

**Foothills Model Forest**

**March 2005 Final Report**

**Project title:** An Exploration of Wildfire Risk Reduction Within Communities Directly Affected by the Lost Creek Fire in 2003

**Authors:** Tara McGee (Principal Investigator)<sup>1</sup>, Bonita McFarlane (Co-investigator)<sup>2</sup>, Jeji Varghese (Research Assistant)<sup>3</sup>

<sup>1</sup> Department of Earth and Atmospheric Sciences, 1-26 ESB

University of Alberta, Edmonton, AB Canada T6G 2G8

Phone: (780) 492-3042

Fax: (780) 492-2030

Email: tmcgee@ualberta.ca

<sup>2</sup> Natural Resources Canada

Canadian Forest Service, Northern Forestry Centre

5320 – 122 Street

Edmonton, AB Canada T6H 3S5

Phone: (780) 435-7383

Fax: (780) 435-7359

Email: bmcfarla@nrcan.gc.ca

<sup>3</sup> Department of Earth and Atmospheric Sciences, 1-26 ESB

University of Alberta, Edmonton, AB Canada T6G 2G8

Phone: (780) 492-5880

Fax: (780) 492-2030

Email: [jeji@ualberta.net](mailto:jeji@ualberta.net)

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## Executive Summary

Many Canadians were affected by wildfires during the summer of 2003. In Southern Alberta, the Lost Creek Fire burned 22,000 hectares, and affected communities in the Municipality of Crowsnest Pass and Municipal District of Pincher Creek. Hillcrest, Blairmore, and Castle Mountain Resort were at risk. Approximately 2,000 residents were evacuated and no homes or business structures were lost. This study was completed to examine how experience with the Lost Creek fire affected local residents' and community leaders' perceptions of wildfire risk, knowledge, and willingness to engage in risk reduction activities. The research team also conducted a similar study in BC, with similar results. Another report, submitted to Public Safety and Emergency Preparedness Canada (PSEPC) draws on results from BC and Alberta. This report presents the detailed results of our study of communities affected by the Lost Creek fire.

This qualitative study focused on four communities – Blairmore and Hillcrest in the Municipality of Crowsnest Pass; and Beaver Mines and Castle Mountain in the Municipal District of Pincher Creek. Semi-structured interviews were completed with 20 residents and 13 municipal officials in July and August 2004. Thematic qualitative analysis was completed using NVivo® qualitative software program to handle the interview data.

The five research objectives were to:

1. Identify post-fire perceptions of wildfire risk amongst a sample of residents and relevant municipal officials;
2. Identify the extent to which risk reduction activities were known, understood, and applied by local residents and municipal officials before and during the Lost Creek fire;
3. Identify whether residents and municipal officials have already, or intend to apply known risk reduction measures during the post-fire recovery period;
4. Examine the role of knowledge and risk reduction actions in reducing vulnerability to the Lost Creek fire and ability to recover post-fire; and
5. Identify obstacles and incentives to implementation of risk reduction activities at household and community levels.

After the Lost Creek fire, a majority of participating residents and municipal officials perceived a high wildfire risk in the area, or a reduced but still prevalent risk. Only six participating residents perceived

there to be a low wildfire risk, which was based on their observations of the large extent of areas burned in the Lost Creek fire (thus low fuels in the area), the perceived infrequency of large fires, the perceived infrequency of hot and dry summers, or a combination of these factors.

Before the Lost Creek fire, only a few risk reduction activities recommended by the FireSmart program were known and applied by participating residents and municipal officials. Activities that appear to have been known included keeping woodpiles away from the sides of homes, mowing grass and de-limbing trees. Many individuals who were aware of risk reduction activities had a low perception of the wildfire threat before the fire and they had not undertaken many risk reduction activities. There was a slight increase in residents' knowledge of risk reduction activities during the fire and an increase in the risk reduction activities undertaken on their properties. These activities focused primarily on installing water systems, keeping lawns green and properties wet, and removing flammable materials away from structures. Very few community-level activities were implemented before and during the 2003 fires. Before the fires, the focus of wildfire management was on emergency planning and some cross training between local fire departments and provincial agencies (thus mainly related to fire suppression rather than fire risk reduction). During the fire, the focus of community-level risk reduction was mainly on vegetation management in the form of fireguards and sprinkler systems. There was limited public education conducted by municipal agencies before and during the fire. Bylaws and legislation, such as restrictions through zoning of where and how homes could be built, were not in place before the Lost Creek fire.

During the post-fire recovery period, though many residents and municipal officials had already or intend to apply known risk reduction measures, the activities being undertaken by residents were still limited to a few of the possible recommended risk reduction measures. The most common type of activities undertaken by residents were landscaping (thinning and de-limbing trees, and keeping lawns mowed), moving firewood and flammables away from the house, practicing responsible burning, and developing a fire evacuation plan. At the time of our interviews, municipal officials appeared to be aware of the range of possible community-level risk reduction activities that may be undertaken, and had taken steps to incorporate or at least consider incorporating them into their wildfire management.

Although our resident respondents appeared to have a higher level of awareness of the nature of wildfires, and were more aware of recommended risk reduction activities during the post-fire interviews, this knowledge did not necessarily translate into a perception that there was a high risk of wildfires nor a high level of implemented risk reduction activity. Lack of knowledge of risk reduction activities does appear to decrease the adoption of risk reduction activities, but high levels of knowledge does not *necessarily* result in high levels of risk reduction actions being implemented.

Management implications of the study focus on public education, tailoring residential risk reduction activities, incentives and community-level mitigation strategies. Our finding that a lack of knowledge appears to decrease the adoption of risk reduction activities indicates that providing information is important to ensure that residents are aware of risk reduction activities. Whether residents choose to implement activities appeared to be influenced by a number of factors, including perception of wildfire risk (partly due to the home's proximity to forested and recently burned areas); willingness to accept risks; alignment of activities with their values/needs (privacy, wildlife, aesthetics, healthy forests); and personal constraints (such as time, money, access to water). Risk reduction measures that incorporate the needs and values of relevance to homeowners are more likely to be accepted by residents. One strategy might be to incorporate a range of expertise into fire management plans, such as landscape architects, who would be able to recommend residential landscaping that help to reduce wildfire risks without compromising homeowner values. Another strategy is to emphasize the multiple benefits of risk reduction activities on education messages. For example, fuels modification on properties may create wildlife habitat, improve forest health, and increase biodiversity; and structural changes to roofs and windows may improve energy efficiency and provide cost savings in the long-term.

Financial constraints may make it difficult for more costly recommended measures to be adopted by some residents; therefore, financial incentives may be appropriate in some cases. Incentives such as a subsidy to help cover costs may encourage some residents to implement these recommendations. Conflicting municipal government regulations may also impede the implementation of risk reduction measures by homeowners. In addition, it appears that some residents are willing to accept the wildfire risks associated with living in the wildland-urban interface, and are not willing to adopt all recommended risk reduction measures, even though they acknowledge the risk and know how to implement the risk reduction measures.

Community-level FireSmart plans should be formulated as a comprehensive strategy with clear responsibilities for provincial government, municipal government, and the homeowner to counter the view that governments are attempting to decrease their responsibilities for fire management through fire suppression. All three of these groups should be involved throughout all stages of plan development. Financial assistance for community-level activities and maintenance would be helpful, particularly to sustain such activities over time.

In conclusion, this study shows that not all residents will adopt risk reduction activities post-fire. The adoption of risk reduction activities is based on a complex suite of factors, including values, constraints, risk perceptions and knowledge. In addition, responsibility for risk management should be shared and integrated at landscape, community and residential levels.



# Table of Contents

<b>1.0</b>	<b>Introduction .....</b>	<b>1</b>
<b>2.0</b>	<b>Methods.....</b>	<b>2</b>
2.1	Site Selection.....	2
2.2	Participant Selection .....	2
2.3	The Participants .....	4
2.4	The Interviews.....	4
2.5	Data Analysis.....	5
<b>3.0</b>	<b>Findings.....</b>	<b>5</b>
3.1	Perceptions of Wildfire Risk.....	5
3.1.1	Resident participant’s perceptions.....	5
3.1.2	Participating municipal official perceptions.....	7
3.2	Risk Reduction Activities Known and Implemented Before and During the Lost Creek Fire 7	
3.2.1	Household activities before the fire.....	7
3.2.2	Household activities during the fire .....	8
3.2.3	Community activities before and during the fire .....	9
3.3	Risk Reduction Activities Known and Implemented in Post-Fire Recovery .....	9
3.4	Role of Knowledge and Risk Reduction Actions in Reducing Vulnerability .....	12
3.5	Factors Influencing Adoption of Risk Reduction Activities .....	14
3.5.1	Adoption of household activities.....	14
3.5.1.1	Factors that may hinder adoption of activities .....	14
3.5.1.2	Factors that may enhance adoption of activities .....	17
3.5.2	Adoption of community activities .....	18
<b>4.0</b>	<b>Management Implications.....</b>	<b>20</b>
4.1	Public Education.....	20

4.1.1	Communicating with the public .....	20
4.1.2	Messages to be communicated.....	20
4.2	Tailor Risk Reduction Activities.....	21
4.3	Community-Level Mitigation .....	22
4.4	Incentives.....	23
<b>5.0</b>	<b>Conclusions .....</b>	<b>23</b>
<b>6.0</b>	<b>References.....</b>	<b>25</b>

<b>Appendix A – Interview Guides.....</b>	<b>A-1</b>
Resident Interview Guide.....	A-1
Municipal Official Interview Guide .....	A-10
<b>Appendix B – Method of Rating Level of Knowledge and Impact of Risk Reduction Activities .....</b>	<b>B-1</b>

## 1.0 Introduction

The forested landscape in Canada is changing as human communities expand further into the wildland–urban interface (WUI)<sup>1</sup>. In recent years, the frequency and severity of impacts of wildfires have increased in Canada, putting human communities at risk. Climate change scenarios suggest that the frequency and severity of wildfire is likely to continue well into the 21<sup>st</sup> century (Weber and Flannigan 1997), potentially increasing the risk to WUI communities. Fire management agencies are considering proactive management strategies directed at the WUI to reduce the threat to private property and human life. The success of proactive management at the WUI depends, largely, on individual homeowners and communities' willingness to support and engage in risk reduction activities. It is unclear, however, how property owners and communities in Canada perceive the threat of wildfire, their preferences for community and landscape level risk reduction, or their willingness to use risk reduction measures on their own properties.

