) less desirable.

A common barrier to reducing flood risk is that actions are, or are perceived to be, complex and necessitating technical knowledge, such as operating and maintaining a sump pump (Valois et al. 2020). This impediment should be identified and addressed in the design of communication. Intended results might not be achieved through a one-off campaign. Reducing flood risk involves repeated and sometimes complex behaviors, such as making sure water runs off away from the home, so engagements should be timed to sustain the desired behavior.

Mental models

Mental models refer to a person's ideas about the surrounding world and their thought process about how things work (Morgan et al. 2002). By understanding a household or community's mental model about preparing for floods, it is easier to effect change that increases personal preparedness (MacKinnon et al. 2018). This is because mental models related to flood risk encompass individuals' assessment of how worried they should be about flooding—known as their 'threat appraisal'—and their feelings about how capable they are to prepare for a flooding event, known as their 'coping appraisal'. The reality of flood risk and the efficacy of personal preparedness measures may differ substantially from an individual's threat and coping appraisals.

However, it is a person's mental model that guides their actions. Our interviewees warned that the mental model of flood risk among residents of the LCRR basin may diverge dramatically from expert understanding. They explained that lake and riverside residents often blame authorities for flood events rather than accepting that flooding is a natural occurrence. Mental models may even be influenced by conspiracy theories circulated on social media. Communications that are not grounded in an understanding of the audience's mental model may be ineffective or even anger the intended audience by

failing to address their most pressing concerns. For this reason, researchers and communication practitioners have developed a flood risk communication approach designed around community mental models of flood risk (Table 1).

The mental model approach involves comparing expert understandings of flood risk with those held by target audiences, to assess gaps, false beliefs, and misunderstandings about personal actions that can be taken to reduce household risk. This assessment can underpin a flood risk communication campaign that meets community members at their level of understanding while working to adjust critical aspects of the community mental model to promote improved understanding of preparedness (Morgan et al. 2002).

Impact of personal experience of flooding on risk perception

Personal experience of a flood event can change risk perception significantly, and it tends to increase risk reduction behavior (Lawrence et al. 2014). This is consistent with research conducted with Quebec residents, which showed people who live in a floodplain and have experience of a flood event are more likely to take preventative measures than those who face equivalent flood risk but do not have previous personal experience (Valois et al. 2020). The relationship between personal experience, risk perception, and behavior can be explained by the different modes of information processing discussed above. That is, personal experience with an event is far more impactful than descriptions or data about potential hazards.

Table 1. The Mental Model Approach to Designing Risk Communication

Step	Goal
1. Create expert mental model	Using expert knowledge, identify the factors that influence a risk and the actions that can be taken concerning the risk. For example, flood risk is influenced by the number of people and buildings exposed to potential inundation, a population's ability to cope with and recover from a flood, and the actions and institutions in place that reduce the consequences of a flood (e.g., emergency services). The intended result is an influence diagram that shows explicit factors that influence a risk and actions that can impact the consequences of a hazard.
2. Conduct mental model interviews	Develop an open-ended interview protocol guided by the (expert) influence diagram. Interview the target audience to identify their beliefs about a risk and compare them with the influence diagram. The purpose of this exercise is to identify correct and incorrect beliefs about a hazard as indicated by the target audience.
3. Conduct structured initial interviews	Develop a structured survey using the feedback from the target audience's mental model. Provide this survey to a larger group (e.g., statistically significant sample of the target audience population). Identify whether this larger group experiences the same or varying understanding of a risk (i.e., the prevalence of these beliefs among a population).
4. Draft risk communication	Draft risk communications messaging that is guided by the information gathered through the experts' and the audience's mental models. This risk communication messaging can target knowledge gaps, false beliefs, and the lack of understanding of actions that can be taken by the target audience to reduce their risk.
5. Evaluate communication	Test risk communications messaging with members of the target audience to determine if the message is interpreted as intended. This can be done by "using one-on-one read-aloud interviews, focus groups, closed-form questionnaires, or problem-solving tasks". This process may need iteration until the messaging is interpreted as intended.

Source: Adapted from (Morgan et al. 2002)

3 FLOOD RISK COMMUNICATION

In this section, we discuss some of the operational objectives behind flood risk communication campaigns, to highlight their diverse uses and potential outcomes.

3.1 OBJECTIVES OF FLOOD RISK COMMUNICATION

Informing and involving the public in flood risk management

Governments have a responsibility to inform and engage the public in flood risk management to enable the wise use of floodplains by all stakeholders. For instance, the United Nations' Convention on Access to Information, Public Participation in Decision-Making, and Access to Justice in Environmental Matters requires that the public be given early, open, and effective opportunities to participate in decisions where there may be significant effects on the environment, including flooding (Wehn et al. 2015). Similarly, the European Flood Directive requires member states to implement mechanisms to incorporate public participation into flood risk management. Both the Convention and the Directive are regional agreements with only European signatories, but best practices have emerged and are increasingly applicable to flood risk management in North America. The fundamental responsibilities of governments to their citizens expressed in these documents should also motivate enhanced flood risk communication efforts in Canada and the United States.

THE NEW ENGLAND CLIMATE ADAPTATION PROJECT CASE STUDY FOR DOVER, NEW HAMPSHIRE

The City of Dover, New Hampshire promoted increased understanding of flood risk through an innovative workshop. Dover faces increasing risks related to precipitation and temperature changes, sea-level rise, and flooding. In the fall of 2012, local research and conservation groups partnered with City representatives to run workshops intended to raise awareness about climate change, and to increase support for local adaptation measures. The workshops included a simulation activity in which participants role-played stakeholders with diverse interests and strove to reach consensus on policies to recommend to municipal leadership. Staff collected data before and after the simulation activity to measure its impact. Afterwards, participants had increased awareness and concern about climate risks. Participants also expressed increased support and a greater sense of local responsibility for climate change adaptation, as well as a better awareness of barriers to local action.

