MAY 03, 2022

UNDERSTANDING PERCEPTIONS OF RESIDENTS AND OFFICIALS TO REDUCE WILDFIRE RISK IN ESTES PARK, COLORADO

Ian Coolidge - Adam Murrison - Hannah Rodenbush - Caitlin Strzegowski
Advisors: Despoina Giapoudzi, Robert Hersh
In collaboration with the Boulder Watershed Collective

WPI

OUR TEAM

STUDENT PROJECT TEAM

Left to right:
Ian Coolidge
Hannah Rodenbush
Caitlin Strzegowski
Adam Murrison

ADVISORS

Robert Hersh
Despoina Giapoudzi

PROJECT SPONSOR

The Boulder Watershed Collective

ACKNOWLEDGEMENTS

Our team would like to thank the Estes Park community, residents and officials alike, for welcoming us and assisting with project efforts. We would also like to thank our sponsor, The Boulder Watershed Collective, for their guidance and assistance over the course of this project.

ABSTRACT

Wildfires have increased in both intensity and frequency across Estes Park, Colorado across decades. Collaborating with the Boulder Watershed Collective, we aimed to understand the perceptions surrounding wildfires from the perspectives of residents, town officials, and external organizations. We conducted 38 semi-structured interviews to understand wildfire plans and document experiences of residents regarding recent wildfires. The interviews were recorded, transcribed, and coded to extract common themes and ideas. The need for evacuation protocols, the importance of communication, and the exclusion of vulnerable populations of Estes Park were among our key findings. The group primarily recommends that communication and education strategies be expanded to reach a greater audience in an emergency.

EXECUTIVE SUMMARY

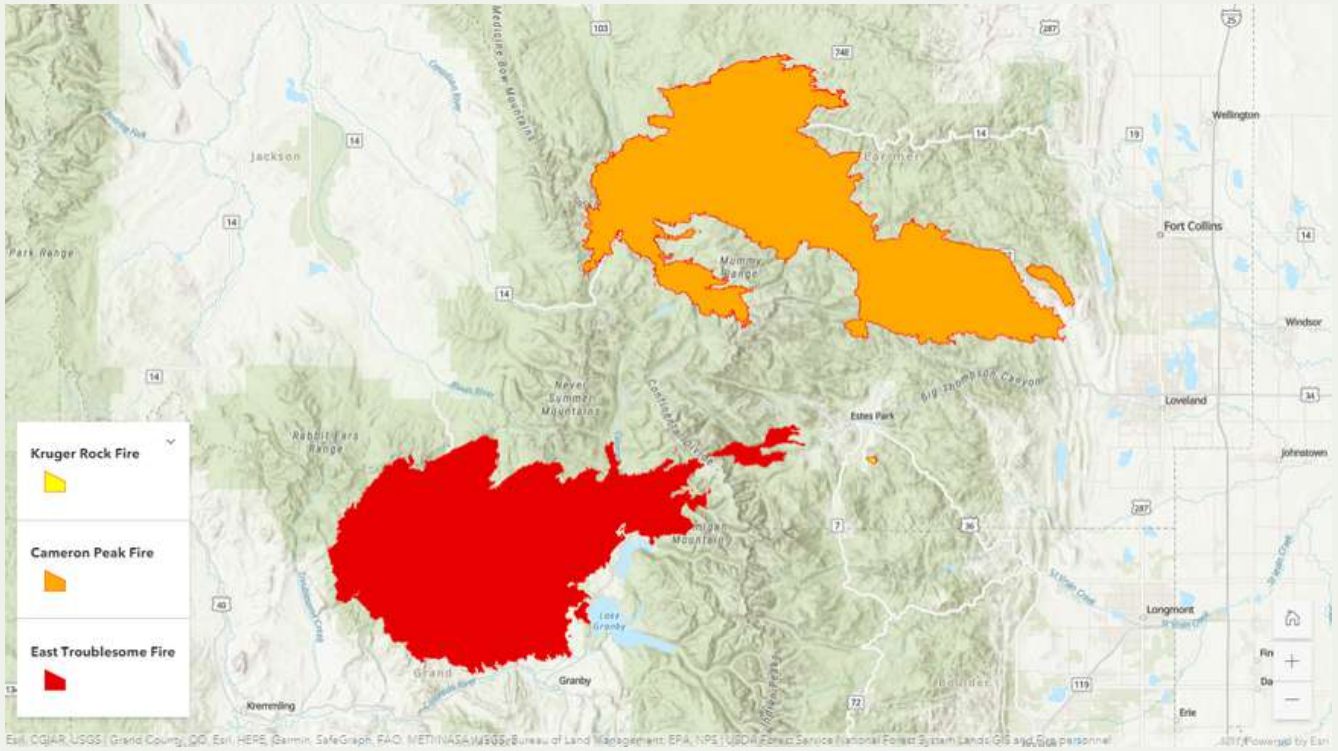


FIGURE A: Map of recent wildfires, Cameron Peak, East Troublesome, and Kruger Rock (Map Courtesy of National USFS)

Estes Park, Colorado is partly a transient community within the wildland-urban interface (WUI) located next to Rocky Mountain National Park. Wildfires in this area are becoming more frequent due to climate change and increasing human-to-nature interactions within the WUI. Most notably, the East Troublesome and Cameron Peak fires of 2020 burned roughly 400,000 acres resulting in mandatory evacuations across the town. As the threat of wildfires continues to increase, the town of Estes Park continues to explore mitigation strategies and policies to fight wildfires.

This project is sponsored by the Boulder Watershed Collective (BWC), a Boulder-based non-governmental organization that participates in various social and ecological projects in order to revitalize forested areas in the Boulder watershed area and beyond. As the Estes Park area is outside the BWC's normal jurisdiction, the BWC is invested in understanding the social climate regarding wildfires in the Estes Valley in order to have a wider knowledge of community perceptions toward wildfires. This IQP project focused on providing the BWC with this understanding by obtaining the perspectives of community members and investigating how these perspectives interacted with current research on community resiliency.

THE PRIMARY GOAL

of our project was to obtain the perspectives of Estes Park residents, as well as local and county government officials and non-governmental organizations (NGOs) on the increasing wildfire threat to the Estes Valley. To this end, we divided our project objective into three main goals.

