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Conceptualizing Response Capacity and Flood Action in the City of Vancouver and District of Maple Ridge, British Columbia, Canada

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A thesis submitted in partial fulfillment of the requirements for the Master of Arts degree in Geography

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by

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Abstract

Attention to effective local flood response has become a necessity in urban governance as issues pertaining to floods become increasingly visible with disasters rising. This research identifies components of response capacity to floods and municipal action, and potential mechanisms to increase response capacity in the City of Vancouver and District of Maple Ridge using interviews (n=7), Q methodology (n=12), and a literature review. Findings show that legislation, institutional behaviour and collective action, technological pathways and resource management are fundamental to an institution or organization's response capacity. Municipal action is influenced by competing priorities as determined through legal responsibility and liability, collective agreements, public behaviour, risk, vulnerability and uncertainty, and the politics of municipal governance. It is viewed by participants that resource efficiency, collaborative, co-management and adaptive co-management techniques could lead to greater response capacity. The findings presented provide a proposed conceptual framework to response capacity to floods and municipal action.

Keywords

Flood management, response capacity, municipal action, disaster risk reduction, Q methodology.

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1 Introduction

1.1 Introduction to the Research

Floods are defined as "an overflow of water onto normally dry land. The inundation of a normally dry area caused by rising water in an existing waterway, such as a river, stream or drainage ditch. Ponding of water at or near the point where the rain fell" (National Weather Service, 2010). They can be caused by a host of various conditions—including severe weather events, sea-level rise, and excess water to a river—and their impacts are diverse. They have and will continue to impact local, regional and national economies, exploit inequalities among social classes, and have profound health and political implications.

Recent reports by the Intergovernmental Panel on Climate Change (IPCC) and others have suggested that under various Representative Concentration Pathway (RCP) scenarios of greenhouse gas emissions, future climate conditions are expected to cause more frequent and intense severe weather related events (IPCC, 2007; 2013). Observations in climate change research, including disaster research, have shown that the effects of a changing climate are already occurring (NatCatSERVICE, 2015; IPCC, 2007; IPCC, 2013; Nicholls et al., 2007). With predictions of more frequent and intense severe weather events in the future, regional resiliency can be expected to decrease as the ability to recover from a disaster may become difficult if regions experience a multitude of disasters over a short timeframe, resulting in the failure to effectively and efficiently mitigate impacts as conditions worsen.

Recent progress toward climate change adaptation and mitigation has been made with regards to understanding the severity and the necessity to address the issues nationally and, also, at municipal and regional scales. Due to communities' differentiated risk (Balica et al., 2012; Wisner et al., 2004; Cutter et al., 2000; Cutter, 1996), a universal solution that adapts to future conditions in all communities is impractical. As such, individual communities must make necessary adjustments to their policy and practices specifically addressing their vulnerability to the potential conditions and disasters that the community

may be subject to. In Canada, cities are responsible for addressing local impacts of large-scale environmental issues, including natural disaster events.[1] Although both the provincial and federal governments do have a role in disaster governance, the specific implementation and governance over practices and policies within Canada is, in large, municipal. Understanding the characteristics of urban governance and local practices seeks to promote disaster resilient policies and practices in order to mitigate future potential loss caused by climate change.

In Canada, more frequent flood events caused by sea-level rise, storm surges, or freshet snowmelt are becoming a new norm. In this introductory Chapter the need for this study is contextualized and the parameters of the study identified. The research, that is described in more detail later in this Chapter, is an extension of Sarah Burch's (2009), *Sustainable Development Paths: Investigating the Roots of Local Policy Responses to Climate Change*, in which the author "seeks to begin a conversation focused on the need to investigate the highly path dependent trajectories that form the context out of which human responses to global climate change arise" (185). As Burch explains, development pathways provide insight on action, identifying barriers and policy-relevant analysis of environmental issues. As climate change is a very large, encompassing term, this research explores one aspect of climate change, focusing on components influencing response capacity to floods and institutional action.

As noted, the following sections of this Chapter provide context for the research and the parameters of the study. Sections on flood context cover climate change and floods, and the economic, social, health and political impacts of floods, as well as the role of government in Canada. Sections regarding the parameters of this research define development pathways and the purpose of this study and outlines the study area.

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[1] Refer to Chapter 3, *Responsibility and Liability in Emergency Management*.

1.2 Climate Change and Floods

Evidence shows the number of disaster events around the world has been increasing over recent decades. Over the last century it is evident that the number of reported disasters leading to loss is increasing, particularly from 1980 to 2014 (refer to Figure 1). Recent flooding in the United Kingdom (2014), Philippines (2010, 2014), Pakistan (2010), United States (New York, 2014, and New Orleans, 2005), Haiti (2010) and others are evidence of an increase in the frequency of flood events around the world. From 2001 to 2011, there have been approximately 785 disasters per year around the world (Institute of Catastrophic Loss Reduction (ICLR), 2012). Although not all of these disasters are flood-related, the evidence is illustrative of an increase in the frequency of natural events around the world.

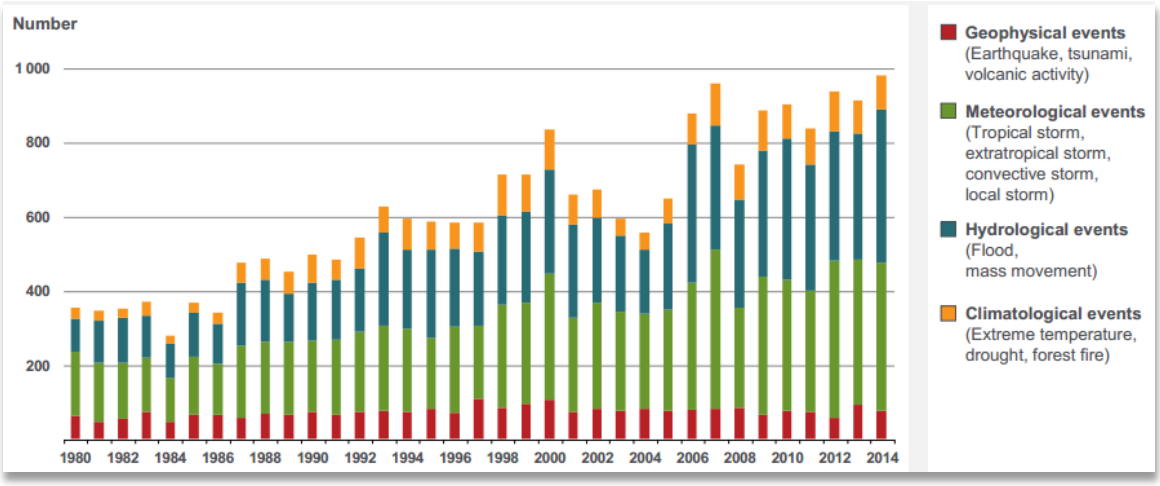

Figure 1: Loss Events Worldwide, 1980-2014 (NatCATSERVICE, 2015)

Scholars have argued that such an increase can be attributed to climate change (IPCC, 2007; 2013). As temperatures rise and changes to the energy budget continue, effects on the hydrological cycle can be seen. Floods are becoming more frequent than in the past and are, in large part, due to heavy precipitation events, rising sea-levels, and, in some locations, due to more extreme annual freshet snowmelts. Historical evidence analyzed by the IPCC (2013) suggest that starting in the late 19th and early 20th century the rate of global mean sea-level change is unusually high with *virtual certainty* (99-100% probability) that global mean sea-level rise has accelerated over the past two centuries. Between 1993 and 2010, the rate of global sea-level rise was *very likely* (90-100%

probability) 3.2mm per year, with 0.8mm per year being attributed to the warming of the ocean.

Based on the IPCC reports (IPCC, 2007; 2013; 2014a), sea-levels are expected to continue to rise. Under an extreme scenario, RCP8.5, sea-level rise is expected to increase by 0.53 to 0.97 meters by 2100. As such, coastal regions can expect more hazardous conditions in the near future. In some areas, evidence of the impacts on the region are already becoming a reality. In Tuvalu—a small island country in the South Pacific north of Australia—the population is in the process of being evacuated as, with climate change, rising sea-levels are encroaching and if IPCC climate models are accurate (IPCC, 2007; 2013) then Tuvalu is expected to be completely submerged by the turn of the next century.

In Maldives, similar concern over the country's future is evident. As much as the area is developing, sea-level rise caused by climate change threatens the safety and security of the country. While the country is not yet submerged, the situation is dire. As former environment minister, Mohamed Aslam, stated, "Just because you are not dead now does not mean you are not dying" (Carrington, 2013).

In Canada, cities are experiencing more frequent and intense floods than in the past. Exposed to a variety of different flood stressors, Canadian cities are increasingly vulnerable to flooding. Recent floods in Alberta (2013), Greater Toronto (2013), and lower Manitoba (2014) have illustrated how severe the impacts of weather-related events can be. In British Columbia, observations show an increase in precipitation since 1950 (ICLR, 2012). As the Institute of Catastrophic Loss Reduction (2012) explains,

> Since 1950 there has been a 20-30% increase in rainfall in coastal British Columbia, a 5-10% increase in the northern interior, and an annual change in rainfall of -10% to +25% in the southern interior. The large variation in these projections is due in part to the potential for large spatial variation that can occur in mountainous regions and interior plateaus. (50-51).

As climate change continues, regional precipitation can be expected to increase (IPCC, 2013). Current climate change models predict that such exposure to flooding is expected to increase throughout parts of Canada (IPCC, 2013). As the ICLR (2012) further states,

> A 5-10% increase in precipitation is expected over the period through 2050, with the largest increase occurring in coastal areas and the northern interior. Increased precipitation is expected across [British Columbia] in the winter, but rainfall should

> decrease in the summer, particularly in the southern interior. There is high confidence that there will be a 10-15% increase in intense rainfall events. (50-51).

Flooding is an issue. How countries, regions, and local areas perceive flooding as an issue varies; however, that does not elude the reality that floods are happening and they are becoming more frequent and intense. Attention to disaster risk reduction research continues to grow with emphasis being placed on the diverse impacts of flooding (IPCC, 2007, 2013, 2014b; Chambwera et al., 2007; Pearce et al., 2012; Ford et al., 2010; Du et al., 2009; Confalonieri et al., 2007), climate change vulnerability and vulnerability indicators (Oulahen, 2014; Mitchell, 1989; Watts & Bohle, 1993; Bohle et al, 1994; Dow & Downing, 1995; Alexander, 1993; Adger, 2006; Liverman, 1990) and developing disaster resilient communities (Burby et al., 2000; Norris et al., 2008; Paton & Johnston, 2001; Leichenko, 2011). As climate properties change, the social, cultural, economic, political and environmental characteristics of regions are vulnerable. It is by examining the impact to these characteristic properties that we can understand the need and urgency for appropriate action.

1.3 Economic Impacts of Floods

From 1980 to 2015, observations show that the costs of floods have been increasing and they have resulted in billions of dollars in damages for single events (EM-DAT, 2015). Over the last decade, insured losses have ranged between $10 billion to $50 billion dollars annually throughout the world (Economics of Climate Change Adaptation, 2009). Damaged infrastructure, loss of material goods, and inadequate local responses and strategies have resulted in immediate economic damage following a disaster. For example, in 2013 Calgary experienced a flood that resulted in approximately $6 billion in damages (Wood, 2013). That same year, Toronto experienced a flood resulting in $850 million in damages (Mills, 2013). In 2010, the City of Vancouver experienced a flood caused by heavy rainfall that resulted in 173 filed claims for negligence with the City in association with maladapted/outdated infrastructure (City of Vancouver, 2013).

Fundamental to the costs to homeowners in Canada is that no insurance company in Canada offers flood insurance under a home policy (The Co-operators, 2014). While coverage is offered for extended water damage, this type of insurance covers some types

of sewer backups and not accidental flooding that may be caused by certain climate related conditions, including sea-level rise, and riverine flooding (The Co-operators, 2014).

As climate change continues to affect the hydrological cycle, more frequent and intense storms will likely increase the costs to insurance companies, globally, while in Canada increasing the costs to homeowners substantially. As the IPCC (2007) reports, "it is *very likely* (90-100% probability) that all regions will experience either declines in net benefits or increases in net costs for increases in temperature greater than about 2-3 degrees Celsius" (TS-4.7). Their 2014(b) report states,

> The incomplete estimates of global annual economic losses for additional temperature increases of ~2°C are between 0.2 and 2.0% of income (±1 standard deviation around the mean) (medium evidence, medium agreement). Losses are more likely than not to be greater, rather than smaller, than this range (limited evidence, high agreement). (663).

As we know from IPCC reports (2007; 2013) in particular, warmer temperatures are linked to the hydrological cycle. With increasing temperatures, the effects on the hydrological system will cause more intense and frequent rainfall events. Combine this information with a rising sea-level scenario, global and regional costs to flood related events can be expected to increase. In Ontario, a study has suggested that insured losses, due to high precipitation events and impacts associated with flooding, will continually increase by approximately 13% by the 2020s, 20% by the 2050s, and 30% by the 2080s (City of Vancouver, 2013).

The evidence suggest that to mitigate future costs related to floods it is necessary to develop effective and adaptive responses. The effectiveness of existing responses to flooding are difficult to measure as it is only after a flood event occurs that these responses can be evaluated and the complexity of a system makes it difficult to capture all the costs and net saving of a specific response. Investment in designing and implementing specific responses to address flood-related issues may prove to be costly, but understanding how those decisions are made is something that this research is designed to evaluate. In fact, many studies have found that adaptation choices have an impact on issues, such as: macroeconomics (Fankhauser & Tol, 1995); funding allocation (Hallegatte et al., 2007; Wang & McCarl, 2013; Chambwera et al., 2007); future resource availability (Chambwera et al., 2007); and risk distribution of the previous issues (Chambwera et al., 2007).

Although future climate conditions and subsequent costs of flood events have a degree of uncertainty it is important that action is taken now. Risk-sensitive decisions, as described by Linquiti and Vonortas (2012) are oriented towards acting or waiting. According to Chambwera et al. (2007), they recommend that due to minimal temperature variability over the next few decades the time to invest in adaptation in now. It will be more beneficial to prepare for the uncertain than to wait for that uncertainty to become a reality. If the proper infrastructure and adaptation strategies are not in place when this uncertainty becomes a reality, the costs to urban characteristics and the economic system of a city, region and/or country could cause a failure/collapse (as illustrated in Figure 2).

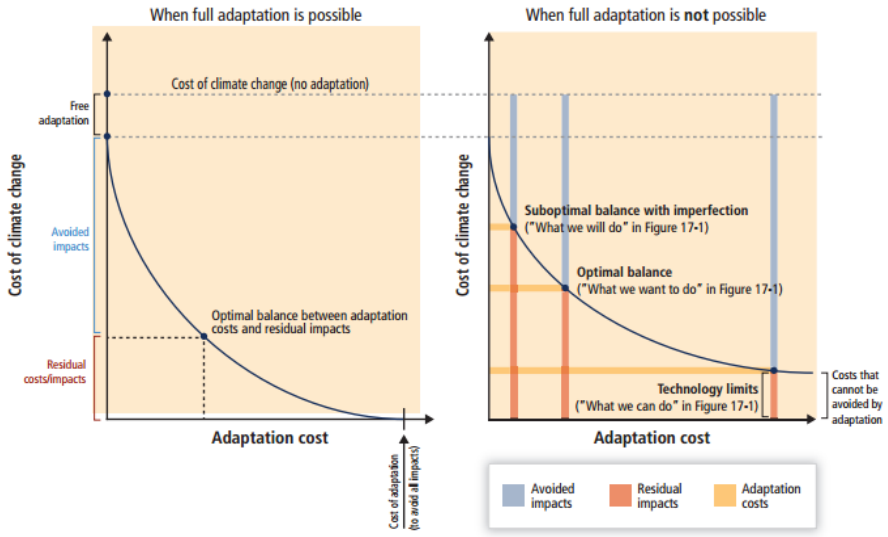

Figure 2: Adaptation-Climate Change Cost Relationship (Chambwera et al., 2007, 953)

1.4 Social Impacts of Floods

Vulnerability is a concept that has emerged over recent decades. Its acceptance as a necessary component in hazards research and its importance in policy-making and coping strategies have been evident in recent years (Pearce et al., 2012; Ford et al., 2010). Although it is defined differently from study to study, vulnerability can broadly be defined as "the potential for loss" (Cutter, 1996, 529). It includes the exposure to environmental and socio-economic stresses as well as the absence of adaptation mechanisms (Adger, 2006). Common characteristics of vulnerability include the exposure to a threat (Mitchell,

1989; Watts & Bohle, 1993; Bohle et al, 1994; Dow & Downing, 1995) as defined by social, economic, and biophysical conditions (Alexander, 1993; Adger, 2006; Liverman, 1990a; Dow & Downing, 1995). As such, vulnerability can be broken down into social vulnerability and biophysical vulnerability. The latter refers to the physical risk of a geographic space to a hazard. It includes the types of hazards the region is susceptible to experience as well as its frequency of occurrence and impact on the system. It provides the framework by which a system is susceptible to experiencing a hazard at its current stage and provides the groundwork for adaptation and mitigation strategies for predicted future conditions (Cutter, 2000). The former vulnerability refers to the risk that a group of people are susceptible to an event and its impacts (Cutter, 1996; Dow & Downing, 1995). It is a function of the social conditions to which a group is subject to, thus, influencing that group's ability to respond and cope with a hazard (Blaikie et al, 1994; Cutter et al, 1997; Mileti, 1999; Cutter et al, 2000; Adger, 2006). It includes: access to resources; weak infrastructure and access to emergency services; lack of political representation; and cultural beliefs and customs.

The parameters of social vulnerability vary from study to study; although some characteristics have been found to be consistent in present social vulnerability assessments. Among these characteristics, studies (Cutter, 1996; O'Brien & Mileti, 1992; Hewitt, 1997; Ngo 2001) have shown that high population density areas with a high population aged under 18 and above 65 are particularly vulnerable to flooding events. This can be attributed to mobility issues and body development. For example, children are more likely to contract an illness or communicable disease associated with poor water quality (as is often the case in flood events) as their immune system and white blood cells that fight diseases tend to still be developing, resulting in the individuals to be more susceptible to bacteria (Cutter et al., 2003). In addition to age, low income areas tend to have a high vulnerability to the impacts of hazards as their ability to relocate and/or be less receptive to harm is lower than higher income individuals; the loss of one dollar to damages associated with the hazard will have a greater impact on the individual with a low income compared to that of a high income individual (Cutter et al., 2000; Morrow, 1999). Similarly, the loss of infrastructure and lifelines such as emergency service access also results in a greater vulnerability. Having minimal support or relief post-disaster presumably results in greater stress on

communities as providing aid to these areas becomes increasingly difficult (Heinz Center for Science, Economics, and the Environment, 2000; Cutter et al., 2003). Finally, the collapse of infrastructure such as roads and sewer pipelines increases social vulnerability as exposure to toxins and bacteria is exacerbated by poor environmental conditions (Heinz Center for Science, Economics and the Environment, 2000). The loss of infrastructure can lead to more pathogens entering the water system in which the population can ingest, absorb, and/or inhale resulting in greater casualties, injuries, and long-term impacts.

Understanding that populations have different risks (Oulahen, 2014; Boateng, 2012; Cutter et al., 2000; Cutter, 1996; Blaikie et al., 1994) makes adaptation design and implementation complex. Although an effective universal strategy may be ideal to address flood concerns throughout a city or region, areas have different exposures to floods and may require alternative responses. Given that responses may be costly in areas where infrastructure and technology lack, the ability of city or region to fully adapt to future conditions can be constrained by timing and limited resources.[2] As such, social impacts are unavoidable; however, the severity of these impacts can be reduced through proper management and adaptation responses.

1.5 Floods and Health

The impacts of floods on health can be categorized into three classifications: immediate impacts, medium-term impacts, and long-term impacts. Immediate impacts are those that exposure to the flood results in severe issues such as drowning, injuries, hypothermia, and animal bites (Du et al., 2009). In 1999, approximately 30,000 died from storms causing flooding and landslides in Venezuela (IPCC, 2007; Confalonieri et al., 2007). Medium-term impacts are impacts that are not a direct result of a flood, but increases in toxins into the water result in lower water quality and subsequent health-related impacts (Du et al., 2009). Research on floods show the likelihood of medium-term health related incidents increase as water quality decreases and exposure to the disaster increases (Du et al., 2009; Confalonieri et al., 2007). Health issues such as infected wounds, poisoning, mental health

[2] Refer to Chapters 4 through 6.

issues, communicable diseases (influenza, measles, mumps, and tuberculosis), and starvation have been seen as exposure increases. In the long-term, chronic disease, disability, poor mental health, and malnutrition are possible if inefficient or ineffective responses are present and exposure is long (Du et al., 2009). A study conducted by Waring et al. (2002) found that, after Tropical Storm Allison, people whose homes had been flooded experienced higher mental health issues post-flooding than those whose homes were not flooded (consistent with Mollica et al., 2004; Ahern et al., 2005). It is imperative to understand that floods have direct and indirect impacts on people.

Regional topography and demographics have an influence on the impacts of floods. Based on the literature presented here less developed regions or regions with insufficient responses to floods (proactive and reactive) have a higher risk of impacts caused by flooding than those with sufficient and effective responses to floods. As Du et al. (2009) have stated, "management of the health impacts of floods is dependent upon an extensive knowledge and understanding of the health risks and on the capacity of the health system to mitigate or manage those consequences" (266). As the European Economic Area reports (2005), adaptation through improved infrastructure and social planning has decreased mortality over the past 30 years. Understanding regional variance of social, economic, political, technological, cultural, and biophysical characteristics can lead to proper management of local responses to flooding by mitigating impacts; doing so can save lives and prevent injury.

1.6 Floods and Politics

In 1972, the UN Conference on the Human Environment (UNCHE) accepted the proposal to focus the attention of governments' and public opinion on the importance and urgency of environmental issues (Vogler, 2008). It was evident post-UNCHE that environmental issues could not be separated from the demands for development, aid and international economic relations (Vogler, 2008). As such, if these demands supersede the demand for sustainability, sustainable development is more difficult to pursue. Therefore, policies that are focusing on sustainable development have greater pressure to ensure that sustainable development does not interfere with other superseding priorities—something that is becoming more difficult as flooding and other disasters become more frequent and intense.

When addressing climate change impacts, the former British foreign secretary, Margaret Becket stated, “those impacts [of climate change] go far beyond the environmental. Their consequences reach to the very heart of the security agenda” (Dyer, 2008, ix). One of the associated impacts of a changing climate is decreased resources (IPCC, 2013). According to Dyer (2008), resource consumption patterns of oil, gas and food availability will change as these resources become scarcer. As these resources decrease, geopolitical tension is expected to increase as countries seek to survive, leading to what Dyer (2008) calls ‘climate wars’. In a study that attempted to forecast future events related to climate change impacts, it was concluded that starving immigrants would lead to wars over food, water, and energy resources (Jurgensen, 2004; Lomborg, 2007). This concept of ‘climate wars’ is being adopted as a fundamental reason for military strategies. In the United Kingdom, the military is developing defense strategies against future refugees that will be seeking asylum due to the lack of resources elsewhere (Dyer, 2008). In order to protect their resources and their citizens, there is a need to develop these strategies, according to this government.

Flooding and community resilience can be directly linked to this concept of ‘climate wars’. As the frequency and intensity of floods increases, more resources will be required to respond to floods—to mitigate health impacts, financial loss, and physically adapt to changing conditions. It is only by developing effective responses to such disasters at the local, regional, and possibly national level that we can reduce the impacts of floods. As the IPCC (2007; 2014) indicate, adaptation and local responses to floods do not solely rely on technology to solve problems. Both social and technology oriented responses can mitigate the impacts of floods. Ideally, trans-community cooperation can help mitigate the impacts of flooding by helping with emergency response, but by developing effective local responses the rate of resource depletion, locally, can decrease. Effective local responses are still being researched. If we can understand the trajectories of local responses to flooding, it is possible that more effective responses that mitigate the impacts of floods and promote regional resiliency and greater response capacity can be developed. With climate change models suggesting that these types of events are expected to increase and become more intense, emphasis on disaster risk reduction strategies become a necessity in governance.

1.7 An Introduction to the Role of Government

The Intergovernmental Panel on Climate Change (IPCC) was created in 1988 and it is one of the world's leading organizations on climate change information. In its recent report, Working Group III recognized that governing global common problems, like climate change, requires international cooperation working together with local, regional, and national policies (IPCC, 2014a). It is through a multi-governance approach that efforts to address climate change and the subsequent hazards is most effective (IPCC, 2014a). One of the fundamental problems associated with climate change action is the evaluation of mitigation options. According to the IPCC Working Group III report on policymaking (2014a), "the evaluation of mitigation options requires taking into account many different interests, perspectives, and challenges between and within societies" (5). Regional and national environmental differences make governing issues of climate change and, subsequently, flooding different from region to region; however, action at the local and regional levels have been evident in addressing concerns related to localized events—such as flooding—in an effort to protect citizens and reduce the associated flood impacts.

Emergency management policies related to disasters have multiple dimensions (Waugh Jr., 2007), including mitigation,[3] preparedness, response, and recovery (Henstra, 2013). Canada has three main bodies of government with ancillary branches that focus on different aspects of governing, but all work to reach a common goal—protecting the safety and security of Canadians. With respect to issues pertaining to floods, municipal governments are responsible for waste management, water quality management, mitigation practices/procedures (this could be technological, land use planning, and/or response during and post-flooding), and emergency management (Metro Vancouver, 2014). Issues that extend across multiple municipalities or if provincial and/or federal assistance is requested can be subject to provincial undertaking by which the role and responsibility to address these issues is uncertain (Henstra, 2013; Valiante, 2002). The former addresses issues pertaining to regulation. Municipal governments, like provincial governments, may

[3] Mitigation in emergency management is different than mitigation in the context of climate change. The latter refers to the reduction of greenhouse gases and the former refers to the prevention of an emergency.

have different strategies/regulations pertaining to flooding (see Chapter 3). When flooding extends beyond the legally defined boundaries of the city, whose regulation and how to regulate inter-jurisdictional issues can become blurred, allowing the provincial government to make decisions and/or take over. This undertaking is designed to reduce conflict between municipalities, and to ensure that effective and efficient responses to floods are maintained. The latter addresses financial assistance. Municipal governments have very tight budgets and high demands for issues unrelated to flooding and other environmental issues (Henstra, 2013). As Donahue and Joyce (2001) argued, local governments worry about existing issues; the uncertainty of future events and the limited financial resources inhibits municipal action towards developing, discussing, and implementing solutions to concerns such as flooding. When a major flood event does occur, the budget of the municipal government may not be equipped to respond to the associated issues, as was the case in the 2013 Calgary flood. In these instances a local state of emergency may be declared, allowing the Province to aid in the response to the flood; however, issues pertaining to the regulating authority between the municipal government and the provincial government become evident. The provincial government may have the resources available to assist in the response to a flood, but the municipality does not necessarily have the right to control where or how these resources are allocated. This can result in political tension as the autonomy of the municipality is constrained.

Most environmental regulation occurs at the provincial level (Valiante, 2002). When addressing environmental issues such as flooding, the provinces can only regulate matters within their spatial boundaries. The provincial governments of Canada have the authority to make laws on issues, such as managing public lands and resources, non-renewable natural resources, property and civil rights, forestry, municipal institutions, electricity generation, and issues of a local or private nature (Valiante, 2002). The limits on provincial authority and provincial environmental statutes are similar to that of the municipal authority and regulations. Provincial regulations pertain only to the province; issues extending beyond the province is federal. If the province requests aid in a provincial state of emergency, they do not necessarily have control over how the resources are allocated (similar to a local state of emergency). Another limit concerns inter-jurisdictional

immunity in which the Crown and its agents may not be forced to abide by the legislation of another level of government (similar to diplomatic immunity).