The 2003 fire season had devastating consequences in many areas of Canada, including in the Crowsnest Pass and Pincher Creek area in southern Alberta (AB). In the Lost Creek Fire, 22,000 hectares were burned, three communities (Hillcrest, Blairmore, and Castle Mountain Resort) were at risk, about 2,000 residents were evacuated, but no homes or businesses were lost.

This study commenced one year after the Lost Creek fire, and aimed to examine the impact of this recent fire event on risk perceptions, knowledge of risk reduction activities, and willingness to engage in such activities.

The research objectives were to:

1. Identify post-fire perceptions of wildfire risk amongst a sample of residents and relevant municipal officials;
2. Identify the extent to which risk reduction activities were known, understood, and applied by local residents and municipal officials before and during the Lost Creek fire;
3. Identify whether residents and municipal officials have already, or intend to apply known risk reduction measures during the post-fire recovery period;
4. Examine the role of knowledge and risk reduction actions in reducing vulnerability to the Lost Creek fire and ability to recover post-fire; and

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<sup>1</sup> The wildland-urban interface is an area where forest and other vegetative fuel types meet or are intermingled with structures such as private homes or other human developments.

5. Identify obstacles and incentives to implementation of risk reduction activities at household and community levels.

The research team also conducted a similar study in communities affected by the McLure fire in BC, with similar results. Another report, submitted to Public Safety and Emergency Preparedness Canada (PSEPC) draws on results from the BC and Alberta studies. This report presents the detailed results of our study of communities affected by Alberta's Lost Creek fire.

## **2.0 Methods**

The case study approach was used for this project, since it is appropriate for exploratory research to “investigate a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident” (Yin, 1984:23). The use of semi-structured interviews provided a means to examine, in detail, the different contexts within which risk reduction decision-making and actions occur, and to identify the language used by local residents and community leaders in discussing wildfire risk reduction. The case study approach, however, does not enable extrapolation of the findings to the population.

### **2.1 Site Selection**

The project team met with members of the Lost Creek Research Advisory Group, and councillors and fire chiefs of the Municipality of Crowsnest Pass and Municipal District of Pincher Creek, at the Municipality of Crowsnest Pass Council Chambers on June 9, 2004, to obtain information on the fire and the communities affected. This meeting also provided an opportunity to discuss the focus of the interviews and receive input on the interview questions. Based on this meeting, initial discussions with key contacts, and a review of local media coverage of the fire, the communities of Blairmore and Hillcrest in the Municipality of Crowsnest Pass, and Beaver Mines and Castle Mountain in the MD of Pincher Creek, were selected for the study.

### **2.2 Participant Selection**

To ensure a range of experiences and opinions were represented among the resident participants, sample selection was guided by a set of criteria, which included length of residence in the community, proximity to forested areas, experience with the Lost Creek fire (e.g., evacuated, not evacuated), type of residence (seasonal or permanent), and home ownership (See Table 1). Resident interview participants were obtained by several methods. Using the selection criteria as a guide, potential participants were identified via recommendations from municipal government and provincial government contacts, a review of media coverage of the fire, and using the local phone book to identify people living in the communities/streets of interest. In addition, a snowball sampling technique was used, whereby

participants recommended other residents who may be interested in participating in the study. Most potential participants were initially contacted by phone and an interview time was set up. Of the residents interviewed, ten resulted from resident recommendations, four from municipal contact recommendations and six from other means.

**Table 1. Resident Participant Selection Criteria**

Criteria
▪ Residents with homes within forested areas & those backing onto forested areas
▪ Residents who were evacuated and residents who were not evacuated
▪ Residents with home businesses and residents without home businesses
▪ Long-term residents and newer residents
▪ Residents in large homes and residents with smaller homes
▪ Residents who were in their homes during the fire & residents who were out of town during the fire
▪ Seasonal residents and permanent residents

Municipal officials were identified through a variety of means, including a review of local media coverage of the Lost Creek fire, and the Crowsnest Pass and Pincher Creek websites. Additional municipal officials were identified through the snowball sampling method.

### 2.3 The Participants

Thirty-three interviews were conducted from July 19 to Aug 7, 2004. These included:

- 13 municipal official interviews, including individuals from the Municipality of Crowsnest Pass and the MD of Pincher Creek; and
- 20 resident interviews: 10 from the MD of Pincher Creek, 10 from the Municipality of Crowsnest Pass. Of those residents interviewed, there were:
  - 11 residents with homes within forested areas or backing into forested areas;
  - 10 residents who evacuated and 9 residents who did not evacuate;
  - 3 residents with homes businesses;
  - 8 long-term residents (~20 years) and 7 newer residents (<5 years);
  - 10 residents in large homes and 9 residents with smaller homes<sup>2</sup>;
  - 5 seasonal residents and 15 permanent residents; and
  - 1 resident who was not in their seasonal residence during the fire.

### 2.4 The Interviews

The resident interviews were conducted in the interviewee's home, and municipal official interviews were conducted in the interviewee's workplace. Most interviews were conducted with one participant, however, in six resident interviews, the participant's spouse or relative joined the interview. These pair interviews were counted as one interview, unless otherwise indicated in the findings section. Resident interviews ranged from 30 to 90 minutes, and municipal official interviews ranged from 30 to 60 minutes long.

Interviews were semi-structured in nature (See Appendix A for Interview Guides). Interviews were tape-recorded with approval from participants. In accordance with the University of Alberta's human ethics requirements, all participants were informed about the nature of the research and relevant ethical issues in an introductory letter that was provided to participants before the interview commenced. Participants were then asked if they had read and understood the letter, any issues related to their participation in the study were discussed, and participants were then asked to sign a consent form. In the letter, participants were informed that their participation was voluntary, and that they were free to withdraw from the study at any time and that any data obtained from them would then not be used.

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<sup>2</sup> Large homes include two story homes or large bungalows. Small homes include trailer homes or small bungalows.

Confidentiality of participants' responses was maintained throughout the study and in the presentation of results.

In addition to the taped interviews, field notes were made after the interviews. Field notes covered additional comments not mentioned on tape, as well as observations made by the interviewer. These field notes were imported into the qualitative data analysis software as memos for each transcript. In addition, a table of interviewee characteristics (covering the sampling criteria) also accompanied the transcripts into the qualitative software, as document attributes.

## **2.5 Data Analysis**

Interviews were professionally transcribed, verbatim. After being transcribed, each transcript was verified against the tapes by the interviewer to ensure accuracy. Computer-assisted data analysis was conducted with NVivo®, a software program used to handle textual qualitative data. 'Headers' added to semi-structured interview transcripts aided in automating the initial coding process whereby interviews were broad-brush coded with topics that parallel the semi-structured interview guide. The interviews were split into two sets, one containing the municipal official interviews, the other containing the resident interviews. For each set, the interviewer then refined each of the broad-brush codes, grouping similar responses into a single category. The next level of analysis involved comparisons across themes and cases, particular attention was given to the impacts that interviewee attributes might have on a given theme. Assay tables and search functions were used to help identify patterns in the data, such as the impact of knowledge on vulnerability.

## **3.0 Findings**

These findings focus on each of the five research objectives stated in the introduction.

### **3.1 Perceptions of Wildfire Risk**

#### **3.1.1 Resident participant's perceptions**

There were mixed perceptions of the risk from wildfire, following the wildfire. In terms of the risk perceived at the time of the interviews, some resident participants perceived a low wildfire risk (n=6), some perceived a high risk (n=8), and others perceived a reduced though still prevalent risk (n=6).

Those who perceived a low risk of wildfire attributed this to the large extent of burned areas; the infrequency of large fires; the infrequency of hot, dry summers; or a combination of these factors. Due to the large areas burned in the Lost Creek wildfire, many participating residents felt that the fuel load in

the area had decreased substantially. In the words of one resident *“Well, I don’t think we have much risk anymore. I mean everything’s burnt that way and I don’t think that they just start, you know, every year.”*

Many of the participants who perceived a high risk of wildfire attributed the risk to the large treed areas that remained untouched by the wildfire. These areas were described as areas ‘primed for a wildfire’, due to tree age and high amounts of underbrush. As one resident commented, *“I’m still concerned, very concerned, especially the north side of the highway...it is apparently about 75 years old in the forest.”* Others said that high risk depends on the weather. A comment by a resident shows this connection of fuel load with weather:

*I feel that the risk is intensifying, we've had a wet spring and early summer but things are dry now. If you look across here at the valley [at] all those trees snapped off in the storm of 2002...So there's a lot of downed fuel, there's a big build-up of fuel, so we're quite concerned... Personally I'd like to see a fire ban come on here again in the near future unless it rains.*

Participants who perceived a reduced but still prevalent risk attributed this to a high amount of fuel accumulated on the forest floor. Quoting one resident, *“I think it's still there, not as great [a risk] as it was last year... I think the risk has lowered, but it's still there.”*

In addition to the risk at the time of the interviews, participating residents were also asked to indicate their perceptions of the wildfire risk over the next few years. One quarter of the participants (n=5) indicated that future wildfire risk depends on a variety of factors including weather, fuel load, fire suppression, and fire risk reduction activities (such as vegetation management around the communities). The remaining participating residents’ perceptions of future wildfire risks were split between an increasing risk (n=4), a high risk (n=2), a decreasing risk (n=1) and a low to minimal risk (n=2). Participants perceiving an increasing or high risk over the next few years attributed the risk to human activity within the forest and the high fuels in the forest. Participants perceiving a decreasing or low risk over the next few years attributed their assessment to the long time required for the forest to regenerate.