Source: Massachusetts Institute of Technology Science Impact Collaborative, Consensus Building Institute, and National Estuarine Research Reserve System 2014

Sharing responsibility for flood risk management

Governments are increasingly interested in flood risk communication as part of a strategy to allocate some of the responsibility for flood risk management to the public. Household risk reduction measures include, for example, purchasing private flood insurance and installing property-level flood protection measures. Higher risk awareness through communication is an essential prerequisite if the public is to be expected to take on responsibility for managing some of their

flood risk. This is a key principle in the Sendai Framework for Disaster Risk Reduction, which states that stakeholders and the public must first understand their disaster risk to reduce their vulnerability.

There is a range of stakeholders who should rightly bear some responsibility for flood risk management. Developers and builders, for instance, expand property exposure to flood hazards, realtors advertise and sell properties in flood-prone areas, and lenders facilitate property acquisition in flood zones by backing mortgages. Despite this complex web of stakeholders, many individual property owners make decisions to live in flood zones without being fully informed about flood risk. For this reason, the proportion of responsibility that households can reasonably be expected to take on is small, as is the scope of behavioral change that can be expected as a result of flood risk communication (Kuhlicke et al. 2020).

In light of these considerations, flood risk communication cannot be regarded as a tool to offload responsibilities from governments and other stakeholders onto the public. Rather, communication efforts should, first and foremost, support fulfillment of the government's responsibility to inform and engage the public and facilitate appropriate sharing of responsibility across a network of stakeholders to enable wise use of floodplain lands. Appropriate sharing of responsibility may also be supported through engaging private stakeholders as extension agents for public flood risk communication. This approach reflects a policy shift toward integrated flood risk management, as observed in many countries, which involves distributing responsibilities among governments, private stakeholders, and the public, and adopting multiple strategies to manage and reduce flood risk (Thistlethwaite et al. 2017).

Inducing behavioral change

Although many flood risk reduction measures, such as the production of flood maps and land-use zoning, are the domain of national and provincial/state governments, other actions can be feasibly implemented by communities and property owners themselves. Property-level flood protection measures include, for example, locating water and electricity shut-offs, installing temporary or permanent flood barriers, and storing valuable items above the ground floor, which can significantly reduce the negative consequences of flooding (Valois et al. 2020). Community-level protection measures include actions such as neighborhood evacuation plans and pre-organized sandbagging strategies. Beyond informing the public, therefore, a flood risk communication campaign might also aim to induce behavioral change at the property or community level (Thistlethwaite et al. 2017). In Germany, for example, flood risk communication efforts over many years increased public awareness and property-level action on flood risk, which helped to achieve a 40% reduction in flood losses (Thieken et al. 2016).

Increasing support for other flood risk management instruments

Effective flood risk communication may also be used to foster public support for other flood risk management measures. Although a wide array of structural and non-structural mitigation actions is available to governments, their effective implementation depends in part on their political and social acceptability among the public (Gervich and Spett 2021). For instance, research conducted by the SPE Analysis Group found that "entrenched positions and perspectives" are a real potential barrier to uptake of the LCRR Study Board's recommendations. Communication efforts may assist in softening perspectives that impede the implementation of certain measures in the LCRR or motivating stakeholders to push for enhanced risk reduction.

The success of certain flood risk management measures may be contingent on public awareness and buy-in. This is perhaps most important for private flood insurance, the economic viability of which depends on broad uptake to spread the risk of loss over a large premium base (see White Paper #4). Effective flood risk communication in the LCRR Basin may also foster

public acceptance of more restrictive land-use zoning (and rezoning) on floodplain lands (see White Paper #3). Flood maps that are designed for public awareness are an important tool to legitimate contentious land-use decisions, including the relocation of structures out of harm's way (see White Paper #1). Finally, effective communication increases public trust in authorities and reduces local resistance to flood risk reduction measures.

Poorly conducted risk communication can erode trust relationships between authorities and the public, and potentially undermine efforts to roll out other risk management measures. As explained by our interviewees, flood risk communication often addresses emotionally charged topics, such as whether homeowners should relocate after a devastating flood. If authorities approach this as a purely technical discussion and are unequipped to manage grief, anger, or denial among community members, then they may be perceived as out of touch, insensitive, or even hostile to local interests.

Fostering mutual learning and trust ties

A final, long-term objective of risk communication is to facilitate mutual learning and increased trust between authorities and the public. When communication practitioners build relationships with the community and listen to concerns about flood risk and its management, they can gain valuable insight into the political and social acceptability of policy choices (Armos 2020). Building trust relationships between authorities and the public also provides more space for experimentation and learning. If planned risk reduction measures have unintended consequences, for example, the public is more likely to forgive, rather than assert blame. Additionally, through deeper and more long-lasting forms of engagement, members of the public may develop a greater sense of responsibility and support for risk reduction measures. These objectives are more likely to be obtained through bi-directional forms of communication and engagement, as discussed below.

