Understanding Perceptions of Climate Change and Resilience in the City of Courtenay, British Columbia

by

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Author’s declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Faced with extreme weather events like flooding and challenges like sea-level rise, cities across the globe are devising strategies to adapt to climate change. Climate change risk perceptions amongst the public have been recognized as important factors influencing their support for various adaptation strategies. It has garnered a lot of attention amongst researchers due to increased focus on democratization and public participation in the last few decades. However, despite being recognized as a key factor influencing climate change adaptation strategies in cities, municipal officials' climate change risk perception has only garnered limited attention.

Accordingly, the main objective of this thesis is to understand the factors influencing city officials' climate change risk perceptions and their influence on climate adaptation strategies, using the City of Courtenay as a case study. Another objective was to observe any emerging relationship risk perception and resilience constructs in the City.

I reviewed 182 City documents to gain an understanding of climate risk perception, and the adaptation actions within Courtenay. Similarly, I reviewed 54 documents to understand the framing of resilience and identify resilience actions within the City. I also conducted semi-structured interviews with five senior municipal officials from various departments within the City to discern how they perceived climate risk, and how they understood resilience.

My findings indicate that climate risk perceptions of officials are influenced by personal experiences, as well as three kinds of knowledge: 1) knowledge of the climate adaptation measures taken by the City (responses); 2) knowledge of climate change projections (future); and, 3) knowledge of what and whom will be impacted in their community (impacts). Further, I found that the climate risk perceptions of officials are reflected in a greater extent in the City

documents, and most adaptation actions in the City address the climate hazards identified. I also found that officials' risk perceptions and professional and educational background play an important role in how officials understand resilience. Further, most resilience actions fall under climate adaptation actions in the City. These findings demonstrate the importance of officials' perceptions when it comes to climate adaptation planning and makes a case for a risk-perception based approach for adaptation planning in cities.

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Chapter 1: Introduction

1.1 Background

Climate change has brought up new challenges that communities across the world have to contend with. Droughts, extreme weather events and sea-level rise are just some of the examples of climate change-induced challenges (Birkmann et al., 2010). Depending on the geographic location and climatic conditions of the region, specific challenges may be pronounced (Füssel, 2009). For example, coastal communities are becoming more susceptible to sea-level rise with the low likelihood of several countries honouring the Paris Agreement and limiting the global temperature rise to 2 degree Celsius (Beiser-McGrath & Bernauer, 2019).

A National Oceanic and Atmospheric Administration technical report (Sweet et al., 2017) projects that by 2100 under high and extremely high greenhouse gas emissions scenarios, the global mean sea level could rise by 2 and 2.5 meters, respectively. Either of these scenarios would pose severe challenges for coastal communities across the world as 13% of the world urban population lives in areas that are less than 10 meters above sea level, and 40% of the world population lives within 100 km from the sea (United Nations, 2017). It is also a great challenge for Canada as it has the world's longest coastline at 243,042 km (Statistics Canada, n.d.) and more than 13% of the country's population resides within 20 km of a marine coastline (Manson, 2005). Given this predicament, the city planners and policymakers across the globe are attempting to tackle climate change-related challenges to varying degrees.

The degree of action depends on various social, political, economic, environmental, and psychological factors. Interdependent nature of these factors makes climate change adaptation and mitigation planning a complex process (Dryzek & Stevenson, 2011). Among these, social

and psychological factors influence how climate change is perceived by groups and individuals, respectively. They also account for the behaviour of different stakeholders.

Risk perception, understood as the subjective assessment or judgement about the occurrence of an adverse phenomenon (Slovic, 2000), has been a preferred construct among researchers seeking to understand psychological and behavioural determinants of climate change action. It is very important in the context of climate change as it could influence collective action (Sullivan et al., 2019). Risk perception among different stakeholder groups in the community determines how climate change is perceived and indicates the willingness of the group or individual to take steps towards adapting the community (Leiserowitz, 2006; O'Connor et al., 1999). In last few decades, the risk perceptions of the public to climate change have been studied by researchers, and this has led to a better understanding of different demographic, socio-cultural, experiential, and cognitive factors influencing how the public thinks about climate change and related hazards.

However, the literature indicates that understanding of how city official's climate change risk perception influences climate adaptation is limited (Aslam, 2013). As a result, their risk perceptions' role in climate change planning is not well understood. To address this crucial gap, in this thesis, I explore the factors influencing municipal officials' climate risk perception. I also investigate if their risk perceptions influence the adaptation actions and the framing of resilience.

In recent times, the term "resilience" has been frequently used by international as well as local organizations in various sectors. The urban planning sector has not been immune to this trend. The modern resilience theory emanating from C.S. Holling's work in the field of ecology has

pervaded other disciplines as well. He defines resilience as a system's ability to withstand shocks and maintain critical characteristics (Holling, 1973).

Strategies for increasing resilience are being adopted by cities across the globe as part of their climate change adaptation or mitigation efforts (Crichton, 2007; Leichenko, 2011; Revi, 2008; Sanchez-Rodríguez, 2009). However, resilience is not understood and conceived similarly by these cities or stakeholders within these cities, and there is not a commonly agreed-upon definition (Brand & Jax, 2007; Meerow et al., 2016; Schiappacasse, 2018). The research on how resilience is framed in practice remains limited. However, some recent research indicates that resilience in cities is often defined based on recently experienced or well-understood risks (Agarwal, 2020; Zack et al., 2019). However, the potential impact of socio-psychological factors like risk perception on the framing of resilience in cities remains under-explored even though studies have suggested that a relation possibly exists between risk perception and resilience constructs (Ruszczyk, 2017; Satterfield et al., 2018).

In this thesis, using the City of Courtenay located on Vancouver Island as a case study, I aim to understand better the influence of officials' risk perception and conception of resilience on climate adaptation planning in the City. To this end, I employ content analysis of official documents and semi-structured interviews with municipal officials in the City in this research.

1.2 Research Objectives and Questions

The first objective of my study is to identify the factors influencing City officials' climate change risk perceptions and understanding of resilience. The second objective is to understand the effect of risk perception and conception of resilience on climate adaptation in the City. The final

objective is to observe any emerging relationship between risk perception and resilience constructs in the City.

Accordingly, my study will address the following research questions:

- What factors affect municipal officials' climate risk perceptions in Courtenay, and how do their risk perceptions influence climate adaptation planning?

- What factors affect municipal officials' understanding of resilience in Courtenay, and how does this understanding influence climate adaptation planning?

- Is there any relationship between climate change risk perceptions and understandings of resilience in Courtenay?

1.3 Thesis Structure

I have divided this thesis into seven chapters. The introduction is the first one. In the chapter, I introduced the topic of research and outlined the research questions that would be addressed. In the second chapter, I delve into the literature and in that process demonstrate the need for research focusing on climate change risk perceptions and understanding of resilience among municipal officials, and its importance for climate adaptation. Following this, in the third chapter, I have outlined the methodology used to gather and analyze data from the City of Courtenay sources. Then, I present the results of the content analysis and thematic analysis of interviews in the fourth and fifth chapters, respectively. Subsequently, in the sixth chapter, I explain the results and discuss their implications. Finally, I present the recommendations, future directions, and limitations of the study in the seventh chapter.

Chapter 2: Literature Review

2.1 Introduction

In this section, I review the academic literature to highlight existing research on the role of municipal officials in climate adaptation planning. First, I discuss the evolution of planning models and how it can benefit from considering municipal official's perceptions. Then, I present the research done in this regard in the Canadian context to demonstrate the need for considering officials' perceptions. Following this, I proceed to outline literature dealing with the resilience and climate change risk perception concepts. Finally, I present the research gaps that emerged from this literature review.

2.2 Urban Planning Models and Climate Adaptation

After World War 2, the planning model evolved to consider more scientific evidence during the planning process. This model is called the rational comprehensive rational model, and it assumes that planners would consider all alternatives, evaluate them, and chose an option that is mostly in community's interest (Hodge & Gordon, 2014). This model formed the basis of modern planning, and despite changes in perspectives, its key aspects are seen even today (Schonwandt, 2008). Present-day adaptation planning practices continue to reflect this model (Graham, 2016).

The rational comprehensive model was criticized for several reasons. The most prominent one being its very top-down approach. It has been called undemocratic for not including the public in the planning process and called out for assuming singular public interest (Davidoff, 1965; Jacobs, 1961). It was also criticized for assuming that planners and their stances are apolitical and that they should make their values explicit (Davidoff, 1965). Further, it was accused of neglecting the influence of institutional norms and values (March & Olson, 1984). These

criticisms led to the emergence of public participation theory that went on to influence planning practices across the western world.

Several planning models advocating for varying levels of public participation have emerged since then. This includes advocacy (Davidoff, 1965), communicative (Habermas, 1987), consensus (Forester, 2006), and collaborative planning models (Innes & Booher, 2004). Despite these models, the rational comprehensive model continues to overshadow planning practices in present times but with additional chances for public input (Berke et al., 2006; Yigitcanlar & Teriman, 2015). This means that the assumption that planners are apolitical and neutral actors continues to persist.

Additionally, planning theory did not recognize planners as a group of people with individual perceptions and biases until recent times. So, there has been increasing calls for planners to consider and reflect on their motivations, biases, choices, interests, and actions (Beunen et al., 2013; Binder & Boldero, 2012). This suggestion is especially crucial at this juncture as studies have shown that individual-level perceptions held by municipal practitioners go on to influence adaptation planning. Factors like understanding of resilience (Oulahen et al., 2019). and risk perception (Lee & Hughes, 2017) among municipal practitioners affect the adaptation planning processes in cities, as discussed in later sections of this chapter. Such findings warrant more investigations on how municipal practitioners' perceptions shape the adaptation planning process and outcomes. Results from these investigations can inform planning models. In the next section, I outline research done so far in Canada in this context.

2.3 Role of Municipal Officials in Climate Adaptation in Canada

In the Canadian context, several studies have examined the role of municipal practitioners in climate adaptation. Graham (2016) found that perceptions among the municipal officials about their responsibility when it comes to climate adaptation influence how they present adaptation options to the city council. She found that municipal practitioners in Metro Vancouver mostly resort to the rational comprehensive model of planning because of their perceived responsibility when it comes to climate change and institutional constraints. This means that the officials mostly try to take a "neutral" and "objective" position rather than advocate for adaptation measures. Along similar lines, Burch (2009, 2010) examined the barriers and enablers of climate action in three municipalities within Metro Vancouver. She identified behavioural and cultural factors within municipal institutions as one of the key factors affecting climate action. She further argues that the personalities of individuals in key positions within the city and culture of groups within the institution can influence local action (Burch, 2009).

A study by Oulahen and associates (2019) found that officials' understanding of the concept of resilience can also influence the choice of climate adaptation strategies. They looked at how local practitioners in the Metro Vancouver area understand the concept of resilience and apply it in climate adaptation practice. The survey conducted as part of the study indicated that more emphasis is being placed on "resilience as resistance" and "resilience as recovery" narrative. However, "resilience as creative transformation" is accorded lower emphasis. They found that their disciplinary background influences municipal practitioners understanding of resilience, and this understanding influences their choice of adaptation strategies (Oulahen et al., 2019).

Based on a study set on the Atlantic coast, Pruneau and associates (2013) found that municipal officials' traits influence climate action. They observed that to adapt their community to climate

change municipal employees in Kent (New Brunswick) engage in risk prediction, futures thinking, problem-solving, and use their local knowledge. Along similar lines, Aslam (2013) argues that climate change risk perception of officials is an important factor influencing climate change decision making in municipalities. She examined the relationship between climate change risk perception of officials and the climate policies in the city of Waterloo, Ontario.

The research done in the Canadian context indicates that individual characteristics, perceptions, and understandings of municipal officials play an important role in climate adaptation processes. But there has been limited effort to examine how various understandings and perceptions interact and overlap when it comes to municipal climate change adaptation. I choose to consider two factors influencing adaptation as identified by research– municipal officials' climate change risk perception (Aslam, 2013) and understanding of resilience (Oulahen et al., 2019).

In the following sections, I present more background information on these two factors and discuss how the field of planning can benefit from considering these factors.

2.4 Risk Perception

Risk is defined as the "a combination of the probability, or frequency, of occurrence of a defined hazard and the magnitude of the consequences of the occurrence" (Harding, 1998, p. 167). Moreover, Slovic (1999) argues that risks are socially constructed. Accordingly, risk perception is described as a subjective assessment or judgement made by people about the occurrence of an adverse phenomenon (Darker, 2013; Slovic, 2000). Risk perception has been used to collate and understand varying levels of worries and concerns about natural and man-made risks. It is said to indicate the willingness of people to take action to reduce that risk (Leiserowitz, 2006; O'Connor et al., 1999).

Rational action theory argues that individuals make best possible decisions after considering all information, potential costs and benefits (Scott, 2000), could incite one to assume that knowledge about risk and certainty of occurrence would determine how one perceives risk. This idealistic outlook doesn't hold for the public as they usually make decisions based on informal thought processes (Paek & Hove, 2017). For example, when your family member or friend dies in a car accident, you are more likely to perceive that driving poses a serious risk. To explain such tendencies that are not explained by simplistic models, better theoretical frameworks were proposed to explain how risks are perceived.

Several concepts have been used to conceptualise risk perception, out of which psychometric paradigm (that delves into cognitive dimensions) (Kahneman et al., 1982; Slovic, 1987), cultural theory (that delves into the cultural origin of risk) (Douglas & Wildavsky, 1982), and the social amplification of risk theory (forefronts the role of communication channels in risk amplification and attenuation) (Kasperson et al., 1988) are the most prominent. I have explained these theories in the next section.

2.4.1 Theories

Psychometric paradigm developed by Slovic (1987) has its origin in psychology. It takes into consideration both the cognitive and emotional dimensions of risk perceptions and assumes that risks don't exist independent of human minds (Slovic, 1992). It also assumes that risk is subjectively perceived by an individual based on influences from different social, psychological, cultural, and individual factors (Sjoberg et al., 2004).

This framework suggests that people make risk judgements based on several risk characteristics and heuristics (rule of thumbs) to estimate how the risk would affect them (Helgeson et al.,

2010). Some of the risk characteristics they would consider include perceptions, attitudes, costs to society and benefits or trade-offs for society (Slovic, 1987; Aslam, 2016).

Psychometric paradigm attempts to quantify lay public risk perceptions alongside expert risk perception. Slovic (1987, 2015) argues that the application of this framework in research has shown that these two groups perceive riskiness of events or hazard differently because they define risks differently. He further argues that public's understanding of risk is subjective and complex owing to the incorporation of considerations like controllability, uncertainty, equity, dread, etc., whereas, experts looked at it in technical terms– risk meant the possibility of harm or expected mortality.

Sociologists and anthropologists developed the cultural theory of risk, and it suggests that social and cultural forces play an important role in how people perceive risks (Marris et al., 1998). The proponents of the theory also argued that the way risks are constructed in a social arena are not inseparable from issues of power, legitimacy, and justice (Tansey & O' Riordan, 1999). For this reason, Douglas and Wildavsky (1982), leading proponents of cultural theory, have critiqued the cognitive and affective conceptions of risk perception for not considering the socio-cultural and political nature of risk.

In line with cultural theory proponents' assertions, studies have found that culture and social factors affect how people construct risks individually. For example, public in different parts of the world perceives hazard-related risks differently depending on what their news media chose to report, their cultural norms etc. (Keown, 1989; Sjoberg et al., 2004). Even proponents of the psychometric paradigm have acknowledged that cultural and social factors affect risk judgements (Sjoberg et al., 2004).

Another major theory that has attempted to explain risk perception is the social amplification of risk theory. This theory tries to incorporate aspects of both psychometric and cultural theories (Kahan, 2012). Kasperson et al. (1988) were the proponents of this theory, and they assert that "hazards interact with psychological, social, institutional, and cultural processes in ways that may amplify or attenuate public responses to the risk or risk event". This theory was an attempt by proponents to create a unified framework that can account for findings from different kinds of risk perception studies including media studies, cultural theory, and psychometric paradigm (Kasperson et al., 2003).

2.4.2 Climate Change Risk Perception Models

Climate change risk perception (CCRP) specifically refers to judgements of risks associated with climate change. This field of research has been greatly influenced by the theoretical debate outlined in the previous section.

Much of the literature on this topic has focused on understanding public risk perceptions. This is because of the push for democratization and people-centric decision making in the last few decades (O'Riordan & Jordan, 1999; Steg & Sievers, 2000). Understanding how the public perceives a risk allows policymakers and bureaucrats to assess what is important to the community they serve. Further, it allows them to understand the level of support for various climate and hazard mitigation and adaptation policies (Leiserowitz, 2006). CCRP is also studied because it can influence the willingness of people to act and change behaviour (Leiserowitz, 2006, Semenza et al., 2008, Spence et al., 2012, Tobler et al., 2012, van der Linden, 2015).

