Taking it into Their Own Hands:
Innovative Wildfire Mitigation Measures at the Municipal Level

by

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Abstract

Wildfires are an environmental hazard event experienced by populations and communities across the world. These events can have significant and long-lasting effects on the communities that are impacted, which makes the importance of mitigation apparent. Partners in Protection, a non-governmental organization in Canada, developed the FireSmart program and manual in 1999. This manual includes recommendations to homeowners and municipalities about how to reduce their wildfire risks. Some municipalities have been innovative by adopting FireSmart recommendations and developing and implementing their own additional measures to reduce fire risks.

The purpose of this study is to explore how and why two local governments in British Columbia conceived, developed and implemented innovative wildfire mitigation measures at the municipal level. In-depth interviews were conducted with a total of 21 individuals involved in municipal wildfire mitigation (such as fire chiefs, mayors, emergency managers) across both communities. The results of this research show that several factors affected the success of these innovative municipal wildfire mitigation programs. These include: the effects of mountain pine beetle; the importance of community support and 'sense of community'; the post-event window of opportunity; access to funding and resources; collaboration and partnership between various stakeholders; and the importance of a 'community champion'. Limitations and obstacles to municipal wildfire mitigation are also identified and discussed.

Keywords: Wildfire, local government, community, wildfire mitigation, policy innovation, case study, British Columbia, Canada

Preface

This thesis is an original work by Léanne Marie Michelle Labossière. The research project, of which this thesis is a part, received research ethics approval from the University of Alberta Research Ethics Board, Project Name “Taking it into Their Own Hands: Innovation Wildfire Mitigation Measures at the Municipal Level”, No. Pro00031378, July 25, 2012.

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Chapter 1: Introduction

1.1 Study Background

Wildfires are an environmental hazard event experienced by individuals and communities across the world. Annually, wildfires impact the lives of thousands of people, from Australia to the U.S., Canada and beyond. Vast areas of the landscape are altered through the effects of wildfire. Over the course of one year, an estimated two million hectares of land are burnt by wildfires in Canada alone (Beverly & Bothwell, 2011). The impacts of wildfire also continue to be exacerbated by climate change, where warmer overall temperatures create hotter and drier summer temperatures, resulting in an increase in wildfire incidents, their scope, and their severity (Dale et al., 2001; Flanigan et al., 2005; Running, 2006; Wotton et al., 2010; Flanigan et al. 2013; Moris & Johnson 2013). As found by Wotton et al. (2010), the recent increases in wildfire activity across Canada will only continue to rise with the climbing global temperatures.

Wildfires interact with people, their homes, and the surrounding environment at the wildland-urban interface (WUI), where the forest meets human development (Anderson & Culbert, 2003; Davis, 1990). The desire for low-density, suburban living across the developed world continues to push housing developments further into the WUI (Radeloff et al., 2005; Theobald & Romme, 2007). Because of this growth into wildland areas, an increasing number of communities are now at a high level of wildfire risk.

The effects of wildfires on communities at the WUI can be devastating. Wildfire can result in the tragic loss of lives, such as the 75 deaths in the 1983 Ash Wednesday wildfires in South Australia, and the 173 people killed during the 2009 Black Saturday wildfires in Victoria, Australia (Cruz et al., 2012; Stephenson et al., 2013). As seen with the 2010 Fourmile Canyon Fire in Colorado, wildfires can also force people to leave their homes and evacuate to another location, only to find upon their return that their homes have burnt down (Brenkert-Smith et al., 2010).

This was also the case during the 2003 Okanagan Firestorm, where wildfires raged through the interior of British Columbia, Canada, destroying 774 homes and forcing over 45,000 people to evacuate (Government of British Columbia, 2004). Most recently in 2011, the Flat Top Complex wildfires destroyed over 300 homes, along with churches, businesses, and the main local government building in Slave Lake, AB, Canada (Flat Top Complex Wildfire Review Committee, 2012). The Flat Top Complex wildfires also caused the evacuation of over 10,000 people in the surrounding area (Flat Top Complex Wildfire Review Committee, 2012).

People's livelihoods may also be lost when forests, farms, and communities are burned in a wildfire (Anderson & Culbert, 2003; Stephenson et al., 2013). Schools may be shut down, access to health services may be reduced, and infrastructure may be damaged or destroyed. In view of the myriad of devastating effects wildfires can have on people and their communities, it is clear that preventative measures must be undertaken to reduce their risk.

In recognizing the potentially devastating impacts of wildfires, the importance of mitigation becomes readily apparent. Mitigation, which consists of any advance action taken to reduce the hazard risk to persons and property, is an important component in the relationship between people, communities, and wildfire (Godschalk, 2003). In the context of wildfire, mitigation actions may include vegetation management, such as removal of dead branches or grasses, or structural changes, like using fire resistant building materials.

Partners in Protection, a non-government organization that started in Alberta, developed the FireSmart manual (Partners in Protection, 2003), which includes recommendations to homeowners and communities about how to reduce the wildfire risks at the homeowner and municipal levels. Mitigation measures recommended in the Partners in Protection manual include: structural changes (roofing, building materials, windows), vegetation management (establishing priority zones around buildings, disposal of fire fuel materials), infrastructure (access to water, roadways), and land use planning (Partners in Protection, 2003). However, it provides only general preparedness and mitigation recommendations for communities, which are not tailored to specific circumstances. Given this generality, local governments may also need to develop their own innovative approaches to mitigating wildfire risk.

Innovation has been studied extensively over the past 50 years (Gopalakrishnan & Damanpour, 1997). The concept of innovation has been studied from a variety of perspectives, such as the development of an innovation, the adoption of an innovation, and the rate at which an innovation

diffuses throughout a population (Rogers, 2003; Gopalakrishnan & Damanpour, 1997). Innovation may result from a desire to succeed economically, to increase efficiency in an organization, to modify or improve technology, or to find a solution to a particular problem (Damanpour & Schneider, 2006; Gopalakrishnan & Damanpour, 1997).

Innovation can be broadly understood as the conception and expression of a novel idea or technique (Altshuler & Zegans, 1990). Innovation may be comprised of the development and implementation of a service, process, policy, administrative system, or structure (Damanpour & Schneider, 2006). It does not need to be altogether new or original – rather, an innovative idea or program may simply be new to the individual or organization that is implementing it (Rogers, 2003). Therefore, innovation may be expressed in different forms in various organizations or communities. This is the focus of this study.

Innovative wildfire mitigation measures are defined, for the purpose of this study, as any mitigation activity that is *not* included in these four main areas of FireSmart (structural changes, vegetation management, infrastructure, and land use planning) or any mitigation activity that *exceeds* the recommended scope of the FireSmart guidelines. For example, a high level of community-wide vegetation management would be considered innovative; additionally, developing a method of conducting vegetation management that is not included in the FireSmart manual (such as using cattle to reduce fuel materials) would also be considered innovative.

Ultimately, this research sought to identify and understand the manner in which local governments came to develop innovative wildfire mitigation measures and what influenced their successful implementation in their respective communities. The results of this research may also provide examples of innovative wildfire mitigation measures that could be considered for use in other communities.

1.2 Study Aim & Objectives

The aim of my research was to understand how and why two local governments conceived, developed and implemented innovative wildfire mitigation measures in their communities. The objectives of this research were:

1) To examine innovative wildfire mitigation measures currently being utilized by the two local governments.
2) To identify what factors influenced these local governments to develop and implement their wildfire mitigation measures in their communities.
3) To identify what challenges, if any, these local governments have faced in developing and implementing their municipal wildfire mitigation measures

1.3 Organization of Thesis

This thesis is organized into six chapters. This first chapter introduces the study background and explores why wildfire mitigation is so important in light of the effects wildfires can have on people and their communities. Chapter 2 consists of an overview of the relevant literature on wildfire mitigation and

mitigation by local governments. The literature review in chapter 2 also describes the factors that have affected local government hazard mitigation as identified in other studies. Chapter 3 describes the research process and methods used to collect, analyze, and interpret the data obtained through this project. Chapter 4 describes the innovative wildfire mitigation measures being implemented in two communities in British Columbia.

In Chapter 5, the factors that influenced the development and implementation of both communities' innovative wildfire mitigation measures are discussed. Chapter 5 also presents the challenges and limitations that both research communities faced while developing and implementing their innovative wildfire mitigation measures. Lastly, Chapter 6 provides a conclusion to the thesis by summarizing and discussing the implications of the main findings of this study, explaining the study's limitations and identifying directions for future research.

1.4 Chapter Summary

Chapter 1 has introduced wildfires and their potential impact on humans and their communities. Wildfires are a part of our ecosystems, but as climate change results in warmer global temperatures and hotter/drier summers, the frequency and severity of wildfires is increasing. This combined with the expansion of communities into the wildland-urban interface results in an increased risk of losses due to wildfires. The importance of mitigation therefore becomes apparent. Partners in Protection has made recommendations for reducing the impacts of wildfires on communities and households, but

communities need to develop wildfire mitigation measures that are tailored to their local context. This study examines innovative wildfire mitigation measures developed by local governments at the municipal level, and to identify the factors that influenced the development and implementation of these measures. The following chapter will review the relevant literature for this study, will identify gaps in the literature, and will justify why this study is needed.

Chapter 2: Literature Review

This chapter reviews the literature that relates to this study, including the broader field of environmental hazards research, wildfire research, human dimensions of wildfire mitigation, innovation, and the factors that may affect the development and implementation of innovative municipal wildfire mitigation measures. The conclusion of this chapter will identify gaps in the literature and outline why this research study is needed.

2.1 Environmental Hazards

The study of wildfires is but one part of the broader environmental hazard literature. As defined by Kates (1978), environmental hazards are "…the threat potential posed to man or nature by events originating in, or transmitted by, the natural or built environment" (p.12). Smith (2004) states that not only do environmental hazards consist of various natural, technological, and industrial phenomenon that pose risk to humans and/or their built environment, they also have the potential to cause loss. This may include earthquakes, volcanic eruptions, nuclear meltdowns, oil spills, drought, floods, and so many more.

Prior to the 1950s, environmental hazards were seen as "acts of god" – they were inevitable, and were directed by a higher power (Smith, 2004). This encouraged people to view hazard events and their devastating consequences as divine punishment, leading them simply to accept these events as being outside of the realm of their control (Smith, 2004). After the 1950s, however, it was the work of researcher Gilbert White on floods that first established that hazards

were inextricably linked to human development and activities (Montz & Tobin, 2010; Smith, 2004). Indeed, human decisions to develop and build in certain areas may result in an alteration of the surrounding environment, potentially *increasing* the number, type, and frequency of hazard events (Smith, 2004).Technological/industrial hazard events like Three Mile Island, Bhopal, Exxon Valdez, and Chernobyl solidified the idea that hazards were not only natural in origin, but human generated as well (Smith, 2004; Cutter et al., 2000).

This connection between humans and the environment provides the basis for the study of the social nature of environmental hazards. Within the past 20 years, the field of environmental hazards has grown beyond solely the physical nature of hazards, and encompasses the social and human nature of hazards as well (Smith, 2004). Indeed, as noted by McCaffrey (2004), the recognition of the social contexts and impacts of wildfire on humans has only recently been addressed in academic research.

Some of the recent research in the field of environmental hazards investigate a single hazard type, like wildfires, floods, or earthquakes, and may seek to explore them from a number of different approaches (such as physical characteristics, risk analysis, mitigation, or preparedness) (Lindell, 2013; Smith, 2004; Alexander, 1997). Other studies have looked at issues or factors that span various hazards, like assessing individual/community vulnerability to hazards, municipal planning for hazards, hazard evacuation responses, perception of risk to multiple hazards, hazard resiliency, and mental health after hazard events

(Kartez & Lindell, 2007; Dombroski et al., 2006; Godschalk, 2003; Bateman & Edwards, 2002; Morrow, 1999; Nolen-Hoeksema & Morrow, 1991; Slovic, 1987).

However, not all hazards have been studied equally in the academic literature. Certain hazards have been more prominent in the hazard literature than others. In particular, hurricanes, earthquakes, floods, and technological/industrial accidents have been the focus of research in the hazards field (Hallegatte et al., 2013; Bouwer et al., 2010; Kahn, 2007; Comfort, 2006; Lindell & Perry, 2000; Whitehead et al., 2000; Bolin & Stanford, 1998; Mileti & Darlington, 1997).

Prior to the 1990s, wildfires were not often the subject of academic research, and rarer still were the human dimensions of wildfire ever addressed (McCaffrey, 2004).This has been attributed to the success of wildfire suppression (wildland firefighting) in wildland areas (McCaffrey, 2004). Because of its success in controlling wildfires, wildfire suppression was seen as the only tool necessary for dealing with wildfires for many years (McCaffrey, 2004). This, however, changed with the increasing expansion of humans into the wildland-urban interface and the effects of climate change on the severity and frequency of wildfires (McCaffrey, 2004). Because of this, the social impacts of wildfires and alternatives to wildfire suppression like wildfire mitigation and preparedness measures have become increasingly important (Theobald & Romme, 2007; Running, 2006).

2.2 Wildfires

Wildfires have been studied from a variety of perspectives. Extensive research has been conducted on the physical characteristics and behavioral patterns of wildfires, such as Gumming's (2001) often cited work on their two main determinants, weather and the availability of fuel (see: Moreno, 2011; Collins et al., 2007; Porterie et al., 2007; Brillinger et al., 2006; Hargrove et al., 2000). Numerous scientific studies have been completed on the impact of wildfires on the ecology of the natural landscape, with particular emphasis placed on the effects of fire events on the health of the ecosystem (see Malone et al., 2011; Smith et al., 2011; Bayley et al., 1992). Much work has also been conducted on the implications of fire for forest management, especially in regards to the effects of silviculture on the natural fire cycle, as detailed in Donato et al.'s (2006) work on increased fire risk post-harvesting (see Stephens & Ruth, 2005; McRae et al. 2001; Johnson et al., 1998). Recently, research has focused extensively on the effects of global warming on wildfires, including changes in forest composition, increasingly hot summer seasons, increases in the overall number of wildfires, and higher intensity wildfires (Flanigan et al. 2013; Moris & Johnson 2013, Wotton et al., 2010, Running, 2006, Flanigan et al., 2005, Dale et al., 2001).

However, wildfire is not construed as a physical hazard alone; rather, the wildfire hazard is understood to be comprised of a combination of physical and social contexts (Gordon et al., 2010; Flint & Luloff, 2005). In recent years, considerable research has been completed on the interaction between the built

human environment and the natural environment, and the impacts of wildfire in the wildland-urban interface areas (Calkin et al., 2014; Thomas & Butry, 2014; Stewart et al., 2007; Theobald & Romme, 2007; Cova, 2005; Cohen, 2000; Plevel, 1997; Radke, 1995; Davis, 1990). This previous research has identified the increasing movement of people into wildland-urban interface areas, the increased risk to these people, their communities, and wildfire, as well as the challenges in protecting these areas from wildfires.

2.3 Human Dimensions of Wildfire Mitigation

In light of the gravity of the impacts of wildfires at the wildland-urban interface, the importance of wildfire mitigation becomes readily apparent. Mitigation, as defined by Godschalk (2003), is any action undertaken to reduce the risk to people and property during natural hazard events. Mitigation has been recognized as an important tool in reducing the impacts of a variety of natural hazard events, such as wildfires (Godschalk et al., 2009). Some examples of wildfire mitigation measures include vegetation management, utilizing fire-resistant building materials, and education/awareness campaigns about hazard risks, though the prevalence and popularity of each mitigation measures differs from one community to the next (Partners in Protection, 2003; Winter & Fried, 2000). Wildfire mitigation is completed at varying levels of responsibility. The following sections will describe research conducted on wildfire mitigation at the homeowner and the local government levels.

2.3.1 Human Dimensions of Wildfire Mitigation at the Homeowner Level

Much of the previous work on wildfire mitigation has focused on homeowners' understanding and implementation of wildfire mitigation measures (Meldrum et al., 2014; Stidham et al., 2014; Faulkner et al., 2011; McFarlane et al., 2009; McGee et al., 2009; Brenkert-Smith et al., 2006; Brenkert et al., 2005; Collins, 2005; McGee & Russell, 2003; Winter & Fried, 2000; Gardner et al. 1987). Research conducted by Brenkert-Smith et al. (2005) focused on the decision-making process that homeowners go through when faced with the issue of mitigation against wildfires. They found that while information and knowledge about wildfire mitigation was readily available, the process of implementing mitigation practices and activities was still an obstacle for many homeowners (Brenkert-Smith et al., 2005).

Researchers such as Collins (2005), McGee, (2005), McGee & Russell (2003) have investigated what wildfire mitigation measures were most likely to be implemented by homeowners, as well as what factors influence decisions about wildfire mitigation at the homeowner level. McGee (2005) found that in a study of homeowners in Edmonton, AB the most frequently implemented wildfire mitigation measures were removing vegetation (mowing the lawn, disposing of leaves, and pruning trees) and installing double/thermal paneled windows. Collins (2005) and Beringer (2000) both found that homeowners were more likely to implement wildfire mitigation over renters, as renters may feel less responsible for protecting the home.

Meldrum et al. (2014) and Brenkert-Smith et al. (2005) found that many homeowners felt that if wildfire mitigation measures were presented to them

with property-specific details instead of general guidelines they would be more likely to implement mitigation measures. The prohibitive cost of wildfire mitigation measures was found to be a negative influence on homeowners' decision to mitigate wildfire risk, as other monetary demands within the household often outweigh the importance of wildfire mitigation (Faulkner et al., 2011). Several studies have also identified aesthetic values around their home as important factors in the decision to implement wildfire mitigation measures (Collins, 2008; Brenkert-Smith et al., 2005; Collins, 2005; McGee, 2005; Nelson, 2005; Daniel et al., 2003).

How a homeowner perceives their wildfire risk also has been found to have an impact on whether or not they implement wildfire mitigation measures (Paton 2003). Risk has previously been understood as the probabilistic chance of loss, but as Slovic (1999) has argued, risk "…is inherently subjective […] it does not exist 'out there', independent of our minds and cultures, waiting to be measured […] there is no such thing as 'real risk' or 'objective risk' " (p.690). Therefore, risk is not simply a number, a probability, or a percentage; rather, risk is subjective, conceptualized by a person's *perception* of their vulnerability to an event that may cause them harm.

Risk perception is composed of a person's judgments when evaluating hazardous activities, situations, or technologies (Slovic, 1987). These judgments are affected by a number of factors, such as a person's ability to control the outcome, the potential of an event to be catastrophic, and the certainty of the outcome of a hazard event (Slovic, 1987). It is also influenced

by social factors, such as the influences of family members, peers, social groups, and authority figures (Kasperson & Kasperson, 1996; Dake, 1992; Slovic, 1987; Short, 1984; Douglas & Wildavsky, 1982). How people perceive risks informs and influences the decisions they make, such as the decision to mitigate the risk posed to them by a hazard (like wildfires) (Slovic, 1987).

McGee & Russell (2003) found that in one community in Australia, higher risk perception of wildfire among homeowners led to a higher likelihood of undertaking wildfire mitigation on their properties. This finding was also echoed by Martin et al. (2009), who found that the higher the risk perception of homeowners towards wildfire in three communities in the Western U.S, the more likely they were to implement wildfire mitigation measures on their property.

Other factors may also affect a homeowner's likelihood to implement wildfire mitigation actions, such as their past experience with wildfire. In two studies (Winter & Fried, 2000, Gardner et al., 1987) past wildfire experience was found to *decrease* the likelihood of implementing household wildfire mitigation measures. Winter & Fried (2000) found that this was due to the feeling of lack of control of wildfires, while Gardner et al. (1987) found in their study of residents in California that having already experienced a wildfire, homeowners felt it was less likely that they would experience another wildfire in the near future.

Martin et al. (2009), in their study of three communities in the Western United States, found that "…direct experience with wildfires did not

significantly influence homeowners' decisions to mitigation the [wildfire] risk" (p.497). Conversely, McGee & Russell (2003) found that for residents in a community in Australia, past experience with a wildfire *increased* the likelihood of them implementing wildfire mitigation measures, as did length of time of residence in the area, and involvement in the local fire brigade. Finally, McGee et al. (2009) identified that "…differences in experiences [for each individual] during a hazard event can impact risk perceptions and adoption of mitigation measures after the event" (p.321), so that while experience with wildfire for one person may increase their likelihood of future wildfire mitigation, for another person the opposite may be true.

2.3.2 Human Dimensions of Wildfire Mitigation at the Municipal Level

The implementation of wildfire mitigation is not solely the responsibility of the homeowner; as implemented by local governments, it is a vital part of reducing wildfire risks to communities. The following section will review the literature relevant to wildfire mitigation by local governments (hereafter referred to as 'municipal wildfire mitigation').

As found by Jakes et al. (2003), municipal wildfire mitigation is influenced by a number of factors. One of these is the importance of collaboration. Collaboration between different levels of government, local organizations, and other community stakeholders has been found to be a key factor in the development of effective wildfire mitigation strategies (Harris et al., 2011, Steelman & Kunkel, 2004). Shiralipour et al. (2006) identified the importance

of working collaboratively with neighbourhood associations in implementing municipal wildfire mitigation measures. In their study of community wildfire protection plan (CWPP) development in communities in Arizona's White Mountain, Fleeger (2008) found that cooperation between local, state, and federal governments as well as collaboration with community members ensured a timely and effective CWPP development process.