Analysis of our data indicates that for nine of our resident participants, awareness of a high wildfire risk remained constant before, during, and after the Lost Creek fire. In nine other cases, resident participants were more aware of the potential for wildfires to affect their community after experiencing the Lost Creek fire, but their perception of this risk varied. For example, at the time of their interview,

three of these residents felt that the current wildfire risk was high, and four felt that the wildfire risk was low.<sup>3</sup>

### **3.1.2 Participating municipal official perceptions**

Participating municipal officials perceived a higher current wildfire risk than our sample of residents. In contrast to the resident participants, ten of the thirteen participating municipal officials perceived a high level of risk; and one perceived a reduced, but still prevalent risk. One municipal official who discussed the potential risk of wildfires over the next 5 to 10 years commented that

*Even with all the moisture that we've had, it's still dry back there...I think that people think "oh well, we've had our fire" No, no that doesn't mean anything. There is still a lot of growth there and it's dry...So it's something you have to be aware of, no different than BC having those fires again.*

The two remaining municipal officials stated that since weather patterns fluctuate, the risk would fluctuate as well. High levels of perceived risks were attributed to weather and fuel load by these two participants. No municipal officials perceived a low level of risk post-fire. Although there was some variation amongst participating municipal officials, most perceived there to be an ongoing risk over the next five to ten years, attributed to the large amount of forest fuel available and increasing activity in the forest such as off-road vehicle use and random camping.

## **3.2 Risk Reduction Activities Known and Implemented Before and During the Lost Creek Fire**

### **3.2.1 Household activities before the fire**

Just over half of the resident participants mentioned receiving information before the Lost Creek fire about activities that can be undertaken at the household level to reduce wildfire risk. Sources of this information included local fire departments (n=3), provincial government departments such as Alberta Sustainable Resource Development (n = 3), word of mouth (n = 3), training received at work (n = 1), and the media (n = 1). One participant was not sure of where they received their information, stating that it is just "common sense", which includes experiential learning and local knowledge.

In general, before the Lost Creek fire, participating residents appeared to know of only a few activities from the entire suite of possible risk reduction measures recommended by programs like FireSmart. Risk reduction activities that participating residents were aware of prior to the fire included keeping wood piles away from the sides of the house (n=5); landscaping such as removing deadfall, and de-limbing trees (n=3); and using non-flammable roof and siding materials (n=3). Other activities that participants

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<sup>3</sup> Two respondents did not provide this information.

were aware of included watering lawns and putting sprinklers on roofs (n=4); burning at appropriate times and in appropriate places with resources on hand to ensure fires are controlled (n=1); and keeping yards clean of debris and garbage (n=1). When asked if they understood how to make these changes on their property, no one indicated difficulty in doing so. Eight of the twenty participating residents mentioned that they were not aware of household risk reduction activities that could be undertaken prior to the Lost Creek fire, and were thus unaware of how to reduce risks from wildfires to their homes.

Twelve resident participants reported undertaking risk reduction activities on their properties before the Lost Creek fire. Of the suite of possible recommended risk reduction measures, only a few activities were undertaken. These twelve residents reported completing landscaping, such as mowing lawns and de-limbing trees (n = 8); keeping lawns green (n = 1); choosing appropriate building materials, such as metal roofs and fire resistant decks (n = 4); and storing potential fuels such as firewood and flammable materials away from the home (n = 2). Other risk reduction activities that were mentioned included practicing responsible burning (n = 6) and being diligent about keeping yards clean of debris and garbage (n = 2). Only five resident participants indicated that they had not undertaken any risk reduction activities before the fire.

Our analysis does not reveal any clear patterns between pre-fire perceptions of wildfire risk and those who applied these recommendations, in part, because those who applied risk reduction activities tended to do them for other reasons than fire (e.g., aesthetics). Many individuals who were aware of risk reduction activities had a low perception of the wildfire threat before the fire, and had not undertaken many risk reduction activities.

### **3.2.2 Household activities during the fire**

Over half of the participating residents mentioned learning of new household risk reduction activities during the fire. Sources of this new risk reduction information included Alberta Sustainable Resource Development (n = 6), the local fire department (n = 4) and the media (n = 2). Other sources of information included word of mouth (n = 1), municipal government (n = 1), and local ski hill management in the case of Castle Mountain (n = 1).

For the thirteen participating residents who indicated that they had received risk reduction information during the fire, the activity that most participants became aware of during the wildfires was to keep the home and surrounding area wet during a fire (i.e., hosing down and installing sprinklers). Participants also became aware of using different building materials for their home, and storing firewood and other flammable materials away from the house. No participants expressed difficulty in understanding how to make the suggested changes to their properties. Seven of the participants indicated that they had not gained any new information about risk reduction activities during the fire.

Fifteen participating residents indicated that they had implemented at least one risk reduction activity during the Lost Creek fire. The most common types of activities were installing water systems, such as hoses and sprinklers (installed by firefighters or by the residents themselves) (n = 9); moving firewood and flammables away from the house (n = 6); landscaping, such as thinning and de-limbing trees and mowing the lawn (n = 3); and keeping lawns green and properties wet (n = 2).

### **3.2.3 Community activities before and during the fire**

Very few community-level risk reduction activities were implemented before and during the Lost Creek fire. Before the fire, the focus of wildfire risk reduction was on emergency planning in the Crowsnest Pass, and some cross training between local fire departments and Alberta Sustainable Resource Development was completed in Crowsnest Pass and Pincher Creek. During the fire, the focus was on fireguards set up by the Municipality of Crowsnest Pass and sprinkler systems set up by the local fire departments at homes that were considered at high risk.

Limited public education was conducted before and during the Lost Creek fire in the MD of Pincher Creek and Municipality of Crowsnest Pass. Before the wildfire, the fire departments would conduct housing risk assessments for interested residents, in addition to a bi-annual fire safety public education campaign. During the fire, the fire departments conducted housing risk assessments for their jurisdictions and provided risk reduction information to the homeowners of properties that fire departments identified as being at high risk. Building requirements in Castle Mountain Resorts require metal roofs, but the feeling was that this was accomplished more because of the heavy snow accumulation rather than for fire reasons. Bylaws and legislation, such as restrictions through zoning of where and how homes could be built, was not initiated before or during the fire. Therefore, many community-level activities could be undertaken in order to reduce the vulnerability of these communities to future wildfires.

### **3.3 Risk Reduction Activities Known and Implemented in Post-Fire Recovery**

Interview participants indicated that since the Lost Creek fire, risk reduction information has been provided to local residents and municipal officials through provincial agencies, word of mouth, the media, and a trade fair. Participating residents reported learning new activities including landscaping, such as thinning<sup>4</sup> and de-limbing trees, and keeping lawns mowed (n=3); followed by building materials, such as having metal roofs and siding construction (n=2); keeping yards clean of debris, (e.g. raking up

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<sup>4</sup> Thinning involved cutting trees; and de-limbing involves taking branches off trees to prevent them from being ladders for fires to climb into the canopy.

last year's leaves and clearing dead standing trees) (n=1); and keeping lawns green (n=1). Nine of the 20 resident participants said they had learned no new risk reduction activities since the fire. Two participants simply stated that the 2003 fire had increased their awareness of risk reduction activities, without stating specific activities that they had learned. When asked about whether participants understood how to make the changes on their property, none of the participants indicated that they had difficulty understanding the information provided.

At the time of our interviews, many participating residents had already or intended to apply known risk reduction measures during the recovery period. Since the Lost Creek fire, the most common type of activity undertaken was landscaping, including thinning and de-limbing trees, keeping lawns mowed, and putting gravel around the home (n=9); moving firewood and flammables away from the house (n=4); practicing responsible burning (n=3); and developing a fire plan or fire evacuation plan (n=4). Seven of 20 participating residents indicated that they had not undertaken any new risk reduction measures since the fire.

During data analysis, participating residents' knowledge of risk reduction activities was rated along a scale from 0<sup>5</sup> (no knowledge) to 5 (high level of knowledge). Ten<sup>6</sup> of the resident respondents were rated as having a knowledge level of 5, three were rated at a level of 4, two were rated at a level of 3, three were rated at a level of 2 and one was rated at the lowest level of 1. The levels of risk reduction activity completed by residents were also rated along a scale from 'high', 'moderate' and 'low', based on the impact<sup>7</sup> of the activities in reducing the risk. Refer to Appendix B for more details on these scales. Activities undertaken by two resident respondents were categorized as high. Activities undertaken by ten resident respondents were categorized as moderate; and eight respondents were categorized as having undertaken no activities or very few, low impact activities. Table 2 summarises residential activity levels undertaken before, during and after the Lost Creek Fire.