Over the last three decades, several climate risk perceptions models have been proposed to explain how the public thinks and behaves. These models have taken different psychological,

cultural, and social variables to explain and predict climate change risk perception. These models have been quantitative in nature. For example, Akerlof et al. (2013) considered personal experience, cultural worldviews, political ideology, place attachment, and socio-demographics to explain local climate change risk. Taking a different approach from Akerlof and associates, a model proposed by Spence et al. (2012) only considered uncertainty, temporal and spatial distance to calculate risk perception index. These examples show that models have used variables that are related but not comparable to account for risk perceptions (van der Linden, 2015). The explained variance of these models varied according to the variables they chose to base their models on. The explained variance of models proposed by Akerlof et al. (2013), Spence et al. (2012), and Brody et al. (2008) are 55, 54, and 42 percentage, respectively.

Recognizing the need for a more systematic organisation of social-psychological determinants to explain climate change risk perception, van der Linden (2015) proposed the Climate Change Risk Perception Model (CCRPM). He attempted to integrate all the primary dimensions that influence risk perception to climate change, as indicated by previous research. He included socio-demographic, cognitive, experiential, and socio-cultural factors. Some of the important variables that he considers a part of these determinants include knowledge, personal experience, affect (feelings about specific ideas, objects, or images), and values. His model incorporates tenets of psychometric as well as cultural theory, and its explained variance value stands at 70 per cent, highest among all models. van der Linden's (2015) results were based on a study conducted in the UK, and it has been replicated in a recent study by Xie et al. (2019) in the context of another western country, Australia.

2.4.3 Climate Change Risk Perception of Government Officials

All the climate change risk perception models have been formulated to understand and explain the predictors of public perceptions of risk. This attention is given to public perceptions is justified, given the divisive opinions on climate change and the need to identify appropriate strategies to address climate change despite differences (Leiserowitz, 2006). Alongside public perceptions of risk, perceptions of experts are often considered by studies to showcase that there are different variables influencing risk judgements (Slovic, 2015). Earlier studies often argued that expert perceptions of risk are more objective in comparison to public perceptions. However, studies later noted that even expert perceptions are subjective and are affected by their organisational affiliation and role (Slovic, 2015).

The role of experts and public perceptions are inarguably important to the conversation about climate action and adaptation. However, there are multiple players in the field of climate change planning who are powerful and can influence the agenda and discourse at various levels. Some of the most important players are government officials. They also happen to be the main beneficiaries and consumers of risk perception studies that focus on the public and experts as it allows them to formulate appropriate policy interventions (Leiserowitz, 2006).

The level of influence government officials has over the community's climate change responses can be understood by the findings of Lee & Hughes (2017). They investigated the factors influencing climate change adaptation strategies in 58 cities across the globe and found that "the number of climate change hazards that decision-makers perceive to be of relevance to their city is the only factor that consistently influences the scope of urban climate change adaptation agendas" (Lee & Hughes, 2017). Other studies have also acknowledged the importance of risk perception of decision-makers (Tang et al., 2010; Zimmerman & Faris, 2011). Despite the level

of influence that these officials have over the mitigation and adaptation agenda, there are only a handful of studies that have studied how they perceive risks due to climate change (Aslam, 2013; Measham et al., 2011). In the next few paragraphs, I provide an overview of key findings from the existing studies that have attempted to identify factors influencing the risk perception of government officials.

A study conducted by Mozumdar and associates (2011) in the Florida Keys found that more work experience and education positively influenced officials' risk perception to loss of land to sea-level rise. Further, they found that gender and work experience influenced the perception of adverse economic impact due to sea-level rise. Findings from a study conducted by Guariguata, Locatelli and Haupt (2012) also indicate that work experience affects risk perception positively. They studied the climate change risk perceptions of officials in forest management sector across the world. Aslam's (2013) study also indicate that more experience positively impacts climate change risk perception.

Stedman (2004) studied the climate change risk perceptions of policy actors from across Canada, and his findings indicate that risk perceptions are affected by general beliefs or worldviews in addition to person's position in the policy process. He included actors from diverse fields including industry, government, academia and environmental groups. Along similar lines, a study by Siña and associates (2016) focused on understanding risk perceptions of decision-makers in Lima, Peru. They found that knowledge of climate change was lacking, and that the awareness of climate risks was tied to socio-economic status and personal experience with extreme weather events. Lehman and associates (2015) also observe the lack of knowledge and awareness of climate change and its impacts in Santiago, Chile. They further note that this might be true in the case of cities in developing countries.

It can be observed that the studies focusing on municipal officials' climate change risk perception have mostly attempted to identify factors influencing their risk perception and a limited attempt has been made to explain how their risk perception influences actions in cities. This aspect requires further investigation.

In the following sections of the chapter, I argue for the need to explore the relationship between risk perception and the conception of resilience. To this end, first, I provide an overview of the literature on resilience. Then, I discuss research literature that has examined any relationship between these two constructs.

2.5 Resilience

In this section, I provide an overview of the importance of the resilience concept and demonstrate the need for understanding how resilience is framed in cities.

2.5.1 Different understandings of resilience

The modern resilience theory is considered to emanate from C.S. Holling's work in the field of ecology. He defines resilience as a system's ability to withstand shocks and maintain critical characteristics (Holling, 1973). But resilience theory is not just limited to the field of ecology as now increasingly other fields like natural disasters and risk management (Gaillard, 2010; Rose, 2007), climate change adaptation (Tanner et al., 2009; Tyler & Moench, 2012) and planning (Davoudi, et al., 2012; Wilkinson, 2011) have applied and used it. But it has been defined differently in different academic fields and the public realm (Masten, 2014; Meerow et al., 2016). It is defined and interpreted differently, even within the same disciplines. Conceptual contestations in the field of ecology and disaster studies are presented below.

Mainly, three perspectives on resilience have emerged: engineering, ecological, and socio-ecological. Holling (1996) explained how engineering and ecological resilience had different underpinnings. He associated engineering resilience perspective with a system's capacity to maintain a steady or equilibrium state after disturbances. This engineering-based perspective strives to maintain the status quo, efficient functioning, and consistency (Folke, 2006; Holling, 1996; Gunderson, 2000). On the other hand, ecological resilience perspective takes contrary positions. It suggests that there can be multiple states of equilibrium, and system can still maintain functionality (Gunderson, 2000). So, this system can exist in the face of uncertainty and unpredictability. The disturbances, in this case, can also lead to behaviour changes to attain stability. Both perspectives assume a closed system and have been criticized for not questioning current norms of behaviour and being reactive by White and O'Hare (2014). The third perspective, socio-ecological resilience suggests that disruptions can present opportunities to innovate, re-organise, adapt, and progress in addition to the ability to return to the pre-disturbance state (Folke, 2006; Klein et al., 2003). This resilience concept also theorises that the stability of the system depends on the interaction of subsystems, not the stability of each component (Walker et al., 2002; Agarwal, 2020).

In disaster studies, initial conceptions took the engineering resilience perspective as it emphasized mitigation measures, i.e. reactive measures (Cutter et al., 2008). However, this position evolved to include social dimensions. Manyena's (2006) definition of resilience deviates from the engineering perspective and incorporates social dimensions while also acknowledging the need for changing behaviours, adapting, and altering social structures. The evolution of the resilience perspective follows the trend observed in ecology. Along the lines of socio-ecological perspective, evolutionary perspective in hazard studies advocates for adaptation, improvisation

and innovation when provided with an opportunity (Paton & Johnston, 2006). Further, resilience in disaster studies is understood as both a process and an outcome (Agarwal, 2020). These conceptions in the field of disaster studies have influenced how urban resilience is theorised, and this is explained in the next section.

2.5.2 Interpretation of Resilience in Cities

In recent times, strategies for increasing resilience are being adopted by cities across the globe as part of their climate change adaptation or mitigation efforts (Crichton, 2007; Leichenko, 2011; Revi, 2008; Sanchez-Rodríguez, 2009). Literature indicates that urban resilience concept borrows heavily from the field of disaster studies. Critique of the resilience concept follows the trend similar to that of disaster resilience outlined above. The engineering perspective of urban resilience that advocates for recovery and return to normalcy has been criticized heavily by Davoudi et al. (2012) and White & O'Hare (2014) for maintaining status quo and being reactive. So, a social-ecological perspective of resilience is suggested in the urban context as cities are a combination of several subsystems (Sharifi & Yamagata, 2018; Wilkinson, 2012). Further, the socio-ecological perspective can enable behavioural or institutional change. Even though these theoretical debates are in existence, academics continue to take different stances when it comes to conceptualising urban resilience.

The meaning and definition of urban resilience are very malleable with about 25 different definitions existing in academic literature (Meerow et al., 2016) and similar differences in understanding among practitioners (Meerow & Stults, 2016). Bene et al. (2018) further observe that definitions of resilience vary when it comes to their specificity, ranging from very specific to general to not defined at all. They also argue that resilience has been used as a goal, an indicator of sustainability, a metaphor, or an analytical framework.

There are several different understandings of resilience, but Bahadur & Tanner (2014) argue that most of the definitions of resilience promote a business as usual and don't question the economic and political status quo. This is because they subscribe to the current form of governance and don't seek transformational change to the present systems. Transformational changes are perceived as expensive and risky, whereas adaptation is viewed favourably as it maintains the status quo (Redman, 2014). This impacts the long-term sustainability of cities (Béné et al., 2018).

Brand & Jax (2007) argue that the lack of consensus about the definition of urban resilience has allowed this concept to act as a "boundary object". The concept of boundary object was introduced by Star & Griesemer (1989, p. 393) and they define it as "objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites". The role of resilience as a boundary object allows multiple stakeholders to converge and collaborate, but it makes urban resilience a difficult concept to operationalise (Gunderson, 2000; Pizzo, 2015; Vale, 2014).

Literature has indicated that resilience isn't understood and conceived similarly by academics, cities or stakeholders within these cities (Brand & Jax, 2007; Meerow et al., 2016; Schiappacasse, 2018). This was reinforced by Agarwal (2020), who investigated how resilience is framed by three different cities. The framing of resilience was found to be influenced by stressors, focusing events, development objectives, and institutional context. It was also found that definitions of resilience adopted by the cities do not subscribe to any particular perspective of resilience (Agarwal, 2020).

2.6 Risk Perception and Resilience

Understanding of resilience concept in cities is ambiguous, and this ambiguity can work in favour of certain interest groups. To counter the possibility of undue influence from powerful groups, researchers have argued that resilience of what to what should be better described (Brand & Jax, 2007; Gillard, 2016). Meerow et al. (2016) further argue that in addition to resilience of what (or whom) to what, it is important to also describe when, where, and why.

Despite such suggestions to conceptualise and operationalise resilience, Sharifi (2016) observes that resilience is a value-laden concept that is influenced by perceptions, attitudes, and preferences of the actors involved. Reinforcing this value-laden and attitude driven nature of resilience, Forsyth (2018) argues that there might be perceptions and assumptions among actor(s) that certain resilience pathways are universally beneficial or that certain risks are experienced at the same level by all stakeholders. So, some scholars have expressed concerns that common approaches to resilience have the potential to be socially exclusionary if they neglect different experiences of risk among stakeholders, i.e. if some risk narratives are considered more valid than others (Agrawala & Van Aalst, 2005; Folke et al., 2010; Forsyth, 2018; Nelson et al., 2007). Arguing along similar lines, Borie et al. (2019) observe that some views might be considered more important resulting in the alienation of others' views. Therefore, they point out that whose risk perceptions and understandings of risk are made integral to the framing of resilience and how matters. Like Borie et al. (2019), several studies have identified risk perception as a key influencer when it comes to how communities plan to enhance resilience to future risks without delving into many conceptual details (Adger, et al., 2009; Botha,2014; Dodman et al., 2010; Fatti & Patel, 2013; Messner and Meyer, 2006).

It can be noted that risk perception has been employed in two different ways in resilience literature. In the first case, it has been projected as an important factor influencing how resilience is framed and understood as outlined above. In the second case, risk perception among stakeholders has been projected as one of the indicators of resilience. That's why risk perception finds a place in some resilience assessment frameworks to indicate disaster preparedness (e.g. Hung et al., 2016). Since this thesis focuses only on how resilience is framed, the role of risk perception in resilience assessment frameworks is beyond the scope of this study.

Béné et al. (2016) argue that risk perception literature has dealt with how varying levels of risk perception lead to different understandings, actions, decisions, and responses in the context of vulnerability but haven't focused on resilience. They also argue that such discussion should be extended to resilience as several scholars have observed that resilience is socially constructed just like vulnerability (Adger, et al., 2009; Béné et al., 2016; Christmann, Balgar, & Mahikow, 2014; Kasperson et al.,1988).

Further, there is a lack of studies that explain how risk perception and understanding of resilience interact and evolve in either risk or resilience literature. Correspondingly, Satterfield and associates (2018) point out that risk perception research has not yet operationalised key constructs like resilience. Likewise, Ruszczyk (2017) argues that resilience lens essentially ignores people's risk perceptions. Therefore, there is a need for research focusing on the relationship between the framing of resilience and risk perception.

2.7 Key Findings

Through this literature review, I have learnt that municipal officials' perceptions and characteristics play a key role in climate adaptation planning (Aslam, 2013; Burch, 2010;

Graham, 2016; Lee & Hughes, 2017). This observation seems logical because planning continues to reflect the rational comprehensive model, i.e. bureaucrats have a greater say in the planning process (Schonwandt, 2008).

Correspondingly, this review showed me that climate change risk perception and understanding of resilience among municipal officials are important factors influencing adaptation planning. However, only limited research has focused on identifying and understanding the factors influencing officials' climate risk perceptions and the impact of these two factors on climate adaptation planning.

Additionally, this review showed me that risk perception and resilience conceptions share a relationship, but it is not defined or established in literature (Satterfield, 2018; Ruszczyk, 2017). This warrants further investigation.

2.8 Research Questions

Considering the key research gaps that have emerged in this chapter, I aim to understand better the municipal officials' role of risk perception and resilience conception in climate adaptation planning. To this end, I take up the case of Courtenay, a coastal city in British Columbia.

My study will address the following research questions:

- What factors affect municipal officials' climate risk perceptions in Courtenay and how do their risk perceptions influence climate adaptation planning in the City?

- What factors affect municipal officials' understanding of resilience in Courtenay and how does this understanding influence climate adaptation planning?

- Is there any relationship between climate change risk perceptions and understandings of resilience in Courtenay?

I used a qualitative approach to address these questions. The details of the study area and methodology are outlined in Chapter 3.

Chapter 3: Methods

In this chapter, I identify the methods used to address the research questions outlined in Chapter 2. First, I describe the City of Courtenay that is going to be the subject of this case study and discuss the reason for choosing it. In later sections, I explain the different qualitative methods that have been used to gather, sort, and analyze data in detail.

3.1 Description of Study Area

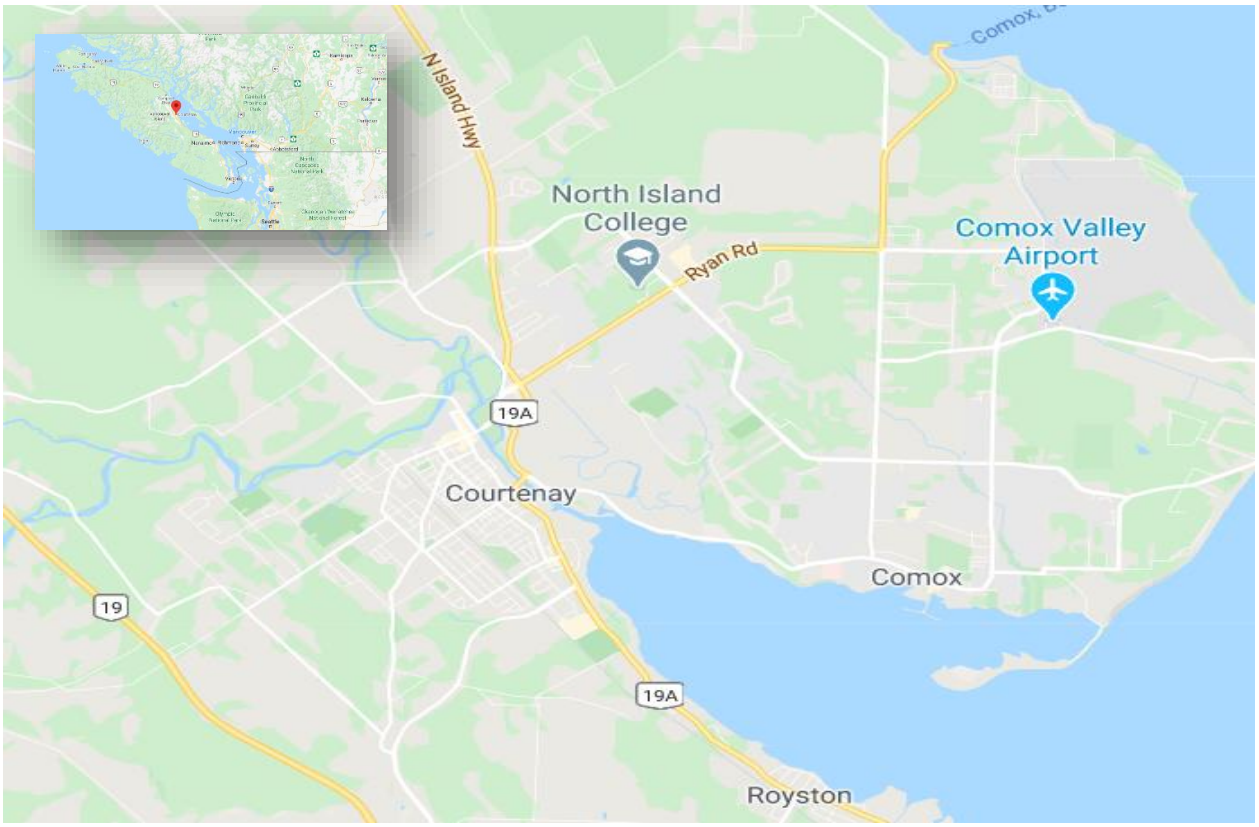
Courtenay is situated within the traditional lands of the K'ómoks First Nation on the east coast of Vancouver Island, British Columbia (City of Courtenay, n.d.). It is located at the confluence of two rivers, Puntledge and Tsolum, and these two rivers join to form river Courtenay before flowing into the Strait of Georgia. There are settlements on both sides of the river and as of 2016, 25599 people lived in Courtenay (Comox Valley Regional District, n.d.).