The federal government of Canada addresses environmental issues at the national scale. According to Valiante (2002), "most attention has focused on the residual power, the power to make laws for the 'Peace, Order, and Good Government of Canada' (or POGG)" (4-5). The courts have recognized two aspects of this power: national concern and national emergency (Valiante, 2002). POGG is a national concern doctrine that applies to matters that start out as local within a province but may cause a national disturbance and matters that did not exist when the Constitution Act of 1867 was adopted. For an issue to qualify as being a national concern, allowing the federal government to take jurisdiction, the matter must be distinguished from matters of provincial concern and federal action must not infringe on the balance of power between the two levels of government. If a province cannot deal with the issue effectively and the failure to do so would affect the interests beyond the province, the federal government can intervene in uniform legislative treatment. A flood event could be considered a national concern if it has the potential to harm the national economy. For example, Metro-Vancouver is Canada's largest port for imports and exports (Port Metro Vancouver, 2014). A flood in this region could prevent the transportation of goods in and out of the country—depending on the size and severity—preventing economic production, revenue, and growth in the region as well as the nation. Therefore, if a flood occurs in this region, federal jurisdiction could be applied if there is potential for national disruption; however, that necessitates the municipality's and province's inability to manage and respond to the flood effectively and efficiently.

1.7.1 The Emergencies Act

The Emergencies Act (1985) replaced the *War Measures Act* in 1988. This Act outlines the provisions by which a national emergency can be declared and the provisions for governing during these emergencies. Under Section 3,

> For the purposes of this Act, a *"national emergency"* is an urgent and critical situation of a temporary nature that
>
> > (*a*) seriously endangers the lives, health or safety of Canadians and is of such proportions or nature as to exceed the capacity or authority of a province to deal with it, or

> (*b*) seriously threatens the ability of the Government of Canada to preserve the sovereignty, security and territorial integrity of Canada
>
> and that cannot be effectively dealt with under any other law of Canada.

This provision of the Act addresses the issue outlined in the previous section regarding a province's inability to manage and respond to an emergency and outlines the conditions necessary to declare that a national emergency has occurred. Ultimately, the purpose of this Act is to provide the context by which a national emergency is appropriate and is not construed as infringing on a province's right to govern by undermining its authority.

Under Section 5(a), a public welfare emergency (PWE) is "an emergency that is caused by a real or imminent fire, flood, drought, storm, earthquake or other natural phenomenon and that results or may result in a danger to life or property, social disruption or a breakdown in the flow of essential goods, services or resources, so serious as to be a national emergency." When a PWE has occurred the Governor in Council—the Governor General who is advised by the Cabinet—must declare so and outline the areas affected by the emergency if all of Canada is not affected, the measures by which the emergency can be dealt with, and the reasoning behind the declaration of the PWE (S. 6 (1)(2)).

This Act gives full authority to the federal government to take the lead in responding to a national emergency, limiting the role of both municipal and provincial government. Since the Act was legislated in 1988 there have been no national emergencies declared in Canada; however, the provisions are in place in case that a situation arises—a precautionary approach addressing disasters.

1.7.2 The Disaster Financial Assistance Arrangements

The *Disaster Financial Assistance Arrangements* (DFAA) is a program that was established in 1970 to provide provincial and territorial governments with financial assistance post-disaster. It is not intended, nor designed, for disaster mitigation projects, meaning that only after a disaster occurs can a provincial or territorial government be eligible for financial relief assistance. The federal program is a cost-sharing approach to disaster relief, administered by Public Safety Canada. This program provides assistance to the provincial and territorial governments and not individuals or businesses. Individuals

and businesses can receive financial assistance for costs associated with a disaster through their territorial and provincial government, however, the program will not directly provide the assistance to these groups.

When a disaster occurs, provincial and territorial governments can apply for financial assistance to subsidize some of the costs associated with a number of expenses and restoration projects, including, but not limited to, evacuation operations, infrastructure and public works restorations to their pre-disaster state, and replacing or repairing essential personal property, small businesses and farmsteads. In this application, governments are responsible for identifying where financial assistance is required and it is up to the DFAA to decide what costs and how much of the costs will be eligible for cost-sharing. Returning to the above point regarding ineligible groups for this financial assistance, it is not that they are ineligible to receive financial assistance, rather they cannot directly apply for the DFAA but can receive assistance by applying to their territorial government or provincial government who in turn may be eligible for assistance.

In order to be eligible for disaster financial assistance, a province or territory's eligible costs must exceed a threshold based on their provincial or territorial population. Beginning February 1st, 2015, amendments were made to the cost-sharing that the federal government would be responsible for. Prior to February 1st, the provincial or territorial government were responsible for the first dollar per capita of population without federal assistance. Beginning February 1st, that amount changed from one dollar to three dollars per capita of population before financial assistance is provided. The next six dollars per capita of population is split by the provincial or territorial government and the federal government. As the costs increased for provincial or territorial governments, the more disaster financial assistance those governments would be eligible for (see Table 1).

Table 1: Cost-sharing responsibility (DFAA, 2015)

Eligible provincial expense thresholds (per capita of population)	Government of Canada share (percentage)
First $3	0
Next $6	50
Next $6	75
Remainder	90

Since the start of the program in 1970, the Government of Canada has been responsible for more than $3.4 billion of financial assistance to provincial and territorial governments. Notable examples of recent floods that have involved financial assistance from this program include the 2005 Alberta floods and the 2006 flood in Newfoundland. Again, the main point to be made here is that this program is designed for post-disaster relief. The responsibility to mitigate the risk of a flood occurring and the potential subsequent impacts is still on the onus of the local governments. It is from this point that we need to focus our attention towards what measures are in place to mitigate such risk and impacts, and how and why such measures were developed, decided on, and implemented.

1.8 Defining Development Pathways

More effective local responses are necessary to mitigate the impacts of floods at local and regional scales. A development pathway is defined as "a complex integration of economic, social, technological, institutional, cultural and biophysical characteristics that determines the interactions between human and natural systems" (Sathaye et al, 2007). Development pathway components have been examined individually in relation to climate change adaptation and mitigation at a global scale; however, these components and their interactions have not been examined in unison (Burch, 2009; Swart et al., 2003; O'Riordan, 2001). Understanding the interactions between the components of development paths are

essential to the development of effective policies seeking to manage flood causes and impacts (Swart et al., 2003; O'Riordan, 2001).

The trajectories of development paths are guided by response capacity (Burch & Robinson, 2007; Winkler et al., 2007). Response capacity is the ability of a group to respond to risk by utilizing human and financial capital, and institutional resources (Burch, 2009), while adaptive capacity is the ability of a group to implement strategies aimed towards preventing a disaster from occurring (Smit & Wandel, 2006), and mitigative capacity is the ability of a group to implement strategies aimed towards reducing the anthropogenic greenhouse gas emissions (Winkler et al., 2007). Response capacity is not the sum of adaptive and mitigative capacity, rather it is the ability to respond most effectively. Adaptive and mitigative capacity are a function of response capacity.

Flood policy progress has been made through: growing public awareness on the issues; new policies that address both causes and impacts; and research (Burch, 2009; Lorenzoni & Pidgeon, 2006). Inconsistencies in past research practices and response design have resulted in a confusion between best-practice local responses and knowledge on effective local responses to flooding (Burch, 2009). Research focusing on identifying existing development pathways of local responses to floods and the relationships between development pathway components seek to resolve this disconnect.

1.9 Research Questions

This research addresses the following research questions:

1. What are the development pathways of local responses to floods?
2. How are local responses to floods reflective of the subjective views of and for flood management?
3. What factors affect municipal action?

The research seeks to develop an understanding of these pathways and address future flood management concerns on policymaking/response by providing necessary information to make informed decisions on efforts to increase response capacity to floods. This study is not comparing the different techniques/approaches to flood response; rather, emphasis is on how flood action emerges and what factors affect the ability to respond to flood risk.

1.10 Study Sites

The Metro Vancouver region has been identified as one of many regions that will be under high stress with rising sea-levels, and increased frequency and intensity of disasters (Nicholls et al., 2007; IPCC, 2013). The melting of glacial ice and warming of oceans have resulted in global sea level rise (Pearce et al, 2012). The IPCC (2013) predicted that it is *likely* (66-100%) that sea levels will rise up to 0.97 meters by 2100. The damages of floods to regions are being documented (Pearce et al, 2010; Forbes et al, 2002; Boateng, 2012; Balica et al, 2012), but reducing the impacts and creating effective local responses to flood events is an area of concern in this region. The latest *Climate Change Adaptation Strategy* report (City of Vancouver, 2013) has argued that current policy and practices that are aimed towards flood events are outdated and needing revision.

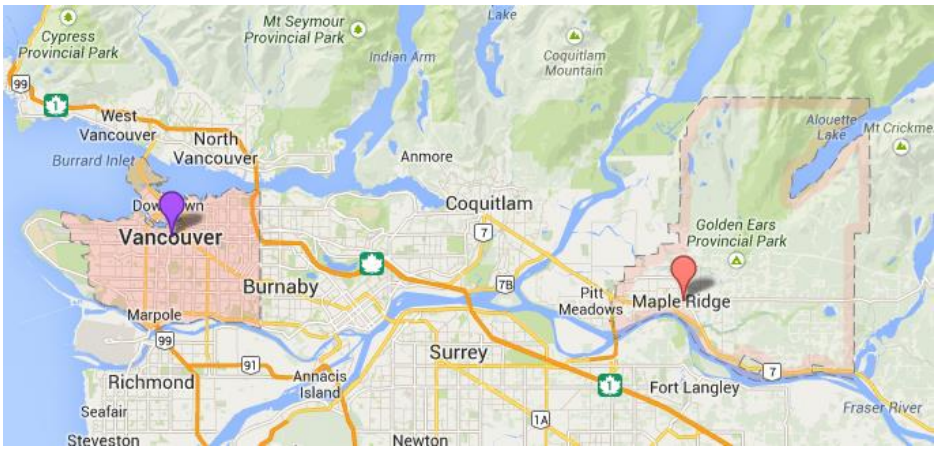

Figure 3: Study Area (Google Maps, 2014)

Two cities in the Metro Vancouver region have been chosen as the study area for this research, including the City of Vancouver and the District of Maple Ridge (see Figure 3). The purpose of two study areas was to conduct a comparative study that seeks to explore existing development pathways. As urban characteristics vary from city to city, including values and vulnerability to flood events, flood responses are likely to differ. Two study sites allow development pathways to be explored, recognizing that one pathway to flood responses is unlikely. Together, the two study sites were used to identify and explore the relationships between development pathway components, seeking to increase knowledge of local response capacity to floods and provide information that can be used to revise policy and practices accordingly.

1.10.1 City of Vancouver

The City of Vancouver has been identified as a top 50 city in the world vulnerable to the impacts of climate change (Nicholls et al, 2007). The coastal city can expect, and, thus vulnerable to, rising sea-levels and frequent and intense storm surges (City of Vancouver, 2013; Nicholls et al., 2007). The City of Vancouver (2013) expects to see an increase of 6% and 9% of precipitation during winters by 2050 and 2080. They are expecting that events that typically occur once every 25 years will occur 2.5 times as frequently by the 2050s. Being an inner city of Metro Vancouver, the existing infrastructure and development leaves limited room for permeable surfaces. As such, the city has an exposure to flood events that can only be expected to increase.

With a regional population greater than 2 million people (British Columbia Statistics, 2013), the City of Vancouver is a hub for economic activity. Port Metro Vancouver is the largest port in Canada (Port Metro Vancouver, 2014). A major flood in the City of Vancouver could prevent imports and exports into and out of the city, province, and country. As such, the importance of flood management from an impact mitigation standpoint and in response to floods after one occurs is vital in protecting the economy.

Current local responses to floods in Metro Vancouver can be categorized under three main themes: flood-proofing policy/strategies; waste management; and emergency management and response practices (City of Vancouver, 2013). Under these different themes, the latest *Climate Change Adaptation Strategy* report (City of Vancouver, 2013) has argued that current policy and practices are outdated. This report has argued that the latest climate predictions suggest that current policies are not as effective as they could be and such policy/strategies should be re-evaluated and updated. It identified that a lack of public participation in flood-response development exists and future response strategies should be more inclusive and cover multiple layers of development paths.

As the City of Vancouver is already developed and surrounded by other developed municipalities, there is little room to continue development and expand the urban boundaries. As such, development is occurring vertically and less emphasis can be placed on more social or land use responses as opposed to technology or infrastructure related. Currently, the City is in the process of implementing a storm-wastewater separation system that allows a greater capacity to reduce the likelihood of a flood event. Although the City

is looking at all options for flood prevention and impact mitigation responses, it has been expressed by participants in the study that technological responses are more common than land use responses due to existing development and limited capacity to expand the urban boundaries. That said, it is clear through the City of Vancouver report (2013) and recent flood events that updating flood management policy and practices is a must.

A flood event on September 19th, 2010, publicized the ineffective nature of current local responses to flooding in Vancouver (City of Vancouver, 2013). As a highly populated coastal city with local response strategies being identified as outdated, examining development paths of local response to flooding in Vancouver provides knowledge of current best-practices, and the relationships between development path components. We can identify the strengths and limitations of existing responses in the city by understanding the development pathways of local responses to floods. This knowledge can be used in discussing policy and practice.

1.10.2 District of Maple Ridge

Maple Ridge is a district municipality in the Metro Vancouver region. It is located along the Fraser River in the northeastern part of Metro Vancouver with Pitt Meadows and Mission being adjacent. It has a population of approximately 75,000 people (Statistics Canada, 2011). In 2006, approximately 65% of the labour force in the District of Maple Ridge commuted to surrounding communities for work (District of Maple Ridge, 2010). A flood in the City of Vancouver, the District of Maple Ridge or anywhere between the two cities could disrupt the economy by restricting commuters to and from work, thus, causing a reduced labour force and resulting in stress onto the local and regional economies. Therefore, it is important to examine how these cities approach flood management.

Unlike the City of Vancouver, Maple Ridge has less concern with floods caused by sea-level rise as the region is further inland. The risk of a flood is less than that of the City of Vancouver, and, therefore, responses are likely to be different and directed towards different threats to the system. The primary concern with regards to flooding in this area is overland flow caused by the flooding of the Fraser River or by heavy rainfall events (see District of Maple Ridge, 2012). The region has had a number of floods since 1900, including a 200 year riverine flood in 1948, a 10 year riverine flood in 2007, and, most

recently, a 10-25 year riverine flood in 2012 (Nagel, 2014). The area's largest flood on record was in 1894, too, caused by an excess amount of water that had entered the Fraser River (Nagel, 2014). Similar to the City of Vancouver, the District of Maple Ridge has been identified as being vulnerable to future flood events as water volume in the Fraser River increases (Nagel, 2014; District of Maple Ridge, 2012; Districts of Maple Ridge & Pitt Meadows, 2008).

According to a Fraser Basin Council's report (2010), "a major flood today would result in severe social, economic, and environmental impacts, including billions of dollars in damage to public and private property, temporary loss of infrastructure and community services and disruption of business and trade" (2). The *Fraser River Freshet Operational Flood Management Plan* (District of Maple Ridge, 2012) suggest that social and economic impacts of a major flood in the region would likely be "nothing less than catastrophic" (5). This report suggests the industrial sector, particularly the Albion Industrial Area (see Figure 4), is a large concern if a flood were to occur due to its contribution towards the community's economy. In the Albion Industrial area a flood could cause more than 850 jobs to be lost. With a growing population and the need to develop the urban area, preparing for future floods has been identified as a priority (District of Maple Ridge, 2012).

In the District of Maple Ridge, the region is mixed with urban and rural areas. As the population grows, urban development outward is likely to ensue. The mixed land uses in the region allow the City to explore and implement more social responses to prevent vulnerable populations from developing. Although the region has not implemented a storm-wastewater system, the use of pump stations seeks to prevent flooding and reduce the impact that floods could have on the region. As the region continues to expand outwards, emphasis is placed on implementing infrastructure that will protect these newly developed areas. Major flood concerns currently are on the already developed area where existing infrastructure is needing maintenance or upgrades. Attention to and investment in flood management is far more limited in the District of Maple Ridge than in the City of Vancouver, in part, due to a much smaller budget. As such, this research identifies similarities and differences in flood management decision-making through the development pathways for flood response capacity and action.

The District of Maple Ridge was chosen as the second study site because of its differences with urban and biophysical characteristics, values, and the history of floods to those of the City of Vancouver. Unlike the City of Vancouver, a large portion of the District of the District of Maple Ridge's population commutes elsewhere; although the Albion Industrial Area is integral to economic activity in District of Maple Ridge. Also, as the District of Maple Ridge is located on the outskirts of Metro Vancouver the city has both urban and rural area that is under the City's governance. The different land uses make responses towards flood management different than those of the City of Vancouver as infrastructure and development in the City of Vancouver is already present, whereas some rural areas in the District of Maple Ridge do not have this infrastructure in place that could reduce the impact of flood. As District of Maple Ridge continues to expand through development based on a growing population, how that development occurs in conjunction with flood responses becomes an important point of inquiry. Finally, District of Maple Ridge is further upstream along the Fraser River than the City of Vancouver. Its position relative to the City of Vancouver makes the biophysical vulnerability to overland flow along the Fraser River greater. As such, response in District of Maple Ridge is oriented around the Fraser River and storm surges, whereas the City of Vancouver's response is directed towards coastal flooding. Comparing the two cities approach to managing floods are ideal for identifying development pathways for local responses to floods and, thus, were chosen for this study.

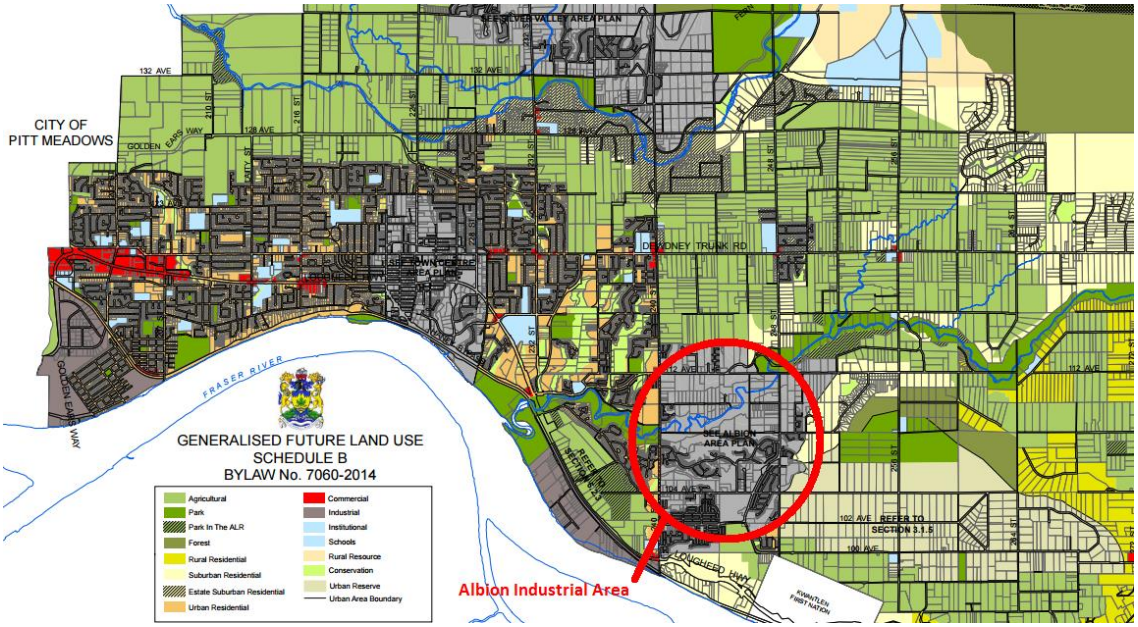

Figure 4: District of Maple Ridge land use (District of Maple Ridge, 2015)

1.11 Overview of the Proceeding Chapters

This concludes the introduction to the study. To recap, the following was discussed: the various impacts that floods are having and are expected to be exacerbated by a changing climate; a brief introduction into the role of Canada's municipal, provincial, and federal governments; details of the *Emergencies Act* and the *Disaster Financial Assistance Arrangements* program; development pathways; and the purpose and study area of this research. In the coming chapters, emphasis is placed on the results of the study. Chapter 2 outlines the methodology that used in this study. Chapter 3 focuses on legal responsibility and liability of emergency management which is critical in understanding the motivations and process of decision-making in the City of Vancouver and District of Maple Ridge. Chapters 4 through 6 focus on variables affecting response capacity to flood response and municipal action, and mechanisms for increasing response capacity as viewed by participants of the study. Finally, Chapter 7 concludes the paper by summarizing the information presented, identifying major limitations and discussing future research needs for response capacity to floods and flood action.

2 Q Methodology

Identifying development pathways of local flood response that is present is a major component of this research. It should be understood before proceeding any further that development pathways are not a constant, rather they shift over time and space. As such, it is the conditions by which decisions are made at the present that directly reflect these development pathways. How and why we make the decisions that we do can be asserted as a manifestation of social constructs. Social constructionism focuses on shared viewpoints, knowledge and discourses (McHoul & Grace, 1995) "that represent the substantive, cumulative and publicly accessible product of innumerable human selections" (Watts & Stenner, 2012, 42). As Watts & Stenner (2012) further explain, "[constructionist] research generally attempts to understand and map the currently predominant viewpoints or bodies of knowledge relative to a particular context, event or object of enquiry" (42). Making the decisions on the appropriate course of action becomes more based on the social constructs of the decision-makers—thus, subjectivity—as many possible approaches to flood response by reducing impacts and increasing the effectiveness of emergency management exist. The 'where,' 'what,' 'how' and 'why' we implement specific responses to floods becomes a reflection of these shared views.[4] Therefore, a methodology designed and oriented around subjectivity was been chosen to complete this study.

2.1 General Overview of Q Methodology

Q methodology was developed by William Stephenson (1953) and later refined by Block (1978). The methodology was developed as a measurement technique to examine human behaviour by attempting to access the views of individuals and groups through a form of factor analysis. It was designed as an alternative measurement technique to psychology tests and scales, but it is increasingly being used in various research fields, including public opinion (Webler, Tuler & Krueger, 2001), policy analysis (Durning, 1999), communication (Carlson & Trichtinger, 2001), landscape planning (Swaffield & Fairweather, 1996;

[4] Refer to Chapter 3, *Responsibility and Liability in Emergency Management*, for further evidence and explanation of the subjective nature of decision-making in emergency management.

Previte, Pini, & Haslam-McKenzie, 2007), and environmental issues (Barry & Proops, 1999). The methodology is centered on subjectivity, self-reference, concourse theory and abduction.

First, it recognizes that individuals are made meaningful by the nature of the relationship with and on the immediate environment. As Stephenson (1953) argues subjectivity is a behavior or activity that is best understood through its impact on the immediate environment. Decision-making in emergency management is based on the individual or group's expertise and judgment towards the best course of action resulting in a City's response system, making these actors meaningful in studying decisions-making and the human-environment relationships that exist. Ultimately, the research conducted is examining the activity or behavior of decision-making in flood management.

Second, in this study, participants were asked to complete a questionnaire that focuses on their level of agreement with a number of statements (see Appendix A). The process of completing this questionnaire is known as Q-sorting and the completed questionnaire is a Q-sort. The process of Q-sorting is self-referent. As Stephenson (1982) states, Q methodology uses "a collection of statements, usually verbal, upon which a person projects feeling, with self-reference" (238). In this methodology, feeling should be understood as a process or activity. It is the "projection of feeling by an active subject" (Watts & Stenner, 2012, 32). In other words, participants reflect on their own experience and opinion to determine their level of agreement with each statement in the questionnaire. Therefore, the views of a participant on each statement is self-referent.

Third, Q methodology is oriented on the concept of communicability; that is to say, an observable domain of shared knowledge and meaning through a series of self-referent statements (Stephenson, 1986). Each identifiable domain is a called a concourse. All concourses represent "the individual's cultural heritage, born of history. It is the single most significant contribution to subjective science. All Q-sorts dip into it, as an empirical field out of which new subjectivity grows" (Stephenson, 1982, 242). In other words, all Q-sorts are in themselves an observable representation of an individual, but together each Q-sort represents part of the shared knowledge and meaning on the topic in question. Therefore, the Q-sorts can be studied individually and as part of the overall collective view

of many Q-sorts. Similarity among Q-sorts lead to identifying these concourses and, thus, identifying domains of behaviour for decision-making in flood management practices.

Fourth, Q methodology is an abduction technique. Abduction is an explanatory framework formalized by Charles S. Peirce (1839-1914). Where deduction refers to a top-down explanatory framework providing a means of linking the cause of a phenomenon to an effect through law/theory, and induction refers to a bottom-up explanatory framework of establishing an applicable description that links the observed facts to the cause, abduction, like induction, is a bottom-up explanatory framework, but it seeks to link the effect to the cause through suitable laws based on a range of hypothetical conditions (Inkpen & Wilson, 2013). It is similar to induction in that it consists of linking the effect to the cause (Shank, 1998); however, it is different in that through induction the effect and the cause are known, but the linking law/theory is unknown, whereas in abduction the effect is known, but the cause is unknown because abduction recognizes that different conditions can lead to different causes (Inkpen & Wilson, 2013). In other words, "abduction is based on being able to tell a plausible story to link effect and cause together via a valid law" (Inkpen & Wilson, 2013) and that many possible laws could be applied to explain an effect which also means that there are a range of possible causes.

In Q methodology, abduction is associated with a factor analysis. Stephenson (1961) viewed "factor analysis as the technical extension of Peirce's theory of abduction, as a way of generating hypotheses *de novo*" (Brown, 1980, 134). As such, the purpose of the factor analysis is to identify collective views within the questionnaire in order to provide a plausible theoretical explanation for these groupings' existence. As Haig (2008) and Watts & Stenner (2012) state, a main difference between abduction and induction is that the latter is an explanatory framework, whereas the former is an exploratory framework. As abduction recognizes many possible laws that could be applied and many possible causes that could result, it becomes difficult to ascertain a causal relationship. Therefore, by using Q methodology, the researcher recognizes that the phenomenon in question may not have an absolute theory that can be applied and that different variables have varying influence that will be dependent on a host of characteristics that differ temporally and spatially.

2.2 Q-set Design and Content

Q method involves four steps:

1) The collection/review of ideas, beliefs, and opinions;
2) The formulation of a set of meaningful statements based on the first step;
3) The distribution and completion of Q-sorts; and
4) A by-person factor analysis comparing participants' Q-sorts. (Shinebourne, 2009).

2.2.1 Pre-Q-sort Data Collection

The data collection involved several different methods, including a literature review of existing responses and theories, in-depth interviews, and the completion of Q-sorts. This multi-method approach was used to explore, identify consistency, and build on the results of each other while recognizing that subjectivity is the key to unveiling the development pathways of local flood response. A multi-method approach to research has been shown to enrich data collection and explore different angles to the same research question (Nagy Hesse-Biber & Leavy, 2004; Rank, 2004). The following paragraphs and sections to come explain the process by which data was collected, analysed, and interpreted.

A literature review of existing development pathway theories and current local responses in the City of Vancouver and District of Maple Ridge was a necessary component to the research process (see Table 2). It provided background knowledge on different theories and their critiques, as well as insight into traditional development pathways. The conducted literature review consisted of research on the relationships between development pathway components (Swart et al., 2003; O'Riordan, 2001), socio-technological change theory (Geels & Schot, 2007; Smith et al., 2005; Berkhout, 2002), organizational theory (Hosmer, 1995; Jones, 2001), social movement theory (Della Porta and Diani, 2006; Escobar, 1998; Laraña et al., 1994; Della Porta et al., 1999; Melucci, 1984), deliberative and participatory democracy (McLean & McMillan, 2015; Calhoun, 2002; Cohen et al., 2012; Lorenzoni et al., 2007; Ran, 2012), and local responses to flooding in the City of Vancouver and District of Maple Ridge.

