

# WILDFIRE-READY PRACTICAL GUIDANCE TO STRENGTHEN THE RESILIENCE OF CANADIAN HOMES AND COMMUNITIES

Supported by:



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The Intact Centre on Climate Adaptation (Intact Centre) is an applied research centre at the University of Waterloo. The Intact Centre was founded in 2015 with a gift from Intact Financial Corporation, Canada's largest property and casualty insurer. The Intact Centre helps residents, communities, and businesses to reduce risks associated with climate change and extreme weather events. For additional information, visit: [www.intactcentreclimateadaptation.ca](http://www.intactcentreclimateadaptation.ca).

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All findings and recommendations of this study are those of the Intact Centre.

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Cover Photo: Fort McMurray, Alberta neighbourhood partially impacted by wildfire. Photo taken May 25, 2016, courtesy of Alan Westhaver, ForestWise Environmental Consulting Ltd.

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Canadians living in forested and grassland regions can reduce their wildfire risk by up to 75%.



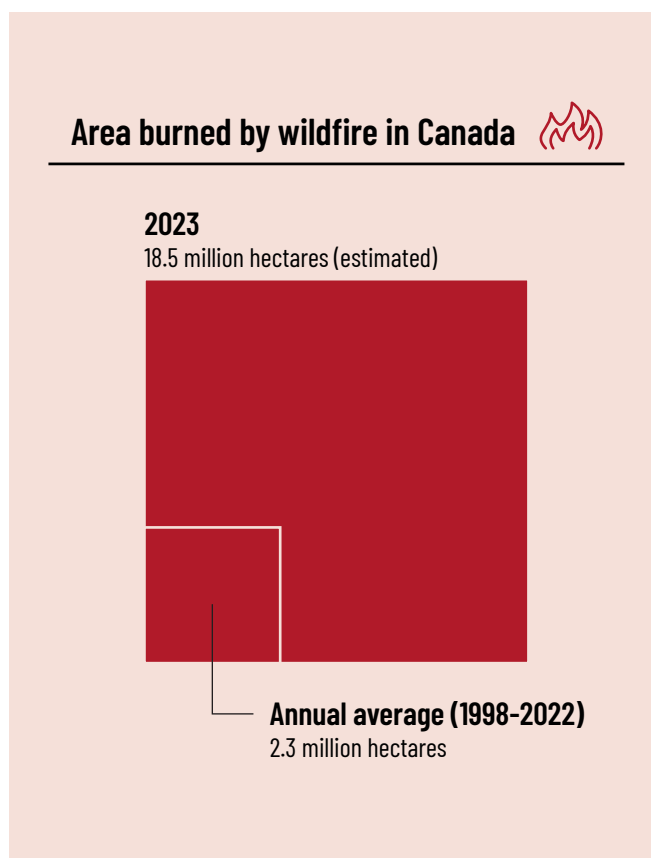
# Executive Summary

Canada's record-shattering 2023 wildfire season burned an area three times the size of Nova Scotia (approximately 18.5 million hectares), more than doubling the previous record set in 1995, and representing eight times the annual average area burned over the past 25 years (2.3 million hectares) (CIFFC, 2023). An unusually warm and dry winter and spring in much of the country set the stage for an unprecedented wildfire season that forced 200,000 Canadians from their homes and ignited nation-wide calls for large scale investment in preventative action to strengthen community wildfire resilience.

Addressing the United Nations in September 2023, one month after wildfire tore through his community, West Kelowna Fire Chief Jason Brolund drove home the wildfire-ready message, “Over \$20 million was spent reacting to [the West Kelowna] fire, not to mention the insurance losses, which could be triple that. What could we have accomplished if we used that same amount of money proactively? **We’re spending the money on the wrong end of the problem.**” Chief Brolund emphasized the critical importance of wildfire-ready investment to minimize damage and streamline recovery, “\$10,000 worth of sprinklers and pumps were placed on our new water treatment plant, and it saved that \$75 million critical infrastructure... It will start providing clean drinking water in just a couple of days.” (Peters, 2023)

**Preventative action is urgently needed TODAY to help protect homes and communities from the growing threat of wildfires.**

**An estimated 60% of Canadian communities are located in the wildland-urban interface (WUI)** – the area where human settlement meets or intermingles with forests and grasslands. Proximity to these wildfire-prone natural ecosystems make communities vulnerable to damage and disruption due to wildfire (Johnston and Flannigan, 2018). Home to an estimated 12.3% of Canadians, including 32.1% of the on-reserve Indigenous population (Erni et al., 2021), community wildfire risk has escalated due to multiple factors. These include the expansion of urban and industrial development, lack of nationally accepted minimum building standards to safeguard against wildfire damage, an increase in the amount and continuity of fuels (e.g., vegetation) surrounding communities as a consequence of roughly 100 years of fire suppression (Parisien et al., 2020). These factors are further compounded by the impacts of climate change (Bénichou et al., 2021). Climate change is lengthening the wildfire season, contributing to larger, more destructive wildfires, and impacting areas across



the country that are not typically regarded as wildfire-prone (Coogan et al, 2020). The Halifax-area wildfire that destroyed 200 buildings in late spring, 2023, is a prime example of unprecedented impact in eastern Canada (CBC, 2023).

Although wildfires may pose threats to Canadian homes and communities, they have also played a vital role in maintaining the ecological health of some of the country’s forests and grasslands for thousands of years. **The good news is that with education and preventative action to protect homes and communities in the WUI, Canadians can work together to learn to live with wildfire.**

This guide identifies many practical actions that can be taken at the home and community level to reduce the risk of damage and disruption due to wildfire events and hasten community recovery.

The information presented is a user-friendly synthesis of voluntary best practice guidance developed by the National Research Council, Canada’s largest federal research and development organization, and by FireSmart™ Canada, a national program that has been helping WUI communities improve their wildfire resilience for 30 years.

**Three Steps to a Cost-Effective FireSmart Home** (Figure 1) is an easy-to follow, step-by-step guide for residents to make their homes and properties more resistant to wildfire ignition and minimize damage if ignition occurs. The steps are:

- 1. Maintain What You’ve Got at Least Twice Per Year**
- 2. Complete Simple Upgrades**
- 3. Complete More Complex Upgrades**

**Three Features of a Wildfire-Ready Community** (Figure 2) highlights best practice guidance that communities can integrate into their wildfire risk management plans, to limit damage and disruption from wildfire events and strengthen emergency preparedness. The three wildfire-ready features are:

- **Wildfire-Ready Structures and Infrastructure**
- **Wildfire-Ready Community Design**
- **Wildfire-Ready Emergency Response**

Residents, governments, Indigenous Peoples, non-governmental organizations, and businesses all have a role to play in creating resilient communities.

**Canada’s National Adaptation Strategy (NAS)** (Environment and Climate Change Canada (ECCC), 2023a) established short-term targets that can be achieved **TODAY** to help community members begin their collective journey to reduce risk, prepare

for emergencies, and “build back better” following a wildfire event. The targets are:

- **Risk Awareness** – By 2025, 60% of Canadians, including northerners and Indigenous Peoples, are aware of the disaster risks facing their household.
- **Preventative Action** – By 2025, 50% of Canadians have taken concrete actions to better prepare for and respond to climate risks facing their household.
- **Community Protection Plans** – Communities, including northern and Indigenous communities, in zones of high risk, as identified by provinces and territories, develop wildfire community prevention and mitigation plans by 2030, with up to 15% implemented by 2028.
- **Building Back Better** – By 2025, complete the modernization of the Disaster Financial Assistance Arrangements to incentivize disaster risk reduction and improve recovery outcomes from large-scale disasters.

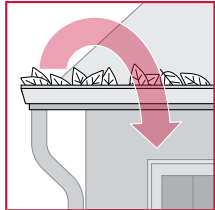
This report aims to advance the goals of the NAS by providing concise, user-friendly guidance that fosters participation, raises awareness, and supports on the ground action from the whole-of-society.

Wildfire is not just one of the financially costliest perils in Canada, it can have significant long-term impacts on the environment, and importantly, the mental and physical health of Canadians. Investing in risk reduction for homes and communities will strengthen the fiduciary capacity of all orders of government, Indigenous Peoples, non-governmental organizations, businesses, and residents to prepare for the growing threat from wildfires, driven in part by irreversible climate change.

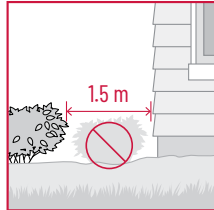
# THREE STEPS TO A COST-EFFECTIVE FIRESMART™ HOME

## Step 1: Maintain what you've got at least twice per year

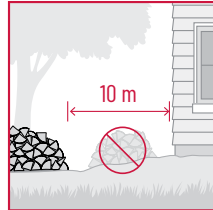
Do-it-yourself, \$0 - \$300



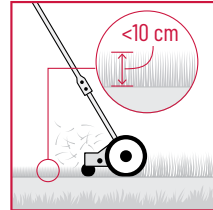
**1** Remove needles, leaves and other debris from gutters, roof surfaces, decks and balconies. Regularly clean vents.



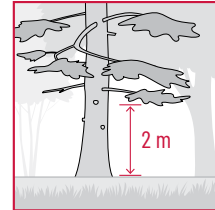
**2** Remove all combustible ground cover (mulch and plants) within 1.5 m of the house perimeter.



**3** Remove combustible materials (firewood and lumber) stored within 10 m of house perimeter and under decks.



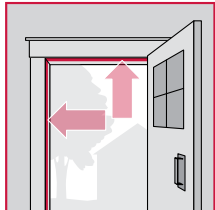
**4** Mow the lawn to <10 cm and plant low-growing, well-spaced shrubs and other fire-resistant plants.



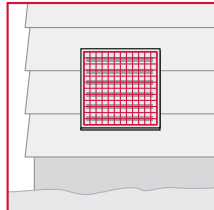
**5** Prune trees to create a 2 m clearance from the ground to the lowest tree branches.

## Step 2: Complete simple upgrades

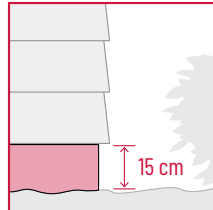
\$300 - \$3,000



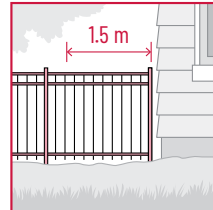
**1** Replace worn or missing weather stripping on all doors including garage doors.



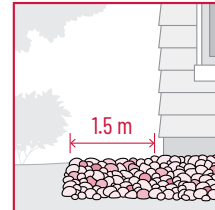
**2** Add a non-combustible 3 mm screen to all external vents, except dryer vents.



**3** Create a 15 cm ground-to-siding non-combustible clearance (e.g., install cement board or metal skirting).



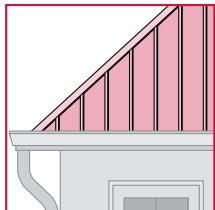
**4** Install non-combustible fencing within 1.5 m of the house (cement fiber, metal, chain link or stone).



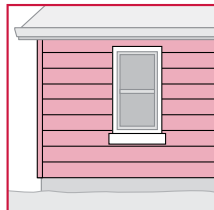
**5** Install non-combustible ground surfaces within 1.5 m of the house (mineral soil, rock, concrete or stone).

## Step 3: Complete more complex upgrades

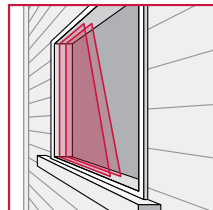
Work with a contractor, \$3,000 - \$30,000



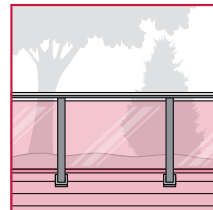
**1** Install Class A fire-rated roof covering (e.g., cement fibre, metal or asphalt shingles).



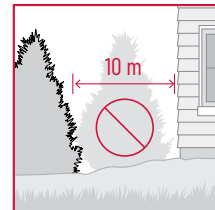
**2** Install non-combustible siding (stucco, metal, stone, cement fibre board).



**3** Install multi-pane or tempered glass windows and exterior fire rated doors.



**4** Retrofit all deck components to be fire-rated, with a continuous surface.



**5** Remove conifer trees that are within 10 m of the house.

Note: not all actions will be applicable to each home. Completing these steps does not eliminate the risk of home or structure ignition.

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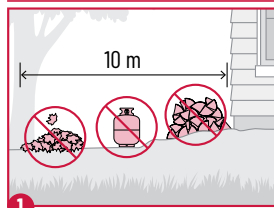
**Figure 1:** Practical actions to improve home wildfire resilience.



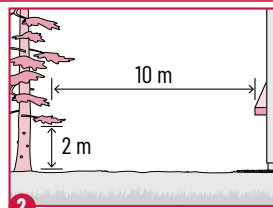
# THREE FEATURES OF A WILDFIRE-READY COMMUNITY

Communities can integrate wildfire-ready features into their risk management plans to limit damage and disruption due to wildfire events and strengthen emergency preparedness. By working with Provincial/Territorial wildfire agencies and municipal/structural fire departments, communities can access available tools, training, and resources to help them assess their unique risks, and create customized action plans.

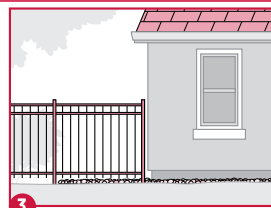
## Feature 1: Wildfire-Ready Structures & Infrastructure



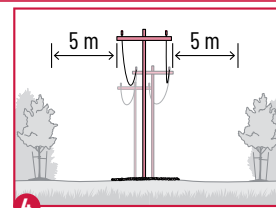
**1** Complete regular maintenance of structures, infrastructure, and landscaping within 10 m to limit accumulation of flammable materials (e.g., leaves, brush piles, stored items, fuel tanks).



**2** Install/replace landscaping with fire resistant materials within 10 m of structures and infrastructure.

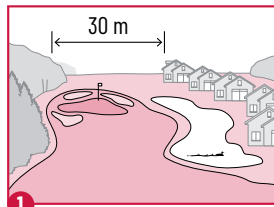


**3** Build/update structures and infrastructure using fire resistant building materials (e.g., Class A roofing/metal roofs, non-combustible siding, metal, or concrete hydro poles).

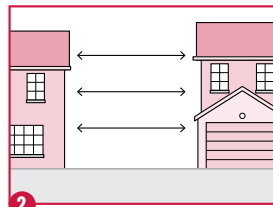


**4** Design/update structures and infrastructure to be ignition resistant (e.g., 5 m distance between vegetation and power lines, power supply lines below ground where feasible).

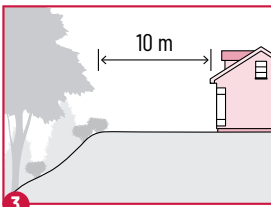
## Feature 2: Wildfire-Ready Community Design



**1** Integrate minimum 30 m wide zones (fire breaks) featuring ignition resistant materials (e.g., mowed grasses, ponds, roads) into community design to limit the spread of fire. Increase minimum to 50 m on steep slopes.



**2** Provide greater spatial separation between structures in hazard areas to limit the spread of fire from one structure to another.



**3** Require minimum 10 m setback from the crest of a hill to limit spread of fire to structures.

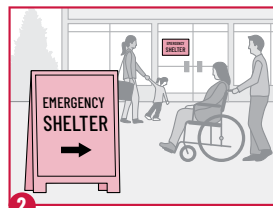


**4** Restrict development in hazard areas where mitigation measures cannot meet minimum standards for health, safety, and environmental protection.

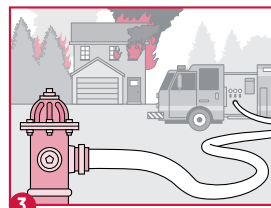
## Feature 3: Wildfire-Ready Emergency Response



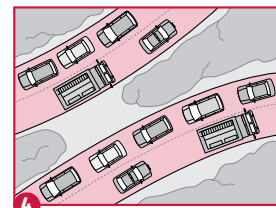
**1** Complete annual emergency planning and cross-training exercises that include multiple agencies (e.g., wildland and structural firefighters).



**2** Designate at least one emergency shelter per community.



**3** Ensure minimum water supply for firefighting.



**4** Provide two or more suitably sized access and egress routes to accommodate the movement of emergency vehicles.

Note: The guidance in this document is voluntary. Completion of actions should not conflict with applicable building and fire codes. Wildfire-ready communities can reduce but not eliminate risk.



**Figure 2:** Practical actions to improve community wildfire resilience.



# 1. The Urgent Need to Address the Growing Threat of Wildfires

Wildfires pose a growing threat to Canadian communities. When wildfires occur, they can cause extensive damage to buildings, disruptions to communities and can even result in death. In Canada, wildfires are projected to become more frequent and extreme, in part driven by climate change (Coogan et al., 2019). Climate change is irreversible (IPCC, 2023) – Canadians need to adapt now to protect themselves from the devastating impacts of wildfire.

An estimated 60% of Canadian communities are in the wildland-urban interface (WUI), the zone where human settlements meet or intermingle with wildfire-prone natural ecosystems, like forests and grasslands (Johnston and Flannigan, 2018). Currently an estimated 12.3% of the Canadian population lives in the WUI, including 32.1% of the on-reserve Indigenous population. (Erni et al., 2021). The expansion of human settlement in the WUI, coupled with a lack of nationally accepted minimum building standards for wildfire protection, and an increase in the amount and continuity of fuels (e.g., vegetation) surrounding communities as a consequence of roughly 100 years of fire suppression (Parisien et al., 2020), has exposed more people, structures and infrastructure to damage and disruption from wildfires. Additionally, the effects of climate change, such as prolonged periods of extreme hot, dry, and windy weather that create ideal conditions for wildfire ignition and fire spread, contributes to heightened risk (Bénichou et al., 2021).

Climate change is irreversible—  
Canadians need to adapt now  
to protect themselves from the  
devastating impacts of wildfire.

## 1.1 Wildfire and Climate Change

Climate change is increasing wildfire risk in Canada by lengthening the season of “fire weather”: hot, dry, and windy days that create more dry fuel, more lightning that ignites fuel, and strong winds that spread the flames (Bénichou et al., 2021). Wildfire season varies across the country, starting as early as April and ending typically in October (Coogan et al., 2020).

**According to historical records, current wildfire seasons start roughly one week earlier and end one week later than 70 years ago**

(Hanes et al., 2019). Scientists project that by the end of the century, fire weather season will be even longer, increasing on average by 30 days a year, but will vary across the country, with western Canada facing a 50% increase of hot and dry days, and eastern Canada a 200 to 300% increase (Wang et al., 2017).