The City is situated in Comox Valley region, one of the fastest growing regions in British Columbia (Comox Valley Economic Development Office, n.d.-a). Canadian Forces Base located in Comox is the largest employer in the Comox region. Also, Courtenay caters to the needs of a large retiree community spurring economic growth while also seeing a growth in the tourism sector (Comox Valley Economic Development Office, n.d.-a). The municipality of Courtenay is the fifth largest employer in the region with approximately 340 employees (Comox Valley Economic Development Office, n.d.-b).

The City has experienced several flood events in the last decade with the last major one taking place in 2014 (City of Courtenay, 2014). As it is located on an estuary, flood events occurring in the City usually coincide with winter storms and rising tides. In addition to this, droughts have become more common over the years in the region as well with different levels of water

restrictions being put in place every year ("Eastern Vancouver Island now under Level 4 drought conditions", 2018; City of Courtenay, 2017, 2019).

Figure 3. 1: Map of City of Courtenay



Given the increased possibility of exposure to such events because of climate change, the City has been taking measures to adapt to these events and many of these efforts are ongoing. Identifying and understanding the factors influencing the adaptation process at this point can allow for incorporation of this knowledge in City's adaptation process. Further, I decided to

choose a city that is actively taking efforts to adapt to climate change. So, Courtenay was a suitable case to examine the nuances involved in the climate adaptation planning process.

However, the foremost reason for choosing Courtenay for this study was the opportunity for collaboration with the City. In 2019, I got an opportunity to work on a collaborative project between the University of Waterloo, Urban Systems Ltd. (an engineering and planning consultancy), and the City of Courtenay. This collaboration involved monetary commitments from all three parties, and they had outlined their desired outcomes from the project. The University's aim was to gain more insight about municipal officials' role in climate change adaptation using the case of Courtenay. Accordingly, my thesis research attempts to achieve this aim.

I aim to understand the processes shaping climate change adaptation in the City, more specifically the role of municipal officials' risk perceptions and understanding of resilience in shaping climate adaptation. I also observe how resilience narratives are shaped in the City and the influence of municipal officials' understanding of resilience on the narratives.

3.2 Data Collection

In this study I take a qualitative approach to address the research questions outlined in Chapter 2. I use two distinct sources, official documents and semi-structured interviews with municipal officials, to gather qualitative data on framing of climate change and resilience in the City of Courtenay.

In the case of qualitative research, reliability is established by demonstrating consistency (Guba & Lincoln, 1994). This means that the researcher should maintain a clear 'decision-trail' and another researcher should be able to find comparable results. To demonstrate consistency, I have

included rich verbatim quotations wherever possible and described all the steps involved in data collection and interpretation transparently.

Additionally, in qualitative research, there are concerns about researcher bias and therefore, transparency when it comes to researcher's value orientation is important. My position in favour of proactive climate change mitigation and adaptation is reflected in the choice of research topic. Accordingly, I focused on barriers and enablers of municipal climate adaptation to advance adaptation efforts.

3.2.1 City of Courtenay Official Documents

Official publications and documents can provide insight into how organizations function and what values cum practices guide their decision making (Bowen, 2009). So, to understand how climate change and resilience is framed in the City, I review the official documents of the City of Courtenay available in public domain. I had access to documents starting from the year 2008 onwards as documents prior to that year were not available on City's website. Also, the City council minutes were only available online from the year 2011 onwards.

The City of Courtenay's website www.courtenay.ca has a search function that enables using key words to find all documents mentioning specific terms. So, I entered the keyword "climate" to find all documents mentioning climate change or climate hazards. Similarly, I used the key word "resilien" to find all documents mentioning the terms resilience, resilient or resiliency. In this manner, I compiled all the City documents from 2008 to June 2020 that contain the terms "climate" and "resilien". Following this, content analysis of these shortlisted documents was conducted, and this process is explained later in the chapter.

3.2.2 Interviews with City Officials

3.2.2.1 Recruitment

My objective was to recruit municipal officials from the City of Courtenay to understand how they perceive risks due to climate change and understand resilience, and further, how it affects the climate adaptation in the City. Therefore, it was important to include officials in senior policy positions within the City who would have say in the adaptation strategies. Further, it is important to include officials from different departments of the City to ensure inclusion.

I recruited interview participants with assistance from the City of Courtenay's Engineering Services department. The staff from the department provided me with email contact details of officials from various departments in the City who might be interested in participating in my research. I contacted the officials using the provided email address and informed the potential interview participants about the nature of research and the time they would have to spare if they wished to take part in the interview. The documents used for recruitment can be found in Appendices C, D, and E. The officials willing to take part wrote back and then, we decided on an appropriate time to conduct the interview. This recruitment process was initiated in October of 2019 following the study approval from the University of Waterloo Research Ethics Committee (ORE #41041).

3.2.2.2 Interview

To better understand how municipal officials perceive risks due to climate change and understand resilience, I conducted semi-structure interviews. Semi- structured interview was chosen over unstructured interviews or structured interviews because it allows focus to remain on issues of interest while also allowing room for additional observations to emerge (Fylan, 2005). Using this technique, I asked officials specific questions to about how they perceive

climate change, associated hazards and resilience. I also gathered their personal information like gender, age, and educational background through the interviews as risk perception might be influenced by personal characteristics. During the course of the interview, I introduced a discussion piece outlining some of the latest climate change induced sea level rise projections for the region and gather their reflections on what this means for the City of Courtenay. I have included interview script and the discussion piece in Appendix A and B, respectively.

Of the seven contacted officials from four different departments of the municipality, five responded to the recruitment emails conveying their willingness to be interviewed. Considering the size of the municipality, five interviewed officials account for ~20% of the total officials in senior positions like director, deputy director or manager in the City. I was unable to recruit and interview more officials because of challenges associated with COVID 19. I conducted all interviews between December 2019 and February 2020.

The interviews were conducted over phone and lasted about 40 minutes each. These conversations were audio recorded after getting the interview participant's consent. Following the interview, all interview conversations were verbatim transcribed to enable further analysis. Thematic analysis was used to analyze these transcripts. It is explained in more detail in the data analysis section.

3.3 Data Analysis

I used appropriate analysis techniques to comb through and identify themes in identified official documents and semi-structured interview transcripts. I outline these methods in this section.

3.3.1 Content Analysis of City Documents

I used content analysis to analyze the City documents mentioning "climate" and "resilien". Content analysis refers to different types of analytical approaches that range from intuitive to systematic and researchers choose approaches that best suits their interests and needs (Hseih & Shannon, 2005; Rosengren, 1981; Weber, 1990). For the current research, systematic approach was used. So, I subscribe to Erlington and Brysiewicz's (2017) assertion that content analysis aims to systematically convert large quanta of texts into very organised and concise summary of texts. It involves familiarizing text under consideration, so that the core meaning remains the same while coding. In essence, this analysis includes, familiarization, dividing text into meanings and units, formulating codes and identifying themes. During this analysis, a researcher initially deals with manifest content and then proceeds to seek latent content in the data (Graneheim et al., 2017). Manifest content refers to the what is readily observable in the data, whereas latent content refers to what lies beneath the literal and manifest content (Erlingsson & Brysiewicz, 2017). Further, both deductive and inductive approaches can be used in content analysis in addition to abductive approach that implies shifting between deductive and inductive approaches (Graneheim et al., 2017).

In content analysis of Courtenay's official documents, I analyzed manifest as well as latent content when it comes to framing of resilience and climate change in the City. Further, I used both inductive and deductive approaches in this analysis. I used inductive approach for analysing the both framing of climate change and resilience. But when it came to framing resilience, the results resembled an already existing theorization. So, I shifted to deductive approach and used the theory by Carpenter and associates (2001) that calls for defining resilience in terms of systems it is framed in reference to and the risk or threat with respect to which it is framed i.e.

resilience of what to what. Agarwal (2020) used the similar approach to understand framing of resilience.

First, I familiarized myself with the documents that mention climate. In that process, I excluded the documents that did not provide any context or were not authored by or for the City administration. I also excluded documents that appeared more than once in some format. I used inductive coding to characterize how climate change risk narrative was framed in the City. I identified the range of words used to describe the risks of climate change. I further identified the risks that were used to justify the climate change risk narrative. I also identified actions taken by the City to adapt to climate change and associated hazards.

I followed the same criteria as above for exclusion and inclusion when it comes to documents that mention "resilien". When it comes to coding, I used inductive coding to initially identify aspects of resilience and resilience actions. But preferred deductive coding to be able to characterize resilience and created two themes – "resilience of what" and "resilience to what". I used Microsoft excel to store and sort all data and create graphs.

I also created Sankey diagrams using RAWgraphs (https://app.rawgraphs.io) to represent relationships between different components. Traditionally, Sankey diagrams are used to visualizer or represent flows of resources or energy (Lupton & Allwood, 2017). However, they are also used to represent arbitrary data in different ways. In my study, Sankey diagrams were used in two ways. First, they were used to represent the relationship between the climate hazards identified and risk perceived. Second, they were used to show how resilience is framed in terms of "resilience of what to what". The results of content analysis are described in Chapter 4.

3.3.2 Thematic Analysis of Interview Transcripts

Thematic analysis is a method used for "identifying, analysing, organizing, describing, and reporting themes found within a data set" (Braun & Clarke, 2006; Nowell et al., 2017). Further, thematic analysis is flexible and is compatible with various theoretical frameworks (Braun & Clarke, 2006). It also considers both latent and manifest content in analysis. So, it is a good fit for analysing the semi-structured interviews conducted as part of this study.

According to Braun & Clark (2006) thematic analysis consists of six phases: familiarizing oneself with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing report. All these steps were followed while analysing all 5 interview transcripts using an inductive approach. After reading and re-reading the transcripts several times, I created initial codes to describe how officials perceive climate change and understand resilience. I also created codes for the kinds of risks they identified with reference to climate change and resilience. Further, I created codes to describe their role during any climate induced extreme events.

The initial codes were revised after reading the transcript again. Following this, they were analyzed to find different themes they would fit into and then the themes were defined and named. I used Microsoft Excel spreadsheet to tabulate the codes from different interview transcripts, compare them, identify and refine themes. The results of thematic analysis are outlined in Chapter 5.

Chapter 4: Framings of Climate Change and Resilience in Courtenay City Documents

4.1 Introduction

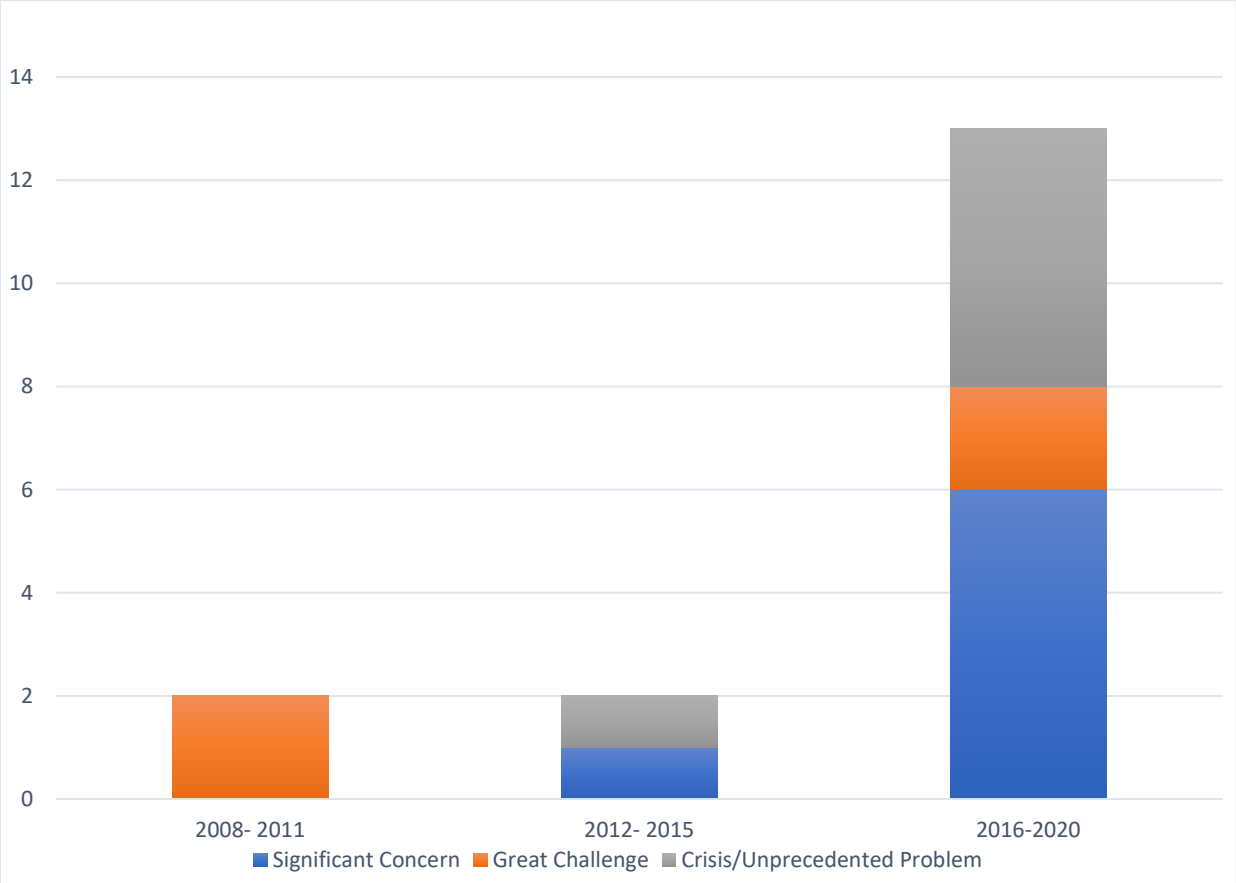
In this chapter, I present the findings of the content analysis of all official documents and news releases of the City of Courtenay available online. Based on the analysis of documents from 2008 to 2020, I observe that there are increasing discussions about climate change that frame it as a credible threat to the community. However, there are notable differences in how the risk due to climate change is framed within the City, indicating varying risk perceptions. Further, I found that in relation to climate change, City acknowledges eight key risks, but they are all framed differently. Also, I identified Climate Adaptation Actions taken by the City in relation to the acknowledged climate hazards. When it comes to resilience, I found 11 different narratives in the City and identified resilience actions outlined by the City. In the following sections, I describe in detail how climate change, climate change risks and resilience are framed in the City.

4.2 Framings of Climate Change

In the City of Courtenay, I found 182 documents and news releases that deal with climate change. These documents include Council Minutes, Staff Reports, Plans, Strategies, News Releases, Stakeholder Engagement Materials, and Informational Materials. On reviewing these documents, I found that only 17 documents characterized and described climate change and the number of documents characterizing climate change has noticeably increased in recent years with 13 out of 17 documents appearing between 2016 and 2020. This uptick could be a response to a significant flood event in Courtenay in 2014 (City of Courtenay, 2014).

On manifest content analysis of these documents, I learned that they convey different perceptions of risk when it comes to climate change and its impacts on the community. I found that risk perception when it comes to climate change impacts is conveyed by the usage of words like "crisis", "great challenge" and "significant concern". Accordingly, I created three broad categories reflecting different characterizations of climate change. Figure 4-1 shows how documents conveying concerns are distributed temporally.

Figure 4. 1: Temporal distribution of City documents characterizing climate change differently



In Courtenay, I found that characterization of climate change as a "Crisis/Unprecedented problem" has gained traction since 2019. This trend coincides with the climate emergency declaration by the City Council. The number of documents characterizing climate change as a "significant concern" are also on the rise in recent years. This narrative has been the most dominant with seven out of 17 documents indicating relatively lower risk perception. Most of these documents appear between 2016 and 2020 alongside documents describing climate change as a "Crisis/Unprecedented problem". Characterization of climate change as a "great challenge" was the least common trend in the City documents, with only four documents characterizing it that way.