Table 2: Theories of Development Pathways

Theory
Socio-Technological Change Theory: Socio-technological change theory refers to the interaction between human behaviour, including an organization's behaviour, and infrastructure. It examines how people use space and it seeks to identify ways in which technologies or processes can be developed to optimize a sustainable interaction between the two (Geels & Schot, 2007; Smith et al., 2005; Berkhout, 2002). As Berkhout (2002) explains, technological innovations for the betterment of a region involves a desire and commitment to replace the existing technologies. Without a firm commitment by the organization or institution for a radical shift towards a new system, the innovation and adoption of such a system is not possible. One of the biggest issues with developing/shifting to a new technological system is that it is difficult to determine which system will produce the best results, particularly if such systems have not been tested or present (Berkhout, 2002). This is one of the reasons why current organizations or institutions are not accepting of the idea of 're-inventing the wheel' or re-structuring their current system without evidence showing the success of the new system. With that success evident comes a greater desire to shift and commitment for change. It is a function of "resources, interests and expectations of institutionally embedded networks of actors" (Smith et al., 2005, 1508). Therefore, for socio-technological change to occur, there needs to be a network of actors committed to adapting the desired regime (Smith et al., 2005; Berkhout, 2002).
Social Movement Theory: Social movement theory explores the socio-cultural characteristics of society that are fundamental to human mobilization (Laraña et al., 1994). Its research provides insight into the power dynamics, collective identity, and influence of institutions that control human behaviour (Della Porta et al., 1999; Laraña et al., 1994; Melucci, 1984). This theory investigates the causes of collective mobilization and the relationship that such mobilization has on influencing change to institutional behaviour. As Tilly & Wood (2013) explain, social movements are the result of multiple stressors which often have negative implications infringing on the human rights of a group of individuals. These

authors explain that, historically, when human rights have been violated activism towards correcting/replacing the instigating body with one that meets the wants and needs of the community.
Organizational Theory: Organizational Theory (also known as institutional theory) is a philosophical approach to understanding how organizations, both governments and businesses, function. It examines the formations of businesses and their relationship with society (Hosmer, 1995). It emphasizes the importance of organizational culture—the set of shared values and norms that control the interaction between the organization and those that seek the attributes and products in which the business provides—and gaining a competitive advantage in the market (Jones, 2001). This theory is formulated around organizational structure, design and culture (Jones, 2001). It provides insights into an organization or institution's behaviour by examining the interaction between its members and its consumers.
Deliberative Democracy: Deliberative democracy is a democratic process leading to decisions through publicly expressed reason, mutual understanding and political inclusion (McLean & McMillan, 2015).
Participatory Democracy: Participatory democracy emphasizes public engagement and involvement in political situations (Calhoun, 2002).

Seven interviews of local practitioners were conducted within the two cities. Seven interviews was sufficient in gathering a data-enriched preliminary view of the development pathways that may exist in the City of Vancouver and District of Maple Ridge due to the downloaded responsibility of emergency management and, subsequently, flood management to municipalities and the internal and external practitioners involved. Interviewed participants ranged in terms of their field of expertise and their role within the development, decision-making, and implementation of flood responses in various organizations and institutions (see Table 3).

Table 3: Interviewed Participants[5]

Interviewed Participants Background
1. Environmental Specialist (City of Vancouver)
2. Environmental Specialist (City of Vancouver)
3. Manager/Executive (City of Vancouver)
4.Technical Expert (District of Maple Ridge)
5. Resource Specialist(District of Maple Ridge)
6. Manager/Executive (District of Maple Ridge)
7. Regional Expert

The purpose of these interviews was to collect ideas, beliefs and opinions and create an expanded review of the development, implementation, and operation process of existing local responses to flooding. Based on the theories described in Table 2, the main principles from these theories were extrapolated and the information gathered regarding the responses that are current in the City of Vancouver and District of Maple Ridge were used to shape the main question that were to be asked in the interviews and formed a foundation to interpret the results of the factor analysis. In the theory presented above, emphasis was placed on technology, culture and public behaviour as it relates to human-environment interaction. How these theories compare to local responses to flood risk is critical in understanding the major components to response capacity to floods and municipal action. Therefore, major focus points for the conducted interviews were designed to examine public behaviour as it relates to concern/advocacy and engagement, and the role that priorities and values have on affecting local response to flood risk. Other major focus points

[5] General pseudonyms are provided to protect the identity of participants.

were centered on science and uncertainty, internal characteristics and interactions with external stakeholders, local demographics, financial capability of the institution or organization and the current state of the economy, biophysical characteristics of the area, and technology and urban planning as these relate to local flood response. This is because of their relevance to these theories and the supporting literature that suggests these topics may have an influence in the development, decision-making and operations for organizations and institutions. Emphasis in these interviews were placed on disaster risk reduction—how to reduce the likelihood of a flood occurring in a specific area and impact mitigation if one were to occur.

The interviews were recorded, transcribed and coded into themes based on an inductive interpretive analysis. The results of the inductive interpretive analysis categorically addressed 6 themes, including drivers for, controls on, approaches to, limitations of, dependencies for success, and the direction of future flood management. It is from the interview data and, thus, within these themes that the statements comprising the Q-sort were formulated.

2.2.2 Development of the Q-set (Items)

This stage of the Q method included 23 meaningful statements that participants are rank-ordering based on their level of agreement with each statement. Each of these statements are referred to as an Item. Together, these 23 Items formulate what is known as the Q-set (see Appendix A). Although Shinebourne (2009) concludes that Q-sets should be at least 40-80 statements to produce satisfactory results, there is little evidence to justify this conclusion (Watts & Stenner, 2012). In fact, a smaller number of Items may produce *very satisfactory* results (Watts & Stenner, 2005). In studies that involve a larger Q-set, the process of completing Q-sorts tends to be exhaustive to participants and can lead to skewed results (Shinebourne, 2009; Watts & Stenner, 2005). In the context of this study, more than 23 Items was not necessary as the Items were designed to allow the participants to complete the survey in a timely manner and to explore areas needing further interpretation in order to make the appropriate conclusions.

The Q-set consisted of positive and negative Items (as recommended by Schlinger, 1969) and similar sentence phrasing for Items oriented around the same theme. For

example, Items 1-4 were worded as "*The major driver for developing and implementing flood management initiatives exceeding provincial and federal legislation is…*" As Watts & Stenner (2012) explain, similar sentence phrasing makes it easier for the participant to complete the Q-sort by minimizing the confusion between Items that are inquiring about the same principle component. From here, the design of the Q-sort for which participants can rank-order Item relative to a corresponding level of agreement was chosen.

In Q method, completed Q-sorts are illustrated through a matrix in which each cell corresponds to a level of agreement value that an Item can be placed in. The matrix format is pre-determined prior to the distribution of Q-sorts to participants. It can follow two different formats: a free distribution format or a forced distribution format. Since the latter forces participants to order all Items and only a set number of Items can be assigned to each level of agreement value, the free format was chosen which (refer to Figure 5) allows participants to assign as many Items a specific value as they feel is appropriate.

Q Sort
#5

-4	-3	-2	-1	0	1	2	3	4
Q19		Q15	Q5	Q16	Q2	Q1	Q3	Q14
		Q21	Q10	Q17	Q4	Q6	Q7	
					Q12	Q8	Q9	
						Q13	Q11	
						Q18	Q22	
						Q20	Q23	

Figure 5: Freely Distributed Q-Sort 5

In this stage of the research, the Q-sort followed a free-distribution format in which local practitioners placed each Item in a valued cell of the Q-sort based on their level of agreement. Items could be placed in one of nine cells corresponding to a level of agreement value of -4 (strongly disagree) to 0 (neither agree nor disagree or the participant is unsure) to +4 (strongly agree). The free distribution format was suited for this study as it allowed participants to express their views without constraining their ability to rank Items. Although a forced-distribution format has been shown to produce more stable results (see Block, 1978; Bracken & Fischel, 2006), this format may not be as accurate for this study

because the Q-set covered multiple subject areas. Therefore, a forced distribution could have led to skewed results.

2.2.3 Administering the Q-sort (procedure)

The development of the Q-sort, to be distributed, was completed in December of 2014 and it was distributed to participants up until January of 2015. In this period, 12 leading local practitioners within various organizations were involved in completing the Q-sort based on the position of their organization/institution and/or the department within the organization/institution that they are affiliated with (see Table 4). A representative of the requested organizations was ideal in this study for two reasons. First, it became apparent early on in the distribution phase of this research that individuals within the same organization have the same position as their colleagues and, as such, they would forward the request along with a corresponding email indicating thusly.

Second, Q methodology is less concerned with the number of participants due to its purpose (Watts & Stenner, 2012). As Brown (1980) notes,

> Q methodology requires enough subjects [or participants] to establish the existence of a [collective view] for purposes of comparing one [collective view] with another. What proportion of the population belongs in one [collective view] rather than another is a wholly different matter and one about which Q technique…is not concerned (192).

The methodology has little interest in generalizing to a population scale; instead, the focus is on establishing the "existence of particular viewpoints" (Watts & Stenner, 2012, 72; Brown, 1980; Stephenson, 1953). It is by this logic that 12 participants representing different organizations and departments within these organizations was considered suitable for the purposes of this study.

Completed Q-sorts were placed in a single document in which no identifiers were present due to the ethical provisions of confidentiality that were conditional for participation in this study. All ethical information was passed along to the participants when requesting their involvement in the study (see Appendix D).

Data collection concluded on February 25th with the completion of the 12th participant's Q-sort. All completed Q-sorts were included in the factor analysis, as described in the next section.

Table 4: Q-sort Participants[6]

Q-sort Participants' Background
1. Environmental Developer (City of Vancouver)
2.Technical Expert (City of Vancouver)
3.Technical Expert (City of Vancouver)
4. Emergency Management Expert (District of Maple Ridge)
5.Technical Expert (District of Maple Ridge)
6. Technical Expert (District of Maple Ridge)
7. Development Expert (District of Maple Ridge)
8. Non-governmental organization (District of Maple Ridge)
9. Regional Environmental Organization
10. Regional Environmental Organization
11. Regional Institutional Manager
12. Regional Consulting Expert

[6] General pseudonyms are provided to protect the identity of participants.

2.2.4 Statistical Analysis

Q methodology uses a by-person factor analysis to identify patterns of similarity and distinct regularities in the Q-sorts. As Watts & Stenner (2012) explain, "it involves a statistical inspection of the correlation matrix that mimics the conceptual or eyeball inspection" (98). The process of a by-person factor analysis measures the correlation among Q-sort configurations. Q methodology is focused on the relationship between participants. In Q the participants are variables being measured and the Items are the sample. Therefore, it should be understood that Q method focuses on the relationship among participants through the factor analysis of completed Q-sorts. The result of this by-person factor analysis is the identification of group(s) representing a collective view or shared behaviour, known as a Factor. Each Factor is a representation of a group of participants that have been identified as having similar behaviour with each other, as expressed through their Q-sorts. They will have their own Q-sort that is outputted, representing the behaviour/views of the Factor. They are designated as Factors because in abduction there are many possible links to a cause and because, in Q methodology, each Factor represents a group's behaviour through its views and they are involved in flood response; attributing a single Factor to link the effect to the cause is inappropriate. Each Item of the Factor's Q-sort has new calculated value that represents that Factor's view. These output values for each Item are known as factor arrays. In order to arrive at these factor arrays there are a series of steps involved.

The by-person factor analysis process in Q method can be understood as being complicated and, as such, it will be described in a step-by-step fashion. The statistical analysis of Q method involves 6 steps, including:

Step 1: Intercorrelation of Q-sorts;

Step 2: Factor extraction;

Step 3: Factor rotation;

Step 4: Factor-defining Q-sorts for 3 factors;

Step 5: Factor weights and estimates; and

Step 6: Factor arrays.

2.2.4.1 Intercorrelation of Q sorts

The first step in Q method is to examine the relationship that each Q-sort has with every other Q-sort in the study. The purpose of this step was to identify groupings of high and low correlations and, thus, variance by producing a correlation matrix (see Table 5). Based on the correlations among Q-sorts, a factor matrix was outputted, identifying "shared forms of understandings among [local practitioners]" (Shinebourne, 2009, 94). As Watts & Stenner (2012) explain, "these initial relationships within the correlation matrix—these patterns of similarity and difference—are very important because they are the site from which our Factors will be born" (98).

The calculation of the correlations between Q-sorts involved Pearson's Coefficient. The other option was to use Spearman's Coefficient, but it really did not matter as the methods would have produced the same results (Brown, 1980). It is from here that a Principle Component Analysis (PCA) was performed on the correlations, leading to the extraction of Factors. Since there were 12 responses to the questionnaire, one can see from Table 5 that some responses were highly correlated and other negatively correlated. For example, Q-sorts 5 and 3 were correlated at 0.801 and 5 and 9 at 0.695 while 1 and 8 were negatively correlated and small (-0.073).

Table 5: Correlation Matrix

		Q Sort 1	Q Sort 2	Q Sort 3	Q Sort 4	Q Sort 5	Q Sort 6	Q Sort 7	Q Sort 8	Q Sort 9	Q Sort 10	Q Sort 11	Q Sort 12
Correlation	Q Sort 1	1.000	.464	.043	.455	.350	.040	.246	-.073	.173	.114	.533	-.031
	Q Sort 2	.464	1.000	.220	.360	.415	.265	.080	.303	.306	.505	.487	.226
	Q Sort 3	.043	.220	1.000	.255	.801	.564	.667	.547	.643	.247	.436	.388
	Q Sort 4	.455	.360	.255	1.000	.431	.437	.125	.125	.472	.413	.782	.448
	Q Sort 5	.350	.415	.801	.431	1.000	.466	.727	.529	.695	.285	.587	.281
	Q Sort 6	.040	.265	.564	.437	.466	1.000	.346	.570	.632	.475	.664	.589
	Q Sort 7	.246	.080	.667	.125	.727	.346	1.000	.438	.397	.138	.375	-.012
	Q Sort 8	-.073	.303	.547	.125	.529	.570	.438	1.000	.627	.229	.300	.411
	Q Sort 9	.173	.306	.643	.472	.695	.632	.397	.627	1.000	.507	.485	.466
	Q Sort 10	.114	.505	.247	.413	.285	.475	.138	.229	.507	1.000	.445	.322
	Q Sort 11	.533	.487	.436	.782	.587	.664	.375	.300	.485	.445	1.000	.311
	Q Sort 12	-.031	.226	.388	.448	.281	.589	-.012	.411	.466	.322	.311	1.000

2.2.4.2 Factor extraction

The second step, factor extraction, is the process of identifying the number of Factors (also known as groupings of shared behaviour) in the study through the identification and removal of common variance from the initial correlation matrix (Kline, 1994; Brown, 1980; Watts & Stenner, 2012). There are two main approaches to factor extraction: 1) a centroid factor analysis; and 2) a PCA. Harman (1976) argues that the two methods are likely to produce similar results, the difference being that the PCA will produce a mathematically best solution.

In this study, the PCA factor extraction technique was performed in which eigenvalues above 1.00 were indicative of a Factor. It is recommended by Brown (1980) and Watts & Stenner (2012) that the number of Factors extracted be based on eigenvalues greater than 1.00—satisfying the Kaiser-Guttman criterion (Guttman, 1954; Kaiser, 1960)—as values less than 1.00 account for less than 1 Q-sort of study variance. As it is indicated in Table 6, three Factors were extracted, equating to 72.73% of the study variance.

Table 6: Factor Extraction

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.458	45.485	45.485	5.458	45.485	45.485
2	1.801	15.007	60.492	1.801	15.007	60.492
3	1.469	12.239	72.730	1.469	12.239	72.730
4	0.865	7.212	79.942			

5	0.647	5.388	85.330	
6	0.494	4.119	89.449	
7	0.422	3.515	92.964	
8	0.330	2.747	95.711	
9	0.266	2.219	97.930	
10	0.119	0.988	98.918	
11	0.085	0.708	99.626	
12	0.045	0.374	100.000	

**Extraction Method: Principle Component Analysis

Q-sorts have a corresponding factor loading to each Factor. A factor loading is the degree of correlation that each Q-sort has with each Factor (see Appendix B). It is these factor loadings that become integral to the final product/arrays as their loadings will determine which Factor they will represent.

2.2.4.3 Factor Rotation

The third step of the by-person factor analysis is a factor rotation. Factor rotation is the process of manipulating the conceptual dimensions of the extracted Factors in order to best position the factor loadings relative to each Factor. It is common practice to perform a factor rotation in Q methodology (Watts & Stenner, 2012; Brown, 1980). As Watts & Stenner (2012) state, "The close proximity of two mapped Q-sorts signals their general agreement and the presence of similar viewpoints. The greater their physical separation, however, the more their respective viewpoints diverge" (115). It is the purpose of factor rotation to align the unique viewpoints of each Q-sort with a shared viewpoint of a Factor by rotating the axes and, thus, spatially adjusting the factor loadings and avoiding negative loading values. This process was undertaken and it is fully described in Appendix B.

2.2.4.4 Factor-defining Q sorts

The next step of the by-person factor analysis was to define the Q-sorts that would be used to calculate the final factor arrays for each Factor. Factor rotation results in new factor loadings for each Q-sort relative to each Factor. It was using these new loadings (see Table 7) that factor-defining Q-sorts were selected. Following the rotation, Q-sort 1's factor loading with Factor 2 has increased while the loadings for Factors 1 and 3 have decreased. It is safe to assume that Q-sort 1 would have a higher significance/role in defining the factor arrays for Factor 2 as opposed to Factors 1 and 3 in this study. Therefore, Q-sort 1 is factor-defining of Factor 2. This process of selecting factor-defining Q-sorts was performed on each Q-sort, resulting in Table 8.

Table 7: Factor loadings post-rotation

	Component (Grouping of Shared Behaviour)		
	Factor 1	Factor 2	Factor 3
Q Sort 1	0.132	0.845	-0.287
Q Sort 2	0.09	0.663	0.249
Q Sort 3	0.833	0.069	0.339
Q Sort 4	0.062	0.72	0.401
Q Sort 5	0.835	0.389	0.178
Q Sort 6	0.402	0.212	0.734
Q Sort 7	0.901	0.137	-0.121
Q Sort 8	0.616	-0.079	0.525
Q Sort 9	0.564	0.255	0.586
Q Sort 10	0.039	0.43	0.578
Q Sort 11	0.331	0.765	0.33
Q Sort 12	0.065	0.093	0.823

Table 8: Factor-defining Q-sorts

Factor Number	Q sort numbers	Total	Cumulative total
1	3, 5, 7, 8	4	4
2	1, 2, 4, 11	4	8
3	6, 12, 10	3	11
Confounded	9	1	12
Non-significant		0	12

It should be noted here that Q-sort 9 had essentially the same loading on Factors 1 and 3.[7]. According to Watts & Stenner (2012), the significant loading of a Q-sort on two or more Factors indicates that the Q-sort is a confounding variable and, as such, it cannot be used as a factor-defining variable. This does not mean that Q-sort 9 is not important or irrelevant to the results of this study, rather, it just cannot be used in determining the final factor arrays. It is in the interpretations of the final product of each Factor that Q-sort 9's distribution was compared to the final factor arrays of Factor 1 and 3, focusing on similarities and differences between these products and this variable with regards to the results of this study. Following the placement of Q-sorts into individual Factors, factor weights, estimates and z-scores were calculated.

2.2.4.5 Factor weights and estimates

Factor weights and estimates are essential to formulating the final factor arrays. A factor estimate is "an estimate of the Factor's viewpoint" (Watts & Stenner, 2012, 129) on a particular Item. It is calculated using the factor weights of all factor-defining Q-sorts of an individual Factor. The final factor weights indicate the percentage that each Q-sort will contribute to the final factor estimates relative to the Q-sort with the highest score (1). It involves three steps that are indicated in the following tables:

[7] Q-sort 9 is the 9th participant's completed questionnaire.

Table 9: Calculating Factor Weights

Step 1: Initial Factor Weight (for Q sort 1)=Factor Loading/(1-Factor Loading^2)					
Factor 1	**Initial Factor Weight**	**Factor 2**	**Initial Factor Weight**	**Factor 3**	**Initial Factor Weight**
Q Sort 3	2.721235108	Q Sort 1	2.954803742	Q Sort 6	1.591348614
Q Sort 5	2.757823466	Q Sort 2	1.18301807	Q Sort 10	0.867977342
Q Sort 7	4.787485587	Q Sort 4	1.495016611	Q Sort 12	2.550585581
Q Sort 8	0.992677393	Q Sort 11	1.844373455		

Step 2: Reciprocal of Largest Factor Weight from Step 1=1/Initial Factor Weight of Qx					
	Reciprocal		**Reciprocal**		**Reciprocal**
Factor 1	0.208877913	**Factor 2**	0.338431953	**Factor 3**	0.392066829

Step 3: Final Factor Weight (for Q Sort 1)=Initial Factor Weight (Step 1)*Reciprocal of Largest Factor Weight (Step 2)					
Factor 1	**Final Factor Weight**	**Factor 2**	**Final Factor Weight**	**Factor 3**	**Final Factor Weight**
Q Sort 3	0.568405911	Q Sort 1	1	Q Sort 6	0.623915004
Q Sort 5	0.576048411	Q Sort 2	0.400371115	Q Sort 10	0.340305124
Q Sort 7	1	Q Sort 4	0.505961391	Q Sort 12	1
Q Sort 8	0.207348383	Q Sort 11	0.62419491		

The calculation of factor estimates were derived from these weights by multiplying the initial score of each Item in the Q-sorts with their corresponding factor weights. The sum of the weighted scores of an Item is the factor estimate for that Item. These factor estimates are indicators for the corresponding factor arrays (see Table 10).

The tables over the next 4 pages show the weighted scores of each Item based on the Q-sort weights and the factor estimates under the 'Total' column. Again, it is from these factor estimates that the factor arrays were derived.

Table 10: Factor 1 estimates

Q sort Weight	3 (0.5684)	5 (0.5760)	7 (1.000)	8 (0.2073)	Total
Item	(Item Ranking)*Weight=Weighted Score				
1	4.5472	4.032	9	1.6584	19.2376
2	3.4104	3.456	8	1.2438	16.1102
3	4.5472	4.608	5	0.8292	14.9844
4	2.842	3.456	5	0.6219	11.9199
5	2.842	2.304	5	0.4146	10.5606
6	2.842	4.032	6	1.4511	14.3251
7	3.9788	4.608	8	1.6584	18.2452
8	3.9788	4.032	7	1.2438	16.2546
9	4.5472	4.608	5	1.6584	15.8136
10	2.842	2.304	5	0.4146	10.5606
11	3.9788	4.608	9	1.6584	19.2452
12	3.4104	3.456	5	1.4511	13.3175
13	2.842	4.032	5	0.6219	12.4959
14	3.9788	5.184	9	1.2438	19.4066
15	1.7052	1.728	4	0.2073	7.6405
16	2.842	2.88	4	1.6584	11.3804
17	2.842	2.88	5	0.6219	11.3439

18	2.842	4.032	5	0.6219	12.4959
19	2.2736	0.576	2	0.2073	5.0569
20	3.4104	4.032	5	1.4511	13.8935
21	1.7052	1.728	3	1.4511	7.8843
22	3.9788	4.608	6	1.4511	16.0379
23	3.4104	4.608	8	0.6219	16.6403

Table 11: Factor 2 estimates

Q sort Weight	1 (1.000)	2 (0.4004)	4 (0.5060)	11 (0.6242)	Total
Item	(Item Ranking)*Weight=Weighted Score				
1	2	1.2012	1.518	1.2484	5.9676
2	7	3.2032	2.024	4.3694	16.5966
3	7	3.6036	3.036	4.9936	18.6332
4	6	0.8008	3.036	2.4968	12.3336
5	5	0.4004	3.542	3.121	12.0634
6	5	3.6036	3.036	1.8726	13.5122
7	6	2.002	4.048	4.9936	17.0436
8	4	1.6016	4.554	5.6178	15.7734
9	1	3.2032	3.542	3.7452	11.4904
10	6	2.4024	4.048	4.3684	16.8188
11	7	2.8028	4.048	5.6178	19.4686
12	6	3.2032	4.048	4.3694	17.6206
13	6	3.2032	4.048	4.3694	17.6206
14	9	3.2032	3.542	5.6178	21.363

15	6	1.2012	1.518	0.6242	9.3434
16	3	0.4004	2.53	3.121	9.0514
17	7	2.4024	3.542	3.121	16.0654
18	9	3.6036	4.554	5.6178	22.7754
19	1	1.2012	2.024	1.2484	5.4736
20	6	3.6036	3.036	3.7452	16.3848
21	3	3.2032	3.036	4.3694	13.6086
22	9	2.8028	4.554	5.6178	21.9746
23	3	1.2012	3.036	4.3694	11.6066

Table 12: Factor 3 estimates

Q sort Weight	6 (0.6239)	10 (0.3403)	12 (1.000)	Total
Item	(Item Ranking)*Weight=Weighted Score			
1	4.9912	2.0418	7	14.033
2	3.7434	1.3612	3	8.1046
3	4.9912	2.0418	6	13.033
4	1.8717	1.0209	6	8.8926
5	3.7434	0.3403	6	10.0837
6	2.4956	2.3821	5	9.8777
7	5.6151	0.6806	7	13.2957
8	5.6151	2.3821	6	13.9972
9	5.6151	2.3821	8	15.9972
10	5.6151	3.0627	8	16.6778
11	5.6151	1.7015	6	13.3166

12	4.9912	1.7015	7	13.6927
13	3.7434	1.0209	6	10.7643
14	4.9912	1.7015	5	11.6927
15	2.4956	0.3403	1	3.8359
16	4.9912	0.6806	7	12.6718
17	1.2478	1.0209	3	5.2687
18	4.9912	3.0627	8	16.0539
19	2.4956	0.6806	4	7.1762
20	4.9912	0.6806	8	13.6718
21	4.9912	2.7224	5	12.7136
22	5.6151	2.3821	5	12.9972
23	4.3673	1.7015	2	8.0688

2.2.4.6 Factor arrays

The final step of the statistical formulation in Q method is determining the factor arrays of each Factor. As mentioned, factor arrays are the corresponding values of a Factor's Items based on the factor estimates of Q-sorts. They represent the Factor's view for each Item. The distribution format (free versus forced) is fundamental in determining the factor arrays. Factor scores or arrays are derived by identifying the factor estimate range that any Item could have and dividing that range by the number of possible rankings—in this case, 9. Each rank is given the same range and Items with factor estimates that fall within a rank's given range will receive the corresponding value. The final factor arrays are displayed in Figures 7-9. It is from the literature review, interview data and these factor arrays that Chapters 4 through 6 of this paper are centered on.

-4	-3	-2	-1	0	1	2	3	4
	Item 19	Item 15	Item 5	Item 4	Item 6	Item 2	Item 7	Item 1
		Item 21		Item 13	Item 10	Item 3		Item 11
				Item 16	Item 12	Item 8		Item 14
				Item 17	Item 20	Item 9		
				Item 18		Item 22		
						Item 23		

Figure 6: Factor 1 arrays

-4	-3	-2	-1	0	1	2	3	4
	Item 1	Item 16	Item 9	Item 4	Item 8	Item 2	Item 3	Item 14
	Item 19		Item 15	Item 5		Item 7	Item 11	Item 18
				Item 6		Item 10		Item 22
				Item 21		Item 12		
				Item 23		Item 13		
						Item 17		
						Item 20		

Figure 7: Factor 2 arrays

-4	-3	-2	-1	0	1	2	3	4
	Item 15	Item 19	Item 2	Item 5	Item 13	Item 1		Item 9
	Item 17		Item 4	Item 6	Item 14	Item 3		Item 10
			Item 23			Item 7		Item 18
						Item 8		
						Item 11		
						Item 12		
						Item 16		
						Item 20		
						Item 21		
						Item 22		

Figure 8: Factor 3 arrays

Each Factor can be characterized based on the outputted factor arrays that correspond to each Item of the Q-sort. Factor 1 is characterized by risk and collaboration. With Items 1, 11, 14 and 7 being valued the greatest in its configurations (+4 and +3), Factor 1 views risk as the biggest or most influential driver for flood management.

Although uncertainty and competing priorities influence investment in flood management, according to this group, the risk of a flood and the associated impacts make flood management a priority in the region. This group takes a precautionary approach to flood response in that they would rather be safe than face the consequences of no preventative action given that a flood event could occur.