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<sup>5</sup> A respondent rated with a low level of knowledge mentioned one example of a risk reduction activity (i.e. plant deciduous trees around the home), whereas a respondent rated with a high level of knowledge mentioned most of the recommended risk reduction activities (such as structural changes, moving flammables away from structures, removing underbrush, thinning trees, not being a source of fire). For more details, refer to Appendix B.

<sup>6</sup> One respondent's knowledge level was not grouped due to insufficient data to make an assessment.

<sup>7</sup> The FireSmart Manual checklist rating system (Partners in Protection, Second Edition: 9-11) of household risk reduction activities was used as the basis for this impact rating. Activities such as removing vegetation and deadfall from around their homes, and installing a metal roof were rated as high. Activities such as thinning shrubs and de-limbing trees around the homes were rated as moderate. Finally, activities such as having fire resistant windows, moving woodpiles away from structures, cleaning eaves and gutters, having wood or vinyl siding are each rated low. These ratings reflect the number of points that each of these activities was awarded in the FireSmart checklist. See Appendix B for more details.

**Table 2: Comparison of Household Risk Reduction Activities Implemented Before, During and After the 2003 Lost Creek Fire by Interview Participants**

Before the Wildfire	During the Wildfire	After the Wildfire
<ul style="list-style-type: none"> <li>▪ A few implemented no risk reduction measures.</li> <li>▪ Most implemented a few activities, but these activities generally had a low overall impact on risk reduction.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Focused on keeping property wet.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Some implemented no new risk reduction measures.</li> <li>▪ Others implemented activities with a range of low, moderate and high impact.</li> <li>▪ Only a few of all recommended activities were implemented.</li> </ul>

An analysis of homeowner risk perception before, during, and after the fire, and risk reduction activities implemented throughout these three periods was used to identify the relationship between risk perception and risk reduction activities. This analysis indicates that of the seven residents who had implemented no to low impact risk reduction activities before, during or even after the fire, all were aware of the high wildfire risk potential post fire, but two of them assessed the current (at the time of the interview) level of risk as low. The two residents, who were rated as having implemented a ‘high’ level of risk reduction activities, were recent homebuilders with large homes and lived in their home for less than 6 years.

During our interviews in the recovery period, municipal officials appeared to be very aware of the range of possible community level risk reduction activities that they could undertake within their area of responsibility, and had undertaken steps to incorporate them into their wildfire management. Alberta Sustainable Resource Development had been involved with the Municipality of the Crownsnest Pass to advocate for a community FireSmart program that includes fuel management around the perimeter of the municipality. The Municipality of Crownsnest Pass and MD of Pincher Creek were involved in promoting residential FireSmart programs by having the FireSmart pamphlets available in their offices at the time of our study. The Municipality of Crownsnest Pass and MD of Pincher Creek were also examining their land-use bylaws to assess which could be changed to incorporate wildfire risk reduction recommendations. Table 3 summarizes the types of community level activities undertaken before, during and after the Lost Creek fire.

**Table 3: Comparison of Community-Level Risk Reduction Activities Before, During and After the 2003 Lost Creek Fire**

<b>Activities:</b>	<b>Before the Wildfire</b>	<b>During the Wildfire</b>	<b>After the Wildfire</b>
<b>Vegetation Management</b>	▪ None	▪ Fireguards	▪ Community Plan
<b>Public Education</b>	▪ Minimal	▪ House Risk Assessments ▪ Residential FireSmart	▪ Residential FireSmart
<b>Structural Controls</b>	▪ Minimal	▪ Sprinklers	▪ Review bylaws
<b>Legislation</b>	▪ None	▪ None	▪ Review Acts

### **3.4 Role of Knowledge and Risk Reduction Actions in Reducing Vulnerability**

During our interviews, our resident participants appeared to have a good level of knowledge about natural and human causes of wildfires. Many participants indicated that they were aware of factors affecting the spread of fires, and overall, there appeared to be a high awareness of local wildfire risks. All of our participating residents mentioned weather (dry, hot conditions) as one variable contributing to the spread of fire. Fourteen of the participating residents noted the role of the fuel load, type of fuels, and age of the timber in the forest. Five participating residents spoke of the lack of initial attack and slow fire management response, or lack of community-level risk reduction activities, such as fireguards and controlled burns, as other variables contributing to the spread of fire. Only one resident spoke about the role of topography in contributing to the spread of wildfire. During our post-fire interviews, sixteen resident participants indicated that they felt the wildfire was predictable due to dry and hot weather, fuel load, activities by members of the public that could cause a wildfire, and a historical presence of forest fires in the area, although some commented that the predictability only was in hindsight. Four resident participants commented that they would not have predicted the 2003 fire. The relatively high level of awareness of the nature of wildfires did not translate into a perception of high wildfire risk or a high level of risk reduction activities.

As discussed in section 3.2.1, before the wildfire, residents had a low level of awareness of the suite of recommended risk reduction activities, such as those found in the FireSmart manual. Before the fire, few participating residents had received risk reduction information from external sources, and no participating residents had applied the entire suite of risk reduction activities recommended within FireSmart (see section 3.1 and 3.2 for the most common activities undertaken prior and during the fire,

respectively). Importantly, the most common activity undertaken before the fire (landscaping, such as mowing lawns and de-limbing trees) was not identified as a risk reduction method by many of those who had undertaken the activities. In other words, residents undertook these activities for reasons other than reducing the risk from wildfire, and decisions to undertake the activities were not based on knowledge of their potential to reduce wildfire risk.

Knowledge of wildfires, awareness of wildfire risk and risk reduction activities gained through experiencing the wildfire encouraged many participating residents to reduce their vulnerability to future fires by implementing some risk reduction activities post-fire, and the fire experience itself played a large role in motivating participating residents to undertake reduction activities on their properties. Eleven of the twenty participating residents felt they were not prepared before the fire, but at the time of our interviews felt they were more prepared as a result of their 2003 wildfire experiences and new knowledge gained, and activities that they had carried out on their properties. Two participating residents, who reported that they felt well prepared before the fire, felt they were even more prepared one year later. For most of these individuals, the direct threat of the fire itself opened their eyes to the potential risk and made them pay attention to information related to risk reduction activities and implement these activities on their property.

Our results indicate that high levels of knowledge of risk reduction activities are associated with varying levels of implementation of these activities; and low levels of knowledge of risk reduction activities are associated with none to moderate levels of risk reduction activities being undertaken by residents (refer to Appendix B for details of the scales used in this analysis). These findings indicate that lack of knowledge of risk reduction activities does appear to decrease the adoption of risk reduction activities, but that high levels of knowledge will not *necessarily* result in high levels of risk reduction actions being implemented.

Appropriate storage of potential fuels, such as firewood and flammables, is one example that helps to show the complexity of knowledge of risk reduction activities and engagement in risk reduction activities. Resident participants seemed to fall into one of five categories based on their awareness of this particular risk reduction method before, during and after the fire and whether they applied this risk reduction measure before, during or after the fire:

- Those who always stored their firewood and flammable materials away from the house (some for risk reduction reasons, some for non-risk reduction reasons, such as keeping vermin away from the house);

- ❑ Those who undertook proper fuel storage during the fire itself specifically to reduce the wildfire risk;
- ❑ Those who chose to adopt these practices post-fire as a result of new knowledge they had gained or a new appreciation of the potential risk;
- ❑ Those who knew that storage for firewood away from the house was a wildfire risk reduction method, but did not choose to implement that strategy; and
- ❑ Those who neither acknowledged nor implemented this activity as a risk reduction activity. Those who fall into this category include those who did not keep potential fuels on their properties and thus it was not a relevant risk reduction activity for their homes.

Coexistence of these categories of behaviours indicates that individuals react to risk perception and new knowledge in different ways. Some respondents took immediate action; some delayed action until there was an imminent threat; some were unaware of risk reduction activities even after a direct fire threat; and some chose not to adopt particular risk reduction activities for reasons discussed further in the following section.

### **3.5 Factors Influencing Adoption of Risk Reduction Activities**

#### **3.5.1 Adoption of household activities**

Overall, the Lost Creek fire appeared to heighten awareness of wildfire risks and encourage an increase in the risk reduction activity undertaken by many participating residents the year after the fire. However, throughout our interviews, a number of themes emerged as factors that may hinder the adoption of risk reduction activities by residents.

##### **3.5.1.1 Factors that may hinder adoption of activities**

###### Perception of risk

Some participating residents felt that the risk of another wildfire in the area was very low. In other words, they thought they ‘had had their fire’ and it would be a long time before wildfire came back to the area. To quote one participant, *“We won't have a fire probably ever again...not in this lifetime.”* Putting time and resources into an event that in their eyes will not occur seemed like a waste, given so many other priorities and issues facing many of these residents.

For other individuals, wildfire was simply seen as a natural part of the rural landscape. They felt that living in a rural area entailed a certain level of risk, and attempting to eliminate this risk is more in line with “urban” rather than “rural” living. This acceptance of some risk seemed to be accompanied by a reluctance of some participating residents to have structural controls imposed by municipal or regional

governments in the form of building permits or land-use bylaws (see discussion of legislation in section 3.5.2).