These different characterizations of climate change indicate that risk perception to climate change is varied within the City. The usage of multiple terminologies to describe climate change risk also indicates inconsistent messaging and climate risk communication within the city. The following excerpts from documents exemplify how some City documents describe climate change:

"The climate crisis has arrived in Courtenay." (Courtenay Citizen's OCP Exploration Workbook, 2020)

"Climate change is one of the most serious challenges we face, particularly as we see these extreme weather events increasing in frequency." (Courtenay Achieves Climate Action Milestone, 2019)

"Unchecked, climate change is expected to have significant impacts on ecosystem integrity, water supply, fluctuations in temperature and food supply in the Comox Valley." (Courtenay Official Community Plan - Appendix A to Bylaw No. 2387, 2016)

4.2.1 Climate Hazards Identified

While describing the seriousness of climate change, most of the documents ventured to explain the climate hazards that make it a matter of concern as seen in the sample excerpts included in the previous section. Based on manifest content analysis, I found eight climate change associated hazards mentioned in the documents. In total, there were 28 mentions of these hazards in 18 documents characterizing climate change. “Flooding and extreme weather events” finds 10 mentions (31%) and this makes it the most commonly identified climate hazard in Courtenay.

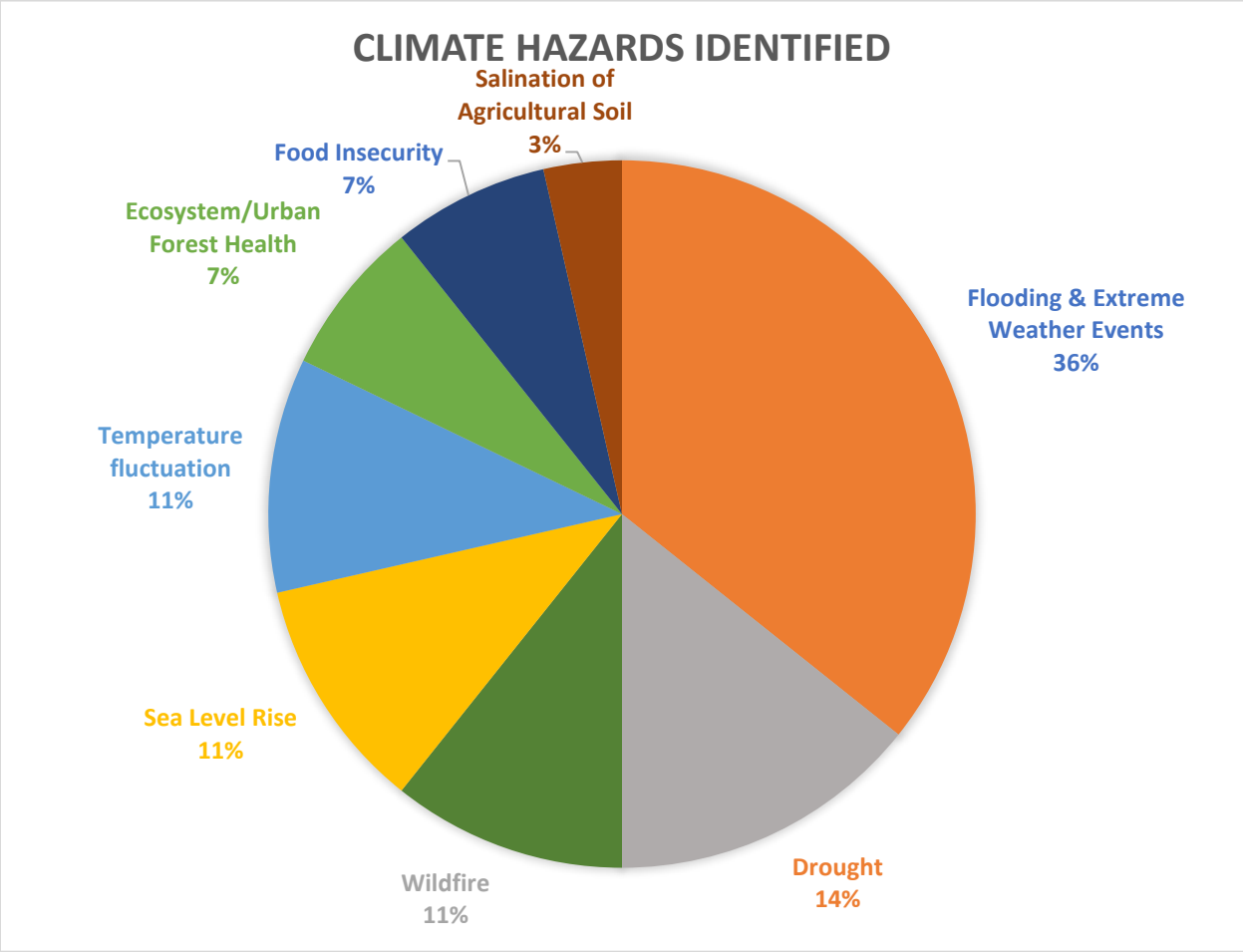
Drought is mentioned in four out of 32 times (13%) whereas wildfire, sea-level rise and temperature variation are mentioned only three times each (9.3%). Other identified hazards include “Ecosystem and Urban Forest Health” (2), “Food Insecurity” (2) and “Salination of Agricultural Soil” (1). Only in four out of 18 documents, climate change was characterized as a matter of concern without mentioning any specific associated hazard. The top hazards that are associated with climate change in the documents are the ones that have already been experienced by the community.

At this juncture, to further visualize how these various climate change associated hazards were used as justifications for different levels of risk perception in documents, I have prepared a Sankey diagram (Figure 4-3). I have employed a Sankey diagram to show how the characterization of climate change relates to the climate hazards identified in the respective documents. In the diagram, the width of each band represents the number of times the climate hazards were used to characterize climate change in a certain way.

Both Figure 4.2 and Sankey diagram show that the climate hazards already experienced by the City like flooding and drought find more mentions than other threats. The diagram also shows

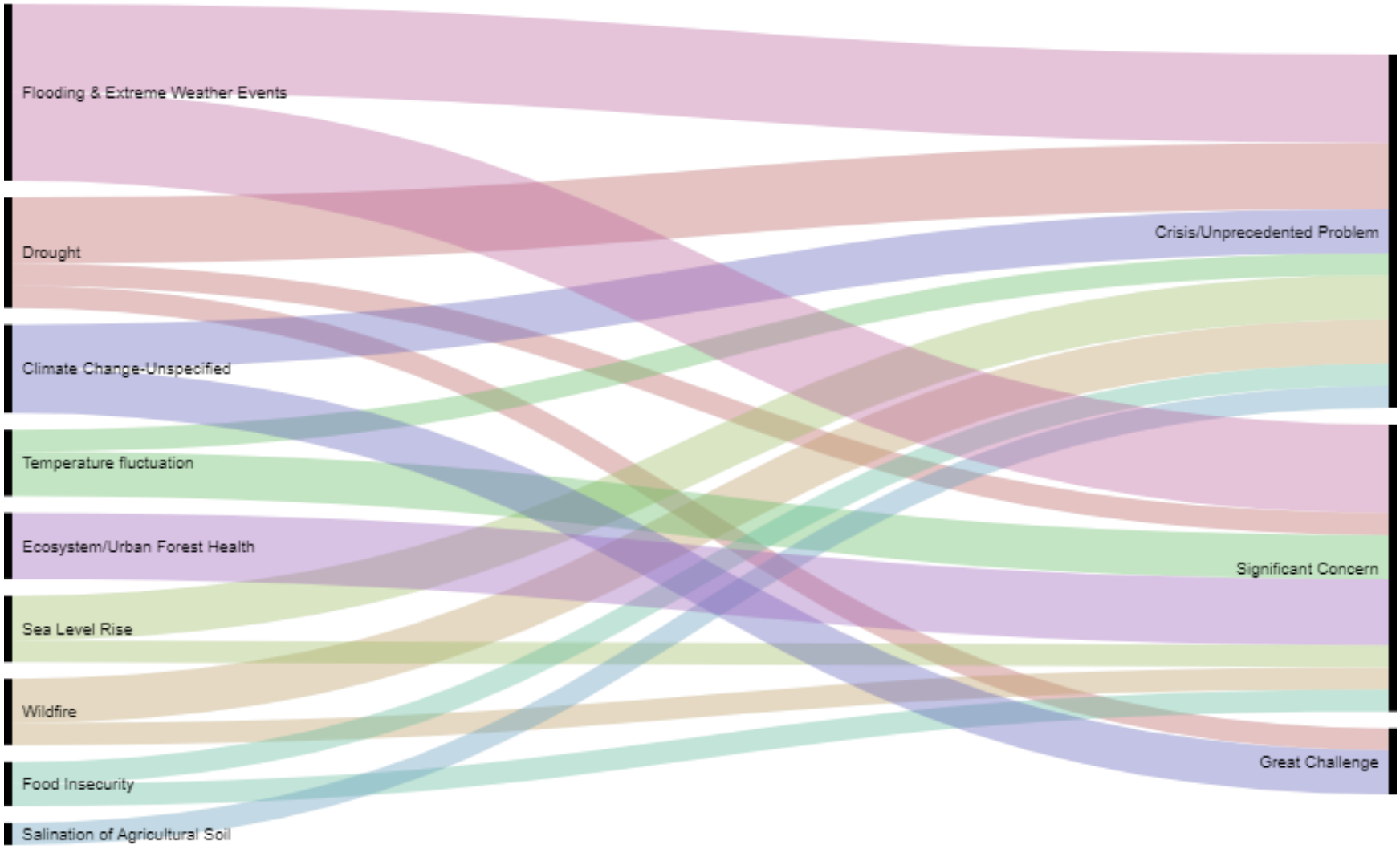
that these major hazards were characterized in more than one way. Similarly, I found that some of the other hazards like “Temperature Fluctuation” and “Sea Level Rise” were also characterized in more than one way. This indicates that there is disagreement within the City when it comes to how much threat these climate hazards pose, i.e. different perceptions of risk coexist within the City.

Figure 4. 2: Identified Climate Hazards



Overall, “Significant Concern” and “Crisis/Unprecedented Problem” remain the two common ways of characterizing most of the climate change hazards. In four documents where no climate change associated hazards were specified, climate change was characterized as a “Crisis/Unprecedented Problem” and a “Great Challenge”, two times each.

Figure 4. 3: Sankey diagram showing relationship between climate hazards and framing of climate change in the City of Courtenay



4.2.2 Climate Change Adaptation Actions

The city documents outline various completed, ongoing, and planned actions taken by the City to adapt to climate change and various hazards. So, I have identified climate adaptation actions based on the kinds of climate hazards they expressly aim to address. I identified 23 climate adaptation actions in total through the manifest content analysis of City documents. Among these actions, eight (35%) did not reference any specific climate hazard, but they aim to address climate change. Some of these actions include Tree Protection Bylaw, Urban Forest Strategy, and Heritage Conservation.

Figure 4. 4: Adaptation Actions dealing with different Climate Hazards

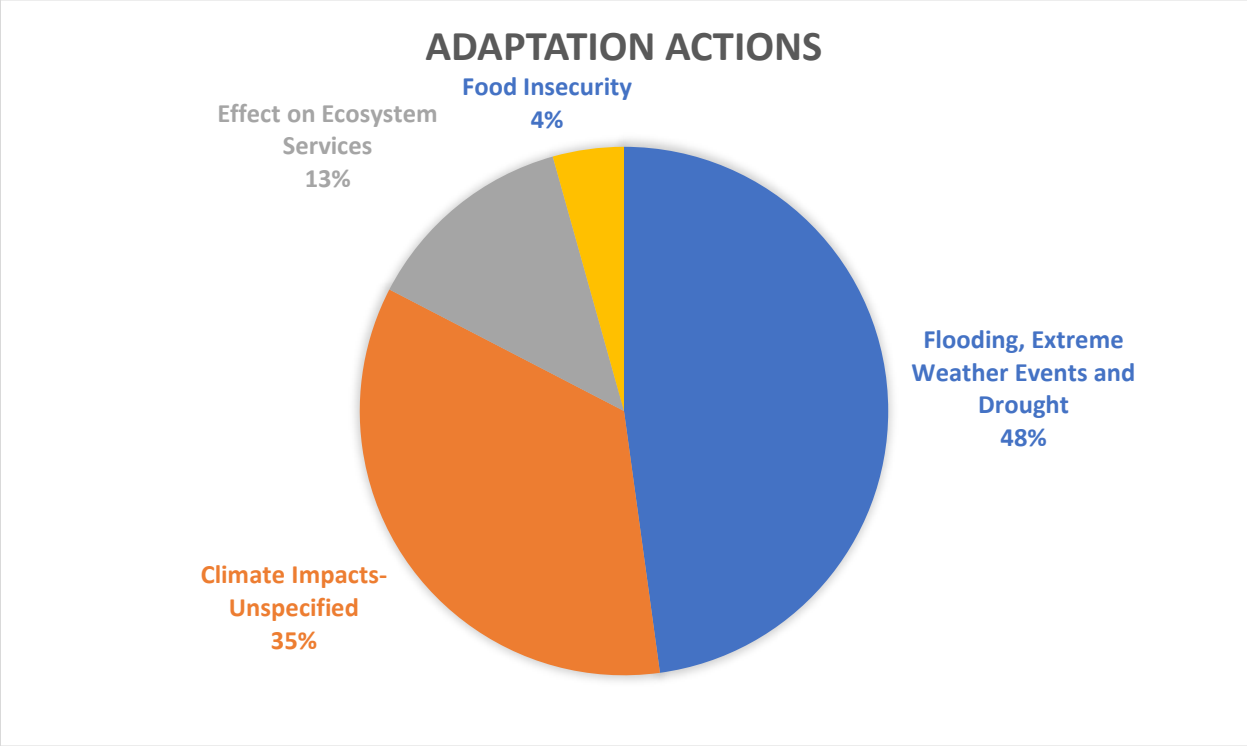


Table 4. 1: Climate Hazards and Adaptation Actions

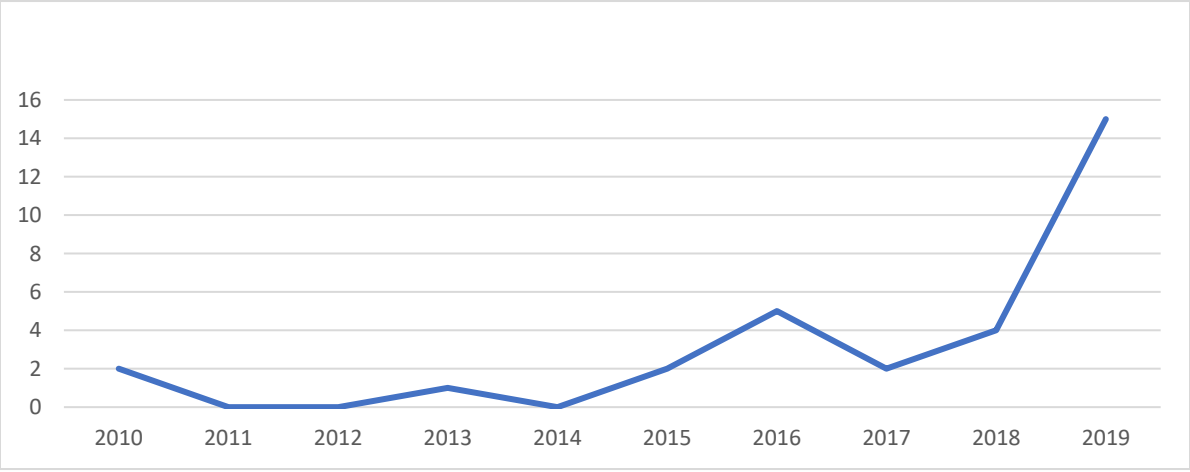
Climate Haazards	Adaptation Actions
Flooding, Extreme Weather Events, Sea Level Rise, & Droughts	Integrated Rainwater Management Plan
	Integrated Stormwater Management Plan
	Climate Change and Storm Surges Modelling
	Dyke Replacement Strategy
	Integrated Flood Management Study
	Asset Management
	Infrastructure Climate Resiliency Guidelines
	Crisis Declaration
	Natural Asset Management Initiative
	Restoration of estuarine site (kus-kus-sum)
	Climate adaptation in all stages of new Official community plan development.
Climate Impacts-Unspecified	Tree Protection Bylaw
	Heritage Conservation
	Climate reparations letter to Fossil Fuels company for costs of local climate change adaptation
	Climate Friendly Official Community plan
	Consider climate impacts during capital projects and land use decisions
	Creating Official community plan advisory committee
	Reviewing new development applications using climate lens
	Urban Forest Strategy
Impact on Ecosystem Services	Environmental Development Permit Guidelines
	Planting climate adapted tree species
	Conserving Coastal Douglas Fir and associated ecosystem
Food Insecurity	Food Security Policy

Other hazards addressed by adaptation actions include “Food Insecurity” and “Impact on Ecosystem Services”. I found that three adaptation actions were linked to climate change’s impact on the ecosystem, whereas only one action corresponding to food insecurity in documents. Additionally, most of the actions target hazards already being experienced by the City.