Factor 2 can be characterized by institutional tension that exists among different levels of government or organizations and the action that results is more social and economically based as opposed to Factor 1's risk-based approach. Based on the outputted factor arrays, Factor 2 views potential economic impacts as the greatest drivers for flood management. This group views the risk of a flood occurring as less of a driver than public pressure and economic impact. They operate more based on public input regarding the existing issues in the region at the present time than the potential risk of a flood occurring. What can be seen as an issue because the impacts are visible (what their reality is) is more influential on institutional behaviour than a perceived threat. Therefore, uncertainty of an event occurring impacts the investment in flood management. Finally, this group views flood management as being a provincial or federal responsibility as opposed to a municipal one. This suggests that a lack of acceptance of responsibility could lead to less investment in and attention to flood response from this group, as will be shown in Chapters 4-6.

Factor 3 is characterized by organizational or institutional structure. It controls the investment in flood response and who is responsible for the development and implementation of the organization or institution's flood response. Although communication and collaboration are important for successful flood management, disconnect among staff and more senior officials within the organization or institution is present and reflects the current state of flood management in the region. This group views climate change and the potential economic impacts associated with a major flood as being major drivers for flood management, but how the organization or institution views the state of the current system and the need to improve that system takes priority. Therefore, disconnect and disagreement regarding responsibility, in part, shape this group. It is also characterized by the politics of approaching issues where results can be seen immediately

for the purpose of re-election and keeping the public happy by approaching their concerns first followed. Ultimately, response occurs when needed.

2.3 Conclusion

Q methodology studies human behaviour through the views, beliefs and experiences of individual participants. It identifies clusters of individuals that share similar viewpoints in order to identify group behaviour. These clusters are known as Factors and the behaviour is identified through the factor scores/arrays that indicate a group's level of agreement with an Item within the Q-sort.

In this study, these Factors and their factor arrays form part of the basis for understanding how institutions and organizations manage and respond to flood risk. They identify patterns of behaviour framed by interacting components in order to aid in the discussion of conceptualizing institutional response capacity to floods and municipal action. The results of the by-person factor analysis supports interview data and information gathered in the literature review. Together, these methods of data collection lead to the conceptual frameworks presented in the coming chapters. Items 4, 5 and 6 of the Q-sort are excluded in the write-up of Chapters 3-7 because the by-person factor analysis shows no conclusive evidence that these Items factor in response capacity to floods or municipal action.

In Chapters 4-6, results of the Q analysis are presented in conjunction with findings from the literature review and the interviews. The tables presented in these Chapters are designed to show the views of the three Factors on particular Items. It should be understood that the values presented on a particular Item should not be taken as a representative value that can be summed to provide one view for all participants; rather, the factor arrays that correspond to a Factor represents that Factor's particular level of agreement with a specific statement. It is not the purpose of these tables to say that Factor 1's level of agreement of an Item is greater or less than that of Factor 2 or 3's level of agreement. The purpose of these tables is to show how these Factors view various aspects of flood response to provide an indication, in conjunction with interview data and literature review findings, of the components of response capacity to floods and municipal action. Therefore, by

understanding that these Factors correspond to separate views from each other, this paper can now proceed with discussing responsibility and liability in emergency management, followed by response capacity to floods and municipal action.

3 Responsibility and Liability in Emergency Management

3.1 Introduction

Jurisdiction, responsibility and exposure to civil liability in emergency management situations are major considerations in the development of emergency policy and response practices. Together, they outline the roles of governments and provide a legal framework for the approach to emergency management.

The main purpose of this Chapter is to provide context for the Chapters to come through a review of the applicable statutory and common law principles and to review the influence that legal responsibility and exposure to civil liability have in emergency management decision-making. The objectives of this Chapter are:

1. Identify the roles and responsibilities of the municipal, provincial, and federal governments as derived through legislation;

2. Explain the heterogeneity in emergency management and planning among municipalities in British Columbia; and

3. Explore the provisions in place that reduce government exposure to liability in emergencies.

3.2 Jurisdiction and Responsibility

Jurisdiction refers to the authority to make laws. In Canada, jurisdiction is a product of the *Constitution Act of 1867*. In 1867, Ontario, Quebec, Nova Scotia, and New Brunswick signed the *British North American Act* (now referred to as the *Constitution Act of 1867*), followed by the remaining provinces and territories at later dates. It established the federal and provincial governments of Canada, outlining their legislative authority over matters in Canada. The federal government was given legislative authority over the militia, military

and naval services, and Defense, as well as criminal law and other matters (Section 91). Provincial governments had legislative authority on all matters pertaining to land and water—provided that the body of water is solely contained in that province—and, most notably, authority over municipal institutions (Section 92).

Probably the most important aspect of this document, at least in the context of emergency management, is that subject matters not mentioned in the Act allows federal and provincial governments to define their roles. Both the federal and provincial governments have the authority to make laws pertaining to emergency management and can use that authority to define their roles. The federal government's approach has traditionally been that emergency management is best suited to be dealt with at the provincial or local level and should not be a federal responsibility because most emergency management has to do with waterways and land which are under provincial jurisdiction. Therefore, the federal government recognizes that responsibility for emergency management lies with the provinces through the *Emergency Management Act*. This is not to say that the federal government is not involved in emergency management, just that the obligation for planning and implementation of emergency management is not their responsibility. Instead, the federal government has chosen to take on a funding and assistance role. The *Disaster Financial Assistance Arrangement* program is designed to assist provinces in post-disaster recovery. In events where a state of emergency is declared, the federal government has provisions in place so that the military can aid in disaster relief (as described in Chapter 1). The actual involvement in emergency management planning and implementation, however, has very little to do with the federal government. They downloaded that responsibility to the provinces.

Provinces also have jurisdiction to make laws on emergency management and can make laws that impose obligations on local governments to do things or not do things. While the province has ultimate jurisdiction to make laws governing emergency preparedness and to establish minimum standards and criteria, that responsibility has largely been devolved down to municipalities who have limited capacity given the financial constraints and other priorities facing them.

In British Columbia, the *Emergency Program Act* passes down responsibility of emergency management to municipal institutions. Instead of taking the lead on emergency

management, the province's approach is that emergency management is best dealt with at a local scale. Risk to hazards differ between municipalities. The City of Vancouver, for example, is exposed to coastal flooding caused by sea-level rise and storm surges. Maple Ridge on the other hand may not have to address direct flooding caused by sea-level rise because it is further inland. A universal plan at the provincial level that can be applied in all regions is viewed as not being the most effective strategy. Instead, management at a local level made more sense to the province. As such, that responsibility was delegated to the municipalities. The province remains involved in emergency management, but their position should be recognized as an advisory role with funding and financial assistance opportunities.

Municipalities, on the other hand, are legal entities defined by provincial legislation. Municipal governments are representative entities of their communities that make communal decisions based on what they perceive to be in the best interest of the community (*Local Government Act*). Where the province and federal government have the authority to define their roles in emergency management, municipalities do not. Municipalities are creatures of statute. They derive their power and existence through legislation, such as the *Local Government Act*. Municipalities, like private entities and citizens, are bound by provincial statutes, including those that direct or require emergency preparedness. As such, they make emergency planning and implementation decisions in both a statutory and common law context.

In 1996, the province of British Colombia adopted the *Emergency Program Act* outlining the duties and responsibilities of government for emergency management and the provisions for which a state of emergency can be declared. It was under this Act that municipalities were given the responsibility for developing and implementing local emergency plans. As stated under Section 6(2) of the amended *Emergency Program Act* (2015), "a local authority must prepare or cause to be prepared local emergency plans respecting preparation for, response to and recovery from emergencies and disasters." Given that sea-levels are rising and storm surges are becoming more frequent and intense, coastal communities have the responsibility to create an emergency plan that should address such concerns. However, communities may be subject to multiple types of hazards and, thus, can interpret this provision of the Act—and the extent to which "preparation for,

response to and recovery from" is appropriate—however they like. For example, "preparation for" could be interpreted as developing a plan if a disaster were to occur, but it does not actually mean that infrastructure has to be implemented that would reduce the likelihood of a flood occurring in a given area. In the City of Vancouver, there is an entire department designated with the task of designing a plan and carrying out that plan addressing climate change which includes reducing flood risk. Other cities will not have the same emergency plans as the City of Vancouver for a variety reasons, but the point here is that the wording in Section 6(2) of the *Emergency Program Act* allows for multiple interpretations and the policies, programs, and decisions made are reflective of such interpretations. Although this Act imposes responsibility for emergency management onto municipalities, there is no defined standard in approaching it. Municipalities are able to approach emergency management as they see fit.

There are programs that are designed to financially assist municipalities in post-disaster recovery that may influence the decisions that municipalities make due to the conditions attached. This can deter emergency management by restricting access to resources if certain requirements are not met. For example, municipalities can receive financial assistance or compensation through the province. The *Compensation and Disaster Financial Assistance Regulation* of the *Emergency Program Act* is designed to outline the conditions for which municipalities and homeowners qualify for financial assistance in the event that a disaster occurs. Claims for compensation by municipalities can be made for structural repair, rebuilding or replacement; however, Section 30 raises issues pertaining to flood plain mapping and the ability to receive assistance. Section 30 states,

> If an area is designated under the [*Local Government Act*] as flood plain and a public facility is built or installed in that area after the area has been so designated, no assistance will be provided to repair, rebuild or replace the public facility if it is damaged in a flood unless the structure was determined by the Minister of Environment, Lands and Parks or by Canada Mortgage and Housing Corporation to have been properly flood protected.

This provision acts as a deterrent for flood plain mapping. It incentivizes local governments to neglect flood plain mapping in their jurisdictions in order to be eligible for assistance if a disaster were to occur. In the event that flood plain maps are up-to-date and a flood

occurs, the burden of the cost to repair, rebuild or replace damaged or destroyed structures located in the designated flood plain falls completely on the local authority without the possibility for compensation or assistance. As one participant in this study explained, the Columbian Basin Trust had the resources to conduct a hydrological assessment in Kootenay for 20 municipalities, but the municipalities turned it down because of the liability attached. Therefore, the liability attached to flood plain mapping was the root deterrent for making this decision. It was decided that the best thing for these communities was not knowing so that if a flood were to occur they would remain eligible for assistance and avoid a potential economic collapse.

Claims for financial assistance or compensation can be reduced or declined if the Minister determines that insufficient measures were taken before, during or after the disaster (*Compensation and Disaster Financial Assistance Regulation*, S. 31). Therefore, although the *Emergency Program Act*, outlined earlier, requires the coordination of action to protect the health, safety, well-being and property from damage in the event that a threat of a disaster exists, if the minister believes that too little action has taken place to protect a structure then that assistance or compensation can be declined.

It is clear that municipalities are responsible for emergency management defined in provincial legislation and that there is no defined standard in its approach allowing municipalities to make decisions on the planning and implementation of responses based on financial resources and other priorities. Again, municipalities choose whether or not to act and how to act with regards to emergency management. The assistance provided in the event that a disaster does occur will be reflective of those choices and, thus, the social constructions of the community's reality. The question now becomes: when does the local authority, having that responsibility to protect the people and property, become legally liable for their actions—including the choice not to act—and the associated costs in the event that a disaster does occur.

3.3 Liability

Legal liability refers to a finding that is made by a court that someone did something that they should not have done or did not do something that they should have which caused damage to someone else. It is a conclusion of law. Someone who does something wrong to

someone else is liable to pay damages. There is a distinction to be made between being responsible and being liable. Having the responsibility does not mean that one is legally liable.

As described earlier, municipalities are legal entities that are treated at law as a person; however, there are circumstances by which municipalities have different liability exposure than private individuals. Like a company, municipalities operate in the interests of their shareholders. For companies, the interests lie in maximizing profits (Jones, 2001). For government, they operate for the greater good and, therefore, they have to make tough decisions at times. As such, municipalities need to be protected against civil liability for the decisions that they make. Provisions in legislation and court decisions have reduced government exposure for this reason. In *Kamloops (City of) v. Nielsen,* the Supreme Court of Canada found that governments have different exposures to private law, stating "municipal legislative functions, are different in kind and are not amenable to judicial constraint by the imposition of a private law duty of care". The Court distinguished between policy decisions, to which no civil liability is attached, and operational decisions where a private law duty of care may arise, the breach of which gives rise to civil liability.

The difference between a policy decision and operational decision is a legal rationalization (Roman, 2002; Henstra & McBean, 2004). McLachlin C.J. wrote in *R. v. Imperial Tobacco Canada Limited*:

> "Core policy" government decisions protected from suit are decisions as to a course or principle of action that are based on public policy considerations, such as economic, social and political factors, provided they are neither irrational nor taken in bad faith. This approach is consistent with the basic thrust of Canadian cases on the issue, although it emphasizes positive features of policy decisions, instead of relying exclusively on the quality of being "non-operational". […] Difficult cases may be expected to arise from time to time where it is not easy to decide whether the degree of "policy" involved suffices for protection from negligence liability. (para. 90).

Due to the complexity of decision-making, policy versus operational decisions are made on a case-by-case basis. As McLaclin C.J. further stated, "a black and white test that will provide a ready and irrefutable answer for every decision in the infinite variety of decisions that government actors may produce is likely chimerical" (para. 90). The choice to implement infrastructure in one area, for example, versus another area is a policy decision due to the economic, social and political factors that influence the decision. If a flood

occurs, the City may not be liable for the damages in the area without the protecting infrastructure because a policy decision was made.

The choice not to act is also a policy decision. In *Eliopoulis v. Ontario*, George Eliopoulis had been infected with West Nile Virus in 2002 and was treated in hospital but later died in 2003. His estate and family members sued Her Majesty the Queen in Right of Ontario for negligence, arguing that Ontario owed the deceased a private duty of care and had the capability of preventing the outbreak in 2002 but chose not to act. The Ontario Court of Appeal found that the choice not to act was a policy decision and, therefore, negated the existence of a private law duty of care, which is a necessary pre-condition to civil liability in negligence.

It is important to understand that reduced government exposure does not mean no exposure to civil liability, just that it is limited in comparison to a private company or an individual. Legislation can limit exposure to liability when acting in face of an emergency or impeding emergency provided the language of the statute is clear and unambiguous. For example, under Section 18 of the *Emergency Program Act*, government cannot be found liable in private law unless in doing the act, decisions were taken in bad faith or they are found to be grossly negligent in doing or omitting that act. Their main exposure to legal liability lies with operational decisions. In a report prepared for the Institute for Catastrophic Loss Reduction, Henstra & McBean (2004) concluded that in order for a government to be found legally liable, they have to be "found negligent in the event that an operational decision breaches a duty of care owed to citizens" (4). Claims regarding the failure to uphold the duty of care can be made in negligence or nuisance.

Operational negligence is a private law claim that can be asserted against governments. Negligence is the result of a defendant's failure to satisfy a duty of care owed to the plaintiff, which causes damages (*Odhavji Estate v. Woodhouse*). Returning to *Kamloops (City of) v. Nielsen*, municipalities cannot be found negligent for policy decisions; however, it is important that government not be completely exempt from liability. In *R. v. Imperial Tobacco Canada*, McLachlin C.J. wrote:

> There is a wide consensus that the law of negligence must account for the unique role of government agencies: *Just*. On the one hand, it is important for public authorities to be liable in general for their negligent conduct in light of the pervasive role that they play in all aspects of society. Exempting all government actions from liability would

> result in intolerable outcomes. On the other hand, "the Crown is not a person and must be free to govern and make true policy decisions without becoming subject to tort liability as a result of those decisions." (*Just v. British Columbia*, 1239).

Thus, governments have exposure to liability in negligence for operational decisions. The key issues remain with the existence of a duty of care and proximity. If it is determined that a private law duty of care is owed, and proximity exist, and, if the decision was operational, a local government can be eligible in negligence.

Under the *Emergency Program Act,* a government has to be grossly negligent in their actions for liability to rise. Claims for gross negligence must show damages occurred where there exists a duty of care. A duty of care is an obligation to take reasonable care to avoid actions that result in an unreasonable risk of harm to others (*Odhavji Estate v. Woodhouse*). The plaintiff must prove that a private law duty of care exists, as defined through:

(a) A statutory scheme;

(b) Interactions between the local authority and the plaintiff without interference from a statute;

(c) Proximity based on (a) and (b); or

(d) Common law for operational action. (*R. v. Imperial Tobacco Canada*; *Swinamer v. Nova Scotia (Attorney General)*).

Foreseeability of the risk of injury can give rise to a duty of care if the harm is a reasonably foreseeable by-product of the action in question. For example, in *Anderson et al. v. Manitoba,* the province diverted water resulting in massive flooding in other communities. The question became whether or not a duty of care existed knowing that by diverting water away from one area to another, the receiving community would be more vulnerable to massive flooding. Although the court declined to certify the action as appropriate for a class action, the court found that the allegations in negligence against Manitoba disclosed a cause of action and permitted that claim to proceed as individual actions by affected persons.

Nuisance is a further ground of civil liability that may apply to flood situations. Nuisance refers to the interference with an individual's use and enjoyment of property through a thing or activity (*MacGregor v. Penner*; *Antrim Truck Centre Ltd. v. Ontario*

(Transportation)). It may be the result of negligence (*Penno v. Manitoba*). In order to prove a nuisance claim the plaintiff must prove that the interference was substantial and unreasonable. To put this into context, in emergency situations there are times where an evacuation order can be implemented. In the event that an evacuation order is implemented during a disaster, the government has the legal authority to occupy private land, under Section 10 of the *Emergency Program Act*. It is expected that the owner tolerates the adverse effects of that occupation (*Anne Hotel Co. v. Ashcroft; Smith v. Inco*). As stated by the Supreme Court of Canada,

> Under the common law of nuisance, sometimes the person whose property suffered the adverse effects is expected to tolerate those effects as the price of membership in the larger community. Sometimes, however, the party causing the adverse effect can be compelled, even if his or her conduct is lawful and reasonable, to desist from engaging in that conduct and to compensate the other party for any harm caused to that person's property. (*Royal Anne Hotel Co. V. Ashcroft (Village),* paras 8-10).

Therefore, civil liability claims on the grounds of nuisance need to show the local authority either acted unlawfully causing harm to the enjoyment or use of one's self or property or even if the municipality acted under lawful authority, the interference with the individual landowner's property is so great that it is unfair to expect that person to absorb those adverse effects without due compensation. In the event that no physical damage has been done, the question becomes whether it is unreasonable for the plaintiff to accept interference for the greater good of the public in all situations or if certain provisions should be in place to protect the plaintiff from such interference (*MacGregor v. Penner*; *Royal Anne Hotel Co. v. Ashcroft*; *Smith v. Inco Ltd.*). As stated in *MacGregor v. Penner*:

> In essence, the common law of nuisance decided which party's interest must give way. That determination is made by asking whether in all the circumstances the harm caused or the interference done to one person's property by the other person's use of his or her property is reasonable. (2).

Hypothetically, an argument could be made that the local authority could be found guilty of nuisance in a disaster situation or impeding disaster if the authority occupied land from private landowners and exceeded the necessary time to respond to the disaster thereby, causing an unreasonable interference with the owner's enjoyment and use of their land. In such cases, compensation may be awarded to the plaintiff/landowner.

Municipalities have tight budgets and many duties to fulfill (Henstra, 2013). With responsibility for the cost of emergency mitigation measures remaining in large part with municipalities, exposure to civil liability for decisions made have to be carefully considered. Natural disasters can affect local, regional and national economies. Evidence in Haiti, the Philippines, Christchurch (New Zealand) and others have shown that the ability to recover post-disaster is highly dependent on resource capacity. When issues pertaining to wrongdoing by the government to an individual or group of individuals arises in the event of a disaster, the ability to recover can be further constrained as it lessens resources available to the institution and region. Resources that would otherwise be used for the collective are restricted, particularly if compensation is owed to a few individuals. That said, compensation is usually awarded at a much later date, but it impedes the region's ability to develop and reduce exposure in the event that a disaster does occur.

Liability for operational decisions could facilitate even tighter budgets and result in delays or dissolution of projects in emergency management or other areas. In the interviews conducted in the City of Vancouver and District of Maple Ridge, participants described resources as being tight which has affected on-going projects. The results of the Q analysis suggests that priorities have a role in the investment in emergency management planning and implementation. If decisions made are found to be liable for damages the available resources allocated to projects can become constrained. Again, governments act in the greater good for their communities. A government that is found liable for an operational decision impedes the ability for governments to act. Therefore, it is important for municipalities to ensure that resources can be allocated for the benefit of the community as a whole. To do so, exposure to civil liability needs to minimized and, thus, it becomes integral in the emergency management decision-making process.

To conclude, statutory responsibilities and potential legal liabilities inform municipal decisions in emergency management. Although municipalities have less exposure to civil liability than that of a company or private individual, they do have to be careful in their approach to emergency management as to not act in bad faith or grossly negligent.

3.4 Conclusion

Jurisdiction, responsibility and legal liability are critical considerations in planning and implementing emergency management. The absence of emergency management in the *Constitution Act of 1867* has allowed the federal and provincial governments to define their roles. While the province has ultimate jurisdiction to make laws governing emergency preparedness and to establish minimum standards and criteria, that responsibility has largely been devolved down to municipalities who have limited capacity given the financial constraints and other priorities facing them. Although municipalities are responsible for emergency management in British Columbia, there is no defined standard in its approach, allowing municipalities to address emergency management as they see fit. Financial assistance and compensation by the provincial and federal government for damages resulting from a disaster can come with conditions, such as no assistance or compensation being provided to municipalities that develop in a designated flood plain. Such conditions have been found to inform emergency management decisions and, in some cases, deter it.

Governments have to make tough decisions at times and, as such, they need to be protected from civil liability for the decisions that they make. Although municipalities have the responsibility for emergency management that does not mean that they are legally liable. When decisions are made, governments have less exposure to civil liability than that of a private individual or company. Policy decisions made are exempt from civil liability unless those decisions were taken in bad faith. Governments do have exposure to civil liability when the government is found to be grossly negligent in their actions. Although that exposure is reduced, governments still take into account their exposure to inform planning and decision-making. Decisions that have greater exposure to civil liability are less likely to be made than a decision that has minimal or no exposure.

Municipalities act in the interest of their communities. The decisions that they make are for the greater good. Their approach to emergency management can be viewed as a social construction of the community's reality. Consistent with organizational theory that argues that culture dictates institutional or organizational behaviour by framing behaviour to meet societal demands, emergency management, too, conforms to this theory. The laws that are in place dictate what is acceptable, unacceptable and the standards to which municipalities, organizations and even the population must conform to reflect the cultural

values of the region. Therefore, emergency policy and practices of communities are a reflection of wants, needs and values of their populations. Although statutory responsibilities and legal liabilities inform the decisions that they make, those decisions will not impede on the interests and values of the community; instead, they work in tandem for the purpose of the greater good. The question becomes what other variables influence planning and decision-making in emergency management, particularly in the context of flood management.

4 Development Pathways of Response Capacity to Floods

4.1 Introduction

Response capacity is a term that depends on context for its meaning. As Burch (2009) explains, response capacity is the ability of a group to respond to any risk by utilizing human capital, financial capital, and institutional resources. The IPCC report (2007) describes response capacity as the ability of humans to manage greenhouse gas emissions and associated effects of climate change (Tompkins & Adger, 2005). In both Burch (2009) and the IPCC (2007), the researchers viewed response capacity as being the ability to manage risk. A nation or region's ability to manage risk is viewed as being highly dependent on resources as related to their socio-technical systems and economic development. Past research has focused on economic elements that influence response capacity (Handmer et al., 1999) but as the IPCC (2001b; 2007) and Sathaye et al. (2007) argue, response capacity is complex and should include other factors that influence a region's ability to respond, such as socio-cultural dimensions.

As Hadfield & Seaton (1999) explain, environmental management involves the complex interactions of human capital, social capital and institutional behaviour and physical change (see Figure 9). Together, these variables affect the way resources are allocated and used in natural and human systems. These authors claim that a change in any component of this interactive model would result in change in environmental management. This model is relevant to the discussion on response capacity to floods as the same themes influencing change in this model are present in what is described throughout this Chapter. As knowledge of flood management continues to develop and emergency management

changes as a priority within institutions, the effect on what resources are allocated to address the issue will result. What is described in this Chapter are the major components by which response capacity is influenced, which are consistent with findings made by Hadfield & Seaton (1999) and Burch (2009).

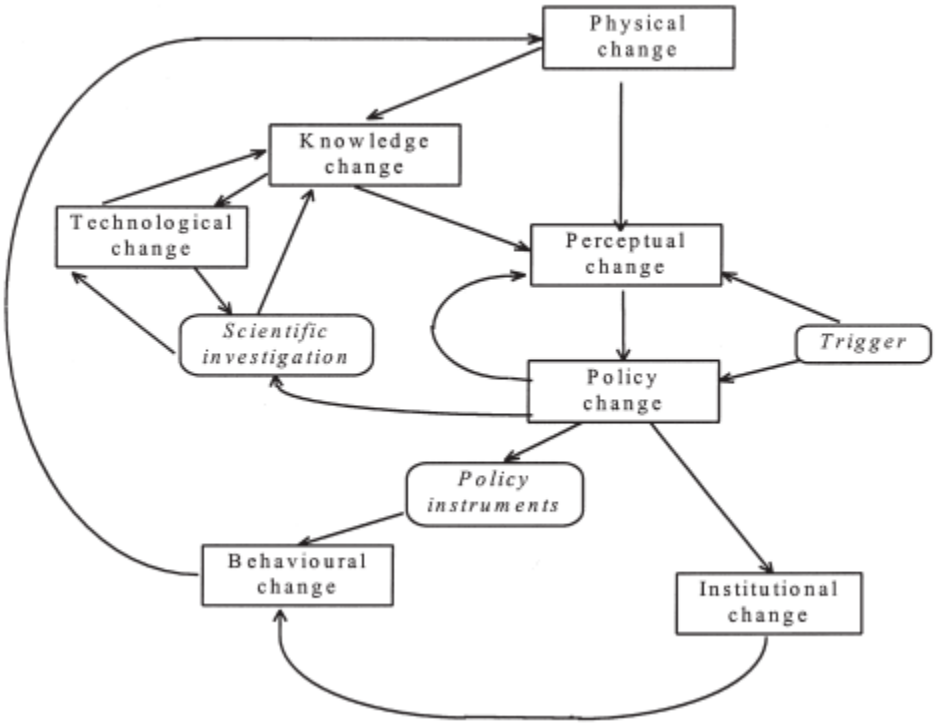

Figure 9: Factors influencing change in environmental management (Hadfield & Seaton, 1999, 586).

In the previous Chapter, the process of downloading responsibility and the legal mechanisms in place that influence decision-making in emergency management are examined. Questions of response capacity and development pathways to flood management now become the critical focus of this Chapter. What influences a community's ability to respond to flood risk is difficult to quantify due to complex issues. What needs to be noted at this time is that response capacity and action are separate. Although action is reflective of response capacity, having the ability to manage risk does not necessarily mean that action takes place.

The purpose of this Chapter is to identify and explain some of the factors influencing response capacity in flood management. It does not offer a complete picture of all influencing factors, rather it seeks to identify and explain some of the main elements affecting response capacity, including: legislation; institutional behavior as seen through priorities and collective agreements; collective action; technological pathways; and resource management. Evidence is presented based on the interview data, literature review and Q analysis.

This Chapter argues that provinces have the ability to develop a baseline response capacity through legislation that mandates a standard for emergency management. Although in Chapter 3 it became clear how responsibility and liability can inform decision-making, how legislation affects response capacity remained incomplete. Beyond the legal aspect, this Chapter argues that institutional behavior in recognizing that flooding is an issue needing attention and investment and collective action, both internally within a municipal institution and with external stakeholders and levels of government, can act as a control mechanism on response capacity as it dictates how resources are allocated. Next, this Chapter focuses on technological pathways and the relationship of technology responses and land use responses with cultural values and urban development. This paper argues that cultural values and urban development influence the orientation of responses in a region, particularly as highly developed areas with limited space to expand place greater reliance on technological responses as the population grows compared to areas where space for urban expansion is greater. Finally, this Chapter concludes with a brief explanation of resource management as it pertains to response capacity, arguing that it is fundamental to institutional response capacity.