This finding was echoed by Jakes & Sturtevant (2013), who found that collaboration between members of a community and community organizations was an important component in the development of CWPPs in four communities in the United States. Jakes et al. (2003) found that agency involvement and collaboration within the community was a factor in the success of wildfire preparedness and mitigation in three communities in the United States. Agencies like a forest service or wildfire management crews provide professional skills and expertise that otherwise may not be available to a local government organization (Jakes et al. 2003; Kruger et al., 2003).

Previous experience with wildfire was also found to have an influence on the success of municipal wildfire mitigation measures. Kruger et al. (2003) found that having previously experienced a wildfire raised awareness amongst community leaders in Waldo, Florida and reinforced the importance of preparing and mitigating their risk to wildfire to these leaders. Muller & Schulte (2011) found that having experienced a wildfire encouraged local governments to strengthen their wildfire mitigation actions in their communities. Plevel (1997) found that experiencing a wildfire often opened up a "window" of

opportunity after the event that caused higher levels of community support for wildfire mitigation measures. In four communities in the United States, Jakes & Sturtevant (2013) identified the post-wildfire event learning that took place, which then positively influenced the improvement in wildfire mitigation and preparedness in these communities. This finding is echoed by Steelman & Kunkel (2004), who found that in Ruidoso, New Mexico the approval of wildfire planning and zoning ordinances were positively affected by the fact that smoke from a nearby wildfire was blanketing Ruidoso as the city council voted on them.

Social capital has also been identified as having an important influence on wildfire mitigation at the municipal level. As defined by Jakes et al. (2003), social capital consists of "…the community characteristics that contribute to collective social action" (p.7). This includes characteristics like leadership within the community, support between community members, and sense of community (Jakes et al., 2003; Kruger et al., 2003). Kruger et al (2003) found that relationships and networks between community members facilitated the development and implementation of municipal wildfire mitigation initiatives in three communities in the United States. Bihari & Ryan (2012) and Agrawal & Monroe (2006) both also found that communities with high levels of social capital had higher levels of municipal wildfire mitigation measures. Sense of community and place attachment were also found to positively influence the likelihood of municipal wildfire mitigation measures being implemented in a community (Bihari & Ryan, 2012).

Community leaders or "champions" have also been found to positively influence municipal wildfire mitigation through their high community profile, their support of wildfire mitigation measures, and their ability to inspire others to participate in municipal wildfire mitigation (Agrawal & Monroe, 2006; Lang et al., 2006; Plevel, 1997).

Access to funding and sources of funding is a key component of wildfire mitigation at the local government level. Plevel (1997) states that funding can be a barrier or a boon to wildfire mitigation – without it, it is unlikely that action would be taken, but with it, local governments are more likely to implement wildfire mitigation. Steelman & Kunkel (2004) identified that while there is often funding available for structural mitigation (such as fuel reduction treatments), there is little funding aimed for social responses to wildfire risk mitigation.

Though the landscape and environmental conditions are often regarded as physical characteristics of risk and not social characteristics, Jakes et al.'s (2003) findings indicate that landscape can play an important role in influencing municipal wildfire mitigation. They found that homeowners and property owners in a community acknowledge their risk as it relates to their surrounding landscape (such as isolation), and this can in turn influence their willingness to participate in municipal wildfire mitigation measures. Harris et al. (2011) also found that the biophysical characteristics of a community, such as size and location, influenced community-wide wildfire mitigation.

No two communities are the same. This is why finding community-specific mitigation solutions to wildfire risk is critical in ensuring the most effective approaches to local government wildfire mitigation. Steelman & Kunkel (2004) as well as Theobald & Shaw (2011) have highlighted the necessity of each local government finding its own innovative approaches to hazard risk in order to cater to the specific characteristics of a community. The following section will expand on the concept of innovation, and the implications of innovation for wildfire mitigation at the local government level.

2.4 Innovation

Innovation, as defined by Damanpour & Schneider (2008), is "…the development and/or use of new ideas or behaviours" (p.496). As stated in Chapter 1, an innovative program, idea, or behaviour may not be brand new or original, but rather, new to the organization implementing it (Kendra & Wachtendorf, 2011; Berry & Berry, 1999; Alshuler & Zegans, 1990). This is the concept of innovation as outlined by Rogers, who states that:

> An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption [like an organization]. It matters little […] whether or not an idea is 'objectively' new as measured by the lapse of time since its first use or discovery. If an idea seems new […], it is an innovation. (2003, p.12)

For the purposes of this study, innovation will be understood as any mitigation measure that is not included in, or exceeds the scope of, the FireSmart program.

Diffusion of innovation theory is a major framework guiding innovation research. It focuses on how adopted innovations are communicated and spread between individuals or within organizations, and is the subject of many studies (Choi et al., 2010; Peres et al., 2010; Greenhalgh et al., 2004; Rogers, 2003; Mintrom, 1997; Valente, 1996). The diffusion of innovation literature has identified characteristics that play a role in the rate of adoption of innovations (Rogers, 2003). These include relative advantage (how much better the idea is over the idea it replaces), compatibility of the innovation (how consistent it is with the values of the idea it is replacing), and how complex an innovation is (how difficult it is to understand or implement). The last two characteristics are the ease of trialability of a proposed innovation (how easy it is to try it out on a limited basis), and the observability of the results of the innovation (how visible its effects are) (Rogers, 2003).

While diffusion of innovations is an important component of the innovation research field, my study did *not* use diffusion of innovation theory. It did not examine how an innovation spreads from individual to individual, nor how it spreads within an organization. Rather, it aimed to examine the factors *influencing* the development and implementation of innovative wildfire mitigation measures by local governments.

Beyond diffusion of innovations theory, academic research in the field of innovation spans both the private and the public sector. Private sector innovation research has mainly focused on technological or industrial innovations, such as developing new products or measures (Kendra &

Wachtendorf, 2011, Orcutt & AlKadri, 2009; Montalvo, 2006; Gopalakrishnan & Damanpour, 1997). As stated by Kendra & Wachtendorf (2011) "…in the corporate world […] organization must respond to constant shifts in the competitive landscape with new products or services, more efficient communications, or information technology" (p.318). Innovation in the private sector works towards improving the bottom line of a company and with it, its chances of survival (Kendra & Wachtendorf, 2011).

Like their private sector counterparts, public sector organizations must also become innovative – sometimes quickly - to deal with the varying issues and problems facing government. As put by Altshuler & Zegans (1990) "…to be deemed effective, governments in the modern era must be highly adaptive to changing demands, problem configurations, and possibilities" (p.16). Innovations in the public sector often involve service delivery to citizens, program development and implementation, or technological changes to improve efficiency (Altshuler & Zegans, 1990). A subset of public sector innovation research has focused on investigating these types of innovations in the public sector: the field of policy innovation.

The field of policy innovation in the public sector broadly aims to explore how new ideas and programs are developed and implemented by governments (Berry & Berry, 1999). Berry & Berry (1999) proposed two mechanisms for understanding policy innovation by governments: diffusion of innovations (see above), and the role of internal determinants. Internal determinants refer to the political, economic, and/or social characteristics or factors that may influence a

government organization in their process of innovation (Berry & Berry, 1999). These may include access to resources, political climate, demographics, and political/citizen support (Krause, 2010)

Most studies conducted on policy innovation have been at the federal or state level, but some studies have been completed at the local government level (Krause, 2010). These studies touch on a variety of fields of research. For example, some studies have focused on policy innovation and climate change initiatives by local governments (Pitt & Bassett, 2014; Krause, 2010; Betsill, 2001)). Jun & Weare (2007), Tolbert et al. (2008) and Wohlers & Bernier (2012) examined how municipal governments implement e-government policy innovation. Morgan (2010) explored policy innovation in economic development by local governments in North Carolina, USA. Korfmacher et al. (2012) studied policy innovations in local government approaches to lead contamination in the water supply of Rochester, NY. Finally, Godwin & Schroedel (2000) investigated innovative approaches to local gun control policies in California.

Previous research on policy innovation at the local government level has also identified factors that foster or impede the development and implementation of innovation. Having sufficient access to funding and/or resources for developing and implementing innovative policies was identified by several studies on local government policy innovations (Wohlers & Bernier, 2012; Betsill, 2001; Bingham, 1978).The presence of strong leadership or a local champion was also determined to be a positive factor on policy innovation

(Wohlers & Bernier, 2012) Morgan (2010) identified the positive influence that inter-jurisdictional cooperation and/or collaboration have on local government policy innovation.

Krause (2010) found that a barrier to policy innovation in climate change policy was the fact that some local governments owned stakes in utilities companies, thereby giving them financial motivation to oppose climate change policies. Betsill (2001) identified lack of administrative capacity (staffing) as an obstacle to implementing climate change policy innovations.

2.4.1 Innovation & Hazards

As found by Kendra & Wachtendorf (2007), innovation, hazards, and local government are all concepts that are inextricably linked – communities faced with the risk of disaster must often come up with their own approaches to mitigating, preparing for, and responding to disaster events. Indeed, as Kendra & Wachtendorf (2007) succinctly state: "survival requires innovation" (p.318). However, little work has been done in understanding and evaluating the factors that affect innovation as led by local governments in the face of hazard events.

The few studies that have been conducted on innovation and hazard mitigation by local governments have focused mostly on innovation and climate change (Pitt & Bassett, 2014; Bassett & Shandas, 2010; Krause 2010; Betsill, 2001). These studies have focused on examining policy innovation by local governments in terms of climate change legislation, operating policies, mitigation and planning. No other studies have been conducted at this point in

time on innovation and municipal wildfire mitigation. This is therefore what this study aims to investigate.

As with the internal determinants mechanism from the policy innovation field, the development and implementation of innovative wildfire mitigation measures at the local government may be influenced, positively or negatively, by a number of factors. Several of the factors that have been previously identified as influencing the development and implementation of wildfire mitigation at the local government level (see section 2.2.2) may also be relevant to the development and implementation of *innovative* wildfire mitigation measures. These factors have also been identified by the results of similar research studies conducted on other hazards (such as drought, floods, etc.) and on other studies on policy innovation. These factors are described in detail in the following section.

2.4.2 Factors Affecting Innovative Municipal Wildfire Mitigation

One of the factors that has been identified in influencing the development and implementation of hazard mitigation is the role of a window of opportunity after a focusing event. Birkland (1998) investigated the role of focusing events in influencing changes to risk reduction and mitigation. A focusing event is:

> …an event that is sudden; relatively uncommon; can be reasonably defined as harmful or revealing the possibility of potentially greater future harms; has harms that are concentrated in a particular

> geographical area; […] and that is known to policy makers and the public simultaneously. (Birkland, 1998, p.54)

Birkland (1998) found that a focusing event, like a hazard event, can raise public interest and increase support for subsequent changes. These changes predominately include mitigation or preparedness measures that aim at reducing the risk of the same type of event happening again. Similarly, Wyner & Mann (1982) found that after a large earthquake event in Santa Rosa, California there was a sharp increase in the willingness of that community to develop and implement earthquake mitigation policies. Tierney et al. (2001) also found that many communities which had experienced a hazard event were more likely to be willing to implement changes to the way that they dealt with and prepared for hazards. Other studies have also identified the importance of a window of opportunity after a wildfire event in the successful development and implementation of wildfire mitigation measures (Jakes & Sturtevant, 2013; Muller & Schulte, 2011; Steelman & Kunkel; Kruger et al., 2003; Plevel, 1997)

Kingdon (1984) identified the importance of a window of opportunity in implementing changes after certain events, including hazards. Similarly, Prater & Lindell (2000) found that the development and implementation of hazard mitigation measures was often influenced by a window of opportunity after a hazard event. Previous experience with environmental hazard events has also been found to provide stimulus for local governments to improve their mitigation efforts (Brody et al., 2011; Tierney et al., 2001; Olson et al., 1998; Berke et al., 1993; Wyner & Mann, 1986).

Partnerships and collaboration have also been identified as important factors. Kusumasari & Alam (2012) found that collaboration between levels of government and community members was integral in the success of hazard mitigation, response, and recovery measures. The importance of collaboration between municipalities and community stakeholders as an important factor in influencing the success of local government policies and programs has been highlighted in a number of studies (Jakes & Sturtevant, 2013; Jones, 2011; Fleeger, 2008; Shiralipour et al., 2006; Jakes et al., 2003) Collaboration with higher levels of government (state/provincial, federal) has also been found to encourage local governments to implement hazard mitigation (Harris et al. 2011; Jones, 2011; Morgan, 2010; Fleeger, 2008; Steelman & Kunkel, 2004; Kruger et al., 2003).

The importance of financial support and access to resources has previously been identified in the hazards and policy innovation literature as playing a key role in innovation development and implementation at the local government level. Access to funding (or lack therefore) has been explored in regards to municipal wildfire mitigation (Steelman & Kunkel, 2004; Plevel, 1997). Several studies have stated that having easy and/or stable access to financial capital as well as access to non-monetary resources such as specialized equipment and personnel positively influenced the development and implementation of innovative programs and policies (Wohlers & Bernier, 2012; Jones 2011; Krause, 2010; Bingham, 1978)

Social capital, which includes support within the community and sense of community, has been identified as a factor positively influencing innovation at the municipal level (Bihari & Ryan, 2012; Agrawal & Monroe, 2006; Jakes et al., 2003; Kruger et al., 2003). Having support for mitigation measures at a variety of levels is another important factor in the development and implementation of hazard mitigation. Jones (2011) found that political will in backing and supporting mitigation efforts is a critical part of the success of climate change mitigation measures in three North American cities. These findings have been similar to others in the hazards and policy innovation field, who have also found that political support is key (Bassett & Shandas, 2010). Support from community members and residents has also been highlighted as an integral component in the success of innovative policy and program implementation at the local government level (Bassett & Shandas, 2010).

Community leaders and issue champions are also another important factor in influencing innovation & mitigation. Leadership is a key part of spearheading the process of innovation within an organization, as it can keep the process rolling until the innovative program is established (Crossan & Apaydin, 2010). Bassett & Shandas (2011), in their study of municipal climate change innovations, found that a critical factor in the development of innovative mitigation plans was a "champion", a high-profile advocate for innovation and change. Kendra & Wachtendorf (2009) also highlight the critical importance of having an issue champion who is focused on the hazard risk, visible in the community, inspired to effect change, and can inspire others

to do the same. Several other studies in hazard mitigation and policy innovation have found that local issue champions and community leaders were a key factor in developing and implementing innovative ideas and programs at the local government level (Salon et al., 2014; Wohlers & Bernier, 2012; Agrawal & Monroe, 2006; Lang et al., 2006; Prater & Lindell, 2000; Plevel, 1997; Wyner & Mann, 1983).

2.5 Chapter Summary

This chapter reviewed the literature relevant to this research study. Environmental hazards, including wildfires, have been studied from a variety of perspectives. Studies have examined the physical characteristics of wildfires, the effects of wildfires on the ecology of the natural landscape, and the effects of climate change on wildfires. Research has also been conducted on the human dimensions of wildfires at the both the individual and community level. The concept of innovation, specifically policy innovation, and how it relates to hazard mitigation was also reviewed.

Though previous research has identified factors that influence the development and implementation of municipal wildfire mitigation, no study has yet sought to investigate how and why certain municipalities develop and implement their own *innovative* wildfire mitigation measures. Indeed, very little research has been done on innovation and the mitigation of environmental hazards in general. This is the gap in the research that this study aims to fill.

In order to achieve this goal, this study therefore aimed to examine what wildfire mitigation innovations are in place in two communities in British Columbia, and what factors have influenced their development and implementation. The following chapter will describe the research methods employed to achieve these research objectives.

Chapter 3: Methodology

This chapter describes the methodology used for this study. A qualitative approach was employed for this research. The study involved 20 in-person, semi-structured interviews with 21 participants from case studies conducted in two municipalities in British Columbia. These interview participants consisted of local fire chiefs, municipal government officials, provincial emergency and wildfire officials, and local residents. Non-probability sampling of potential interview participants was used for the purpose of this study. After the interviews and the completion of field work in the two communities, the data was transcribed and analyzed. These methods will be discussed in the following subsections of this chapter.

3.1 Methodological Approach

A qualitative approach was used in all aspects of this research study. This approach was used as it allows a researcher to "…understand how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" (Merriam, 2014, p.5). A qualitative researcher seeks to "...study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meaning people bring to them" (Denzin & Lincoln, 2000, p.3). They collect and interpret materials and use these materials to create representations and interpretations of how people view their world (Denzin & Lincoln, 2000). By using qualitative methods in

research, we seek to understand the subjective lived experience of people in relation to a certain phenomenon.

A qualitative approach was used because this research study sought to explore not only what innovative wildfire mitigation measures were being used by local governments in British Columbia, but also to explore *how* and *why* they were developed and implemented. This type of research lends itself well to understanding the context around a particular research topic, and allows a topic to be explored in-depth.

3.1.1 Research Paradigm

When conducting qualitative research, it is important for the researcher to recognize that they approach their research with their own "...philosophical assumptions of the nature of the world [...] and how we can understand it" – in essence, there is no 'objective' truth (Maxwell, 2005, p.36). These philosophical assumptions form the basis of the conceptual framework used to conduct qualitative research, and help to provide a basic set of beliefs that guide the research project. There are four main paradigms present in qualitative research – postpositivism, social constructivism, advocacy/participatory, and pragmatism (Creswell, 2007). A researcher does not have to only select a single paradigm to guide their research; as Maxwell (2005) states "...it is possible to combine aspects of different paradigms and traditions" (p.37).

This research study was approached from the philosophical assumptions of the *social constructivist* paradigm. The social constructivist paradigm is a worldview whereby the researcher seeks to investigate how their participants

view and experience their world (Creswell, 2007). It aims to reconstruct the "local and specific constructed realities" of the participants' view of the phenomenon under study (Lincoln & Guba, 2005, p.168).

Constructivism does not start with a theory to be tested – rather, the researcher seeks to inductively investigate the phenomenon at hand through the subjective experiences of the participants (Creswell, 2007). It assumes that reality is a socially constructed concept, and that each individual will have their own subjective view of what reality is (Berger & Luckman, 1966). This research study sought to investigate the socially constructed reality of municipal wildfire mitigation from the perspective of those individuals involved in its development and implementation.

3.1.2 Case Studies

For this research project, two case studies were conducted in order to achieve the research objectives. A case study is a method of inquiry where "...the investigator explores a bounded system (a case) or multiple bounded systems through in-depth case description and case-based themes" (Creswell, 2007, p.73). Case studies seek to provide an in-depth exploration of the complexities of a phenomenon within its natural setting and context (Lee et al., 2010; Yin, 2003). To accomplish this, "...the case study approach aims to provide rich, in-depth information" (Lee et al, 2010, p.683) about the characteristics of the phenomenon.

There are three main variations on the type of case study that can be undertaken by a researcher: the intrinsic case study, the single instrumental case

study, and the multiple case study (Creswell, 2007). A multiple case study approach was selected for this research. A multiple case study is where one concern or phenomenon is selected, but more than one case is used to investigate the phenomenon (Creswell, 2007).

Two case studies were selected because they were two communities that had developed and implemented the most innovative wildfire mitigation measures. They were identified through a survey of wildfire mitigation activities being completed by local governments in Alberta and British Columbia (see section 3.2 for more on this selection process). A multiple case study approach was used in order to provide more than one perspective on the research question. Additionally, a multiple case study was also used in order to account for the unique contexts of both communities when investigating both of their innovative wildfire mitigation measures.

3.2 Selection of Case Study Communities

Potential communities for this study were identified via a survey of local governments in BC and Alberta by Labossière & McGee (2013), which aimed to identify how local governments in the two provinces were mitigating wildfire risks. The survey was emailed to all fire chiefs and/or chief administrative officers in 373 towns, cities, and regional districts/counties in BC and Alberta. These contacts were obtained through the Alberta Fire Chiefs' website (Alberta Fire Chief's Association, 2012), the Fire Chief's Association of British Columbia (Fire Chief's Association of British Columbia, 2012) and the 2012 Alberta Municipal Officials Directory (Government of Alberta, 2012).

Of the 373 local governments contacted, respondents in 67 local governments returned their completed survey.

From these surveys, 11 communities were identified as having adopted Partners in Protection's FireSmart recommendations (2003) and developed or implemented their own additional potentially innovative wildfire mitigation measures to reduce fire risks. The FireSmart activities recommended by Partners in Protection (2003) fall into five main categories, as outlined in Table 1.

Table 1: Description of FireSmart wildfire mitigation activities (from Partners in Protection, 2003)

FireSmart Activity	Description of the Activity
Vegetation Management	Vegetation management entails the reduction or removal of "...fuels capable of supporting fast-spreading, high-intensity fires" (Partners in Protection, 2003, p.3-3). The primary three approaches to vegetation management are fuel removal, fuel reduction, and fuel conversion (replacing more flammable plant species with wildfire-resistant ones). It can also involve the establishment of priority zones, which uses vegetation management to create a defensible space around a structure. At the municipal level, a fireguard can be created to form a defensible space around the entirety of the municipal area.
Structural Options	Structural options refer to the methods or materials used in constructing new buildings or retrofitting existing ones in the wildland-interface area. This includes materials used for roofing), for exterior siding or for windows
Infrastructure	This refers to the municipal infrastructure in place in a community, such as roadways, utilities, water supply, and access routes. This also includes appropriate and visible signage to guide emergency crews in and out of an area. Access to water can be an issue as well; during wildfire, fire trucks and helitack crews may need to refill with water, but without easy access to a dependable water source their efforts may be limited.
Communication	Communication about wildfire risk is key component in attempting to reduce the risk of wildfires in a municipal area. These types of activities involve the development of a communications plan, developing targeted messages (for diverse groups like schoolchildren, industry personnel, church groups), and strategies for interacting with the media.
Land Use Planning	This entails the use of planning principles as well as legislation and by-laws to include wildfire mitigation in the development and construction process.