Wildfire is part of the complex positive feedback loop that exacerbates climate change, which in turn, creates the ideal conditions for more fire.

Wildfires also contribute to climate change through the release of carbon dioxide into the atmosphere (Natural Resources Canada, 2022a). Over the past few decades, Canadian forests have shifted from being carbon sinks (removing carbon from the atmosphere), to becoming a source of carbon as the total annual area burned has increased (Natural Resources Canada, 2022a). In 2020, wildfires were the second highest contributor of greenhouse gas emissions in Canada from natural disturbances (ECCC, 2022). In 2023, wildfires released an estimated two billion tonnes of CO<sub>2</sub>, representing roughly triple the country’s annual carbon footprint (Cecco, 2023). In this way, wildfire is part of the complex positive feedback loop that exacerbates climate change, which in turn, creates the ideal conditions for more fire (Whitman et al., 2022).

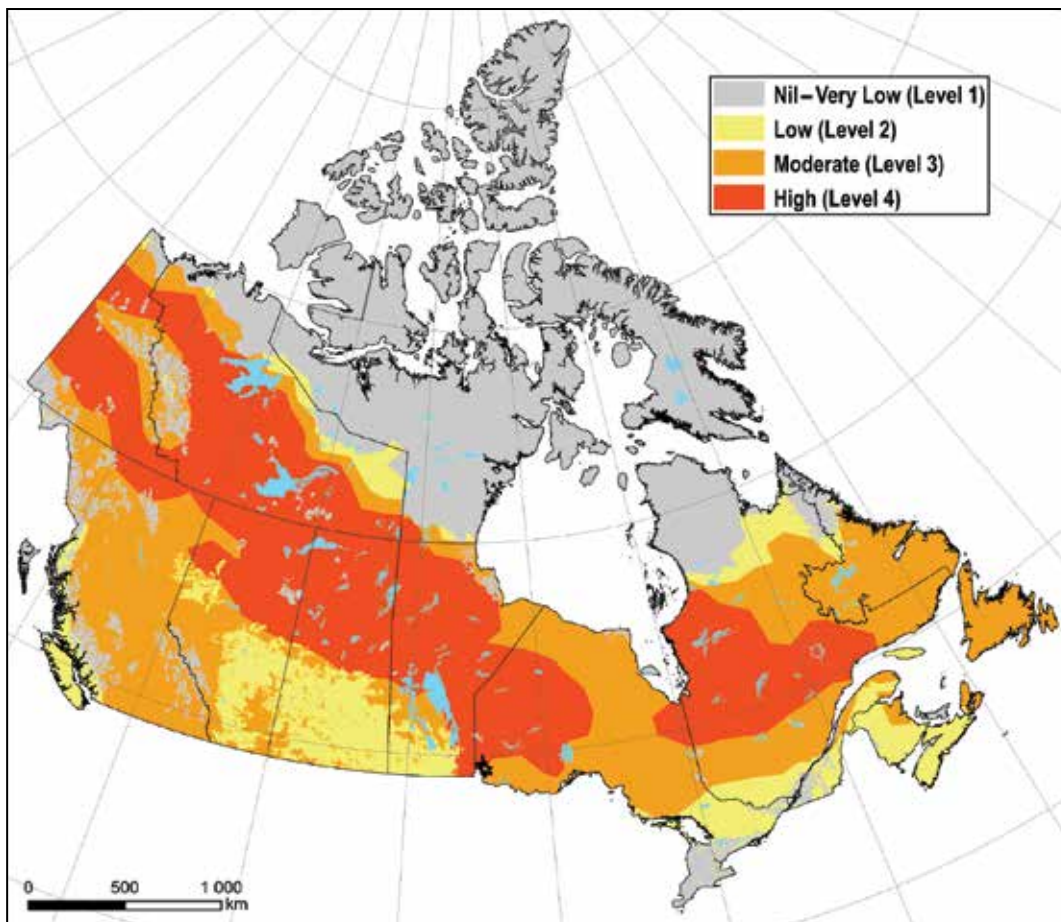
## 1.2 Impacts of Wildfire

Although wildfires have a variety of benefits in natural ecosystems (i.e., vegetation regeneration, soil nutrient dynamics, hydrology, etc.) (Coogan et al., 2020), when wildfires shift from consuming wildland fuels to human-made structures, their impact on communities can be catastrophic. Wildfire hazard varies widely

across the country, based on topography, weather, and the flammability of tree, shrub, and plant materials (fuel) (Figure 3). Figure 3 reflects historical conditions—however, currently, rapid changes in wildfire hazard are being observed in some parts of Canada including the interior of BC (Parisien et al, 2023). Impacts also vary widely across the country and can dramatically shift each year based on ignition of fuels, the ability of people to safely evacuate, and the amount of damage and disruption that occurs during and after a wildfire event. Impacts are often interconnected and compounding, but for the sake of simplicity, they are presented below as **physical, environmental, social, and economic**.

### 1.2.1 Physical Impacts

The impacts of wildfires can be severe, causing significant damage to property, critical infrastructure, and services that are essential to Canadians. Therefore, it is crucial to consider the wildfire hazard when designing, operating, and maintaining infrastructure and systems, including emergency-management. The following are specific examples of how wildfires can affect various systems, many of which are interconnected and can cause cascading impacts.



**Figure 3:** Historical wildfire hazard mapped from spatial burn probability outputs based on 30-year fire history. Retrieved from Bénichou et al., 2021. Note: map to be updated to reflect rapid changes in wildfire hazard that are currently being observed in some parts of Canada including the interior of BC (Parisien et al, 2023).

### **Power Supply**

When large wildfires occur, power lines and transmission towers may get knocked down, becoming a potential new source of ignition for wildfire, creating a safety hazard, and leading to power failures of critical infrastructure like hospitals and water treatment plants (Bénichou et al., 2021). This can lead to further endangering the community and firefighters, as well as limit water supply for fire suppression (Bénichou et al., 2021). Furthermore, downed power lines can also obstruct access or egress roads required for evacuations and hinder the firefighters' ability to reach the affected area (Bénichou et al., 2021). Power may also be cut off as a precautionary measure as a wildfire approaches a community, resulting in a variety of unintended consequences and underscoring the need for backup power supplies.

### **Telecommunications**

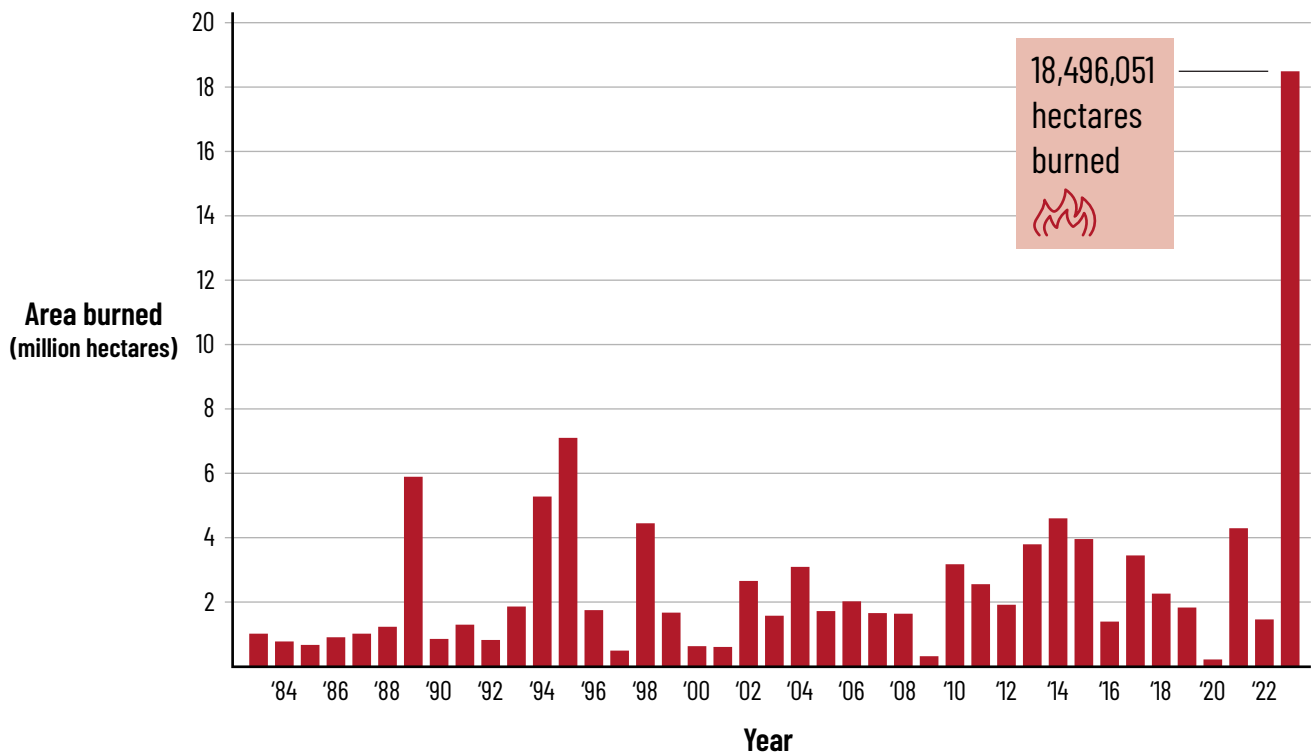
During wildfires, power outages can spread rapidly, severely impacting telecommunications. In 2019, a wildfire that tore through Pikangikum First Nation,

Ontario, burned the broadband communications line, leaving the community without phone service or internet access (CBC News, 2019). Similarly, in 2017, wildfires in British Columbia damaged a cellphone tower near Ashcroft Indian Band, complicating evacuation plans and search efforts for missing Band members (Government of British Columbia, 2018). These incidents highlight the critical importance of reliable communication systems during wildfire events.

### **Transportation**

During wildfires, access and egress roads play a vital role in facilitating evacuations and enabling firefighting services to reach affected communities (Bénichou et al., 2021). However, road closures during wildfire events can impede evacuation efforts and firefighting operations. Additionally, post-fire, there can be an increased risk of landslides in some areas, which can further disrupt road access, as exemplified by the temporary closure of a section of the Trans-Canada highway following the destruction of Lytton, BC. (CBC News, 2021).





**Figure 4:** Annual area burned in Canada. Adapted from: Canadian Interagency Forest Fire Centre, 2023.

## 1.2.2 Environmental Impacts

Certain wildfires can have extensive implications for the environment, including the loss of vegetation, and the potential for increased flood conditions (Morton et al., 2003). The following sections describe these impacts.

### Vegetation Loss

Wildfires that occur in dense, continuous, highly flammable ecosystems, such as boreal spruce forests, can generate intense heat and flames, and may consume vast areas of forest. Over the past 25 years, **the number of fires per year has declined overall but the area burned has doubled to an average of 2.3 million hectares per year (about half the size of Nova Scotia) and projections indicate the area could quadruple by the end of the century** (Hope et al., 2016). In 2023, the record for area burned in one year was shattered with a total estimated 18.5 million hectares (CIFFC, 2023), more than double the previous record of 7.1 million hectares, set in 1995 (Figure 4).

In addition to the loss of vegetation, climate change-influenced drought stress can cause other disturbances such as insect outbreaks and tree mortality, which can have cascading effects on ecosystems. These changes in forest composition can negatively alter the habitat of Canada's emblematic species, such as the Boreal woodland caribou (Barber et al., 2018). Additionally, heat and flames during a wildfire event and vegetation loss post-fire both contribute to wildlife mortality (Pau et al, 2023).

### Increasing Flood Conditions

Wildfire has long-lasting effects after the flames are extinguished, such as increased flood risk. In 2021, British Columbia had the fourth worst wildfire season on record, which was closely followed by a devastating flood season, destroying highways and submerging homes (Chung, 2021). When high-intensity fire burns through an area, heat and flames consume materials on the forest floor and leave behind scorched, water-repellent soil, increasing the risk of landslides,

and flooding for up to five years after a wildfire (Government of British Columbia, 2021; Federal Emergency Management Agency, 2020). If there is rapid snowmelt or an intense rainfall event, the post-wildfire impermeable soil can lead to the flooding of nearby homes (Government of British Columbia, 2021). These post-wildfire impacts can have severe consequences for communities and infrastructure downstream, amplifying the costs of recovery and impacts of wildfire beyond the initial event.

### 1.2.3 Social Impacts

Wildfires can have far-reaching effects on the physical and mental health, as well as overall wellbeing, of affected communities. Below are some of the main social impacts.

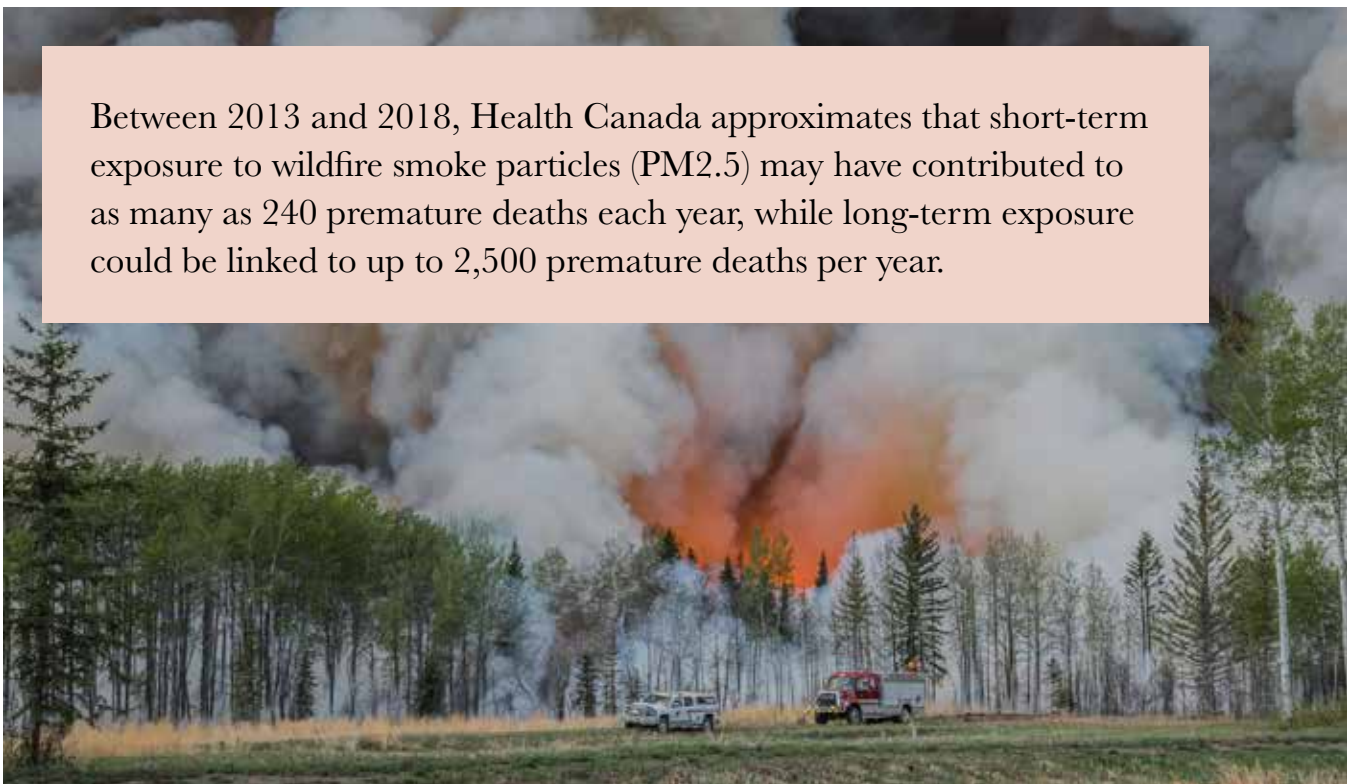
#### Physical Health

Wildfire smoke can be carried in the wind for thousands of kilometres, crossing international boundaries and

exposing large populations to airborne contaminants (Lavoue and Stocks, 2011). The smoke contains small particles that can easily enter the lungs and bloodstream (Government of Canada, 2023) causing breathing problems, and affecting heart health (Rosenthal et al., 2021). In addition, the toxic particles from smoke and the ash from burned materials can enter surface waters and contaminate the local drinking water, which can increase the risk of cancer (Rosenthal et al., 2021).

Between 2013 and 2018, Health Canada approximates that short-term exposure to wildfire smoke particles (PM<sub>2.5</sub>) may have contributed to as many as 240 premature deaths each year, while long-term exposure could be linked to up to 2,500 premature deaths per year (Government of Canada, 2023). Additionally, wildfire season can coincide with extreme heat events, simultaneously exposing populations to an increased risk of smoke inhalation and of heat stroke (Government of Canada, 2023; Eyquem and Feltmate, 2022).

Between 2013 and 2018, Health Canada approximates that short-term exposure to wildfire smoke particles (PM<sub>2.5</sub>) may have contributed to as many as 240 premature deaths each year, while long-term exposure could be linked to up to 2,500 premature deaths per year.



**Figure 5:** Smoke and fire danger require the closure of a community road. Courtesy of FireSmart Alberta, 2023.

## Mental Health and Wellbeing

Wildfires take a toll on the mental health and wellbeing of impacted community members. There is increasing evidence that following the destruction of one's home, loss of belongings, and the threat to the safety of the community, **survivors suffer from anxiety, depression, post traumatic stress disorder, and substance abuse** (To et al., 2021). Following a severe wildfire season in the Northwest Territories (NT) in 2014, community members reported feeling “fear, stress, uncertainty and isolation” due to the constant threat of wildfire and presence of smoke (Dodd et al., 2018).

When community members are given evacuation orders, they may experience anxiety and post-traumatic stress, particularly when separated by long distances and if orders last a long time or happen frequently

(Dodd et al., 2018). In August 2023, Yellowknife, NT, declared a state of emergency and issued the territory's largest evacuation order to date to its 20,000 residents (Minogue, 2023). The evacuation lasted 22 days (Austen, 2023), with some residents travelling over 2,000 km to safety (Jones, 2023). The number of wildland fire evacuations and number of evacuees has been steadily rising in Canada, since the 1980's (Natural Resources Canada, 2020), with 2023 setting a record of 200,000 residents evacuated for the year (Peters, 2023).

**Firefighters experience physical and mental health challenges that far exceed those of the broader population.** Firefighters face cancer, traumatic injury, cardiovascular disease, respiratory disease, and mental health deterioration (Ramsden et al., 2018).