1. Document experiences and attitudes of residents of Estes Park about wildfire risk.
2. Identify current approaches to wildfire preparedness in Estes Park and Larimer County.
3. Assess opportunities to improve current wildfire mitigation strategies in relation to vulnerable populations in Estes Park.

UNDERSTANDING LOCAL PERSPECTIVES THROUGH INTERVIEWS

Our primary method of obtaining information on community resilience was obtaining community members' perspectives through interviews. Over the course of this project, our team conducted 38 key informant, semi-structured interviews with community residents, local and county government officials, and external stakeholders in order to gather personal stories from recent wildfires in Estes Park, as well as perspectives on disaster preparedness, mitigation, evacuation, and risk perception. Our interview sampling varied across multiple demographics including occupation, age, gender, and living status (renters and permanent residents). Through our interview inquiries, we aimed to understand existing community mitigation efforts for wildfire, and assess gaps in communication and understanding between decision-makers and the general population of the Estes Valley.

FINDINGS

Our team extracted a set of themes that were recurring in the interviews we conducted, and developed a coding system to obtain an understanding of the common issues that affect wildfire resilience in Estes Park. Below we summarize our findings regarding each of these themes.

CLIMATE CHANGE

Wildfire risks have increased significantly over the last five years as a result of climate change. Multiple effects of climate change contribute to this increased risk, including higher temperatures and reduced rainfall and snowfall. The concept of "wildfire season" has expanded significantly; where previous wildfire seasons would encompass primarily the summer months (May to September), conditions today can be ripe for wildfire as late as October or November. Residents and officials in Estes Park are largely at risk to the effects of climate change on the wildfire season.

MITIGATION PRACTICES

In the aftermath of the East Troublesome and Cameron Peak fires, Estes Park residents have showcased a wide variety of practices, from renters who do very little mitigation themselves to some long term residents who are participating in several mitigation and preparedness efforts. Mitigation and preparedness practices adopted by residents include reducing slash around homes, keeping a firebox with important valuables, and preparing a Go Bag with evacuation essentials. Homeowners associations (HOAs) have the ability to impose stricter regulations than the town on mitigation practices, however these are not always easily enforceable.

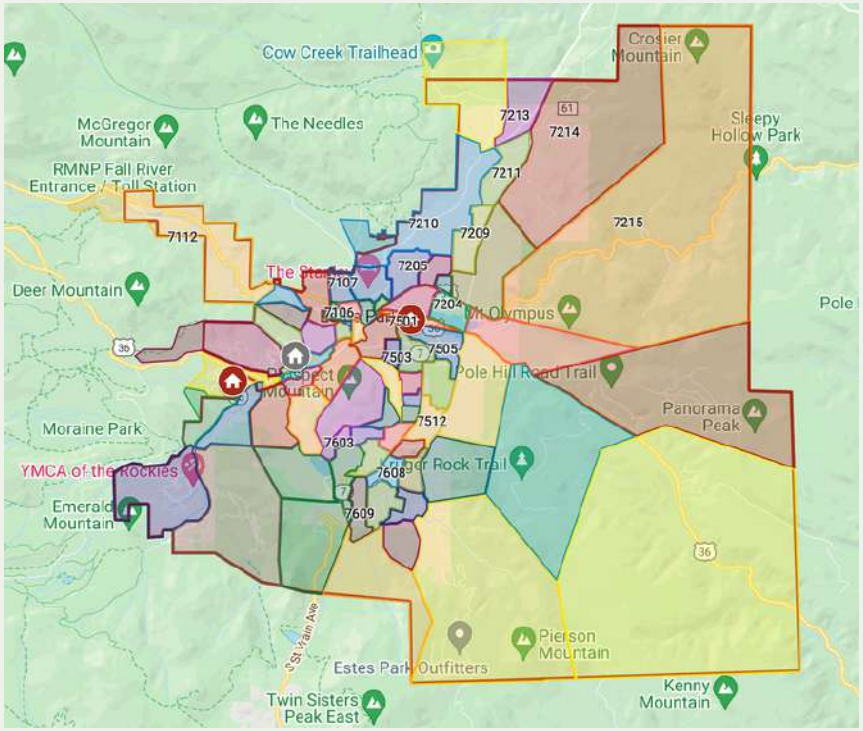


FIGURE B: Evacuation Polygons of Estes Park
(Map courtesy of Estes Park Fire Department)

EVACUATION

The evacuation due to the East Troublesome fire in October 2020 was successful. These efforts are streamlined through the use of polygons, as seen in Figure B, for evacuation created by the fire department, and other methods including canvassing by police; emergency alert systems are also in place in order to communicate evacuation protocols. These efforts resulted in the successful evacuation of Estes Park during the East Troublesome fire; the entire population was out of town, about 6,500 people, in approximately four hours.

COMMUNICATION

Communication between different departments (local fire department, police department, county departments) is streamlined and efficient during a wildfire event. On the other hand, there is a need for improved communication between decision-makers and the people that they serve during emergencies. Alert systems are in place, such as the LETA alert system, however more work is required to ensure that these systems reach populations including those without cellphones and visitors who are not on the alert system. Educational materials and seminars are another potential way to increase wildfire preparedness, as most residents mention that they have not received materials from the town government in the aftermath of the 2020 fires.

EMOTIONAL IMPACT

Wildfire events take a significant emotional toll on the populations that they affect. The stress of evacuating during a wildfire or the concern about loss of property or life has had a lasting impact on many of the residents of Estes Park. PTSD groups continue to operate to provide emotional support to people who have been impacted by wildfires. These emotional connections can affect the ways in which residents interact with wildfire and give them reasons to return to their residences before it is safe to do so, for example to retrieve belongings or pets. Similarly, residents with children in school may be forced to evacuate separately from their children, which can itself cause traumatic experiences and altered decision-making. On the other hand, the tight-knit connections within the town of Estes Park mean that residents are more likely to help each other during emergency situations.