3.2 THE SPECTRUM OF PUBLIC COMMUNICATION AND ENGAGEMENT

Public communication is intuitively understood as informing the public about flood risk and management options. But this encompasses just one of many forms of public engagement about flood risk. Determining the desired level of engagement and extent of public impact is a critical aspect of deciding on the objectives of a public communications plan. The International Association for Public Participation (IAP2), a global leader in public engagement, offers a spectrum of public participation to assist engagement and communication practitioners. It includes five levels of engagement which, when applied to flood risk management, include:

- *Informing*: providing the public with flood risk management information to assist in their understanding of the problem and potential solutions.
- *Consulting*: obtaining public feedback on flood risk management options.
- *Involving*: including the public fully throughout flood risk management decision-making to ensure that concerns and aspirations are consistently understood and considered.
- *Collaborating*: partnering with representative public groups to make flood risk management decisions.
- *Empowering*: placing final decision-making power in the hands of the public.

The level of engagement and methods employed must be tailored to the objective and target audience. Engagement levels with a lesser degree of direct public impact (i.e., informing and consulting) require less time and resources than higher levels of engagement such as collaborating and empowering. For informing the public, practitioners may employ relatively simple and inexpensive methods, such as websites, fact sheets, or open houses. Consulting requires increased time and resources to gather public input, consider the contributions, and, potentially, make changes based on public feedback. Consultation may be conducted through focus groups, surveys, or public meetings. Involving the public in decision-making requires more engaged methods such as focus groups. For collaborative engagements, practitioners may utilize citizen advisory boards, consensus-building exercises, or other participatory decision-making models. An empowering approach hands over decision-making authority to the public through methods like citizen juries, ballots, or delegated decision processes.

In contrast, engagement approaches that do not allow for public participation in decision-making risk frustration and resistance to imposed solutions among residents. Public communication plans that do not consider public input also forgo learning opportunities. More engaged methods enable expert flood risk managers to learn from the public, who may possess valuable local knowledge of flood risks or provide insight into solutions that are most appropriate and effective in their community. All of the experts interviewed for this paper strongly recommended using methods that involve building a relationship with the public. They emphasized that entrenched positions and false beliefs will not be overcome through informational pamphlets and websites, but rather require prolonged dialogue oriented towards developing a shared vision.

There are good reasons for adopting any of the five approaches to engagement, and the level of participation can progress through various levels throughout a campaign. Regardless of the specific approach, clarity on the communications objective, the scope of the decision-making, and whether and where public input can influence the decision-making process is critical for success.

3.3 FLOOD RISK COMMUNICATION AND OTHER POLICY TOOLS

Flood risk communication is an important complement to other policy tools for flood risk management that aim to assist communities in preventing, preparing for, and recovering from flood impacts. The following tools—land use regulation, flood maps, and flood insurance—are each detailed in the other White Papers commissioned by the Study Board.

Land-use regulation is a powerful tool to prevent and reduce exposure to flooding (see White Paper #3). On both sides of the Canada-US border, local governments are granted authority by provincial (state) legislation to regulate land use within their boundaries through the adoption of zoning by-laws. This planning authority is used to prohibit or restrict residential development in flood-prone areas, but these controls are often contested by development interests and sometimes questioned by political actors. Flood risk communication campaigns can strengthen public and political support for land use regulation in flood-prone areas because people gain a better understanding of the social and economic risk flooding poses to the community and an appreciation of the need to protect people and property.

Flood maps are another type of flood risk management tool, used worldwide to communicate risk to public audiences (Hagmeier-Klose and Wagner 2009; Kellens et al. 2009) (see White Paper #1). Flood maps used for risk communication generally seek to raise public awareness about flood impacts, impart flood preparedness advice, and increase transparency about government actions for reducing flood risk. However, flood maps designed for this purpose must also ensure that intended audiences can understand and correctly interpret the information presented (Kellens et al. 2009; Van Kerkvoorde et al. 2018).

The experts interviewed for this paper warned that even flood maps designed to inform the public may be misleading. For example, if a map indicates only the 100-year flood zone as risky, users might assume unmarked areas outside the zone have no flood risk. This can be remedied with more holistic visualizations and descriptions of the degrees of risk in floodplains.

A third policy tool is *flood insurance*, which offers a legitimate and efficient means to finance household recovery from flood damages (see White Paper #4). By engaging private resources of insurers and property-owners themselves, flood insurance shares the responsibility for flood risk management beyond governments. Voluntary uptake of flood insurance by households is often low, however, so flood risk communication can be a valuable support for making residents aware of their protection gap. In February 2020, for instance, Wisconsin's Governor declared a Flood Insurance Awareness Week, with the objective of "encouraging Wisconsin consumers to learn more about the importance and benefits of flood insurance so they can be sure that they have the financial protection they need" (Wisconsin Office of the Commissioner of Insurance 2020).

4 EFFECTIVE FLOOD RISK COMMUNICATION METHODS

Based on a comprehensive review of pertinent literature, an assessment of professional publications, and expert interviews, this section outlines a series of ideas for designing an effective flood risk communication campaign. Where appropriate, it grounds these ideas by presenting concrete examples of how they have been implemented in practice.

Develop a targeted campaign

To be effective in raising awareness and engaging the public, a flood risk communication campaign must be targeted, meaning it should be designed around a specific set of objectives, tailored to the audience and the type(s) of flooding they face, and explicit about the behavior that officials want residents to take. Analysts have long recognized the limitations of a "toolkit" approach, characterized by a homogenous message, one-size-fits-all strategy, and hierarchical (top-down) delivery. Rather, they view flood risk communication as a public engagement process that builds trust between officials and target audiences for more lasting impacts.