4.3 Framings of Resilience

On searching for the word “resilience” in the context of the City of Courtenay, I found 54 official documents and news releases. On review of these documents, I found that only 31 of these documents contextualised resilience and were prepared by the City or on behalf of the City. The remaining documents that mention resilience were prepared or authored by external agencies communicating with the City. In these 31 identified documents, resilience was mentioned 36 times. When analysing these 31 documents further, I found that the usage of the word resilience is on rise in recent times with the maximum mentions in 2019 as seen in Figure 4-5. I did not include the results for the year 2020 in the graph as it may not reflect the yearly trend.

Figure 4. 5: Mention of Resilience in City documents between the years 2008 and 2019



To understand how resilience is framed in the documents, I have used two aspects associated with resilience. I have identified which systems' resilience is being talked about and what it needs to become resilient to in all 36 cases. Now in the following sections, I present the different characterization of resilience based on these two aspects.

4.3.1 Resilience of what?

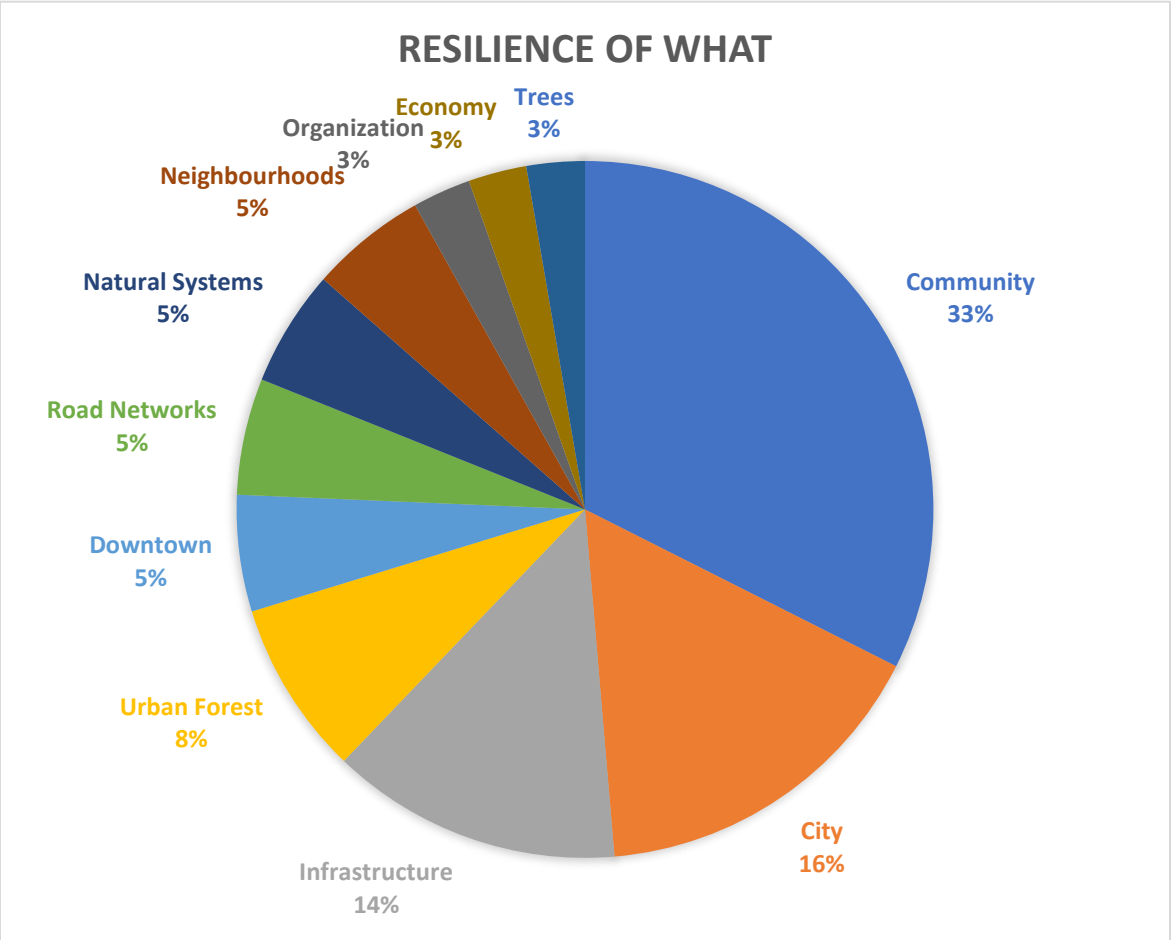
I found that the resilience of 11 different systems was discussed in the documents with "Community" dominating the narrative. The resilience of "Community" was mentioned 12 (33%) out of 36 times. "City" and "Infrastructure" were mentioned six and five times (14%) in the documents, respectively, making them the second and third most dominant resilience narrative. Further, the resilience of "Urban Forest" (8%) was mentioned three times. Figure 4-6 shows all the systems with reference to which resilience is framed.

I found that the most discussed systems when it comes to resilience narrative, City and community, have been used interchangeably in the City documents. They were used as all-encompassing terms; in other words, they refer to City in its entirety. To demonstrate this, here are some excerpts:

"The City of Courtenay was shortlisted in 2017 for a national pilot project that will help strengthen the City's resilience to the effects of climate change." (Courtenay Annual Municipal Report, 2017)

"Courtenay's efforts to protect nature and let it do its job will result in a healthier, more resilient community and keep costs down." (Courtenay Urban Forest Strategy, 2019)

Figure 4. 6: Systems with respect to which resilience is framed in the City documents



In the City documents, a group or collective of trees are understood to be an urban forest and considered different from individual tree while framing resilience. Accordingly, I have accounted for this difference in framing in this analysis. Some examples from the documents:

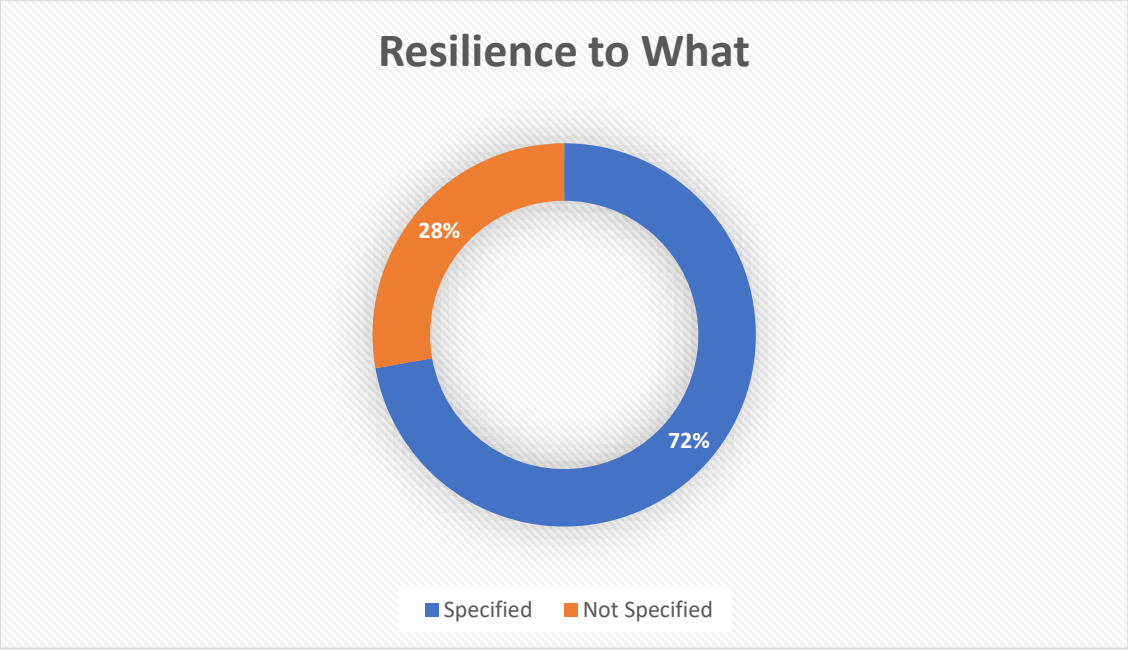
"Arborist is a person certified by the International Society of Arboriculture available to provide advice on the classification and resiliency of trees. Properties that qualify, according to the Tree Management and Protection Bylaw (No. 2461), are required to retain such professional services." (Courtenay Subdivision User Guide, 2018)

"Manage proactively to enhance urban forest health, safety and resilience by managing alongside other infrastructure goals." (Courtenay Urban Forest Strategy, 2019)

4.3.2 Resilience to what?

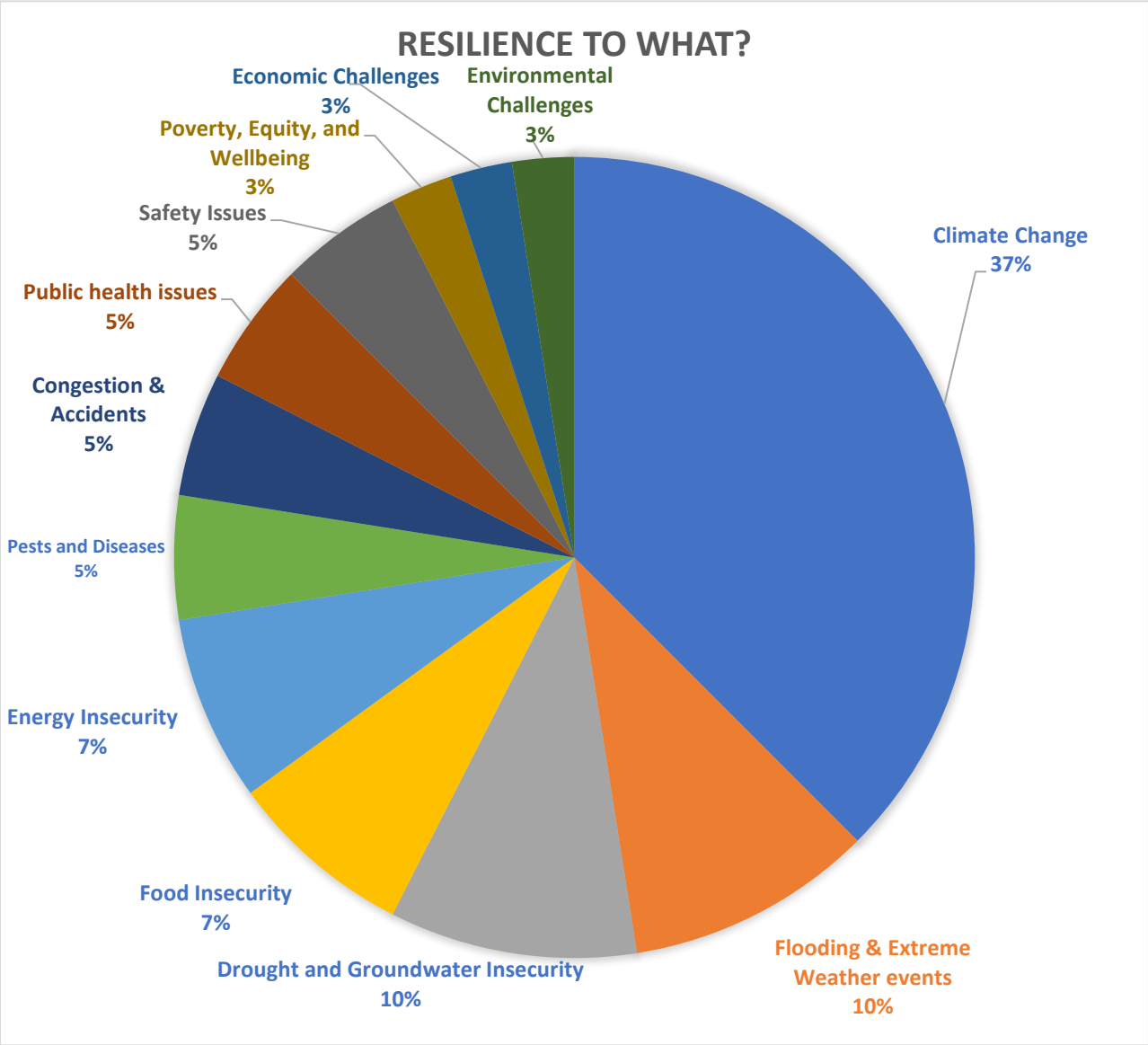
I found 12 different hazards or threats that the systems previously identified should be resilient to according to the City documents. In 10 out of 36 times (28%), "resilience of what" has been made clear, however, "resilience to what" hasn't been delved into. This is represented in the Figure 4-7. I also found that when it comes to six out of 11 identified systems, the threats they need to become resilient to are not identified.

Figure 4. 7: Proportion of cases where "Resilience to What" is specified vs unspecified



Out of the 12 threats identified, “Climate Change” finds most mentions at 15 (37%), whereas “Flooding” and “Drought” find four mentions (10%) each. All threats mentioned in relation to resilience narrative are depicted in the pie diagram below.

Figure 4. 8: Threats with reference to which resilience is framed in City Documents between 2008 and 2020



To provide more context about how the City frames resilience, here are some excerpts from the documents:

"Community gardens enhance the food security and resilience of a city, with important social, environmental and economic roles." (Courtenay Parks & Recreation Master Plan, 2019)

"In early 2018 the City of Courtenay was selected to participate in a national pilot project through the Municipal Natural Assets Initiative (MNAI), aimed at supporting local governments in identifying, valuing, and accounting for natural assets, and in developing sustainable and climate resilient infrastructure" (Courtenay Annual Report, 2018)

"The tree plantings are in line with the goals of the Urban Forest Strategy:

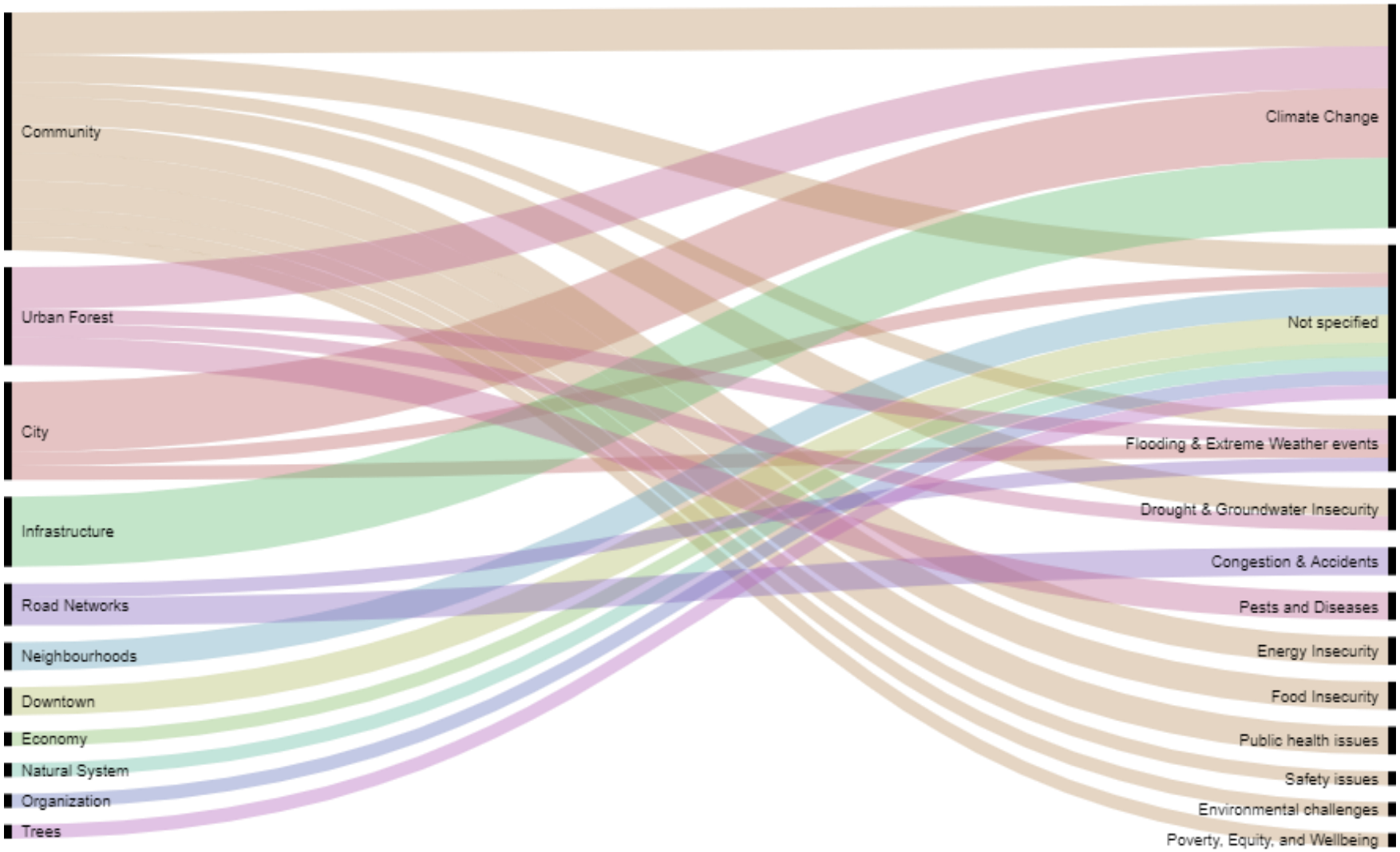
- *Increase canopy cover*
- *Increase species diversity*
- *Enhance resiliency of the Urban Forest with respect to insect pests and disease*
- *Enhance resiliency of the Urban Forest with respect to a changing climate." (Courtenay Planting Trees this Autumn, 2019)*

At this juncture, I have used a Sankey diagram to visualise how resilience is framed in the City. This diagrammatic representation shows "resilience of what" on the left side and "resilience to what" on the right side. This diagram only represents the number of different threats any system should become resilient to according to documents, and it does not truly represent the number of times the "resilience of what" is mentioned in the documents as several systems have been framed in relation to more number of threats in comparison to others. For example, Urban Forest

finds only three mentions in relation to its resilience, but four different threats it needs to become resilient to have been mentioned in the documents. As a result, despite its diminished presence in Figure 5.6, it holds a prominent position in the Sankey diagram (Figure 5.9). I found that resilience of “Community” has been framed with respect to the greatest number of threats followed by “Urban Forests”.