Residents and officials view their risk as something that is simply a part of living in a WUI area such as Estes Park, and are willing to tolerate that risk to continue living in the town. On the other hand, residents often underestimate the situation and feel that their own property is at lower risk relative to the community as a whole.

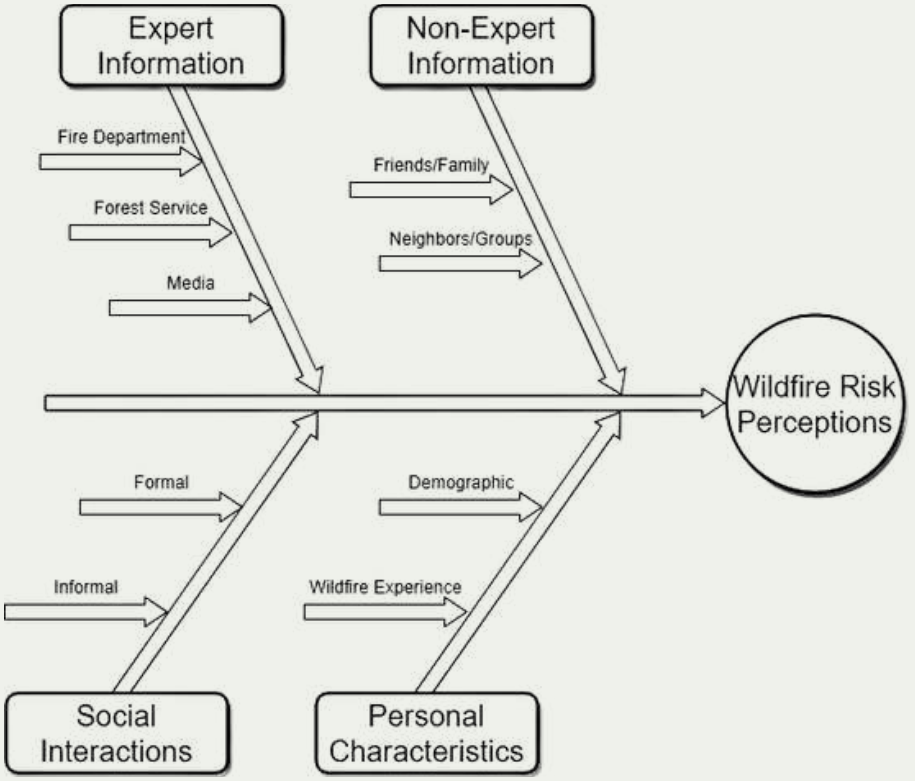


FIGURE C: Our project utilized a model to understand how various factors affect residents' perception of their risk from a wildfire

VULNERABLE POPULATIONS

Vulnerable populations are defined as any social or other group of people that requires additional attention or communication during an evacuation beyond the normal level of communication. In Estes Park, these populations fall primarily into three categories: those with challenges to mobility, non-English speakers, and visitors. These populations are found to need more assistance with communication, evacuations, and educating in regards to the threat of wildfire.

RECOMMENDATIONS

By analyzing the interviews and identifying themes prevalent in them, our team was able to locate several areas of improvement that the Estes Park community can focus on regarding their preparedness to wildfires.

Improving communication systems will allow wildfire information to reach a wider population. Currently, Estes Park and Larimer County utilize a county-wide alert system which requires residents and visitors to sign up themselves. These alerts lack effective evacuation strategies as well as the ability to reach all vulnerable populations in Estes Park, such as non-English speakers, visitors, and the elderly. Government officials and residents repeatedly expressed the need to enhance these communications between people in decision-making roles and those receiving the alerts. Local debriefings and open forums would allow communication on what the residents of Estes Park would like to see implemented for future planning regarding wildfires.

Another area of improvement could be to continue educating the Estes Park community with the use of multimedia tools. For residents of high risk areas, investigating preparedness awareness is key to ensure successful wildfire evacuations. Multimedia tools, such as widespread brochures and pamphlets, would spread information quickly to visitors and residents who are unsure of current evacuation protocols and would benefit those short term rentals, such as hotels, Airbnb or VRBO. Such a brochure could include a Go Bag checklist and evacuation routes out of both the property and the town. This would be a simple list that can be quickly read and understood by any tourist in an emergency.

Lastly, enforcing mitigation practices would lead to more readiness for wildfires in the future. Implementing new building codes, such as the International WUI code (IWUI), reduces the threat of losing properties or lives. The IWUI would enforce certain building materials and creating a defensible space around your property, which would decrease the town's risk to wildfires overall.

AUTHORSHIP

Section	Primary Author
Abstract	Caitlin
Executive Summary	Hannah/ Ian
Introduction	All
Climate change has increased the frequency and intensity of wildfires	Caitlin
Analysis of current wildfire mitigation policies concerning Estes Park, Colorado	Adam/ Caitlin
Wildfire Communication and Risk Perception	Ian
Estes Park Wildland Urban Interface	Hannah
Document experiences/attitudes of residents	All
Identify Current Approaches to Wildfire Preparedness	All
Assess Opportunities to Improve Wildfire Mitigation	All
Deliverable	All
How do residents perceive wildfire threat now, after the East Troublesome, Kruger Rock and Cameron Peak fires?	Ian
What factors shape residents' attitudes toward wildfire risk?	Caitlin
What steps have residents taken in the last few years to reduce their risk from wildfires?	Hannah
What constitutes a "vulnerable" group in the context of Estes Park? What makes them vulnerable?	Ian
How did the fire district, municipal and county officials prepare for wildfire threats from the East Troublesome, Cameron Peak, and Kruger Rock fires?	Hannah
What were the major concerns of residents following evacuation protocols?	Caitlin
What are the major challenges faced by authorities to address the increase in frequency and severity of wildfires?	Adam
How do fire officials collaborate with the public in order to improve wildfire preparedness and resilience?	Adam
Are there any limitations with the current research that was done?	All
Improving communication systems will allow wildfire information to reach a larger population	Adam
Multiple media tools can help build greater awareness of wildfire threats and heighten awareness	Caitlin
Enforcing mitigation practices will lead to more readiness for wildfires in the future	Hannah
Areas of Future Research	Ian

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF APPENDICES

1.0 INTRODUCTION

Wildfires across the western United States, and particularly in Colorado, have become more destructive since 1980. Approximately 5 million acres of wildland burned in 1980 compared to about 10 million acres in 2020 (Insurance Information Institute, 2021), while the area burned by wildfires doubled over 40 years. Climate change is one of the main drivers behind this; warmer temperatures, less precipitation, and stronger winds have contributed to more intense burns. Notably, Colorado has been in a drought of historic proportions; since 2000 the state has experienced droughts at the greatest length and severity in 1200 years (NOAA). The little moisture has led to very dry conditions which have led to large, destructive burns that occur not only in the wildfire season, from May to September, but also outside the wildfire season months.