## Box 1.1 Fort McMurray Wildfire Recovery

In 2016, a catastrophic wildfire swept through Fort McMurray, triggering the largest evacuation in Alberta's history, with more than 88,000 people forced to flee their homes. The slow process of recovery contributed to the financial and emotional distress of hundreds of families who not only lost their homes, but in seeking temporary housing were disconnected from their jobs, schools, friends, and neighbours. Seven years after the devastating event, the community has made significant strides toward recovery. However, **it took two years to repair just 20% of the 2,400 homes and commercial buildings that were damaged by the wildfire** (CTV News, 2018). Six years after the fire, 86% of the affected structures had been reconstructed, with about 244 remaining lots that still await redevelopment (McDermott, 2022).





It can take years for a community to recover from wildfire (Box 1.1), adding to the mental health challenges experienced by survivors.

### 1.2.4 Economic Impacts

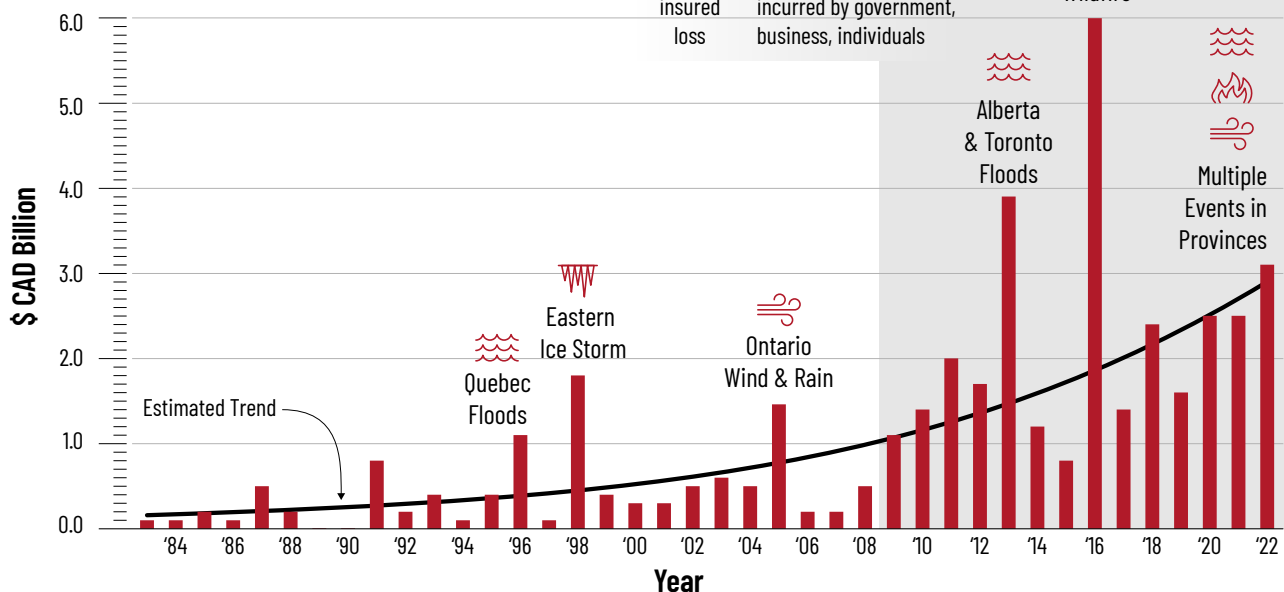
Until 2003, no single wildfire event had caused insured losses exceeding \$10 million. In the years since, insurers have had to pay out between \$250 million and \$3.8 billion for five separate wildfires (Bénichou et al., 2021). For every dollar that is covered by insurers, it is estimated that an additional \$3 - 4 in uninsured costs are borne by residents, businesses, and governments (Figure 6). **Since 2010, 19% of the Federal Government’s Disaster Financial Assistance Arrangement expenditures have been spent supporting recovery from wildfire** (Porter et al., 2021).

In the last decade alone (ending 2020), the cost of fire suppression in Canada has increased to an average

of \$1 billion annually (Hoffman et al., 2022b). When the total direct fire damage and indirect costs (such as environmental, economic, and social impacts) are considered, the average rises to \$2 - \$30 billion annually (Hoffman et al., 2022b). As WUI wildfires increase in frequency and severity, **Canada will need to double its current fire suppression budget by 2040 to maintain the same level of protection** (Bénichou et al., 2021; Wooten et al., 2017).

Proactive funding for wildfire risk reduction and emergency preparedness is disproportionately low compared to direct suppression costs (e.g., on the ground firefighting personnel, water bombers, etc.), often less than 10% (Hoffman et al., 2022b). In some jurisdictions, while budgets for proactive and reactive fire suppression are increasing, those designated for fuel management and emergency preparedness remain insufficient to adequately support risk reduction in at-risk communities. Population growth and climate change will put additional strains on limited risk

## Costs of Extreme Weather: Catastrophic Insurable Losses



Source: IBC Facts Book, PCS, CatIQ, Swiss Re, Munich Re & Deloitte

Note: values in 2022\$ CAN, corrected for inflation and per capita wealth accumulation.

**Figure 6:** Annual catastrophic insurable losses in Canada from 1982-2022 (IBC, 2023).

reduction-focused budgets, unless significant new investments are made (Tymstra et al., 2020).

Proactive funding for wildfire risk reduction and emergency preparedness is disproportionately low compared to direct suppression costs, often less than 10%.

### Health-Related Financial Impacts

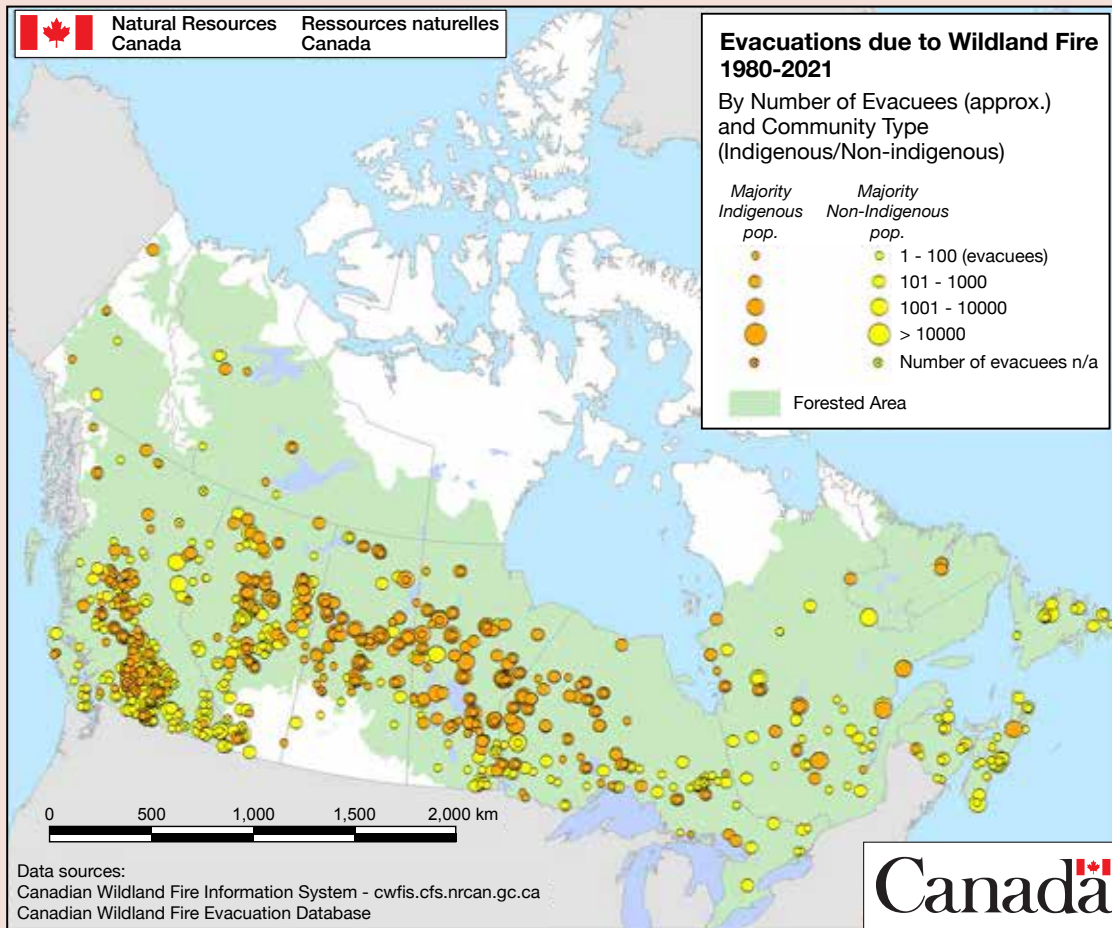
Wildfire events can have significant financial impacts associated with public health, from the direct costs of medical treatment as well as indirect costs, such as lost productivity. In the case of acute impacts, such as medical expenses and lost work time, estimates range from \$410 million to \$1.8 billion per year in Canada (Matz et al., 2020). However, when considering the long-term or chronic health impacts, the total cost rises substantially to between \$4.3 billion and \$19 billion annually (Matz et al., 2020).



## Box 1.2 Disproportionate Impacts on Indigenous Peoples

First Nations, Inuit and Métis communities face disproportionate impacts from wildfires in Canada. This is due in part to their greater exposure to wildfire hazards, as 60% of Indigenous communities are in remote and forested regions with limited access to firefighting personnel and equipment.

**Indigenous communities are 30% more likely to be evacuated due to wildfires than non-Indigenous communities**, a stark disparity that underscores the impact of these events on Indigenous Peoples (Figure 7) (McGee et al., 2019; Natural Resources Canada, 2022).



**Figure 7:** Evacuations due to wildland fire 1980-2021 by community type, retrieved from Natural Resources Canada, 2022.

Indigenous Peoples are often removed from their traditional territories during evacuations, causing significant disruptions to their daily lives and having negative impacts on their mental health and overall wellbeing. Additionally, these evacuations may bring back historical trauma stemming from past forced relocations and government interference in the lives of Indigenous Peoples. (National Collaborating Centre for Indigenous Health (NCCIH), 2022).



## 2. Wildfire Management Across Canada

Wildfires are a necessary and beneficial natural disturbance in many of Canada's vast wildland ecosystems, such as forests and grasslands. About half of wildfires are ignited by lightning and play an important role in maintaining the health and diversity of the landscape (Natural Resources Canada, 2022b). However, when wildfires shift from consuming natural fuels to consuming materials that humans value to safely live, work and play, they become natural disasters. These values at risk include structures, infrastructure, natural and cultural assets that hold significant measurable or intrinsic worth (Bénichou et al., 2021). Effective wildfire management can help prevent loss of life, minimize economic and social disruption, and promote the ecological role of wildfire (Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNR), 2014; Canadian Council of Forest Ministers, 2005 ).

# Wildfire Fast Facts



## How Do Wildfires Start?



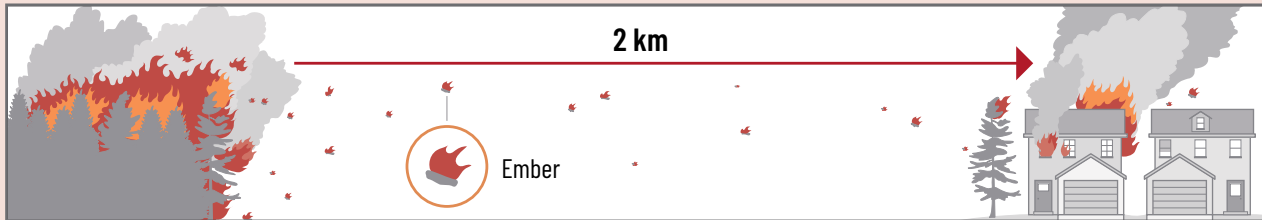
**ABOUT 50%** of wildfires across Canada are ignited by humans (e.g., vehicle and engine use, industrial activity, windborne embers from open burning, arson, etc.).



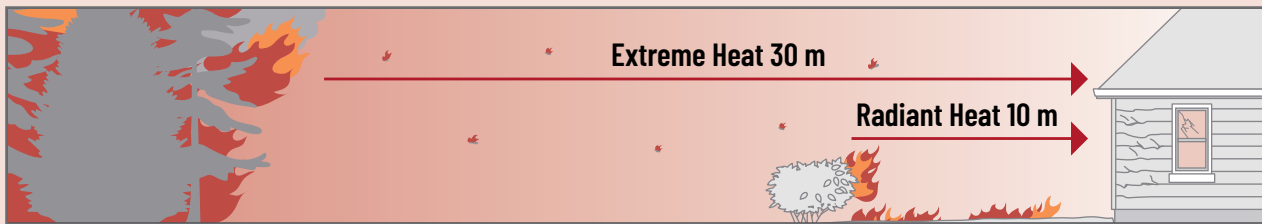
**ABOUT 50%** of wildfires are ignited by lightning.

## How Do Wildfires Spread into Communities?

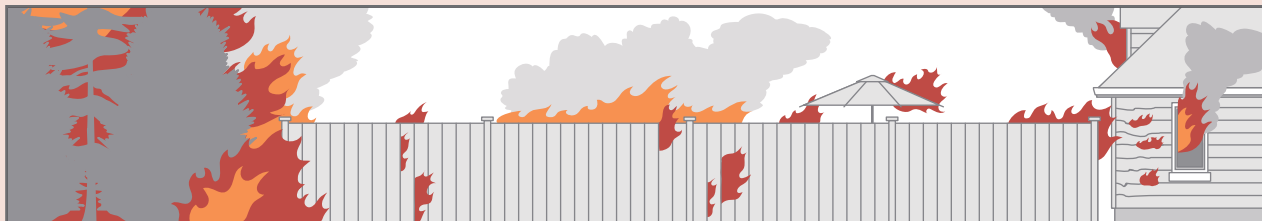
**Embers** – These small burning fragments, produced by wildfires, **can be carried by wind and hot air 2 km or more from the active wildfire**. These embers can ignite flammable materials on and around the home.



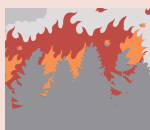
**Extreme and Radiant Heat** – Fires can generate extreme heat up to 30 m away from flames, making flammable materials more vulnerable to ignition. Radiant heat can break glass, melt siding and ignite flammable materials up to 10 m away from flames.



**Direct Flame** – Wildfires spread by igniting flammable materials with which they come in direct contact.



## What Factors Influence Wildfire Spread?



**Continuous Vegetation** – The burning of vegetation generates intense heat and flame. Flames can move more quickly in areas with continuous vegetation than those with sparse, patchy vegetation. Flames can move horizontally by igniting ground-level materials and vertically by climbing from the ground into tree crowns.



**Weather** – Prolonged periods of hot, dry weather can make vegetation more susceptible to ignition. Wind can help to speed up the movement of fire on the ground and transport burning embers 2 km away or more, igniting multiple fires upon landing on flammable materials.

**Slope** – Wildfires can move more quickly on slopes than on flat surfaces. The steeper the slope, the faster wildfires can spread.

(Adapted from FireSmart BC Homeowners Manual)

## 2.1 Shifting the Way Wildfires are Managed

Approaches to managing wildfires in Canada have shifted over time (Pyne, 2008). For millennia, Indigenous Peoples have used preventative (cultural) burning techniques to mimic natural burn cycles. For example, Fire Keepers Joe Gilchrist (Secwepemc and Nlaka'pamux Nation) and Harry Spahan (Coldwater First Nation) note that a fire cycle for grassland is 2 years, ponderosa pine is 7-15 years, and lodgepole pine is 60-100 years (FireSmart Canada, 2020). Cultural burning is an integral part of land stewardship practices and plays a significant role in reducing wildfire risk by managing fuel loads and controlling the frequency, timing, and severity of fires (Christianson, 2015). These small, intentional “good fires” encourage the growth of culturally significant plants used for food and ceremonial purposes, and attract game animals, which are hunted for sustenance, clothing, and shelter (FireSmart Canada, 2020).

Cultural burning is an integral part of land stewardship practices and plays a significant role in reducing wildfire risk by managing fuel loads and controlling the frequency, timing, and severity of fires.

European settlement and colonization in Canada led to the systemic displacement of Indigenous Peoples and prohibition of cultural burning, shifting the dominant risk reduction approach from proactive to reactive. Fire suppression became the primary means of protecting “values at risk” (Dupuis et al., 2020; Hoffman et al., 2022a). The interruption of natural fire cycles led to homogenous, densely vegetated

landscapes characterized by a buildup of dead and diseased materials, which in turn, contributed to the development of larger, more intense “bad fires,” increasing the threat to communities (Cohen, 2008; Parisien et al., 2020).

Wildfire research in Canada gained momentum in the 1960s, resulting in another paradigm shift in wildfire management. This shift recognized the role wildfire plays in ecological processes. Current management policy includes a range of approaches including full suppression, fuel management, and allowing fires to burn (Coogan et al., 2020).



**Figure 8:** Controlled burn. Courtesy of FireSmart Alberta, 2023.

About half of forest fires in Canada do not pose an immediate threat to populated or timber harvesting areas, and as a result, they are not actively suppressed by wildland firefighters (Johnston, 2016). Proactive fuel management strategies are regaining recognition as vital to limiting fuel pathways from wildlands to human-made structures. Unfortunately, longer wildfire

seasons may reduce the number of days available to apply weather-dependent fuel management strategies, such as controlled burns. Common fuel management strategies include:

1. **fuel removal** - tree extraction and controlled burns (Figure 8),
2. **fuel reduction** - grazing, mowing, pruning, thinning, mulching vegetation (Figure 9), and
3. **species conversion** - replacing highly flammable vegetation (coniferous) with less flammable vegetation (deciduous) (Government of Alberta, 2013).

### A Whole-of-Society Approach to Wildfire Management

The management of wildfires in Canada is evolving to embrace a comprehensive, whole-of-society approach aimed at enhancing the resilience of communities (Public Safety Canada, 2019). Creating wildfire-ready communities requires collaboration between wildfire management agencies, communities, Indigenous Peoples, industry, property owners and managers (Canadian Council of Forest Ministers, 2021, Natural Resources Canada, 2020).