From those 11 communities identified by the survey, two were selected for further study based on the extent of the innovative mitigation measures they had developed and implemented. These two municipalities are Logan Lake British Columbia, and Kamloops, British Columbia. As seen in Figure 1, both communities are located in the interior region of British Columbia, northwest of Kelowna.

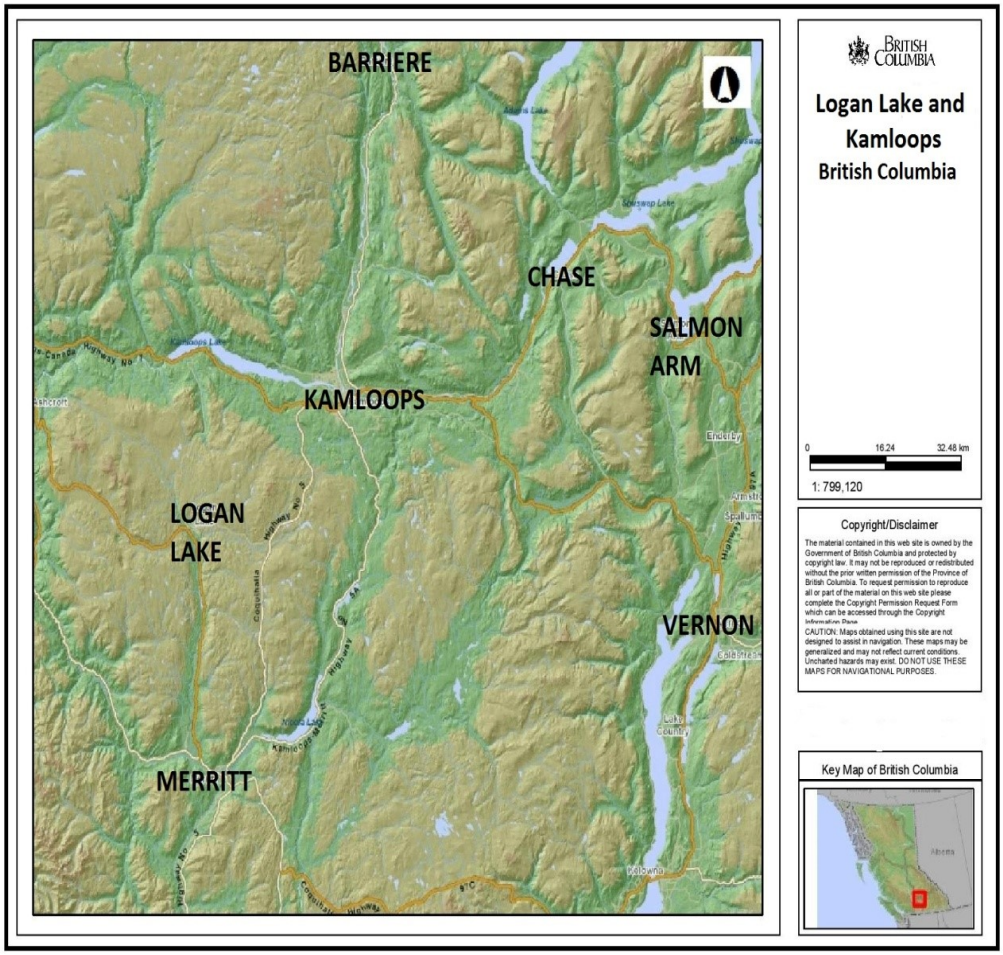

Figure 1: Location of Logan Lake and Kamloops in British Columbia (from http://maps.gov.bc.ca/ess/sv/imapbc/)

3.2.1 The District of Logan Lake

The District of Logan Lake, British Columbia was chosen as one of the two case studies because it was found to be implementing several wildfire

mitigation measures that were not being implemented in any of the other municipalities and were beyond the scope of activities in the FireSmart manual (Partners in Protection 2003). Their wildfire mitigation measures are described in chapter 4, section 4.1.

Logan Lake is a community of approximately 2,000 people, located 56km southwest of the city of Kamloops (Government of Canada, 2007). It is a relatively new community, having been established in the early 1970s as a settlement for workers at the nearby Highland Valley Copper Mine. Logan Lake is situated on the Lac le Jeune Plateau, and sits at an elevation of approximately 1,100m above sea level (J.S Thrower & Associates, 2004).

The town is located in a heavily forested area, comprised primarily of Douglas fir and lodgepole pine, as well as some Ponderosa pine and spruce (J.S Thrower & Associates, 2004). The community also sits at the north end of a valley, thereby creating an uphill slope from the valley into the town. This feature can influence fire behaviour, as both uphill slopes and the wind that accompanies them can increase the spread rate of a wildfire (J.S Thrower & Associate, 2004; Partners in Protection, 2003).

In terms of climate, Logan Lake typically experiences dry conditions and hot temperatures during the summer months. The community is a popular vacation spot for camping, fishing, and all-terrain vehicles during the summer. Importantly, all-terrain vehicles can increase the risk of igniting a wildfire due to the sparks produced by the engine, which in turn increase the risk of a

wildfire event in the area around Logan Lake (J.S Thrower & Associates, 2004).

3.2.2 The City of Kamloops

The second community of Kamloops, British Columbia was selected because it had implemented its own measures to reduce wildfire risks and had completed extensive wildfire mitigation measures recommended by Partners in Protection. The community has been working on wildfire mitigation issues since 1985, after the 'Kel' wildfire spread into the interface area around the community (Partners in Protection, 2003). These innovative wildfire mitigation measures are explored in detail in chapter 4, section 4.2.

The City of Kamloops is located in the south-central interior of British Columbia. The city is spread across 27,000 hectares, stretching from the valley floor where the North and South Thompson Rivers meet, and extending to the upper plateaus about 550m above the valley (City of Kamloops, 2008). Due to the sprawling nature of the city, Kamloops covers a large variety of terrain ranging from lush riverside habitat to semi-arid hillsides.

Kamloops, with a population of over 98,000, is considered to be a regional hub in the area, servicing smaller communities like Logan Lake, Chase, Rayleigh, Cache Creek, and Ashcroft (Government of Canada, 2012). In terms of climate, Kamloops is located in the dry-belt interior of the province, and is considered to be semi-arid. Vegetation in the area around the community is characterized by Ponderosa pine and Douglas fir, with some pockets of lodgepole pine (City of Kamloops, 2008). Kamloops has experienced around

175 wildfires within its city limits, and the Kamloops Fire Centre responds to an average of 400 wildfires in the region on an annual basis (City of Kamloops, 2008).

3.2.3 Comparison of the Two Municipalities

Logan Lake and Kamloops share a number of similarities. As outlined in Table 2, both communities are located in a semi-arid area that frequently experiences hot, dry summers. They also both have a conifer-dominated forest ecosystem (conifer trees are more flammable than their deciduous counterparts, and thus pose a higher risk of wildfire), and have both experienced the ravages of mountain pine beetle in the past eight years (J.S Thrower & Associates, 2004; City of Kamloops, 2008).

However, the two municipalities differ from one another in several regards. For instance, the City of Kamloops is an urban municipality much larger in both population and size than the District of Logan Lake, a rural community. Kamloops also has a much more varied terrain, ranging from the bottom of the valley to up along the steep hillsides, while Logan Lake is located entirely on a plateau at the end of the valley (also see section 5.2) The heterogeneity in the characteristics of both communities increases the potential generalizability of the findings – if there are similar results found in each community despite the difference in their contexts, the more likely the findings will be applicable to a broader population (Gomm et al., 2009).

Table 2: Overview of demographics and characteristics of case study communities

Characteristics	Logan Lake, British Columbia	Kamloops, British Columbia
Demographics*		
Population (2011):	1,975	85,678
Population density (/km^2):	398.0	286.3
Private dwellings (2011):	1,039	36,949
Land area (km^2):	4.96	299.23
Main industries:	Copper mining, forestry, some tourism	Tourism, forestry, copper mining, post-secondary education
Physical Characteristics		
Climate:	semi-arid, dry/hot summers	semi-arid, dry/hot summers
Forest type:	Douglas fir, lodgepole pine (includes stands infected with mountain pine beetle)	Douglas fir, Ponderosa pine (includes stands infected with mountain pine beetle)

*Statistics Canada, Community Profiles 2011 Census Data

3.3 Research Ethics

As this study uses interview data from human subjects, ethics approval was required before proceeding with fieldwork and interviews. Approval for the work conducted in this study was obtained through a formal ethics review from the Research Ethics Board (REB) at the University of Alberta in July, 2012. A copy of the ethics approval for this research project can be found in Appendix A.

At the beginning of an interview session, I provided each interview participant with a second copy of the information letter and then asked them to sign a letter of informed consent (see Appendix C). Informed consent refers to obtaining consent from a prospective research participant after careful explanation and disclosure of all aspects of the research project (Fontana & Frey, 2008). It explains the rights of the participant during the interview process, such as the voluntary nature of their participation and their right to confidentiality as well as protection of their identity and privacy (Seidman, 2006).

Confidentiality is important to maintain when working with human participants in qualitative research (Longhurst, 2010). Through both the information letter and the letter of informed consent, participants were also made aware of the actions being taken to guarantee the confidentiality of their information, such as keeping the electronic interview data in password protected files and keeping all physical forms of interview data in locked cabinets only accessible to myself (Longhurst, 2010). Finally, I removed all personal identifiers (such as names, specific position titles) from the interview data in order to maintain participants' confidentiality.

Participation in this study was voluntary, and those involved were informed that they were able to withdraw from the study before the end of the data collection phase should they choose to no longer participate (Longhurst, 2010). It was also made clear to the participants that if they had any questions about the study or required any further information they were welcome to

contact myself or my supervisor at any time (contact information was provided in both the information letter and the letter of informed consent).

3.4 Participant Recruitment

My key contacts in each community were the two individuals who had responded to the initial survey completed by Labossière & McGee (2013). These two individuals helped with initial participant selection by giving me the names of additional individuals who were involved in wildfire mitigation in their community. This method of locating potential interview participants is referred to as snowball sampling, where referrals are made by initial contacts to identify others who might be of interest to the research study (Biernacki & Waldorf, 1981). I then continued with this method of snowball sampling until there were no new names mentioned by my interview participants.

In Logan Lake, I gave a copy of my invitation to participate in the interview process to my key contact who then distributed it to the first few prospective interview participants via email. In Kamloops, however, I sent out the initial invitation by email to prospective interview participants. Both emails contained a letter of information about the study (see Appendix B). This letter contained the statement of the research purpose, my contact information as well as my supervisor's contact information, and a description of both the interview process as well as the responsibilities of the potential participant (University of Alberta, n.d). This is also in accordance with tradition in the social sciences, whereby "…research subjects have the right to be informed about the nature

and consequences of experiments in which they are involved" (Christians, 2000, p.138).

I then followed up this initial email by contacting the potential participants to establish their interest in becoming involved in the research project. In total, 22 individuals were approached to participate in the interviews (11 in Logan Lake, 11 in Kamloops). In Logan Lake, all 11 approached agreed to participate, while in Kamloops all but one participated in the interviews[1].

I conducted these interviews with individuals who were involved in the development and the implementation of innovative wildfire mitigation methods at the local government level. They included local government employees, elected officials, emergency response personnel, and community residents.

3.5 Interviews

In-depth, semi-structured interviews were conducted in person in both of the communities. In-depth interviews were chosen as they allow the participants to describe their own lived experiences in their own words (Seidman, 2006). The semi-structured format was chosen as it allows space for the interviewer to proceed with their list of prepared questions while still maintaining a conversational tone (Longhurst, 2010). This allows the interviewer the flexibility to detour from the interview guide to follow up on a point of interest brought up by the participant during the interview.

[1] The person who declined to participate in the interviews did so due to their absence from the community during the interviews, and subsequent efforts to contact them were unsuccessful.

The interviews were completed in person in each of the two communities. Interviewing in person instead of interviewing over the telephone is advantageous as being in the community can provide more information about the participant, their answers, and the community itself. For example, in both communities I was able to sit down with the participant and *see* what landmarks or buildings they were referring to.

Being in the community to interview participants in person also provided me with the opportunity to build rapport – in one instance I had a very lively discussion with a participant about the freshly fallen snow before proceeding with the interview. In addition, conducting interviews face-to-face can provide additional insight into the participants' feelings and opinions through visual observation of non-verbal cues which would not be possible through telephone interviews (Rubin & Rubin, 1995; Baxter & Eyles, 1999).

I organized and scheduled interviews with participants in both communities. Interviews were held in the participants' offices, homes, or other quiet work spaces – in Logan Lake, this also included the fire hall, where through my key contact I was able to have a private space in order to conduct interviews.

Other than myself and the participant, there was no one else present in the room during the interviews. As noted by Rubin & Rubin (1995), conducting interviews in a private location can help to set a conversational tone, as there are no external distractions and less fear of having someone overhear the interview process. This also serves to put the participant at ease and to make

them more comfortable for the interview (Longhurst, 2010). I also brought coffee, juice, water, donuts, and muffins to interviews for participants; as Longhurst (2010) notes, "...it is worth [it to offer] drinks and food as a way of relaxing people" (p.107).

I created a semi-structured interview guide (see Appendix D) and used this guide for all interviews in both communities. Interview questions and prompts were designed to be open-ended, allowing participants the opportunity to respond in their own words, at their own pace (Seidman, 2006; Rubin & Rubin, 1995). The questions focused on the history of both the participant and the community, how and why wildfire mitigation had become a priority in the community, what factors had influenced the development and implementation of their current wildfire mitigation activities, and what obstacles or challenges they might have faced in the course of their endeavours.

I began each interview with questions about the participant's history in the community, their role in their community, and their personal experiences with wildfire. These types of "introductory" questions allow the participants to become more comfortable with the interview process, while still funneling the interview towards the questions most relevant to the research project (Rubin & Rubin, 1995).

The length of the interviews varied, with the shortest interview being 16 minutes and the longest 76 minutes. On average, the interviews were 25-30 minutes in duration. The interviews were recorded with the use of a voice recorder. Audio-recording an interview can be beneficial as it permits the

interviewer to focus on the participant instead of trying to frenetically write notes as the interview progresses (Longhurst, 2010).

After the completion of the interviews and the remainder of the field research process in late 2012, I returned to both communities and presented back to them findings of my research in April 2014. In Kamloops, I presented my research to my key contact in the form of a Powerpoint, who then kept a copy of the Powerpoint to present to colleagues and local council members. In Logan Lake, I presented my findings to the current mayor, 2 councilors, the chief administrative officer, and the fire chief. I also left a copy of my PowerPoint presentation for them for their future use.

3.6 Transcription, Coding, & Data Analysis

Analysis began with combining the data from the various sources into a detailed description of the case itself, and then organizing and coding the data into themes. In terms of the multiple case study approach, "... a typical format [of analysis] is to first provide a detailed description of each case and themes within the case, followed by a thematic analysis across the cases (cross-case analysis)" (Creswell, 2007, p.75).

Transcription is the next part in the analytical process – putting your data into words is, as Oliver et al. (2005) stated, "...a powerful act of representation [...] that can affect how data is conceptualized" (p.1286). I began to transcribe the interviews during the fieldwork process and continued once I returned from the field. Beginning the transcription process early allows for better retention of details from the interview, such as the mood of the

participant, environmental conditions, tone of the conversation, etc. (Longhurst, 2010).

Interviews were transcribed with Microsoft Word through the use of a naturalized approach, where all pauses, stutters, and other idiosyncrasies of speech are included in the transcript (Oliver et al., 2005). This is also of benefit to the analytical process as "...talk is peppered with verbal and non-verbal signals that can change the tenor of conversations and meaning" (Oliver et al., 2005, p.1276). The use of Microsoft Word facilitated the analysis process, as the transcribed interview data could be easily transferred into NVIVO 10 for analysis (Seidman, 2006). All interview participants were able to ask for and review their transcripts should they wish to verify them; however, none of the participants requested a copy of their transcripts. After the completion of transcription, the data were then analyzed.

As stated by Basit (2003), a qualitative researcher "…attempt[s] to gain a deeper understanding of what they have studied and to continually refine their interpretations" (p.143). In order to achieve this, the data were thematically analyzed. This process was informed by the concepts that were previously identified in the existing literature and in the literature review (e.g. window of opportunity, the importance of community champions; see Chapter 2). Following this, emergent theme analysis was utilized in order to determine if there were any new themes present in the data (Creswell, 2007). Themes are recurring important ideas identified in the data that relate to the research questions posed by the study (Braun & Clarke, 2006).

I began my data analysis with the establishment of seven initial codes. Codes represent recurring ideas and/or concepts in the data, where information is then labelled under one or more codes. These initial codes were based on the themes that had been identified in the literature review before the commencement of the research (such as window of opportunity, partnerships, etc.). A codebook was developed that contained the names of each code, as well as a description of what each code represented. All interviews (in .docx file format) were imported into NVIVO10 qualitative data analysis software. NVIVO allows for large amounts of data to be stored, sorted, and coded. New codes continued to be added during the coding process as new ideas and/or concepts were identified in the data. In total, 20 codes were established as seen in Table 3. Coding reliability was established through having both myself and my supervisor code the same interview in order to check if the same codes were being identified in the data. These codes were then organized under broader *themes*, which are then are named and defined. Themes represent broader patterns of meaning within the data.

Table 3: Data Codes

Name of Code
Community and Resident Support
Community Connection
Community Risk Awareness/Perception
Informed Local Government
Intra-community Communication
Partnerships and Collaboration
Leadership in the Community
Community Characteristics Relating to Risk
Experience with Wildfire
Impacts felt from Past Wildfires
Window of Opportunity
Description of Mitigation Efforts
Funding and Resources for Wildfire Mitigation
History of Municipal Wildfire Mitigation
Mitigation Limitations or Opposition
Factors Affecting Mitigation Limitations
Mitigation Successes
Factors Affecting Mitigation Successes
Responsibility for Wildfire Mitigation
Policies and Regulations Around Wildfire Mitigation

3.7 Reflexivity, Reliability, & Rigour

In qualitative research, the researcher is very much an instrument of their own work – they interact with their study and their participants, and are part of the research experience (Crabtree & Miller, 1992). In order to succeed at qualitative research, it is imperative that the researcher recognize and accept their role within the research, such as conducting interviews or observing research participants (Seidman, 2006). It is also important to recognize that the researcher is not a neutral figure in the qualitative research process – the researcher brings their own biases, life experiences, and motives to the research at hand (Maxwell, 2005; Fontana & Frey, 2008).

Throughout my research, I sought to remind myself of my own impact upon the research process (Widdowfield, 2000). As an outsider to both communities, I found ways to connect with my participants in order to create a sense of camaraderie, making them more at ease. Though not originally from British Columbia, I spent much of my childhood living in small, industry-driven communities nestled in wildfire-prone areas of Manitoba. My father worked as a helitack firefighter (aerial wildfire firefighter), and I have worked with Parks Canada for several years and received some introductory training in wildland firefighting. This helped me to establish connections with local residents, firefighters, and others through shared interests and experiences.

An important component of qualitative research is ensuring rigour. Baxter & Eyles (1997) define rigour as "… the satisfaction of the conventional criteria of validity, reliability, and objectivity" (p. 506). One method of doing so is through careful accounting and recording of each step of the research process (Yin, 2003). As stated by Yin (2003), a way of dealing with the issue of reliability is "...to conduct research as if someone were always looking over your shoulder" (p.38). This is so that another researcher, given the same case, could repeat all the steps of the research process – following a chain of evidence - and arrive at the same conclusion (Yin, 2003).

I established rigour in my research study by following recommendations proposed by Baxter & Eyles (1997): I justified my rationale for selecting my chosen research approach, I described the process through which interview participants were selected for the study, I described in detail the approach I used

for data analysis, and I used direct quotes from my interviews in the reporting of my research findings.

Several other steps were taken to establish the rigour and trustworthiness of the data collection and analysis. All interviews and transcription was completed by me, thereby allowing for consistency in the interpretation of the data (Baxter & Eyles, 1999). However, inter-researcher triangulation was also performed in order to ensure that the same trends and concepts in the data identified by one researcher could then be found again by another researcher (Baxter & Eyles, 1999). This was accomplished with the assistance of my thesis supervisor, who coded a sample of my interviews in order to check the validity of my coding methods by ascertaining that we were both in agreement about the codes applied to the interview data.

3.8 Generalizability of Findings

The generalizability of the findings from case study research has at times been controversial in qualitative research. As a case study takes place within a bounded environment with its own specific context, it can be challenging to extrapolate a generalizing theory on a phenomenon from a single case study (Yin, 2003; Jensen & Rodgers, 2001). However, as Flyvbjerg (2006) states in his study on the misunderstandings of case studies, even though a case may represent only one particular instance of a certain phenomenon, it can and does contribute to the *cumulative* development of knowledge. Even though a single case may not establish a new theory, it can still offer findings

generalizable to other cases as well as contribute to perhaps the *eventual* crafting of an overarching theory.

Having two cases can also potentially increase the likelihood of generalizability of their findings to other cases. As stated by Schofield (2009), "…generalizability is best thought of as a matter of the 'fit' between the situation studied and others to which one might be interested in applying the concepts and conclusions of that study" (p. 31). Schofield (2009) also stresses that this is why thick description of context in regards to case studies is essential – with more information provided about a case, the easier it is to make an informed decision on whether the findings are relevant to another case. This is also echoed by Falk & Guenther (2007), who state that one of the best ways to determine the generalizability of case study research is to be meticulous in describing the details, methods, and measures of the research process, as well as taking steps to ensure any limitations to the study are noted and disclosed.