### Values

For some individuals, the emotional and symbolic meaning that they assign to their homes is linked to living within the forest. The beauty of the view from their windows and porches and being close to trees was embedded in participating residents' reasons for moving into, or staying in the WUI. They expressed reluctance to altering the trees on their properties to create defensible space, but many were willing to undertake other risk reduction measures. A few participating residents stated that they would prefer to save their trees, rather than their house, because structures were easily replaceable within a year, whereas mature trees would not be grown there within the homeowner's lifetime. In addition to their attachment to the trees on their properties, trees were also important for aesthetic appeal, as windbreaks, and as shade from the sun. The willingness to undertake some risk reduction measures instead of others is clear in the words of the following resident:

*Well I've decided not to cut every tree within ten meters, but I've decided to keep it well watered, and keep easily flammable materials [away from the house] and keep the old pine boughs and the dead stuff cleaned up.*

Others felt that safety of persons was more important than protecting their houses. In the words of one resident, *"If I lose everything as long as we've got the kids, our safety... everything else can be replaced.* Participating residents who expressed these types of sentiments felt that spending the time and money to become 'FireSmart' was not a high priority because material possessions that were being protected could be replaced. It is important to acknowledge that, like those who would rather save their trees than their houses, not all individuals share the same level of attachment to their houses and material belongings. The desire of homeowners to protect non-material values is in sharp contrast to the recommended risk reduction activities that stress the protection of structures.

A few individuals mentioned that concerns about the environment/wildlife influenced their decisions about removing vegetation on their properties. As one resident mentioned:

*[referring to the FireSmart suggestions] Well it all makes sense, but it would be a little hard on the natural environment...I don't cut this [grass] because the wildflowers grow and then come back every year but I do keep it well watered and green but if there's extreme fire hazards I'd do what I'd have to do. But I'm trying to keep a little bit of natural... I've worked hard to bring this back to more natural conditions and so, I understand what they're saying but I'm not utilizing every step, I'm doing the ones that make sense.*

Another couple stated *“If I have a nice shrub four feet from the house, I’m going to leave it there because ...it’s alive...Yeah, we try to be very... ecologically correct.”*

#### Perception of recommended risk reduction activities

Some participants felt that they had already taken sufficient measures to protect their houses from wildfire, and hence additional measures were not necessary in their view and thus were not adopted. Others felt that when living in rural communities, one already has and applies knowledge related to risk reduction activities and thus recommended risk reduction measures that are provided through sources including the FireSmart manual are seen as irrelevant. A few participants mentioned that they briefly skimmed the FireSmart manual and then discarded it, indicating that it might be useful for newer residents from urban areas, but is not relevant for those who have grown up with wildfires on the rural landscape. Those who had these views were highly to moderately knowledgeable and had implemented moderate levels of risk reduction activities on their WUI homes, despite their view that the FireSmart manual was not relevant to them. Some participants who felt that most of the suggestions were mere ‘common sense’ activities undertook them as part of regular property maintenance.

Another factor that influences the adoption of risk reduction activities is their perceived (lack of) effectiveness. Those who believe that people cannot reduce the impacts of wildfires find little reason to engage in risk reduction activities. A few participants indicated that residential risk reduction activities were ineffective, and they felt that risk reduction activities should focus on a community scale, including creating a defensible space around the perimeter of the community, rather than focusing on residents’ houses. This view was due to some participants’ beliefs that it was too difficult to convince all residents to implement recommended measures at the household level, and in part because of a view that if the wildfire has reached the community then it is too late to do anything meaningful to reduce the wildfire’s impact.

Some participants felt that implementing the risk reduction measures would mean a change in lifestyle or fundamental change in their home, and were therefore not willing to implement some of the activities. Some recommended measures were perceived by participants as a way to accommodate the fire fighters by creating a “safe defensible space”, but also a sterile unappealing place for residents. The words of one resident capture this sentiment quite succinctly:

*There’s a reason that people move to the country, and basically the FireSmart program, as I see it, is designed for the convenience of the fire department. That’s it...Fire managers want to do the smallest amount possible at the least cost possible at their convenience, and without regard for why people like to live in this place.*

A few participants felt that focusing on residential FireSmart activities was government's way of abdicating responsibility for expending resources to implement community-level risk reduction measures or fight a fire in its initial stages. Some felt the provincial government was attempting to transfer responsibility to the residents. The sentiment expressed by a few residents was that if a wildfire gets out of control and burns houses, and homeowners have not implemented the recommended risk reduction measures, then governments cannot be held responsible for damage to homes. Participating residents who hold this view may be less likely to engage in many residential risk reduction activities. The timing of the delivery of the FireSmart homeowner's manual (which for many residents occurred during the fire) was also mentioned as an ineffective means of informing residents. Delivery during the wildfire was seen as being too late by some participants; the feeling was that this type of information should have been disseminated well in advance, especially since many of the activities listed need to be undertaken well before a fire event. Hence, the delay in raising awareness may hinder adoption of risk reduction activities. To add to the complexity of the information timing issue, our results indicate that some participants who perceive there to be a low wildfire risk before the fire may not pay attention to risk reduction information until an actual wildfire event such as a nearby fire or a neighbouring community facing evacuation alters that perception.

#### Financial constraints

Recommended risk reduction measures such as metal roofs, fire retardant siding, and thermal paned windows were viewed as being expensive, particularly for existing houses.

#### Institutional obstacles

Conflicting regulations were mentioned as a constraint for undertaking some risk reduction measures. For example, lawn watering bylaws made it difficult to maintain a green perimeter around the house, and restrictions on timber removal on or adjacent to country residential properties made it difficult to implement recommendations to clear trees within close proximity to houses.

### **3.5.1.2 Factors that may enhance adoption of activities**

#### Incentives

Financial incentives may have limited success. Only a few participating residents mentioned that financial incentives would enable them to undertake risk reduction activities. For example, some mentioned that reductions in home insurance premiums would motivate them to undertake risk reduction activities. Another financial incentive that was mentioned was a government subsidy to assist homeowners in the interface to implement FireSmart recommendations on their properties. Some felt that the imposition of structural controls would be the only incentive to ensure that other residents would comply with risk reduction measures, but few embraced such structural controls for themselves. A few participating residents felt that the only factor that would increase their level of activity (to

undertake activities they had chosen not to do) would be if a fire was coming directly towards their house; their preference was to maintain their current lifestyle for as long as possible.

### **3.5.2 Adoption of community activities**

#### *Perception of recommended risk reduction activities*

Residents' perceptions of community-level risk reduction activities have an impact on whether or not such measures are adopted within a community, as many of these recommendations must pass through a local public consultation process. In addition, the effectiveness of these risk reduction measures will also be dependent upon the buy-in of residents. Overall, vegetation management, public education and structural controls were supported by less than half of the resident participants.

Vegetation management (such as logging and controlled burns) at the community level was supported by nine of the 20 residents in our sample, however three of these residents indicated that their support was conditional. Such conditions included receiving advice from 'experts' about the most effective forms of vegetation management, the ability to guarantee that such burns would not become uncontrollable, and that fireguards are put in place before the fire (rather than during the fire, which was seen as being too late). At the time of the interviews, the proposed community level vegetation management plan was still in the planning stage and had not yet been revealed to the residents, hence these comments were based on their thoughts of vegetation management prior to any consideration of the proposed plan.

Public education activities were supported by seven of the participants as an effective means of community-level risk reduction. A few participating residents who did not support public education activities indicated that providing information without ensuring subsequent implementation was 'futile'.

Structural controls, such as requiring residents to use less flammable materials to build their home, were supported by six participants (two indicated conditional support). Those in favour of structural controls felt that any community-level measures would be a positive step, or that structural controls would force residents to implement the recommended activities. Those who expressed concern about structural controls felt that they infringed on people's choice to construct houses that reflected their own preferences.

There was limited support for legislation (3 were in support, 6 were opposed) such as restricting through zoning where and how homes can be built, because this was felt to infringe on people's rights to live where and how they wanted.

A combination of all four potential community-level risk reduction measures (vegetation management, public education, structural controls, and legislation) was supported by four of our resident sample. However, two participating residents felt that the four measures would be ineffective, citing people's reluctance to change their behaviours.

### Financial constraints

Vegetation management entails costs with respect to planning where and what vegetation to manage, conducting public consultation, as well as the cost to conduct the thinning or controlled burns around communities. Public education has costs associated with disseminating the information to the public. Structural controls and legislation both have costs associated with monitoring and enforcement. Communities must decide between fire risk reduction initiatives and other competing priorities. As one municipal official noted:

*You know somebody will have to bear the costs of education programs, putting resources in place, managing these issues when they get to be a problem, all those kinds of things. There's always a cost to it...resources are always a finite thing. Where are the priorities? Do you spend them on...proactive things and try to get some handle on what the benefit of that is, or do you spend it all on putting out fires every year that are already started.*

### Jurisdictional Issues

Jurisdiction plays a role in a community's ability to reduce wildfire risks. A municipality's jurisdiction to create and implement bylaws without contravening provincial acts (mentioned by 2 of 3 community leaders from Pincher Creek), and the perceived lack of management of high risk activities on adjacent provincial crown lands (mentioned by both community leaders as well as residents), are two examples of this jurisdictional issue. The Alberta Municipal Government Act provides municipalities with the power to make local decisions, including the creation, implementation and enforcement of bylaws, within their boundaries. The MD of Pincher Creek has a bylaw that prevents homeowners from storing firewood under their deck. However, because of the location of these communities within the forest, the Forest Protection Act covers communities like Castle Mountain or Burmis within the MD of Pincher Creek, where no such bylaws exist. Thus, the MD of Pincher Creek has no jurisdiction to enforce their fire bylaws in these wildland-urban interface areas, and yet the Municipal District is responsible for

responding to fires that take place in these communities. Another jurisdictional issue is the perceived lack of provincial government management of activities such as random camping, off-road vehicle use occurring on forested crown land adjacent to these communities, which may ignite wildfires.

## **4.0 Management Implications**

Management implications of the study focus on public education strategies, tailoring risk reduction activities to individual needs, community-level mitigation strategies, and incentives to encourage the adoption of risk reduction activities.