**Figure 9:** Forest thinning. Courtesy of FireSmart Alberta, 2023.

## Wildfire Fast Facts



### The WUI Disaster Sequence

Hot, dry conditions, particularly exacerbated by multi-year droughts, render wildland tree, shrub and plant materials—such as those found in forests as grasslands—more prone to ignition. Once ignited, high winds can cause wildfires to spread rapidly, fueled by a combination of direct flame, radiant heat, and floating embers that can travel up to 2 km or more and ignite materials. When multiple embers land and ignite flammable materials within a community, it becomes challenging for firefighters to extinguish all fires that pose a threat to valued assets. Once multiple structures ignite, inadequate supply of firefighting equipment and personnel make it impossible to extinguish all fires, leading to the rapid spread of flames from building to building, ultimately culminating in a WUI wildfire disaster.

### Breaking the WUI Disaster Sequence

The most effective way to break the WUI disaster sequence is to reduce the property level vulnerability of structures and infrastructure to wildfire ignition. Jack Cohen, US Forest Service Scientist explained very simply, **“If homes do not ignite, they cannot burn... If homes do not burn, then disaster is avoided”** (Calkin et al., 2014).

## Practice Guidance

### A National Guide for Wildland-Urban

**Interface Fires (WUI Guide):** the National Research Council, Canada's foremost federal research and development organization, released a comprehensive WUI Guide (Bénichou et al., 2021), which identifies national best practices for enhancing the resilience of buildings, infrastructure, and communities in the face of wildfire threats.

**FireSmart Canada:** FireSmart Canada is a national program that has been working with communities in the wildland-urban interface (WUI) for 30 years to develop action-focused educational materials and training programs that aim to reduce wildfire risks and enhance resilience to wildfires. FireSmart Canada works closely with its provincial and territorial chapters and operates under a mandate from the Canadian Interagency Forest Fire Centre (CIFFC).

To improve community wildfire resilience, FireSmart Canada advocates for the balanced application of a suite of preventative actions that are divided into categories known as **The Seven FireSmart Disciplines**: 1) **Interagency Cooperation**, 2) **Education**, 3) **Vegetation Management**, 4) **Legislation**, 5) **Development**, 6) **Emergency Planning**, and 7) **Cross Training**.

The Seven FireSmart Disciplines can be applied as a comprehensive system over time to develop and implement a coordinated, community-based action plan that addresses a community's unique risks and priorities for action. This approach empowers communities to create their own customized risk reduction strategies and to coordinate the collective efforts of multiple stakeholders. Applying FireSmart as

a system allows communities to achieve the following objectives (Figure 10):

1. Enhance collaboration and coordination of all community stakeholders and rights holders
2. Educate and empower the whole-of-society to take preventative action
3. Reduce wildfire risk in a systematic way throughout the community
4. Improve emergency response to enhance protection of values at risk and public safety

### Applying the FireSmart™ System to Strengthen Community Wildfire Resilience



#### Enhance Collaboration and Coordination



Interagency Cooperation

#### Reduce Wildfire Risk



Vegetation Management



Legislation



Development



Education

#### Improve Wildfire Response



Emergency Planning



Cross Training



FireSmart™, Intelli-Rev and other associated Marks are trademarks of the Canadian Interagency Forest Fire Centre (CIFFC).

**Figure 10:** The FireSmart System. Courtesy of Stewart and Evans, 2023.



## 2.3 Roadmap to Wildfire Resilience

In 2023, the Government of Canada released its first **National Adaptation Strategy (NAS)** (ECCC, 2023a)—a roadmap to create a more climate resilient Canada that is achieved by employing a whole-of-society approach. The NAS highlights wildfire, flood, and extreme heat as the primary climate-influenced perils affecting Canada and emphasizes that building resilience to these perils requires a collective effort. This means that all levels of governments, Indigenous Peoples, communities, non-governmental organizations, individuals, and the private sector must work together and coordinate their efforts to minimize costs and achieve maximum benefits.

The core guiding principles of the NAS include:

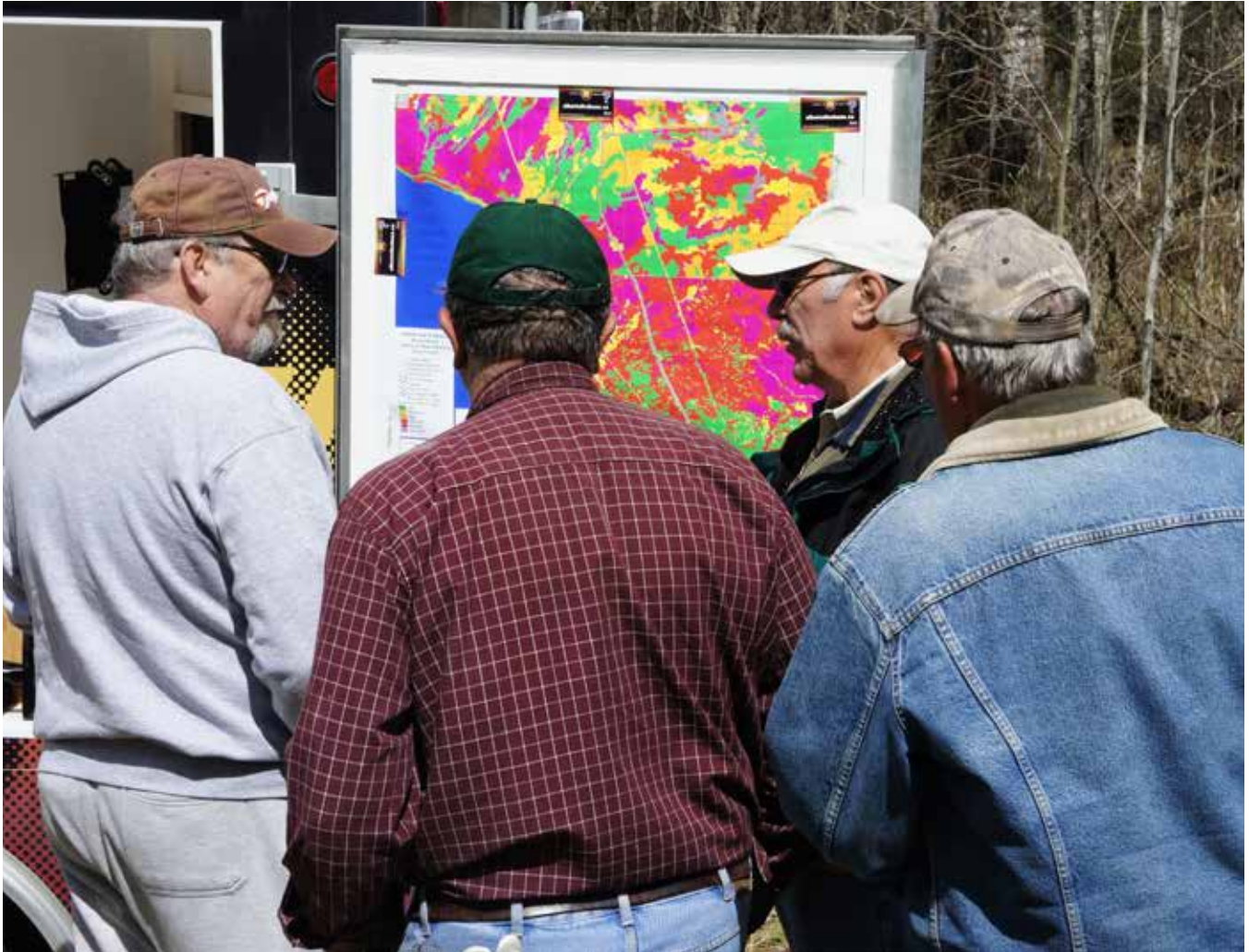
1. respecting and upholding Indigenous rights,
2. advancing equity and environmental justice,
3. taking proactive, risk-based measures to reduce climate impacts, and
4. maximizing benefits when planning for the future by considering multiple perils (such as extreme heat, flooding and wildfires) to avoid addressing one problem while causing another (maladaptation).

The NAS established short-term targets that can be achieved TODAY to help community members from the whole-of-society to embark on a collective journey to reduce risk, prepare for emergencies, and “build back better” following a wildfire event. The targets are:

- **Risk Awareness** – By 2025, 60% of Canadians, including northerners and Indigenous Peoples, are aware of the disaster risks facing their household.

The **NAS** established short-term targets that can be achieved TODAY to help community members from the whole-of-society to embark on a collective journey to reduce risk, prepare for emergencies, and “build back better” following a wildfire event.

- **Preventative Action** – By 2025, 50% of Canadians have taken concrete actions to better prepare for and respond to climate change risks facing their household (see Figure 11).
- **Community Protection Plans** – Communities, including northern and Indigenous communities, in zones of high risk, as identified by provinces and territories, develop wildfire community prevention and mitigation plans by 2030, with up to 15% implemented by 2028.
- **Building Back Better** – By 2025, complete the modernization of the Disaster Financial Assistance Arrangements to incentivize disaster risk reduction and improve recovery outcomes from large-scale disasters.



**Figure 11:** A FireSmart expert leads a community planning exercise. Courtesy of FireSmart Alberta, 2023.



**Figure 12:** Neighbours work together to reduce risk during Wildfire Community Preparedness Day. Courtesy of FireSmart Alberta, 2023.

# 3. Practical Guidance to Create Wildfire-Ready Homes and Communities

This chapter summarizes nationally recognized best practice guidance to improve wildfire resilience by taking practical actions to create wildfire-ready homes and communities. By working together, residents, Indigenous Peoples, industry, businesses, non-governmental organizations, and governments can reduce disaster risks, and in turn minimize the physical, environmental, social, and economic impacts associated with WUI wildfires and get “back to normal” as quickly as possible following a wildfire event (see Figure 12).

*Implementing wildfire-ready guidance can help to reduce but not eliminate risk, much like speed limits on highways cannot guarantee “no accidents”.*

**Three Steps to a Cost-Effective FireSmart Home** and **Three Features of a Wildfire-Ready Community** were developed to complement and reinforce the best practices identified in the following publications:

1. **National Guide for Wildland-Urban Interface Fires** (Bénichou et al., 2021),
2. **Wildfire-Resilience Best-Practice Checklist for Home Construction, Renovation and Landscaping** (FireSmart Canada et al., 2022b),
3. **FireSmart Begins at Home: Home Development Guide** (FireSmart Canada, 2018a), and
4. **FireSmart Guidebook for Community Protection** (Government of Alberta, 2013).

The best practice guidance provided may have limited applicability to remote and Indigenous communities; additional research is needed to address these gaps. Please see the source documents for a full list of all best practices.

### **Voluntary Best Practice Guidance**

At this point in time, **Canada’s National Building Code** and **Canada’s National Fire Code** (both updated in 2020), do not include specific requirements to improve the wildfire resilience of homes and structures in the wildland-urban interface. Building codes also differ among provinces and territories. The best practices listed in this chapter should therefore be considered voluntary and should not conflict with applicable building codes (Bénichou et al., 2021).

## **3.1 Wildfire-Ready Homes**

Wildfire-ready homes are resistant to ignition. If they do ignite, they sustain lower levels of damage than wildfire-vulnerable homes. This means lower repair costs, and less time to restore, allowing families to “get back to normal” faster than those in wildfire-vulnerable homes. Wildfire-ready homes are NOT fireproof and are NOT intended to provide safe shelter to residents during a wildfire event. **Residents should be aware of provincial, territorial, and local wildfire alerts and work with family, friends and neighbours to safely evacuate when ordered to do so** (Porter et al., 2021).

### **3.1.1 Benefits of Improving Home Wildfire Resilience**

Every resident faces unique risks, has unique opportunities to address those risks, and a unique set of opportunities and resources available to help them improve resilience. For example, only property owners can authorize physical changes to the structure of the home, not tenants. However, both tenants and owners typically have authority to complete important maintenance activities such as mowing lawns and moving firewood at least 10 m from the home.

**Between 50-90% of homes that are destroyed by wildfires are initially ignited by burning embers.** Up to 40% reduction of wildfire risk can be achieved by replacing fire-vulnerable with fire-resistant materials. **Up to 75% reduction of wildfire risk can be achieved by updating both building materials and landscaping materials to 10 m away from the home** (Czajkowski et al., 2020).

FireSmart Canada describes the Home Ignition Zone as the area within 30 m of a home and its attachments (such as decks) that have a direct influence on the potential for home ignition by wildfires (Figure 13). To achieve the most significant risk reduction, residents should prioritize actions starting at the home and moving out to 30 m. Actions taken in the Immediate

Zone (0 to 1.5 m) reduce the chance that wind-blown embers will ignite the home. Actions taken in the Intermediate Zone (1.5 to 10 m) reduce the likelihood that fire will spread to the home. Actions in the Extended Zone (10 to 30 m) are designed to help reduce the intensity (extreme heat generated) by the flames (FireSmart Canada, 2023). Follow these same steps to protect sheds and outbuildings (Czajkowski et al., 2020).

By completing a series of cost-effective steps, residents can reduce the likelihood that their home and materials surrounding it will ignite. Working with neighbours to complete preventative actions is critically important to reduce the likelihood that fire will spread from one property to another, and to prepare for safe evacuation during a wildfire emergency.

### 3.1.2 Three Steps to a Cost-Effective FireSmart™ Home

**Three Steps to a Cost-Effective FireSmart Home** highlights practical actions that residents can take to make their home and property more resistant to wildfire ignition and minimize damage if ignition occurs (Figure 14). The guide identifies “no-cost” maintenance activities, “low-cost” upgrades, and “costlier”, more complex upgrades that can be planned for and completed as time and budget permits.

#### Integrating Wildfire Resilience into New Builds

Wildfire resilience can be integrated most cost-effectively into home and landscaping design and construction when a new home is being built, rebuilt following a wildfire, or when a new addition is being



**Figure 13:** Home Ignition Zone, reproduced with the permission of FireSmart Canada, 2023.

added. Using fire-resistant instead of fire-vulnerable building materials adds an estimated 2% to new construction costs (Porter et al., 2021).

### Taking a Multi-Hazard Approach to Achieve Multiple Benefits and Avoid Maladaptation

When planning actions to improve wildfire resilience it is also important to consider opportunities to achieve multiple benefits and improve resilience to overall climate-related risks, such as flood, wildfire, extreme heat, hail, and wind. For example, in locations that are prone to wildfire and extreme heat, ground cover, plants, shrubs and trees within 10 m of the home can be selected that are both ignition resistant and drought tolerant.

It is also important to avoid maladaptation, or fixing one problem while creating another. For example, if a roof is being updated to be wildfire resilient and the home is located in an area that regularly experiences hailstorms, installing a metal roof that will be vulnerable to hail damage should be avoided.

Through careful planning and consideration of multiple extreme weather perils, residents can implement short-, medium- and long- term plans to create a **climate-ready home**.

## Wildfire-Ready Home Fast Facts



For high-hazard communities that implement wildfire-ready best practices over a 10-year period:

### Cost to Benefit Ratio of Wildfire-Ready Home Retrofits

**Building Materials:** homes save an estimated \$14 for every dollar invested in replacing fire-vulnerable with fire-resistant materials.



**Landscaping:** homes save an estimated \$32 for every dollar invested in replacing highly combustible vegetation with ignition-resistant vegetation.

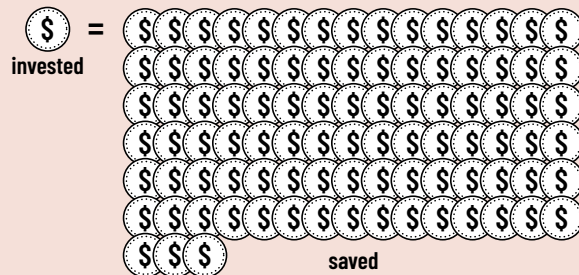


### Cost to Benefit Ratio of Wildfire-Ready New Construction

**Building Materials:** homes save an estimated \$34 for every dollar invested in non-combustible construction.



**Landscaping:** homes save an estimated \$93 for every dollar invested in ignition-resistant vegetation.

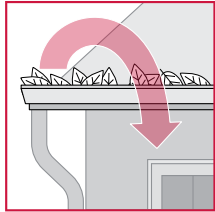


From Porter et al., 2021

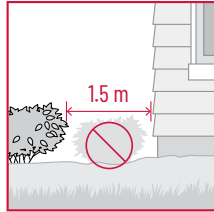
# THREE STEPS TO A COST-EFFECTIVE FIRESMART™ HOME

## Step 1: Maintain what you've got at least twice per year

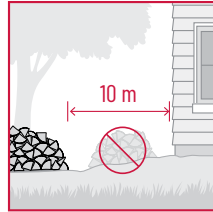
Do-it-yourself, \$0 - \$300



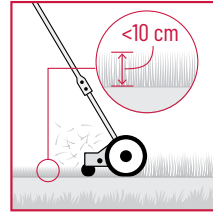
**1** Remove needles, leaves and other debris from gutters, roof surfaces, decks and balconies. Regularly clean vents.



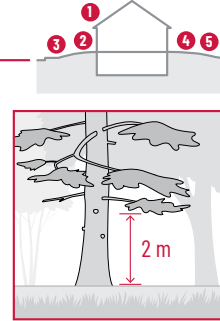
**2** Remove all combustible ground cover (mulch and plants) within 1.5 m of the house perimeter.



**3** Remove combustible materials (firewood and lumber) stored within 10 m of house perimeter and under decks.



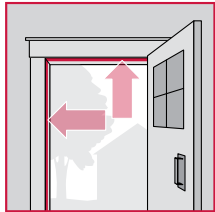
**4** Mow the lawn to <10 cm and plant low-growing, well-spaced shrubs and other fire-resistant plants.



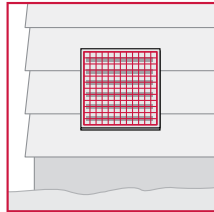
**5** Prune trees to create a 2 m clearance from the ground to the lowest tree branches.

## Step 2: Complete simple upgrades

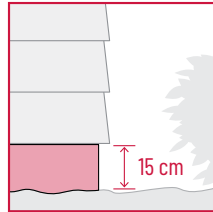
\$300 - \$3,000



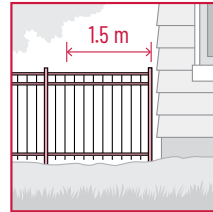
**1** Replace worn or missing weather stripping on all doors including garage doors.



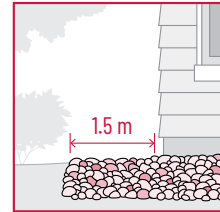
**2** Add a non-combustible 3 mm screen to all external vents, except dryer vents.