USING STORYTELLING TO HEAL COMMUNITY TENSIONS IN LONDONDERRY, VERMONT

Londonderry, a town of 1,700 located just southeast of Lake Champlain, struggled to rebuild and heal following devastating riverine flooding in 2011. The flooding had been worsened by a dam on the river that runs through the center of the town. The dam holds deep cultural significance to the local community and, following 2011, Londonderry residents were deeply divided as to whether or not to have it removed. In 2013, the regional planning commission partnered with the local college to run a 6-day workshop with residents focused on collective healing from the flood. The workshop was supported by a $40,000 grant from The National Endowment of Arts. A group of 18 Londonderry residents collaborated with experts, professionals, and artists to conduct community research and run public meetings.

The workshop activities experimented with different modes of expression and engagement, including an emotive-physical story-telling event attended by 50 residents. Guided by a choreographer facilitator, participants collaboratively created a movement piece which interwove physical gestures they used to describe the river and their dialogue with each other about their personal experience of the flood. The unconventional methodology disarmed participants, allowing them to engage in a new conversation about the flood and the dam, which departed from prior unproductive arguments and avoidance. Residents reported that participation in the workshop events fostered feelings of community connection and open-mindedness. Use of such methods can help to transcend skepticism and fear, two common roadblocks for participatory planning, especially around divisive issues in the community.

The workshop was successful, in part, because it was tailored to the community characteristics and with an awareness of the community tensions. The method holds promise for the LCRR basin, particularly in small, rural towns (e.g., 70percent of towns in Vermont have less than 2,000 people), and where community divisions over flood-related issues exist.

Source: Ryan 2016

Leverage calendar milestones and attention-focusing events

In light of the cognitive limits and biases discussed above, flood risk communication must be repetitive and sustained to be effective. One proven strategy is to leverage the attention around significant dates and milestones to direct people's attention to flood risk. The changing seasons, for instance, are quarterly milestones that can be used to remind target audiences about season-specific actions they can take to protect themselves and their property. Other notable times, such as the beginning of the annual homebuying season, and events focused on emergency preparedness (e.g., Canada's Emergency Preparedness Week), offer periodic opportunities to remind residents about flood risk and protective actions. Flooding events, either those that occur locally or are observable elsewhere, typically generate considerable media attention, and this "window of opportunity" can be harnessed to exhort target populations to prepare themselves for a similar event.

LEVERAGING THE KING TIDE FOR PUBLIC ENGAGEMENT IN ST MARY'S, GEORGIA

St. Mary's, Georgia leveraged the natural cycle of the tides to increase turnout for public engagement on flooding. The town had made flooding and sea-level rise a priority after discovering that 90 percent of its historic structures were located in a 100-year flood zone. In 2013, the town received National Sea Grant funding to complete resilience and adaptation planning, and the funding was used to develop the St. Mary's Flood Resiliency Plan. Public engagement featured significantly in the plan. In March 2014, officials hosted a public town hall to collect local knowledge about vulnerability to flood risk. The event was timed to correspond with the day of the local King Tide. By hosting the event on the day that sea level rise is most apparent, the issue was made more salient and pressing, attracting higher participation.

Source: Gambill et al. 2017

Employ multiple media

In recognition that people have divergent approaches to accessing information, effective flood risk communication campaigns harness a diversity of media to disseminate messages. These media include traditional print sources, such as newspapers and local and regional newsletters, as well as online delivery mechanisms such as websites, social media platforms, and apps (discussed below). Research suggests that people find non-traditional print sources appealing as a source of flood risk information, such as door handle notices and mailouts with municipal utility and tax invoices. Interviewees emphasized that in-person methods, such as community information sessions or door-to-door campaigns, are critical for building trust between communicators and target audiences. These two-way communication venues allow concerned residents to ask questions and draw lessons from each other's experiences, while organizing officials can listen and learn from the dialogue.

COLLABORATIVE MAPPING IN GIS IN DELTA, BRITISH COLUMBIA

Geographic information system (GIS) technology has transformed flood risk management. It also shows promise as a tool for public communication and engagement. In Delta, British Columbia, for instance, GIS was used as part of a stakeholder engagement process intended to stimulate dialogue between experts, government officials and community participants about future local landscape and flooding possibilities. The workshop organizers developed four "visioning packages", through which participants could interact with future landscape and adaptation scenarios for their city. The process was highly productive, generating flood risk management solutions for the Delta region. For example, participants flagged greater certainty in predictive models and greater human and technical capacity as some of the enabling conditions required to strengthen flood risk management.

Source: Burch 2010

Use mobile applications to support flood preparedness and response

Smartphones have become an integral part of daily life for most North Americans. Mobile apps are one medium through which flood risk preparedness information and warnings can be shared with the public. Most apps appear to be designed primarily to provide emergency alerts to the public around the time of an extreme weather event, and some also provide information about preparedness. Other apps are designed to enable the public to gather and share location-specific data with authorities to inform real-time disaster response (Frigerio et al. 2018).

As flood risk communication tools, apps have both significant strengths and notable limitations (Intrieri et al. 2020). Mobile apps created by well-known authorities, such as the Federal Emergency Management Agency (FEMA) app discussed below, provide trustworthy information. This is an advantage over other common sources of information such as word-of-mouth or stories on a Facebook feed, which may or may not come from a reliable source (Fischer et al. 2019). Another strength of apps is that they can actively warn users about a crisis using push notifications (e.g., a loud noise or buzz), likely triggering the user to read the emergency alert immediately. Apps are also valuable for communicating flood risk because, using the smartphone's GPS connection, they can send information customized to the user's location. For these reasons, smartphone apps can act as a fast, efficient, and far-reaching form of crisis communication.