Additionally, I noticed that flooding, extreme weather events, drought and groundwater supply are the specific climate hazards with respect to which resilience is predominantly framed. This indicates that resilience narrative is mostly framed with respect to the hazards that the City has already experienced.

Figure 4. 9: Sankey diagram showing how "Resilience of What" (the left side) and "Resilience to what" (the right side) are related



4.3.3 Resilience Actions

Most of the 31 documents that framed resilience ventured further to enumerate actions that can advance the resilience of the system in question against various threats. In total, I found 24 actions that expressly advance the resilience of systems in question. Among these 25 actions, I found that two actions were advancing resilience of more than one system according to the documents. First, Municipal Natural Asset Initiative was advancing resilience of "Community", "City", as well as "Infrastructure". Similarly, Tree Protection and Management Bylaw was advancing the resilience of both "Trees" and "Community". All the resilience actions and corresponding threats they address are presented in Table 5.2. Only four of the 24 resilience actions don't mention the threats they would address.

The resilience actions outlined in the documents contribute to both climate adaptation and mitigation in the City. For example, actions to enhance energy efficiency aim to reduce GHG emissions, whereas steps like establishing infrastructure climate resiliency guidelines contribute to the adaptation of City's assets to the effects of climate change. To exemplify how resilience actions are mentioned while characterizing the resilience of a specific system, here are some excerpts from the City documents:

"The City of Courtenay has been chosen to participate in a national pilot project that will help strengthen the City's resilience to the effects of climate change." (Courtenay Selected for National Pilot Project, 2018)

"Add a new connection to divert traffic from congested roadways, provide a more direct connection between regional connections and East Courtenay, and improve the resiliency of the network." (Connecting Courtenay Engagement Summary: Round 2, 2018)

Table 4. 2: Resilience actions corresponding to the threats

Resilience to what	Resilience Actions	Resilience of What
Climate Change	Municipal Natural Asset Initiative	Community, City, Infrastructure
	Restoration of old Field Sawmill site (Kus-kus-sum)	City
	Integrated Rainwater Management Plan	City
	International Council for Local Environmental Initiatives (ICLEI) project addressing climate change and extreme weather	City
	Establishing a GHG emission reduction target	Community
	Infrastructure Climate Resiliency guidelines	Infrastructure
	Investing more in the early years of tree establishment	Urban Forest
	Urban Forest Strategy	Urban Forest
Energy and Groundwater Supply	OCP review, Sustainability goals	Community
	Review Development Permit Area guidelines	Community
	Reduce Development Cost Charge for sustainable energy and water efficient infrastructure	Community
	Review and amend the Tree Bylaw to include measures to support Climate Change initiatives	Community
	Retrofitting of existing municipal buildings to make them more energy and water efficient	Community
	Integrated River Basin Management planning	Community
	Revise street design standards	Community
	Enforce Part 10 of the BC Building Code that pertains to water and energy efficiency	Community
	Performance-based bylaws to protect watersheds and riparian habitat areas, and to consider alternative stormwater management practices	Community
Congestions and Accidents	Building new road connections	Road Networks
Poverty, Equity, & Wellbeing	Asset-Based Community Development- building on the local strengths, connections, citizen leadership and individual talents	Community
Public Health & Safety	Registering to get notification through text and voice calls	Community
Pests and Diseases/ Climate Change	Planting drought tolerant, cold hardy, and adaptable plants	Urban Forest
Not specified	Tree Protection and Management Bylaw	Community, Trees
	Building Secondary Suites	Neighbourhood
	Community gardens	City
	Join Green Jobs Plan for British Columbia	Community

4.4 Relationship between Framings of Climate Change and Resilience

My analysis of city documents has shown that characterization of climate change as a matter of concern is on the rise in recent years and a similar trend is seen with respect to the usage of the term “resilience” by the City. These seemingly unrelated trends are very closely linked. The similar upward trajectory can be attributed to the fact that resilience in the City of Courtenay is predominantly used with respect to climate change and associated hazards.

About 37% of the time, the term “resilience” was used with respect to the risk posed by climate change to different systems. Further, it was framed around climate change associated hazards like “flooding/extreme weather events” and “drought/groundwater supply” 20% of the time. The top two hazards that City documents associate with climate change are flooding/extreme weather impacts and drought, and these are the same top threats with respect to which “resilience” is used in the City documents. This indicates that these are the top of the mind threats facing the City.

Given the level of congruence between increasing concern for climate change and the usage of the term resilience in City documents, it can be expected that the actions taken to increase the resilience of the City would overlap with the climate change adaptation actions undertaken in the City. My results indicate that this observation is true. Out of the twenty-five resilience actions identified, ten of the actions also find places in the adaptation actions list. This does not mean that other resilience actions don’t contribute to adaptation, but they don’t expressly aim to adapt to climate change and associated hazards. This relationship between adaptation actions, perceptions of risk, and framing of resilience show how different levels of concern can shape climate adaptation discourse and action within a municipal government.

Chapter 5: Framings of Climate Change and Resilience by Courtenay City Officials

5.1 Introduction

In this chapter, I present the findings of the thematic analysis of interviews with municipal officials of the City of Courtenay. I found several patterns when it comes to how climate change is looked at by officials. To describe these patterns, I have chosen three overarching themes- "Knowledge and Experience", "Risk Perception", and "Action". When it comes to the official's understanding of resilience, I have identified two themes based on the influence of officials' background and definition of resilience, respectively. Finally, I present observed relationships between framing of climate change and risk perception.

5.2 Framings of Climate Change

In this section, I outline the themes that deal with characterization of climate change risk by interview participants and the factors that may be influencing their risk perception.

5.2.1 Knowledge and Experience

As part of the interview, I asked the interview participants if they have experienced the effects of climate change. This question yielded a variety of answers that delved into their personal & professional experiences, as well as knowledge of other people's experiences. Subsequently, when I asked them to enumerate the impacts of climate change on Courtenay, they identified a whole range of impacts. In this section, I present the themes that emerged from the analysis of their responses.

5.2.1.1 Everyone has experienced Climate Change

The manifest analysis showed me that all participants reported having experienced the impacts of climate change. But most of them drew a distinction between their personal and professional experience. Three of the participants reported having personally experienced the effects of climate change, whereas, four of them said that they acquired knowledge and experience of climate change in their professional role. Here is one of their responses:

"Overall, there hasn't been much of an impact personally. In my work life, yes. There have definitely been more calls generated due to changes in weather patterns in our area." (Participant 5, Fire Department)

5.2.1.2 Seeing is believing

The participants identified a range of climate impacts they have experienced or have knowledge about. Based on my manifest analysis, flooding and other extreme weather events were the most commonly identified climate impacts with all participants mentioning it. The increase in temperature was mentioned by four participants, and drought was mentioned by three participants. The other two impacts that I identified include shrinking glaciers and king tides.

The hazards officials associate with climate change seems to be the ones that the City has experienced more often, for example, flooding and extreme weather events. Further, more visible impacts on the community like flooding, drought and hotter weather are more often perceived as climate hazards in comparison to climate impacts like shrinking glaciers that are outside their professional purview. Here are some of the excerpts from the interviews that identify different impacts.

"It is warmer overall than when I was younger." (Participant 3, Development Services)

"I used to jump off the top of the garage into the snow pile while growing up. Snow pile just grew smaller with time. Similarly, I have personally visited glaciers and seen how much they have shrunk with time. Increasing extreme events and flooding also point to the climate change that we are experiencing." (Participant 4, Parks and Recreation Services)

5.2.2 Risk Perception

In this section, I outline the findings from participants' responses when I asked them to characterize the challenges due to climate change and associated impacts like sea-level rise.

5.2.2.1 Describing Climate Change Risk

Based on the manifest analysis, I noticed that most of the participants characterized climate change and associated risks as a "significant" or "serious concern" with just one of them describing it as a "concern". In all these cases, officials offered explanations to justify their risk stances, and this can be noticed in excerpts below. My analysis of their explanations indicates that several factors maybe influencing how participants characterize risks associated with climate change.

The reassurance and the feeling of security stemming from climate change adaptation measures taken by the City seem to be tempering the risk perception level. The following excerpt shows how the City's adaptive actions may be influencing risk perceptions.

"It's a cause for concern. I think the City has done a pretty good job to mitigate impacts. Maybe in 2015…maybe 2014 when we did have some significant flooding in our downtown area, in the low lying area, the City has made adjustments to the dyke wall, a permanent wall that acts as a bank extension and helps out the situation while also working in conjunction with BC hydro who

control the reservoir on the river that I was talking about earlier." (Participant 5, Fire Department)

The uncertainty when it comes to climate change also seems to influence how participants characterize risk. The reduced ability to accurately predict the extent of climate change impacts on a small region seems to be the reason for the uncertainty. The following excerpt is an example.

"The melting polar ice caps and glaciers are increasing the ocean level. But it is very difficult to understand how it will affect any particular piece of land. We can, of course, model the scenarios but there is uncertainty in how things will progress. This is of serious concern. This creates problem in terms of upgrading infrastructure." (Participant 4, Parks and Recreation Services)

Further, I observed that the knowledge of the climate change impacts on the community influenced how the officials framed climate change risk. For example, Participant 1's knowledge of the impact of climate change on the City's economic district and vulnerable groups seems to influence how the participant characterizes the risk due to climate change.

"I guess there's potential for serious implications for the economic district and for certain vulnerable citizen groups in the City. There's the... I would say there are pretty large magnitude events that we need to be concerned about. And it's not necessarily on a day to day basis. But these discrete events... these discrete flooding events, or these discrete storm events can be large scale risk for the City and its operations." (Participant 1, Engineering Services)

5.2.2.2 Who will climate change affect in Courtenay?

The participants identified different groups in and near the City of Courtenay, who would be affected by climate change associated hazards. All participants said that the property owners of buildings and houses located on waterfront or floodplains would be affected by erosion, flooding, and sea-level rise. Four participants identified the businesses in the downtown business district as the group that would be affected. Further, two participants identified the homeless and the K'omoks First Nation as groups vulnerable to climate change effects like flooding and sea-level rise. Other identified groups include the elderly and children, fishers, and trailer park residents (by one participant each).

5.2.3 Action

In this section, I have described the officials' role when it comes to events associated with climate change in the City. Based on the analysis, I also describe the extent to which climate change was considered in the City's operations.

5.2.3.1 Climate Change Adaptation Roles

When asked about their role with respect to any climate change-related event, the participants described when and how they take part in the City's response to such events. Based on the manifest analysis, I make the following observations.

Most often, the officials used the example of flooding to illustrate their role. Engineering Services and Development Services departments play strategic and long-term planning roles for adapting the City for future events. This means they act well ahead of the expected events or after the events to prepare the City for future events.

Parks and Recreation Services, Fire and Public Works departments are involved in managing operations just before and during the events like flooding. Parks and Recreation is involved in the evacuation of property on floodplain and cancelling any planned events. The Fire department is involved in activities like diverting traffic from hazardous routes, and Public Works is involved in projects like installing aqua dams. On the other hand, Development Services plays a role before an event as well by enforcing building, zoning, and floodplain bylaw that reduce impacts or prevent these events.

In the following excerpt, a participant explains his/her department's role when it comes to climate change associated events.

"Our department would come in after. So, we're not an operations crew. We're not the first-line response or anything like that. We execute capital projects as they're identified in the capital plan or possibly on a needs basis. So, funding would actually be approved, and then we would do a project, and you know, probably be something coming out of a study or something in response to it." (Participant 2, Engineering Services)

5.2.3.2 Integration of climate change considerations

Four out of the five participants said that climate change is considered in their department's operations and projects to some extent. Some of them indicated that the integration of climate change considerations in their projects and planning would become more prevalent in future, especially since the City has declared climate emergency. But one of these participants pointed out that budget constraints don't always permit such considerations in the projects:

"Try to wherever possible. It's, it's a tricky one for us. Again, a budget target is a challenge. But we definitely feel like we should be considering it. There should be a consideration. I feel as

though in the future, this will be more of an issue going forward." (Participant 2, Engineering Services)

Participant 2's response also indicates that climate change is seen as a greater challenge moving forward relative to current times, i.e. temporal distance is perceived. Further, only one of the participants said that their department doesn't specifically consider climate change but enforce policies and bylaws that are already in place.

5.3 Framings of Resilience

I asked the officials to explain how they understood resilience as part of the interview. I present the findings from the analysis of their responses.

5.3.1 Background and professional role affect the framing of resilience

Based on the analysis, I found that the interview participants' definition of resilience aligned with their fields of practice and their professional responsibility within the City. Table 5-1 shows all the different understandings of resilience among the participants. The systems whose resilience is being mentioned is showed in the first column, and the second column shows the threats with respect to which the resilience is framed. The last column indicates the number of interview participants who framed resilience in respective ways.

There were three participants with an educational and professional background in engineering, and all of them defined resilience with respect to infrastructure and building systems. However, only two of them identified climate change as a threat to those systems, and one participant did not identify any threats while defining resilience. One of the participants on being asked to explain their understanding of resilience reported:

"I guess resilience to me means not just survive under these changing conditions, but to still provide the same level of service that residents in the community are used to or expect. So, I guess to me, resilience is that no matter the conditions that we encounter, we're still able to provide a certain level of service to our residents." (Participant 1, Engineering Services)

Table 5. 1: Framings of Resilience by Municipal Officials

System	Threat	Number of Participants with this view
Infrastructure	Climate Change	3
Infrastructure	Not Specified	1
Plants	Inundation, strong winds, and salt	1
Firefighters	Adverse Situations	1

A participant with a background in landscape design framed resilience in two ways. The first framing was in reference to infrastructure while the second one dealt with plant systems. When it comes to infrastructure, the participant identifies climate change as a risk, whereas in the case of plants, inundation, salt, and strong winds were identified as threats by the participant. Here is the participant's explanation of plant resilience:

"In terms of my field, I would say, plant resilience is important..choosing plants that are resistant to inundation, strong winds, and salt." (Participant 4, Parks and Recreation Services)

One of the participants with a background in emergency services framed resilience around firefighters and their exposure to adverse situations while carrying out their duties. Here is the participant's response:

"So, resilience for us…we tend to look at that our firefighters. They see a lots of nasty stuff throughout the course of their careers here. Their ability to continue to work in those situations..under those circumstances, and be able to come out of it and keep showing up for more. That's resilience." (Participant 5, Fire Department)

5.3.2 Similar Understanding of Resilience, Different Levels of Specificity

I found that all the participants defined resilience as the ability of respective systems to continue to function at the same level despite shocks or stressors. The excerpts from interviews exuding this understanding of resilience are available in the previous section.

Additionally, I noticed difference in the level of specificity while defining resilience. While the systems whose resilience was being considered by participants were very specific, the threat these systems could be exposed to varied greatly in terms of specificity. For instance, Participant 5 used a broad term "adverse conditions" to denote threats faced by firefighters, whereas another participant mentioned very specific threat like "strong winds" while framing the resilience of plants. This varying level of specificity could be because of the kind of threats systems in question would be exposed to. Firefighters respond to a whole range of threats and therefore "adverse conditions" could have been used to denote a wide range of threats they are exposed to.

5.4 Relationship between Framings of Climate Change Risk and Resilience

Most of the officials described climate change as a significant concern, and this is reflected in how they frame resilience. In half of the instances, they framed resilience around climate change as seen in Table 5-1. Further, I noticed that all the framings with respect climate change were with respect to City's infrastructure owing to more officials having engineering background.

Based on these results, I make two observations. Professional and educational background of officials could be influencing which systems' resilience they talk about, whereas, their level of climate risk perception could be affecting which threat they frame resilience with respect to.

Chapter 6: Discussion

In Chapter 2, I demonstrated that public risk perception to climate change has garnered much attention among researchers. However, there is limited research focusing on risk perception of other important actors like government officials. Taking this into account, in this study, I aimed to identify the factors influencing municipal officials' risk perceptions and understand their influence on climate change adaptation planning by taking the City of Courtenay as a case study. As understandings of resilience among officials is known to play a role in shaping climate adaptation strategies, I also identified the factors affecting them and examined their effect on adaptation planning in the City. Finally, I wanted to observe any relationship that might emerge between officials' risk perception and conception of resilience as it hasn't been observed before.