**3** Create a 15 cm ground-to-siding non-combustible clearance (e.g., install cement board or metal skirting).



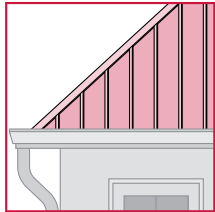
**4** Install non-combustible fencing within 1.5 m of the house (cement fiber, metal, chain link or stone).



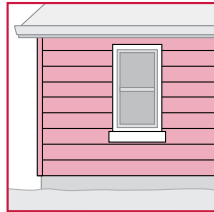
**5** Install non-combustible ground surfaces within 1.5 m of the house (mineral soil, rock, concrete or stone).

## Step 3: Complete more complex upgrades

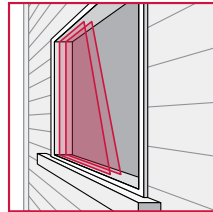
Work with a contractor, \$3,000 - \$30,000



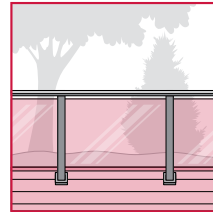
**1** Install Class A fire-rated roof covering (e.g., cement fibre, metal or asphalt shingles).



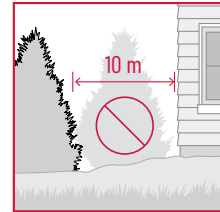
**2** Install non-combustible siding (stucco, metal, stone, cement fibre board).



**3** Install multi-pane or tempered glass windows and exterior fire rated doors.



**4** Retrofit all deck components to be fire-rated, with a continuous surface.



**5** Remove conifer trees that are within 10 m of the house.

Note: not all actions will be applicable to each home. Completing these steps does not eliminate the risk of home or structure ignition.

**INTACT CENTRE**  
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 **UNIVERSITY OF WATERLOO**

 **FireSmart**  
Canada

Scan the code or click the link for additional resources at [www.intactcentre.ca](http://www.intactcentre.ca)



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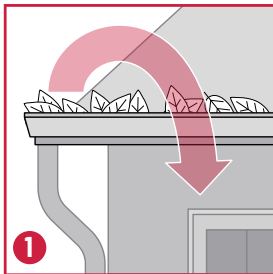
**Figure 14:** Practical actions to improve home wildfire resilience (ICCA and FireSmart Canada, 2022).

### Three Steps to a Cost-Effective FireSmart Home

Residents can assess their unique risks and complete three cost-effective steps to reduce the likelihood that wildfires will spread to their homes and to minimize damage if ignition occurs (Figure 14). For actions listed under Step 3, residents should check with their local/regional government about permit requirements and availability of wildfire-ready retrofit and new construction subsidies.

#### Step 1: Maintain What You've Got at Least Twice per Year (\$0-\$300 )

Complete these low-cost maintenance tasks on a regular basis to reduce the likelihood that burning embers from wildfires will ignite flammable materials on and around the home. These actions will also reduce the likelihood that ignited materials on the property will provide a “fuel” pathway to the home and to neighbouring properties.



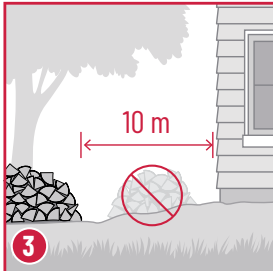
**Remove needles, leaves and other debris from gutters, roof surfaces, on or under decks, and balconies. Regularly clean vents.**

Regularly remove fine, highly flammable materials (such as pine needles and leaves) that collect on the structure and surfaces within 10 m of structures and attachments.



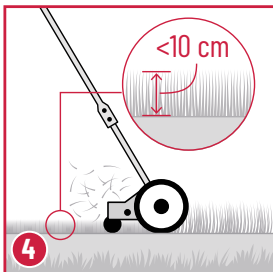
**Remove all combustible ground cover (mulch and plants) within 1.5 m of the house perimeter.**

Create a “non-combustible” zone within 1.5 m of all structures and attachments that feature materials such as gravel, brick, or concrete. Remove plants and decorative items such as planter boxes from this area.



**Remove combustible materials (firewood and lumber) stored within 10 m of the house perimeter and under decks.**

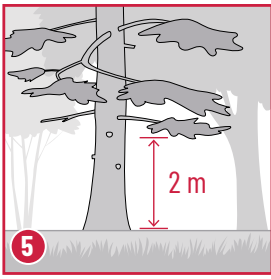
Remove combustible materials such as firewood and construction material at least 10 m from structures and attachments.



**Mow the lawn to <10 cm and plant low-growing, well-spaced shrubs, and other vegetation.**

Install well-spaced, low-growing, ignition-resistant plantings within 1.5 - 10 m of the home. Regularly mow lawns to maintain a height below 10 cm.



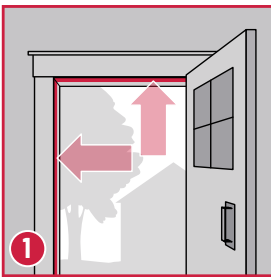


**Prune evergreen trees to create a 2 m clearance from the ground to the lowest tree branches.**

Remove the bottom branches up to a height of 2 m, to a maximum of 1/3 crown (needles and branches) on evergreen trees within 10 - 30 m of the home to prevent ground-level flames from climbing into the upper tree branches.

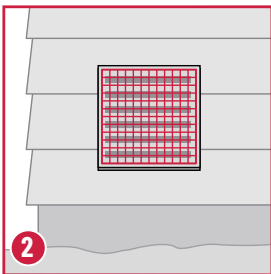
**Step 2: Complete Simple Upgrades (\$300-\$3,000)**

Complete simple upgrades to reduce the likelihood of home ignition by preventing burning embers from entering the home and by using only non-combustible materials within 1.5 m of the home. Residents can complete these simple, low-cost upgrades themselves or with the help of a qualified contractor.



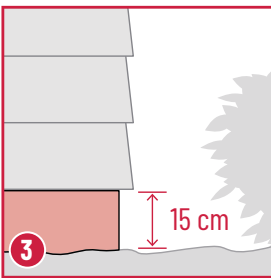
**Replace worn or missing weather stripping on all doors, including garage doors.**

Fill gaps and cracks where burning embers can enter your home and cause ignition. Replace worn or missing weather stripping on all doors, including garage doors. Use fire resistant caulking or sealing products to seal exterior penetrations, joints, and gaps.



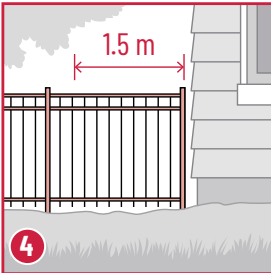
**Add a non-combustible 3 mm screen to all external vents, except dryer vents.**

Fit external vents with 3 mm non-combustible screens to prevent ember penetration into the home. To ensure the safe discharge of hot air and dryer lint from the home, do not install screens on dryer vents or solid fuel or gas heating appliances. Clean dryer vents regularly.



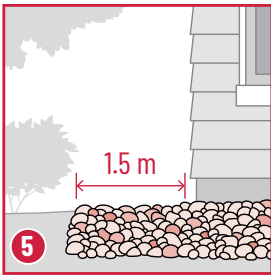
**Create a 15 cm ground-to-siding non-combustible clearance (e.g., install cement fibre board or metal skirting).**

Ensure that exterior siding ends 15 cm above grade. Cover the exposed foundation between grade and siding with non-combustible material such as stucco, metal, stone, or cement.



**Install non-combustible fencing within 1.5 m of the house (e.g., cement fibre, metal, chain link or stone).**

To reduce the likelihood that flames will move from the fence to the home, ensure that any fence panel within 1.5 m of the home is made of non-combustible materials such as cement fibre, metal, chain link or stone.

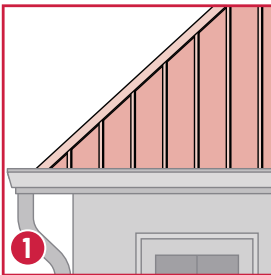


**Install non-combustible ground surfaces within 1.5 m of the house (mineral soil, rock, concrete or stone).**

Remove any combustible materials within 1.5 m of the home and attachments. Replace with non-combustible ground surfaces such as mineral soil, rock, concrete or stone.

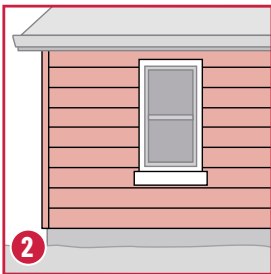
### Step 3: Complete More Complex Upgrades (\$3,000- \$30,000)

Complete more complex upgrades to minimize the likelihood of structural damage to the home and deck if ignition occurs. Repair and replace aging and damaged home components with fire-resistant materials.



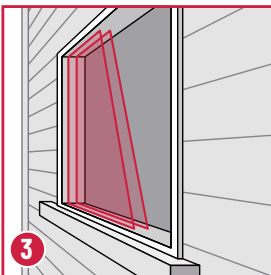
**Install Class A fire-rated roof covering (e.g., cement fibre, metal, or asphalt shingles).**

Repair or replace any roofing material that is curling or damaged with Class A fire-rated roof covering (e.g., cement fibre, metal, or asphalt shingles).



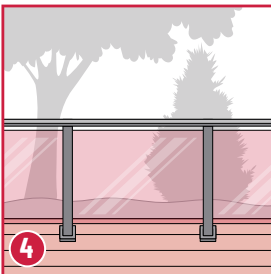
**Install non-combustible siding (stucco, metal, stone, and cement fibre board).**

Repair or replace combustible siding, such as vinyl cladding, with non-combustible siding composed of stucco, metal, stone, or cement fibre board. Ensure that siding terminates 15 cm from grade.



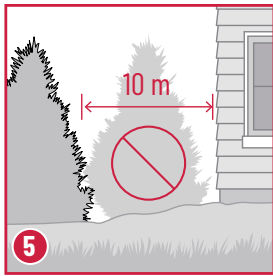
**Install multi-pane or tempered glass windows and exterior fire-rated doors.**

Replace broken and/or non-fire rated windows and doors with multi-pane glass windows and exterior-fire-rated doors.



**Retrofit all deck components to be fire-rated, with a continuous surface.**

Repair and upgrade decks, balconies, patios, and porches to have a continuous, ignition-resistant, or non-combustible surface (e.g., fire-rated pressure treated wood or composite decking) and non-combustible railings (e.g., metal, glass). Enclose space under decks with 12 mm sheathing or 3 mm non-combustible screens.



### Remove conifer trees that are within 10 m of the house.

Remove conifer trees and shrubs located within 10 m of the house to reduce the likelihood that fire will spread to structures, attachments, and neighbouring properties.

### 3.1.3 Free Self-Help Resources for Residents

Examples of national-scale wildfire-ready home resources are provided below. Additional Indigenous, national, provincial, territorial, and locally adapted resources can be accessed for free with an online search.

#### Understand Risks

1. Infographic: [Three Steps to a Cost-Effective FireSmart Home](#)
2. Online Risk Assessment: [FireSmart Begins at Home Online Application](#)
3. Risk Assessment Score Card: [Home Ignition Zone Self-Assessment Score Card](#)

#### Make and Implement a Risk Management Plan

4. FireSmart Home Ignition Zone: [Self-Help Poster](#)
5. Home Resilience Manual: [FireSmart Begins at Home Manual](#)
6. Landscaping Guide: [FireSmart Guide to Landscaping](#)
7. Technical Checklist: [Wildfire-Resilience Best-Practice Checklist for Home Construction, Renovation and Landscaping](#)

8. On-site Assessment by Formally Trained Assessor: [Advanced Home Assessment Program](#)

#### Prepare for Emergencies

9. Interactive Wildfire Maps: [Canadian Wildland Fire Information System](#)
10. Emergency Alerts: [Alert Ready Emergency Alert System](#)
11. Emergency Preparedness Resources: [What to Do Before, During and After a Wildfire](#)



**Figure 15:** Neighbours remove debris from eaves troughs to reduce risk of home ignition. Courtesy FireSmart Alberta, 2023.

### 3.1.4 Accelerating the Uptake of Actions to Create Wildfire-Ready Homes

The following section provides examples of innovative programs that are accelerating the uptake of practical actions to create wildfire-ready homes. Many of these initiatives achieve multiple benefits and avoid maladaptation, thereby creating not just wildfire-ready homes but also climate-ready homes.

#### FireSmart BC Plant Program

Gardeners, landscapers, and suppliers can make properties more resilient to wildfire by choosing fire-resistant plants that are less prone to burning. Through the FireSmart BC Plant Program, anyone can easily identify “FireSmart plants” through FireSmart Plant Tags (Figure 16) at participating garden centres.

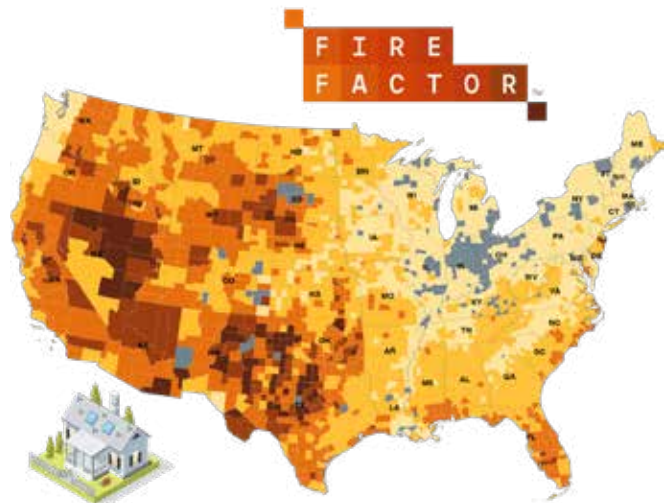
This program complements the [FireSmart BC Landscaping Guide](#), and the interactive [landscaping hub](#), that provides fire-resistant plant suggestions by hardiness zone specific to British Columbia.



**Figure 16:** Garden centres participating in the FireSmart BC Plant Program. Retrieved from <https://firesmartbc.ca/landscaping-hub/plant-program/>

#### RiskFactor.com - Flood, Wildfire, Heat, and Wind Scores, USA

[RiskFactor.com](#) is a free, online tool created by not-for-profit First Street Foundation to ensure that all American residents have the insights they need to understand their home’s current and future levels of risk associated with flood, wildfire, heat, and wind events. Residents enter their home address to instantly receive a simple risk score per peril ranging from 1 (minimal) up to 10 (extreme) (Figure 17). Residents can also make informed and proactive long-term planning decisions by selecting from a range of climate change risk scenarios to understand future risk exposure of their home.



**Figure 17:** Fire factor provides online wildfire risk scores. Retrieved from [RiskFactor.com](#).

Developing a similar tool in Canada could empower home buyers to make risk informed decisions in advance of real estate purchases. It could also help property owners to prioritize climate-ready home upgrades to help safeguard, what is for most families, their greatest financial asset.

### **Wildfire Prepared Home™, USA**

An insurance-backed voluntary program that residents can follow to increase their home's resilience to wildfire (Figure 18). Homeowners complete a checklist of actions to reduce the risk of home and property ignition, apply for designation, and after a home inspection, are eligible to receive a certificate they can present to their insurance provider.

The program launched in 2022 in Paradise, California, a town severely impacted by the 2018 Camp Fire, the deadliest and largest in the state's history. Recognizing the importance of enhancing wildfire resilience, the Paradise City Council made a unanimous decision to require all homes in the city to obtain the institute's basic certification. Additionally, the council is actively pursuing grants and financial aid to support homeowners in meeting the certification requirements (Insurance Institute for Business & Home Safety (IBHS), 2023).

### **FireSmart Advanced Home Assessment Program**

FireSmart provides a free, voluntary on-site wildfire risk assessment service to residents in communities where project funding is available. A FireSmart trained professional (Figure 19) walks the resident through a review of wildfire risks within the home ignition zone (Figure 13), and highlights practical opportunities to reduce risk. The assessor provides a written report summarizing key findings and points to a variety of additional resources for the resident.

In British Columbia, in communities where project funding is available, residents may access the **FireSmart Home Partners Program**. In addition to an onsite assessment and a summary report identifying practical actions to reduce risk, the program also issues a certificate to residents whose homes and properties meet all recommended FireSmart best practices. Residents can share this certificate with participating insurance companies to receive insurance discounts.



**Figure 18:** Wildfire Prepared Home™ offers wildfire resilient home designations. Retrieved from [WildfirePrepared.org](https://www.wildfireprepared.org)



**Figure 19:** A FireSmart assessor during a home visit. Courtesy of FireSmart Canada.

## 3.2 Wildfire-Ready Communities

Wildfire-ready communities have structures and infrastructure that are resistant to ignition. If they do ignite, they sustain lower levels of damage than those that are wildfire-vulnerable. **Wildfire-ready communities are NOT fireproof.** These communities have emergency plans in place to ensure that residents are aware of wildfire alerts and have the capacity to safely shelter in place and evacuate when orders are issued. Agreements are in place with nearby communities to share firefighting and public shelter resources, to ensure that in the event one community requires assistance, the neighboring community is prepared and capable of providing the necessary support. **Wildfire-resistant communities sustain less damage than wildfire vulnerable communities—repair costs are lower, and the recovery period is shorter, facilitating a quicker return to “normal”** (Porter, et al., 2021).



**Figure 20:** Wildland and structural firefighters participate in a cross-training exercise. Courtesy of FireSmart Alberta, 2023.

## Wildfire-Ready Community Fast Facts



For high-hazard communities that implement wildfire-ready best practices over a 10-year period:

### Cost-benefit ratio associated with improving community wildfire resilience

1. Communities will save an estimated **\$14 for every \$1 dollar** invested to improve wildfire resilience, when collective costs to homeowners, municipalities and utilities are taken into consideration.

Invested



Saved

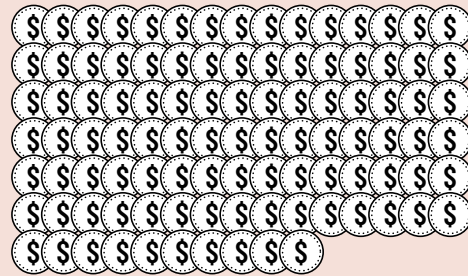


2. Nature-based solutions, such as vegetation control at the community scale, requires cooperation and ongoing maintenance, but it costs only one-third as much as structural updates and produces up to an estimated **\$100 return for every \$1** invested.

Invested



Saved



### How many jobs can be created by improving wildfire resilience?

The work required to increase community resilience for 10,000 homes creates 50 long-term jobs.