Push notification technology embedded in mobile apps can be harnessed to direct flood information to relevant audiences in between the periods of heightened attention discussed above. For instance, location-triggered notifications based on flood maps could inform people they have entered a high-risk flood area. Smartphones can also serve as an "augmented reality" interface, whereby users can view three-dimensional digital representations of flood maps in real time (Rydvanskiy and Hedley 2020).

Apps also have several drawbacks, however. Individuals must install the app, which means they must understand they are exposed to risk, be aware that the app exists, and perceive the app as a useful tool. There may be greater barriers to effective use of phone apps amongst certain populations, such as the elderly, who have a greater reticence towards online tools and lower technological literacy. Additionally, apps that provide location-specific information also present privacy concerns, as users must share their location data to enable this function.

LEARNING FROM THE FEMA MOBILE APP FOR EMERGENCY PREPAREDNESS AND RESPONSE

The FEMA app provides people with information about what to do before, during, and after disasters, including flood events. Users receive location-specific weather alerts from the National Weather Service. Push notifications and alarms notify users about extreme weather events. Users can learn how to remain safe on their property or find the nearest emergency shelter. The app also supports advanced preparation for flooding and extreme weather events by providing emergency safety tips, instructions for building an emergency kit, and an interface for creating a family safety plan. The FEMA app has received mixed reviews. The emergency alerts and safety information it provides have been useful for some, but many users have complained of serious problems, including emergency alert failures. Such glitches are all but inevitable in complex technologies that interface with people, but FEMA app developers have remained in dialogue with users and made continuous improvements. Willingness to listen to users has improved the product and built trust with the public.

Source: Fitzhenry 2019

Distribute and amplify messages through trusted sources

A well-established principle of effective risk communication is that the audience must trust the source before trusting the message. For this reason, awareness-raising campaigns about flood risk should be planned to involve collaboration with a network of trusted organizations within communities, such as cultural associations, recreational groups, faith-based institutions, emergency responders, and not-for-profit agencies that engage with target audiences on other issues. Leveraging these trusted "extension agents" expands the reach of flood risk communication, broadens its influence, and enables feedback about community concerns, preferences, and outcomes.

The experts interviewed for this paper emphasized the importance of local messengers, and particularly local government officials, in delivering flood risk messages. They suggested that resources for communication may be most effectively used to train local authorities on how to communicate with residents about flood risk. Local officials who are informed about flooding can be influential in reducing risk in their community, whereas municipal leaders who themselves misunderstand flood risk can devastatingly undermine risk reduction efforts. Multiple interviewees suggested arranging platforms for municipal officials from different jurisdictions affected by flooding to share their experiences and provide advice.

SUSTAINABLE CLEVELAND'S NEIGHBORHOOD CLIMATE ACTION TOOLKIT

The City of Cleveland, Ohio used a creative method to amplify climate change adaptation risk management and engagement through local messengers. As part of Cleveland's 2013 climate action plan, the City launched the Neighborhood Climate Action Toolkit. The Toolkit was designed to enable community partners, including churches and local associations, to educate their members about local climate change impacts and solutions, and to implement their own adaptation and mitigation projects. Using the Toolkit, community partners are guided through a series of steps to learn about climate change in the Cleveland context, identify climate change problems and opportunities in their neighbourhood, and create a proposal for a local climate adaptation project. The community partner may then choose to apply for a $5,000 (US) grant from the City of Cleveland to implement their project. The program took an approach that focuses on empowering citizens and cultivating community resilience assets.

Source: City of Cleveland 2013

Evaluate outcomes

One of the most important aspects of risk communication is evaluating its effectiveness. Evaluation is challenging, however, and many studies have noted that risk communication activities are rarely evaluated, due in part to the difficulty of establishing a causal link between messages and behavioral outcomes (Rohrmann 1992; McComas 2006).

In the context of flood risk management, some analysts have proposed frameworks for evaluating the effectiveness of risk communication and stakeholder engagement. Stokes et al (2015), for instance, divide effectiveness into "outcome" indicators—an increase in participants' flood-related knowledge, greater confidence in their flood-related decision-making, and so on—and "process" indicators, such as participants' perceptions of the quality of communication content and delivery. Similarly, Rohrmann (1992) outlines four criteria for evaluating risk communication effectiveness, including:

- *content*: whether the message and its presentation were appropriate and adequate to achieve the communication goals,
- *process*: how well the risk communication effort was conducted, including whether relevant target actors were identified, reached, and motivated to exchange information,
- *outcomes*: whether instrumental objectives of the risk communication effort were achieved, such as "improving the receiver's comprehension, knowledge, problem awareness, and involvement", and whether these achievements are likely to ultimately change the beliefs, attitudes, and behaviors of target groups, and
- *organization*: the administrative practicality and costs (i.e., expenditures, personnel, and time) of the risk communication initiative.

Methods used to evaluate risk communication initiatives typically include before-after assessment and control group observation. The former involves administering an initial questionnaire that probes participants' knowledge and beliefs about flood risk and then administering the same questionnaire after exposing them to risk messaging, to identify differences that can be traced to the risk communication "treatment". The latter approach involves dividing off a subgroup of participants who will not be exposed to risk messaging and will rather serve as a control group to validate the influence of the risk communication on target audience knowledge and beliefs.

5 RECOMMENDATIONS FOR FLOOD RISK COMMUNICATION MESSAGES

In addition to the methods discussed above, the literature review and expert interviews yielded guidance on the optimal structure and content of flood risk communication messages. This section offers some best practices to maximize the effectiveness of messages used in flood risk communication campaigns (Ziolecki and Thistlethwaite 2019).