### **4.1 Public Education**

#### **4.1.1 Communicating with the public**

Public education initiatives to date have relied heavily on the distribution of the FireSmart manuals with a goal of improving household implementation of risk reduction activities. Increasing awareness of the risk and mitigation activities, and knowledge of fire, are often cited by fire management agencies as the primary solutions to the WUI problem. However, this study and others suggest that simply supplying information about risk reduction activities does not necessarily result in their adoption (Brunson and Shindler 2004). Although many factors may influence the success of public education, the method of communication is a vital component in successful risk reduction initiatives. Education programs that rely solely on printed materials that emphasize the threat of fire and what to do to reduce risk (such as the FireSmart manual) may not be very effective in convincing homeowners to undertake mitigation activities (Monroe and Nelson 2004). Personal contact with fire management agencies (McGee and Russell 2003), and targeting specific audiences (McCaffrey, 2004a; Zaksek and Arvai, 2004), has been shown to be effective. McCaffrey (2004a) found that computer-generated wildfire scenarios, and personal and fire management agency contacts were more effective in educating and engaging homeowners in risk reduction than newspapers, magazines, and television. This suggests that the current approach in Alberta of distributing risk reduction information via printed material or the use of other forms of popular media is not the most effective way to engage homeowners. Expanding public education to include interaction with fire agency personnel may be more effective.

#### **4.1.2 Messages to be communicated**

Our results suggest that some residents view the promotion of risk reduction activities as a downloading of responsibility from fire management agencies and local fire departments to the homeowner. The perception of who is responsible for hazard mitigation and preparedness may influence homeowner engagement in risk reduction activities. For example, residents in Australia, who viewed landowners as responsible for wildfire risk mitigation had undertaken risk reduction activities (McGee et al. 2000). The increasing frequency and intensity of wildfires in Canada suggests that a reactive strategy of fire suppression alone may no longer be enough to protect communities from catastrophic wildfire.

Residents should be made aware of the changing fire regime, that fire suppression resources are being stretched to the limit, and that it is not prudent to rely solely on fire suppression to protect properties. This information is particularly important to counter the predominant view among many participating residents that fire suppression by government authorities is the first line of defense against a wildfire, and that homeowner risk reduction activities are only useful when fires cannot be controlled by firefighters.

If homeowners believe that risk reduction activities are ineffective, they are unlikely to expend resources on these activities (Gregory et al. 1997; Winter and Fried 2000). Additionally, the activities that homeowners are undertaking may not be the most effective in reducing risk. After the Lost Creek fire, residents seemed more aware of the potential risk, but this did not translate into a substantial increase in the implementation of risk reduction activities. It will be important to communicate to residents that their homes are not 'FireSmart', when they have performed only a few landscaping activities such as general yard maintenance. Providing an example of a 'FireSmart' home may help homeowners experience first hand what is required to help reduce wildfire risks. As McCaffrey (2004b:514) noted "although a fire event can create an opportunity to raise awareness levels, managers also need to recognize and address potential negatives of experience, such as explaining why defensible space didn't work and highlighting where it did". Information provided to the public should also emphasize that recommended activities *reduce*, but do not *eliminate* the wildfire risk.

#### **4.2 Tailor Risk Reduction Activities**

The importance of incorporating homeowners' values in mitigation and education strategies is evident from the results of this study. Residents tended to undertake some risk reduction measures for reasons other than risk reduction (such as aesthetics or cost efficiency). Therefore, it may be useful to emphasize the multiple benefits of risk reduction activities. For example, a metal roof prevents snow from building-up; thermal pane windows are energy efficient; thinning trees have benefits for forest health, wildlife habitat, biodiversity; and moving firewood away from the home prevents vermin such as mice from having easy access to homes. Even though many residents had experienced the Lost Creek fire firsthand, they were not willing to remove trees close to their homes because of the values associated with them. These findings are supported by the literature, which suggests that the values homeowners associate with their land can influence whether or not these residents will accept mitigation strategies such as the creation of defensible space (Nelson et al. 2003; Monroe and Nelson 2004). Emphasizing values that are relevant to homeowners (e.g., privacy, wildlife, aesthetics, healthy forests) in mitigation and education strategies may help motivate residents to engage in risk reduction activities. Additionally, fire management agencies should become more creative in their approach to risk reduction and incorporate expertise (such as landscape architects) into risk management plans. Although fire behaviour expertise is vital in identifying wildfire risks, other expertise may be required to design houses and yards that are appealing to homeowners and still provide a substantial reduction in risk (e.g., using less flammable vegetation, use of landscaping materials such as crushed rock, incorporating ponds). Risk reduction

programs tailored to take into account resident values are more likely to be adopted (Monroe et al., 2003).

Management agencies should recognize that not all residents embrace risk reduction activities. Some residents appear to be willing to accept the risk of wildfires and not undertake risk reduction activities, trading off lifestyle choices with the unknown risk of a wildfire.

### **4.3 Community-Level Mitigation**

Since the Lost Creek fire, several communities (such as the Municipality of the Crownsnest Pass, Castle Mountain Resort and the MD of Pincher Creek) have been developing plans to reduce the risk from wildfire. The success of these plans will depend on several factors, some of which are identified in this study.

The importance of including the public in developing community mitigation and preparedness plans is well recognized (Beebe and Omi 1993; Tàbara et al. 2003). A study of community-based collaborations in the US concludes, “relying on communities to identify and define their own alternatives as they build their capacity to respond to wildfire threats is the surest way to provide a long-term solution to the wildfire problem” (Steelman and Kunkel 2004: 698). For the communities included in this study, developing a fire management strategy that involves community leaders and homeowners from the outset may help overcome the perception that agencies are downloading responsibility to homeowners.

A successful fire management strategy (such as fuel modifications) on public lands surrounding communities requires an understanding and incorporation of public preferences. Although this study did not conduct a thorough examination of public preferences for community-level activities, it does provide some insight into the potential acceptance of community-level approaches. In this study, there was not strong support for vegetation management, public education, or structural controls. There was even less support for legislation. This suggests that implementation of a community plan without including public concerns in the early planning stages may not be readily accepted. Additionally, to be successful in fuel management strategies, it is important to understand the variability in public acceptance and the reasons for variability across settings (Brunson and Shindler 2004). Development of community plans should be tailored to meet the local social and environmental conditions. In a study of several US communities, Brunson and Shindler (2004) conclude that a “one-size-fits-all” approach to community wildfire strategies is unlikely to be successful.

#### **4.4 Incentives**

Financial incentives may encourage the adoption of some of the risk reduction activities, for some individuals. For many, however, a reduction in home insurance premiums is not viewed as an effective incentive for implementing some of the recommended activities. Some of our participants felt that insurance companies were unlikely to undertake the monitoring that would be required to make such assessments, and others felt that the amounts discounted would not compensate for the expenses incurred. For residents who felt that structural changes are too expensive, financial assistance (e.g., subsidy) may provide an effective incentive. In addition, financial assistance for community-level activities and maintenance would be effective particularly to ensure that such measures were ongoing, rather than a one-time activity.

#### **5.0 Conclusions**

This study has identified several factors that may influence homeowners' adoption of risk reduction activities.

First, experiencing a wildfire firsthand seemed to increase awareness of the risk, motivating some (but not all) residents to undertake more activities. However, most of these activities were limited to general yard and house maintenance. The creation of defensible space remains a controversial issue for some residents.

Second, education on how to reduce the risk did not seem to result in substantial changes in risk reduction activities. Increased awareness did not necessarily result in adoption. Public education of risk reduction activities therefore should not be the only activity in a risk reduction strategy. Knowledge of risk reduction activities provides a toolbox for residents and communities to draw from, but provides no guarantees of implementation.

Third, some homeowners are not convinced of the effectiveness of the recommended activities against high intensity fires such as those experienced in 2003. Several residents concluded that suppressing fires before they reach a community is the only effective strategy. There is a need to counter the perception that risk reduction activities are ineffective in crowning fires, and the role of these activities to reduce the impact rather than eliminate the risk needs to be clear.

Fourth, the promotion of risk reduction activities by fire management agencies is viewed by some residents as a downloading of government responsibility and is more for the benefit of fire fighters than

the homeowner. Responsibility for risk management should be integrated at landscape, community and residential levels, and shared amongst residents and local governments.

Fifth, homeowners have an array of values that they associate with their properties, many of which have not been incorporated into recommended risk reduction activities. Hence, when homeowners make decisions about risk reduction activities they must trade-off many values (not only the protection of structures) for an unknown reduction in risk. Recommended risk reduction activities may actually conflict with the values that are of importance to homeowners. To take into account the varying values, risk reduction measures themselves should be tailored to better meet the values of importance to homeowners.

Finally, financial considerations and institutional issues were also identified as hindering the adoption of some activities. The affordability of activities and conflicts in by-laws and jurisdiction may affect their adoption. Constraints might be addressed through financial incentives for more costly residential activities and funding mechanisms that address the sustainability of community-level activities over time.

This study is one of the first to examine some of the human dimensions of wildfire risk reduction in the WUI in Canada. Although it has provided valuable information of interest to fire management agencies and others, there are several areas where further research is needed. First, this study included communities that had experienced a recent large fire. There is a need to examine other Canadian communities with different fire histories and social and environmental conditions. Second, social science models and processes developed elsewhere (US and Australia) should be tested for their applicability in a Canadian context. Third, future studies should explore the relative importance of the causal factors identified in this study in adopting risk reduction activities. Fourth, this study provided some insights into risk perceptions, knowledge and implementation of community-level risk reduction activities by municipalities. There is a need for a more detailed study of institutional factors that influence the adoption of community-level mitigation activities. Lastly, a follow-up study would enable further insights into how the influence of experience changes over time.