Therefore, having *two* case studies thickly described with emphasis placed on their similarities and differences in their contexts makes it easier to identify if the "fit" would be appropriate to extrapolate relevant findings to another case study. Like Logan Lake and Kamloops, other communities with high wildfire risk often share characteristics like hot summer climates, low summer precipitation rates, the potential for high wind conditions, as well as the presence of dry vegetation (trees, shrubs, grasses) that have the potential to be wildfire fuel. Kamloops and Logan Lake also differ in their population size,

population density, size of the municipality, and topography – other communities will differ in these regards as well.

I conducted case studies in two different communities, but obtained very similar findings from both – taking into account both their similarities and their differences. This indicates the possibility that my findings are generalizable beyond the extent of my two case studies (Falk & Guenther, 2007).

Additionally, it is important to note that case study findings are not inherently transferable to all other similar cases – the researcher needs to establish what attributes of their case studies makes the findings transferable (such as community size or composition) (Kennedy, 1979). When the common attributes between the case studies and the new instance of interest are established, the transferability of research findings becomes feasible (Kennedy, 1979). Furthermore, many of my own results build upon the findings reported in Plevel's (1997) earlier case studies on wildfire mitigation adoption by local governments in California (Orange County & Oakland) and Arizona (Eastern Pima County), reinforcing the generalizability of some of the study findings.

3.8 Chapter Summary

The methods used in this study were explained in this chapter. Two case studies were completed in the communities of Logan Lake, British Columbia and Kamloops, British Columbia. These case studies entailed conducting in-depth, semi-structured interviews with individuals in the communities that were involved in local wildfire mitigation measures in a number of capacities. Interviews were conducted in person in both communities, and involved local

government officials, fire department members, emergency services personnel, community leaders, and local residents.

The aim of these interviews was to establish *what* innovative wildfire mitigation practices were in place in these communities, *how* they had been developed and implemented, *why* they had been developed, and finally *what* factors influenced the development and implementation of these innovative wildfire mitigation measures. Data obtained from these interviews were coded and then analyzed through thematic analysis means to identify codes and, subsequently, broader themes in the data. The following two chapters will describe and interpret the results obtained from data analysis.

Chapter 4: Results & Discussion – Wildfire Mitigation Measures

This chapter describes and examines the wildfire mitigation measures currently employed by both case study communities. Each community's history of wildfire mitigation and current wildfire mitigation measures is described. The information presented in this chapter was collected during the in-person interviews conducted in each community, and supplemented by supporting documents (government reports, municipal government websites). Chapter five examines the factors that influenced how these wildfire mitigation measures were developed, why they were developed, and how they came to be implemented.

4.1 The Community of Logan Lake, British Columbia

Prior to 2001/2002, the community of Logan Lake had few, if any, wildfire mitigation measures in place. The community and the municipal government had knowledge about the wildfire risk, but had no formal emergency plan, mitigation measures, mitigation policies, or Community Wildfire Protection Plan (CWPP) in place.

> *"They basically had a map – yeah, they had a document, one page […] and it was just a map of Logan Lake with some colours on it saying that these are the higher hazard areas. And that was all they had."*
>
> - *Fire Department [Logan Lake]*

The municipal government in Logan Lake became more and more cognizant of the risk wildfires posed to their community, and after 2001/2002

they began conducting community risk assessments. The 2003 Kelowna Firestorm had a positive impact on the progress of wildfire mitigation in Logan Lake due to factors like the extensive media coverage during that fire season, increased community awareness of the issue, and visible/audible reminders of the risk wildfires posed (smoke from distant wildfires and noise of the water bombers passing overhead).

4.1.1 Wildfire Mitigation Measures

One of Logan Lake's innovative wildfire mitigation measures is their rooftop sprinkler program. This program is focused on improving community wildfire resilience by implementing municipally-subsidized wildfire mitigation at the homeowner level.

> *"We use sprinklers on homes, which the fire department goes around and assists the homeowner in installing it. It's a high-quality sprinkler, the ones they used in the sprinkler protection units. It is installed on the home and tested."*
>
> - *Fire Department [Logan Lake]*

For $40, a homeowner in Logan Lake can have a qualified member of the fire department come out to their property and install a high-quality sprinkler on their roof; without this program, a rooftop sprinkler would cost in excess of $100, which does not include installation. This sprinkler can only be connected to the municipal water supply by the fire department via a specialized hose line, and is only intended for use during a wildfire when the fire department or emergency operations deems fit. Additionally, the sprinklers

also provide protection in the event of a house fire – the fire department can connect the hoses to the sprinklers around a burning home to help ensure that adjacent homes do not also catch fire. As of 2012, approximately one-third of the community's homeowners were participating in the rooftop sprinkler program.

At the same time that the rooftop sprinkler is installed on a home, the fire department also conduct a home and property assessment for wildfire risk and inform the homeowner of their risk rating.

> *"We do an assessment of their home for wildfire protection – that includes the gutters, the roof, the vents, in and around the room[s], the trees, the shrubs, anything they've got around the home – and we grade it for them, and give them a copy of it."*
>
> - *Fire Department [Logan Lake]*

The fire department representative will also provide the homeowner with information on how to reduce these risks. This information is also inputted into a GIS database by the local fire chief, who then uses it to determine what houses might be most at risk should a wildfire come through the area.

Beyond mitigating wildfire risk at the homeowner level, the local government has also developed and implemented the Community Forest Corporation. The Community Forest Corporation – the first of its kind in British Columbia – is a corporation developed by the municipal government of Logan Lake in order to obtain the cutting tender rights in the forested areas around the community and manage their wildfire risk. Originally proposed and

developed in 2003 and in full operation by 2007, the Community Forest Corporation (CFC) now holds exclusive timber rights for a 17,000 hectare area in the WUI around Logan Lake. Annually, the CFC harvests and sells locally over 20,000 cubic meters of harvested wood. The profits of the CFC are used to fund other municipal wildfire mitigation measures such as the Super Key program, and the 'Cowmunity' program (described below).

Originally funded by local tax dollars in the form of a loan for $100,000, the CFC has since repaid the community the original loan over the past five years and has cleared over $700,000 in net revenue. The Community Forestry Corporation enables the community to coordinate and execute the selective thinning and wildfire prescriptions undertaken in the WUI, and also ensures that they remain in control of how their town manages wildfire risk in the forests around them. Additionally, the Community Forest Corporation provides the community with supplemental funds.

> *"Now we have a forest tenure that we have exclusive rights to the forest management of; […] we generate money with that tenure that we can then invest back into [the Community Forest Corporation], and in other [wildfire mitigation] projects in the community."*
>
> - *Forestry Official [Logan Lake]*

These additional funds enable the community to have a reliable source of funding as opposed to applying for grants, which can be unpredictable, and renders them less reliant on external sources of funding.

One of these measures that obtain funding from the Community Forest Corporation is the Super Key program. This program, originally based on a teaching module on forestry that was being taught at the local high school in the early 2000s, has two aims: 1) to reduce wildfire risk in and immediately around the community, and 2) to provide local youth with employment opportunities as well as training them in forestry-related skills.

> *"For Super Key, what they've done is they get a group of kids, pay them for the summer, they go and choose specific patches of the forest around Logan Lake. […] They'll cut down small trees that are too close together […] they'll prune all the trees. […] Then they'll make piles, they put all the dead stuff they cut it into small pieces, they'll make piles in an open area far away from trees […] so that the firefighters can go and burn it."*
>
> - *Fire Department [Logan Lake]*

During the summer months, between six and eight high school students are hired by the Super Key program administrators to work on the removal of wildfire fuel materials (such as deadfall and leaves), laddering fuels (removal of branches up to six feet on a tree), and thinning out the forest (as much as they can without power tools). This work takes place in both the community itself and the forest area immediately around it. This work, due to the ages of the students, is all done without the use of power tools or axes - instead, they employ hand saws and pole saws to remove what they can.

"They [Super Key students] would go out […] and pick up and trim the trees in the designated areas that we set up prior to the season."

- *Fire Department [Logan Lake]*

All material that the Super Key students collect is piled up within the forest and burnt at a later date by the local fire department. The students employed by the Super Key program are paid significantly more than the provincial minimum wage of $10.25/hour (Government of British Columbia, 2012) for their work (approximately $16.00/hour in 2012).

With both the Community Forest Corporation's and the Super Key program's involvement in selective thinning and removal of trees in the forests adjacent to the District of Logan Lake, the interface area around the community has increasingly begun to transform into a parkland-like environment. Where once trees grew in too thick to walk through, there is now ample space between trees stands where grasses and weeds have started to grow. Without competition from trees and with the additional access to sunlight provided by a diminished canopy, grasses and weeds can grow unabated in this new parkland.

These grasses and weeds can now also serve as fuel materials for wildfire, and need to be controlled in order to help lower the wildfire risk. In order to control these grasses and weeds, the District of Logan Lake has developed a partnership with the local ranching community, to run the "Cowmunity" program. Through this program local ranchers will come into the community during the summer months with their cattle and let them graze on

the grasslands in the immediate interface area, which then reduces the amount of grass around the community.

> *"We have cows coming in closer to the community […] almost within some people's backyards, and the cows come in and eat as much as they can in and around the area to try and reduce the grass areas down."*
>
> - *Fire Department [Logan Lake]*

Grazing has a significant effect on wildfire behavior – with a reduction in low ground fuels, wildfire intensity decreases and the length of flames decreases, thereby reducing the risk of vegetation higher up (such as branches) catching fire (Lovreglio et al., 2014). Additionally, grazing by cattle or goats is a non-toxic, non-polluting, and environmentally friendly alternative to mechanized vegetation removal (Lovreglio et al., 2014). The interface area is transformed by the grazing from an overgrown area with high wildfire risk to a parkland area with a significantly lower wildfire risk.

While the cattle are effective at reducing the level of grasses in the WUI, they do not consume the weeds that grow up amongst the grasses. Within the past two to three years, the District of Logan Lake has hired contractors to bring in their goat herds to come in several times over the summer months to graze their goats on the weeds in the interface area. Goats are a successful tool in wildfire mitigation as they have a very varied diet, and are able to tolerate vegetation with high tannin concentrations, which other grazing animals cannot (Lovreglio et al., 2014). The goats are supplied by goat herders from a Kamloops area farm. These herders come into the community with 350 goats

and allow them to graze the weeds around the lake, the subdivisions, and the community trails. The annual cost for this project is approximately $5,000, with funds coming from the Community Forest Corporation's profits.

Logan Lake also has several smaller scale innovative wildfire mitigation measures in place. Mountain Pine Beetle has infested and killed many trees on both public and private land in the community; pine beetle-killed trees are extremely flammable and pose a significant wildfire risk, and need to be removed. In order to prevent local homeowners from burning their own pine beetle-killed trees on their properties, the District of Logan Lake has provided several dumpsters spread across the town for homeowners to dispose of the wood, free of charge. This provides an alternative to uncontrolled, unmonitored burning of pine beetle-killed trees by homeowners, and therefore reduces the risk of a backyard fire becoming out of control.

> *"People […] realized that the beetle-killed wood was taking a toll on their properties too. With the assistance of the community, we managed to assist our residents by giving them dumpsters to put their wood in to be taken away free, to prevent burning […] by the homeowners, which would cause a lot more problems in the community as far as smoke."*
>
> - *Fire Department [Logan Lake]*

At the community level, the District of Logan Lake has established some multi-use fireguards around the town. These fireguards are strips of land where trees, shrubs, and grasses have been significantly reduced or removed to reduce wildfire risks. Some of these fireguards have been converted into

recreational trails – trails for mountain biking, for hiking, for horseback riding, and for ATV riding. The District of Logan Lake has also created their own brochure about the wildfire mitigation measures in place in their community, as well as their willingness to help any other community with starting up their own wildfire mitigation programs (see Appendix D). This brochure highlights their successes and raises awareness of wildfire risk and mitigation in Logan Lake, which can help to create a sense of community around wildfire mitigation in their town.

The municipal government also produced a video[2] "In Our Defence" in conjunction with the Knowledge Network. This video focused on Logan Lake's wildfire risk, wildfire prevention by homeowners, and the community's steps to establish wildfire mitigation programs since the 2003 Kelowna Firestorm.

> *"We also did a film on the Knowledge Network about, you know, what people can do to keep their own homes safe and make it safer for the firemen to fight fires so we've made a really big attempt to let everybody know what the importance of [wildfire mitigation] is."*
>
> - *Local Government [Logan Lake]*

The District of Logan Lake has established partnerships with community groups, local industry, and most importantly with the provincial wildfire management branch. These partnerships contribute significantly to the wildfire mitigation efforts in the District. These include partnerships, both formal and informal, with community groups, local government, and the

[2] This video can be found at http://www.youtube.com/watch?v=vG5RFiD5Elg

provincial wildfire crews. These partnerships will be further discussed in Chapter 5.

The District of Logan Lake has also developed and implemented a number of wildfire mitigation measures in their community that are also being completed in other communities in Canada. First, the municipal government of Logan Lake has completed vegetation management. This includes establishing fireguards (long, straight strips of forest kept clear of brush, trees, and other fuels), forest underbrush thinning (removal of thick brush from secondary road areas/interface areas), removal of laddering fuels (branches up to 6 feet high on a tree), selective forest thinning (removal of trees), and digging trenches to prevent root fires from spreading underneath the ground. Additionally, the District of Logan Lake engages in preventative burning, where they will burn off piles of dead material in the winter months or burning off excess grass before the onset of summer.

Secondly, the municipal government has also financed the purchase of materials and equipment needed to respond to a wildfire. Their public works department has purchased a vacuum truck which can, during a wildfire event, quickly pump up water from one of the town's lakes or ponds to one of the fire department's three holding ponds. These holding ponds then supply the water needed to fill up the fire trucks that are responding to a wildfire event. The District of Logan Lake has also improved road access within the community (such as widening narrow roads, improving road quality through paving gravel

sections), making it easier for emergency crews to access areas during a potential wildfire event.

Thirdly, the District of Logan Lake has developed and implemented a Community Wildfire Protection Plan (CWPP). CWPPs are an important aspect of wildfire mitigation, as they outline the factors affecting the community's wildfire risk, as well as the mitigation goals and mitigation efforts that a municipal government has in place. The aim of Logan Lake's CWPP is to "…recommend actions […] on how to reduce the risk of wildfire to the people, property, and resource values of the community and surrounding area" (J.S Thrower & Associates, 2004). It evaluates the current wildfire risk conditions in the community, and outlines recommendations as well as future goals for the District of Logan Lake.

Finally, the District of Logan Lake runs education programs in schools and community awareness events where FireSmart information booklets/pamphlets are provided to residents. Information bulletins and announcements regarding wildfire mitigation and current wildfire risk levels are printed in the local paper and announced on the District's website[3]. Local fire department members as well as volunteers do seasonal door-to-door campaigns, where they distribute wildfire mitigation information and FireSmart pamphlets directly to each home in the community.

[3] The District of Logan Lake's website information on wildfire can be found at: http://www.loganlake.ca/municipal-hall/departments/emergency-services/wildfire-mitigation

4.2 The Community of Kamloops, British Columbia

Wildfire has long been part of the ecosystem in the Kamloops area – First Nations peoples, who have long been in the area, have historically engaged in traditional burning practices.

> *"…you look at the grasslands […] and historically First Nations would burn it all off, so [wildfire] has been here as part of our ecosystem forever."*
>
> - *Provincial Fire Crew[Kamloops]*

The City of Kamloops began implementing wildfire mitigation measures after the 'Cow' wildfire in 1984, the 'Kel' wildfire in 1985, and the Dome fire in 1991 (Partners in Protection, 2003). These mitigation measures included vegetation management and thinning projects in and around the hillside communities (such as the Rose Hill housing development).

Communication between the municipal fire department and the provincial fire crews was also a priority after these three wildfires, as well as the development of an incident command system (Partners in Protection, 2003). Like Logan Lake, Kamloops was also significantly affected by the 2003 Kelowna Firestorm. Kamloops experienced the Strawberry Hill wildfire in August, 2003; this wildfire just south of the city threatened homes in Tk'emlúps te Secwèpemc and came close to the suburbs on the edge of Kamloops (Government of British Columbia, 2004).

"…it's really become a priority since 2003, […] we saw the devastation it did around our province and in our own community, and that we could do something about this, so it has been a priority since then."

- *Fire Department [Kamloops]*

The 2003 wildfire season raised further awareness of wildfire risk in Kamloops and emphasized the need for wildfire mitigation. This will be further discussed in Chapter Four.

4.2.1 Wildfire Mitigation Measures

The City of Kamloops has implemented several innovative wildfire mitigation measures in their community. One of these mitigation measures is encouraging xeriscaping and FireSmart landscaping by local residents on their properties. Xeriscaping is a landscaping technique that emphasizes the use of plants that do not require additional irrigation beyond rainfall, but that still maintain an aesthetically pleasing appearance (City of Kamloops, 2014). Xeriscaping is primarily used to decrease water consumption and garden/vegetation maintenance in a community, especially during the hot, dry summer months.

In Kamloops, xeriscaping is combined with FireSmart principles to establish front/back gardens that adhere to the priority zone principles, use fire resistant plants, and that use a minimal amount of water. Priority zone principles, as detailed in the FireSmart manual (Partners in Protection, 2003), refer to the establishment of three concentric zones around a home of a building, with the zones decreasing in priority with distance from the home.

Within each of these zones, vegetation management is done to reduce the risk of wildfires spreading to the home or building.

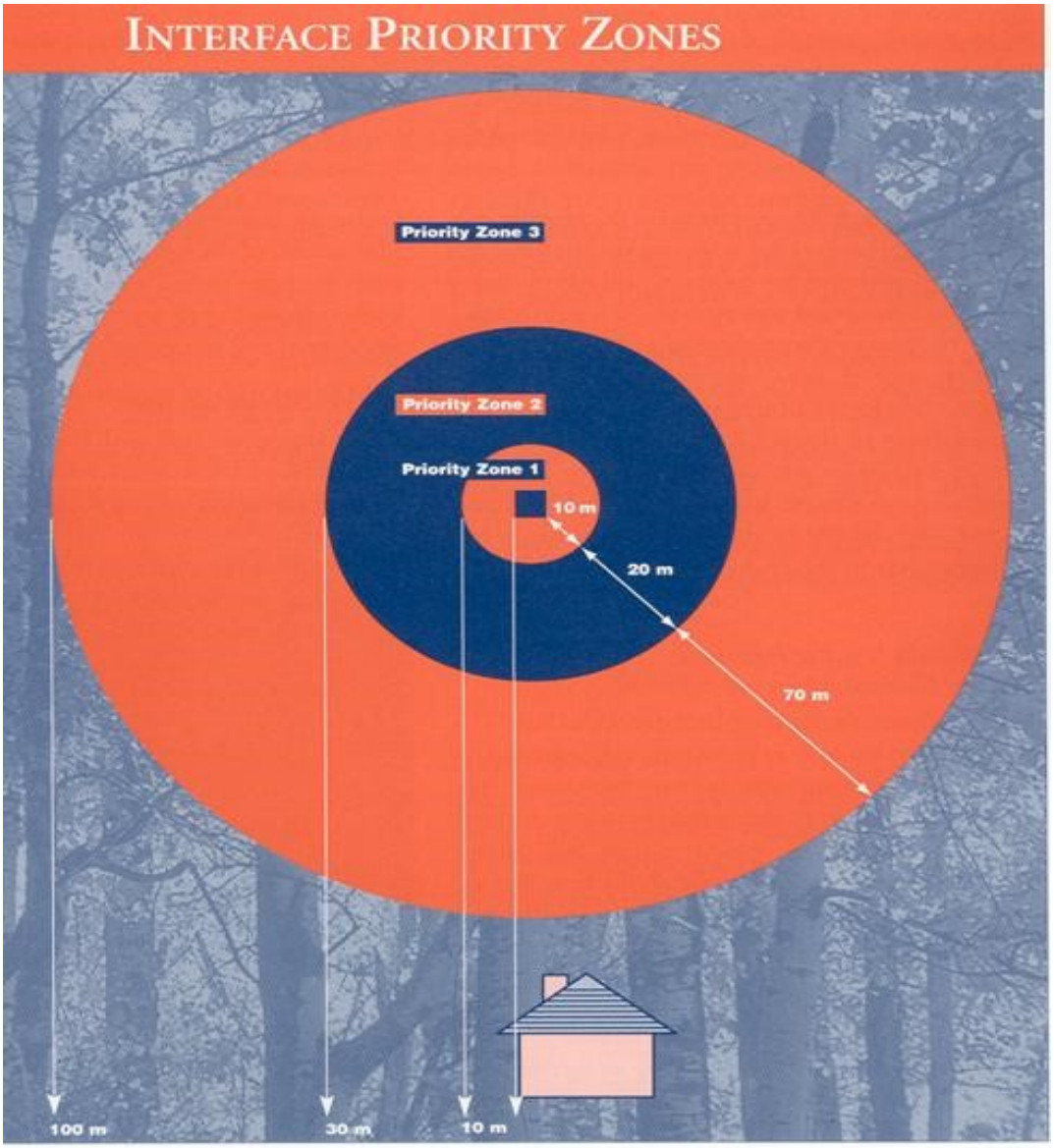

Figure 2: Diagram of FireSmart Priority Zone principles (Partners in Protection, 2003)

The municipal government has developed a brochure on FireSmart/xeriscape suitable plants and has distributed copies of the brochure within the community to facilitate the adoption of both programs in Kamloops.