### How can improving wildfire resilience improve health and wellbeing?

Improving community wildfire resilience results in an estimated 20 lives saved, and avoids 75 injuries and 75 instances of post-traumatic stress disorder (PTSD).

From Porter et al., 2021

### 3.2.1 Benefits of Improving Community Wildfire Resilience

Every community faces unique risks and has unique opportunities and resources to improve resilience. Vulnerability to wildfire damage differs among communities due to factors like proximity to hazardous fuel sources, housing quality, and population density (Beverly et al., 2010). For example, some higher risk communities may be located near dense boreal forests, while others may have poor quality, ignition-vulnerable housing. Others have densely constructed housing with minimal separation between structures, making it difficult to contain fire spread from one building to the next.

Rural and remote communities often face additional challenges due to limited access to essential firefighting infrastructure, including trained personnel, equipment, and water sources. They also face the challenge of being far from other communities with adequate infrastructure and shelter for evacuees. As a result, residents in these areas experience more frequent and extended evacuation periods compared to urban areas with better firefighting infrastructure (Hoffman et al., 2022a).

Communities have unique assets, such as buildings, ecosystems, roads, and cultural heritage sites, which they aim to protect from wildfire damage. These “values at risk” are managed by various public and private organizations. Given that wildfires do not adhere to legal or jurisdictional boundaries and are influenced by fuel availability, it is critically important that multiple property owners, managers, wildfire managers, and jurisdictions work together to reduce risk and prepare for emergencies.

### 3.2.2 Three Features of a Wildfire-Ready Community

**Three Features of a Wildfire-Ready Community** (Figure 21) highlights best practice guidance that communities can integrate into their

wildfire risk management plans, where applicable, to limit damage and disruption from wildfire events and strengthen emergency preparedness.

#### **Integrating Wildfire Resilience into Existing Structures, Infrastructures and Community Expansions**

It is important to consider opportunities to integrate wildfire-ready features when repairing or replacing existing structures and infrastructure and when designing and building community expansions. Wildfire resilience can be integrated most cost-effectively into structure, infrastructure and landscaping design and construction when new facilities are being built, rebuilt following a wildfire, or when a new addition is being added. It is estimated that in high-hazard areas over a 10 year period, communities will save \$34 for every \$1 invested in new wildfire-ready construction, and \$14 for every \$1 for retrofits (Porter et al., 2021).

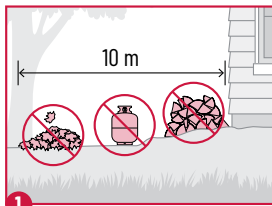
#### **Taking a Multi-Hazard Approach to Achieve Multiple Benefits and Avoid Maladaptation**

When planning actions to improve wildfire resilience, it is also important to consider opportunities to improve the resilience of the community to other climate-related risks, including flood, wildfire, extreme heat, hail, and wind. For example, communities planning to build a new community centre, can achieve multiple benefits by adding features that enable the facility to function as a cooling shelter during extreme heat, while also functioning as a reception centre for wildfire evacuees from neighbouring communities. It is also important to avoid maladaptation or fixing one problem while creating another. For example, by building the new community centre in a low wildfire and flood hazard location, the risk of damage from these perils is minimized, thereby avoiding maladaptation.

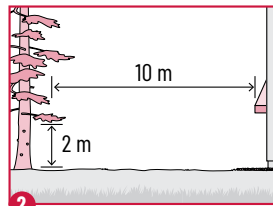
## THREE FEATURES OF A WILDFIRE-READY COMMUNITY

Communities can integrate wildfire-ready features into their risk management plans to limit damage and disruption due to wildfire events and strengthen emergency preparedness. By working with Provincial/Territorial wildfire agencies and municipal/structural fire departments, communities can access available tools, training, and resources to help them assess their unique risks, and create customized action plans.

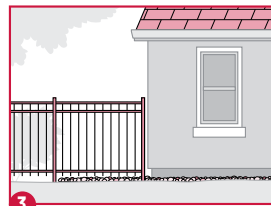
### Feature 1: Wildfire-Ready Structures & Infrastructure



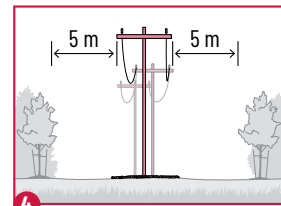
1 Complete regular maintenance of structures, infrastructure, and landscaping within 10 m to limit accumulation of flammable materials (e.g., leaves, brush piles, stored items, fuel tanks).



2 Install/replace landscaping with fire resistant materials within 10 m of structures and infrastructure.

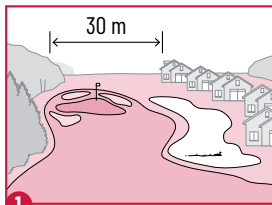


3 Build/update structures and infrastructure using fire resistant building materials (e.g., Class A roofing/metal roofs, non-combustible siding, metal, or concrete hydro poles).

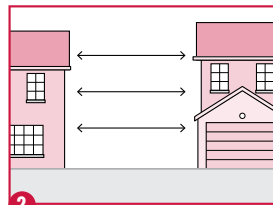


4 Design/update structures and infrastructure to be ignition resistant (e.g., 5 m distance between vegetation and power lines, power supply lines below ground where feasible).

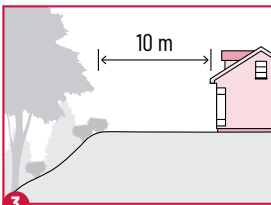
### Feature 2: Wildfire-Ready Community Design



1 Integrate minimum 30 m wide zones (fire breaks) featuring ignition resistant materials (e.g., mowed grasses, ponds, roads) into community design to limit the spread of fire. Increase minimum to 50 m on steep slopes.



2 Provide greater spatial separation between structures in hazard areas to limit the spread of fire from one structure to another.



3 Require minimum 10 m setback from the crest of a hill to limit spread of fire to structures.

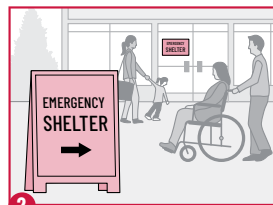


4 Restrict development in hazard areas where mitigation measures cannot meet minimum standards for health, safety, and environmental protection.

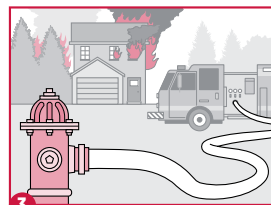
### Feature 3: Wildfire-Ready Emergency Response



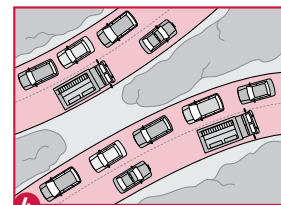
1 Complete annual emergency planning and cross-training exercises that include multiple agencies (e.g., wildland and structural firefighters).



2 Designate at least one emergency shelter per community.



3 Ensure minimum water supply for firefighting.



4 Provide two or more suitably sized access and egress routes to accommodate the movement of emergency vehicles.

Note: The guidance in this document is voluntary. Completion of actions should not conflict with applicable building and fire codes. Wildfire-ready communities can reduce but not eliminate risk.



**Figure 21:** Practical actions to improve community wildfire resilience.

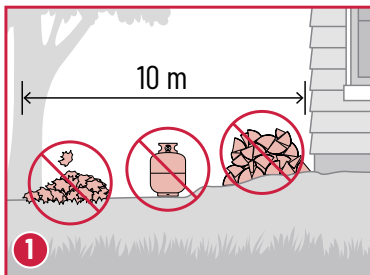


### Three Features of a Wildfire-Ready Community

Communities can integrate wildfire-ready features into their wildfire risk management plans to limit damage and disruption due to wildfire events and strengthen emergency preparedness.

#### Wildfire-Ready Structures and Infrastructure

To reduce the likelihood of ignition and spread of wildfires from wildlands into communities and from structure to structure, complete regular maintenance of structures, infrastructure, and landscaping within a 10 m radius. Update existing structures using fire resistant materials. Integrate wildfire-resilient design and materials into all new projects.

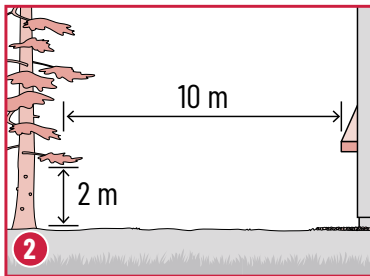


#### Complete regular maintenance of structures, infrastructure, and landscaping within 10 m.

Regularly remove fine, highly flammable materials (such as pine needles and leaves) that collect on surfaces within 10 m of structures, infrastructure, and attachments.

Remove all flammable items (e.g., fuel tanks, brush piles) within 10 m of structures, infrastructure, and attachments.

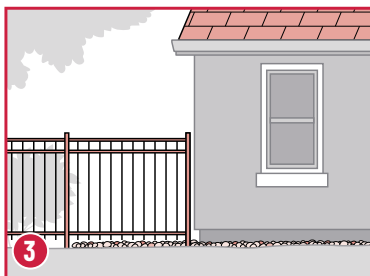
Keep lawn mown below 10 cm.



#### Install/replace landscaping with fire resistant materials within 10 m of a structure and infrastructure.

Replace combustible materials (e.g., wood mulch) with non-combustible ground surfaces such as mineral soil, rock, concrete or stone within 1.5 m of structures, infrastructure, and attachments.

Install well-spaced, low-growing, ignition-resistant plants and remove evergreen trees within 1.5 - 10 m of structures, infrastructure, and attachments.

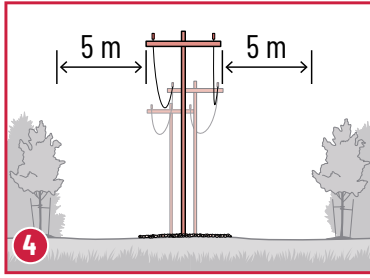


#### Build/update structures and infrastructure using fire resistant building materials.

Repair or replace any roofing material that is curling or damaged with Class A fire-rated roof covering (e.g., cement fibre, metal, or asphalt shingles).

Repair or replace combustible siding, such as vinyl cladding, with non-combustible siding composed of stucco, metal, stone, or cement fibre board.

Ensure that siding terminates 15 cm from grade.



**Design/update structures and infrastructure to be wildfire resilient feasible.**

Design structures to minimize buildup of flammable debris (e.g., simple roof lines with no valleys).

Locate fire vulnerable components underground (e.g., power supply lines), where not exposed to flood or earthquake risk.

Replace fire vulnerable support structures (e.g., wooden poles) with fire resistant poles (e.g., metal or concrete).

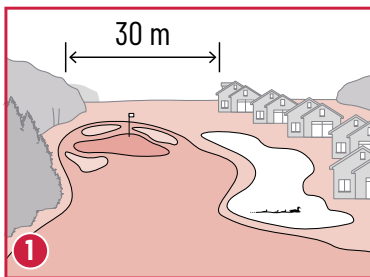
Where replacing fire vulnerable support structures is not feasible, maintain a 1.5 m non-combustible surface around them (e.g., stone, mineral soil).

Locate and maintain power lines at a minimum distance of 5 m from vegetation.

Remove hazardous trees that may fall on power lines (e.g., trees with a height greater than 1.5x their distance to the power line).

**Wildfire-Ready Community Design**

To reduce the likelihood of ignition and spread of wildfires, integrate wildfire resilient design into new residential communities. To ensure continuity of business operations and critical infrastructure delivery, integrate wildfire resilient community design into new commercial, industrial, and critical infrastructure projects.

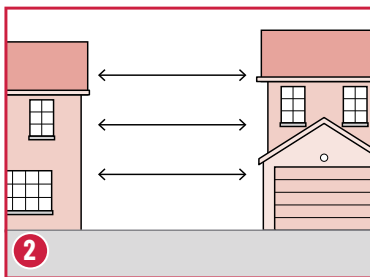


**Integrate minimum 30 m wide zones (fire breaks) featuring ignition resistant materials (e.g., mowed grasses, ponds, roads) into community design to limit spread of fire. Work with a qualified professional to determine appropriate treatment.**

Create a minimum 30 m fire break for slopes of less than 5%.

Create a minimum 40 m fire break for slopes 5-15%.

Create a minimum 50 m fire break for slopes greater than 15%.

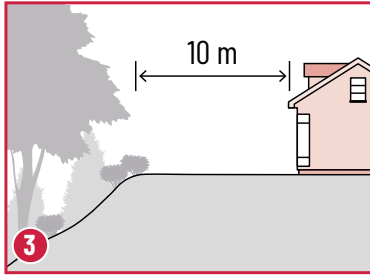


**Provide greater special separation between homes in hazard areas to limit the spread of fire from one structure to nearby structures.**

Require greater spatial separation between structures in residential neighbourhoods located in hazard areas (e.g., minimum 10 m).

Require additional separation for structures on moderate (5-15%) to steep (15%+) slopes.

In areas of high-density housing, increase the fire resistant requirements for the exposed building faces.



**Require minimum 10 m setback from crest of a hill.**

Require home/structure setback of no less than 10 m from the crest of a hill.

Require greater setbacks for structures on moderate (5-15%) to steep (15%+) slopes.

Where a 10 m setback is not possible, increase the fire-resistant requirements for the exposed building face.



**Restrict development in hazard areas where mitigation measures cannot meet minimum standards for health, safety, and environmental protection.**

Limit or discourage the construction of critical infrastructure in hazard areas (e.g., facilities for food supply, electricity, fuel, water, wastewater, telecommunications services, and transportation).

Limit or discourage the construction of public services (e.g., schools, community centres, government offices, hospitals, police stations).

Limit or discourage the construction of residential development.

**Wildfire-Ready Emergency Response**

To strengthen the capacity of the community to safely evacuate residents and halt the advance of wildfires into communities, emergency responders can complete annual training exercises and update emergency plans and procedures. Communities can also integrate wildfire-resilience into community design by designating emergency shelters, ensuring minimum water supply for firefighting and providing at least two access and egress routes.

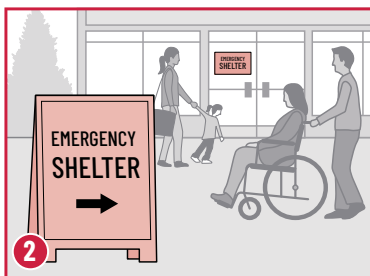


**Complete annual emergency planning and cross-training exercises that include multiple agencies (e.g., wildland and structural firefighters, infrastructure managers, Indigenous/provincial/territorial/local government agencies, non-governmental organizations, etc.).**

Complete annual desktop and in-field emergency response simulation exercises to coordinate activities between firefighters, emergency managers and critical infrastructure managers.

Complete annual reviews and updates to resource sharing agreements between jurisdictions.

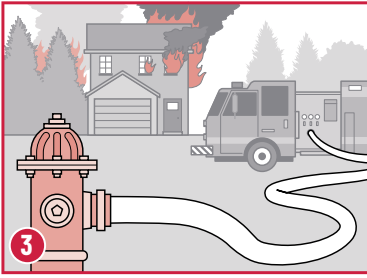
Complete annual reviews and updates to emergency plans and procedures.



**Designate at least one emergency shelter per community.**

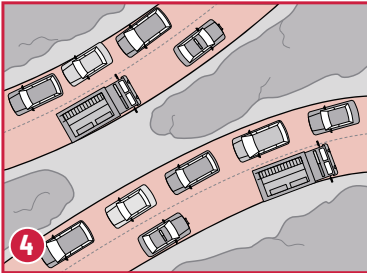
Designate at least one publicly accessible emergency shelter if residents cannot safely shelter in place during a wildfire emergency (for example, if unhoused individuals require shelter from smoke or high air temperatures during extreme heat events).

The emergency shelter may also be used as a “reception centre” to host members of neighbouring communities who have been displaced by wildfire events.



### Ensure minimum water supply for firefighting.

Specify standards for availability of water for firefighting in the event of a wildfire emergency (e.g., municipal water supply and/or surface water supply).



### Provide two or more suitably sized access and egress routes to accommodate emergency vehicles.

Specify roadway design standards or guidelines for access and egress of emergency vehicles and residents during wildfire emergencies.

If the community has fewer than 600 households, provide two or more access/egress routes.

If the community has more than 600 households, provide three or more access/egress routes.

## 3.2.3 Free Self-Help Resources for Communities

Examples of national-scale wildfire-ready community resources are provided below. Additional Indigenous, national, provincial, territorial, and locally adapted resources can be accessed for free with an online search.

### Local/ Regional Government Self-Help Resources

1. Community Wildfire Exposure Assessment Guide: [FireSmart Wildfire Exposure Assessment](#)
2. Community Wildfire Resilience Planning Guide: [FireSmart Guidebook for Community Protection](#)
3. Neighbourhood Scale Education Program: [FireSmart Neighbourhood Recognition Program](#)
4. Free Online Wildfire Literacy Training Program: [FireSmart 101](#)
5. Interactive Wildfire Maps: [Canadian Wildland Fire Information System](#)

6. Wildfire Grading Index: [Fire Underwriters Survey Municipal Portal](#)
7. Toolkit for Public Health Authorities: [Provincial/ Territorial Guidance Document Links](#)

### Free Self-Help Tools for Non-Governmental Agencies Responsible for Managing Wildfire Risks

8. Industry: [Industrial Wildfire Control Plan \(IWCP\) User Manual](#)
9. Power Supply: [Power Line Hazard Assessment](#)
10. Railways: [CN Extreme Weather Fire Risk Mitigation Plan](#)
11. Farms: [The Farm/Ranch Wildfire Plan Guide and Workbook](#)
12. Oil and Gas: [FireSmart Guidebook for the Oil and Gas Industry](#)

### 3.2.4 Accelerating Uptake of Actions to Create Wildfire-Ready Communities

The following section highlights just a few of the many examples of innovative programs that are driving the uptake of practical actions to create wildfire-ready communities. These projects not only achieve multiple benefits but also avoid maladaptation, making them instrumental in fostering both wildfire-ready and climate-ready communities.

#### Unprecedented Risk Mitigation Projects in Quebec

Since 2022, nine northern communities in Quebec have received funding from the Ministry of Public Security and the Northern Plan Corporation for the implementation of risk mitigation measures related to forest fires. This program is the first of its kind for Quebec. Northern communities are particularly vulnerable to forest fires due to their remote locations, geographical isolation, and close proximity to dense coniferous areas with a high susceptibility to ignition.