## 6.0 References

- Beebe, G.S., and P. N. Omi.1993. Wildland burning. The perception of risk. *Journal of Forestry*. Vol. 91. No.9:19-27.
- Brunson, M.W., and B. A. Shindler. 2004. Geographic variation in social acceptability of wildland fuels management in the western United States. *Society and Natural Resources*. Vol. 17:661-678.
- Gregory, G., A. Loveridge, and J. Gough. 1997. Social and cultural aspects of natural hazard perception and response. *The New Zealand Geographer*. Vol. 53, No.1:47-54.
- McCaffrey, S.M. 2004a. Fighting fire with education. What is the best way to reach out to homeowners? *Journal of Forestry*. Vol. 102, No.5:12-19.
- McCaffrey, S. 2004b. Thinking about wildfire as a natural hazard. *Society & Natural Resources*. Vol.17:509-516.
- McGee, T.K. and S. Russell. 2003. Fostering prepared communities: An investigation of wildfire in rural Australia. *Global Environmental Change Part B: Environmental Hazards*. Vol. 5, No.1&2:1-12.
- McGee, T. Reinholdt, S., Russell, S., Rogers, N. and Boxelaar, L. (2000) Effective Behaviour Change Programs for Natural Hazard Reduction in Rural Communities, Final Report - IDNDR project 7/99.
- Monroe, M.C., A.J. Long and S. Marynowski. 2003. Wildland fire in the southeast. Negotiating guidelines for defensible space. *Journal of Forestry*. Vol. 101, No. 3:14-19.
- Monroe, M.C., and K.C Nelson. 2004. The value of assessing public perceptions: Wildland fire and defensible space. *Applied Environmental Education and Communications*. Vol. 3:109-117.
- Nelson, K.C., M.C. Monroe, J.F. Johnson, and A.W. Bowers. Public perceptions of defensible space and landscape values in Minnesota and Florida. In Jakes, P. (compiler), *Homeowners, Communities, and Wildfire: Science Findings from the National Fire Plan*. Proceedings of the Ninth International Symposium

on Society and Resource Management, June 2-5, 2002, Bloomington, Indiana (pp. 55-62). Gen. Tech. Rep. NC-231. St. Paul, MN: USDA Forest Service, North Central Research Station, 2003.

Partners in Protection. n.d.. *The Home Owners FireSmart Manuel. Protecting Your Home from Wildfire*. 2<sup>nd</sup> edition. Edmonton: Partners in Protection.

Steelman, T.A. and G.F. Kunkel. 2004. Effective community responses to wildfire threats: lessons from New Mexico. *Society and Natural Resources*. Vol. 17:679-699.

Tàbara, D., D. Sauri, and R. Cerdan. 2003. Forest fire risk management and public participation in changing socioenvironmental conditions: a case study in a Mediterranean region. *Risk Analysis*. Vol. 23, No. 2:249-260.

Winter, G., and J.S. Fried. 2000. Homeowner perspectives on fire hazard, responsibility and management strategies at the wildland-urban interface. *Society and Natural Resources*. Vol. 13:33-49.

Weber, M.G., and M.D. Flannigan. 1997. Canadian boreal forest ecosystem structure and function in a changing climate: impact of fire regimes. *Environmental Review*. Vol. 5:145-166.

Yin, R. K. *Case Study Research: Design and Methods*. Newbury Park, CA: Sage, 1984.

Zaksek, Melissa and Joseph L. Arvai. 2004. Toward improved communication about wildland fire: Mental models research to identify information needs for natural resource management. *Risk Analysis*. Vol. 24 No.6:1503-1514.

## Appendix A – Interview Guides

### Resident Interview Guide

#### Introductory questions:

- How long have you lived in this community? In this house?
- How long do you plan to stay in this community? In this house?
- What attracted you to this house/property?
- What were your experiences with the Lost Creek Fire?

#### Risk Perception:

- In your view, how predictable was last summer's wildfire?
- Before last summer's wildfire, how concerned were you about wildfire risks to your property and community?
  - *Was wildfire safety an issue that you considered when you bought/rented this house?*
- How much of a wildfire risk did you feel there is currently in this area? Within the next few years? Within the next 10 years?
- Are there any other hazards in this community?
- Who do you believe is responsible for protecting you, your home, and community from wildfire,
  - both during the fire (extinguishing the fire), and
  - reducing the risk to your home/property before a fire?
- Do you think it is possible for a homeowner to reduce the impact of a wildfire on their property?
- Do you think it is possible to reduce the impact of a wildfire on the community (and its residents, natural environment)?

#### Knowledge:

- What are the sources of wildfire risk in this area?
- What factors influence the spread of fire? [here and elsewhere]

- Before the 2003 fires, how much information do you feel you had about local wildfire risks?

**Note: The next three questions ask what information residents obtained before, during and after the 2003 fires about risk reduction at the household level, and their perceptions of the usefulness of this information.**

- Before the 2003 fires, did you hear of any ways that homeowners can reduce risks from wildfires on their properties?
  - *What are these ways?*
  - *Do you remember when you received this information?*
  - *Do you remember who provided this information to you?*
  - *Did you find this information to be useful?*
  - *Before the 2003 fires, do you feel that you had a good understanding of how to make these changes to your property?*
  
- During the 2003 fires, did you hear of any ways that homeowners can reduce risks from wildfires on their properties?
  - *What were these ways?*
  - *Do you remember when you received this information?*
  - *Do you remember who provided this information to you?*
  - *Did you find this information to be useful?*
  - *During the 2003 fires, do you feel that you had a good understanding of how to make these changes to your property?*
  
- Since the 2003 fire, have you heard of any (other) ways that homeowners can reduce risks from wildfires on their properties?
  - *What were these ways?*
  - *When did you obtain this information?*
  - *Who provided this information to you?*
  - *Have you found this information to be useful?*
  - *Do you feel that you now have a good understanding of how to make these changes on your property?*

- Have you ever spoken to anyone about wildfires or risk reduction activities?
- Where would you turn for additional information?

Household Risk Reduction Activities:

- Provide a list of recommended risk reduction measures, from FireSmart manual [see A-5].
  - How do you feel about these suggested risk reduction methods?
  - Do you believe that they would be an effective way to reduce the risk to your property from wildfire?
  - Do you think that there are any negative consequences of any of these activities?
  - Would you say that there are any non-fire benefits of any of these activities?

Similar to the knowledge questions above, the following three questions seek information about decision-making and risk reduction activities before, during and after the 2003 fire.

- Before the 2003 Lost Creek Fire, were there any decisions that you made (or things that you did on your property) to reduce the wildfire risk to your property?
  - *What were they?*
  - *When did you do them?*
  - *Why did you do them?*
    - *Were these completed for fire risk reduction, or other reasons?*
    - *Were there any activities that you made a decision not to do?*
  
- During the 2003 fires, were there any (other) decisions that you made (or things that you did on your property) to reduce the wildfire risk to your property?
  - *What were they?*
  - *When did you do them?*
  - *Why did you do them?*
  - *Were these completed for fire risk reduction, or other reasons? Were there any activities that you decided NOT to undertake during the 2003 fires?*
  
- How prepared do you feel you and this community were, for the 2003 wildfires?
  
- Since the 2003 Lost Creek Fire, are there any decisions that you have made, or things that you have done on your property, to reduce the wildfire risk to your property?
  - *What are they?*
  - *When did you do them?*
  - *Why did you do these things?*
    - *Were they completed for fire risk reduction, or other reasons?*
  - *Are you planning to continue to do these activities?*

- Are there any activities that you have decided not to do on your property (or have not yet completed), to reduce the wildfire risk to your property? [*which ones? What influenced your decision? Is there anything that would encourage you to undertake these activities?(e.g., insurance incentive/disincentive)*]
- Do you know if other residents in this neighbourhood are planning to, or doing any of these activities?

Risk reduction:

- In some places in Alberta and elsewhere, things are being done at the community level, to try to reduce the potential impact of wildfire, such as:
  - Vegetation management (fuel removal, harvesting, prescribed fire)
  - Public education (informing residents, developers, insurance, politicians, environmental groups of the problems and FireSmart recommendations).
  - Structural controls – requiring residents to use less flammable materials to build their home.
  - Legislation – restricting (through zoning) where and how homes can be built.
- Have you ever heard of these sorts of activities being used?
- How do you feel about these tools?
- How effective do you think they would be in reducing the wildfire risk?
- Is there anything else that you feel should be done to reduce the impact of wildfire in this area?

Post-fire recovery:

- Have you been affected by any fires prior to the Lost Creek Fire last summer?
- How do you feel the 2003 fires affected:
  - You?

- Your views of the wildfire risk in this area?
- Your views of ways to reduce wildfire risks at household and/or community levels?
- This community?
- The environment and the forest?
- Did the fire provide any benefits (positive outcomes) for you, the community, or the environment and forest?
- How prepared do you believe you and this community are if another wildfire should occur in this area?
- Are there any other issues that you would like to raise, that we have not yet talked about?