FIGURE 1: Home destroyed in Louisville, CO, due to the Marshall Fire of 2021-2022, credit Hannah Rodenbush

While climate change has led to more extensive wildfires, from 1990 to 2010, 25 million people have moved into the Wildland Urban Interface (WUI), or the area where natural environment meets the built environment. This has resulted in the building of about 12.7 million more homes (Radeloff et al., 2018) in the WUI, which increases the difficulty for firefighters to extinguish wildfires and can lead to wildfires burning more intensely for a longer period of time. The wildfire risk is higher in the WUI where residents may be vulnerable and unable to reduce their risks.

Estes Park, a mountain town that is the gateway to the Rocky Mountain National Park in Colorado, is part of an expanding wildland urban interface. The region has seen a number of significant fires in recent years, notably the East Troublesome fire, Cameron Peak fire, and Kruger Rock fire. Due to the location, past wildfires, and climatic conditions most of the region is now classified as “High Hazard” or “Very High Hazard” for wildfire risks.

Estes Park continues to explore mitigation strategies and policies to fight wildfires, particularly in the areas of emergency communication between decision-makers and residents. The sponsor of this project, The Boulder Watershed Collective (BWC), is involved in discussions with local and state governments, fire districts, NGOs, and community groups about wildfire mitigation strategies across the Front Range. The BWC would like to better understand the concerns and perspectives of residents in Front Range communities, including Estes Park, about the risks posed by wildfires in order to obtain insights that may be able to guide policymakers' future work.

OUR GOAL

for this project was to understand the perceptions of wildfire risk in Estes Park from residents including homeowners and renters, long term residents and new arrivals. We also interviewed local government agencies such as fire departments, planners, town engineers, and the Estes Valley Watershed Coalition to develop an understanding of what had been done and will be done to reduce risks from wildfires.

Based on the information gained through interviews and observations, the group developed outreach materials to be distributed among residents, employees, and officials on our findings and identified potential areas of improvement for policymakers.

2.0 BACKGROUND

Credit: Ben Efram, courtesy of InciWeb

The town of Estes Park, located in northern Colorado, is surrounded by thousands of acres of wilderness, and borders the Rocky Mountain National Park.

Recent wildfires in Estes Park include the East Troublesome, Cameron Peak, and Kruger Rock fires. In Section 2.1 we examine the increase in wildfire frequency and intensity around Estes Park as a result of climate change. In Section 2.2 we discuss Community Wildfire Protection Plans and the setbacks with these plans. Section 2.3 analyzes individuals' perception of risk - whether their own or the communities' - from wildfires through the lens of social science and heuristics. Finally, Section 2.4 discusses the ways in which the WUI interacts with wildfire risk in Estes Park.