Profile the audience

Understanding the characteristics of the target audience—demographics, owners vs. tenants, residential vs. business property owners, and so on—is important for the design of flood risk communication materials. The audience profile can then inform a communications plan, which might involve strategies like translating messages into multiple languages, using a larger font to accommodate older residents, or highlighting different actions that are appropriate for property owners versus renters.

Promote benefits and anticipate barriers to action

Simply supplying people with flood risk information will not necessarily prompt them to take any action to address it. An important step in designing a flood risk communication campaign, therefore, is to research the factors (benefits) that motivate people to undertake socially desirable behaviors like adopting property-level protection measures, as well as the barriers that inhibit the adoption of these behaviors. Typically, this is achieved through early interactions with target audiences, such as focus groups, which yield information about the benefits and barriers to action, and communication pilots that test messaging to assess its impacts. Once the benefits and barriers to action are understood, then risk communication can be enhanced by, for instance, promoting social norms (i.e., persuasion based on observing the behavior of others) or offering incentives to adopt socially desirable behaviors.

Keep messages simple

Public attention is scarce and fleeting, so flood risk communication materials must be simple and brief. Straightforward, plain language messages that focus on one distinct action people can take to manage their flood risk are preferable to those that aggregate many behaviors because the latter can overwhelm recipients. When distributed online, such messages can include a link to more comprehensive information about why the action is important, the benefits that can be realized by taking the action, and the risks involved in failing to take it up.

TURN AROUND, DON'T DROWN

Most deaths associated with flooding occur due to people walking or driving into hazardous flood waters. To combat this risk, many years ago the US National Oceanic and Atmospheric Administration started a public service announcement campaign using the simple slogan, "Turn Around, Don't Drown". The phrase is now one of the most well-recognized flood-related messages, which is broadcast and displayed on road signs during floods.

Source: NOAA 2021

Make it understandable

To be effective, the language and terminology used in flood risk communication must be understandable to target audiences. Many Canadians and Americans have weak literacy skills (i.e., the ability to acquire and communicate meaning through language) and numeracy skills (i.e., the ability to make informed decisions based on quantitative or spatial information). It is therefore counterproductive to use terms such as fluvial and pluvial to describe types of flooding or to refer to flood-related hazards using terms such as inundation zone and 100-year flood, which are likely to be misunderstood. Language should be inclusive, simple, and clear. Messages should be written at a level appropriate to the literacy and numeracy skills of the audience. If more technical terminology is necessary to communicate in resources such as brochures, booklets, or websites, a glossary should be provided for reference.

COMMUNICATING FLOOD INSURANCE CHANGES IN NEW YORK CITY

In 2013, an update to FEMA's flood insurance rate maps doubled the number of properties required to buy flood insurance in New York City. Recognizing these changes would pose financial challenges for low and middle-income families, the Center for NYC Neighborhoods launched a FloodHelpNY website to inform and engage residents about flood risk and resilience. A user-friendly interactive map allowed residents to search whether insurance rules for their property were projected to change under the revised maps. The FloodHelpNY website explained the complexities of flood risk and insurance, including different insurance policies across FEMA flood zones. The site also empowered residents to reduce their flood risk, by connecting them with a free audit of their home's resilience to flood events. It also connected users with a program to assist middle- and low-income households in retrofitting their homes to lower their insurance rates.

Source: US Climate Resilience Toolkit 2018

Explain flood risk clearly

In addition to making flood risk understandable, how it is communicated to the public might influence people's willingness to pay attention to and act on the information. Experts typically quantify and discuss flood hazards using probabilities: the 100-year flood, for example, refers to a flood the magnitude of which has a 1% chance of occurring in any given year. Research has shown, however, that the public finds this terminology confusing.

Behavioral experts warn that public perception of danger is skewed because people tend to overestimate the probability of rare, extreme events while underestimating the risks associated with more common hazards. To remedy this distorted risk perception, it is more effective to communicate risk using cumulative probability—the likelihood that a risk outcome will occur within a specified, more meaningful period—rather than annual probability. For example, instead of informing people that their property faces a 1% (or 1-in-100-year) annual flooding probability (which individuals might discount as insignificant), officials should frame the risk within a more meaningful period, such as the life of a residential home mortgage (e.g., 26% chance of flooding over 30 years). Researchers who study the presentation of probabilities such as flood risk argue the latter framing increases the likelihood that target audiences will be willing to take preparedness actions.

Keep the message positive

Risk communication messages that evoke negative emotions such as fear and sorrow are more likely to cause individuals to ignore or discount the message than to take action. People are frequently exposed to negative and frightening messages about formidable contemporary issues such as climate change, environmental degradation, and income inequality, and this communication can make people despondent over time. Seeing images of flood devastation risks causing people to feel overwhelmed and disengaged. It is therefore important for flood risk communication to adopt an optimistic tone when framing messages to nudge people into action. Developing communication materials that inspire positive feelings such as hope and solidarity are more likely to attract public attention and motivate protective action.

Use evocative imagery

Whether communicated via social media, a website, infographic, or mail insert, flood risk communication materials that include imagery are more likely to capture a reader's attention. While many forms of imagery are useful, photographs that reflect a positive, optimistic tone are preferable. Photos of individuals engaging in the desired behavior (e.g., viewing a flood map or elevating their home) are more effective than images of the devastating impacts of flooding. Images of individuals that reflect the target audience and demographic further reinforce the message, because recipients can see themselves in the message.

Make the message memorable

Like a successful marketing campaign, making flood risk communication messages memorable to the audience is an important objective that increases the likelihood that people will take action to reduce their flood risks. Where appropriate, for instance, inserting humorous or playful language or using rhyming terminology in communication messages can increase their memorability because they are easier to recall.