Demographic questions:

- Do you interact with many of your neighbours?
  - *Do you or other members of your household have friends and/or family living nearby?*
  - *Do local residents often get together?*
- Are you involved in any local groups? *Are any of your neighbours involved in these sorts of groups?*
- Home ownership‡ home rental‡
- Employment status \_\_\_\_\_
- Industry of employment \_\_\_\_\_
- Highest level of education
  - Less than high school graduate certificate
  - High school graduate certificate and/or some post secondary
  - Trades certificate or diploma
  - College certificate or diploma
  - University certificate, diploma, or degree

- Age group

a) 18-24†

d) 55-64†

f) 75-84†

b) 25-44†

e) 65-74†

g) 85+ †

c) 45-54†

### **Some Fire Smart Recommendations**

- ❖ *Keep your grass mowed and watered within 10 metres of your home.*
- ❖ *Remove shrubs, trees and deadfall within 10 metres of your home.*
- ❖ *10 to 30 metres from your home, thin shrubs or trees so that adjacent trees do not touch.*
- ❖ *Store firewood well away from the home.*
- ❖ *Remove needles, leaves, and overhanging trees and vegetation from the roof, gutter and eaves.*
- ❖ *Ensure driveway is wide enough for movement of emergency vehicles.*
- ❖ *Screen house soffit vents and gutters.*
- ❖ *Screen or enclose undersides of decks and porches, and enclose balconies and crawl spaces.*
- ❖ *Use metal, asphalt or ULC treated shakes for the roof.*
- ❖ *Use stucco, metal, brick or concrete for exterior walls.*
- ❖ *Use tempered glass for exterior glass doors.*
- ❖ *Use double or thermal paned windows.*

*[Above list was provided for respondents during the relevant section of the resident interview]*

## Municipal Official Interview Guide

### Introductory questions:

- How long have you lived and worked in this area?
- How were you involved in the 2003 Lost Creek fire?

### Risk perception:

- How predictable was last summer's fire? *[How much of a wildfire risk did you feel there was in this area? Before last summer's fire, how concerned were you about wildfire risks in this area?]*
- How much of a wildfire risk do you feel that there is currently in this area? Within the next few years? Within the next 10 years? Why?
- Do you think it is possible to reduce the impact of wildfire on a community?
- Who do you believe is responsible for protecting this community (and its residents, homes) from wildfire, both during the fire (extinguishing the fire), and reducing the risk before a fire?

### Knowledge:

- What are the sources of wildfire risk in this area?
- What factors influence the spread of fire?
- Before the Lost Creek Fire, how much information do you feel you had about wildfire risks, and reducing the risks of wildfires in your municipality? *[Which risk reduction methods?; When did you receive this information?; Who provided this information to you?; Did you find this information to be useful?]*
- During the fire, how much information did you obtain about wildfire risks, and reducing the risks of wildfires in your municipality? *[Which risk reduction methods?; When did you receive this information?; Who provided this information to you?; Did you find this information to be useful?]*
- How much information do you feel you currently have about wildfire risks, and risk reduction options and their implementation? *[Which risk reduction methods?; When did you receive this information?; Who provided this information to you?; Did you find this information to be useful?]*

### Risk Reduction Activities:

- Were there any decisions that you or your municipal government made, or activities that were completed before or during the Lost Creek fire, to reduce the wildfire risk within this municipality?

- *What were they? When were these done?*
- *How effective do you feel these were in reducing the impacts of the wildfire?*
- *How prepared do you feel this municipality was for the 2003 wildfires?*
- *Were there any activities that your municipal government decided not to undertake before or during the fires, to reduce the wildfire risk in this area?*
- *What do you feel influenced your/your municipality's decisions about what activities to complete before the 2003 fires?*
- Are there any decisions that have been made, or activities that have been undertaken since the 2003 fires, to reduce the wildfire risk in this area? What are they?
  - *How effective do you feel these would be in reducing the impact of a future wildfire?*
  - *Are there any activities that your municipality has decided not to complete?*
  - *What influenced your/your municipality's decisions about which activities to complete?*
- Risk reduction activities that may be undertaken by municipalities include:
  - Interface planning for entire Municipality.
  - Vegetation management on municipal lands.
  - Structural & infrastructure controls development planning
  - Public education.
  - Legislation (land use bylaws, design guidelines).
  - Cross training and interagency cooperation.
  - Emergency planning.
- For those activities that have NOT been completed by the municipality, what is your/your local governments view of these activities?
- Do you feel that these should be used here?
- Are there any negative consequences of these activities? If yes, what are they?
- Is there anything that restricts your municipality's ability to undertake these activities?
- Is there anything that would encourage your municipality/community to undertake these activities?
- How prepared do you believe this municipality/regional district is now, for wildfires? Why?

Post-fire recovery:

- How do you feel this fire affected this municipality and its communities, and the environment/forest?
  - *Did the fire benefit this municipality, or the environment or forest in any way?*
  - *How do you feel the 2003 fires affected your municipal government's views of the wildfire risk in this area?*
  - *How do you feel the 2003 fires affected the risk reduction decisions or activities undertaken (and/or not undertaken) by your municipality?*
- How prepared do you believe this community now is, should another fire come through this area?
- Is there anything you would like to add?

## Appendix B – Method of Rating Level of Knowledge and Impact of Risk Reduction Activities

As part of the data analysis, cumulative knowledge and impact of risk reduction activities were rated along a scale.

The rating of participants' level of knowledge included knowledge of risk reduction activities before the fire and new knowledge gained during and after the fire. Participants' knowledge rating ranged from 0 (no knowledge) to 5 (high level of knowledge). The following table provides a brief overview of how individuals' knowledge were categorised.

**Table 4: Qualitative Assessment of Risk Reduction Activity Knowledge**

Level	Qualitative Rating	Example
0	No knowledge	<ul style="list-style-type: none"> <li>Indicated no knowledge of risk reduction activities.</li> </ul>
1	Low level of knowledge	<ul style="list-style-type: none"> <li>Provided one example of a risk reduction activity (i.e., plant deciduous rather than coniferous trees around the home).</li> </ul>
2	Some knowledge	<ul style="list-style-type: none"> <li>Provided at least two examples of risk reduction activities.</li> </ul>
3	Moderate level of knowledge	<ul style="list-style-type: none"> <li>Mentioned four or five examples of risk reduction activities.</li> </ul>
4	Moderately high level of knowledge	<ul style="list-style-type: none"> <li>More knowledge than the 'moderate' levels, but not as much as the 'high' level.</li> </ul>
5	High level of knowledge	<ul style="list-style-type: none"> <li>Mentioned most of the recommended risk reduction activities (such as structural changes, moving flammables away from structures, removing underbrush, thinning trees, not being a source of fire etc).</li> </ul>

Risk reduction activities completed by resident participants were also rated along a scale, from 'high', 'moderate', 'low' and 'none'. These activities included those undertaken before the fire, and additional activities undertaken during and after the 2003 fire. All of these activities taken together provide an indication of the risk reduction implemented by each participating resident. The impact of individual activities was estimated using the FireSmart Manual checklist rating system (Partners in Protection, Second Edition: 9-11) of household risk reduction activities. The checklist allocates points (e.g., 30 if you

have an unrated wooden shake roof, and 0 if you have asphalt, metal, tile or ULC rated shakes) that reflect the importance of each of the factors, such as roofing material, for helping a property survive a wildfire. Activities that are allocated 30 points in the manual were labelled as high impact activities. Activities with fewer than 10 points were labelled as low impact activities. Note that not all activities mentioned by participating residents are rated by this system. For example, practicing responsible burning and installing a sprinkler during the fire is mentioned in the manual, but are not included in the checklist. Activities like putting out spot fires and foaming structures is not mentioned specifically within the manual. These activities were not included in the analysis unless residents fell on the borderline between two categories and the additional activities were deemed sufficient to categorise them into a higher category.

In general, a *high impact* rating was given to participating residents who implemented a combination of high, moderate and low impact activities. *Moderate impact* ratings were given to those who implemented a combination of high and low impact activities, and a *low impact* rating was given to those who implemented at least one low impact activity.

**Table 5: Example of Ratings of Risk Reduction Activities**

<i>High Impact Activities (30 points in the FireSmart Manual)</i>
<ul style="list-style-type: none"> <li>▪ Keep your grass mowed and watered within 10 metres of your home.</li> <li>▪ Use metal, asphalt or ULC treated shakes for the roof.</li> <li>▪ Remove shrubs, trees and deadfall within 10 metres of your home.</li> </ul>
<i>Moderate Impact Activity (10 points in the FireSmart Manual)</i>
<ul style="list-style-type: none"> <li>▪ 10 to 30 metres from your home, thin shrubs or trees so that adjacent trees do not touch.</li> </ul>
<i>Low Impact Activities (1-6 points in the FireSmart Manual)</i>
<ul style="list-style-type: none"> <li>▪ Remove needles, leaves, and overhanging trees and vegetation from the roof, gutter and eaves.</li> <li>▪ Screen house soffit vents and gutters.</li> <li>▪ Use tempered glass for exterior glass doors.</li> <li>▪ Store firewood well away from the home.</li> <li>▪ Screen or enclose undersides of decks and porches, and enclose balconies and crawl spaces.</li> <li>▪ Use stucco, metal, brick or concrete for exterior walls.</li> </ul>

▪ Use double or thermal paned windows.
<i>Unrated activities</i>
▪ Ensure driveway is wide enough for movement of emergency vehicles.

It is important to note that a list or survey instrument was not used to prompt participants to identify activities that they knew or had completed; therefore activities mentioned by participants, and included in this analysis may be fewer than those that interview participants actually knew or had implemented. In addition, this analysis does not indicate whether particular activities were relevant for properties. For example, some homes had no trees or shrubs within 10 metres of their homes, so the recommendation to remove vegetation within 10 metres of their homes would not be relevant for those residents. Recommendations to store firewood well away from the home, was irrelevant to residents who did not keep firewood on their properties.