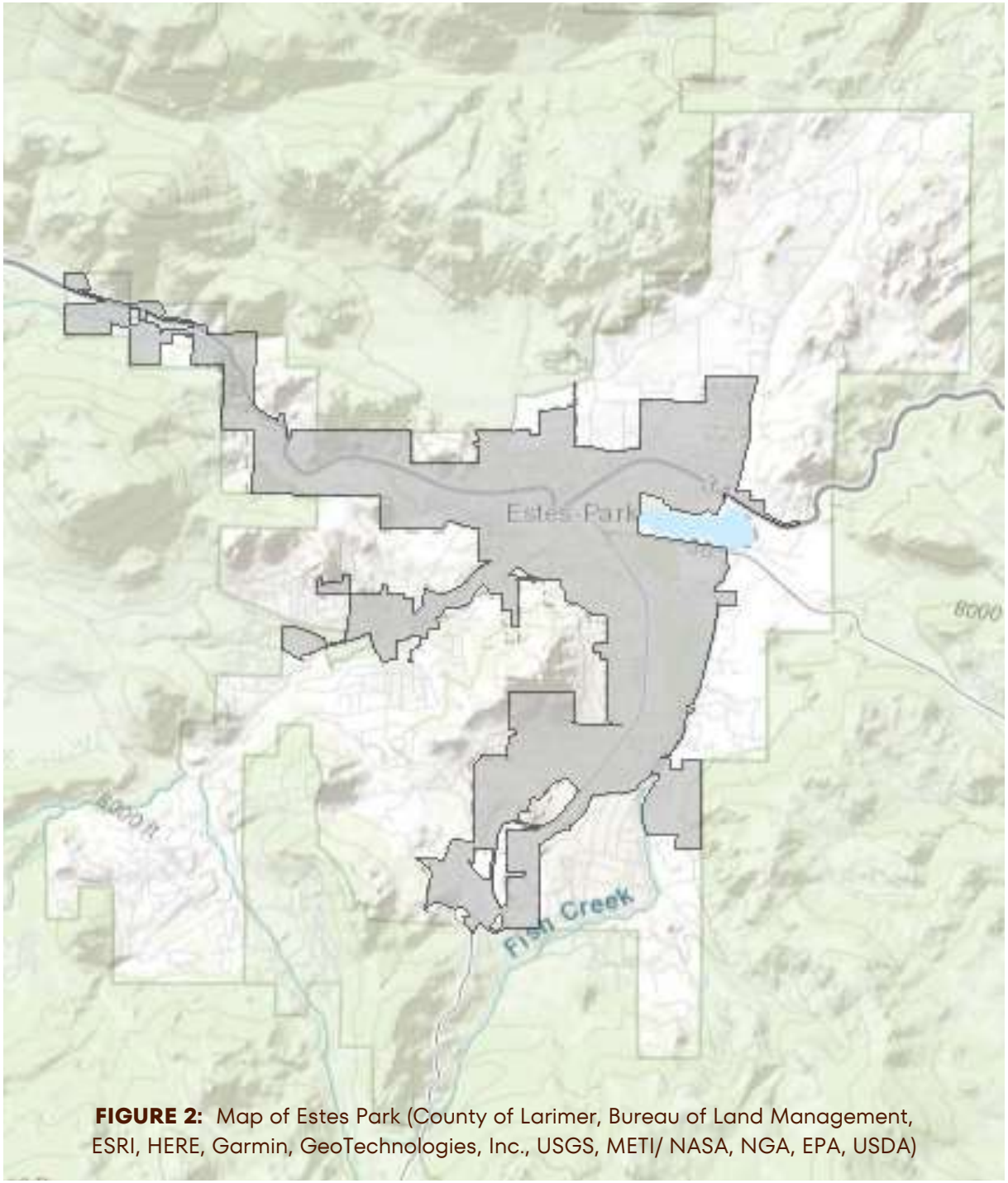
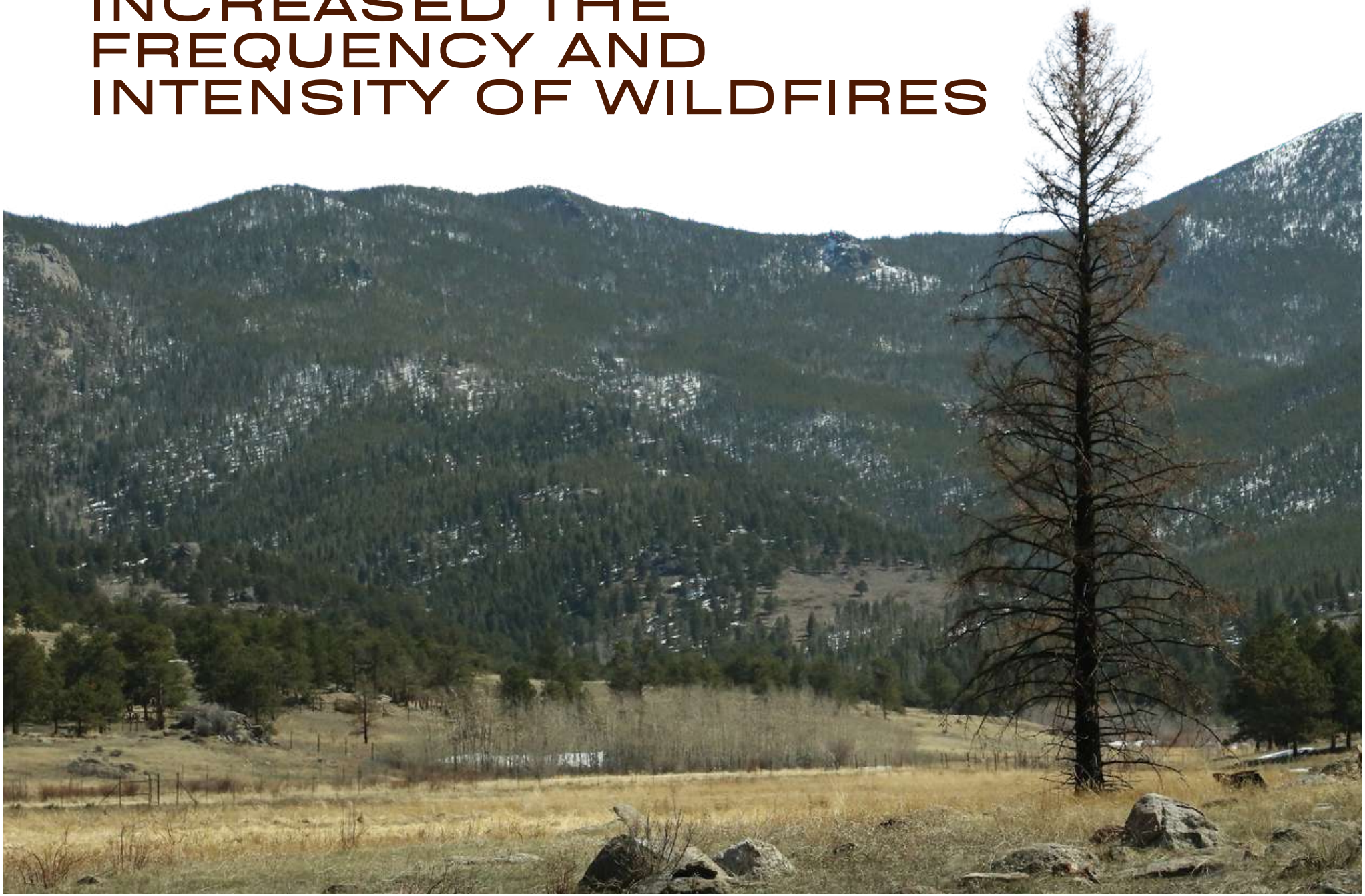


FIGURE 2: Map of Estes Park (County of Larimer, Bureau of Land Management, ESRI, HERE, Garmin, GeoTechnologies, Inc., USGS, METI/ NASA, NGA, EPA, USDA)