6 EMERGING COMMUNICATION STRATEGIES

In this section, we describe several emerging approaches to risk communication that could be adapted to raise public awareness of flood risk in the LCRR basin.

Community-based social marketing

Community-based social marketing (CBSM) is a promising emerging method for promoting behavioral change in response to flood risk. CBSM is grounded in social and psychological understandings of human behavior. It involves targeting a specific action and then using various tools to reduce barriers to and enhance the benefits of, that action (Smith et al. 2019). Common CBSM tools include:

- *Social norms* are implicit rules about acceptable behavior in a culture or social group that can be leveraged to induce behavioral change. Research in Australia, for instance, found that people are more likely to purchase flood insurance if they perceive that there is a social norm to do so (e.g., that their neighbors, friends, and family are purchasing flood insurance and/or approve of the behavior) (Lo 2013).

- *Prompts* are regular reminders for people to participate in the desired behavior. For example, stickers for residents to place at the expected flood line in their basement are a useful reminder not to permanently store valuable items below that line.

- *Commitment* asks participants to explicitly commit to performing the desired behavior, increasing the likelihood that they will follow through. After a town meeting, for example, participants could be asked to check a box indicating that they will review a flood readiness guide.

- *Incentives* involve financial inducements to engage in the desired behavior, such as a tax credit for those who implement property-level flood risk measures.

- Convenience involves making the desired behavior as easy as possible to adopt by providing the necessary guidance and resources. An example is a program in which experts schedule home visits with property owners to provide advice and resources on how to improve flood resilience (Smith et al. 2019)

- Social diffusion seeks to increase the normality of new behaviors by highlighting those who engage in them. An example is a lawn sign that identifies a property that has been retrofitted for flood mitigation.

Real estate disclosure to inform potential buyers about flood risk

Real estate disclosure involves releasing information about a property that is pertinent to a potential buyer's decision. Releasing information about flood risk is an emerging strategy through which property owners are provided with information in advance of purchasing their home and, therefore, may choose freely whether or not to take on property-level flood risk. There are multiple avenues by which disclosure of flood risk may be incorporated into the process of purchasing real estate. For instance, flood risk data could be included in real estate information systems such that prospective buyers can view property flood risk as part of their search or could be disclosed once the sale process is already underway.

Real estate disclosure strategies have already been developed significantly in the United States. The First Street Foundation, a private non-profit group, has mapped flood risk nationwide and these data have been integrated into the national real estate listings website realtor.com. Those browsing the site can view a "Flood Factor" score rating each property's flood risk on a scale of one (minimal) to ten (extreme). In Canada, this opportunity for increasing transparency and providing advanced notice of risks to potential home buyers remains largely unexploited.

Current and potential mechanisms for real estate disclosure during the sale of properties vary across Canada and the United States. Several US states already require property sellers to disclose flood risk to buyers. In almost all Canadian provinces, property sellers are asked to disclose, to the best of their knowledge, conditions pertinent to a potential buyers' decision. An expert from Quebec suggested that localization plans, which are required for real estate transactions, could be a medium for property flood risk disclosure. Provincial and state governments could also mandate flood risk disclosure at other key transaction points related to property, such as development application submission, title transfers, occupancy leases, and issuance of tax assessment notices.

Weather forecasters as communicators of local flood risk

Weather broadcasters are potential extension agents for local flood risk communication. They are trained communicators who are trusted and well-liked by their local communities. Many weather forecasters also possess in-depth knowledge about their region and have some formal or informal training in meteorology. Hundreds of weather forecasters in the United States have already embraced communication of local climate change impacts as part of their role (Maibach et al. 2016). The Climate Matters program, for instance, provides graphics and information resources for weather forecasters to discuss local climate trends and impacts, including flooding. Audiences whose weathercaster participated in the Climate Matters programs gained an increased understanding of local climate change effects. No such program exists in Canada, but some Canadian weather forecasters are interested in stepping into this expanded role (McIlroy-Young 2018).

Weather broadcasters could be effective communicators of flood risk and preparedness within the LCRR basin. Residents of rural towns with aging populations, like those in many parts of the LCRR basin, are likely to be frequent viewers of local television. People living on the Quebec side of the basin are reported to already use local television as the main source of flood risk information (Gervich and Spett 2021). Enlisting and resourcing weather forecasters in the basin would provide a natural opportunity to reach many thousands of residents, multiple times each day, with flood-related information. Weather forecasters could share occasional educational tips about flood risk in the region, or even go so far as to share resources and advice on how to increase property- and community-level flood resilience.

7 CONCLUSIONS

This White Paper is the second of a series of four papers commissioned by the Study Board to assess best practices for flood risk management in the Lake Champlain-Richelieu River basin. The basin is a diverse region with unique challenges and opportunities for engaging residents about their flood risk. Property owners in Quebec, New York, and Vermont have a low understanding of flood risk and are generally ill-prepared for flood events. Enhanced communication is required to fulfill the government responsibility to enable wise use of floodplains by the public and appropriately share responsibility for flood risk management across all stakeholders.

How individuals perceive flood risk and how they respond to risk communication are heavily influenced by social, emotional, and experiential factors. Communicating risk effectively requires much more than providing one's audience with the relevant information. A technical or scientific description of risk may even seem far removed from an individual's first-hand experience with a flood event. Successful risk communication campaigns should be conducted with knowledge of the target audience's pre-existing understanding of and opinions about flood risk. It is worth investing time and resources to develop such campaigns. When executed successfully, flood risk communication has the potential to shift perceptions, change behaviors, and build support for the authorities and their efforts to implement other risk mitigation instruments. When executed poorly, flood risk communication will effect no change in the intended audience, or, potentially, erode public trust in the authorities and build political resistance towards other risk mitigation efforts.