In order to promote both the FireSmart program and the local xeriscaping program, the Kamloops Fire Department has also developed and built a demonstration house. The demonstration house, which serves as a pump house for the fire department, adheres to the principles of FireSmart (established priority zones, trees set back from the home) and xeriscaping (attractive, low-water, fire-resistant plants).

Figure 3: The Kamloops demonstration house (City of Kamloops photo)

> *"We actually have a demonstration house that we have in West Side – it's actually a pump station, but it looks like a house […] so we landscaped it with [xeriscape] FireSmart plants, and we're putting signage up there for educating [the public]."*
>
> - *Local Government [Kamloops]*

This demonstration house allows residents to see an example of how a house built and maintained with FireSmart/xeriscaping can look without sacrificing aesthetics for wildfire safety.

Kamloops, much like Logan Lake, was heavily impacted by the mountain pine beetle from 2005 to 2008, and has had significant conifer mortality in the city, both on private property, and in the forested areas adjacent to the community. Because of the high wildfire risk that mountain pine beetle-killed trees pose, the trees had to be removed from private lands.

> *"We came up with a residential curbside program that helped us get a whole bunch of those dead standing trees out of [those properties] – at a huge cost savings to the residents – and we recovered our costs by selling the [wood] fiber to [a local company], for chips, for pulp. […] We estimated that we saved the residents of the city about $13 million in their own private costs of removing timber because of [the] program."*
>
> - *Local Government [Kamloops]*

This program encouraged local homeowners to remove the dead trees on their properties and the City provided removal and disposal for free. In light of the mountain pine beetle passing through the city, the municipal government has also implemented a species conversion program, where the municipal government offers trembling aspen trees free of charge to local residents to replace the trees lost to mountain pine beetle and to local vegetation management projects. Trembling aspen trees require ample water to become established, but are a fire-resistant species that is native to the Kamloops area, and can provide shade as well as privacy around a home.

> *"We created an aspen tree program where we […] offer aspen trees to residents. […] The aspen trees will provide a heat shield, they will*

provide you with cover and shade during the summer, they will reduce the wildfire risk – [the resident] won't have a conifer tree that close to [their] property."

- *Local Government [Kamloops]*

The City of Kamloops initially faced opposition from homeowners who did not want to lose the privacy and the aesthetic appeal of healthy conifer trees next to their homes, but when many conifer trees were killed due to mountain pine beetle, the program was accepted by residents and is now well supported in the community.

The community has also developed an inter-agency committee dedicated to wildfire mitigation in the greater Kamloops area – the Kamloops Interagency FireSmart Committee (KIFC).

"[KIFC is] made up out of members of the [Kamloops] Fire Department, members of the [Kamloops] Parks Department, and also [Provincial] Forestry, the Thompson-Nicola Regional District, our native band that's here in town, the Ministry of the Environment - we have just about everybody we could think of be a part of that committee and decide how things should proceed and what things we should tackle."

- *Local Fire Department [Kamloops]*

Through the cooperation of the multiple stakeholders involved, the KIFC aims to develop and support wildfire mitigation in the Kamloops area and to cooperatively discuss issues and concerns that may arise around wildfire

mitigation (such as open air burning or forest thinning practices). They have also developed a pre-formatted public FireSmart presentation that can be requested by community groups or local citizens – a representative from the KIFC will come out to go through the presentation and promote awareness of wildfire mitigation issues in Kamloops (City of Kamloops, 2008).

Additionally, the KIFC has also created a Community Wildfire Protection Planning Group that consists of local experts in relevant fields, such as the community wildfire protection officer, members of the provincial wildfire management branch, as well as city engineering and fire department employees. This planning group was responsible for the creation of the Kamloops' CWPP, and is tasked with updating it at least every five years (City of Kamloops, 2008).

A fire weather monitoring system has also been implemented in Kamloops. This system aims to record and monitor local conditions that may influence wildfire behavior in the area – such as wind, precipitation, temperature, and lightning strikes.

> *"We have our own fire weather and fire preparedness and fire behavior analysis program […]; we process the data every day and come up with indices, and provide those to the Fire Department."*
>
> - *Local Government [Kamloops]*

There are currently four fire weather monitoring stations in Kamloops, with each station costing approximately $15,000 to install. These stations utilize a fire weather software program that remotely collects and analyzes current local

conditions to come up with a Fire Weather Index value (City of Kamloops, 2008).

In addition to the fire weather stations, the City of Kamloops also uses historical data in conjunction with wildfire prediction software to make predictions on possible wildfire behavior patterns. These two systems help with planning decisions in the community (indicates what areas might be at risk of a wildfire), as well as with evacuation decisions and wildfire suppression plans should a wildfire occur in the community. City of Kamloops also does a pre-season risk analysis, whereby local fire managers use past fire season data, historical trends, and current weather/fuels information as indicators to determine what type of fire season may be upcoming. This analysis is then used to inform city officials and provincial/local fire crews about what kind of fire season they can expect and the amount of resources that may be needed to prepare for it.

In addition to their more formal programs, the City of Kamloops has also engaged in training scenarios where the local fire department, in conjunction with municipal government departments (such as Parks, Engineering) and the provincial wildfire management branch, have a mock wildfire drill.

> *"We had a full-scale scenario [in 2010], and we actually evacuated a [housing subdivison] community, we set up sprinklers, we had truck responses, we had air tankers, and we had heli-rapidtack teams – it was pretty big."*

- *Fire Department [Logan Lake]*

Community residents actively participated in the mock scenario, even evacuating their community and checking into the emergency operations centre – this also helped to educate local residents on the proper procedures and steps should an actual wildfire evacuation occur.

The City of Kamloops is also implementing wildfire mitigation measures that are also being used in other municipalities. Like Logan Lake, Kamloops has created a Community Wildfire Protection Plan for the city which seeks to inform administrative and elected municipal government officials about the wildfire risk present in the community (City of Kamloops, 2008). The goal of the CWPP is to "…identify and reduce the risk of life, property, and environmental losses directly or indirectly to wildfire within, or threatening City boundaries through effective pre-planning and preparation" (City of Kamloops, 2008, p.7). The CWPP also outlines current wildfire mitigation initiatives already in place, and outline future project goals for the community.

The municipal government also employs a number of other smaller programs to promote wildfire mitigation and to reduce wildfire risk. Municipal by-laws are used to enforce city-wide wildfire prevention standards. For example, Fire Prevention By-law No. 10-37 requires property owners/residents to keep their properties clear of flammable vegetation, and to take reasonable precautions to lower the risk of wildfire to their properties (City of Kamloops, 2008).

An invasive species removal program has also been developed in order to combat the spread of non-native species like knapweed (which propagates through wildfires) and cheatgrass (which is extremely flammable) (City of Kamloops, 2008). Removal of these invasive species combined with seeding of native grass species is intended to reduce the spread of these invasive species, promote the growth of native species that can be maintained through wildlife grazing, and reduce of wildfire risk in the interface areas. Education of local residents has also been a priority for the City of Kamloops, this includes door-to-door delivery of FireSmart booklets, as well as informational open houses, and targeted media campaigns.

> *"A lot is done through […] the various forms of the media. The television media, and the print, radio all have great relationships with [wildfire management] […] – the messaging is always organize, and consistent, and there's a real effort to make it timely."*
>
> - *Provincial Fire Crew [Kamloops]*

Finally, the City of Kamloops has also completed thinning and clearing of vegetation in and around the city, as well as implementing buffer zones to reduce the risk of wildfires transitioning from outside the interface areas into the Kamloops area.

4.3 Chapter Summary

The innovative wildfire mitigation measures developed and implemented by Logan Lake, BC and Kamloops, BC were described in this

chapter. These included a wide variety of measures, ranging from fuels management, vegetation thinning, education programs, the development of community wildfire plans, infrastructure, resource sharing, partnerships between stakeholders, and community organized timber corporations.

The innovative wildfire mitigation measures summarized in this chapter provide the context for the following chapter, where the factors that influenced the development of these innovative wildfire mitigation techniques in both study communities will be discussed.

Chapter 5: Results & Discussion – The Influencing Factors

The analysis of the data obtained during the in-person interviews conducted in both municipalities indicated that there were six major factors that influenced the development and implementation of innovative wildfire mitigation measures in these communities. These six factors are:

1) The post-wildfire window of opportunity
2) The effects of mountain pine beetle
3) Social capital: support & sense of community
4) Community leaders and 'issue champions'
5) Access to funding and resources
6) Partnerships & external collaborations

These factors are discussed in the sections below.

5.1 The Post-Wildfire "Window of Opportunity"

The first factor that may influence the development and implementation of municipal wildfire mitigation after a wildfire event is the impact of a focusing event, or window of opportunity. As stated by Plevel (1997), a window of opportunity is the time after a hazard event where the public now has a high level of support for actions to reduce future hazard risks – it is the time immediately after a hazard event where the public cries out for change and for action in order to stop a similar event from happening again.

As put by Prater & Lindell (2000), the window of opportunity "…usually occurs in the immediate aftermath of a disaster when the community

is most receptive to [mitigation] policy changes" (p.75). Wyner & Mann (1982) found that community members in Santa Rosa, California were much more likely to support earthquake mitigation in the period immediately after a major earthquake. They found that "…if the earthquake had not occurred, land-use change[s] would have been much more difficult. Unquestionably, the earthquake was itself the agent of change. It provided the opportunity, resources, and motivation that were necessary." (Wyner & Mann, 1982, p29).

This finding is echoed by Steelman & Kunkel (2004), who found that in Ruidoso, New Mexico proposed wildfire planning and zoning ordinances were helped into being approved by the fact that smoke from a nearby wildfire was blanketing Ruidoso as the city council voted on them. Prater & Lindell (2000) and Tierney et al. (2001) both found that many communities that had experienced a hazard event were more likely to be willing to implement changes to the way that they dealt with and prepared for hazards. Overall, the post-wildfire window of opportunity may serve to remind a community how vulnerable it is to the risk of a hazard event, and may subsequently spur them on to take steps to make their community a safer place.

In my study, the experiences of my two study communities with the 2003 Okanagan Valley wildfires seemed to have opened a window of opportunity for developing municipal wildfire mitigation measures. The Okanagan Valley wildfires served as a focusing event for the two communities, revealing the potential for a similar wildfire event to affect them (Birkland, 1998).

"[The Okanagan Valley wildfires in] 2003 made us realize that Logan Lake was just too – too bad, and if there was a fire it would just get wiped out, so we needed to change it."

- *Fire Department [Logan Lake]*

Other participants described the 2003 Okanagan Valley wildfires as initiating the process of developing their wildfire mitigation plans. In the weeks and months after the Okanagan Valley wildfires, plans were already being put into motion by local government officials in Logan Lake, helped along by an outpouring of public support for these new developments and initiatives.

"[The 2003 wildfires]… I think that was the best thing that could have happened. Because it was early on in our planning stages, and that was early on in the process, and that kind of made people realize how important it is and, you know, how we can benefit from having the plan in place and what that plan will do to decrease our risk."

- *Local Government Official [Logan Lake]*

For many residents, community leaders, and local officials, seeing the effects of a wildfire on a community nearby put a spotlight on the risk that wildfires posed to their community. Participants in Kamloops also mentioned the impact upon their community from having wildfire evacuees from nearby towns placed in Kamloops. Seeing how wildfire had forced people from their homes in a community not far from Logan Lake had an impact on a few participants, who expressed that it made them feel like the threat of a wildfire impacting their community had become more tangible. This is turn had a

positive impact on reinforcing the importance of wildfire mitigation to elected local officials and other members of local government, and provided the drive to continue supporting wildfire mitigation efforts.

> *"I think that the Okanagan fires, in 2003, that was a big eye-opener for a lot of people because everybody saw how much people suffered at that time, […] and we've carried on with the work that was done before [by previous councils], and I think everybody on [the current] council is very supportive."*
>
> - *Local Government Official [Logan Lake]*

This reinforces the importance of a post-hazard event window of opportunity in a community, as it demonstrates the effect that witnessing a hazard event close to home can have on raising risk awareness as well as potentially increasing political and bureaucratic drive to back new mitigation initiatives. This demonstrates why the period immediately post-wildfire event is a key component in drastically improving the likelihood of success for municipal wildfire mitigation measures.

As found by Kingdon (1984), however, the window of opportunity does not stay open long. The crises or events (like wildfires) that create these windows of opportunity are fleeting and do not last indefinitely. As stated by Kingdon (1984) "…people can stay excited about an airline crash or a railroad collapse for only so long" (p.169). This was seen in both Kamloops and Logan Lake after the 2003 Okanagan Valley wildfires. Several participants in both communities noted that though initially the general public's awareness of

community wildfire risk as well as support for wildfire mitigation was high, it did not remain so as more time elapsed after the 2003 Okanagan Valley wildfires.

> *"After 2003, [wildfire mitigation] was very important to local residents – it was the number one topic around here for years, but also as time goes by people forget and it becomes less important to the general public."*
>
> *- Fire Department [Kamloops]*

This can lead to less support for wildfire mitigation.

> *"I worry about the fact that now the flavor of the day [wildfires] is gone, and nothing will happen until we have [wildfire] losses again. […] In 2003, 2004 we were doing presentations and open houses all winter and it was awesome. And then in 2005, we could get 3 people out to an event."*
>
> *- Local Government Official [Kamloops]*

In both Logan Lake and Kamloops, the smoke and the flames from the 2003 wildfires in the Okanagan Valley was enough to spur them to action, taking advantage of the 'window of opportunity' that exists after a hazard event. However, results from both communities reinforced findings from previous studies that indicate that there is only a short period of time after an experience with a wildfire (or similar focusing event) where heightened awareness and support exists to implement changes in a community (Plevel, 1997; Birkland, 1997; Kingdon, 1984).

5.2 The Effects of Mountain Pine Beetle

In both Logan Lake and Kamloops, an environmental condition emerged as having an unexpected positive impact on their wildfire mitigation measures: the spread of mountain pine beetle. Mountain pine beetle is a bark beetle species that attacks pine trees and kills them by both laying eggs that consume the tree's interior, as well as transmitting a fatal fungus (Jenkins et al., 2008). The mountain pine beetle began to move through the areas around both communities in 2005, and killed many of the pine trees in the interface areas, with up to 80% of all ponderosa pine stands in Kamloops infected by 2008 (City of Kamloops, 2008). The infected trees then become highly flammable and unstable, posing both a wildfire risk and a physical risk to people and homes near them (City of Kamloops, 2008).

> *"…we are surrounded by [coniferous trees], and with the pine beetle killing all of the trees around here, [it] made it even that more strategic that something be done to protect the town."*
>
> - *Community Leader [Logan Lake]*

This in turn increased residents' support for the removal of trees in and around the communities.

> *"It's funny because the pine beetle was our biggest friend. When we went in prior to the pine beetle, especially in these communities up the hill [in Kamloops], and said 'We want to go in and thin out your trees' […] they flat out said "No way, you're not doing that". […] And then as soon as the pine beetle hit […] those very same people were calling*

us saying "Come and get rid [of these affected trees], they're a fire hazard!"

- *Local Government Official [Kamloops]*

Participants also expressed that because mountain pine beetle infected trees were less aesthetically pleasing, it also became much easier to convince community residents to mitigate wildfire risk on their properties.

"I think that the pine beetle was the catalyst that pushed the fuel mitigation, because everybody saw, it was visual – it was red, it was dead, and [the pine beetles] were everywhere. So they want to get [the infected trees] gone now, and now you look at it there's hardly any red and dead trees around anywhere…"

- *Fire Department [Kamloops]*

In both communities, local government officials noted that the mountain pine beetle greatly reduced the aesthetic appeal of the trees around resident homes' and public spaces. This is significant, as several studies have identified the value of aesthetics towards trees and forest environments as inhibiting wildfire mitigation on the part of local residents (Collins, 2008; Brenkert-Smith et al., 2005; Collins, 2005; McGee, 2005; Nelson, 2005; Daniel et al., 2003). With the reduction in the aesthetic values of the trees around their homes and their communities, local residents were therefore more likely to support and implement wildfire mitigation measures. This echoes the findings from McFarlane et al. (2012), who found that residents in areas affected by mountain

pine beetle in Alberta felt that the scenic quality of the natural areas around them was diminished by the effects of the mountain pine beetle.

This reduction in aesthetic appeal thereby rapidly increased public support for removal both by themselves and by their local governments. This also increased awareness in the communities about their wildfire risk due to the highly flammable nature of pine beetle killed trees, and subsequently increased support for wildfire mitigation measures in both communities.

Though very little research has been done to date specifically on the effects of mountain pine beetle on wildfire mitigation, previous studies on other forest disturbances (like deadfall from past wildfires) has demonstrated that residents often support post-disturbance forest management. As found by Hamin & Ryan (2009), resident support for the removal of trees after a wildfire event was attributed to aesthetic reasons and safety concerns: residents did not like the sight of the burnt trees, and were concerned about the risk of blow-down hazards from the burnt trees still standing. Kooistra & Hall (2014) found that "…people generally support active forest management to mitigate negative impacts associated with [forest] disturbance" (p.222).

This indicates that people would potentially be more inclined to support wildfire mitigation through fuels removal in order to deal with the negative effects of mountain pine beetle on the forests around their homes and community.

5.3 Social Capital: Support & Sense of Community

The importance of social capital had been previously identified in the hazards and policy innovation field, and was identified in this study as playing a key role in the development and implementation of municipal wildfire mitigation in Kamloops and Logan Lake. Social capital is defined as characteristics within a community that influence action within the community, which includes support and sense of community. These factors have been separated into separate sections below.

The support that both Logan Lake and Kamloops received from their citizens, politicians, government officials, and other stakeholders was found to be a key factor in ensuring the success of their community-based wildfire mitigation measures. This support came in a variety of forms – from approval to public endorsements, as well as donations of time, money, or expertise.

5.3.1 Resident Support

Participants in both communities reported that, for the most part, residents were aware of the risk that wildfires posed to their homes and their community, and therefore recognized the need to support wildfire mitigation measures and projects. Being aware of the risk and the potential consequences of a wildfire for their community has been found to increase resident support for wildfire management and mitigation (Winter & Fried, 2000). The same has been found in both Logan Lake and Kamloops.

> *"[Wildfire mitigation] is very important [to local residents]. I think the residents really have a good understanding of the threat, and they've*

learnt that through sitting and watching and listening to everything that's gone on and in the community."

- *Local Government Official [Logan Lake]*

Participants in Kamloops also reported public support for wildfire mitigation around their homes and within city limits – to the point where some residents even take municipal wildfire mitigation into their own hands.

"When things gets busy I know people are actually – like in Peterson Creek for example – people are using weed whackers to lower the grass heights adjacent to the trails. They do it on their own."

- *Local Government Official [Kamloops]*

In Logan Lake, residents have also demonstrated support of municipal wildfire mitigation by understanding and tolerating the noise produced by heavy equipment needed for vegetation management. They recognize that the short term noise pollution from logging equipment is a part of ensuring long term wildfire mitigation success in their community. This support is a key factor in wildfire management (Shindler, 2007).

As found by Shindler (2007), "…citizen support is an essential component of effective fire management measures, particularly fuel reduction activities […] at the wildland-urban interface" (p.2). Fuel reduction activities can be controversial for a number of reasons among residents, including their valuation of the forest environment, and so having the support of residents for fuel reduction is a major factor in the success of wildfire mitigation.

"We've had logging equipment working long hours which is fairly noisy and people recognize [the noise], but at the same time it's more of they – they appreciate the fact that the guys are out there working because they know that the end result is that it will make the community more safe. So [there is] a high level of acceptance."

- *Forestry Professional [Logan Lake]*

In both communities, resident support of municipal wildfire mitigation measures is also expressed through ownership of responsibility to prevent wildfires.

"There's the social side of the community that really stands behind everybody, and they're very supportive [of reducing wildfire risk] to the extent that people will drop a cigarette out of the car in downtown Kamloops and people will […] even get out of their car and walk up to them and say "here's your cigarette back" and that sort of stuff."

- *Provincial Fire Crew [Kamloops]*

This sentiment was also echoed in Logan Lake, where residents actively participated in wildfire mitigation by informing summer tourists in the area about the risk that wildfires posed to the community and to the surrounding natural recreation areas.

"…people just came and said 'What do we need to do? What can we do to help out' And they were our eyes and ears in the bushes, you know. There's recreational trails all over the place, so we were having the bikes come in from Tunqua Lake, and the exhaust from the bikes, and it

was so hot at that time that it was so easy for them to start a fire from their exhaust systems… So the residents, we handed out posters, they went and put them out everywhere and asked people […] to not ride around like that, it's too dangerous [for wildfires]."

- Local Government Official [Logan Lake]

Interview participants also noted that support for municipal wildfire mitigation was also expressed through residents' ownership of their community's well-being and safety. They felt as if they had a direct part in the responsibility of protecting their local forest from unnecessary wildfire risk (like the bikes' exhaust).

"We've always phrased it as "their forest". […] There's a [sense of] belonging then, right? So when it belongs to them they're going to look after it, and take an interest in it, and seeing it as their community. And you can't walk away from something that is yours…"

- Local Government Official [Logan Lake]

Several factors have also affected community residents' support of wildfire mitigation measures. For example, in Kamloops awareness of wildfire risk and subsequently support for mitigation was positively affected by the presence of the provincial wildfire management branch and the Kamloops Fire Centre. Through exposure to the activities of the wildfire management branch based in their own city, Kamloops residents became more aware of the reality of wildfires in their region and the risk that they pose.