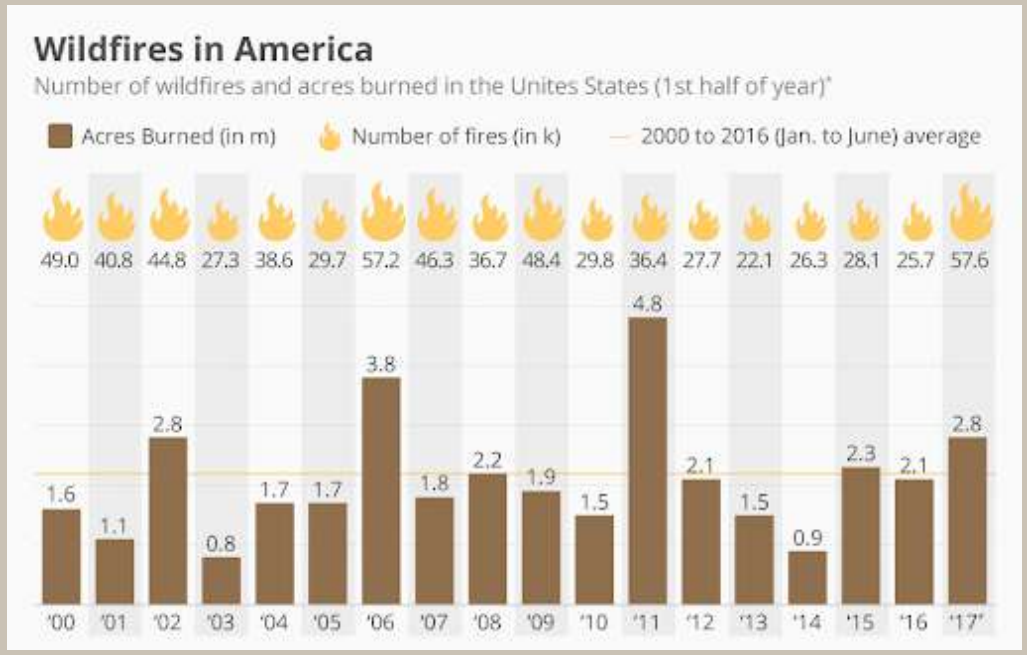
Credit: Adam Murrison

2.1 CLIMATE CHANGE HAS INCREASED THE FREQUENCY AND INTENSITY OF WILDFIRES



Climate change has increased the intensity and frequency of wildfires across the western United States from 2000 through 2017, as seen in Figure 3 (Loesche, 2017). Both the number of fires and the number of acres burned have increased over this time period.

Specifically, the annual acres burned in the United States from 1983 to 2020 has increased from 1.32 acres to 10.12 acres, as seen in Figure 4 (National Interagency Fire Center, 2021). Global increases in temperature, drought, and extreme weather events have contributed to the increases in wildfires and acres burned (Stevens Rumann, Kemp, Higuera, Harvey, Rother, Donato, Morgan, Veblen, 2017).



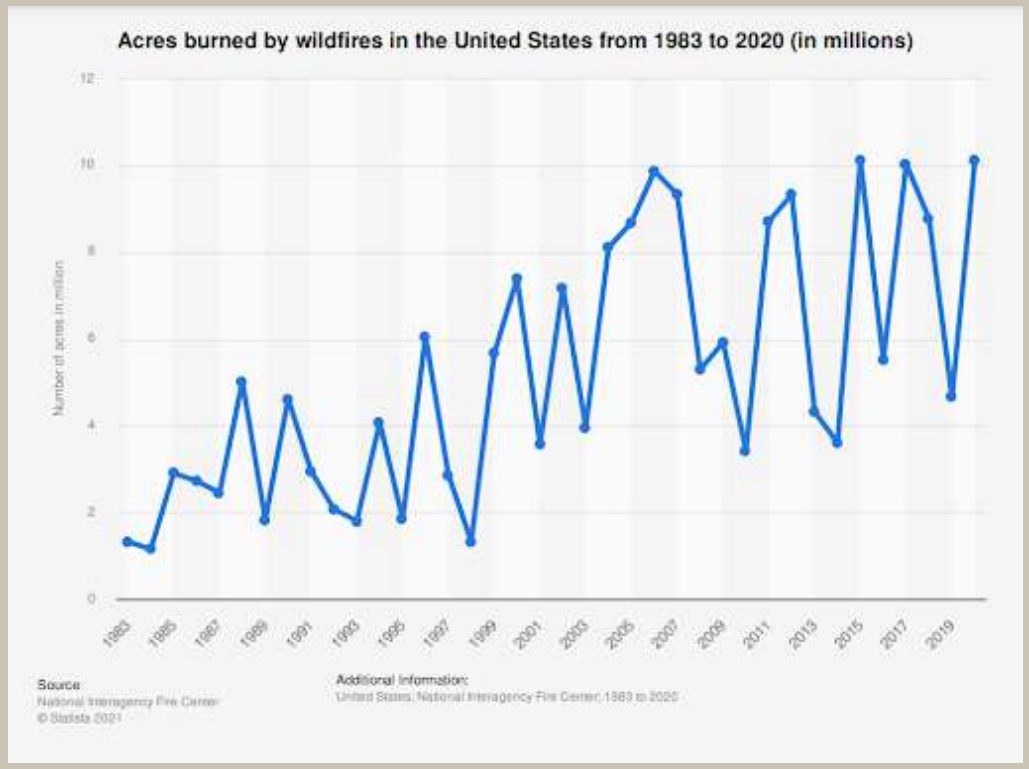


Figure 3 (TOP): An overall increase in the number of fires and the acres burned over 17 years (Loesche, 2017).

Figure 4 (BOTTOM): Since 1983 the annual acres burned by wildfires across the United States has increased by 8.8 million acres (National Interagency Fire Center, 2021).

2.1.1 LOWER PRECIPITATION LEVELS INCREASE FREQUENCY AND INTENSITY OF WILDFIRES

Increasing temperatures decrease annual precipitation which leads to water stress and drought. Drier years are commonly associated with large wildfire years compared to wetter years since wildfires need dry brush as fuel to burn (Stevens Rumann et al., 2017). There has been an increase in dry forest area, low humidity, and warmer temperatures (Colorado State University, 2022). Since 1985, the number of sites that have burned has significantly increased across the west and within Colorado (Stevens Rumann et al., 2017).