Based on expert advice and technical guidance from the Société de protection des forêts contre le feu (SOPFEU), these projects involve the implementation of practical strategies to limit impacts when a wildfire approaches a community (Figure 21). These measures include:

- vegetation control in prioritized areas (Figure 22),
- public awareness, and
- training for local first responders.

For more information about the work of SOPFEU and a variety of self-help resources for residents and communities visit [sopfeu.qc.ca/en/](https://sopfeu.qc.ca/en/).

#### Rocky View County: Alberta Home Fire & Flood Risk Assessments

Rocky View County in Alberta prioritized increasing disaster resilience in their community through a door-to-door home risk reduction education



**Figure 22:** Fuel management near a residential area in Fermont, Quebec (SOPFEU, 2023).

campaign that was delivered by Canadian Red Cross volunteers (Figure 23). The program ran from 2019-2022 and residents were provided access to free onsite home flood and wildfire risk assessments completed by trained assessors. Following the assessment, residents were eligible for a **home improvement grant** of up to \$9,054 to support specific flood and wildfire resilient retrofits. The program was actively promoted by the Insurance Brokers Association of Alberta.

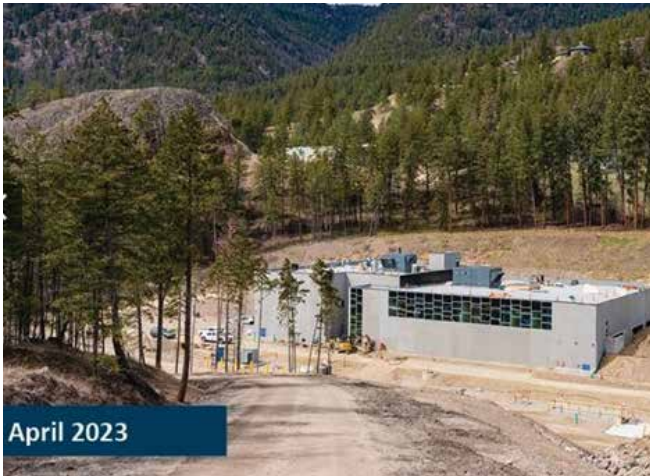
#### Wildfire-Ready Construction Protects West Kelowna



**Figure 23:** Door-to-door risk reduction education campaign (Canadian Red Cross, 2023).

## Water Treatment Plant

After 12 years of fundraising, planning and four phases of construction, the Rose Valley Water Treatment Plant, located in West Kelowna, BC was finally completed in the spring of 2023 (Figure 24). On August 16, 2023, the McDougall Creek wildfire spread rapidly, launching embers across Okanagan Lake, igniting the drought-stricken forest on the opposite side. This prompted the City of Kelowna to declare a state of emergency and ordered the evacuation of 10,000 residents. The blaze engulfed 140 km<sup>2</sup>, damaging, or destroying approximately 200 homes and structures (Clarkson et al., 2023). Fortunately, wildfire-ready planning and construction protected the plant, supporting a swift community recovery.



**Figure 24:** Rose Valley Water Treatment Plant. Retrieved from WestKelownaCity.ca, 2023.

One month after the blaze tore through his community, **West Kelowna Fire Chief Jason Brolund** shared the importance of investing in risk reduction with members of the United Nations, “Over \$20 million was spent reacting to [the West Kelowna] fire, not to mention the insurance losses, which could be triple that. What could we have accomplished if we used that same amount of money proactively? We’re spending the money on the wrong end of the problem...\$10,000 worth of sprinklers and pumps were placed on our new water treatment plant, and it saved that \$75 million critical infrastructure...

It will start providing clean drinking water in just a couple of days.” (Peters, 2023)

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## Australia: Controlled Burns Yield GHG Credits and Income for Indigenous Peoples

In northern Australia, the Nature Conservancy has partnered with Indigenous communities to combine Traditional Ecological Knowledge with the latest in fire science to manage wildfire (Nature Conservancy of Australia, 2023). In the months leading up to the dry season, residents burn small, controlled fires removing dry grass that would otherwise act as fuel for larger wildfires. In addition, avoiding large fires reduces the volume of greenhouse gases released to the atmosphere.

Indigenous groups document the controlled burns, calculate the greenhouse gas reduction associated with catastrophic wildfire prevention, and receive carbon credits from the Australian government (Figure 25).

Each tonne of carbon dioxide reduced results in one carbon credit awarded. The sale of carbon credits by Indigenous groups helps to generate income, which supports sustainable land management and increases biodiversity (Nature Conservancy of Australia, 2023).



**Figure 25:** An Indigenous ranger ignites a controlled burn. Courtesy of Ted Wood, 2023.

Indigenous groups document the controlled burns, calculate the greenhouse gas reduction associated with catastrophic wildfire prevention, and receive carbon credits from the Australian government.



## 4. Conclusions and Next Steps

Wildfires pose a growing threat to homes and communities in the wildland-urban interface (WUI). To reduce the devastating physical, environmental, social, and economic impacts of WUI wildfire, Canadians must work together to adapt NOW.



This report highlights nationally applicable best practice guidance that residents and communities can consider to reduce their risk of damage and disruption due to wildfire events and strengthen emergency preparedness.

In line with the wildfire-ready targets set out in Canada's National Adaptation Strategy, by taking a whole-of-society approach, residents, governments, non-governmental organizations, Indigenous Peoples, industry and businesses can work together to promote existing FREE programs and resources and implement a variety of low cost, low effort, high impact actions TODAY.

### MOVING FORWARD

The following improvements to current programs, new research, and policy updates should be considered to help Canada make additional progress towards creating wildfire-ready homes and communities.

#### Scale up Wildfire-Ready Education

**The Government of Canada** (i.e., Public Safety Canada, Environment and Climate Change Canada, and Natural Resources Canada) should launch a **National Home and Community Wildfire-Ready Education Program**. A wide variety of tools, including FireSmart Canada resources, are already in hand. As a fiduciary, the federal government of Canada should promote these tools.

#### Support Indigenous-Led Research and Knowledge Mobilization

Support Indigenous-led research to develop and share practical, cost-effective and culturally appropriate wildfire-ready home and community tools and resources that address the unique needs of Indigenous communities.

The Government of Canada (i.e., Public Safety Canada, Environment and Climate Change Canada, and Natural Resources Canada) should launch a National Home and Community Wildfire-Ready Education Program. A wide variety of tools, including FireSmart Canada resources, are already in hand. As a fiduciary, the federal government of Canada should promote these tools.

#### Develop Simple Risk Assessment Tools

Develop and share simple, low cost, user-friendly climate-risk assessment, mapping and scoring tools for use by residents and local authorities.

#### Take a Multi-Hazard Approach

Identify climate-ready best practices at the home and community scales to achieve multiple benefits and avoid maladaptation.

All orders of government, Indigenous Peoples, industry, businesses and residents have a role to play in helping Canada to be wildfire-ready. By embarking on a collective journey **TODAY** to create wildfire-ready homes and communities—as clearly spelled out in **Canada's National Adaptation Strategy** (Table 1)—Canadians will be **READY** to face the flames during the longer, hotter, drier wildfire seasons of the future.

**Table 1:** National Adaptation Strategy Targets that Can be Achieved with Immediate Action.

National Adaptation Strategy Target	Act Today
<p><b>#1: Increase Risk Awareness</b></p> <p>By 2025, 60% of Canadians, including northerners and Indigenous Peoples, are aware of the disaster risks facing their household.</p>	<p><b>Support Wildfire-Ready Education</b></p> <ol style="list-style-type: none"> <li>1. Distribute <b>Three Steps To A Cost-Effective Firesmart™ Home</b> to residents living in the WUI</li> <li>2. Promote FireSmart home self-help resources and training programs and other resources developed with the Provinces and Territories, such as SOPFEU in Quebec</li> </ol>
<p><b>#2: Preventative Action</b></p> <p>By 2025, 50% of Canadians have taken concrete actions to better prepare for and respond to climate change risks facing their household.</p>	<p><b>Create Wildfire-Ready Homes</b></p> <p>Promote:</p> <ol style="list-style-type: none"> <li>1. FireSmart Risk Self-Assessment tools that highlight practical actions to reduce risk and other resources developed with the Provinces and Territories</li> <li>2. Online wildfire risk reduction training programs (e.g., FireSmart 101 and how-to videos)</li> <li>3. Available financial incentives and low interest loans to complete resilient home retrofits and lot-level actions to reduce risk of the ignition and spread of fire</li> </ol>
<p><b>#3: Community Protection Plans</b></p> <p>Communities, including northern and Indigenous communities, in zones of high risk, as identified by provinces and territories, develop wildfire community prevention and mitigation plans by 2030, with up to 15% implemented by 2028.</p>	<p><b>Create Wildfire-Ready Communities</b></p> <ol style="list-style-type: none"> <li>1. Distribute <b>Three Features of a Wildfire-Ready Community</b> to communities located in the WUI</li> </ol> <p>Promote:</p> <ol style="list-style-type: none"> <li>2. Community-scale wildfire hazard maps and emergency preparedness resources</li> <li>3. Community wildfire risk assessment and planning guides</li> <li>4. Available funding programs to develop and implement wildfire-ready community plans</li> <li>5. Case studies featuring communities demonstrating wildfire-ready leadership</li> </ol>
<p><b>#4: Building Back Better</b></p> <p>By 2025, complete the modernization of the Disaster Financial Assistance Arrangements to incentivize disaster risk reduction and improve recovery outcomes from large-scale disasters.</p>	<p><b>Support Wildfire-Ready Recovery</b></p> <p>Promote:</p> <ol style="list-style-type: none"> <li>1. Wildfire resilient community national best practice guidance</li> <li>2. Available funding programs to develop and implement wildfire-ready community plans</li> <li>3. Case studies featuring communities that have “built back better” following a catastrophic wildfire event</li> </ol>

# References

Alam, R, Islam, S, Mosely, E., Thomas, S., Dowdell, V, & Doel, D. (n.d.). Rapid Impact Assessment of Fort McMurray Wildfire. Institute for Catastrophic Loss Reduction and MacEwan University. [http://0361572.netsolhost.com/images/AlamIslam\\_QuickResponseSummary-ICLR.pdf](http://0361572.netsolhost.com/images/AlamIslam_QuickResponseSummary-ICLR.pdf)

Austen, I. (2023, September 6). After 3 Weeks of Wildfire Exile, a City of 20,000 Returns. The New York Times. <https://www.nytimes.com/2023/09/06/world/canada/wildfire-yellowknife-evacuation-return.html>

Barber, Q. E., Parisien, M. A., Whitman, E., Stralberg, D., Johnson, C. J., St-Laurent, M. H., ... & Flannigan, M. D. (2018). Potential impacts of climate change on the habitat of boreal woodland caribou. *Ecosphere*, 9(10), e02472.

BC Climate Change Adaptation Program. Farm/Ranch Wildfire Plan Guide and Workbook. Retrieved on Jan. 19, 2023, from <https://bcclimatechangeadaptation.ca/resource-items/farm-ranch-wildfire-guide-and-workbook/>

Bénichou N., Adelzadeh M., Singh J., Goma I., Elsagan N., Kinateder M., ... Sultan M. (2021) National guide for wildland-urban-interface fires. National Research Council Canada. <https://doi.org/10.4224/40002647>

Beverly, J., Bothwell, P., Conner, J., & Herd, E. (2010). Assessing the exposure of the built environment to the potential ignition sources generated from vegetative fuel. *International Journal of Wildland Fire*. 19(3), 299-313.

Bruce, G. (2023, June 9). Canada's wildfires: Where they are, how much has burned and how it's changing air quality. CBC News. <https://www.cbc.ca/news/canada/canada-fires-map-air-quality-1.6871563>

Calkin, D. E., Cohen, J. D., Finney, M. A., & Thompson, M. P. (2014). How risk management can prevent future wildfire disasters in the wildland-urban interface. *Proceedings of the National Academy of Sciences of the United States of America*, 111, 746-751. <https://www.pnas.org/doi/pdf/10.1073/pnas.1315088111>

Canadian Council of Forest Ministers. (2005). Canadian Wildland Fire Strategy: A Vision for an Innovative and Integrated Approach to Managing the Risks. Retrieved from [https://publications.gc.ca/collections/collection\\_2008/nrcan/Fo134-1-2005E.pdf](https://publications.gc.ca/collections/collection_2008/nrcan/Fo134-1-2005E.pdf)

Canadian Council of Forest Ministers. (2021). Wildland Fire Management Work Group - Action Plan 2021 - 2026. Retrieved from <https://www.ccfm.org/releases/wildland-fire-management-working-group-action-plan-2021-2026/>

Canadian Interagency Forest Fire Centre Inc. (2023, September 27). Fire Statistics. Retrieved from <https://ciffc.net/statistics>

Canadian Pacific. (2021, July 27). Interim Extreme Weather Fire Risk Mitigation Plan. [https://www.cpr.ca/en/safety-site/PublishingImages/Pages/Interim-Extreme-Weather-Fire-Risk-Mitigation-Plan/CP\\_Interim\\_Extreme\\_Weather\\_Fire\\_Risk\\_Mitigation\\_Plan\\_2021-07-27.2pdf](https://www.cpr.ca/en/safety-site/PublishingImages/Pages/Interim-Extreme-Weather-Fire-Risk-Mitigation-Plan/CP_Interim_Extreme_Weather_Fire_Risk_Mitigation_Plan_2021-07-27.2pdf)

Canadian Wildland Fire Information System (CWFIS). 2023. Canadian National Fire Database (CNFDB). <https://cwfis.cfs.nrcan.gc.ca/interactive-map>

CBC News. (2023, May 29). About 200 homes, structures ‘damaged’ as Halifax-area wildfire burns out of control, officials say. CBC News. <https://www.cbc.ca/news/canada/nova-scotia/tantallon-hammonds-plains-pockwock-wildfire-evacuations-forest-fire-halifax-1.6857729>

CBC News. (2019, June 1). Evacuation from Pikangikum First Nation continues as forest fire burns nearby. CBC News. <https://www.cbc.ca/news/canada/thunder-bay/pikangikum-update-saturday-1.5158794>

CBC News. (2021, August 18). What you need to know about B.C. wildfires for Aug. 18. CBC News. <https://www.cbc.ca/news/canada/british-columbia/wyntk-bc-wildfires-aug-18-1.6144391>

CBC News. (2023, May 29). About 200 homes, structures ‘damaged’ as Halifax-area wildfire burns out of control, officials say. CBC News. <https://www.cbc.ca/news/canada/nova-scotia/tantallon-hammonds-plains-pockwock-wildfire-evacuations-forest-fire-halifax-1.6857729>

CBC News. (2023, May 31). ‘Take the wildfire situation as seriously as we are,’ minister urges Nova Scotians. CBC News. <https://www.cbc.ca/news/canada/nova-scotia/tantallon-hammonds-plains-pockwock-wildfire-evacuations-forest-fire-halifax-may-31-1.6860135>

Cecco, Leyland. (September 22, 2023). Wildfires turn Canada’s vast forests from carbon sink into super-emitter. The Guardian. <https://www.theguardian.com/world/2023/sep/22/canada-wildfires-forests-carbon-emissions>

Christianson, A. C. (2015). Social science research on Indigenous wildfire management in the 21st century and future research needs. *International Journal of Wildland Fire*, 24(2), 190–200.

Chung, Emily. (November 18, 2021). Why are the B.C. floods so bad? Blame the wildfires, at least in part. CBC News. <https://www.cbc.ca/news/science/post-wildfire-flooding-1.6253544>

Clarkson, B., Holliday, I. & Frisk, A. (2023, August 18). Structures burned, people trapped as parts of B.C.’s Okanagan ordered to evacuate. CTV News Vancouver. <https://bc.ctvnews.ca/kelowna-declares-state-of-emergency-evacuation-orders-issued-as-wildfire-jumps-okanagan-lake-overnight-1.6524568>

Climenhaga, C. (2022, November 7). This year’s wildfire season fluctuated wildly across provinces. Here’s a look at the numbers. CBC News. <https://www.cbc.ca/news/canada/edmonton/prairie-wildfire-season-numbers-1.6637306>

Cohen, J. (2008). The Wildland-Urban Interface Fire Problem. *Forest History Today*. [https://foresthistor.org/wp-content/uploads/2016/12/Cohen\\_wildland-urban-interface-fire-problem.pdf](https://foresthistor.org/wp-content/uploads/2016/12/Cohen_wildland-urban-interface-fire-problem.pdf)

Cohen, J. & Westhaver, A. (2022). An examination of the Lytton, British Columbia Wildland-urban fire destruction. Institute for Catastrophic Loss. <https://FireSmartbc.ca/wp-content/uploads/2022/05/An-examination-of-the-Lytton-BC-wildland-urban-fire-destruction.pdf>

Coogan, S.C.P., Daniels, L.D., Boychuk, D., Burton, P.J., Flannigan, M.D., Gauthier, S., ... Wotton, B.M. (2020). Fifty years of wildland fire science in Canada. *Canadian Journal of Forest Research*. 51(2): 283-302. <https://doi.org/10.1139/cjfr-2020-0314>

Coogan, S.C.P., Robinne, F-N., Jain, P. & Flannigan, M.D. (2019) Scientists' warning on wildfire — a Canadian perspective. *Canadian Journal of Forest Research*. 49(9): 1015-1023. <https://doi.org/10.1139/cjfr-2019-0094>

CTV News. (2022, May 3). Two years later: 20 per cent of homes lost during Fort McMurray wildfires fully rebuilt. CTV News.

Czajkowski, J., Young, M., Giammanco, I., Nielsen, M., Russo, E., Cope, A., Brandenburg, A., & Groshong, L. (2020). Application of Wildfire Mitigation to Insured Property Exposure. CIPR Research Report. [https://content.naic.org/sites/default/files/cipr\\_report\\_wildfire\\_mitigation.pdf](https://content.naic.org/sites/default/files/cipr_report_wildfire_mitigation.pdf)

Dodd, W., Scott, P., Howard, C., Scott, C., Rose, C., Cunsolo, A., & Orbinski, J. (2018). Lived experience of a record wildfire season in the Northwest Territories, Canada. *Canadian Journal of Public Health*, 109(3), 327-337. [doi:10.17269/s41997-018-0070-5](https://doi.org/10.17269/s41997-018-0070-5)

Dupuis, S., Gauthier, S., Bergeron, Y., & Leduc, A. (2020). Forest transformation following European settlement in the Saguenay-Lac-St-Jean Valley in Eastern Québec, Canada. *Frontiers in Ecology and Evolution*, 8, 257.