4.2 Jurisdiction and Baseline Response Capacity

The provinces have the ability to establish baseline conditions for response capacity of emergency management and, subsequently, flood management through their authority to make laws governing land, water, and municipalities within their provincial boundaries. They can force municipalities to abide by a specific set of conditions that would control institutional behaviour in what practices would be considered legally acceptable or unacceptable with regards to land use and emergency management. Provinces have the

ability to create a standard for emergency and flood management which all municipalities and organizations would be required to meet.

It is evident in the previous Chapter that no standard is set in British Columbia's legislation on how municipalities are to proceed with regards to emergency management; instead, municipalities can approach the situation however they see fit provided that there is at least a plan for the "preparation for, response to and recovery from emergencies and disasters" (*Emergency Program Act*, 2015, 6.2). What those plans consist of and what action results are, in part, a function of the responsibilities imposed on local governments and the liability attached. Legislation imposing a minimum standard in emergency management can be viewed as reflective of response capacity as it can provide boundaries for action. More laissez-faire legislation allows municipalities to interpret statutes and regulations more freely, whereas stricter policies on emergency management practices would increase what is minimally required by municipalities. As such, the provinces have the ability to influence response capacity by mandating a standard in emergency management practice that municipalities would be forced to abide by.

To illustrate this in an international context, in the United States, state environmental employees in Florida were told by state officials not to use terms such as climate change and global warming because the state was not convinced that climate change is occurring (Korten, 2015; Jaffe, 2015; The McCoy, 20015). By not recognizing climate change as occurring and, thus, an issue, the state does not have to respond. Therefore, although there is no official policy that states climate change is not occurring, baseline response capacity in Florida remains low because precautionary municipal and state action is not needed for something that is not recognized as occurring. If the state recognizes sea-level rise, for example, as an issue then it can impose obligations onto municipalities for action. If the state's position rejects the need for action then the municipalities would have to take it upon themselves to recognize sea-level rise as an issue needing action, but due to the state's position, they are not required to.

In British Columbia, however, climate change is an issue and the disasters that are likely to occur in the future are recognized as a concern. Although in the *Emergency Program Act* there is no mention of climate change, municipalities are required to have plans for emergencies that they are likely to experience, which can include flooding.

Therefore, municipal response capacity is greater because they are forced to address emergency management to the degree set out by the province. With stricter legislation obligating a standard, municipal response capacity would increase as it would force municipalities to meet greater minimum requirements.

Response capacity in flood management, therefore, is, in part, a reflection of legislation as controlled by the institutional behaviour of the actor with the greatest authority to impose obligations through law. Their position can dictate bottom-line behaviour by mandating a minimum standard for local governments and organizations. Therefore, baseline response capacity can be viewed as the outcome of a product (legislation) that is developed through a jurisdictional body. However, this is not to say that developing a standard for emergency management through legislation is the appropriate course of action to increase response as it will be clear in the upcoming sections that factors interact with each other, creating a complex system that must be carefully managed.

4.3 Institutional Behaviour and Collective Action

Baseline response capacity should be referred to when discussing what is minimally required by municipalities and organizations. It speaks to the entire region where such requirements are imposed; however, within the region different municipalities and organizations will act beyond what is minimally required to different degrees. What factors influences these municipalities and organizations' ability to manage flood risk should be kept separate from baseline response capacity or, if viewed as a mathematical equation, an addition to the baseline response capacity where baseline response capacity remains a constant.

Fundamental to the concept of institutional response capacity—which exceeds minimum requirements—is institutional behaviour and collective action. The former refers to "individual behaviour [that] can be simply aggregated into collective phenomena, thus yielding the behaviour of institutions amenable to explanation simply by reference to the preferences of the individuals that compose that institution" (Burch, 2009, 180). How an institution prioritizes items affects how much investment is placed on any given item. In other words, the response capacity of an institution is influenced by competing priorities.

The lower flood management is as a priority results in a smaller financial investment and, thus, reducing the response capacity of an institution on flood management.

This claim is evident in a comparison of the City of Vancouver and District of Maple Ridge. The results of the Q analysis show that competing priorities affect investment in flood management (see Table 13). Such findings are consistent with interview data. In the study sites, participants agreed that flood management is a high priority, but other priorities, such as transit, economic development, and environmental conservation, can deter focus on and investment in flood response as was particularly the case in the District of Maple Ridge. As one interviewed participant in the study explains, governments have to balance response with other priorities. As a result, competing priorities can inhibit action by deterring investment or focus on issues that are not as high of a priority as others.

Table 13: Results for Items 12-15 of the Q-sort analysis

Item	Factor (factor array)
12. Success of flood management is dependent on or will increase depending on competing priorities elsewhere that put less emphasis on and investment in flood management.	Factor 1 (1) Factor 2 (2) Factor 3 (2)
13. Economic and relating activities, such as tourism, are controls on updating existing infrastructure.	Factor 1 (0) Factor 2 (2) Factor 3 (1)
14. Flood management and initiatives that focus on reducing the impacts if a flood occurs are a high priority within your municipal boundaries and/or in your profession.	Factor 1 (4) Factor 2 (4) Factor 3 (1)
15. Flood management is the top priority in the region, above, for example, transit, economic activity, and environmental conservation.	Factor 1 (-2) Factor 2 (-1) Factor 3 (-3)

Similar to the discussion in the last section, collective agreements can increase response capacity to floods by mandating action on particular issues. They can force response by prioritizing items in which response beyond provincial legislation is voluntary. For example, the Metro Vancouver 2040 was adopted by 21 municipalities in 2011 as a regional growth strategy, representing a "collective vision" for accommodating population growth. It contains strategies relating to urban development, regional economy, the environment and climate change, housing, and land use and transportation (Metro Vancouver, 2015). Under Section 3.4.1 of Metro Vancouver 2040, risk assessments are to be incorporated "into the planning and location of Metro Vancouver utilities, assets and operations" (42). For municipalities, they must adopt Regional Context Statements outlining policies that promote settlement in areas while minimizing risk associated with natural hazards and they must also consider using risk assessments in planning.

Therefore, what can be concluded here is two-fold. First, the Metro Vancouver 2040 is a reflection of emergency management response capacity exceeding baseline requirements as it recognizes emergency management from a risk-mitigation standpoint as a primary objective in the region as the population continues to grow. As it was identified in the previous section of this Chapter, by recognizing climate change and the need for disaster risk reduction, the response capacity of an institution is greater than those that do not recognize the issue because a region will not plan or prioritize if they believe that response is not necessary. Recognizing the issue can make it a priority. As several interviewed participants explained, the flood management response in the City of Vancouver has, in large part, resulted because the municipality believes that potential flooding is an issue that endangers the population, assets and operations within the city. This is consistent with findings by Burch (2009), Lawrence & Suddaby (2006), and DiMaggio (1988) regarding institutional theory. As Burch (2009) explains, "organized actors with resources may significantly impact the structure and function of institutions by utilizing strategies such as lobbying or leadership. […] Strategies are revealed by which actors may guide the evolution of institutions" (181). The behaviour of individuals within the institutions have made flood management a priority for the municipality. The focus on and investment in flood management will be dependent on where this issue stands as a

priority when compared with other concerns and responsibilities as determined by institutional behaviour.

Second, similar to the previous section, the wording of the regional growth strategy is open to interpretation as to the degree to which risk assessments in planning are used. Risk assessments are powerful tools in planning as they can provide the basis for formulating strategies that align with the values of the region while mitigating the impacts that disasters could have. As Adger (2006) explains, vulnerability assessments challenge "the design of good governance to promote resilience to minimize exclusion thereby reducing the severity of perceived vulnerability and its structural causes" (276). They spatially allow practitioners and government to identify areas at highest risk for flooding and populations where the greatest impacts may be experienced. It reflects response capacity by reducing uncertainty for areas at greatest risk, thereby, providing a framework for the strategic development and implementation of responses.

The other major components in this section regarding institutional behaviour and collective action are the concepts of group cohesion and collaboration. Group cohesion refers to factors influencing group performance among a diverse group of individuals (Harrison, Price & Bell, 1998). In Chansler, Swamidass & Cammann (2003), the authors concluded that poor cohesion can lead to reduced performance.

In the City of Vancouver and District of Maple Ridge, interviewed participants and the results of the Q analysis indicated that although participants believe flood management should be the responsibility of a different level of government, communication among departments within organizations and among organizations, and strong collaboration with the province are major factors in the region's current state of flood management. It was evident in these interviews that a lack of cohesion internally could disrupt flood management response as issues pertaining to the appropriate course of action, the resources that should be allocated, and debates over whether or not flooding is within that organization's purview, could become a major factor in preventing flood response.

That said, it was also evident in the District of Maple Ridge that miscommunication between senior officials within organizations and their staffs have produced a misconception regarding the need for greater flood response. The interview data shows several staff members in an organization discussing the need for greater flood response;

however, when discussing the current state of flood response with more senior ranking officials within this organization they mention only minor issues that need to be addressed, their perception overall remains that the current state of flood management in the region does not require major revisions. As one participant in the District of Maple stated,

> I would say this community is pretty solid in terms of flood risk. I do not think we really have to make that a big consideration. Like the areas that we are at risk to flood—like I'm talking about the Fraser now—I do not think we are particularly. I think that we have kind of built that into the way that the community has been built. I do not think there are any areas that could flood where we would be going.

The results of the Q analysis are consistent with this claim. Approximately one-third of the participants gave a negative score to Item 23—o*ur flood management approach has been very successful here and can be seen as a leader for others to follow*—indicating that the overall perception on flood management in this region is diverse, which can ultimately influence flood response as discussed. In fact, the results of the Q analysis for Item 21 further indicates that a disconnect among staff may exist. Factor 3's factor array for Item 21 is 2, which corroborates the above claim regarding a disconnect; however, Factor 1's factor array of -2 shows the opposite. Factor 1's position supports interview data in the City of Vancouver as participants indicated strong cohesion among staff, other organizations and council, whereas several participants in the District of Maple Ridge argued that disconnect in the region exists, thereby effecting flood response (consistent with Factor 3).[8]

Therefore, an organization's cohesion internally, among various organizations and levels of government, act as a control mechanism in response capacity as it influences institutional behaviour. The ability to respond to flood risk can decrease as tensions increase and information is miscommunicated among these actors.

Institutional response capacity exceeding provincial legislation is, therefore, a function of institutional behaviour and collective action as dictated through competing priorities, collective agreements, group cohesion and collaboration. Together, they provide a key part of the foundation for institutional response capacity by accepting the responsibility for

[8] Factor 2's factor array of 0 does not provide any indication to whether or not disconnect exists as this Factor's view is that it neither agrees or disagrees or it is unsure whether disconnect is present.

flood management exceeding baseline requirements. Institutional behaviour is an important factor in evaluating response capacity, but it represents only part of the system comprised of interrelating variables.

4.4 Technological Pathways

How an institution recognizes the risk of flooding, combined with the characteristics of the region, influences the orientation of responses and can limit options for response, which, in turn, may adversely affect the region's ability to respond to flood risk. As Burch (2009) explains, there has been a recent shift in technological pathway research that recognizes the role of cultures, perceptions and institutions in decision-making with regards to the type and extent of response. The purpose of this section is to present technological pathways of flood response as influenced by culture and land use, making clear connections with the way these pathways relate to response capacity to floods.

As it relates to decision-making on the type and extent of flood response, the cultural values of a region play an important role. Elected officials are representatives of the people. They make sure the wants and needs of the people are being met while ensuring that cultural values are maintained. As one participant explains, regarding the response in the City of Vancouver,

> Vancouver has traditionally had a very 'Green' attitude. You know, we are very proud of our parks and outdoor spaces, sea-wall, and Stanley Park and whatnot, so I think that carries through with flood work, that we don't want to diminish any aesthetics of our city and they want to make sure what measures are put forward are still 'Green'.

In the District of Maple Ridge, the *Official Community Plan* (2014) suggests that one of the priorities of the region is to maintain Maple Ridge's unique identity as it relates to the environment. As several participants noted, inputting infrastructure that would impinge on the values of the region, even though it would increase protection from floods, is not necessarily the best course of action. Planners and decision-makers must work together to find a solution that increases flood protection while not impinging on those values. Therefore, cultural values act as a control on response capacity as it aids in dictating how responses are developed and decided on.

Urban development is another major component influencing technological pathways of response capacity to floods. It is evident in this study that highly developed

areas with limited space to expand are more likely to have technological/infrastructure related responses as the population grows compared to areas where space for urban expansion is greater. This is not to say that highly developed areas, like the City of Vancouver, do not explore and utilize a diverse range of options that include land use planning responses, but when it comes to protecting the population and assets of the region technological solutions are more likely than social responses (see Table 14). As another participant stated,

> Some areas may not have technologies built to be clear. It is not just looking at infrastructure. The City is looking at the full range of approaches—and emergency management and response, building construction—those are all things that are definitely on the table. Planning tools are definitely on the table. For us it is a little challenging in that most of the city is built out, so retreat takes a long time.

In the District of Maple Ridge, with urban development continuing, land use planning and more socially-oriented responses are able to be included in flood management practices because the space is there to make these types of decisions. As one participant explained, they can implement the necessary infrastructure without having to remove existing infrastructure that is out-of-date or they can designate areas for different land uses in order to minimize vulnerable populations before they can become highly vulnerable based on where they live. It is in these developing areas where infrastructure design and other technological responses become the primary way to respond to mitigate risk.

Again, the argument being made here is not that highly developed areas are more likely to seek out technological responses to mitigate potential flood impacts; rather, major responses that exist in these areas are more likely to be technologically-based due to the degree of mitigation impact and the fact that infrastructure is likely already in place. It influences response capacity because it controls what response occurs and how response is developed. What is concluded in this section of the Chapter is that culture and urban characteristics can influence institutional behaviour and, therefore, responses. As Burch (2009) stated, with reference to Anderson (1998) and Arthur (1989), "the institutional and cultural contexts within which innovation occurs are of equal importance to the technologies themselves and represent path dependent trajectories, which are not easily re-oriented" (180).

Table 14: Results of Q analysis for Items 16-17

Item	Factor (factor array)
16. Response to reduce flood impacts are primarily based on technology with some social components.	Factor 1 (0) Factor 2 (-2) Factor 3 (2)
17. Responses to flooding are primarily based on social approaches (land use designations) with some technological components.	Factor 1 (0) Factor 2 (2) Factor 3 (-3)

4.5 Institutional Behaviour and Resource Management

As it has been alluded to in all previous sections of this Chapter, resources are critical to response capacity. It is through resource management that institutional responses are developed, decided on, implemented and maintained. As Mitchell (2002) defines it, resource management is "the capacity to control, handle or direct" how resources are allocated and used (6). It can include action and decisions pertaining to "money, materials, staff, and other assets that can be drawn on by a person or organization in order to function effectively" (Oxford Dictionary, 2015).

Response capacity is, in part, a function of resource availability as controlled through resource management. How resources are managed depends on institutional behaviour as dictated by priorities. With tight budgets and a host of duties to fulfill, resources within organizations have to be carefully managed. For example, municipalities in British Columbia receive 8 cents of every dollar paid to the government which is inadequate to allow municipalities to address all issues at once and develop a perfect system. As one participant states, "for municipalities to shoulder the burden of massive environmental catastrophe is very challenging. Unfortunately the way it works is that the federal government, if there is a flood, they will come and help you financially, but they will not help you prevent the damage from a flood." Municipal ability to respond is affected by the resources that they have available to them.

At times, institutions have not had the resources available to properly handle flood management responses. As several participants explained, in the District of Maple Ridge there are several dykes that need to be fixed; however, the municipality is not equipped to handle such projects. As one participant stated,

> The modelling on the Fraser River has changed. So they came out with one that said 'you have to raise the dykes by half a meter' and the next one says 'oh, well they need another half of a meter.' It's like when is it going to stop. Unfortunately, that model keeps making a worse and worse case scenario, but we are not catching up with raising the dykes. Raising the dykes in the Albion area is like a $20 million endeavor. It's not going to happen.

It exposes the reality of the situation, that the ability to respond to flood risk is a function of the available resources. Without the resources—whether it be money, materials, staff, or other assets—the ability to invest in developing, implementing and maintaining flood initiatives becomes constrained.

As another participant stated in the City of Vancouver, "I would say by far, in a way, the single biggest barrier to investment is how we are feeling about climate change which is a very hard thing to write a policy to overcome and then right after that would be just competing priorities for municipal dollars." What it comes down to is where flood management is as a priority within an organization and the available resources for any given project. The priority of flood response will dictate how much is invested.

Therefore, response capacity to floods is, in part, a function of available resources as it dictates the degree of response that can occur. As such, municipalities have to assess the risk, compare the need to act with other priorities and make a decision as to how much of their resources they can afford to spend on flood management given a flood might not even occur. It is a complex system that involves government weighing many different factors (see Chapter 5).

4.6 Conclusion

The literature review, interview data and Q analysis findings indicate that legislation, institutional behaviour, technological pathways, and resource management are major factors affecting response capacity. The jurisdiction over land, water, and environmental issues within provincial boundaries allows a province to determine a baseline response capacity to floods by mandating a precise or imprecise (or no) standard in emergency

management practices. While the province can establish a baseline response capacity to floods, institutional response capacity will vary from region to region, but the factors influencing their abilities to respond to flood risk remain consistent.

As it has been reiterated time and again in this paper, municipal governments are representatives of and for the people. Their political platforms are a reflection of the wants and needs of the public as voted on through an electoral system. As such, the priorities of local governments are a reflection of the wants, needs, and values of the public. Literature on the politics of disaster risk reduction has argued that political conflict in disaster risk reduction policy is the result of differences of stakeholders' interests, jurisdictional conflict between levels of government, and citizens as 'aggressive consumers' of policy (Prater & Lindell, 2000). In fact, some researchers assert the claim that local governments often reject adopting risk reduction strategies due to liability concerns (see Chapter 3), competing priorities, and disruption of cultural values favouring aesthetics (Prater & Lindell, 2000; Burby & French, 1981; Burby et al., 1985).

It is evident in this Chapter that institutional response capacity is a function of interacting variables. Changes to any one of these variables could impact a region's overall ability to manage risk. With limited resources, tight budgets, many responsibilities, changing environmental conditions and urban growth, understanding the interactions that affect institutional response capacity remains an important aspect of flood response and research. As one participant noted on flood management practices in the District of Maple Ridge,

> I think one of the biggest issues related to flooding is the limited resources and attention given by senior governments to the issue and more and more downloading the responsibility to local governments with their limited resources, time and talents for such a task. Maple Ridge is influenced by a number local rivers that in themselves have significant flood issues that are not well understood or documented. The occurrences of significant storm events is increasing significantly each year. It is not uncommon now in any winter to experience not just one but multiple 1 in 100 year storm events. Development continues to be allowed in the region on all flood plain protected by dykes that are both public and privately managed, some of which are probably inadequate to the task.

It is evident that there are clearly some issues between levels of government, each having limited resources that impact the effective management of risk. The questions now become: when does response capacity lead to action knowing that it is, in large part,

controlled by competing priorities and resource management; and how can response capacity to floods increase so that the effectiveness of flood management in regions can too increase?

5 Municipal Priorities Dictating Flood Response

5.1 Introduction

To recall, response capacity to floods, exceeding baseline requirements, is a function of institutional behaviour, collective action, technological pathways and resource management; however, having a high response capacity does not necessarily lead to action. Action is the result of institutional behaviour as dictated by competing priorities within an organization or institution. The priority that an issue is given by the organization or institution will determine whether or not action takes place. If an issue is recognized as needing action that exceeds the minimum requirements set in legislation then the degree of action will depend on how the need for action for this priority compares to other priorities as prioritization will determine the amount of resources allocated.

Institutions and organizations have a responsibility to their stakeholders. For many organizations, that responsibility is to maximize revenues for the benefit of investors and the company (Jones, 2001). For municipalities, their responsibilities and duties are vast, requiring decision-makers to evaluate the wants and needs of the city and their individual objectives in determining the appropriate course of action. Evidence from the literature review, interview data and Q analysis shows that competing priorities act as a control mechanism for action in terms of timing, resource management and response capacity. Establishing priorities within these institutions is complex, involving many interacting variables. It is through public concerns and advocacy, risk, vulnerability and uncertainty, politics and collective agreements, that municipal priorities are influenced and the degree of action is determined.

In Chapter 3, it is evident that responsibility and liability exposure have influenced decision-making in emergency management and, subsequently, flood management. In Chapter 4, evidence from this research and others is presented to discuss factors influencing response capacity, including institutional behaviour through competing priorities. What remains absent in these chapters are the factors which influence institutional priorities

requiring action that exceeds minimum requirements. As responsibility and liability in emergency management have already been discussed in Chapter 3, and collective agreements in mandating institutional attention were discussed in Chapter 4[9], the emphasis of this Chapter is on additional factors influencing institutional priorities that, ultimately, dictate action beyond baseline requirements and collective agreements. In this Chapter, this paper argues that flood response is, in part, a function of resource management that is determined by institutional priorities. The purpose of this Chapter is to identify and discuss:

1. The role of the public in setting municipal priorities through cultural values and collective action;
2. The link between uncertainty, risk and vulnerability in establishing municipal priorities; and
3. The influence of politics and re-election on investment in and focus on flood management.

5.2 The Role of the Public

One of the most critical factors influencing institutional priorities is public advocacy for action. Public behaviour has the ability to influence policy and practices through collective action. High advocacy on an issue can force institutions to examine their current position on the matter and re-evaluate their approach. Past research suggests that collective action in the public sphere can affect environmental management by influencing public policies through environmental citizenship and the support or acceptance of public policies (Stern, 2002; Jamison, 2010). As Stern (2002) notes, individual behaviour for action is less influential on public policies and practices than collective movements. The author further notes that the influence on public policies and practices can change the behaviour of individuals, groups and organizations.

In Canada, municipalities are representatives of the people and operate in the interests of their community's wants, needs and values. As such, the public can aid in establishing municipal priorities through collective action. By pressuring practitioners and

[9] See pages 79 & 80 of Chapter 4, *Development Pathways of Response Capacity to Floods*.

government, action can be facilitated by mandating priorities. In fact, current investment in and focus on floods in the City of Vancouver and District of Maple Ridge are, in part, the result of the public's concern for the need for action. As one participant explains, "[the City of Vancouver] routinely gets in the high 80 percentage points for support on the *Greenest City Action Plan* and climate adaptation is even higher than that still, so obviously it is something people want to see the City working to address."

The results of the Q analysis reinforce this position as Factors 1 and 2 view public concern and advocacy for flood management as a major driver for action exceeding provincial and federal legislation (Item 2). Factor 3 yielded a score of -1, which suggests that the overall influence of public concern/advocacy for action has less influence on developing and implementing flood response than other drivers. This is not to say that the collective action on flood response has no influence on action in the view of this group, but that it tends not to be the dominant influencing driver. In fact, all interviewed participants and Factors of the Q analysis suggest that greater public pressure on practitioners and government will lead to more successful flood management practices (see Table 15).

Table 15: Results of Q analysis for Items 2, 8, 11 & 19

Item	Factor (factor array)
2. The major driver for developing and implementing flood management initiatives exceeding provincial and federal legislation is public concern/advocacy for flood management.	Factor 1 (2) Factor 2 (2) Factor 3 (-1)
8. Successful flood management is dependent on or will increase with public pressure on local practitioners and on government for increased action.	Factor 1 (2) Factor 2 (1) Factor 3 (2)
11. Success of flood management is dependent on or will increase with having an engaged community and a community voicing their concerns towards flooding.	Factor 1 (4) Factor 2 (3) Factor 3 (2)

19. The public/community is not or has not expressed concerns about flooding since the 2010 election.	Factor 1 (-3) Factor 2 (-3) Factor 3 (-2)

Even so, as this paper has noted previously, institutions, including municipalities, have to balance resources with many responsibilities and other priorities. As a result, what the public views as the most pressing issues requiring immediate attention will be given higher priority, which affects investment in and focus on other priorities, including flood management. As one interviewed participant stated regarding competing priorities and operating in the District of Maple Ridge,

> It definitely has an impact. You know we've got the Golden Ears Park up here, one of the busiest parks in the lower mainland during the summer. You are stupid to do any road work on the way to the park during the summer. […] You have all this traffic. Thursday is the worst day. That is the mother with the kids screaming, pulling the fifth wheel up there to get a campsite. Don't even think about working on the way to the park on Thursday.

It is evident here that competing priorities have the ability to inhibit action, not just through investment in or focus on, but when and where action can take place which is controlled, at least in part, by the public.

Priorities are not a constant, rather they shift over time. What the public values affects the priorities of government. As priorities shift, investment in and focus on such priorities will also shift. As another participant explains regarding the District of Maple Ridge,

> What is a priority one year is not necessarily a priority the next. Priorities shift. Right now, I think we are more focused than we were on economic sustainability [which] relies on having a healthy local economy. […] The creation of local jobs is a huge part of what we need to do to help our environment. […] The priority is to build a balance, healthy, sustainable community. What we need to do at any given time changes to try and hit that target. Where our needs are and where our gaps are changes. It changes with the economy. It changes with the reality.

In the City of Vancouver, participants emphasized when the public's concern for flood action is highest and when their voices are the loudest on the issue. Financially, flood management is a high priority according to participants, but as a day-to-day matter that

people worry about, it is not something that people are very concerned with. As one participant stated, "People worry about: how much they are paying for housing; are their children looked after; are they going to a job during the day or school or whatever it is that they want to be; increasingly, are my parents looked after if they are seniors; and then transit." When it comes to flood management, "people tend not to prioritize things that are working well even though they may value it."

In the District of Maple Ridge, several interviewed participants noted that public concern over flooding remains minimal and that it is only after the Fraser River water levels are high that a few people start to initiate discussion with the City. In fact, these participants argued that public concern and advocacy for flood management tended to be highest when a flood in the area had occurred and, ultimately, this has affected the behaviour of the municipality. The municipality's attention to and investment have fluctuated with the public's stance on the issue.

Attention to public problems increase when events exploit failures in practice (True et al., 2008; Baumgartner & Jones, 1993; Light, 1982; Walker, 1977). Such an incident is known as a 'focusing event'. As Birkland (1998) explains, a focusing event is an event that is sudden, relatively uncommon, defined as harmful or has the possibility to be harmful, and is known to the public and policy-makers simultaneously. Past research by Baumgartner & Jones (1993) and others have found that following a focusing event, interest groups, government leaders, media and/or members of the public pay greater attention to problems that highlight a failure of policy for the purpose of developing an active search for solutions that would lead to policy change (Birkland, 1998).

Concern over issues become something that the public prioritizes when a perceived threat becomes a reality. Consistent with findings made by Baumgartner & Jones (1993), Kingdon (1995) and Birkland (1998), interviewed participants in this study stated that following the 2008 flood, there was greater public concern and advocacy for better flood management practices. Although attention to flood management dissipated over a short period and focus on flood management in government shifted in response to the public's concern, it is evident that it was not until a perceived threat became a reality that public scrutiny over the governance of that issue was brought to bear. Focusing events have an impact on institutional priorities as stakeholders want to be protected and the failure of

existing policy and practices show the public that their needs are not being met to the degree of satisfaction that they require. It is when these events occur that the public's voices tend to be loudest. This is not to say that flood response is not a priority currently within these institutions; rather, the focus on and investment in flood response tends to be partially reflective of the public's behaviour.

Municipal priorities, therefore, are a function of the public's behaviour on issues. When the public is able to see first-hand what issues are present in the community, their advocacy on those issues tends to be higher. This is fundamental to understanding why public concern on flood action is typically at its highest following a focusing event. The reality is that the public does not necessarily know or recognize their vulnerability until a disaster happens because it becomes difficult to analyze the effectiveness of current practices and policy without an event. Without the direct impacts being visible to the public, their behaviour on the issue tends to be reduced and so does focus on flooding within government. Therefore, what can be concluded from the data is that collective action can facilitate or inhibit action by controlling competing priorities and, thus, resource management.