"...we have the provincial air tanker base [...] at our airport, so there's a very definitive sound that a water bomber [makes]. I think [...] when you hear water bombers every hot summer day flying overhead non-stop pretty much all day long, you're very well aware of it that fires happen and they can happen at any time, so I think the general community has finally bought in and agreed to do the mitigation on their own properties that they need to do."

- Local Government [Kamloops]

This awareness of risk and knowledge of the issues around wildfire mitigation on the part of residents in both communities was a positive influence on the acceptance and success of municipal wildfire mitigation measures. This finding is supported by previous research that found that increased levels of knowledge helped build support for community wildfire fuel reduction and mitigation measures (Toman et al., 2011; Blanchard & Ryan, 2007; Brunson & Shindler, 2004; McCaffrey, 2004; Loomis et al, 2001; Cortner et al., 1984).

Ultimately, the support of residents for wildfire mitigation around their homes and in their communities is a deciding factor in whether or not wildfire mitigation measures will ultimately be successful. As stated by Reams (2005), "…the most serious obstacles to the success of their [mitigation] measures have to do with… negative attitudes on the part of residents." (p.823) Without the support of residents, political backing of wildfire mitigation may be lost (due to potential fears of not being re-elected), and wildfire mitigation may fall to the wayside in order to focus on other civic issues.

Residents may even seek to "…modify, postpone, or prevent the implementation of [mitigation] plans" (Shindler, 2004, p.3). Without the support of residents, wildfire mitigation may be hampered by long delays and subsequent higher costs, frustration from lack of action, and even long-term resentment from local citizens (Shindler, 2007; Shindler et al., 1993). As noted by Shindler & Toman (2003), "… public acceptance is essential to virtually every resource management decision facing public agencies today" (p.13).

In the case of Kamloops and Logan Lake, resident support of municipal wildfire mitigation meant that residents were supportive of the measures being implemented by local government, that they understood the importance of wildfire mitigation at the municipal level, and that they were a part of municipal wildfire mitigation through their support.

5.3.2 Political Support

Beyond the support of the residents of both communities, interview participants also identified the importance of political support for wildfire mitigation measures as a key factor influencing the success of their measures. In both Logan Lake and Kamloops political support for wildfire mitigation measures was strong, and this is likely no small part due to the support of residents for wildfire mitigation. If residents tell their politicians that municipal wildfire mitigation is important to them, they are likely to listen as they know that citizens control their popularity, whether it's during an election or not (Prater & Lindell, 2000). After all, as found by Plevel (1997), "…politicians

don't want to make decisions that will affect them while in office or harm their chance for re-election" (p.14).

With residents supporting wildfire mitigation measures in the two communities, the locally elected officials are most likely to align their policy decisions with the issues that are important to their local constituents rather than perhaps more pressing policy issues that do not receive as much public traction (Jones, 2011; Rossi et al., 1982). Kamloops' wildfire mitigation programs, for example, have enjoyed ample financial backing from local government due to the support of politicians in the city.

> *"[Our city council has] really stepped up to the plate for us. We have a pretty significant budget – I'd say we have one of the highest wildfire budgets in the province, and possibly in Canada. They've been very supportive to the entire mitigation program. […]Definitely the mayor is extremely well versed in the wildfire risk and […] he actually pays attention to it."*
>
> - *Local Government Official [Kamloops]*

Similarly in Logan Lake, having a local council that was well informed and proactive in their actions towards supporting and fostering the development of wildfire mitigation measures was essential in ensuring the success of those measures.

> *"I think the innovation here, and it's not a practice, but I think it's the will and it's the will of the [fire] chief and the council to make it happen. And because they understand the significance for the*

community and I think that in itself will hold the community in good stead."

- *Local Government Official [Logan Lake]*

As noted by Davis (1990, p.28): "…making a community less prone to [wildfire] loss involves planning and budgeting, but above all the problem must be recognized by community leaders". This is echoed by the findings of Salon et al. (2014), and Alesch & Petak (2001), who found that the support of policy makers and politicians were a key component in implementing local level mitigation measures (see also Allman et al. 2004). Without the support of local politicians and the recognition of the issue by other community leaders, the success of wildfire mitigation in a community would be difficult to achieve. The key role played by community leaders will also be explored in section 5.4.

5.3.3 Sense of Community

In addition to the support offered by local residents and politicians, the importance of a "sense of community" was also highlighted as having a positive impact on the success of wildfire mitigation in the two study communities. Sense of community refers to "…[the] feeling that members have of belonging, a feeling that members matter to one another and to the group" McMillan & Chavis, 1986, p.9). The concept of a sense of community amongst community members has also been previously identified by Prior & Ericksen (2013) as playing a strong, positive role in influencing wildfire preparedness in a community.

In Kamloops, for example, interview participants stated that due to the still relatively small population of the city, people still felt as if they knew one another and identified with each other, and that that connection between residents and community leaders made it much easier to transmit knowledge about wildfire risk and the importance of wildfire mitigation. This echoes Obst & Smith's (2002) finding that "…the more a resident identified with their particular community, the more likely they were to have a strong sense of community" (p.129). Having that sense of community, in turn, has been found to increase participation in community action (Chavis & Wandersman, 1990). Equally in Logan Lake, the feeling of having a supportive and well-connected community was reported by interview participants as facilitating the communication between community members about how essential wildfire mitigation was to reducing the risk of wildfire in the community.

This is in keeping with McMillan & Chavis' (1986) findings that the greater the sense of community, the greater the impact community members will feel they have on their environment (such as supporting or implementing wildfire mitigation actions). Indeed, Prior & Eriksen (2013) found that a strong sense of community positively influenced the cooperation between community members and led to community-wide collaborative problem solving on wildfire related issues.

Overall, the support provided for wildfire mitigation measures by residents, organizations, and politicians alike strongly influenced the ability of the local government to implement both non-innovative and innovative wildfire

mitigation measures. Without that support, wildfire mitigation measures may never have received political backing and in turn municipal funds, or may never have been adopted and accepted by local residents. In addition, the sense of community present in both Logan Lake and Kamloops helped to reinforce the idea of wildfire mitigation as a community activity and a community responsibility.

> *"I think it's built for Logan Lake enough momentum that it's culture now, from the council side of things and the community and land managers within the community – this is normal business."*
>
> - *Local Government Official [Logan Lake]*

Having a strong sense of community between members of a community has been previously found to "…positively influence [wildfire] risk and mitigation beliefs so that wildfire preparation becomes the norm in the community rather than the exception" (Prior & Eriksen, 2013, pp.1583-1584). This sense of community appeared to ingrain wildfire mitigation as an integral part of the local culture and made it part of the everyday norms in the two communities.

5.4 Community Leaders & 'Issue Champions'

In both Logan Lake and Kamloops, community leaders and issue champions (individuals who advocate strongly for a particular cause) were identified by participants as playing key roles in developing, campaigning, and ultimately implementing the wildfire mitigation measures in their respective municipalities. Prater & Lindell (2000) have identified the issue champion as

being one of the most important components of ensuring the success of hazard mitigation measures or policies: "…this is an advocate or champion who will sponsor an issue, make sure it stays on the agenda, and [who will] mobilize community support." (p.76)

Leaders within a local government organization are often looked to for help and advice before, during, and after a hazard or disaster event (Eggleston & Koob, 2006). These leaders may also serve as key contacts between different stakeholders and groups, such as acting as a liaison between local government and provincial government, or between different community groups (Eggleston & Koob, 2006).

Wyner & Mann (1983) found that community officials that took active roles as leaders in fostering hazard mitigation within their jurisdictions were instrumental in encouraging others to support mitigation activities. They also point out that dedicated and long-standing commitment from local leaders to the goals of hazard mitigation is one of the most important components in the facilitation of effective mitigation practices – the perseverance of local leaders in pursuing their goals is necessity for any type of mitigation program to succeed (Wyner & Mann, 1983).

Community leaders also tend to be relatively high-profile and have influence over the community agenda (Bassett & Shandas, 2010). Therefore, their support or campaigning on the behalf of hazard mitigation can raise the profile of mitigation policies and activities in a community, helping to keep

mitigation in the public eye and on the community agenda (Salon et al., 2014; Prater & Lindell, 2000).

Occasionally, one leader alone can achieve much in the name of hazard mitigation within a community – Bassett & Shadas (2010) found that the efforts and dedication of a single, high-profile advocate can greatly influence the success of proposed mitigation efforts and activities. Christianson et al. (2012) found that a single forestry coordinator played a critical role in the success of municipal wildfire mitigation measures on the Peavine Métis Settlement in Alberta, Canada. Shindler (2007) and Olson & Olson (1994) also found that successful wildfire communication amongst members of a community could be linked back to a single individual with high stature in the community. These issue champions, sometimes operating alone, can make or break the process of developing and implementing new mitigation policies and procedures.

In both study communities issue champions were instrumental in elevating the importance of wildfire mitigation to local residents, groups and politicians and by carrying the projects through to fruition. In Logan Lake, three key leaders were identified as being integral to championing wildfire mitigation in their community: a local forestry consultant, a former mayor, and the local fire chief. All three leaders brought attention to wildfire mitigation in Logan Lake in different ways. First, the former mayor was integral in bringing the issue of wildfire mitigation to the attention of their fellow elected council members at the time and to the attention of the local residents. This mayor's

actions took place immediately before, during, and after the 2003 Kelowna Firestorm.

> *"How did these innovations come about? Well I think the mayor – one of the previous mayors was very proactive with the idea of getting the program going."*
>
> - *Local Government Official [Logan Lake]*

This former mayor was also credited with keeping the community informed about wildfire preparedness activities as well as creating awareness around wildfire mitigation within her council and within the community itself.

After the actions of the former mayor to begin the campaign for wildfire mitigation in Logan Lake, a second issue champion came into the spotlight. This was a local forestry consultant based out of the nearby community of Merritt who was brought in by the council after the push by the former mayor to proceed with wildfire mitigation in Logan Lake. This consultant had worked most of his adult life as a forestry professional, and after retiring from that career had become a consultant dedicated to helping communities reduce their wildfire risk.

> *"[The local consultant] had worked in forestry for many years, and council [at the time] hired him, which was probably one of the best things they ever did, because he […] knew what should be done."*
>
> - *Local Government Official [Logan Lake]*

This individual was well-known for his passion in promoting wildfire mitigation throughout the community, which went beyond the bounds of his

contracted services – he spent countless, unpaid hours championing the cause of wildfire mitigation to community leaders and residents alike.

> *"[The local consultant] – he had such a passion for protecting communities. He was very instrumental in […] taking that education that he'd learned from his career and applying that to community members and meetings and trying to address their concerns and issues. [Pause] He was the champion for Logan Lake, if you will."*
>
> - *Emergency Services [Kamloops]*

Several interview participants explained the critical role that this person had in implementing wildfire mitigation in Logan Lake. He was identified as being integral in the initial stages of municipal wildfire mitigation measures in Logan Lake, as well as leading the charge to inspire others in the community to implement wildfire mitigation in their homes and neighbourhoods as well.

> *"The one person who springs to mind is [the local consultant]. […] He was the one that started the initiative to get us going. He was the one who said we're not going to sit around doing this – we're going to go and we're going to do it now. Like a 'no mercy' kinda guy, he would just go and he did it. He was the one who started it, he was the one who got people on board. […] I think he was the captain of it, saying 'Hey we are going to go and do this, and that, let's get this plan going."*
>
> - *Fire Department [Logan Lake]*

Finally, a third issue champion – the current local fire chief - was repeatedly identified by interview participants as playing a key role in the ongoing wildfire

mitigation measures and efforts underway in Logan Lake at the time of my study. This fire chief had only moved into the community five years previously, but had quickly established himself as a passionate advocate for wildfire mitigation in the community. He not only worked to maintain wildfire mitigation measures already in place, but was also credited as playing an important role in establishing new, innovative initiatives in Logan Lake.

> *"I think that we've got a fire chief that really does look at the various types of [wildfire mitigation] things that you can do, and that you might not find in an average community."*
>
> - *Forestry Professional [Logan Lake]*

The fire chief was also recognized as being the principal leader in the community working to keep the community informed about wildfire mitigation nearly 10 years after the initial push for wildfire mitigation measures in Logan Lake.

> *"He's on it all the time. […] He talks to the people and walks around their houses and says 'These are the bad spots' […] and he's there, on top of things, all the time."*
>
> - *Fire Department [Logan Lake]*

In Kamloops, a single individual was repeatedly identified as playing an important role in the success of wildfire mitigation. This individual, a local parks department technician, had extensive experience in wildfire management and wildfire mitigation, both with other communities and with the federal

government. A participant also indicated that this individual was well respected in Canada and elsewhere for his knowledge on wildfire and wildfire mitigation.

> *"[The parks technician], he's recognized not just within Canada, but literally around the world in doing great work in that regard."*
>
> - *Local Government Official [Kamloops]*

While Kamloops has a history of wildfires and has had some fuel management work done in the past, many interview participants identified this individual as being the leader and a principal advocate for wildfire mitigation measures in the city.

> *"It started with [the parks technician]. […]He has sort of spearheaded everything and has brought it to the attention of [the municipal government], and with that the municipal government has provided funding and support, and the provincial government as well…"*
>
> - *Fire Department [Kamloops]*

Overall, many of the interview participants in both communities cited at least one issue champion as being one of the principal reasons for the success of wildfire mitigation in their communities.

> *"…a lot of it comes down to the dedication of the people to do it, and you've got a few very dedicated people, which certainly helps and has moved the whole process along a lot quicker than normally had we not had [them]."*
>
> - *Community Leader [Logan Lake]*

The passion and the dedication that these issue champions demonstrated for municipal wildfire mitigation as well as their long-term efforts to keep wildfire mitigation in the spotlight has contributed significantly to the ongoing success of their measures and initiatives. The importance of these issue champions in municipal wildfire mitigation has been recognized in previous research by Plevel (1997), who states "…if wildland-urban interface fire problems are to be addressed, 'issue champions' at the local level – vocal individuals both inside and outside government – will have to keep the wildland-urban interface problem in the forefront" (p.17).

This similar to findings from Stidham et al. (2014), who identified that in their study of six communities in the United States "…the majority of communities had a central leader, or change agent that inspired action within the community and served as an important point of contact with external resources" (p.68). Community leaders and issue champions are intrinsically in a good position to obtain the commitment and support of their fellow community members, as well as better able to mobilize the resources necessary to develop and implement innovative municipal wildfire mitigation (Lang et al., 2006).

Therefore, finding and supporting an issue champion is of significant importance in attempting to implement new community-wide mitigation activities, programs, and measures. They are uniquely able to reach out and influence their fellow residents, to inform others about the importance of wildfire mitigation, and to mobilize the resources needed for community wide wildfire mitigation measures.

5.5 Access to Funding and Other Resources

Participants from both communities spoke about the importance of access to resources when it came to the success of their wildfire mitigation measures. Resources includes funding, in-kind contributions (such as donated time or labour), and the use of wildfire mitigation equipment (such as bulldozers or backhoes). Some of these resources were internal to their local government, such as local fire department volunteers or funding provided by the local government, while other resources were external, such as funding provided by external organizations or manpower donated by provincial wildfire crews.

Funding was the primary resource referred to by interview participants, with funds being obtained from a number of internal and external sources.

> *"[Mitigation measures were funded] jointly, which was taxpayers' dollars here, which could be 20% to 30% of the total cost, and then the balance was through funding from the province […] through the UBCM. […] So it's the local money and [provincial] government money."*
>
> - *Local Government Official (Logan Lake)*

The importance of the Union of British Columbia Municipalities' (UBCM) funding opportunities was identified by interview participants in both communities. Under UBCM's 'Strategic Wildfire Prevention Initiative', funding is available for a variety of measures relating to wildfire mitigation, starting with grants offered for the development of Community Wildfire

Protection Plans (CWPP) as well as fuel management prescriptions and operational fuel management projects. All municipal governments in British Columbia are eligible for this grant funding, pending their application to the granting program.

> *"UBCM developed a program out there for grants to allow [communities] to write documents so that they could have a wildfire protection plan, follow a plan, and spend the grants [on mitigation projects]. And they are still putting out grants today to allow prescriptions, operations, and the writing of plans and so there's still grants out there for us..."*
>
> - *Fire Department [Logan Lake]*

Several participants in Logan Lake referenced the UBCM funding measures, and stressed the importance of these funding programs in the success of their wildfire mitigation measures. This was also echoed in Kamloops, with several participants highlighting the key role played by UBCM granting programs in funding their initial wildfire mitigation and fuel treatment projects. Federal and provincial/state funding sources have also been identified as the primary source of financial support for mitigation at the local government level in the U.S. (Steelman & Kunkel, 2004; Muller & Shulte 2011).

> *"We treated 950 hectares, and we wouldn't have been able to do that initial treatment without the UBCM money, there's no way. We wouldn't have been able to do all that initial treatment."*
>
> - *Local Government Official [Kamloops]*

However, interview participants indicated that the UBCM funding opportunities also presented challenges to both communities. Firstly, UBCM funding cannot pay for the entirety of a fuel management project or the development of a CWPP – the community itself must also contribute financially to the project as well. This required community contribution can range from between 10% to 25% of the costs, which can pose a challenge to a community to raise or divert funds for wildfire mitigation projects.

> *"The problem with the whole [UBCM] situation is that smaller communities don't really have the money even though the grants are up to 80% - smaller communities don't have that 20% or 15% required to fulfill some of them. So they can't apply for the grant, because they don't have [their share] of the money."*
>
> - *Fire Department [Logan Lake]*

For some of these communities, even though 20% of a grant may account for less than $5,000, it is still beyond their reach in terms of committing municipal funds to wildfire mitigation.

> *"So the funding formula [for UBCM grants] is now 90/10 – 10% of an in-kind of community contribution, whether that's cash, or manpower, or other resources. So that 10%, for some communities, still continues to be a stretch."*
>
> - *Emergency Services [Kamloops]*

Participants mentioned the difficulties in obtaining the required share of their

municipal contribution in order to qualify for the funding. In both communities, they ultimately were able to find the requisite municipal funds, but expressed some trepidation over their ability to do so again in the future.

Another issue that was raised by the participants regarding the UBCM funding was the problem of not having a high enough level of community wildfire risk to qualify for the granting programs. Under the UBCM funding initiative, a community must qualify as having 'high' or 'extreme' risk in order to be deemed eligible. Both Logan Lake and Kamloops initially qualified for UBCM funding due to their levels of wildfire risk, but the two communities have since been able to reduce their risk to a "moderate" level due to their wildfire mitigation efforts.

> *"The [UBCM] funding is only available to people that were in a high to extreme [risk zone]. So now that we're moderate [risk] – we've treated all those lands that were in high or extreme [risk] - we're not eligible for funding anymore. So what do you do, not treat [wildfire risk] anymore?"*
>
> - *Fire Department [Kamloops]*

This in turn affected the ability of these communities to maintain their recently achieved lower level of risk. Participants expressed frustration at what they perceived to be short-sightedness on the part of the granting organization as without the funds supplied by UBCM, they were left scrambling in their efforts to locate funds for maintaining their wildfire mitigation projects. Past studies have highlighted the frustrations of other municipalities who expressed

disappointment that many funding programs were short-sighted and did not extend into long-term funding opportunities (Salon et al., 2014; Allman et al., 2004; Fleming & Webber, 2004).

UBCM grants were also primarily available for fuel management wildfire mitigation measures, with little to no funding available for social mitigation measures (like education campaigns). This echoes Steelman & Kunkel (2004)'s finding that most federal/state/provincial government granting programs only target fuel management as mitigation measures. Finally, UBCM grants are only available for use on land owned by the municipal government, and cannot be used to treat private property in the community or, in the case of Kamloops, federally-owned First Nations reserve land.

In terms of internal funding, both communities utilized tax payer dollars to fund wildfire mitigation measures, albeit to a different extent in each community. Kamloops, with a municipal population of 80,000+, has a larger tax base and therefore access to a larger potential pool of funding. This funding, however, is contingent on political support in the community for mitigation and is variable from year to year through allocations in the annual civic budget. Funding for wildfire mitigation through tax payer funds must also compete with funding for other municipal activities and services (such as water treatment plants, waste removal, road infrastructure maintenance, etc.) (Alesch & Petak (2001). Logan Lake, on the other hand, has a much smaller population base to rely on (2,000+), and therefore has had to find other ways to finance their wildfire mitigation measures.

Beginning in 2004, the municipal government of Logan Lake started an initiative to set up a provincially recognized Community Forest adjacent to their community. This would then allow them to obtain timber rights for a selected area around the community through their newly established Community Forest Corporation and permit them to selectively harvest within that area. Upon approval of plans by the provincial government in 2007, the local council invested municipal funds into hiring contractors to selectively harvest timber in the Community Forest. In turn, the sale of this commercially viable timber provided the municipal government of Logan Lake with the funds necessary to support their municipal wildfire mitigation projects.

> *"We now have a forest tenure that we have exclusive rights to the forest management of […] So we generate money with that tenure that we can then invest back into that project, and in other [wildfire mitigation] projects in the community."*
>
> - *Forestry Professional [Logan Lake]*

This source of funding has been essential in Logan Lake to maintain their other wildfire mitigation programs, like the Super Key program and 'Cowmunity' fuels management program [see Chapter 4]. This type of innovative funding source has allowed Logan Lake to adequately fund its own mitigation measures, much like certain UK local governments that had created their own energy service companies to support their climate change mitigation measures (Allman et al., 2004).