Environment and Climate Change Canada (2022). Canadian Environmental Sustainability Indicators: Land-based greenhouse gas emissions and removals. Retrieved April 13, 2023, from <https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/land-based-greenhouse-gas-emissions-removals.html>

Environment and Climate Change Canada. (2023a). Canada's National Adaptation Strategy: Building Resilient Communities and a Strong Economy. <https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/national-adaptation-strategy.html>

Environment and Climate Change Canada. (2023b). Wildfire smoke, air quality, and your health. Retrieved April 6, 2023, from <https://www.canada.ca/en/environment-climate-change/services/air-quality-health-index/wildfire-smoke.html>

Erni, S., Boulanger, Y., Manka, F., Bernier, P., Eddy, B., Christianson, A., Swystun, T., & Gauthier, S. (2021). Exposure of the Canadian wildland-human interface and population to wildland fire, under current and future climate conditions. *Canadian Science Publishing*, 51(9). <https://cdnscepub.com/doi/full/10.1139/cjfr-2020-0422>

Eyquem, J. L., & B. Feltmate. (2022). Irreversible Extreme Heat: Protecting Canadians and Communities from a Lethal Future. Intact Centre on Climate Adaptation, University of Waterloo. <https://www.intactcentreclimateadaptation.ca/irreversible-extreme-heat-protecting-canadians-and-communities-from-a-lethal-future/>

Federal Emergency Management Agency (FEMA). (2020). Flood Risk Increase After Fires. Retrieved April 17, 2023, from [https://www.fema.gov/sites/default/files/documents/fema\\_flood-after-fire\\_factsheet\\_nov20.pdf](https://www.fema.gov/sites/default/files/documents/fema_flood-after-fire_factsheet_nov20.pdf)

FireSmart British Columbia. (n.d.). FireSmart Plant Program. <https://FireSmartbc.ca/landscaping-hub/plant-program/>

FireSmart Canada. (2018a). FireSmart Begins at Home: Home Development Guide. [https://FireSmartcanada.ca/wp-content/uploads/2019/10/FireSmart\\_Canada\\_Home\\_Development\\_Guide.pdf](https://FireSmartcanada.ca/wp-content/uploads/2019/10/FireSmart_Canada_Home_Development_Guide.pdf)

FireSmart Canada. (2018b). FireSmart Begins at Home Manual. [https://FireSmartcanada.ca/wp-content/uploads/2022/01/FS\\_Generic-HomeOwnersManual\\_Booklet-November-2018-Web.pdf](https://FireSmartcanada.ca/wp-content/uploads/2022/01/FS_Generic-HomeOwnersManual_Booklet-November-2018-Web.pdf)

FireSmart Canada. (2020). Blazing the Trail: Celebrating Indigenous Fire Stewardship.

FireSmart Canada. (2020). FireSmart Guide to Landscaping: Second Edition. <https://FireSmartcanada.ca/product/FireSmart-guide-to-landscaping/>

FireSmart Canada. (2023). FireSmart Home Ignition Zone Poster. Retrieved from <https://firesmartcanada.ca/wp-content/uploads/2023/02/Home-Ignition-Zone-Poster-EN-SCREEN.pdf>

FireSmart Canada. (n.d.). FireSmart Home Ignition Zone Assessment Score Card. Retrieved on Jan. 19, 2023 from [https://FireSmartcanada.ca/wp-content/uploads/2022/01/FSC\\_NRP\\_HIZ-ScoreCard\\_Form-final-03-15-TM-1.pdf](https://FireSmartcanada.ca/wp-content/uploads/2022/01/FSC_NRP_HIZ-ScoreCard_Form-final-03-15-TM-1.pdf)

FireSmart Canada. (n.d.). The Seven FireSmart Disciplines. Retrieved January 19, 2023, from <https://FireSmartcanada.ca/about-FireSmart/the-seven-FireSmart-disciplines/>

FireSmart Canada, Canada Wildfire, & Intact Centre on Climate Adaptation. (2022). Wildfire-Resilience Best-Practice Checklist for Home Construction, Renovation and Landscaping. [https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2022/02/FSC\\_ConstructionChecklist\\_FINAL.pdf](https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2022/02/FSC_ConstructionChecklist_FINAL.pdf)

FireSmart Canada & Intact Centre on Climate Adaptation. (n.d.). Three Steps to a Cost-Effective FireSmart Home. [https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2022/12/IntactCentre\\_3-steps-to-a-cost-effective-FireSmart-Home.pdf](https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2022/12/IntactCentre_3-steps-to-a-cost-effective-FireSmart-Home.pdf)

Flannigan, M.D., Logan, K.A., Amiro, B.D., Skinner, W.R. & Stocks, B.J. (2005). Future Area Burned in Canada. *Climatic Change* 72, 1–16. <https://doi.org/10.1007/s10584-005-5935-y>

Government of Alberta. (2013). FireSmart Guidebook for Community Protection: A Guidebook for Wildland/Urban Interface Communities. <https://wildfire.alberta.ca/FireSmart/documents/FireSmart-GuideCommunityProtection-Nov2013.pdf>

Government of British Columbia. (2018). BC Flood and Wildfire Review: Addressing the New Normal - 21st Century Disaster Management in BC. Retrieved from <https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/bc-flood-and-wildfire-review-addressing-the-new-normal-21st-century-disaster-management-in-bc-web.pdf>

Government of British Columbia. (2021). Landslide Flooding Risks Due to Wildfires Brochure. Retrieved April 17, 2023, from [https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/resource-roads/local-road-safety-information/landslide\\_flooding\\_risks\\_due\\_to\\_wildfires-brochure.pdf](https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/resource-roads/local-road-safety-information/landslide_flooding_risks_due_to_wildfires-brochure.pdf)

Government of British Columbia. (2023). Wildfire Averages. Retrieved April 12, 2023, from <https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-statistics/wildfire-averages>.

Government of Canada. (2023, May 12). Wildfire smoke, air quality and your health. Retrieved June 1, 2023, from <https://www.canada.ca/en/environment-climate-change/services/air-quality-health-index/wildfire-smoke.html>

Hanes, C., Wang, X., Jain, P., Parisien, M.-A., Little, J., & Flannigan, M. (2019). Fire regime changes in Canada over the last half century. *Canadian Journal of Forest Research*, 49(3), 256-269.

Hoffman, K. M., Christianson, A. C., Dickson-Hoyle, S., Copes-Gerbitz, K., Nikolakis, W., Diabo... & Daniels, L. D. (2022a). The right to burn: barriers and opportunities for Indigenous-led fire stewardship in Canada. *FACETS*, 7(1), 464-481. <https://doi.org/10.1139/facets-2021-0062>

Hoffman, K. M., Christianson, A. C., Gray, R., & Daniels, L. (2022b). Western Canada's new wildfire reality needs a new approach to fire management. *Environmental Research Letters*, 17. <https://iopscience.iop.org/article/10.1088/1748-9326/ac7345/pdf>

Hope, E. S., McKenney, D. W., Pedlar, J. H., Stocks, B. J., & Gauthier, S. (2016). Wildfire Suppression Costs for Canada under a Changing Climate. *PLoS ONE*, 11(8), e0157425. <https://doi.org/10.1371/journal.pone.0157425>

Insurance Bureau of Canada (IBC). (2023). Severe Weather in 2022 Caused \$3.1 Billion in Insured Damage – making it the 3rd worst year for insured damage in Canadian history. Media Releases. Retrieved January 18, 2023, from <https://www.abc.ca/news-insights/news/severe-weather-in-2022-caused-3-1-billion-in-insured-damage-making-it-the-3rd-worst-year-for-insured-damage-in-canadian-history>

Insurance Institute for Business & Home Safety (IBHS). (2023). Wildfire Prepared: A program of IBHS. <https://wildfireprepared.org/>

IPCC. (2023). Summary for Policymakers. In: Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland. <https://www.ipcc.ch/report/ar6/syr/>

Johnston, L., & Flannigan, D. (2018). Mapping Canadian wildland fire interface areas. *International Journal of Wildland Fire*, 27, 1-14. <https://www.publish.csiro.au/wf/pdf/WF16221>

Jones, D. (August 17, 2023). Out-of-control wildfires in Canada force all 20,000 residents of Yellowknife to flee. npr. <https://www.npr.org/2023/08/17/1194388692/wildfire-yellowknife-canada-evacuation>

Lavoue, D., Stocks, B.J. (2011). Emissions of air pollutants by Canadian wildfires from 2000 to 2004. *International Journal of Wildland Fire*. 20:17-34. <https://cfs.nrcan.gc.ca/publications?id=33061>

Matz, C. J., Egyed, M., Xi, G., Racine, J., Pavlovic, R., Rittmaster, R., Henderson, S. B., & Stieb, D. M. (2020). Health impact analysis on PM<sub>2.5</sub> from wildfire smoke in Canada (2013-2015, 2017-2018). *Science of Total Environment*. 725, 138506. <https://doi.org/10.1016/j.scitotenv.2020.138506>

McDermott, V. (2022, May 3). Roughly 86 per cent of properties destroyed in 2016 have been rebuilt. *Fort McMurray Today*. <https://www.fortmcmurraytoday.com/news/roughly-86-per-cent-of-properties-destroyed-in-2016-wildfire-have-been-rebuilt>

McGee, T. K., Nation, M. O., & Christianson, A. C. (2019). Residents' wildfire evacuation actions in Mishkeegogamang Ojibway Nation, Ontario, Canada. *International Journal of Disaster Risk Reduction*, 33, 266–274.

Ministry of Northern Development, Mines, Natural Resources and Forestry's (NDMNRF). 2014. *Wildland Fire Management Strategy*. Toronto: Queen's Printer for Ontario. <https://www.ontario.ca/page/wildland-fire-management-strategy>

Minogue, S. (2023, August 16). Yellowknife begins evacuation as wildfires approach. *CBC News*. <https://www.cbc.ca/news/canada/north/nwt-wildfire-emergency-update-august-16-1.6938756>



Morton, D. C., Roessing, M. E., Camp, A. E., & Tyrrell, M. L. (2003). Assessing the Environmental, Social, and Economic Impacts of Wildfire. GISF Research Paper 001. Forest Health Initiative. Yale University. School of Forestry and Environmental Studies. Global Institute of Sustainable Forestry. 360 Prospect Street, New Haven, Connecticut 06511 USA.

Mosleh, Omar. (2023, May 17). Canada's wildfires are getting worse. Here are some of the long-term effects they're having. Toronto Star. <https://www.thestar.com/news/canada/2023/05/17/behind-the-smoke-canadas-worsening-wildfires-are-exacting-a-hidden-toll.html>

National Collaborating Centre for Indigenous Health (NCCIH). (2022). Climate Change and Indigenous Peoples' Health in Canada. In P. Berry & R. Schnitter (Eds.), Health of Canadians in a Changing Climate: Advancing our Knowledge for Action. Ottawa, ON: Government of Canada

Natural Resources Canada (2020, July 15). Wildland fire evacuations. Retrieved October 5, 2023, from <https://natural-resources.canada.ca/climate-change/impacts-adaptations/climate-change-impacts-forests/forest-change-indicators/wildland-fire-evacuations/17787>

Natural Resources Canada (2022). Evacuations due to wildland fire 1980-2021. Retrieved from Christianson, A., August 2023.

Natural Resources Canada (2022a, May 31). Forest Carbon. Retrieved April 13, 2023, from <https://natural-resources.canada.ca/climate-change-adapting-impacts-and-reducing-emissions/climate-change-impacts-forests/forest-carbon/13085>.

Natural Resources Canada. (2022b). The State of Canada's Forests: Annual Report 2022. [https://natural-resources.canada.ca/sites/nrcan/files/forest/sof2022/SoF\\_Annual2022\\_EN\\_access\(4\).pdf](https://natural-resources.canada.ca/sites/nrcan/files/forest/sof2022/SoF_Annual2022_EN_access(4).pdf)

Natural Resources Canada. (2023, May 30). Forest Fires. Retrieved June 1, 2023, from <https://natural-resources.canada.ca/our-natural-resources/forests/wildland-fires-insects-disturbances/forest-fires/13143>

Natural Resources Canada. (2023, September 27). Wildland Fire Evacuations. Retrieved September 27, 2023, from <https://natural-resources.canada.ca/climate-change/impacts-adaptations/climate-change-impacts-forests/forest-change-indicators/wildland-fire-evacuations/17787>

Parisien, M.-A., Barber, Q.E., Hirsch, K.G., Stockdale, C.A., Erni, S., Wang, X., Arsenault, D., & Parks, S.A. (2020). Fire deficit increases wildfire risk for many communities in the Canadian boreal forest. *Nature Communications*, 11(2121), 1-9. <https://doi.org/10.1038/s41467-020-15961-y>

Parisien, M.-A., Barber, Q., Bourbonnais, M., Daniels, L., Hoffman, K., Gray, R., Jain, J., Taylor, S., Whitman, E., & Flannigan, M. (2023). Abrupt, climate-induced increase in wildfires in British Columbia since the mid-2000s. *Communications Earth & Environment*, 4, 309. <https://doi.org/10.1038/s43247-023-00977-1>

Pau, M., Gauthier, S., Boulanger, Y., Ouzennou, H., Girardin, M. P., & Bergeron, Y. (2023). Response of forest productivity to changes in growth and fire regime due to climate change. *Canadian Journal of Forest Research*. <https://doi.org/10.1139/cjfr-2022-0207>

Peters, J. (2023, September 21). Canadian fire chiefs deliver climate change message to United Nations following devastating season. CBC. <https://www.cbc.ca/news/canada/british-columbia/fire-chief-brolund-un-speech-1.6974427>

Porter, K.A., Scawthorn, C.R., & Sandink, D. (2021). An Impact Analysis for the National Guide for Wildland-Urban Interface Fires. Prepared for the National Research Council of Canada. Institute for Catastrophic Loss Reduction, Toronto, ON. <https://www.iclr.org/wp-content/uploads/2021/05/ICLR-SPA-Risk-Impact-Analysis-for-the-National-WUI-Fire-Guide-2021.pdf>

Province of Alberta (2022a). Industrial Wildfire Control Plan (IWCP) User Manual. <https://wildfire.alberta.ca/prevention/industry/industrial-wildfire-control-plan.aspx>

Province of Alberta (2022b). Power Line Hazard Assessment. Retrieved January 19, 2023, from <https://wildfire.alberta.ca/prevention/industry/powerline-hazard-assessment-plan.aspx>

Public Safety Canada. (2019). Emergency Management Strategy for Canada: Toward a Resilient 2030. Retrieved January 19, 2023, from <https://www.publicsafety.gc.ca/cnt/rsrscs/pblctns/mrgncy-mngmnt-strtg/mrgncy-mngmnt-strtg-en.pdf>

Pyne, Stephen J. (2008) *Awful Splendor: A Fire History of Canada*. UBC Press. <https://www.ubcpres.ca/awful-splendour-1>

Ramsden, R., Smith, J., Turcotte, K., Garis, L., Kunz, K., Maxim, P., Pike, I., & Pike, I. (2018). Determinants of injury and death among Canadian firefighters. *Injury Prevention*, 24, A213. doi: [10.1136/injuryprev-2018-safety.551](https://doi.org/10.1136/injuryprev-2018-safety.551)

[RiskFactor.com](https://www.riskfactor.com/). Find your Property's risk. Retrieved on January 19, 2023, from <https://www.riskfactor.com/>

Rocky View County, Alberta. (2022). Residential Resilience Grant. <https://www.rockyview.ca/Portals/0/Files/Emergency/Protect/Residential-Resilience-Grant-Funding-Application.pdf>

Rosenthal, A., Stover, E., & Haar, R. J. (2021). Health and social impacts of California wildfires and the deficiencies in current recovery resources: An exploratory qualitative study of systems-level issues. *PloS one*, 16(3), e0248617. <https://doi.org/10.1371/journal.pone.0248617>

Stewart, L., & Evans, C. (n.d.). Applying the FireSmart System to Stengthen Community Wildfire Resilience. Adapted from FireSmart Canada.

The Nature Conservancy Australia (2023, February 28). The smart use of fire for huge reductions in greenhouse gas emissions. Retrieved January 19, 2023 from <https://www.natureaustralia.org.au/what-we-do/our-priorities/climate-change/climate-change-stories/fighting-fire-with-fire/>

To, P., Eboreime, E., & Agyapong, V. I. (2021). The impact of wildfires on mental health: a scoping review. *Behavioral Sciences*, 11(9), 126. <https://doi.org/10.3390/bs11090126>

Tymstra, C., Stocks, B., Cai, X., & Flannigan, M. (2020) Wildfire management in Canada: Review, challenges, and opportunities. *Progress in Disaster Science*. 5. 100045. <https://www.sciencedirect.com/science/article/pii/S2590061719300456>

Wang, X., Parisien, M.-A., Taylor, S. W., Candau, J.-N., Stralberg, D., Marshall, G. A., ... & Flannigan, M. D. (2017). Projected changes in daily fire spread across Canada over the next century. *Environmental Research Letters*. 12(2), 025005. <https://doi.org/10.1088/1748-9326/aa5835>

Weichel, Andrew. (2023, August 22). Nearly 200 structures lost or damaged by wildfires in Kelowna, B.C., area, officials say. *CTV News Vancouver*. <https://bc.ctvnews.ca/nearly-200-structures-lost-or-damaged-by-wildfires-in-kelowna-b-c-area-officials-say-1.6529455>

West Kelowna, British Columbia. (2023) Rose Valley Water Treatment Plant. [https://www.westkelownacity.ca/en/our-community/rose-valley-water-treatment-plant-project.aspx?\\_mid =38297](https://www.westkelownacity.ca/en/our-community/rose-valley-water-treatment-plant-project.aspx?_mid =38297)

Whitman, E., Parks, S. A., Holsinger, L. M., & Parisien, M. A. (2022). Climate-induced fire regime amplification in Alberta, Canada. *Environmental Research Letters*, 17(5), 055003. <https://iopscience.iop.org/article/10.1088/1748-9326/ac60d6/meta>

Wotton B.M., Flannigan M.D. (1993). Length of the fire season in a changing climate. *The Forestry Chronicle*, 69,187-192. <https://doi.org/10.5558/tfc69187-2>

Wotton B.M., Flannigan M.d. & Marhsall G.A. (2017) Potential climate change impacts on fire intensity and key wildfire suppression thresholds in Canada. *Environmental Research Letter*, 12(9), 095003. <https://iopscience.iop.org/article/10.1088/1748-9326/aa7e6e>



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