5.3 Risk, Vulnerability and Uncertainty

5.3.1 Risk and Vulnerability

The second major factor influencing municipal prioritization of flood action that will be discussed in this Chapter is risk and vulnerability to a flood event. Risk is often referred to as the product of a hazard's probability of occurrence and its consequences (Birkmann, 2007). As Birkmann (2007) explains, "risk can be viewed as a function of the hazard event and the vulnerability of the elements exposed" (21). Vulnerability, as defined earlier as "the potential for loss" (Cutter, 1996, 529), can be viewed as an inherent characteristic of a system (Birkmann, 2007). Together, risk and vulnerability are integral in disaster risk reduction action as they provide the foundation warranting action. Without risk or vulnerability action is not necessary. As the findings from this research will show, questions surrounding whether or not risk and vulnerability exist remain absent; however, the question becomes whether or not the risk and vulnerability present warrant action. As one participant noted,

> The two big factors [for action] are the likelihood of something happening and severity/repercussions/downside if it does happen. Low likelihood and severity then we do not have to worry about it. If it is a high-high then it is a no brainer, we have deal with it. It is when you get that low-high mix that we get differences in opinions.

It is up to decision-makers to evaluate the region's risk and vulnerability, knowing that high risk does not necessarily mean high vulnerability, and determine whether the current risk and vulnerability is acceptable to not act or should immediate action take place and, if so, the degree of that action.

The results of the Q analysis suggests that the risk of climate change and its disaster-related effects on people and the economy motivates municipalities to address disaster risk reduction. Factors 1 and 3's scores for Item 1 and Item 3 suggest an association between risk and action (see Table 16). In the City of Vancouver, interviewed participants argued that by knowing that various models suggest the region is vulnerable to flooding caused, primarily, by sea-level rise and more frequent and intense storm surges as the result of climate change has motivated the City to act. In part, it facilitates action by making flood management a municipal priority. These interviewed participants went further in suggesting that climate change and its potential impacts are the most influential drivers in promoting action beyond provincial and federal legislation.

In the District of Maple Ridge, interviewed participants sported the claim that the risk of a flood event is a major driver for action. They argued that safety of the public is the most important priority when it comes to flooding. The fact that there is risk of flooding which ultimately poses a threat to the safety and well-being of the population puts flood management on the political agenda. As one participant explained, "People sleeping in bed drowning is not a good scenario. A business getting wet at night, okay, yeah a lot of money but less life. Life is high on the list; property not as high. So it really helps with prioritizing."

Table 16: Results of Q analysis for Items 1 & 3

Item	Factor (factor array)
1. The major driver for developing and implementing flood management initiatives exceeding provincial and federal legislation is climate change and impacts from storm surges, sea-level rise, and/or spring snowmelt.	Factor 1 (4) Factor 2 (-3) Factor 3 (2)
3. The major driver for developing and implementing flood management initiatives exceeding provincial and federal legislation is the potential economic impact that a flood could have on the city or business.	Factor 1 (2) Factor 2 (3) Factor 3 (2)

Institutions will use a number of tools to aid discussions surrounding risk, vulnerability and action, including forecasting models, history, and risk and vulnerability assessments. The use of forecasting models and the history of flood events in the region have assisted discussions surrounding the need for action. For example, the District of Maple Ridge is further inland and, thus, does not have to worry about overland flow encroaching as the result of sea-level rise. Instead, focus has been on the annual freshet snowmelt further up the Fraser River and potential severe weather-related events. Historically, the area has not experienced a major flood event since 1948 (200 year event). As several participants explained, this has been used to fuel differences in opinion among decision-makers regarding the likelihood of a major flood event happening, the severity of that potential event and, thus, the need for action. In the City of Vancouver, the municipality's *Climate Change Adaptation Strategy* (2012) set out a need to conduct a coastal flood risk assessment, including the types and severity of impacts that would likely occur through storm surge and sea-level rise. Through this assessment the municipality has recognized that the results of various models and extreme scenarios present a range of risk to the region for which the costs to not act, given that these models are correct, is too great. With the population of the city growing, emphasis on protecting the public in the event of a flood has become a priority.

In both study locations, the use of forecasting models and the history of floods in the region have been critical in determining flood action. Where these two regions' approaches differ is in the value that forecasting models versus the history of floods in the area have on local flood response. The City of Vancouver emphasized forecasting models as the main motivation for local response, whereas the District of Maple Ridge, although they value and use forecasting models in their approach, the history of floods in the area has weighed more heavily in the attention and investment in flood response. Although the actual degree to which each of these tools influenced decision-making on flood action remains incomplete here, it is evident that risk and vulnerability are being measured to determine if action is needed.

5.3.2 Uncertainty

The other major component influencing priorities and action as it relates to risk and vulnerability is centered on uncertainty. The uncertainty of when and where an event will occur and the intensity of the event is integral to decision-makers in prioritizing issues. Decision-makers examine uncertainty to assess the degree of risk requiring action and whether or not action can be delayed. As one participant stated,

> Uncertainty is more around the details and stuff and I don't think municipalities care so much about the fact that we don't know whether sea-levels are going to rise by 20 centimeters or 30 centimeters—that's not the uncertainty. The uncertainty that concerns municipalities in terms of their lack of action is we don't know when it is going to happen or where it is going to occur; that is the bigger issue for municipalities.

As other interviewed participants explained, uncertainty leads to differences in opinions in terms of whether or not to act, where to act and how to act. As Donahue and Joyce (2001) argue, local governments worry about existing issues; the uncertainty of future events and the limited financial resources inhibit municipal action in developing, discussing, and implementing solutions to concerns, such as flooding. Reinforcing these findings, the results of the Q analysis shows that uncertainty does affect investment in flood management initiatives (see Table 17). With greater uncertainty, participants argued that flood management becomes less of a priority than issues where the impacts can already be seen or are more readily apparent. Similar to the argument made in the previous section on public behaviour, it is not until a disaster occurs that municipalities focus more on flood

action. As the quoted participant above further stated, “It is not a priority until it is happening and then it is too late.”

Table 17: Results of Q analysis for Item 20

Item	Factor (factor array)
20. The uncertainty of floods—in terms of when, where and intensity—and frequent changes to recommendations on how to reduce impacts of flooding deter investment in flood management and more towards other high priority projects.	Factor 1 (1) Factor 2 (2) Factor 3 (2)

Risk and vulnerability are integral to prioritizing issues in a municipality. They act as drivers for and controls on action that interact with a number of variables. For action to result, municipalities must recognize that the risk of an event and the vulnerability to its impacts are great enough to cause action—that a threshold for acceptable risk without action has been breached. As described by participants, this is usually determined through cost-benefit analyses, but other information tools are clearly evident in the decision-making process. Although municipal focus on floods tends to be highest when risk becomes a reality, it has not prevented action in the absence of an event in the City of Vancouver and District of Maple Ridge. It is clear in these two cities that proactive measures are being taken in the event that a flood may occur. It has been recognized by the municipalities that the choice to not act could be detrimental to the city and its citizens. Therefore, municipal priority-setting is, in part, a balancing of risk, vulnerability and uncertainty. With greater risk and vulnerability, issues tend to be a higher priority. The question now becomes what is the role of decision-makers in priority-setting, given their personal goals/objectives.

5.4 Politics and Prioritizing Flood Action

5.4.1 Political Cycle

In British Columbia, local elections for mayor and council have to be held every four years as required under the *Local Government Act*. Elections are a time for municipal leaders to raise awareness on the concerns of the public and address their plans to ensure that the

wants, needs and values of the public are kept. During the time of election, however, emphasis on flood management in campaigning tends to be pushed aside. Despite flood management being a high priority, during 'election season' candidates' campaign on other issues where evidence of their past success on other relevant issues can be seen or on issues where there is the greatest ongoing debate. As one participant explains, there is little emphasis on flood management in campaigning, in part, because "nobody cares" about how much is spent on flood management even though the "single largest allocation in the *Capital Plan* is flood management related." This participant further stated, "people will argue over the $3 million for whatever bike related infrastructure is in [the *Capital Plan*], but the $325 million for the sewage upgrades is like 'meh. Whatever. Fine. Sure.'" The reality is candidates focus on the issues where there is the greatest public debate because these are the issues that the public really wants something to be done and it is what will determine winners in elections. Why campaign about the problems of the current flood management policy and practices if the public does not think that the system is broken?

In the District of Maple Ridge, a participant viewed the current flood management system as successful, emphasizing the major issues in the area relate to post-secondary education, mental health and policing. Another participant discussed tourism and that dyke maintenance is done in advance of the "busy season" in coordination with park managers because the tourism industry is a high economic priority in the area. A third participant argued that work on flood management is really controlled by shifting politics as it determines the amount of resources that will be allocated to fund different projects. In all three interviews, emphasis was on the effects of competing priorities which take away from the need for and investment in flood management; instead, the emphasis rests on the key issues being debated.

As was described earlier, public awareness and advocacy for more focus on and investment in flood management is highest post-disaster—also known as a focusing event (True et al., 2008; Jensen, 2010; Green-Pedersen, 2007; Green-Pedersen & Krogstrup, 2008). This is due in large part to the realization by the public that the current emergency management system is 'flawed' and 'should be' better; however, it escapes most political campaigns in the absence of these events because it is not until an event occurs that the effectiveness of the emergency management system can really be evaluated and used to

promote or leverage a candidate's campaign. In the Q-sort of this study, participants were asked to provide their view on the dependency of flood management action in relation to the political cycle (Item 10). The results can be seen in Table 18 below. All three Factors viewed the political cycle as having an influence on flood management action. It supports the claims made by interviewed participants—that flood management falls into the background at certain times in political cycles, most notably during elections, and that the politics of re-election is a reflection of other municipal priorities.

Table 18: Results of Q analysis of Item 10

Item	Factor (factor array)
10. Flood management initiatives are dependent on the political cycle.	Factor 1 (1) Factor 2 (2) Factor 3 (4)

5.4.2 Champions for Action

The downloading of responsibility and acceptance of that responsibility for emergency management by municipal governments are critical in establishing municipal priorities. Although municipalities are required to address emergency management under the *Emergency Program Act*, response exceeding provincial legislation is directly affected by the degree of willingness to accept that responsibility. A municipal government's unwillingness to accept responsibility for emergency and flood management translates into resources allocated to address the matter only to what is necessary to meet minimum requirements. As the majority of interviewed participants noted, flood management action is highly dependent on council recognizing that flooding is an issue that needs to be addressed, even if the view is that efforts to mitigate flood risk should be the province's responsibility. As one participant stated, "it really does come down to 1 or 2 champions, whether it is citizen champions or someone on staff, who decides this is their issue." If a municipal government does not recognize that flooding is their responsibility, then the resources allocated to address it will be minimal.

In the City of Vancouver, interviewed participants noted that it was council's acceptance of the need for climate change adaptation and, subsequently, flood management that has increased action. By accepting that responsibility and investing in flood management, the municipal government prioritizes the issue. As the four interviewed participants in the City of Vancouver argued, residents in the city have been concerned about the environment, their natural environment, and, increasingly, toxins and climate, which has translated into municipal action. From the municipality's perspective, these are issues that the public wants to see their government working on. The government's willingness to accept an issue as their responsibility makes it a priority in the region. Again, this returns to the public's behaviour in establishing municipal priorities, but what is being noted here is that there is a relationship that exists between the public behaviour and politics.

In the District of Maple Ridge, several participants concurred with the above argument, stating that the council's willingness to accept responsibility for a potential threat to the city is fundamental to municipal priority-setting and, thus, resource management. What became evident in these interviews is that changes in government have resulted in a fluctuation in government focus on and investment in flood management over time as different players have different objectives and political platforms. Where the District of Maple Ridge differs from the City of Vancouver is in the recognition and acceptance that the current flood management system needs to be revised. Contradictory views were expressed by several participants in the District of Maple Ridge with respect to the need to invest more and pay greater attention to the changing environmental conditions to which the area will be exposed. One participant went as far as to say that the current state of flood management in the District of Maple Ridge is good because they have not experienced a flood in a long period of time, but where the major issues of the area are is in post-secondary education and mental illness. This is consistent with the views expressed by other participants in the area that although they believe that there is a need for greater attention and investment in flood management, they perceive that others in management within various organizations, businesses, and the municipality do not necessarily agree and this can be seen in the area's current response. As changes in government, including staff, occurred, municipal priorities have been affected. These changes did not and do not occur overnight, but took and continue to take, at least, months

to years of restructuring. Such changes are a reflection of changes in public behaviour that translate into political will.

5.5 Conclusion

Competing priorities are the foundation for institutional resource management. Legal responsibility and liability (Chapter 3), collective agreements (Chapter 4), public behaviour, risk, vulnerability and uncertainty, and the politics of municipal governance are factors affecting decision-making with regards to action on municipal priorities. Together, they interact to inform decision-makers as to what degree of response is necessary on any given issue. The complexity of balancing resources and priorities in government makes it difficult to assess the thresholds and the degree of influence that each factor affects action in relation to one another.

In the City of Vancouver and the District of Maple Ridge, participants viewed their flood management response as being highly dependent on public concern and advocacy for action, council recognizing that the costs not to act breaches the threshold of acceptable risk, and champions in government or through external institutions who take the lead on flood management. The evidence presented in this Chapter has suggested that public advocacy for action is reduced, most notably during 'election season' and in the long absence of an extreme event. Although this is not to say that flood management is not a municipal priority, interviewed participants have noted that attention to and investment in flood response has faded in the past as a result. Therefore, increasing the awareness of the issues and increasing municipal response is critical to flood management.

Past research (Birkland, 1998; Jensen, 2010; True et al., 2008) has shown that municipal response tends to be highest in the immediate aftermath of a disaster, forcing municipalities to (re)engage in the environmental stressors that face their region. Some have argued that focusing events are necessary to facilitate action. As one participant explained, to re-engage municipalities in greater flood management practices another flood event is needed because "at the end of the day that is what really motivates municipalities to change." It shows the failure of existing policy and practices, and thereby changes public behaviour, and translates into municipal action.

The premise of social movement theory is that socio-cultural characteristics influence the collective behaviour of citizens guiding the decisions and behaviour of institutions (Passy, 2003). The success of such movements are rooted through networks; the more networks connected to the socio-cultural characteristics of the region has resulted in a greater turnover (Diani and McAdam, 2003). As Passy (2003) explains, people participate in social movements because they "share certain norms and values" that are related to a political disagreement. In these instances social movements provide an outlet for the collective voice of a subset of the population, providing individuals with an identity or a sense of purpose (Freeman, 1973; Morris, 1984; Andrews, 1991; and Melucci, 1996). The networks aid in the development of an identity by acting as the forum through which groups of people can express their views and they reinforce these identities by reaffirming individuals that their views are representative of the movement. By creating a collective identity through networks, social movements grow in numbers and strength (Passy, 2003).

As Tilly & Wood (2013) explain, social movements are the result of multiple stressors which often have negative implications infringing on the human rights of a group of individuals. These authors explain that, historically, when human rights have been violated, activism leads to correcting/replacing the instigating body with one that meets the wants and needs of the community. By raising the issue to the municipality for a better management system, the public has expressed to the institution their expectations which in turn forces the institution address the issue.

This process can lead to a socio-technological regime shift as institutions recognize that the current system is undesirable as evidenced by the outcome of an event, and that the culture may have changed by the event to value greater environmental management. It may lead to greater investment in flood management technological innovation or even the adoption of a system that has been employed elsewhere. In the City of Vancouver, the municipality adopted a sustainable adaptive framework developed by ICLEI (Local Governments for Sustainability). They recognized a need for a different climate change adaptation system, which includes flood response, and they are making that transition to a new socio-technological regime.

Therefore, there is a relationship that exists between the factors presented in this Chapter regarding institutional behaviour and the dynamic interaction that physical change

and technological systems have with each other, as Hadfield & Seaton's (1999) environmental management model suggests (Figure 10). In this Chapter, it was evident that factors affecting municipal priorities are diverse and range from forces within institutions to external pressures. Although major contributors to action have been discussed and analyzed in the Chapter, questions surrounding how to increase an institution's ability to manage flood risk becomes a main point of discussion for flood response policy and practice.

6 Mechanisms to Increase Response Capacity

6.1 Introduction

While the ability to respond to flood risk is dependent on a number of components, including resources, institutional behaviour and collective action, and technological pathways, attention to approaches that would enhance an organization or institution's ability to respond to flood risk is critical in flood response research. Evidence from the research conducted shows that tight budgets and limited resources, combined with limited knowledge and disconnect internally among organizations and levels of government can inhibit response capacity to floods. Together, they act as barriers to response capacity. As such, future flood management response will depend on minimizing these barriers so that an organization or institution can increase its response capacity to floods.

The purpose of this Chapter is to identify and discuss mechanisms—as identified by participants—that have the potential to increase the response capacity of an organization or institution. Resource efficiency, increasing cohesion through greater communication and interdisciplinary collaboration, shared responsibility and management, and utilizing an adaptive framework for flood response are mechanisms viewed by participants that could have this effect on response capacity to floods and will be discussed in this Chapter. This Chapter does not focus on the 'how to' develop an adaptive framework or increase cohesion through interdisciplinary collaboration as that is an area of further research that goes beyond the scope of this research; rather, this Chapter provides a simple explanation of four mechanisms that have the potential to enhance response capacity.

6.2 Resource Efficiency and Interdisciplinary Collaboration

Resource efficiency is a term focused on production and consumption patterns of a system. It emphasizes maximizing a system's output while minimizing input in a sustainable way (Huselid, 1995). It does not mean that a system is increasing its means of production; rather that the system is increasing the value of every input into the system. A number studies that have focused on strategies that have potential for significant cost-savings (Arney et al., 1998; Clinch & Healy, 2000) have been recognized since the early 1970s (Delmas & Pekovic, 2015). Efficient use of human capital, social capital, financial capital and materials can increase a system's output and allow for more investment in any given project within that system. Emphasis is on how to maximize the output of these resources.

In this study, the majority of those interviewed and Q sort participants argued that increasing resource efficiency is integral to the success of flood response (see Table 19). One participant strongly disagreed with this argument, indicating a score of -4, consistent with the view of Factor 2. One other participant did not provide a positive score to Item 9, indicating that the participant neither agreed nor disagreed or was unsure whether or not resource efficiency is important to the success of flood response. Although there was not 100% agreement in the Q analysis regarding Item 9, two important conclusions can be made. First, most participants view resource efficiency as it relates to resource management as being influential to the success of a system's flood response; and second, cross-sector communication may be able increase resource efficiency through proper coordination with other projects. With overlapping projects, such as upgrading sewers and road infrastructure, time and financial capital can be conserved by efficiently using resources that would otherwise be used separately and drain resources more quickly. [10]

[10] Evidence of the latter's effectiveness in flood response remains incomplete and is recognized here as such. Further research and more data would be needed to provide a definitive, in-depth analysis of this claim. Therefore, it stands in this report as a hypothesis.

Table 19: Results of Q analysis for Item 9

Item	Factor (factor array)
9. Success of flood management is dependent on or will increase with efficient use of resources such as working in tandem with other projects. For example, updating existing infrastructure at the same time as doing road work.	Factor 1 (2) Factor 2 (-1) Factor 3 (4)

As Chapter 4 notes, group cohesion can affect response capacity by increasing or decreasing an institution's ability to respond to flood risk depending on whether or not strong cohesion exists. As Huselid (1995) explains, human resource management policies and practices can impact a firm's performance. This author argues that High Performance Work Practices "can improve knowledge, skills, and abilities of a firm's current and potential employees, increase their motivation, reduce shirking, and enhance retention of quality employees while encouraging non-performers to leave the firm" (Huselid, 1995, 635; Jones & Wright, 1992). They have the ability to affect group cohesion within an institution as actors within these institutions work together toward a common goal. By regulating who is working on what and the communication among staff and departments, response capacity is ultimately affected because it affects the ability to develop and execute plans (Begin, 1991; Butler, Ferris & Napier, 1991; Wright & McMahan, 1992, 2011).

According to the IPCC (2014b), leadership, staffing and skill development affect institutional capacity to respond to risk. Beyond recognizing flooding as an issue needing action (see Chapters 4 and 5; Anguelovski & Carmin, 2011; Carmin et al., 2012), an interdisciplinary approach to flood response is necessary for greater institutional response capacity. The dynamic human-environment interactions require environmental problems to be understood as complex and, as such, they extend beyond any one discipline's knowledge. To understand the complexity, Lubchenco (1998) argued that an integration of knowledge from many disciplines is necessary. Kinzig (2001) argues that non-interdisciplinary approaches to such complex problems limit the capability to respond to a problem. Taking an interdisciplinary approach to complex environmental issues like

flooding by including policymakers, scientists, managers, and other stakeholders, essentially 'opens the door' to more possible solutions to address a given problem. It increases the collaboration and communication that takes place among disciplines.

These arguments are consistent with the views of interviewed participants in the City of Vancouver and District of Maple Ridge. In the City of Vancouver, one participant notes, "where the City has had great success with the *Greenest City Plan* is because the departments have figured out how to work collaboratively together." This participant argued that other projects that have been done in the past or are currently being done do not have the same degree of collaboration which has translated into the degree of success of that project. Therefore, by working together towards a common goal and recognizing individual limitations in accomplishing that goal, the ability to respond can be affected.

More broadly, establishing an environmental focal point or office in an institution or organization can aid in coordinating action across departments and agencies (IPCC, 2014a; Roberts, 2008, 2010; Anguelovski & Carmin, 2011; Hunt & Watkiss, 2011; OECD, 2011; Brown et al., 2012). When dealing with the complexity of environmental issues, responsibility can become blurred within an institution on as basic a principle as who is to take the lead on an issue, including flooding. Is it a problem needing an engineering solution or is it a problem needing an urban planning solution or is it a problem needing both and, if so, who should take the lead and who should be held responsible given that an event occurs and exposes a system's failure? As one participant stated, "often times in government what you will see across departments is 'I don't want to get stuck holding that bag so I am not going to step up for this, so you do it' and everybody else has the same thoughts, so nobody actually gets around to doing it." Having a specific department as the focal point in an institution with a clear mandate outlined can increase response capacity because it establishes overarching responsibilities that cannot be diverted to other departments. It creates a lead for action and clears any confusion as to which department is responsible.

Therefore, the ability to respond to risk can be expected to improve with an established focal point from which action stems together with an interdisciplinary approach with appropriate staff involved. In the City of Vancouver, the City has a Sustainability Department which is responsible for climate change adaptation. This department is the

focal point for flood action within this institution. They have mandated responsibilities by the municipal government to focus on these issues. Responsibility within this institution is clear. This department is known to be working with multiple stakeholders and consulting with other departments to develop a flood management system that is designed to better protect the city's population and assets (see City of Vancouver's *Climate Change Adaptation Strategy*, 2013). As participants in both the City of Vancouver and District of Maple Ridge noted, this communication among departments and stakeholders is critical to establishing an interdisciplinary framework for flood response and can be indicative of an institution's response capacity as it pertains to cohesion, collaboration and leadership.

In the District of Maple Ridge, Planning, Engineering, Operations, and Emergency Services are City departments that have a role in flood response. Together, they make up the institution's flood response and share responsibility. Participants have noted that the fragmented structure of the institution can influence the flood response system, but especially critical to flood response is the interdisciplinary communication that takes place between these departments and with external stakeholders.

Therefore, it is important to increase response capacity to floods in an institution by fostering an environment of increased cohesiveness of the actors involved and by maintaining an interdisciplinary network. Focus on enhancing social networks among internal and external stakeholders and managing human capital effectively is viewed by participants as important to being able to increase response capacity as it grants access to more resources that can be used to aid the development and execution of response strategies. Knowing that municipal resources are limited and budgets are tight, maximizing the input value into a project can relieve stress to the system and enhance the system's performance.

6.3 Co-Management and Collaborative Management

One of the other major focus points from participants as it relates to increasing response capacity is through increased intergovernmental collaboration and having shared responsibility for flood response. This is not to say that should an event happen, failure of policy and practice is shared; rather, the investment in flood management should be shared among levels of government. As it stands now, municipalities are solely responsible for

developing an emergency management plan (see Chapter 3) and the implementation of that plan is dependent on municipal resources (see Chapters 4 & 5). The province's role is more of an informative one with assistance being provided should an event occur, but it is not something that they plan and practice for on a day-to-day basis. As one participant describes it,

> They think of it as something you plan for and practice for, but they don't really think about the day-to-day integration of it. It is like, Cities have to make sure that every soccer player, every baseball player, anyone who wants to do a sport today can do that, and tomorrow and the day after and the day after. The province is more like 'breakup', right. So they are like 'put on the big spectacle and then everybody goes home and then we will do it again next year', and that is kind of how their approach to emergency management is. I get the sense that should there be some big disaster they would actually do a reasonably good job for the first sort of 72 hours to maybe week and then we are kind of on our own.

The main issue in emergency and subsequent flood management is a lack of resources and capacity to address the issues. As the Organization for Economic Co-operation and Development (OECD, 2010) noted, approximately 70% of public spending in urban areas is the responsibility of local governments. Carmin et al. (2012) found that approximately 60% of local governments are not receiving any financial support for climate change adaptation, which includes emergency management preparation. As participants noted in this study, it can be difficult to receive financial support for emergency preparation or disaster risk reduction efforts; financial support is often reactive after the results of a disaster are known or are occurring and it is for the purpose of rebounding back to the original state. As the IPCC (2014b) further notes, large cities that have administrative capacity and strong economies best attract external funding. This leaves smaller cities more vulnerable to be stuck with the burden of funding projects with no assistance and as this paper has noted several times, the capacity to respond to risk is highly dependent on having those resources.

Co-management and collaborative management contemplates management techniques "conveying the sharing of rights and responsibilities by the government and civil society" (Plummer & FitzGibbon, 2004, 63). Collaborative forms of management are increasingly appealing to policymakers and decision-makers because learning and innovation is likely to occur through meaningful interactions where uncertainty exists

(Armitage, Berkes & Doubleday, 2007). Co-management techniques are appealing because they include more efficient, appropriate and equitable governance and they can improve processes and functions of management (Armitage, Berkes & Doubleday, 2007). As Pinkerton (1989) notes, co-management may enhance data gathering, logistical decisions, allocation decisions, protection of resources from environmental damage, regulation enforcement, long-term planning, and more inclusive decision-making.

For emergency management, including flood management, Henstra (2013) argues that "management requires authority and resources from all levels of government as well as collaboration with stakeholders from the private and voluntary sector." The latter half of that argument is not in dispute. Evidence in the previous section shows the necessity for collaboration with stakeholders from industry and civil society. For the former, evidence in this study shows that government assistance and responsibility beyond the municipality remains minimal. It is clear that both the province and the federal government are involved in emergency management, but whether or not the degree of involvement is adequate could be debated.

In this study, interviewed participants, particularly in the District of Maple Ridge, indicated that flood management of the Fraser River should be the responsibility of the BC government because it crosses municipal boundaries and the scope of managing the system within the municipal boundaries is too great for any one municipality to handle. In the Q analysis, the majority of participants felt that the provincial and/or federal governments should have some responsibility to financially assist municipalities in flood management (see Table 20). Factor 1's score of 0 does not indicate disagreement with this finding. In fact, only one participant in the Q study assigned a negative value (-2) to Item 18 and two others gave a value of 0. Overall, the results indicate that participants' view that the provincial and federal governments should have an increased role in flood management policy and practice than is currently the practice. The results of the Q analysis are consistent with views expressed by interviewed participants in the District of Maple Ridge and three of four in the City of Vancouver. Participants of the Q analysis further expressed their position on future flood management success (see Table 20). All but one participant gave a value greater than 0 and the other participant gave a value of 0 on Item 22. The concepts

of co-management and collaborative management appealed to these participants as the appropriate direction for future flood response practice.