Overall, Logan Lake and Kamloops were found to have relied heavily

on the UBCM grants to fund their municipal wildfire mitigation measures, Kamloops, due to its larger population size and therefore larger tax base, is able to obtain some funds from the City of Kamloops for wildfire mitigation. Logan Lake relies mostly on the profits from their Community Forest Corporation to provide funds not covered by UBCM grants.

5.6 Partnerships & Collaborations

Partnerships and collaboration have been defined as "…consist[ing] of long-term, committed relationships [that] have a collective identity and vision" (Brooks et al., 2006, p4). Increasingly, collaborative efforts between affected stakeholders have been found to be a factor in the successful implementation of municipal wildfire mitigation projects like CWPPs as well as in other areas of natural resource management (Cheng & Sturtevant, 2012; Jakes et al., 2011). These two concepts of partnerships and collaborations were found to be vital components in the success of wildfire mitigation measures in both Logan Lake and Kamloops.

Interview participants from both communities frequently mentioned a variety of formal and informal partnerships between organizations that contributed to the success of their wildfire mitigation measures. These ranged from small-scale neighbourhood collaborations to relationships between regional-level and even provincial-level organizations.

5.6.1 Local Partnerships

In Logan Lake, homeowners and neighbourhood groups were identified as being active partners in supporting and implementing wildfire mitigation

measures around their homes and neighbourhoods. Homeowners were noted to have been supportive of seasonal wildfire fuel materials pick-up, and were often proactive in contacting the local fire department when they felt that there was too much dry grass, fallen trees, and leaves in the green spaces around their homes. Local homeowners were also keen to offer their help in terms of vegetation management, rooftop sprinklers, etc. to the fire department in regards to wildfire mitigation in the town.

> *"There wasn't anybody that said 'No, I'm not going to do that' […] it was more like when we had our town hall meetings, [homeowners said] 'What can we do?'. So right from the residents looking after their own yards and houses, to putting sprinklers on their roofs […], there's been partnerships – it's cooperative, you know, getting along – [the homeowners] see what the need is, they recognize the plan, and they understand the results, and everybody pitched in to do that."*
>
> - *Local Government Official [Logan Lake]*

Similar partnerships were also established between the local fire department, the City of Kamloops, and local homeowners. Informal citizens' patrols looked out for potential wildfire causes, such as cigarette butts or sparks from recreational vehicles. One neighbourhood association in Aberdeen (a neighbourhood in Kamloops) also took the initiative to become more involved in wildfire mitigation at the homeowner and neighbourhood level by promoting FireSmart to the members of its residents' association.

"We have groups now that are coming out that want to be a part of the FireSmart communities, so we got out there and provide them some support so they can get their programs started. That's one thing I really like about that program – it's ground-up."

- *Fire Department [Kamloops]*

In both communities, local groups also worked together with local fire departments on wildfire mitigation and on raising wildfire risk awareness within the community. Schools in both communities were visited by local fire department officials or local foresters and students were given presentations on wildfire risk, preparedness, and the local mitigation measures.

In Logan Lake, the local Communities in Bloom (a Canada-wide program that supports civic beautification through gardening and green spaces) volunteer group invited the local forester in charge of the community forest to speak about the importance of wildfire mitigation and how the community forest works for Logan Lake. This in turn has increased the knowledge of wildfire mitigation for the Communities in Bloom group, which is considering changing their program to include more drought-tolerant and wildfire resistant plants in the town. In Kamloops, the city fire department and the wildfire management branch have made efforts to collaborate with the media in order to distribute information about wildfire risk, wildfire mitigation, and wildfire preparedness.

"Media is one of our best friends – they work with us, and they are doing a great job, you know – we ask them if we can do something, you

know, with awareness to the public, and they're more than willing to help us do that."

- *Fire Department [Kamloops]*

Finally, local homeowners have also been active and willing participants in local mock emergency exercises – they have been evacuated, sent to reception centers, and participated in reception centre protocols in order to aid the fire department and the City of Kamloops in practicing for a potential wildfire event.

These local partnerships in Kamloops & Logan Lake are similar to those found in other communities who had implemented municipal hazard mitigation measures. In these communities, the importance of partnerships and collaborations between community stakeholders such as local groups as residents was determined to be an integral part in the success of these mitigation measures (Jakes & Sturtevant, 2013; Jones, 2011; Fleeger, 2008; Shiralipour et al., 2006; Jakes et al., 2003).

5.6.2 Regional and Provincial Partnerships

However, both communities have formed and maintained partnerships that extend beyond the local level. Interview participants also mentioned the partnerships their respective communities had forged with regional organizations and neighbouring communities. In Logan Lake, the local fire department as well as local government officials works closely with the neighbouring communities of Merritt and Kamloops, sharing information between them on wildfire mitigation as well as forming lines of contact should

a wildfire threaten one of the communities. Both communities also worked closely with the Thompson-Nicola Regional District, which is the regional government that surrounds both communities.

This type of municipal inter-cooperation may be due in part to the governance structure in British Columbia. In BC, they have established a system of regional governance that aims to establish a regional administrative and political framework for delivering regional services on a partnership basis with their partner municipalities in the region (BC Chamber of Commerce, 2014). This form of regional governance may result in higher levels of cooperation between municipalities, as opposed to municipalities in other provinces who do not have the same governance model (such as Alberta).

The Kamloops Interagency FireSmart Committee (KIFC) is a collaborative alliance between members of the city fire department, the city parks department, members of the provincial wildfire management branch, and members of the Tk'emlúps Indian Band. The members of KIFC work together to make decisions on wildfire mitigation in Kamloops, and meets several times a year to review plans as well as discuss their future objectives. A similar group in Arizona with members from the local, state, and national government levels as well as stakeholders from other groups (like First Nations and the Forest Service) was found to have had a positive effect on reducing their region's risk to wildfires (Lenart, 2006). A key part of that group's success was the involvement of individuals who had roles in influencing wildfire mitigation decisions in their own groups or governments, which was also found in the

KIFC's membership (fire chiefs, wildfire branch managers, elected politicians) (Lenart, 2006).

In both communities, involving various stakeholders from different backgrounds was found to be an important factor in the success of their municipal wildfire mitigation measures. This echoes findings from previous studies that as different stakeholders collaborate on a common problem, they bring their own diverse skills and resources to the problem at hand, which increases the likelihood of successful problem resolution (Allen et al, 1994; Wandersman et al., 1994).

As identified in both Chapter 4 and earlier in this chapter, both communities worked closely with the provincial wildfire management branch on their wildland-urban interface fuel management and other wildfire mitigation measures. The provincial headquarters for the province of British Columbia's wildfire management branch is located at the Kamloops Fire Center, making it an easily accessed and convenient potential partner for both communities.

Partnerships with provincial/state level wildfire management departments have been found to be an important piece in ensuring the success of municipal wildfire mitigation measures (Fleeger 2008; Lenart, 2006; Frentz et al., 2000). As identified by Fleeger (2008) in his study of the Arizona White Mountains, the partnership between local governments in the area and the U.S. Forest Service provided local governments with expertise and resources that

they otherwise would not have been able to access. This was also found to be the case in Logan Lake and Kamloops.

For Logan Lake, the partnership between their local fire department and the Kamloops-based wildfire management branch crews proved to be invaluable to the development and implementation of their wildfire mitigation measures. For the past four to five years, wildfire management branch crews will come during the summer months to assist with fuel management and carrying out selective thinning prescriptions, bringing in qualified crews as well as heavy machinery that the District of Logan Lake would not otherwise be able to access.

The wildfire management branch crews also work with school-age children to increase their awareness of wildfire risk and to in turn demonstrate effective wildfire mitigation measures to the community as a whole.

> *"The [wildfire management branch] crews came out and taught kids how to do [the interface work] here, and then we showcased that to the community and said 'This is what we need to do' and the kids are really proud of their work, right? And the parents – everyone – was proud to see the difference [that] it made."*
>
> - *Local Government Official [Logan Lake]*

For the City of Kamloops, due to the proximity of the wildfire management branch headquarters based at the Kamloops Fire Center, a strong partnership has been established between themselves and the provincial wildfire management branch.

"We have a very good working relationship with the wildfire management branch here in the Kamloops fire zone. […] All of our fire responses are unified responses – the forest service and the fire department respond to everything as a unified – under a unified command, and they work really well together."

- *Local Government Official [Kamloops]*

Efforts are also made to establish consistent messaging between the wildfire management branch and the City of Kamloops in terms of public education and safety in the community.

"We have a really good relationship with [the technician] in the Parks Department; we have a good relationship with the wildfire management branch, so that any time we have a program we try to team up so we can deliver it together. It's the consistent message we're sending, right, whether it's from wildfire management or from the fire department or from parks, so we always have good participation from all of those organizations."

- *Fire Department [Kamloops]*

However, the partnership between these two communities and the provincial wildfire management crews did not solely benefit the District of Logan Lake and the City of Kamloops – for the wildfire management branch crews, they had an opportunity to keep their crews working when they weren't actively engaging in firefighting, as well as using the work in Logan Lake to help with skills recertification and for training.

"We [the wildfire management branch] look at it for training – we use [the projects in Logan Lake] as opportunities for some burning of range grasslands training; it also provides for certification for our crews and for recurrency [sic] training for our crews at the beginning of the season. We use it for saw training and for danger tree assessing, and also areas that we're moving into provides for understanding what a [wildfire] prescription is, and what that prescription means from a fuels management point of view.

- *Provincial Fire Crew [Logan Lake]*

Further to the benefit of the wildfire management branch crews, the position of Logan Lake (south and west of Kamloops on the high mountain plateau) makes it an ideal position for them to have their crews based during the fire season.

"So you get to Logan Lake, just by coincidence they have a highway going south, a highway going west, and east – it makes for easy access into the Cache Creek/Ashcroft area, down into Merritt, back into Kamloops, or off the Coquihalla [highway] so strategically it's a great spot to station a crew."

- *Provincial Fire Crew [Logan Lake]*

Similar to Logan Lake, Kamloops also provides more convenient locations for the wildfire management branch crews to base their operations out of.

"If they want to base their crews on the other side of the river [that runs through the city] during the summer time during a long weekend

because it takes them a long time to get through traffic from the airport, the fire department's been very good at accommodating their crews for day-basing and such up at our training centre."

- *Local Government Official [Kamloops]*

Beyond their collaborations with the provincial wildfire management branch crews, the City of Kamloops also worked closely with the Ministry of Forests to work on disposing of timber in and around the City that was not commercially viable.

"…so we sat down with the Ministry of Forests on trying to figure out alternatives [for disposing of the timber], and they did things like give us a blanket timber mark for the whole city, where typically they have a timber mark for each piece of property – that allowed us to move that material out."

- *Local Government Official [Kamloops]*

These types of arrangements between the two levels of governments greatly facilitates the wildfire mitigation work in the area – without them, wildfire mitigation through timber disposal would take much more time and a lot more money.

5.6.3 Industrial Partnerships

Some partnerships were also established with local industrial partners in both communities. In Logan Lake, the Highland Valley Copper Mine – the major industry in the area - provided support to the District of Logan Lake for the production of their wildfire risk & mitigation awareness video "In Our

Defense" (see Chapter 3), as well as establishing links with the town to provide support in case of an emergency due to wildfire (assisting with equipment, evacuations, etc.). Local agricultural partners such as cattle ranchers as well as logging companies operating in the area have also established links with Logan Lake in terms of responding to a wildfire-related emergency. In Kamloops, local industries such as the sawmill assisted with the disposal of non-commercially viable timber that was removed from the areas in and around the city. This supports the findings of Allman et al. (2004), who identified that collaborations with local industries enabled local governments to more efficiently reach their mitigation goals.

Overall, the forging and maintaining of partnerships and collaborations in both Logan Lake and Kamloops demonstrated the importance of *collaborative capacity*. Collaborative capacity is, as defined by Brooks et al. (2006), "…the mobilization of skilled committed individuals, their relationships, and the physical resources within a given […] community that can be leveraged to collectively solve problems and sustain community well-being" (p.4). Partnerships and collaborations between all levels of stakeholders in both communities yielded access to a vast supply of skilled professional resources, material resources, human resources, and support that would not have been possible with each stakeholder operating on their own. Having that involvement from a variety of groups across different levels of influence was identified as having a positive influence on the success of their communities' wildfire mitigation efforts.

"I think that the community took the approach that 'the more people involved, the better.' […] It was always a good thing to bring it up to someone [that could be involved] and say 'This is what we need to do because of this, and what can you do to help us out with that?'"

- Local Government [Logan Lake]

Indeed, the presence of partnerships may have acted as the "make or break" for several wildfire mitigation initiatives in both communities – several interview participants from both Logan Lake and Kamloops stressed how without partnerships, they were not certain if their wildfire mitigation measures would have been possible.

"I think if you don't have those partnerships, it makes it very difficult for any community […] to succeed."

- Emergency Services [Kamloops]

Above all, the formation and maintenance of effective partnerships and collaborations across several stakeholder levels have had a significant impact on the success of wildfire mitigation measures in both Logan Lake and Kamloops.

5.7 Challenges to Wildfire Mitigation Implementation

The third objective of this research was to identify any challenges or barriers to wildfire mitigation that the two participating local governments had encountered. Several participants described challenges that influenced their municipal wildfire mitigation efforts. First and foremost, participants from both Kamloops and Logan Lake frequently remarked that funding was generally the

most important limiting factor in the development of their communities' wildfire mitigation measures. Funding has also been highlighted in previous research on mitigation by local governments as one of the key constraints on the success of wildfire mitigation. Reams et al (2005) found that "… the most significant obstacles reported [by fire managers] deal with inadequate program funding and negative public attitudes." (p825) Several other researchers also found that financial constraints were one of the most important limiting factors in the ability of local governments to implement hazard mitigation measures (Kusumasari & Alam, 201; Allen, 2006; Allman et al., 2004; Alesch & Petak, 2001).

Several participants also expressed their frustration with the Union of British Columbian Municipalities' (UBCM) funding formulas. Under UBCM's "Strategic Wildfire Prevention Initiative", municipalities in BC can obtain funding for a number of wildfire mitigation and prevention activities (such as the creation of a Community Wildfire Protection Plan or fuel management prescriptions). However, a municipality is only eligible for this funding *if* they are at a high level of wildfire risk. Once the communities have mitigated the risk down to a lower risk level, they are unable to obtain long-term funding to maintain their mitigation efforts. This echoes previous research findings that highlight the lack of long-term funding as a limitation to the success of municipal mitigation measures (Salon et al., 2014; Allman et al., 2004; Fleming & Webber, 2004)

Due to the prohibitive cost of wildfire mitigation and the lack of long-

term funding for projects, participants in both communities expressed worry that they would have to lapse in their mitigation efforts until their wildfire risk levels would rise high enough again that they would be able to access the UBCM funding once more.

Secondly, participants in both Kamloops and Logan Lake spoke about how no matter what they do, there are still residents in both communities that do not buy into wildfire mitigation efforts, both at the homeowner level and at the municipal level. Reams et al. (2005) identified that the lack of support and negative attitudes of certain residents is a major obstacle in the success of municipal wildfire mitigation measures. One participant in Kamloops remarked that it was frustrating to deal with because even though the municipal government can do as much mitigation as they can on their public lands, they cannot touch private lands. Therefore, if the owners of private lands or properties do not follow suit with wildfire mitigation on their property, the wildfire risk remains high in that area and threatens adjacent areas, decreasing the effectiveness of any wildfire mitigation measures currently in place in surrounding areas.

Additionally, this lack of mitigation at the homeowner level is mirrored on the government side as well: a participant in Kamloops noted that due to the presence of the Tk'emlúps First Nation band immediately adjacent to the city, there is a need for the federal government (who is responsible for the First Nations' land) to also be an active participant in wildfire mitigation on the lands

under its jurisdiction. However, this has not yet occurred and thus the federal land remains at a high level of wildfire risk.

Thirdly, participants in both communities voiced how they had faced opposition from local residents in regards to removing trees on both their own property and on municipal land. Residents initially did not want to remove trees from their own property due to the aesthetic value of the trees (increased property value, improved view, shade, etc.) and refused to do so even if the presence of the trees increased their risk of wildfire. This finding echoes that of Davis (1990), who found that vegetation management (such as the removal of trees) was often opposed by residents due to the aesthetic value of the trees.

Municipal lands were similar as well as some residents did not want the forest to be "chopped down" or to have trees removed from city parks due to their aesthetic value. However, the arrival of the mountain pine beetle in both communities seemed to have reduced the importance of this particular limitation as with the death of infected trees, their aesthetic appeal drops drastically and residents no longer want the trees on their property or on municipal lands (Kooistra & Hall, 2014; Hamin & Ryan, 2009).

Fourthly, as one participant in Kamloops remarked, there are no provisions included for regulatory wildfire mitigation building principles in either the Canada Building Code or in the British Columbia Building Code. This is seen as a limitation to an effective wildfire mitigation program, as many other wildfire mitigation program managers believe that regulations are an integral part of a wildfire mitigation program (Reams et al., 2005). As this

participant noted, this means that there is no legal entrenchment of wildfire mitigation requirements (such as building materials or distances between buildings) in either building code. Because of this, there is no avenue for local government officials in Kamloops to require new buildings to use wildfire mitigation principles in their development and construction, thereby removing any sort of legal incentive to reduce wildfire risk for new properties.

Fifthly, two participants in Kamloops each spoke about how air quality regulations can also impede wildfire mitigation activities in their community. Selective burning and the burning of piles (dead trees and leaves) are an effective way to rapidly reduce wildfire fuel loads as well being considerably easier to do compared to hand removal or removal by machine (due to the need to transport all excess fuel materials out of the area). However, the smoke produced by these burning projects is subject to the BC Ministry of the Environment regulations on air quality and the City of Kamloops "Airshed Management Plan". Both of these organizations severely restrict the quantity of smoke that can be produced by fires, which in turn makes selective burning nearly impossible.

In additional to the regulations around the smoke produced from selective burning, a few of the participants in both Kamloops and Logan Lake remarked that some local residents in both communities did not like the haze and the smell associated with the burning projects, and therefore did not support the use of selective burning as a wildfire mitigation tool. These objections were not only based in aesthetics, but also in serious concerns over the health, as

wildfire smoke can cause moderate to severe respiratory complications, especially in those already suffering from pulmonary conditions like asthma (Finlay et al., 2012; Morgan et al., 2010).

5.8 Chapter Summary

This chapter presented and discussed six factors that had a significant influence on the success of both innovative and non-innovative wildfire mitigation techniques in the study communities of Kamloops and Logan Lake, British Columbia. Amongst these factors, five had already been identified in previous studies as factors influencing municipal mitigation of wildfires and other hazards. These included the importance of a post-event window of opportunity, resident, political, and community support, access to adequate funding & other resources, the role of partnerships and collaboration between stakeholders, and the importance of community leaders and issue champions.

One new factor that was found in this study was the effects of mountain pine beetle on selected conifer tree species in both communities resulted in reduced aesthetic appeal of these trees due to their death or sickness caused by the beetle, and increased support for removal of the affected trees as part of wildfire mitigation efforts. Previous studies on mountain pine beetle and forest management practices had also found that the aesthetic impacts of the mountain pine beetle increased support for forest management practices (Kooistra & Hall, 2014; McFarlane et al., 2012). However, this was the first time that the link

between mountain pine beetle and its positive effect on wildfire mitigation has been established in academic research.

Chapter 6: Conclusions

This research project used a case study approach to investigate innovative municipal wildfire mitigation in the two communities of Logan Lake, BC and Kamloops, BC. In-depth, semi-structured interviews were conducted with 21 participants who were involved in municipal wildfire mitigation in their communities. Data collected and analyzed from those interviews was used to examine what innovative wildfire mitigation measures were currently in place in both communities, as well as exploring the factors that influenced the success of those innovative wildfire mitigation measures. The challenges faced by local governments in developing and implementing municipal wildfire mitigation measures were also discussed.

This chapter first summarizes the findings of this research study. Following this, the implications and recommendations of this research for academic research and for practical implementation are then described. This chapter also provides recommendations for local government officials and emergency managers related to developing and implementing innovative wildfire mitigation measures based on the results of this study. Direction for future research will also be discussed.

6.1 Summary of Research Findings

This study identified six factors that impacted the success of local government-based wildfire mitigation measures and initiatives. First, the importance of having experienced a post-wildfire window of opportunity was

identified as having an impact on increasing the awareness of local residents and local officials to the risk of wildfires to their community.

The second factor identified was the importance of the effect of mountain pine beetle on the development and implementation of municipal wildfire mitigation measures. The aesthetic appeal of conifer trees in and around the two communities dropped significantly after their infection by mountain pine beetle, and because of this, residents were more willing to have their trees removed.

The third factor was the importance of resident and political support for wildfire mitigation efforts. Having a sense of community amongst community members was also identified as a key factor in positively influencing the implementation of municipal wildfire mitigation.

The fourth factor identified by this study highlighted the key role that local leaders and "issue champions" played in ensuring the success of their communities' wildfire mitigation activities. Having an issue champion in place to spearhead mitigation efforts, to drum up support from residents and politicians alike, and to keep the issue in the spotlight is an important factor in implementing effective wildfire mitigation measures at the local government level.

The fifth factor identified was the importance of ensuring access to appropriate sources of funding and other necessary resources. The funding provided to municipalities through UBCM's "Strategic Wildfire Prevention Initiative" made the implementation of wildfire mitigation measures in both Logan Lake and Kamloops possible – without that funding the cost of wildfire

mitigation activities would have exceeded the financial capabilities of both communities. In addition to funding, other resources like donated labour and access to heavy machinery was also identified as playing a key role in the success of wildfire mitigation efforts in Logan Lake and Kamloops.