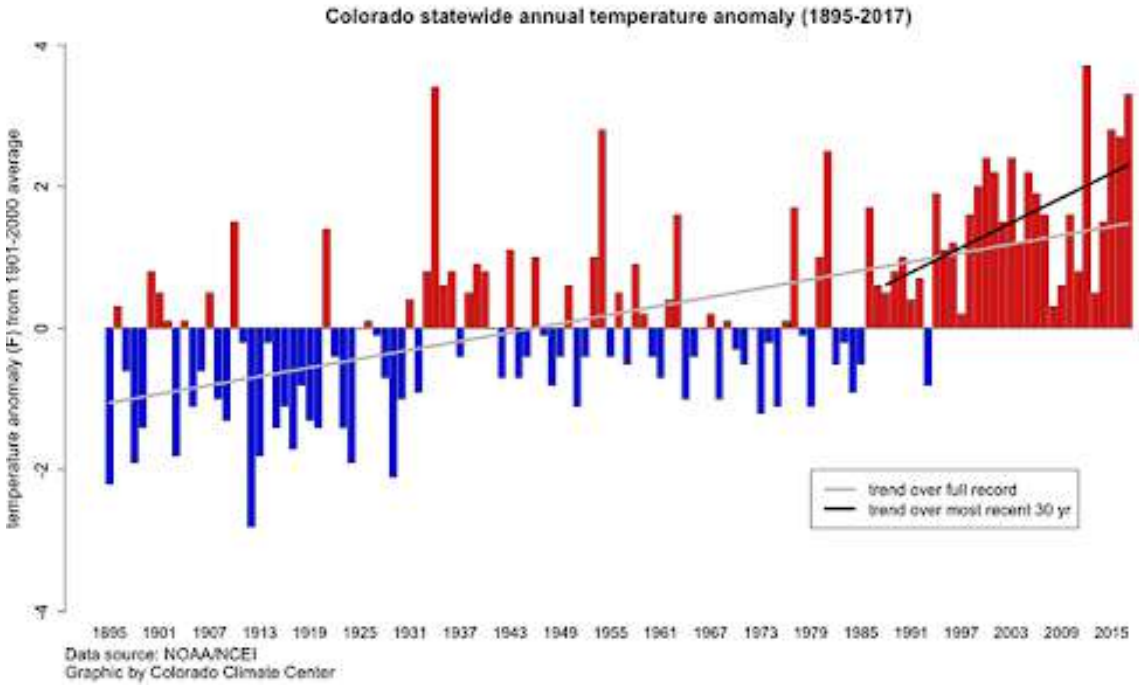


Figure 5: An increase in the overall temperature in Colorado across both the 122 year period and 30 year period (Colorado State University, 2022).

Warmer temperatures cause wildfires to increase in duration and intensity (Running, 2006). Since 1986, summers in the western United States have become about 78 days longer and have gradually become warmer resulting in a fourfold increase of wildfires and a sixfold increase in the area of forest burned (Running, 2006). Since the overall temperature in Colorado has been increasing over the past 122 years, it will result in more intense and long burning wildfires in Colorado (Colorado State University, 2022). The average duration of a burn has increased from 7.5 days to 37.1 days, a result of climate conditions that are prime for a fire to burn. Prime fire conditions include dry, warm air with wind that helps to spread the fire and dead and dry vegetation that provides more fuel.

2.1.2 EARLIER SNOW MELTING AFFECTS DURATION OF BURNING

Premature snow melts cause forests to become combustible earlier. Following a snowmelt, a forest is combustible within one month (Running, 2006). Therefore an earlier snowmelt means an earlier period when forest burning can begin. Steven Running found that years with early snowmelt saw five times as many wildfires compared to years where the snow melted later. Combining the negative effects of climate change results in an overall increase in the number of large fires and acres burned across the western United States, as seen in Figure 3 and 4 above. Wildfire burns have also been more destructive as seen in Figure 6 which shows the acres burned each year (Quinton, 2019). Specifically, the Rocky Mountains had a significant increase of about 40 major wildfires in the region from 1984 to 2012 (Running, 2006).

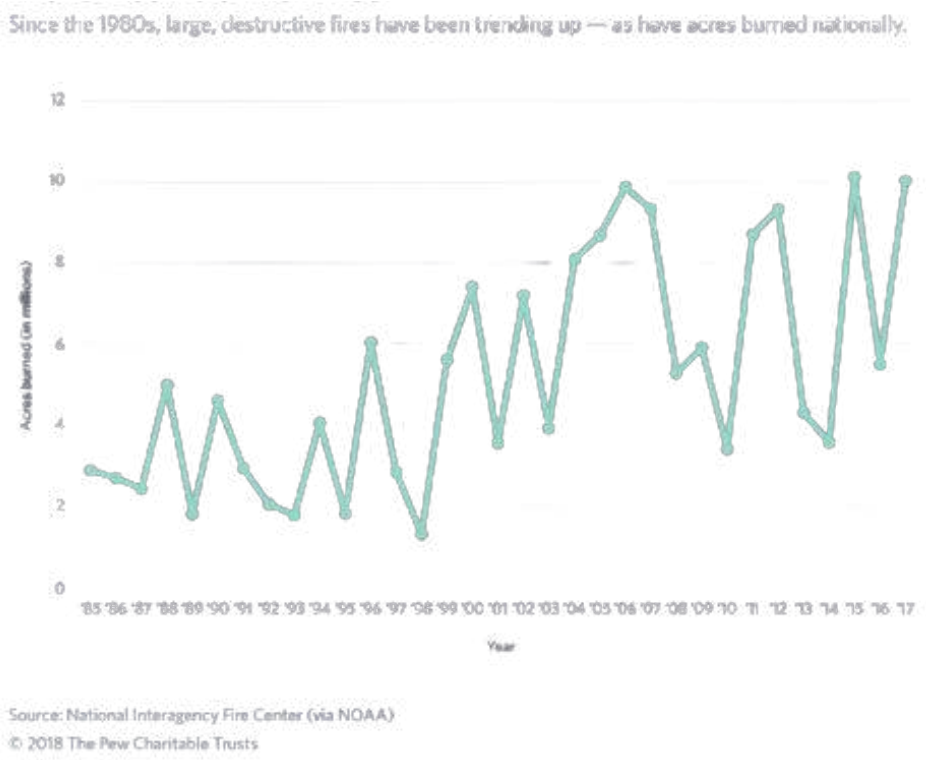


Figure 6: Increasing trend of wildfires becoming more destructive and burning more acres (Quinton, 2019).