In this chapter, I first discuss the relationship between the findings from the content analysis of city documents and the thematic analysis of interviews with municipal officials. This discussion will show the extent to which municipal officials' perspectives on climate change and resilience is reflected within the City. Following this, I discuss how climate change risk perceptions relate to the framing of resilience. Finally, I discuss what officials' risk perceptions and understanding of resilience mean for municipal climate change adaptation.

6.1 Relationship between Municipal Officials' Perceptions and City Documents

In this section, I first discuss the relationship between the framing of climate change by the City documents and municipal officials. Then, I consider how resilience is framed in both cases. In both of these instances, I also discuss the factors that could be influencing these framings.

6.1.1 Framings of Climate Change

Previous research indicates that risk perception studies are a representation of risk judgements prevalent at that time, in other words, they provide a snapshot of risk beliefs prevalent at the time of investigation (Loewenstein & Mather, 1990; Wilkinson, 2001). Therefore, I consider the characterization of climate change risks in recent times by the City documents alongside the officials' perceptions about climate change risks. Doing so would ensure that there are higher chances of their current perceptions being represented in recent documents. So, I am considering documents from 2016 to 2020 for this discussion. It is also logical because the highest number of documents characterizing risks due to climate change appeared since 2016.

Most of the officials described climate change as a "significant concern", and similar characterization of climate change has been on the rise in the City documents that were published in recent years. Of the documents published between 2016 and 2020, 46% reflected this tone, making it the most prevalent characterization of climate change. This indicates that municipal officials' perceptions of risk could have influenced how climate change and associated hazards are described in the City documents.

In the documents, characterization of climate change as a crisis is also on the rise in recent times. However, it was not described that way by the interviewed officials. This lack of congruence and could be due to several reasons. First, climate emergency declaration was made by the City of Courtenay Council only in May 2019 alongside several hundred municipalities across the globe, leading to the characterization of climate change as a crisis in several City documents. So, one of the reasons for officials not reflecting this tone could be the lack of enough time for the infusion of this value throughout the City administration.

Additionally, this act of announcing climate emergency by most municipalities has been a symbolic move rather than a literal one (Selby & Kagawa, 2020) and therefore, officials may not reflect that tone. Further, the lack of financial resources to undertake all activities to adapt to and mitigate climate change without the support of upper-level governments can be prohibitive (Bierbaum et al., 2013). The City officials indicated the lack of enough funds to consider climate change as part of all City projects.

Characterization of climate change as “a significant concern”, “a great challenge”, as well as “a crisis” in the city documents indicates that there is no uniform understanding of climate change risk in the city. This should be a matter of concern as words and frames used to describe and communicate climate change risks matter as they convey climate issues to other relevant stakeholders and this could affect the climate policy discourse (Nerlich et al., 2010). The usage of different words could also be due to the inherent complexity of climate change and the inability of the policymakers to grapple with it (Nerlich et al., 2010). In addition to these factors, officials' individual factors affect their climate risk judgements as well. I have discussed these factors in the following section.

6.1.1.1 Knowledge and Climate Change Risk Perceptions

I found that most officials' risk perceptions are reflected in the City documents, and so, understanding the factors influencing them gains special significance. Through thematic analysis of interview transcripts, I learned that officials' risk perception could be influenced by embankment effect. It refers to the reassurance (lower risk perception) stemming from more knowledge of City's adaptation measures (Lechowska, 2018). This phenomenon has been observed in previous research (e.g., Terpstra et al., 2009; Ludy & Kondolf, 2012).

Through analysis of interview transcripts, I also learned that uncertainty associated with climate change predictions was one of the factors affecting officials' risk perception. This has been observed in previous studies focusing on public and other groups. Slovic (2015) argued that uncertainty affects public risk perception, as their risk perceptions are subjective. In the case of officials, I argue that uncertainty is not just due to the subjective assessment of risk. The complexity inherent in climate science is also affecting their risk perceptions. So, it is not the lack of knowledge of climate change phenomena that is influencing officials' risk perception, but its the lack of detailed information on how climate change will progress and affect their community in future. This means that the limits on humans' predictive capacity can be responsible for officials characterizing climate change in a certain way. According to Yu and associates (2020), less knowledge of climate change leads to uncertainty among individuals. In the case of officials, I find this observation to be correct, but the definition of knowledge of climate change has different meanings for officials. In the case of municipal officials, knowledge is more detailed and technical.

Additionally, through thematic analysis, I also learned that knowledge of local climate change impacts and the vulnerable groups could affect the characterization of climate change by officials. These findings are in line with Yu and associates (2020) argument that more knowledge can impact the risk perception of individuals. These findings are also in agreement with van der Linden's (2015) Climate Change Risk Perception Model that recognizes knowledge as a prerequisite for risk perception.

All of these findings indicate that different kinds of knowledge may be influencing official's risk perceptions. So far, I have discussed three kinds of knowledge– the knowledge of the climate adaptation measures taken by the City, knowledge of climate change projections, and the

knowledge of what and whom will be impacted in their community. These findings are very much in line with van der Linden's (2015) model that tries to explain and predict climate change risk perception among the public. Applying his model, he found that knowledge of climate causes, impacts, and responses are one of the significant predictors of public risk perception (van der Linden, 2015). Further, my findings disagree with Brody and associates' (2008) findings that no significant relationship exists between climate risk perception and knowledge. I am not alone in my disagreement as several other studies have argued that knowledge affects risk perception (e.g., Milfont, 2012; Sundblad et al., 2007).

Additionally, as my findings suggest that individual's knowledge and experience shape their risk perception, they reflect the psychometric theory and not cultural theory. Psychometric theory argues that risks judgements are made at individual level based on influences from other factors (as described in Chapter 2). In the following section, I discuss the level of congruence when it comes to the climate hazards identified by the officials and the hazards mentioned in the documents.

6.1.1.2 Experience and Climate Adaptation

The top climate hazards identified by the officials find a similar level of prominence in documents describing climate risk. "Flooding & Extreme Weather Events", "Drought", "Increasing Temperature", and "Coastal Risks" (like King Tides, Erosion) are the top climate hazards both mentioned by the officials and City documents. These hazards seem to be highly prioritized because they are already starting to influence the quality of life in the City, i.e. climate change discourse in the City revolves around the hazards the City has already experienced. Most of these hazards have also been experienced at a personal or professional level by more than one interviewed official. This suggests that the officials' perceptions of risk

and experience could be playing a role in shaping the City's climate change discourse and policy. A similar observation was made by Ray and associates (2017). They found that people who have experienced extreme weather are more likely to support climate adaptation policy.

Out of the 15 climate change adaptation actions in the City that specify climate hazards they expressly aim to address, 11 actions aim to address flooding, extreme weather events, droughts, and sea-level rise. This reinforces the argument that most of the actions target hazards posing a threat to the City at present and are perceived by the officials as risks. These findings are in line with Lee and Hughes (2017) findings that indicate that risk perception of the officials is the most important factor determining the climate adaptation strategies. The findings also indicate that climate change adaptation in the City is reactive, just like many other cities across the world (Amundsen et al., 2010; Dulal, 2019). In the next section, I discuss how officials' understanding of resilience affects the framing of resilience in the City.

6.1.2 Framings of Resilience

In this discussion, I consider how resilience is framed in the City documents in recent years alongside the officials' understanding of resilience since there is more likelihood of the interviewed officials' understanding affecting recently published documents. So, in this discussion, I am considering the framing of resilience by documents between the years 2016 and 2020.

I found that there is an increased usage of the term resilience in recent years in the City documents. I also found that resilience is predominantly framed with respect to overarching or all-embracing systems –city and community. However, infrastructure and urban forest are more specific systems with respect to which resilience is used mostly in the documents. Parallelly,

most of the interviewed officials framed resilience with respect to the City's infrastructure with one each framing it around firefighters and plants. This shows how resilience is a boundary object, as emphasized by several scholars (Brand & Jax, 2007; Meerow & Newell, 2016). However, I also observe that most officials subscribe to the engineering definition of resilience owing to their educational and professional background. This finding reflects the observations made by Oulahen and associates (2019) that disciplinary background of officials influences how they understand resilience.

Further, I observed that the systems of interest to officials, infrastructure and plants, find more prominent places in City's resilience narrative, i.e., officials' understanding of resilience is reflected in the documents. This shows the important role officials' background plays in shaping not only their understandings of resilience but the resilience narratives in the City.

When it comes to the threats with reference to which resilience is framed, most of the officials framed resilience with respect to climate change. I observed a similar trend in the City documents as well. More than 50% of the City documents framed resilience with respect to climate change and associated hazards. This indicates that the hazards that officials think are important are reflected in City's resilience discourse.

Given the level of focus on climate hazards and resilience of infrastructure and urban forests, it would be expected that the resilience actions (identified in Chapter 5) would reflect these threats and systems. Climate change and associated hazards find represented in the resilience actions, as most actions are expressly conceived to address these hazards. Further, the resilience actions predominantly attempt to increase the resilience of all-encompassing systems– community and City. However, more specific systems whose resilience most actions are expressly concerned

with are urban forest and infrastructure. This indicates the integration of officials' understandings in resilience discourse as well as actions taken by the City.

I also observed that all the officials' definitions of resilience fell within "resilience as resistance" line of thinking. Officials wanted the systems to continue functioning at the same level even when faced with threats. Similarly, Oulahen and associates (2019) found that "resilience as resistance" finds most emphasis in practice in comparison to other perspectives like "resilience as recovery" and "resilience as creative transformation". On the other hand, Agarwal (2020) on analysis framing of resilience in three Canadian cities found that they do not subscribe to any particular perspective of resilience. In the case of Courtenay, the official documents did not provide enough explanations on resilience to be able to decide which perspectives they adhere to.

The literature review indicated that the relationship between resilience and risk perception had not been well understood and established (Satterfield, 2019; Ruszczyk, 2017). So, in the following section, I present observed relationships.

6.2 Climate Change Risk Perception & Framing of Resilience

I presented the relationship between the characterization of climate change risk and resilience in both Chapter 4 and 5. One key understanding of the relationship between the resilience and risk perceptions constructs emerges from the results. I found that resilience narrative in the City is dominated by the hazards that are accorded top priority by officials. For example, "Flooding and extreme weather impacts" was identified as the highest priority climate hazard as all officials mentioned it. Correspondingly, I found that this hazard was accorded the highest level of importance in City's resilience narrative. A similar trend was observed in the case of "drought",

another climate hazard that was accorded high priority by officials. This indicates that officials' risk perceptions might be a key influencer when it comes to the framing of resilience. This finding reinforces Sharifi's (2016) observation that resilience is affected by perceptions and attitudes of actors involved.

Additionally, I observed that the background of officials works in tandem with their risk perception to influence the framing of resilience in the City. I found that the background of the officials influences the kind of systems they frame resilience in reference to, and risks perceived influences the threat they would frame resilience in reference to. For example, an official with a background in engineering who recognized climate change as a risk, on being asked to describe resilience went on to describe it with reference to infrastructure and the risk it faces due to climate change.

6.3 Implications for Municipal Climate Change Adaptation Planning

My study indicated that climate change adaptation efforts in the City focus on climate hazards already experienced by the officials. This suggests that officials' risk perception is an important factor in shaping climate change adaptation in cities. This finding is in line with Aslam's (2013) arguments that municipal official's risk perceptions play a crucial role in climate change planning. My finding further dispels the notion that that municipal practitioners are "neutral" entities and shows that individual perceptions, and experiences influence climate change planning. This observation is in agreement with scholars who have argued that planners' perceptions and biases influence the planning process (Beunen et al., 2013; Binder & Boldero, 2012). Further, this observation runs counter to rational action theory that argues that individuals (in this case, officials) make best possible decisions after considering all potential costs and benefits (Scott, 2000).

Additionally, my results also indicate that previously undertaken climate adaptation actions have the potential to influence future measures. This is because knowledge of previous measures affects the risk perception of the officials at present. In other words, embankment effect arising from knowledge of past measures can lower the risk perception as discussed earlier. My results also indicate that the availability or lack of knowledge of local effects and better climate projections for the community affect risk perceptions and that in turn would influence climate adaptation in the City. These findings emphasize the need for investments for understanding and modeling impacts of climate change on the community now and in future. Further, these findings highlight the need for a risk perception-based approach to understanding stakeholder perspectives. The need for a risk-based approach for climate adaptation has also been highlighted by Natural Resources Canada adaptation guide (Bruce et al., 2010) for Ontario municipalities.

I found that different understandings of resilience among the officials could be influencing the climate change adaptation in the City as well. Their background as well as risk perception influenced their understanding. This went on to influence the systems and threats officials frame resilience in reference to. Further, I found that their framing influenced the actions adopted by the City to increase resilience.

Actions meant to increase resilience predominantly dealt with climate adaptation. These findings are in line with Oulahen and associates' (2019) observation that municipal practitioners' understanding of resilience can influence climate adaptation strategies. Further, "resilience as resistance" view prevalent among officials may affect the climate adaptation planning but it was outside the scope of the thesis.

Since the results indicate that officials' background may go on to shape climate adaptation, it is important to consider the role of cognitive diversity in adaptation planning. Page (2014) argues that in the case of complex problems like climate change, cognitive diversity can provide better solutions and enhanced resilience. But it has also been argued that the benefit of diversity cannot be reaped unless it is intentionally leveraged (Landermore, 2013). As the cities have different departments with staff from diverse technical backgrounds and knowledge, it can be leveraged to create more comprehensive and inclusive climate adaptation strategies.

Chapter 7: Conclusion

Planning over the last few decades has evolved to include more public input. However, past studies indicate that the rational comprehensive model still dominates planning practice (Schonwandt, 2008). A similar trend is observable in local climate adaptation planning in the Canadian context (Graham, 2016). This implies that municipal practitioners continue to have a greater say in climate adaptation process. However, only limited research has focused on understanding local officials' perceptions and beliefs on climate change planning.

Taking this into consideration, using the City of Courtenay as a case study, I specifically examined the influence of municipal officials' climate change risk perception and understanding of resilience on the City's climate change adaptation planning as they are recognized as important factors influencing it. I also identified the factors that could affect their risk perception and their understanding of resilience.

I conducted a content analysis of official documents and thematic analysis of interview transcripts to get an understanding of framings of climate change and resilience within the City and among the City officials. I also used the content analysis to identify actions planned in the City to adapt to climate change and improve resilience.

The results of my analyzes indicate that officials' climate risk perceptions could be shaped by factors that are also known to shape public risk perception like experience and knowledge. Further, I found that three different kinds of knowledge are influencing officials' risk perceptions, namely, knowledge of the climate adaptation measures taken by the City (responses), climate change projections (future), and what and whom will be impacted in their

community (impacts). Moreover, most of the adaptation actions in the City focus on addressing the climate risks identified by officials.

When it comes to the framing of resilience in the City, I found that there were multiple framings of resilience present among officials and the City documents. However, as the engineering-driven understanding of resilience was the dominant trend among the officials, it finds represented in the actions taken by the City to improve resilience. This engineering-driven framing was because of the officials' technical background. I also found that in addition to officials' background, the climate hazards identified by the officials in the context of the City were shaping the resilience narrative to a great extent.

All these findings indicate that the municipal practitioners' experiences, education, professional role, and different kinds of knowledge could affect their risk perceptions and understandings, that go on to decide which hazards are prioritized in climate adaptation planning. This reaffirms the observation made by previous studies (e.g., Aslam, 2013; Lee & Hughes, 2017) that officials' risk perceptions could be playing an important role in climate change planning. To incorporate these findings in climate planning practice, I have outlined some suggestions in the next section.

7.1 Recommendations for Climate Change Planning Practice

1. *Recognize that officials' individual characteristics and perceptions could influence climate adaptation decisions and create multi-disciplinary teams.*

It is crucial to have multi-disciplinary teams with officials from different departments, different educational and professional backgrounds when it comes to climate change planning. This is because, to quote Scott Page (2007, p.7), "two people with different perspectives test different potential improvements and increase the probability of an innovation." Further, this diversity

would reduce the chances of certain perspectives dominating the climate planning process and resulting actions.

2. *Take a risk perception-based approach to understand what different internal and external stakeholders value and perceive to be at risk.*

In addition to risk perceptions of public and other stakeholders who might be affected by climate change associated hazards, risk perception of officials involved in adaptation planning exercise should be considered while devising adaptation strategies. This suggestion is also reflected in climate adaptation guide for Ontario prepared by Bruce and associates (2010).

3. *Use consistent language with reference to climate change to ensure clarity of message.*

The usage of multiple terminologies in documents can create policy confusion. Therefore, it is important to take a clear stance on climate change and monitor language use to ensure that messaging is uniform across the city departments.

7.2 Study Limitations and Future Directions

My plan for this study was to interview more officials from the City of Courtenay, but COVID 19 and time constraints hampered the recruitment process. So, I was able to interview fewer participants. Further, I could not interview officials from some of the City departments like Public Works and Financial Services. So, the sample considered in this study may not be fully representative of the diversity of professions and backgrounds of municipal officials in the City. This could have affected the study findings.