Table 20: Results of Q analysis for Items 18 & 22

Item	Factor (factor array)
18. The Provincial and/or Federal Government should be taking the lead on flood management, including the financing of flood management initiatives being done at the local level by either the municipality or local practitioners.	Factor 1 (0) Factor 2 (4) Factor 3 (4)
22. Future flood management is dependent on increasing communication and collaboration between different levels of government to work together and share the responsibility of flood management.	Factor 1 (2) Factor 2 (4) Factor 3 (2)

In the City of Vancouver and the District of Maple Ridge, it is clear that collaborative management is characteristic of their flood management approach. Their interactions with stakeholders inform decision-making and reflect existing flood response policy and practices. Evidence in this study suggests that emergency and flood management practice is less co-managed than is desired. Shared responsibility and greater input into an emergency management system would increase response capacity because co-management of emergency management would increase municipal access to external resources. One of the challenges to co-management with provincial and federal governments in the context of emergency management is whether or not it is feasible to provide all municipalities with access to provincial and federal resources. In other words, what would intergovernmental co-management of emergency management look like?

Increased communication and collaboration with stakeholders, other municipalities and among levels of government could lead to greater response capacity as it relates to increasing group cohesion among multiple actors and access to external resources. How to achieve this is beyond the scope of this research and should be explored further. What can be concluded from this section is that municipal response capacity may be affected by co-

management and collaborative management techniques and future flood management will be dependent on maximizing these relationships.

6.4 Adaptive Co-Management

Adaptive co-management is an adaptive management approach. It is an experimental management technique focused on monitoring, learning and recalibration (Noble, 2013; Ruhl, 2004; Armitage, Berkes & Doubleday, 2007) and can be defined as the "process by which institutional arrangements and ecological knowledge are tested and revised in a dynamic, ongoing, self-organized process of learning-by-doing" (Folke et al., 2002, 20). As Noble (2013) and Olsson et al. (2004) explain, adaptive co-management often involves networks of actors sharing responsibility and management power. Its principles include: favour action; accept and benefit from uncertainty; be experimental; emphasize resiliency; provide feedback; use as a learning tool that leads to action; and it is adjustable as knowledge increases (Noble, 2013). As Morghan et al. (2006) note, it is designed to provide feedback to researchers and managers so that decisions can be improved as the information regarding natural systems, human systems and their interactions with each other continue to develop. It recognizes that the current state of the management system is not necessarily perfect and that adjustments will likely be required at some point. It is the purpose of this system to be able to make those adjustments quickly and with as little restraint as possible.

As it relates to response capacity for floods, participants view that collaboration, shared responsibility and management, and an adaptive framework (see Table 21) would lead to more successful flood response. Referring to the latter, ten out of twelve Q participants ranked Item 7 greater than 0 and only one participant gave a negative value (-3). The majority of participants viewed that an adaptive framework is critical in flood management. Interviewed participants supported this position, arguing that the knowledge on flood response is incomplete; having the ability to adjust current policy and practices is fundamental in emergency management because what works today may not necessarily work tomorrow. It is critical in post-recovery emergency management that a system is able to change policy and practices so as to make the necessary adjustments to better protect the population and assets. By contrast, static systems would be as vulnerable to the impacts of

another event as they were prior to that initial event; their ability to reduce those impacts further are constrained.

Table 21: Results of Q analysis for Item 7

Item	Factor (factor array)
7. Successful flood management is dependent on or will increase if an adaptive framework is used so that new information and technology and changing conditions can effectively and efficiently lead to necessary adjustments.	Factor 1 (3) Factor 2 (2) Factor 3 (2)

For example, under Section 25 of the *Compensation and Disaster Financial Assistance Regulation* of British Columbia's *Emergency Program Act*, financial assistance can be awarded to a municipality for the purpose of repairing, rebuilding, or replacing public facilities; however, repairs must be made to return to the original state of the facility as it existed prior to the disaster. Assistance will not be provided to repair a public facility if it is determined that changes to that facility will be made using these resources even if those changes would minimize future risk to a similar event. The problem is that in the event that a flood does occur and failures in existing policy and practices are determined, adjusting municipal practice by enhancing infrastructure, for example, becomes very difficult because access to external resources is reduced.

By having an adaptive framework in place so that institutional policy and practices can be adjusted as knowledge on flood response increases, the ability to respond to flood risk is less constricted. As one participant stated,

> Everything is fluid. It sounds like some pun on flood management, but it really is. The important thing is that your adaptation strategy is able to adapt and that is the challenge of it because politicians and staff, especially professional staff, do not like to say things that tomorrow might no longer be true, but the reality of flood management in a changing climate is we only know what we know today and tomorrow we are going to have to be prepared to go 'who knew' and 'now we know'. So we need to take more action.

Therefore, it can influence response capacity to floods as it can affect an institution's ability to make necessary adjustments to policy and practices when needed in a timely manner.

6.5 Conclusion

Literature, interview data and Q analysis findings indicate resource efficiency and collaborative management, co-management, and adaptive co-management as mechanisms that can increase an institution's ability to respond. More efficient use of resources allows institutions to maximize their flood management system's output by optimizing the value of every input. Collaborative management focuses on maximizing performance through meaningful interactions with stakeholders. Co-management increases an institution's access to external resources and lessens the burden of emergency management through shared responsibility and shared managing power. Finally, adaptive co-management is a hybrid management approach combining collaborative management and co-management, but with emphasis on adjusting policy and practice with minimal interference as knowledge on flood and emergency management continues to increase.

Interviewed and Q participants viewed interdisciplinary collaboration, shared responsibility among levels of government, and an adaptive framework as essential mechanisms for successful flood response. Data suggested a need for greater involvement at higher levels of government beyond the municipality. Focus on enhancing cohesion among departments within an institution, with other institutions, and among levels of government is viewed by participants as necessary for future flood management success. Although the participants in the City of Vancouver and District of Maple Ridge noted strong collaboration and communication with external stakeholders, they also noted that the involvement from higher levels of government in emergency and flood management is sporadic, needing greater communication.

Organizational theory is oriented on organizational structure, design and culture as fundamental to identifying organizational behaviour (Jones, 2001; Hosmer, 1995). The mechanisms presented in this Chapter show that organizational behaviour is influenced by the interactions that take place internally and with other organizations or institutions. The mechanisms show that the organization or institution's output is highly dependent on networks of actors contributing to a common goal and the resources that can be attributed to having those connections in place.

Under the various management approaches, it was evident how these approaches could affect response capacity, but what remained unanswered was what these flood

management systems should look like. This goes beyond the scope of this study although it is a logical next step. At this juncture, the outcome of such study would be highly speculative. Interviewed participants in the City of Vancouver did note that an ICLEI framework for climate change adaptation, which includes their flood response, is being undertaken at the moment, and has been reported as being successful in other municipalities that follow the same framework. Again, there is a need to further explore adaptive co-management as it relates to increasing an institution's response capacity to floods. It is through future research on increasing response capacity to floods that the knowledge gap in flood response may be reduced.

7 Conclusion

7.1 Introduction

Evidence of climate change and increases in disasters around the world suggest a necessity to adapt to future conditions; however, disaster risk reduction policy and practice has developed into a complicated system due to the complexity of municipal, regional, and national governance. The purpose of this paper is to aid decision-makers of flood response by creating a conceptual framework for discussion of institutional response capacity and municipal action. The purpose is not to expose any failure in policy and practice, but instead to assist decision-makers in understanding how response capacity is built and identify areas by which institutional action can be affected.

This study also addresses a knowledge gap in literature relating to community-based response capacity and action. It is argued that the ability to manage risk is complex and involves many interacting variables, including institutional behaviour and collective action, technological pathways, and resource management. This study promotes precautionary adaptive co-management and it provides a foundation for further research that seeks to increase response capacity through different management techniques. It offers a preliminary investigation into urban governance and flood and emergency response.

The purpose of this final Chapter is to summarize the findings presented in this project, identify significant limitations of this study, and discuss the direction of future research on flood response.

7.2 Summary of the Results

This paper addresses questions surrounding emergency and, subsequently, flood management in a changing climate. With RCP scenarios and other models suggesting future climate conditions will lead to more frequent and intense weather-related events, sea-level rise, and other disaster scenarios, research on managing risk and adapting to these future conditions have become major focus points in environmental management, academically and in government. It is the purpose of this paper to address a gap in literature for which flood and emergency management policy and practices at a community scale can be understood in order to aid in guiding future research and governance. It addresses three distinct questions identified in Chapter 1:

1. What are development pathways of local responses to floods?

2. What factors affect municipal priority-setting?

3. How is local response reflective of a community's reality?

From the by-person factor analysis (Q analysis), three groups of behaviour known as Factors emerged: Factor 1 was highlighted as having a risk-based approach to flood response; Factor 2 was identified as relying on the public to identify issues needing immediate attention which really dictates the priority that flood response receives; and Factor 3 was oriented more towards the politics of institutional behaviour and the arrangements that these institutions or organizations have with each other and different levels of government in relation to their flood response.

As the information presented throughout this paper has shown, the approach to flood risk differs among organizations and institutions in the City of Vancouver from those in the District of Maple Ridge. Certain Factors can be seen as similar or common with the organizations and institutions within these two regions, based on a comparison of the interview data gathered and the Q analysis. For example, in the City of Vancouver, interviewed participants argued that risk is the dominant factor in their approach to flood response and that, although the public is influential in institutional/organizational behaviour, their approach to flood risk is more associated with taking a proactive/precautionary approach using forecast models. Again, public advocacy and

concern do have a role in the attention and investment that flood management receives, but the probability of a flood occurring in the area necessitates action. Therefore, the organizations and institutions in the City of Vancouver can be associated closely with Factor 1.

The views of the interviewed participants in the District of Maple Ridge is more oriented toward Factor 2's association. In the interviews conducted in the District of Maple Ridge, participants frequently attested to the public's involvement in institutional and organizational behaviour, arguing that, although the history and forecasting models show the region's vulnerability/exposure to flooding, the public's concern and advocacy for various issues is essential in determining the issue's priority within the organization or institution and, thus, their action. According to these participants, it is less about the risk of a flood occurring at higher positions within the organization or institution and more about meeting the demands of the public first.

Finally, Factor 3 is associated more with department leads within organizations and institutions in the District of Maple Ridge and their views on flood response as it compares with the views of more senior ranking officials within the organization or among organizations. Where Factor 1 argues strong communication and collaboration exists—both internally and externally and is consistent with interviewed participants in the City of Vancouver—several interviewed participants in the District of Maple Ridge noted a disconnect between departments and other organizations, as well as with higher management which is consistent with Factor 3's description. This group emphasizes politics as being influential on response, suggesting that action at the municipal level is typically directed toward issues where an impact can be immediately seen as opposed to one that has not occurred recently like a flood; the results of that action cannot be seen until an event allows for an evaluation. This has resulted in greater attention to and investment in addressing issues where results can be seen in a short turnaround time rather than for a perceived but only potential threat. Again, this is not to say that this group's behaviour in respect of floods does not involve action, rather politics and structure are critical in its approach.

Therefore, it is evident that Factors 2 and 3 are more apparent in the District of Maple Ridge while Factor 1 is predominately associated with the organizations and

institutions in the City of Vancouver. The factors that define response capacity and municipal action are consistent among interviewed participants and the Factors in both regions; however, the degree of influence that these components have with regards to response capacity to floods and institutional action in these two regions varies. The information presented throughout this paper demonstrates the importance of these components to response capacity for floods and institutional action and these Factors aid in illustrating the differences in the two regions' approach to flood response and emergency management.

7.2.1 Defining Response Capacity to Floods

Through interviews, literature, legal documents, and a by-person factor analysis on participants' view of flood response in the City of Vancouver and District of Maple Ridge, major indicators of an institution or organization's ability to manage flood risk are identified. This paper argues that the governing body with the greatest jurisdictional authority has the ability to mandate a minimum standard for emergency and, subsequently, flood management, thereby establishing a baseline response capacity to floods. Beyond this baseline response capacity, this paper notes institutional behaviour and collective action, technological pathways, and resource management characterize an institution or organization's response capacity to floods.

The evidence presented throughout this paper show that in a broader context, these components are consistent with Burch's (2009) findings on sustainable development pathways to climate change and Hadfield & Seaton's (1999) environmental management model. These factors influencing community scale response capacity should not be understood as being the same as action. These two components of emergency management are separate, but related; action is a function of response capacity. An institution or organization's flood response does not have to equal their response capacity, but it also cannot exceed it.

This paper notes the factors affecting action differ in terms of their degree of influence on action at a local or community as to what may exist at a national level. It should be understood that the factors affecting local or institutional action, in terms of the orientation of the responses that occur, is likely to be different at a smaller scale than at a

national or sub-national level. The way that emergency management is approached at different levels of government show that emergency management response capacity and action is different among levels of government, organizations and institutions.

7.2.2 Urban Governance as Social Constructions of Reality

Under the Hyogo Framework for Action (HFA), five priorities were identified to assist in building disaster resilient communities and countries. They included: making disaster risk reduction a local and national priority with strong institutional arrangements; monitor and assess risk and vulnerability; use knowledge, innovation and education to create a culture of resilience; reduce risk through appropriate management; and strengthen disaster preparedness at all levels of government (UNISDR, n.d.). Understanding what influences an institution or organization's ability to manage risk is fundamental to this Framework. It is clear that educating decision-makers and the public could increase awareness and lead to more radical shifts in disaster governance; however, the public's behaviour on issues with uncertainty surrounding the likelihood of something occurring is critical to action.

Human behaviour, as it relates to institutional action, has traditionally been oriented to the 'here and now' scenario by which advocacy for action is loudest only when an individual or group's traditional way of life is infringed upon (see Chapter 5). Whether the infringement comes from an organization or institution imposing certain restrictions impacting cultural values and traditions or from a natural disaster causing various social, economic, health, political or biophysical impacts, it is not until that abstract becomes a reality that people's behaviour toward an issue really takes flight, increasing advocacy for action. The public activism translates to an institution or organization's behavioural change because these institutions have a responsibility to meet the public's wants, needs and values and organizations have a responsibility to their shareholders which are typically aimed at maximizing access to the market (Jones, 2001).

Institutions have to make difficult decisions that involve many interacting factors. Beyond the influence of the public, but still important to institutional behaviour for local response to floods, are risk, vulnerability and uncertainty and the politics of action, including responsibility and liability. It is through these factors and by this logic that urban governance can be understood as a social construct of a community's reality.

7.3 Q Methodology in Hindsight

Q methodology is an approach to study the subjective views of an individual or group of individuals in order to identify group behaviour on a particular topic (Stephenson, 1953). In this study, participants completed a questionnaire, known as a Q-sort, on their own. By not being present during the Q-sorting process the depth of the data gathered was more narrow than it could have been. It would have benefited the study if the researcher was present during the Q-sorting process to make inquiries as to why the participant rank-ordered each Item the way that they did. By having a brief interview regarding each statement in the Q-sort, the researcher may access the individual's behaviour with more empirical thought as oppose to speculation as to why such behaviour exists. In the study, interviews were conducted prior to the distribution of the Q-sort, allowing for this empirical thought, but to enrich the data, an interview post-Q-sorting is recommended.

It can be difficult to identify the behaviour of an individual or even group behaviour when the content of the Q-set can be interpreted loosely by the participant. In the study, several participants needed clarification as to what was being stated in the questionnaire and whether or not their interpretation of the statements were correct. In particular, the wording of Item 12 in the Q-sort was considered confusing to some participants and to others nothing was stated. Again, having the researcher present during the Q-sorting process would benefit the study as the researcher can guide participants through the Q-sort to ensure that all participants understand each statement to the same extent and reduce that degree of inference by the participant. As it stands in this paper, some of the results presented using Q findings had cautionary statements attached to the Factors factor arrays, such as Factor 3's factor array for Item 2 (see pages 77). An argument can be made that having the researcher present during the Q-sorting could assist in eliminating or reducing the need for such statements.

7.4 Limitations

While the study provides an analysis of flood management policy and practice, the framework for understanding response capacity and municipal action was derived through two study sites and should not be applied, with certainty, to all communities and organizations. As participants noted, the applicability of this research to other regions

should be approached with caution. The research provides an overview for small-scale response capacity to floods and urban governance in a First World city. The degree that each component has on response capacity and municipal action in relation to one another remains incomplete and is likely to differ among municipalities and regions. How the results compare to response capacity to floods and urban governance in other cities and countries and other political regimes remain incomplete. An analysis of intergovernmental politics in other countries could aid in this discussion by providing greater insight into emergency management and flood response.

The study identifies components that determine baseline and institutional response capacity and municipal action, but it fails to analyze the degree of influence that each component has in relation to one another. In part, this is due to the methodology that was chosen. In Q methodology, the purpose is not to compare Item 1 against Item 2, for example, rather identify the subjective views of individuals and groups through a by-person factor analysis. It is not suited to examining the degree of influence that each variable has on municipal action, particularly due to the complexity of urban governance and the small number of participants included. Performing R methodology factor analysis on the factors affecting municipal action and response capacity to floods could provide greater insight into the findings presented in this paper, but to do so would require significantly more participants, a greater understanding of all variables that could affect response capacity to floods and municipal action, and a way to standardize the variables.

In the paper, it is argued that public behaviour is influential to politics. Examining this relationship more closely by talking with residents and business owners to understand differences in opinion and power relations with government could provide greater knowledge on flood response. The evidence presented show response capacity to floods and municipal action as a complex system involving many interacting variables. The study focuses on developing a conceptual framework for discussion and identifying further research needs.

7.5 Future Research

In Chapters 4 and 5, it is argued that cohesion and collaboration with stakeholders act as control mechanisms on response capacity. The evidence presented show co-management,

collaborative management and adaptive co-management as management techniques that could positively affect response capacity by increasing access to external resources and allow smooth transitions to new policy and practices as knowledge on flood response increase. What remains absent in these Chapters, however, is how these management techniques should be framed to allow optimal response capacity. The research conducted here in the City of Vancouver and District of Maple Ridge fails to include provincial and federal government input as it is designed to focus on municipal governments and other organizations working on flooding. Therefore, further research on intergovernmental management and local management techniques that addresses this gap is a key focus point for future flood research. Questions surrounding the feasibility of intergovernmental adaptive co-management or the degree of co-management that could exists through strategic planning are fundamental to future response capacity research.

It is presented in the previous section that this study focuses on two sites to make the conclusions that are presented throughout the paper and it presents a major limitation as to its applicability to other communities, both within British Columbia, across provinces, and to other urban centers around the world with different political regimes. Response capacity is recognized in Chapter 4 as being different from region to region, and the degree that factors affecting municipal action have (Chapter 5) will differ on a case-by-case basis. Where further research is needed is on the conceptual framework's applicability throughout the province and even across provinces. The wants, needs and values are different throughout the provinces in Canada and in other countries, but whether or not the same components of response capacity to floods and municipal action are consistent is necessary in validating and further exploring this topic. By exploring this area more in other regions, research could provide the groundwork for developing a response capacity index.

The study indicates major factors affecting both response capacity to floods and municipal action, but it should be recognized that not all factors may have been included. In particular, the study did not examine or discuss the influence that the state of local, provincial, and national economies have on response capacity and municipal action. Questions surrounding whether or not the ability to respond and the investment in flood response shift in times of economic downturn was not investigated enough to determine its relevance to this research. Emphasis in this study is placed on the role of the public, risk

and the politics of local flood management and not on the economic processes ongoing within the cities. When asked about the role of the state of the local economy on investment in flood management, most participants said it is hard to determine as there has not been enough evidence in the study areas to describe what would happen. To provide an in-depth analysis into the role of the economic status in emergency and flood management in the City of Vancouver and District of Maple Ridge would have been highly speculative. Therefore, further research examining economic downturn and its influence on response capacity to floods through institutional behaviour could provide greater insight into this research area.

Similar to the above argument, provincial and national influence on local flood response remains largely absent in the study, excluding jurisdiction, responsibility and liability. Although the roles of each level of government was defined, the operations of these higher levels of government remain absent in the study, in part, due to the complexity of intergovernmental politics and to do so goes beyond the scope of the research. Further research is needed to understand intergovernmental relations and their impacts on flood response.

The conducted research focuses on organizations and institutional flood response; however, response capacity to floods should not be understood as being solely institutional and/or organizational. Further research is needed to examine individual response capacity and neighbourhood response capacity. Interviewing local residents and business owners on how they respond to flood risk beyond what their municipality provides could lead to greater tools for institutional practices to work with and optimize local response capacity. It could provide interesting community-government research and collaboration opportunities.

Finally, the role of aboriginal communities on decision-making with regards to flood and emergency management is not included in this study. The history of aboriginal relations with government throughout Canada can be described as tenuous. Relocating communities, violating land treaties, and efforts to assimilate aboriginals into Canadian culture (including the use of residential schools), have aided to developing a complicated aboriginal-government relationship. In the study, interviewed participants in the District of Maple Ridge acknowledged that communication and collaboration with aboriginal

communities are important to decision-making. Clearly, these communities have a role in urban governance, but due to the complicated history of aboriginal-government relations and the limited time period to conduct the research it made sense to keep this subject matter separate. Further research needs to consult with these communities as the evidence provided by interviewed participants representing various organizations and institutions can only provide a piece of an incomplete picture into the role that aboriginal communities have on urban governance and flood management. By consulting both parties, a further understanding can be developed, but for the purpose of this paper their role remains incomplete.

7.6 Conclusion

While the study provides insight into response capacity to floods and municipal action, it is clear that the findings should act as no more than a preliminary inquiry into flood response. The information presented in the paper contributes to the overall knowledge on response capacity to floods and urban governance, but it is evident that further work is needed to complete our understanding of response capacity to floods and institutional behaviour. As disasters continue to rise in frequency and intensity, it is be critical to understand response capacity and the mechanisms that can increase local response. Investigating intergovernmental management and adaptive co-management techniques may prove to increase local response capacity to disasters, but the knowledge on such approaches and its feasibility in disaster risk reduction research remains incomplete. Although research on flood response and disaster risk reduction is incomplete, the findings presented in this paper make significant contributions for policy-makers and decision-makers of institutions and organizations working in urban environments and provides groundwork for future research.

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9 Glossary

Abduction: a bottom-up explanatory framework that seeks to link an effect to a cause through suitable laws based on a range of hypothetical conditions. It is different from induction in that in abduction the linking law/theory that connects the effect and the cause is unknown.

Adaptive co-management: the process by which institutional arrangements and ecological knowledge are tested and revised in a dynamic, ongoing, self-organized process of learning-by-doing. It often involves networks of actors sharing responsibility and management power.

Baseline response capacity: the minimum requirements mandated for municipalities and organizations as set out by the governing body with the greatest jurisdictional authority.

By-person factor analysis: a statistical inspection of the correlation matrix identifying distinct regularities or patterns of similarity among Q-sorts.

Co-management: management techniques that convey the sharing of rights and responsibility by government and civil society.

Collaborative management: management techniques that recognize that learning and innovation is likely to occur where uncertainty exists through meaningful interactions.

Concourse: an observable domain of shared knowledge and meaning.

Confounding variable: a Q-sort that loads significantly in two or more Factors.

Deduction: a top-down explanatory framework providing a means of linking the cause of a phenomenon to an effect through law/theory.

Development pathway: a complex integration of economic, social, technological, institutional, cultural and biophysical characteristics that determines the interactions between human and natural systems. They characterize response capacity.

Factor: a collective view of particular participants manifested through a by-person factor analysis on completed Q-sorts.

Factor array: a corresponding value representing a Factor's view for a particular Item in the Q-sort.

Factor-defining Q-sort: a Q-sort used in the by-person factor analysis that aids in determining the collective view of a particular Factor.

Factor estimate: an estimate of the Factor's viewpoint on a particular Item.

Factor extraction: the process of identifying the number of Factors in the study through the identification and removal of common variance from the initial correlation matrix.

Factor loading: the degree of correlation that each Q-sort has with the Factor.

Factor rotation: the process of manipulating the conceptual dimensions of extracted Factors in order to best position the factor loadings relative to each Factor.

Factor weights: the percentage that each Q-sort will contribute to the final factor estimates relative to the Q-sort with the highest score.

Flood: an overflow of water onto normally dry land. The inundation of a normally dry area caused by rising water in an existing waterway, such as a river, stream or drainage ditch. Ponding of water at or near the point where the rain fell.

Focusing event: an event that is sudden, relatively uncommon, defined as harmful or has the possibility to be harmful, and is known to the public and policy-makers simultaneously.

Forced distribution format: a Q-sort format that allows participants to rank-order a set number of Items per value. Each cell can correspond with one Item.

Free distribution format: a Q-sort format that allows participants to rank-order as many Items as they choose with a particular value.

Group cohesion: factors influencing group performance among a diverse group of individuals.

Induction: induction refers to a bottoms-up explanatory framework of establishing an applicable description that links the observed facts to the cause.

Institutional behaviour: individual behaviour that can be aggregated into collective phenomena, thus yielding the behaviour of institutions amenable to explanation by reference to the preferences of the individuals that compose that institution.

Institutional response capacity: the ability of an institution to manage risk.

Item: a meaningful statement that participants rank-ordered in the process of Q-sorting.

Jurisdiction: the authority to make laws.

Legal liability: a finding that is made by a court that someone did something that they should not have done or did not do something that they should have which caused damage to someone else. It is a conclusion of law.

Negligence: the result of a defendant's failure to satisfy a duty of care owed to the plaintiff, which causes damages.

Nuisance: the interference with an individual's use and enjoyment of property through a thing or activity.

Operational decision: decisions as to a course or principle of action that are not based on public policy considerations and may give rise to a private law duty of care which, if breached, can lead to civil liability.

Policy decision: decisions as to a course or principle of action that are based on public policy considerations, such as economic, social and political factors, provided they are neither irrational nor taken in bad faith.

Q methodology: a methodology developed as an alternative measurement technique to psychology tests and scales. It attempts to access the subjective views of individuals and groups through an inverted or by-person factor analysis.

Q-set: all Items that participants in the Q study are to rank-order.

Q-sort: a completed rank-order questionnaire focused on a participant's level of agreement with each Item.

Risk: the product of a hazard's probability of occurrence and its consequences.

Resource: money, materials, staff, and other assets that can be drawn on by a person or organization in order to function effectively.

Resource efficiency: the process of maximizing a system's output while minimizing its input in a sustainable way.

Resource management: the capacity to control, handle or direct how resources are allocated and used.

Response capacity: the ability to manage risk.

Self-reference: a reflection of one's own experience and opinion.

Varimax rotation: an orthogonal rotation—axes remain 90 degrees relative to each other—that rotates Factors to account for the maximum amount of study variance.

Vulnerability: the potential for loss.

Z-score: a statistical value that allows for cross-Factor comparison.