Academic literature, interviews with subject area experts, and case studies from exemplary communication practices provide ample guidance for effective flood risk communication. Messaging that is specific to the community and led by trusted, familiar messengers (such as the town mayor or the regional weathercaster) with intimate knowledge of the local area are most likely to be heard by community members. Campaigns should experiment with multiple online and print media, but person-to-person communication is most powerful at shifting attitudes and building a common understanding. Using simple messages to explain flood risk in understandable and non-technical terms is critical for getting through to the audience. Messages can be made more memorable and impactful by using compelling images and catchy language.

Communication that effects behavioral change is difficult to achieve, but behaviors such as purchasing flood insurance or retrofitting one's home can be encouraged through engagement campaigns. Strategies from community-based social marketing emphasize the importance of clearly identifying target behaviors. By leveraging social norms and applying insights from behavioral psychology, these strategies can reduce the barriers and enhance the benefits of the target actions.

Designing campaigns that shift perceptions and change behavior is challenging. Regardless of the techniques and objectives of communication, remaining in dialogue with the public and continually evaluating and improving upon communication strategies is critical. Through the application of these best practices, flood risk communication can play an essential role in enhanced public understanding and wiser management of flood risk in the Lake Champlain-Richelieu River basin.

EXPERTS INTERVIEWED AND CONSULTED

- Sherry Godlewski, Resilience and Adaptation Manager, New Hampshire Department of Environmental Services
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- Nicolas Milot, Research Advisor, Montreal Metropolitan Community
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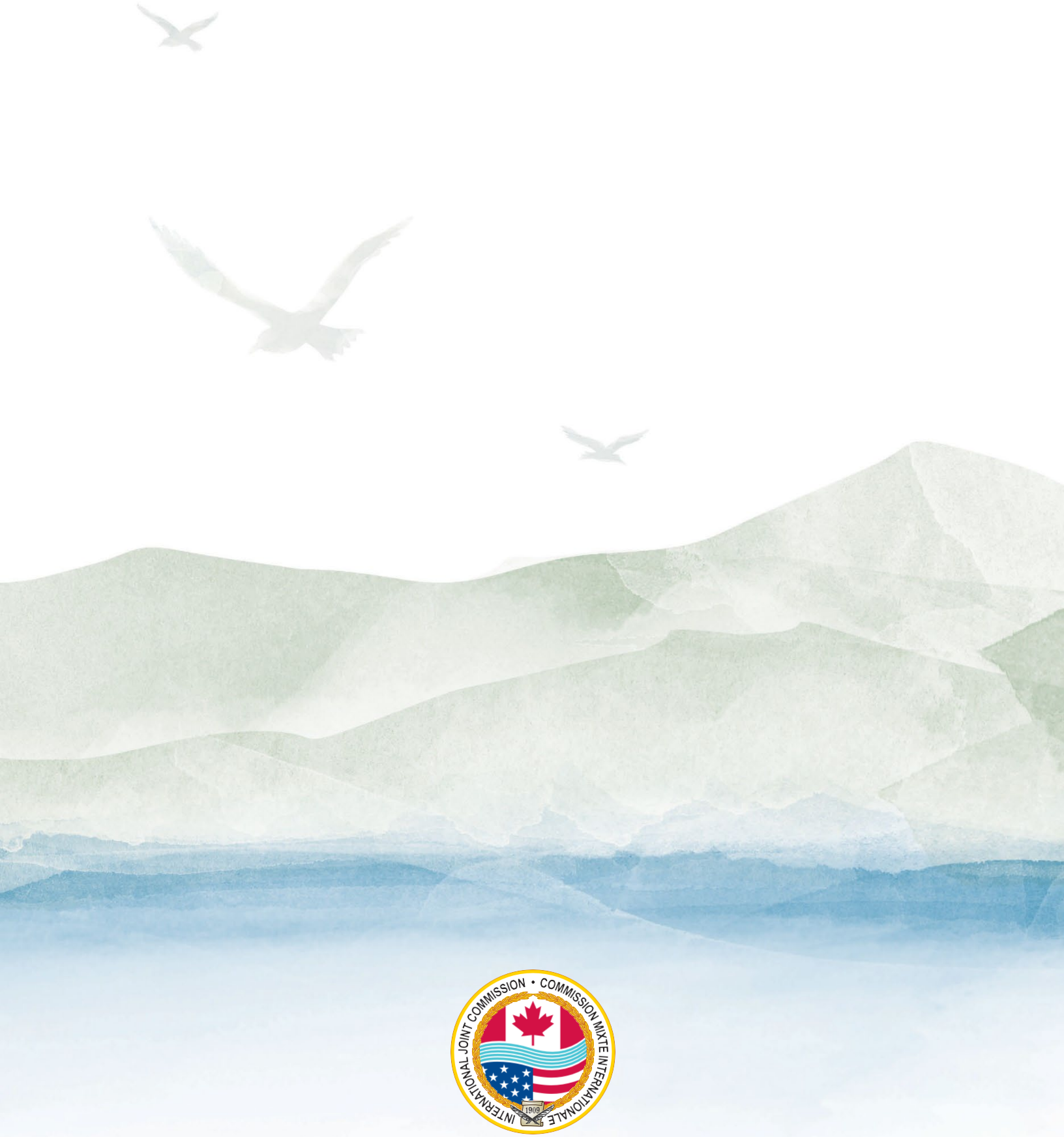
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