As this thesis explored officials' climate risk perceptions using a qualitative approach, future studies can use this knowledge to devise detailed quantitative approaches to develop risk

perception models. Such models can be compared with already existing public risk perception models. Further, a comparative study between cities where different municipal departments oversee adaptation strategy could shed more light on the role played by officials' background in shaping strategies.

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Appendix A: Interview Script

Interview Questions

Student Investigator explains the purpose and goals of this research to the interviewee. Further, he explains that these questions are meant to understand their perspectives on resilience, climate change (CC) and sea-level rise (SLR).

Following this, the interviewer seeks consent from interviewee to be audio recorded, while making sure that the interviewee understands the purpose of the interview.

Since this is a semi-structured interview, follow up questions may be asked when required for clarification.

Introduction

1. Student Investigator introduces the interviewee and their job title for audio recording. He asks the interviewee their age, gender and educational background, and further, asks them to briefly describe their occupational career and time spent with the City of Courtenay.

Questions on Personal Experience

2. Have you experienced any changes indicative of CC? What are they?

3. Has Courtenay experienced any changes indicative of CC? What are they?

Questions about Perception/Risk perception to SLR

4. How would you characterize challenges posed by SLR for the world in general and Canada specifically?

5. How would you characterize challenges posed by SLR for Courtenay?

Questions on Factors affecting Perception/Risk Perception

Cognition

6. What effects do you think SLR would have on Courtenay and in what time frame? (e.g. Safety, Socio-economic, Environmental)

7. Who would be the vulnerable groups?

Organizational / Departmental Experience

8. What has been the role of your department just before, during and after the CC related event? *(If answered 'yes' for question 3*)

(or)

What has been the role of your department just before, during and after any coastal surge events or flooding in the estuary? *(If answered 'no' for question 3*)

9. How do you think the role of your department will change/be affected by SLR and CC in future?

Organizational Culture/ Norms

10. Does your department consider CC and SLR as part of your operations and projects?

11. Does your department feel obligated to integrate CC and SLR considerations as part of your operations and projects? If yes, why?

Questions about their Understanding of Resilience

12. What does resilience mean in your line of work and how do you understand and visualize urban resilience in practice?

13. How do you envision your department's contribution in increasing SLR resilience of Courtenay?

Questions about Resilience Pathway

At this point during the interview, a discussion piece on uncertainty in decision making when it comes to Sea Level Rise would be shared (see attached to research ethics application).

14. How do you think SLR planning and adaptation fares among other priorities within the City Council and staff's agenda and are there any ongoing projects and/or planned steps that you think will help the City respond to sea level rise?

15. Given the potential for uncertainty, competing interests and risk to community from SLR, how would you want the city to proceed with deciding on 2100 SLR values to plan for?

16. Given the fact that there are different projections with different inbuilt assumptions, which projections do you think Courtenay should be planning for and how often should it be reviewed and revised?

Questions if time permits:

17. Are there any other steps the city can take to tackle the challenges arising from SLR in Courtenay more effectively?

18. Which competing interests have the potential to influence decisions when it comes to deciding SLR projections for Courtenay?

Appendix B: Interview Discussion Piece

Those making decisions about planning, infrastructure, and service delivery in coastal communities need to consider how sea level rise (SLR) may influence their decisions. But what assumptions should decision-makers use about how much sea levels will change and by when?

There are **several factors** that influence Sea Level Rise:

- Thermal expansion of ocean and salinity
- Melting of high-altitude glaciers
- Antarctic ice sheet collapse/melting
- Melting polar ice sheets due to ocean current feedback mechanism
- Regional subsidence/uplift

While we know that each of these factors will influence the magnitude and pace of sea level rise, they each also have inherent uncertainty – leading to different predictions about how sea levels will change. The further we project into the future, the greater the level of uncertainty is.

Understanding SLR Predictions

Why are there differences in SLR projections from credible organizations?

Projections **differ** based on:

- The date that the projections were developed (in particular, the date of development of the input data). Scientific knowledge about climate change and sea level rise is evolving rapidly and as knowledge evolves, so do the projections.

- The assumptions and models used to develop the projections. Each organization applies a different model and set of assumptions to create their projection, leading to different projections.

Sea Level Rise Predictions

Organization	Projections	Projection Year	Inclusions/ Exclusions	Disadvantages/ Advantages
Province of British Columbia	≈ **0.8 to 1.2 m** under extreme emissions scenario for different places across BC. [1] However, recommends **1 m SLR by 2100 for planning.**	2007	Does not **consider Antarctic ice sheet collapse, ocean ice sheet melt, feedback mechanism and the effect on the Pacific Ocean**. [2]	Data may be outdated
Natural Resources Canada	**More than 1 m rise by 2100** for most of 13 BC municipalities under high emissions scenario. [3]	2014	Considers **Antarctic ice sheet collapse** by **adding an additional 0.65 m.** [2] **Doesn't consider latest discoveries** about **ocean sheet melt, feedback mechanism** and its **effect on the Pacific Ocean.**	More current than Province of BC's 2007 projections
US National Oceanic and Atmospheric Administration (NOAA)	*Global Mean Sea Level (GMSL)* in year **2100** could rise by **2.0 m and 2.5 m under high and extreme emissions scenario.** [4] **Higher Regional Sea Level rise for Pacific Northwest** than *GMSL* rise.	2017	Considers **melting ice** and **feedback mechanism**. [2 4]	Based on latest scientific developments/ discoveries

Selecting a SLR Value for Decision-Making

When selecting a SLR projection, decision-makers should apply a process that considers factors including, but not limited to:

- The type of decision, and how easily it can be adapted with new information in the future
- The organization's risk tolerance
- How frequently the organization is willing to review and revise assumptions about SLR in planning and decision-making

1 Bornhold, B. (2008). Projected sea level changes for British Columbia in the 21st century. Retrieved from Province of British Columbia website: http://a100.gov.bc.ca/pub/eirs/viewDocumentDetail.do?fromStatic=true&repository=EPD&documentId=8609

2 Coastal Ocean Research Institute Report (2018). Oceanwatch B.C. Coast Edition. Retrieved from: https://www.dropbox.com/s/457z8jtezizb4pf/OceanWatch_BCCoastReport-online.pdf?dl=0

3 James, T. S., Henton, J.A., Leonard, L.J., Darlington, A., Forbes, D.L., & Craymer, M. (2014) *Relative sea-level projections in Canada and the adjacent mainland United States*. Natural Resources Canada.

4 Sweet, W. V., Kopp, R. E., Weaver, C. P., Obeysekera, J., Horton, R. M., Thieler, E. R., & Zervas, C. (2017). Global and regional sea level rise scenarios for the United States.

Appendix C: Email Recruitment Script

Date:

Dear XXX,

My name is *Vignesh Murugesan* and I am a Master's student working under the supervision of Dr.*Carrie Mitchell* in the *School of Planning* at the University of Waterloo. I am contacting you to request your participation in an interview that aims to understand internal stakeholders' understanding of urban resilience and their risk perceptions to Sea Level Rise in the City of Courtenay. This study is being conducted for my Masters' thesis research.

As you may know, Climate Change and related effects like Sea Level Rise have implications for the City of Courtenay as it is a coastal city. You may also be aware of some of the city's efforts to respond to it. Because you are part of the city administration, your opinions are important to this study. I would really appreciate it if you would take part in this study.

Taking part in the study would involve a *40 minutes* one-on-one interview in your office, alternate location or over phone at a convenient location and time. Some questions pertain to your experiences as part of your job as well as off work. Other questions pertain to your opinion on Sea Level Rise, its effect on Courtenay and city's policies cum response (such as 'Has Courtenay experienced any changes indicative of Climate Change?' 'Which groups in the city would be vulnerable to Sea Level Rise?'). Some questions seek to collect basic demographic information like age, gender and educational background. You may decline answering any questions you feel you do not wish to answer. To keep your identity confidential, your comments will be grouped with responses from other interview participants. Further, your name or job title

will not be included in my thesis or in any report or publication resulting from this study. The data collected through this study will be kept for a period of at least *7 years* in my supervisor's lab at the University of Waterloo. This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee.

I have attached an information letter to this email that outlines the details about the study and your rights as a participant to help you make an informed decision. It further elaborates on usage of your data and any potential risks. If you are considering taking part in this study, please contact me at vmuruges@uwaterloo.ca and please also mention your preferred meeting time and location. For any other questions, don't hesitate to write to me.

I would be pleased to send you a short summary of the study results when I finish going over the results. Please let me know if you would like a summary and what would be the best way to get this to you.

Thank you for your assistance with this project.

Yours sincerely,

Vignesh Murugesan

Student Investigator

Appendix D: Information Letter

Title of the study: *Internal Stakeholders Risk Perception to Sea Level Rise and understanding of resilience in the City of Courtenay*

Faculty Supervisor: *Carrie Mitchell, PhD, School of Planning, University of Waterloo. Phone: 1-519-888-4567 x33027, Email: carrie.mitchell@uwaterloo.ca*

Student Investigator: *Vignesh Murugesan, MSc, School of Planning, University of Waterloo, Email: vmuruges@uwaterloo.ca*

This letter has been drafted with the intention of informing your decision regarding participating in this research study. It also outlines possible risks and benefits and your rights as a participant. If you have any doubts or queries, you can ask the student investigator. Kindly read through this letter before making your decision about participating in this research study.

About the Study

As you may know, Climate Change and related effects like Sea Level Rise have implications for the City of Courtenay as it is a coastal city. You may also be aware of some of the city's efforts to respond to it. Because you are part of the city administration, your opinions are important to this study. So, you are invited to take part in this research study that looks at your perceptions and risk perceptions to sea level rise and climate change and factors affecting them. It also looks at how you understand and conceive urban resilience. The participants of this study are being recruited from among the high-level municipal officials working for the municipality of Courtenay who can recommend and influence policy directions and decisions in the city.

Past research has looked at the perceptions and risk perceptions of public when it comes to climate change and hasn't looked into perceptions of risk among internal municipal stakeholders, especially in the case of small and mid sized communities. This research therefore tries to address this lack of research.

This study is funded by Social Sciences and Humanities Research Council (SSHRC) and it is being undertaken as part of my (Vignesh Murugesan) Masters thesis research. My research plans to understand the relationship between risk perceptions and understanding of resilience when it comes to climate change at municipal level.

About Participation

Taking part in the study would involve a ***40 minutes*** interview in your office, alternate location or over phone at a convenient time. You must be 18 years of age or above to participate in the study. Some questions pertain to your experiences as part of your official role within the City of Courtenay. Other questions pertain to your opinion on Sea Level Rise, its effect on Courtenay and city's policies cum response (such as 'Has Courtenay experienced any changes indicative of Climate Change?' 'Which groups in the city would be vulnerable to Sea Level Rise?'). You will also be asked some demographic questions. The demographic factors like age, gender, and educational background are important for this research study because they are known to influence how people think about and perceive climate change.

Your participation in this study is **voluntary**. You may decide to leave the study at any time by communicating this to the interviewer. If you decide to stop, we will ask you how you would like us to handle the data collected up to that point. This could include returning it to you, destroying it or using the data collected up to that point. You may decline to answer any question(s) you

prefer not to answer. You can request your data be removed from the study up until April 2020 as it is not possible to withdraw your data once my thesis has been submitted.

Data Handling and Anonymity

Your identity will be kept confidential and your information/data will be grouped with responses from other interview participants. Further, you will not be identified by name or job title in my thesis or in any report or publication resulting from this study. The data collected through this study will be kept for a period of at least ***7 years*** in my supervisor's lab at the University of Waterloo. Only the research team will have access to study data.

Key observations and findings from the interviews will be shared with the municipality of Courtenay in the form of a report for assisting it with sea level rise planning. Moreover, once all the data are collected and analyzed for this project, I plan on sharing this information with the research community through seminars, conferences, presentations, and journal articles.

I would be pleased to send you a short summary of the study results when I finish going over our results. Please let me know if you would like a summary and what would be the best way to get this to you.

Possible benefits of the study

Participation in this study may not provide any personal benefit to you. The hope is that the study will identify barriers and enablers when it comes to adapting City of Courtenay to sea level rise.

Associated Risks

There are some possible risks of being identified by a motivated individual because of small sample size and research study focusing on a smaller municipality. The interview questions asked are not intended to be controversial. You will be given an opportunity to review your interview transcript. By grouping your information with other interview participants this risk will be mitigated as well.

Contact

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #41041). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

If you have any questions regarding this study or would like additional information to assist you in reaching a decision about participation, please contact me.

Vignesh Murugesan, MSc

Student Investigator

Master of Environmental Studies (MES) Planning Student

School of Planning

University of Waterloo

Email: vmuruges@uwaterloo.ca

Carrie Mitchell, PhD

Faculty Supervisor

School of Planning

University of Waterloo

Phone: 1-519-888-4567 x33027, Email: carrie.mitchell@uwaterloo.ca

Appendix E: Consent Letter, Oral Consent Script and Appreciation Letter

Consent Form

By signing this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

I agree to participate in an interview being conducted by ***Vignesh Murugesan*** of the ***School of Planning, University of Waterloo*** under the supervision of Professor ***Carrie Mitchell.*** I have made this decision based on the information I have received in the Information Letter and have had the opportunity to receive any additional details I wanted about the study. As a participant in this study, I realize that I will be asked to take part in a forty-minute interview and that I may decline answering any of the questions, if I so choose. All information which I provide will be held in confidence and I will not be identified in the thesis, report or publication. I understand that I may withdraw this consent at any time by asking that the interview be stopped.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #41041). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

I may contact Prof. Carrie Mitchell (Principal Investigator) at 1-519-888-4567 x33027 or carrie.mitchell@uwaterloo.ca and Vignesh Murugesan (Student Investigator) at vmuruges@uwaterloo.ca if I have any questions about the research study, my participation in the study, and handling of my data.

I agree to have my interview audio recorded.

☐YES ☐NO

I agree to the use of anonymous quotations in any thesis or publication that comes of this research.

☐YES ☐NO

I agree of my own free will to participate in the study:

Participant's Name: _____

Participant's Signature: _____

Signature of Researcher/Witness: _____

Date: _____

Title of the study: *Internal Stakeholders Risk Perception to Sea Level Rise and understanding of resilience in the City of Courtenay*

Faculty Supervisor*: Carrie Mitchell, PhD, School of Planning, University of Waterloo. Phone: 1-519-888-4567 x33027, Email: carrie.mitchell@uwaterloo.ca*

Student Investigator*: Vignesh Murugesan, MSc, School of Planning, University of Waterloo. Email: vmuruges@uwaterloo.ca*

Oral Consent Script

Student investigator asks the interviewee if they have read the information letter and if they have any questions about the same. Following this, he clarifies any doubts and answers questions.

Student investigator informs the interviewee about their rights as a research study participant before, during and after the interview.

Consent questions:

- Do you have any questions or would like any additional details? *[Answer questions.]*
- Inform the participant that *'By agreeing to consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities'.*
- Do you agree to have your interview audio-recorded? *[Logs verbal consent]*
- Do you agree to the use of anonymous quotations in any thesis or publication that comes of this research? *[Logs verbal consent]*

- Do you agree to participate in this study knowing that you can withdraw at any point with no consequences to you?

  [If yes, begin the interview.]

  [If no, thank the participant for his/her time.]

Verbal consent will be recorded in a log sheet by the researcher.

Researcher's Log for Recording Verbal Consent

Participant's Unique ID number	**Participant's name**	**Do you agree to have your interview audio-recorded?**	**Do you agree to the use of anonymous quotations in any thesis or publication that comes of this research?**	**Do you agree to participate in this study knowing that you can withdraw at any point with no consequences to you?**	**Date**

Appreciation Letter

Date:

Dear xxx,

I would like to thank you for your participation in this study entitled 'Internal Stakeholders Risk Perception to Sea Level Rise and Understanding of Resilience in the City of Courtenay'. As a reminder, the purpose of this study is to understand internal stakeholders' understanding of urban resilience and their risk perceptions to Sea Level Rise.

The data collected during interviews will help me identify and understand various enablers and barriers when it comes to planning for sea level rise and climate change in smaller cities. This will help me come up with recommendations for making planning process more robust.

Please remember that your identity would be kept anonymous in the work emanating from this research study. Once all the data are collected and analyzed for this project, I plan on sharing this information with the research community through seminars, conferences, presentations, and journal articles. If you are interested in receiving more information regarding the results of this study, or would like a summary of the results, please provide your email address, and when the study is completed, anticipated by April 2020, I will send you the information. You can request your data be removed from the study up until April 2020 as it is not possible to withdraw your data once my thesis has been submitted. After my thesis is submitted and becomes available on UW Space, an online open source platform of University of Waterloo, you may also access the thesis online.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #41041). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

In the meantime, if you have any questions about the study, please do not hesitate to contact me or my research supervisor. Contact details are as follows:

Vignesh Murugesan (Student Investigator)

School of Planning

University of Waterloo

vmuruges@uwaterloo.ca

Prof. Carrie Mitchell (Principal Investigator)

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