Appendix A: Q Sort Questionnaire

Understanding Development Pathways of Local Responses to Floods: Responses in the City of Vancouver and Maple Ridge, British Columbia

Department of Geography

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1. The major driver for developing and implementing flood management initiatives exceeding provincial and federal legislation is climate change and impacts from storm surges, sea-level rise, and/or spring snowmelt.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

2. The major driver for developing and implementing flood management initiatives exceeding provincial and federal legislation is public concern/advocacy for flood management.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

3. The major driver for developing and implementing flood management initiatives exceeding provincial and federal legislation is the potential economic impact that a flood could have on the city or business.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

4. The major driver for developing and implementing flood management initiatives exceeding provincial and federal legislation is the demographic characteristics and available technological solutions in the region.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

5. The implementation of flood management responses is based primarily on demographic characteristics with the risk of a flood occurring having less influence.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

6. The implementation of flood management responses is based primarily on the risk of a flood occurring with the demographic characteristics having less influence.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

7. Successful flood management is dependent on or will increase if an adaptive framework is used so that new information and technology and changing conditions can effectively and efficiently lead to necessary adjustments.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

8. Successful flood management is dependent on or will increase with public pressure on local practitioners and on government for increased action.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

9. Success of flood management is dependent on or will increase with efficient use of resources such as working in tandem with other projects. For example, updating existing infrastructure at the same time as doing road work.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

10. Flood management initiatives are dependent on the political cycle.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

11. Success of flood management is dependent on or will increase with having an engaged community and a community voicing their concerns towards flooding.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

12. Success of flood management is dependent on or will increase depending on competing priorities elsewhere that put less emphasis on and investment in flood management.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

13. Economic and relating activities, such as tourism, are controls on updating existing infrastructure.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

14. Flood management and initiatives that focus on reducing the impacts if a flood occurs are a high priority within your municipal boundaries and/or in your profession.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

15. Flood management is the top priority in the region, above, for example, transit, economic activity, and environmental conservation.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

16. Responses to reduce flood impacts are primarily based on technology with some social components.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

17. Responses to flooding are primarily based on social approaches (land use designations) with some technological components.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

18. The Provincial and/or Federal Government should be taking the lead on flood management, including the financing of flood management initiatives being done at the local level by either the municipality or local practitioners.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

19. The public/community is not or has not expressed concerns about flooding since the 2010 election.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

20. The uncertainty of floods—in terms of when, where and intensity—and frequent changes to recommendations on how to reduce impacts of flooding deter investment in flood management and more towards other high priority projects.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

21. There is disconnect between staff with each other, others in your profession, and/or council on the understanding of the effectiveness of existing flood management in the city.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

22. Future flood management is dependent on increasing communication and collaboration between different levels of government to work together and share the responsibility of flood management.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

23. Our flood management approach has been very successful here and can be seen as a leader for others to follow.

☐ Strongly Disagree (-4) ☐ -3 ☐ -2 ☐ -1 ☐ Neither Agree or Disagree, or Are Unsure

☐ +1 ☐ +2 ☐ +3 ☐ Strongly Agree (+4)

Appendix B: Factor Rotation in Q methodology

Factor rotation is common practice in Q methodology (see Watts & Stenner, 2012; Brown, 1980). To recall, it is the process of manipulating the conceptual dimensions of the extracted Factors in order to best position the factor loadings of each Q-sort relative to each Factor. Before manipulating the conceptual dimensions of the factor loadings of Q-sorts, it should be understood that these factor loadings can be spatially mapped out as coordinates in a space of meaning. The poles of the *x* and *y* axis represent the shared viewpoint of two Factors. Each Q-sort represents a unique viewpoint. By mapping these unique viewpoints we can conceptually visualize each viewpoints' position relative to the shared viewpoints—that are the Factors—and to each other. The closer that an individual Q-sort is to an axis indicates that the behaviour of this participant aligns with the Factor represented by that axis. Each mapped Q-sort can be compared to each other and to the Factors themselves.

For example, Figure 11 shows the mapped out Q-sort loadings for Factor 1 and Factor 2 based on the factor loadings in Table 22. In the top-right quadrant of the diagram, Q-sorts 1, 2, 4, 10 and 11 have significant loadings to both Factor 1 and Factor 2. By performing a factor rotation, it is the purpose to have these Q-sorts align more close with one axis as oppose to both and thus load significantly more to one Factor. In Figure 12, the results of this rotation can be seen. It is evident in this rotation that Q-sorts 1, 2, 4, 10 and 11 no longer load significantly with Factors 1 and 2; rather they load more significantly with Factor 2. This process is important in determining Factor-defining Q-sorts (see Section 2.2.4.4).

Table 22: Factor Loadings of Extracted Factors

	Component (Grouping of Shared Behaviour)		
	Factor 1	Factor 2	Factor 3
Q sort 1	0.363	0.659	0.498
Q-sort 2	0.544	0.463	-0.003

Q-sort 3	0.761	-0.449	0.183
Q-sort 4	0.653	0.523	-0.124
Q-sort 5	0.838	-0.166	0.388
Q-sort 6	0.782	-0.144	-0.336
Q-sort 7	0.580	-0.371	0.609
Q-sort 8	0.649	-0.475	-0.119
Q-sort 9	0.825	-0.179	-0.119
Q-sort 10	0.575	0.257	-0.351
Q-sort 11	0.797	0.403	0.083
Q-sort 12	0.555	-0.067	-0.615

**Extraction Method: Principal Component Analysis

Different factor rotation techniques can be used in factor analysis. The factor rotation method performed in this study was a varimax rotation. The varimax rotation is an orthogonal rotation—axes remain 90 degrees relative to each other—that rotates Factors to account for the maximum amount of study variance. Figures 10-15 illustrate the process of the varimax factor rotation that was performed in this study. Again, the objective of this rotation is to align the viewpoints of individual Q-sorts with the shared meanings of Factors. The output to this step was an adjusted factor loading matrix of Q-sorts relative to each Factor (see Table 7 in the section 2.2.4.4). From here, the next step was to place each Q-sort into 1 of the 3 Factors based on their new loadings (see Section 2.2.4.4).

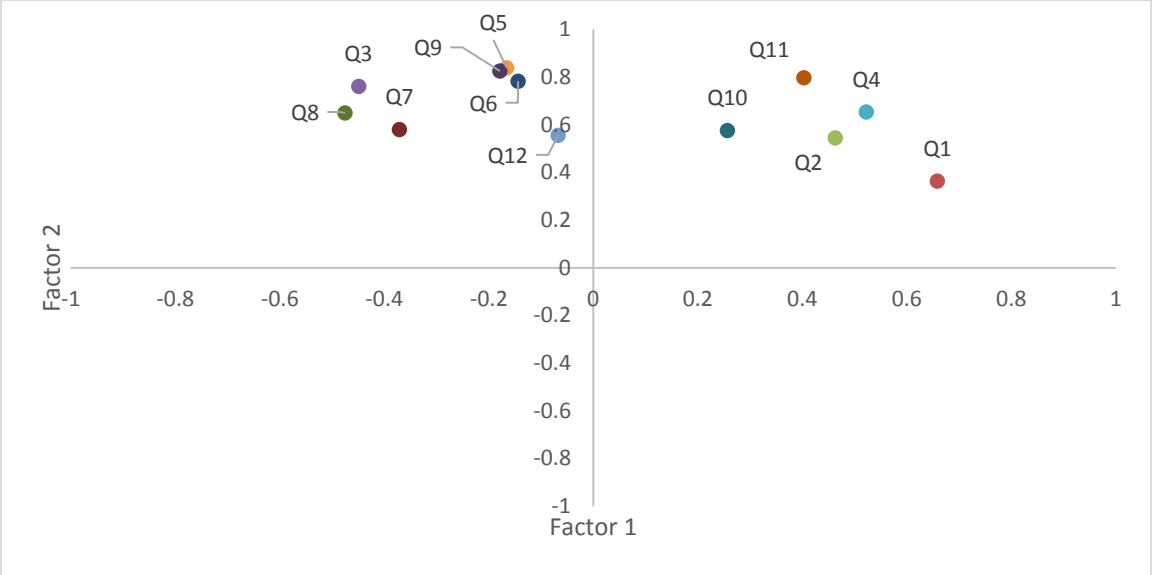

Figure 10: Unrotated Factors 1-2 Comparison

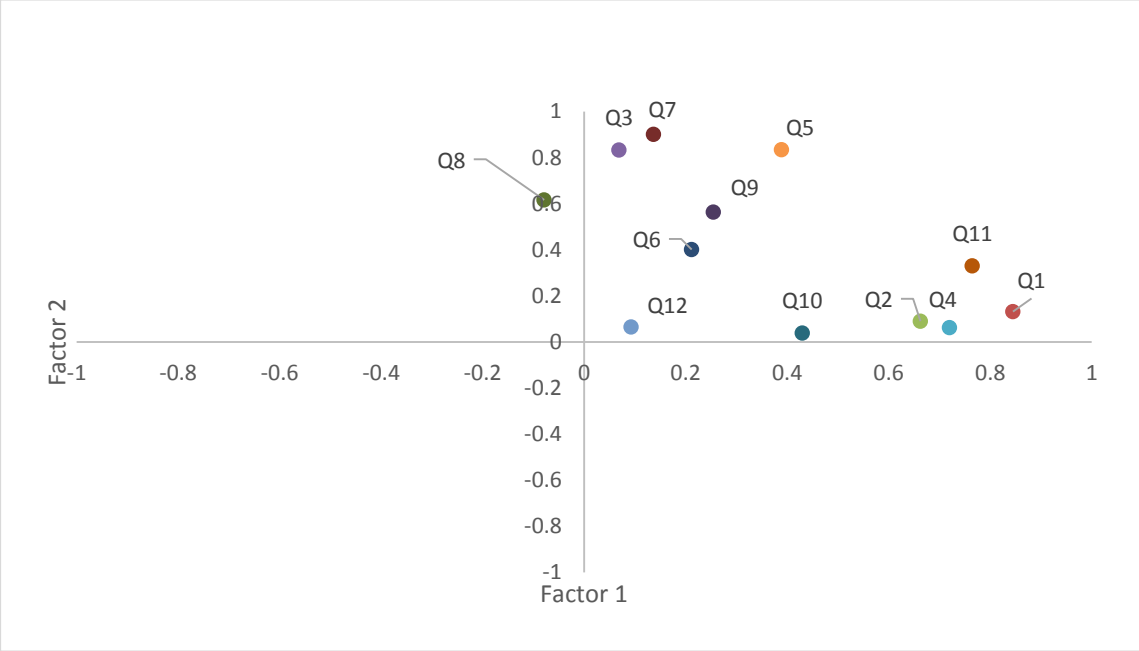

Figure 11: Rotated Factors 1-2 Comparison

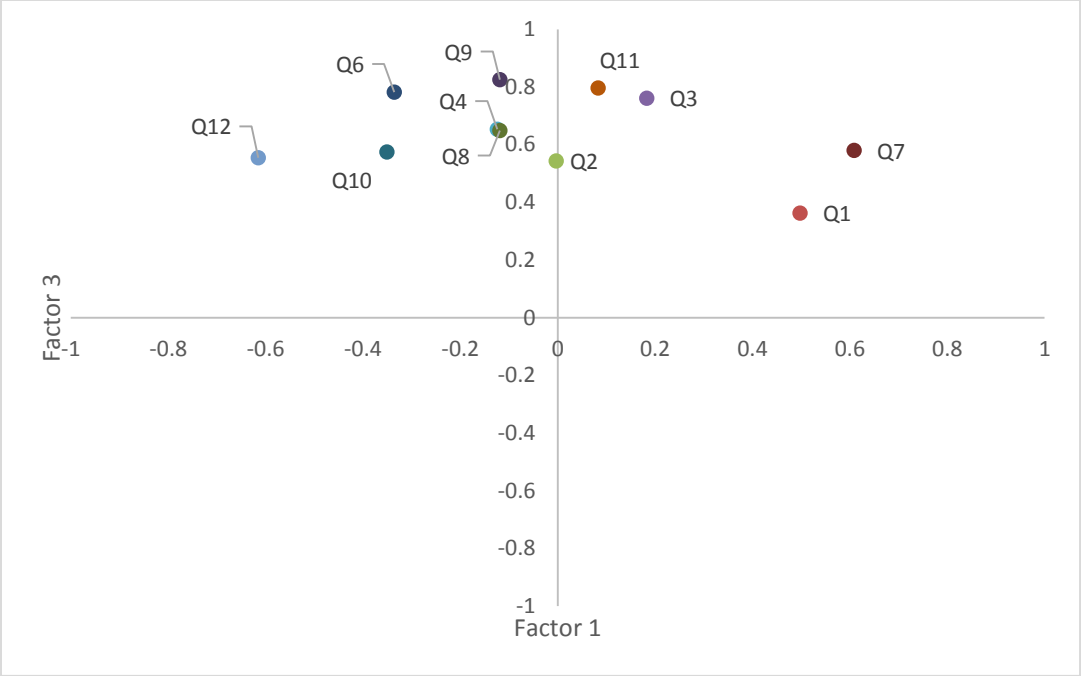

Figure 12: Unrotated Factors 1-3 Comparison

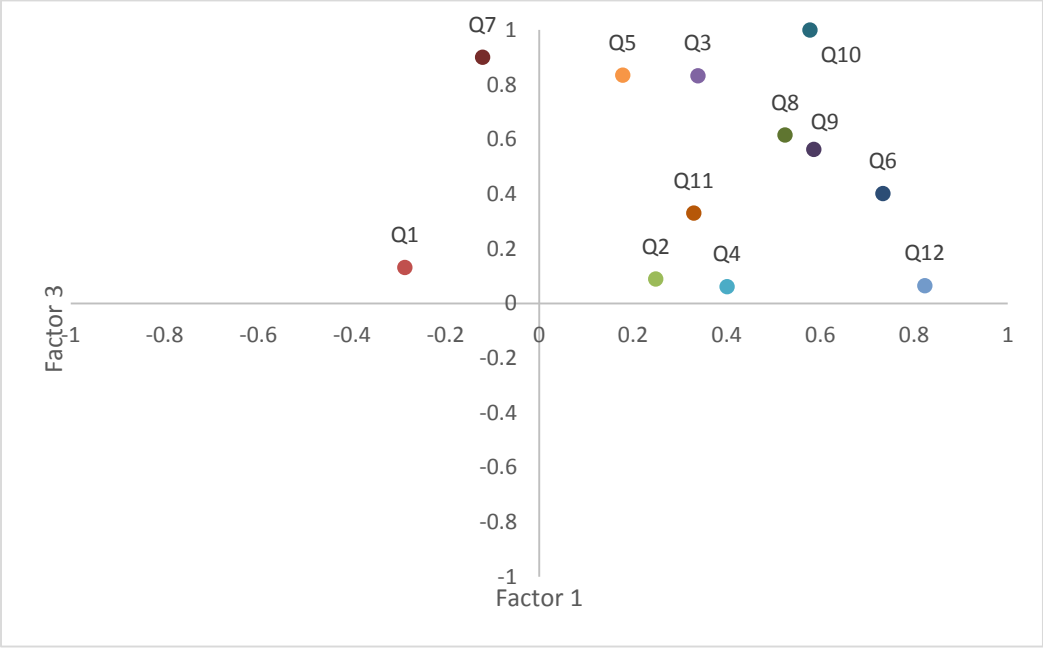

Figure 13: Rotated Factors 1-3 Comparison

Figure 14: Unrotated Factors 2-3 Comparison

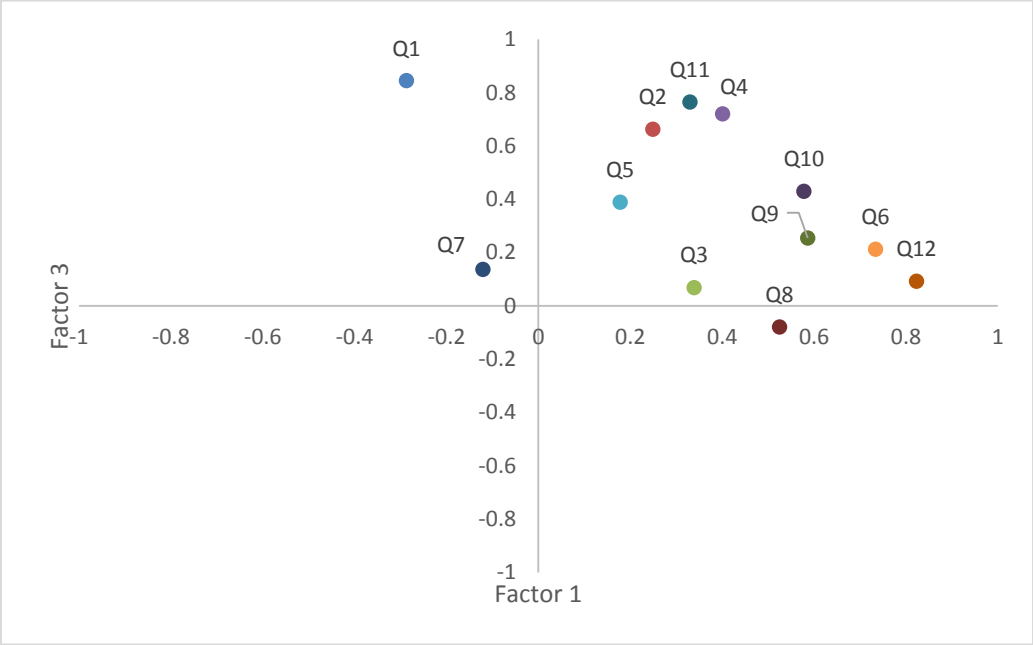

Figure 15: Rotated Factors 2-3 Comparison

Appendix C: Ethics Approval Notice

Western Research

Research Ethics

Western University Health Science Research Ethics Board
NMREB Delegated Initial Approval Notice

Principal Investigator: Dr. Gordon McBean
Department & Institution: Social Science\Geography,Western University

NMREB File Number: 105519
Study Title: Understanding Development Pathways of Local Responses to Floods: Response in the City of Vancouver and Maple Ridge, British Columbia, to Flooding
Sponsor:

NMREB Initial Approval Date: August 22, 2014
NMREB Expiry Date: April 30, 2015

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Letter of Information	This is new letter of information modified on the basis of the Board's recommendation.	2014/07/24
Letter of Information & Consent	This is the interview written consent form.	2014/07/24
Letter of Information & Consent	This is the instructions and provisions for implied consent on the questionnaire.	2014/07/24
Other	This are the general probing questions.	2014/07/25
Revised Western University Protocol	This is a clean copy of the ethics application form.	2014/07/25

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

This is an official document. Please retain the original in your files.

Appendix D: Letter of Information and Consent Forms

Project Title: Understanding Development Pathways of Local Responses to Floods: Response in the City of Vancouver and Maple Ridge to Flooding, British Columbia.

Investigators: Professor Gordon McBean (Principal Investigator) and Jonathan Raikes, Master of Arts Candidate, Department of Geography, University of Western Ontario

Letter of Information

Purpose of Letter

The purpose of this letter is to provide you with the information necessary to make an informed decision to participate in a study focusing on local responses to flooding in proposed study locations. You are being invited to participate in this research study because you have experience with flood-related response development, decision-making, and/or implementation. To participate, you must be an existing local practitioner and/or policy maker that makes design and development criteria in response to flood-related issues in the City of Vancouver or District of Maple Ridge. Your knowledge and professional experience addressing flood issues makes you the ideal candidate in which understanding development pathways of local responses to flooding can be optimized. Participants will not excluded from the study based on gender, race, or sexuality, however, participants must be literate and able to speak English fluently. If at any point of the research you would like to discontinue your involvement in data collection, you are welcome to do so with no impact on your participation on future studies or on your employment.

Purpose of Study

Evidence has suggested that efforts to reduce the impacts of floods are dependent on social, economic, institutional, cultural and biophysical characteristics of a region. The complex integration of these characteristics that is deterministic of the effectiveness of local responses to flooding is referred to as a development pathway. Research on development pathway components (social, economic, institutional, cultural, and biophysical characteristics) tend to focus on these components separately, failing to examine the relationships between them. Understanding the interactions between the components of development paths is essential to the development of effective policies and responses seeking to manage flood causes and impacts.

The purpose of this research is to identify existing development pathways of local responses to flooding in the City of Vancouver and the District of Maple Ridge, and explore the component relationships of such responses. This research seeks to develop an understanding of these relationships and optimize the potential that these relationships could have on policy/response formulation by providing the necessary information to make informed decisions through the knowledge gained from this study.

Why the City of Vancouver and District of Maple Ridge?

The Metro-Vancouver region has been identified as one of many regions that will be under high stress with rising sea-levels, and increased frequency and intensity of disasters. The melting of glacial ice and warming of oceans have resulted in global sea-level rise. The 2013 IPCC report has stated that sea-levels are predicted to rise by 0.97 meters by 2100. The damages of flooding to regions are being documented but reducing the impacts and creating effecting local responses to flood events is an area of concern in this region. The latest *Climate Change Adaptation Strategy* report (prepared by the City of Vancouver in 2013) and the *Fraser River Freshet Operational Flood Management Plan* (prepared by the District of Maple Ridge, 2012) have argued that current policy and practices that are aimed towards flood events are outdated and needing revision. Evidence in these reports, among others, have argued that existing dikes are not equipped to handle a major flood. As the climate continues to change stronger and more frequent weather events suggest an increase in major flood events occurring. Your participation in this study is critical in the development and implantation of future strategies seeking to prepare and prevent future floods.

Participation

There are two phases to this study where participation in warranted. You have the option of participating in a single stage or both stages if you choose to participate, but you must have experience developing, deciding on, and/or implementing responses that addresses flooding. For example, strategies could be anything from land use planning to emergency procedures or technological solutions when developing land; any strategy that addresses floods qualifies you as a suitable candidate to participate.

The first stage of this research consists of in-depth interviews with existing local practitioners and/or policy makers. Written consent is required to participate in an interview due to the exchange of personal experience related to flood responses. The purpose of these interviews is to collect ideas, beliefs and opinions on existing local responses to flooding. These interviews will explore the relationships between development pathways components. Prior to the commencement of interview questions, you will be asked to confirm your understanding of what is meant by a development pathway. If there is any confusion on the definition of a development pathway clarification will be provided to you before proceeding. Emphasis in this stage is on the subjective understanding (i.e. individual approach) of response development and decision-making. Questions regarding your opinions on the effectiveness of local responses will be avoided; rather, inquiring what factors are considered when you develop, decide on, and/or implement local responses will be the focus of these interviews. As stated, you can choose at any point to withdraw from the interview or refuse to answer any questions.

It is anticipated that the interview will take a little more than an hour and no longer than 1.5 hours. Interview date and time are flexible but will be conducted from September 22nd

to October 4th. The interview location will be at your workplace; however, if you would be more comfortable elsewhere the interview location will be discussed.

Interviews will be recorded using an audio recording device and transcribed post-interview. If you choose you do not want to be recorded with the use of an audio recording device, you will not be excluded from participating in an interview. The transcribed interviews will be analyzed and used to develop a set of approximately 20 statements that will be the basis for the second stage of the study.

The second stage of the study where participation is warranted is the completion of a questionnaire. The questionnaire is a rank ordering exercise in which participants will be provided a set of statements that they are to identify their level of agreement (strongly disagree, disagree, agree, strongly agree, or no opinion). Each of these level of agreements will be given a representative number that will be used in a factor analysis. For the purpose of this study a set of approximately 20 statements regarding individual component characteristics and component relationships when developing, deciding on, and implementing responses to strategies will be given. Completed questionnaires will be compared through a factor analysis identifying shared forms of understanding among participants, confounding and non-significant respondents.

As a participant you will be filling out the questionnaire at your own convenience without a Project Team Member present. The questionnaire could take up to a couple hours of your time, but you will have approximately three weeks to sort statements. Completed questionnaires are to be sent via email to Jonathan Raikes at _____. Addressed envelopes are provided to participants.

Your participation in this study is voluntary. Participants will NOT be asked to provide personal information during the questionnaire. Completion of the questionnaire gives the Project Team implicit consent to use your completed questionnaire. Instructions and provisions for implicit consent to participate in the questionnaire are provided on the first page of the questionnaire.

Possible Risks and Harms

There are no known or anticipated risks or discomforts associated with participating in this study.

Possible Benefits

Benefits to Participants
The data that you provide will lead to knowledge on existing development pathways and component relationships. This information will be useful to you as it will provide you with knowledge/information needed to develop more effective responses to flooding.

Benefits to Society

This study has the potential to create a more effective procedures in flood situations. It has the potential to enhance our knowledge on strategies to reduce flood impacts; ultimately, this research seeks to provide the regions with the opportunity to save lives and protect the economy.

Confidentiality

All data collected will remain confidential and accessible only to the investigators of this study. Data collected will be stored on a password protected computer and/or locked cabinet in a locked office at the University of Western Ontario. If the results are published, your name will not be used. If you choose to withdraw from this study, your data will be removed and destroyed from our database. While we will do our best to protect your information there is no guarantee that we will be able to do so. Representatives of The University of Western Ontario Non-Medical Research Ethics Board may contact you or require access to your study-related records to monitor the conduct of the research.

Contact Information

If you have any questions or concerns regarding your participation in this study please contact Jonathan Raikes (primary contact) or Dr. Gordon McBean.

Jonathan Raikes
Email: _____

OR

Dr. Gordon McBean
Email**:**_____
Phone: _____

If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Research Ethics (519) 661-3036, email: ethics@uwo.ca.

This letter is yours to keep for future reference.

Consent Form

Project Title: Understanding Development Pathways of Local Responses to Floods: Response in the City of Vancouver and Maple Ridge to Flooding, British Columbia.

Study Investigator's Name: Professor Gordon McBean (Principal Investigator) and Jonathan Raikes, Master of Arts Candidate, Geography, University of Western Ontario.

I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction. The completion of this form gives the Study Investigators permission to contact and interview me.

Participant's Name (please print):

_____

Participant's Signature:

_____

Email That Investigator Can Contact Participant:

-

_____

Telephone Number That Investigator Can Contact Participant (Optional):

_____

Date:

_____

Person Obtaining Informed Consent (please print):

_____

Signature:

_____

Date:

_____

Questionnaire Instructions and Consent

Project Title: Understanding Development Pathways of Local Responses to Floods: Response in the City of Vancouver and Maple Ridge to Flooding, British Columbia.

Study Investigator's Name: Professor Gordon McBean (Principal Investigator) and Jonathan Raikes, Master of Arts Candidate, Geography, University of Western Ontario.

Instructions

Non-interviewed local practitioners and policy-makers will express their views on the development, deciding on, and implementation of local responses to flooding by completing a questionnaire. The questionnaire involves a set of meaningful statements that are to be ranked according to the participant's level of agreement of each statement.

There are 23 statements in this questionnaire. As a participant we ask you to read each statement carefully and mark the level of agreement you share with the statement. Views will be expressed through a rank order between negative four (strongly disagree) and positive four (strongly agree). Upon completion of the questionnaire, please send the completed questionnaire to Jonathan Raikes at the University of Western Ontario via email.

Upon completion of the questionnaire each questionnaire will be placed in a single document where no names of participants will be included and a factor analysis will be conducted that compares the correlation between respondents. Your email address will be attached to the email you send Jonathan Raikes upon completion of the questionnaire, however such data will not be included in analyzing the data. Upon placing the completed questionnaire into a single separate document, your email will be deleted to ensure confidentiality purposes.

As a participant you are to complete the questionnaire at your own convenience, separate from the presence of a Project Team member. Please complete and have the questionnaire sent to Jonathan Raikes by January 1st, 2015 to ensure that your views on local responses to flooding are included in the data analysis and results of this study.

Consent

I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction. I understand that no personal information of myself or others will be asked in the completion of this questionnaire. The completion of the questionnaire gives the Study Investigators permission to use data expressing my views on developing, deciding on, and implementing local responses to flooding towards the results and discussion of this study.

If you have any questions or concerns regarding your participation or access to the results of this study please contact Jonathan Raikes (primary contact) or Dr. Gordon McBean.

This letter is yours to keep for future reference.

Contact Information

Jonathan Raikes
Email: _____

OR

Dr. Gordon McBean
Email: _____
Phone: _____

If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Research Ethics (519) 661-3036, email: ethics@uwo.ca.

Curriculum Vitae

Name: Jonathan Raikes

Post-secondary Education and Degrees:
University of Guelph
Guelph, Ontario, Canada
2008-2013 B.A.H.

Honours and Awards:
Edward G. Pleva Fellowship Award
2013/14

Related Work Experience
Teaching Assistant
Western University
London, Ontario, Canada
2013-2015

Presentations
Understanding Development Pathways of Local Responses to Floods: Responses in the City of Vancouver and District of Maple Ridge. Association of American Geographers Conference, Chicago, 2015.

Conferences/Workshops

Social Vulnerability Workshop, Vancouver, Canada. February, 2015.

MEOPEER Training Workshop, Quebec City, Quebec, Canada. February, 2015.

MEOPEER Training Workshop, Halifax, Nova Scotia, Canada. June, 2014.

WatIF Conference, Kingston, Ontario, Canada. May, 2014.

2014 Symposium on Extreme Weather: Impacts Challenges and Adaptations, Ottawa, Canada. April, 2014.

Coastal Cities at Risk Workshop, Vancouver, British Columbia, Canada. February, 2014

MEOPAR Workshop, Ottawa, Ontario, Canada. February, 2014.