The final factor identified by this study was the importance of partnerships and collaborations between municipalities and other agencies, businesses and organizations. Collaborations between both communities and the provincial wildfire management crews were integral in ensuring that activities like fuels management treatments or cross-organizational training initiatives were made possible.

All of these factors except for one had been previously identified in the hazards and policy innovation literature as potentially having an impact on the success of hazard mitigation policies or measures. The effects of the mountain pine beetle and the subsequent death of large amounts of conifer trees in and around both communities on the development and implementation of innovative wildfire mitigation measures had not been previously identified in the hazards or policy innovation literature.

This study also sought to explore any challenges that impeded these mitigation efforts by local governments. The first three challenges to effective wildfire mitigation program development and implementation identified in this research study had been previously identified in the hazards and policy innovation literature. They are a lack of regulatory provisions, lack of buy-in for wildfire mitigation on the part of some residents in both communities, and

the aesthetic appeal of healthy trees on personal and public properties that prevented effective fuel management on certain sites (Collins, 2008; Brenkert-Smith et al., 2005; Collins, 2005; McGee, 2005; Nelson, 2005; Daniel et al., 2003).

The two remaining challenges identified in this study have not been previously identified in the hazards or policy innovation literature. These two were the conflict between selective burning of wildfire fuels and air quality regulations, as well as the lack of access to funding for *maintaining* wildfire mitigation measures. The lack of funding for maintenance of wildfire mitigation programs is possibly due to the fact that as the UBCM funding program is relatively new (having been established after the 2004 Filmon report), the need for maintenance program funding has not yet been identified by policy makers. Both Logan Lake and Kamloops were some of the first communities to access UBCM funding for wildfire mitigation.

Air quality regulations had not been identified in previous literature as a challenge in implementing municipal wildfire mitigation programs, but had been identified as a challenge in *state* wildfire management and mitigation (Schweizer & Cisneros, 2014). Wildfire management and mitigation through prescribed burning is seen as controversial due to public perceptions around the health risks of wildfire smoke, and therefore may not be widely used by local governments (Schweizer & Cisneros, 2014).

6.2 Implications and Recommendations

6.2.1 Research Implications & Recommendations

The primary research implications of this research study are its contributions to the literature in the fields of human dimensions of environmental hazards and policy innovation. This research supports previous scholarship in a number of areas. First, the concept of a "window of opportunity" was identified as playing a key factor in the success of wildfire mitigation measures in both Logan Lake and Kamloops. This builds on previous research that identified the role of post-event windows of opportunities in facilitating policy decisions and mitigation development and implementation (Steelman & Kunkel, 2004; Prater & Lindell, 2000; Birkland, 1998; Plevel 1997; Kingdon, 1984; Wyner & Mann, 1982). The communities of Logan Lake and Kamloops acted upon the window of opportunity opened by the 2003 Okanagan Wildfires, in order to establish their municipal wildfire mitigation measures.

Second, the importance of community leaders and issue champions were found to be a key part of successful mitigation program implementation, building on the findings of several other studies from the environmental hazards field. (Salon et al., 2014; Christianson et al., 2012; Eggleston & Koob, 2006; Prater & Lindell, 200; Plevel, 1997). This also confirms findings from a study by Wohlers & Bernier (2012) on the role of community leaders in influencing innovation in e-government policy adoption at the local government.

Third, this research also confirmed the importance of the support of residents and politicians, as well as the importance of a sense of community

amongst community members in regards to wildfire mitigation. This supports previous findings that many decisions and actions at the local government level are dependent on obtaining approval from their residents and their elected politicians (Shindler, 2007; Shindler & Toman, 2003; Winter & Fried, 2000; Plevel, 1997; Rossi et al., 1982).

Fourth, partnerships and collaboration, which have been investigated in previous research studies, were found to play a key role in allowing access to resources and expertise that communities would not otherwise be able to obtain (Jakes et al., 2011; Lenart, 2006). This study also supported earlier work on the important role that provincial/state agencies have to play in municipal wildfire mitigation (Fleeger, 2008; Lenart, 2006; Frentz et al., 2000). The results of this study show how partnering with them can increase the likelihood of success for municipal wildfire mitigation measures. In addition, this study also confirms findings from Morgan's (2010) research that identified collaboration as a factor in the adoption of economic policy innovation.

Fifth, this study also supported previous findings that lack of funding played an important role in limiting the successful implementation of mitigation efforts by local governments, especially in the long-term and in the maintenance of ongoing measures ((Kusumari & Alam, 2012; Allen, 2006; Reams et al., 2005; Allman et al., 2004). This was also the case with several studies from the policy innovation field (Wohlers & Bernier, 2012; Betsill, 2001; Bingham, 2012).

Sixth, this study also identified a factor affecting wildfire mitigation that had not been previously identified in academic research. Mountain pine beetle had begun affecting both communities of Logan Lake and Kamloops over the past five years, infecting certain species of conifer trees and killing them off. Due to the diminished aesthetic appeal of infected and dead trees, residents were more supportive of local government efforts to remove them, even though the primary aim of the removal was to reduce wildfire risk.

This study therefore adds to the academic literature by identifying the role that mountain pine beetle has to play in encouraging support for municipal wildfire mitigation. This finding also supports the idea that certain environmental factors like forest diseases or forest disturbances may have unexpected positive outcomes when it comes to forest management or the implementation of mitigation measures (Kooistra & Hall, 2014; Hamin & Ryan, 2009)

6.2.2 Practical Implications & Recommendations

Though the research communities of Logan Lake and Kamloops differed in their population levels, population densities, location, size, and type of innovative and non-innovative wildfire mitigation measures implemented, the same factors influenced their wildfire mitigation measures. This may indicate that though wildfire mitigation may come in many different shapes, sizes, and forms in all sorts of communities, the factors that influence their successful development and implementation may be similar. This has practical implications for local government officials and decision makers, as the factors

identified in this study therefore may also be relevant for other communities. However, a caveat must be included that the two communities are located close to each other therefore it would be worthwhile to investigate if communities further afield identified similar factors in the success of their wildfire mitigation measures.

A practical policy implication from this study is the need for a funding scheme at the provincial level in British Columbia (and possibly in all Canadian provinces) that provides for the maintenance of areas that have already been mitigated for wildfire risk. At the time of this study, there was no funding available for municipalities that have already made strides in mitigating their wildfire risk and have dropped down into a lower level of risk. This means that in order for them to access funding, they need to bring their risk level back up. Having a dedicated fund set aside for maintenance purposes would go a long way in ensuring the longevity of wildfire mitigation efforts and would serve to maximize the benefit of the initial funding from programs like UBCM's "Strategic Wildfire Prevention Initiative".

Recommendations for local governments looking to implement municipal wildfire mitigation would include encouraging community buy-in for wildfire mitigation, establishing political support from local councils for wildfire mitigation (as they are the often the guardians of the municipal coffers), and identifying and supporting issue champions within the community who can actively campaign for the cause.

First, public support for municipal wildfire mitigation is needed in order to succeed with municipal wildfire mitigation (Bassett & Shandas, 2010). In both Kamloops and Logan Lake, residents were supportive of municipal wildfire mitigation, and therefore local government officials did not have to deal with pushback or loss of public support in regards to wildfire mitigation.

In the same vein, having political support from local council members will also have a positive impact on whether or not wildfire mitigation remains a priority. As seen in Logan Lake and Kamloops, having political support for municipal wildfire mitigation facilitates access to municipal funds and allocation of resources to implement municipal wildfire mitigation. Without having this support from both residents and politicians, local governments will face negative public attitudes, setbacks, and may even be stopped from implementing municipal wildfire mitigation measures (Shindler, 2004).

Identifying potential individuals in the community (such as community group leaders) to serve as champions for wildfire mitigation is also a recommended action. In Kamloops and Logan Lake, issue champions were integral in keeping municipal wildfire mitigation in the public eye as well as supporting municipal wildfire mitigation through their leadership. Having these wildfire mitigation champions will work to ensure that wildfire mitigation stays in the public eye and will potentially set an example for their fellow citizens in regards to supporting and implementing wildfire mitigation.

It is also recommended that local government actively seek out funding opportunities to support not only the initial cost of municipal wildfire

mitigation but also the maintenance of on-going mitigation measures. This may require obtaining provincial or federal grants, but more importantly it may also require local governments to develop their own ways of sustainably funding long-term wildfire mitigation and maintenance. This could be similar to Logan Lake's Community Forest Corporation, where their revenue from selective logging in forest areas adjacent to the community pays for municipal wildfire mitigation measures. Similar innovative efforts in funding climate change mitigation have previously been identified in the literature, with some municipalities in the UK developing their own energy services corporations to finance local mitigation initiatives (Allman, 2004).

Funding could also be obtained through community fundraisers, partnerships with neighbouring industrial operations or through cost-sharing with nearby municipalities on larger mitigation projects. This is echoed by the recommendation that local governments seek to establish long-term, supportive partnerships with community members or organizations that have a stake in wildfire mitigation. This may allow them to obtain access to resources (personnel, knowledge, equipment, etc.) that they otherwise would not be able to afford or find.

Lastly, local governments are encouraged to start efforts to mitigate municipal wildfire risk if they have already been afflicted with mountain pine beetle. The presence of mountain pine beetle in Logan Lake and Kamloops was found to have reduced the aesthetic appeal of the trees in and around the community, and greatly facilitated public uptake of wildfire mitigation

measures. Therefore it is recommended that local governments take advantage of this opportunity if they are looking to implement municipal wildfire mitigation measures.

6.3 Study Limitations

As discussed in Chapter 3, the use of cases studies does have limitations. Case studies are all unique, and exist in their own specific context. Because of this, it can be difficult to extrapolate the findings of case studies to other cases. However, one of the considerations in this study was to provide thick description for both case studies on background, method, and results. This was done to enable others to examine whether the findings from this study could potentially be generalized to other municipalities.

Another limitation was that in one of the communities a key figure who was heavily involved in developing and implementing their wildfire mitigation measures unfortunately passed away about a year before the start of this study. This person was mentioned many times over the course of interviews in the community, and it would have been very valuable to have been able to include them in this study.

A third limitation may have been the relative homogeneity of experience of the interview participants involved in this research study. As this study primarily sought input from individuals involved at the upper level of management in local government, most individuals had been in their roles for over five years, had considerable professional qualifications and experience,

and had considerable familiarity with the communities due to their time spent in their roles.

A fourth limitation to this research was the location of the two communities. Both study communities were located in approximately the same region, in the interior of the province of British Columbia. This may have had an influence on the similarity of results between the two cases. It would be interesting to investigate how municipal wildfire mitigation in other provinces and territories is conducted, as well as identifying whether the factors identified in this study in BC also made those measures successful or unsuccessful.

6.4 Future Research

Further research is needed in several areas. First, there is a need to investigate further whether or not the effects of mountain pine beetle or similar conifer forest diseases have an impact on the development and implementation of wildfire mitigation. Evaluating the effects of mountain pine beetle on both non-innovative and innovative wildfire mitigation in other communities in Western Canada would be valuable in understanding the role that aesthetics play in influencing the success of wildfire mitigation at the municipal level.

There is also a need to consider in more detail the two barriers to municipal wildfire mitigation measures that were identified in this study but have not appeared in previous literature. Restrictions on the disposal of wildfire fuels through burning due to air quality regulations may prevent some communities from effectively mitigating their risk to wildfires. However, this needs to be considered in conjunction with role that air quality regulations have in

mitigating air pollution and the negative respiratory health impacts associated with it.

This is also the case with the lack of access to funds for maintenance – as there currently does not exist a funding option for maintaining a lower level of wildfire risk, many communities must return to higher levels of risk to regain access to funds. It would be of value to investigate if this is the case in other communities as well.

This study also did not explore what would occur if an issue champion were to leave the community. This has implications for the ongoing success of a community's municipal wildfire mitigation measures. For example in Kamloops, where there was a single individual serving as an issue champion, would the mitigation measures continue to succeed without him? More research is needed to see how intertwined issue champions are with the long-term success of municipal wildfire mitigation measures.

It would also be of benefit to return to conduct further research on these communities should they experience a future wildfire event., As identified by Tierney et al. (2001), it is possible that if future experiences with a hazard, such as a wildfire, are mild or relatively minor it may "…lead people to believe that [hazard events] are not really anything to worry about and that preparing is [no longer] necessary" (p166). It is therefore possible that even though a large wildfire event created the opportunity to develop and implement innovative wildfire mitigation, a smaller, less impactful event at a later date may serve to disable or destroy it.

Conducting a similar study using the case study approach with several communities that failed to develop and/or implement wildfire mitigation measures at the local government level would also be of further research interest. Identifying barriers and limitations as well as investigating any factors that influenced the failure of their attempts to implement wildfire mitigation would be very useful in terms of obtaining "lessons learned" from these communities. By identifying and exploring the failure of these wildfire mitigation projects or initiatives through this type of research, recommendations could be made in order to avoid similar situations happening again in other municipalities elsewhere.

At the international level, it would be of interest to compare Canadian approaches to innovative wildfire mitigation at the local government level with similar approaches in countries like the United States, Spain, or Australia. This may highlight other approaches or factors that could increase the likelihood of municipal wildfire mitigation success for Canadian municipalities.

Finally, a long-term study of municipal wildfire mitigation in these two study communities would also be useful to determine the longevity and the sustainability of these types of mitigation measures. Do they continue to be maintained over the long term, or does the momentum behind municipal wildfire mitigation decrease with time? This type of research could yield important insights about maintaining or improving the long-term success of municipal wildfire mitigation measures.

6.5 Chapter Summary

As the effects of climate change continue to be felt across the planet, the importance of hazard mitigation becomes more and more apparent. In terms of wildfire, climate change will only continue to increase the intensity, frequency, and patterns of wildfires globally. This increase in wildfire events combined with the continued expansion of human settlement into the wildland-urban interface highlights the importance of wildfire mitigation. As towns and cities move further into the wildland areas, municipal governments must take steps to manage wildfire risk effectively.

One of the ways to achieve effective municipal wildfire mitigation is to take into account the specific contexts of the community. This often requires innovation, as the current guidelines in Canada for municipal wildfire mitigation are only general guidelines (Partners in Protection, 2003). This study examined two cases where municipal governments developed and implemented innovative wildfire mitigation programs in their local context.

This study sought to identify the factors that influence how and why local governments may choose to develop and implement innovative wildfire mitigation measures. The results of this study will hopefully encourage other local governments to develop and implement *their* own innovative wildfire mitigation measures. It may also help local governments to understand what factors may help or hinder their municipal wildfire mitigation efforts. Finally, this research study may encourage further study to confirm if these factors hold true for other communities, and other environmental hazards.

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Appendix A – Information Sheet

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University of Alberta – Innovative Wildfire Mitigation by Local Governments Information Sheet

My name is Léanne Labossière, and I am a Master's student working with Dr. Tara McGee within the Department of Earth & Atmospheric Sciences at the University of Alberta. As part of a research team based at the U of A, I am completing research into how local governments in Alberta and British Columbia are managing wildfire risks. We would like to invite you to participate in this research by participating in an in-person interview regarding your community's wildfire mitigation measures. The aim of this study is to develop a better understanding of what local governments in BC and Alberta are doing to mitigate wildfire risks.

The interview is anticipated to last approximately 40 minutes and may be completed in your home, in your workplace, or in another public location. With your permission, the interview will be audiotape recorded and all information you provide in the interview will be kept confidential. The names of the interview participants will not be recorded on the interview tape or the transcribed interview notes. The transcribed interview notes will be analyzed and summarized. The results of the study will be presented in the form of a thesis report, conferences, published in an academic journal, and a summary presented to all participants

The information that you provide will be kept confidential. The interview data will be stored both electronically in a password protected file and physically in a locked filing cabinet. It will only be available to the member of the research team. Your participation is voluntary, and you are free to end the interview at any time. You may withdraw from further participation in the project at any time during the data collection phase of the project. In such a case, we will not use any of the information that you provided in the survey. If you would like us to send a copy of the transcribed interview to confirm, clarify, or remove any of the content, please let us know.

If you have any further questions, feel free to contact either myself or my supervisor.

Léanne Labossière, Masters Student, University of Alberta
Email: labossie@ualberta.ca Phone (780) 819-6430

or

Dr. Tara McGee, Associate Professor, University of Alberta
Email: tmcgee@ualberta.ca Phone (780) 492-3042

Appendix B – Letter of Introduction

Letter of Introduction
Good day,

My name is Léanne Labossière, and I am a Master's student working with Dr. Tara McGee within the Department of Earth & Atmospheric Sciences at the University of Alberta. As part of a research team based at the U of A, I am completing research into how local governments in Alberta and British Columbia are managing wildfire risks. We would like to invite you to participate in this research by participating in an in-person interview regarding your community's wildfire mitigation measures. The aim of this survey is to develop a better understanding of what local governments in BC and Alberta are doing to mitigate wildfire risks.
The information that you provide will be kept confidential. The interview data will be stored both electronically in a password protected file and physically in a locked filing cabinet. It will only be available to the member of the research team. Your participation is voluntary, and you are free to end the interview at any time. You may withdraw from further participation in the project at any time during the data collection phase of the project. In such a case, we will not use any of the information that you provided in the survey. If you would like us to send a copy of the transcribed interview to you, please let us know.

If you have any questions or concerns regarding this interview, please feel free to email either Léanne Labossière at labossie@ualberta.ca or Tara McGee at tmcgee@ualberta.ca or (780)492-3042.

Appendix C – Informed Consent

UNIVERSITY OF ALBERTA
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Informed Consent

Research Project: Taking it into their own hands - Innovative wildfire mitigation techniques by local governments

Investigators:

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	Yes	No
Do you consent to being audiotaped?		
Do you understand that you have been asked to participate in a research study?		
Have you read and received a copy of the introduction letter?		
Have you had an opportunity to ask questions to discuss this study?		
Do you understand that you can withdraw from participation in this project at any time before the data is analyzed?		
Has confidentiality been explained to you?		
Do you understand who will have access to the information that you provide?		
Do you understand what the information you say will be used for?		

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I agree to take part in this study:

This study was explained to me by _____

Printed name of research participant _____

Signature of participant _____

Date: _____

Printed name of researcher_____

Signature or researcher _____

Date _____

Appendix D – Interview Guide

Interview Guide

Innovative wildfire mitigation measures implemented by local governments

Introduction:

My name is Léanne Labossière, and I am a graduate student at the University of Alberta. As part of my Masters project, I am conducting a study on innovative mitigation techniques implemented by communities in Alberta and British Columbia. You recently completed a survey where I identified that your local government is implementing innovative wildfire mitigation measures. In order to follow-up to that survey, I am now looking to learn more about selected cases where local governments have developed innovative approaches to wildfire mitigation.

The information obtained from this interview will be transcribed and returned to you for your approval. If there is something in the transcript that you are uncomfortable with, you can ask for it to be removed.

This interview will take approximately one hour to complete, and will be audio recorded. If at any time you would like to pause or stop the interview, please let me know and I will cease recording and taking notes.

I have previously spoken with these _____ members of your community prior to your interview.

Background & Community:

What is your position within the local government?

How long have you been in this position?

How long have you been a member of this community?

What experiences, if any, has your community had with wildfires in the last twenty-five years?

- ➔ **Prompts: What happened? What type of incident was it? How was it caused?**

What impacts, if any, has your community felt from wildfires?

How much of a risk, in your opinion, do wildfires pose to your community?

Do you feel that your community is close-knit? Why or why not?

Describe the communication between community leaders and residents in regards to wildfire mitigation.

Mitigation & Innovation

In your opinion, what does mitigating for wildfires mean?

Who do you believe is responsible for mitigation in your community?

How important is wildfire mitigation to your local government? To your council?

- ➔ **Prompts: Do you feel that local government officials are informed about wildfire risk and mitigation?**

How important is wildfire mitigation to local residents?

- ➔ **Prompts: Do you feel that local residents are informed about wildfire risk and mitigation? Do local residents voluntarily implement their own wildfire mitigation?**

Did your community have any type of mitigation procedures in place before previous wildfires?

- ➔ **Prompts: What were they? Why did you have them? Did they work? What worked/didn't work?**

In your own words, what are the innovative wildfire mitigation meaures currently in place in your community?

How did these innovations come about?

- ➔ **Prompts: What prompted the development of these measures?**

How did your local government develop them?

Why did your local government develop them?

Who was involved with the development of these wildfire mitigation measures?

- ➔ **Prompts: Where different levels of government involved? Did you receive assistance or support from external groups/governments? Are you working with any industrial partners? Any local partners?**

How was the development of these measures funded?

- ➔ **Prompts: internal (locally)? externally?**

Were there any factors that made it difficult for your municipality to implement these mitigation measures?

Do you feel that these mitigation measures are supported within the community? Why or why not?

Do you feel that these measures have been successful for your community?

- ➔ **Prompts: What factors make these measures successful in your community?**

How do you and your community intend to proceed with wildfire mitigation in the future?

How do you *feel* about your community's wildfire mitigation efforts?

- ➔ **Prompts: Positive or negative emotions? Ambivalence?**

Is there anything else you would like to add?

Is there anyone else you can recommend that I speak to in regards to your community's wildfire mitigation measures?

Would you like a copy of the results once the study is completed?

Thank you again very much for participating in this interview. If you have any concerns or wish to get in contact with me, I can be reached at 780-819-6430 or labossie@ualberta.ca

Again, thank you for taking the time to participate in this interview.

- *Léanne Labossière*