Credit: Adam Murrison

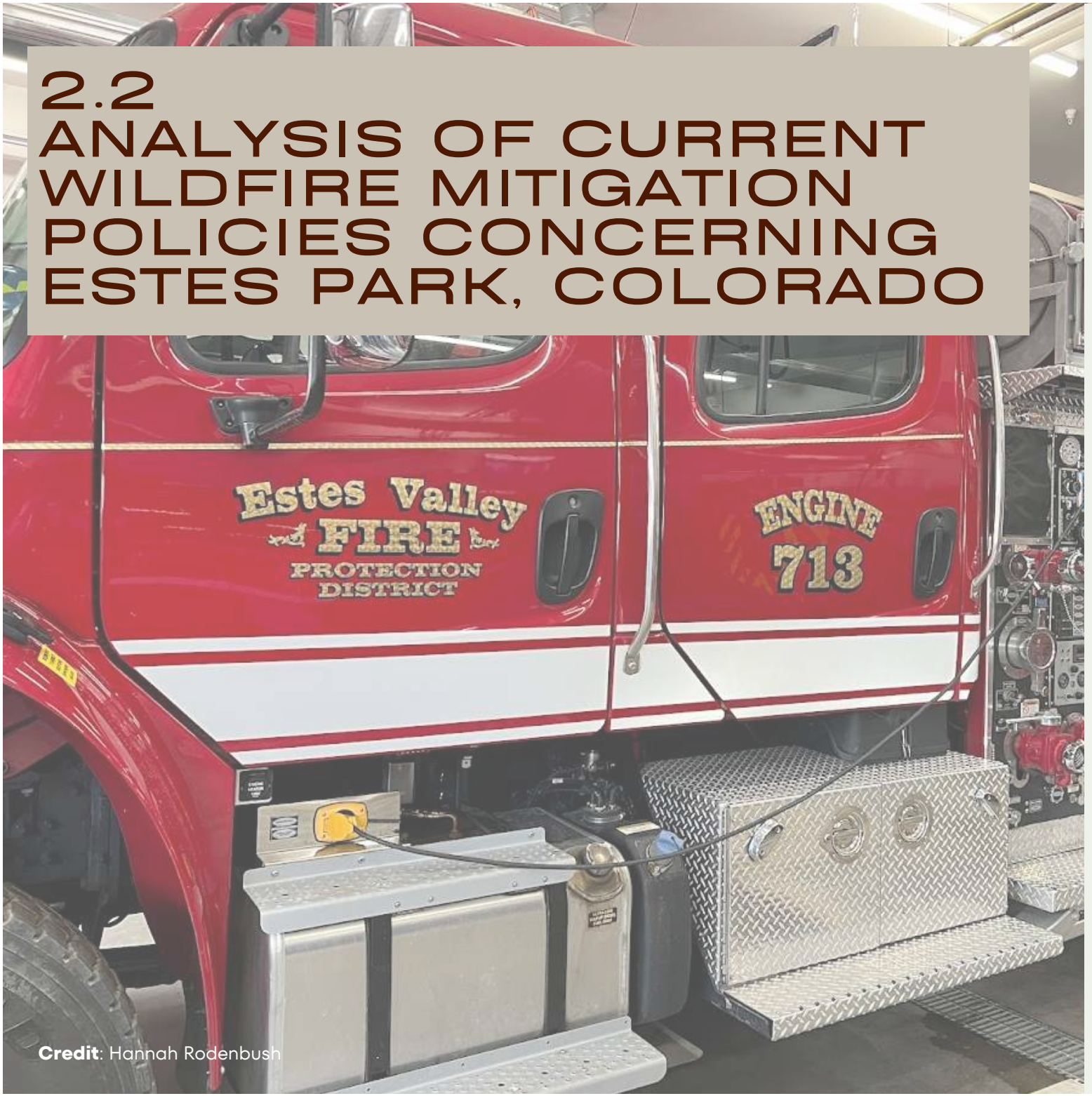
2.1.3 FUTURE TRENDS

In the future, conditions will only continue to worsen. In Colorado, the increasing temperatures are expected to continue through 2050 with an increase of about 6.5 degrees Fahrenheit (Colorado State University, 2022). In addition to an increase in temperature, a 15% decrease in precipitation is expected over the same time period (Running, 2006). The fuel aridity, or imbalance in water availability, is set to increase twofold in the years 2021-2050 (Abatzoglou, J.T., Battisti, D.S., Williams, A.P., 2021). The area burned by wildfires is expected to increase between 74% and 118% over the next century across Northern America (Running, 2006). In the western United States, by 2050, the annual forest-fire area (FFA) is expected to increase by about 20,000 square kilometers (Abatzoglou, J.T. et al., 2021). This adds to an expected FFA value of about 40,000 square kilometers which is about 4.5% of forested area.

Credit: Adam Murrison

With Colorado's growing population and steady rise of wildfires, both in frequency and severity, the Pinchot Institute found that "a buildup of forest fuels, combined with increasingly flammable forest conditions caused by drought, aging trees, and beetle kill, have created unprecedented hazards to Front Range water supplies in terms of severe wildfire hazard," (p. 32). The increase in wildfires and hazards creates a need for preparation policies and practices that can be implemented to protect communities.

2.2 ANALYSIS OF CURRENT WILDFIRE MITIGATION POLICIES CONCERNING ESTES PARK, COLORADO



Credit: Hannah Rodenbush

With the rise in intensity and frequency of wildfires in the wilderness areas, especially across the arid west, experts are focusing more on "effective agricultural and forest management plans, alongside public awareness, responsibility, and concern." (EARTH OBSERVING SYSTEM, 2021).

2.2.1 LARIMER COUNTY, COLORADO

Estes Park is located in Larimer County. The county created a Community Wildfire Protection Plan (CWPP) (2009), "to provide a cooperative framework under which fire management programs are developed and implemented to protect human and natural resource values in an effective and efficient manner" (Larimer County Fire Plan, n.d.). Overseen by the Larimer County Coordinating Group (LCCG), made up by the USDA Forest Service, the Colorado State Forest Service, the Larimer County Wildfire Safety Coordinator, and the USDI National Park Service, the Community Wildfire Protection Plan was created and last updated in 2009 to coordinate efforts "between all relevant agencies in determining appropriate combinations of wildland fire management actions and programs" (Larimer County Fire Plan, n.d.).

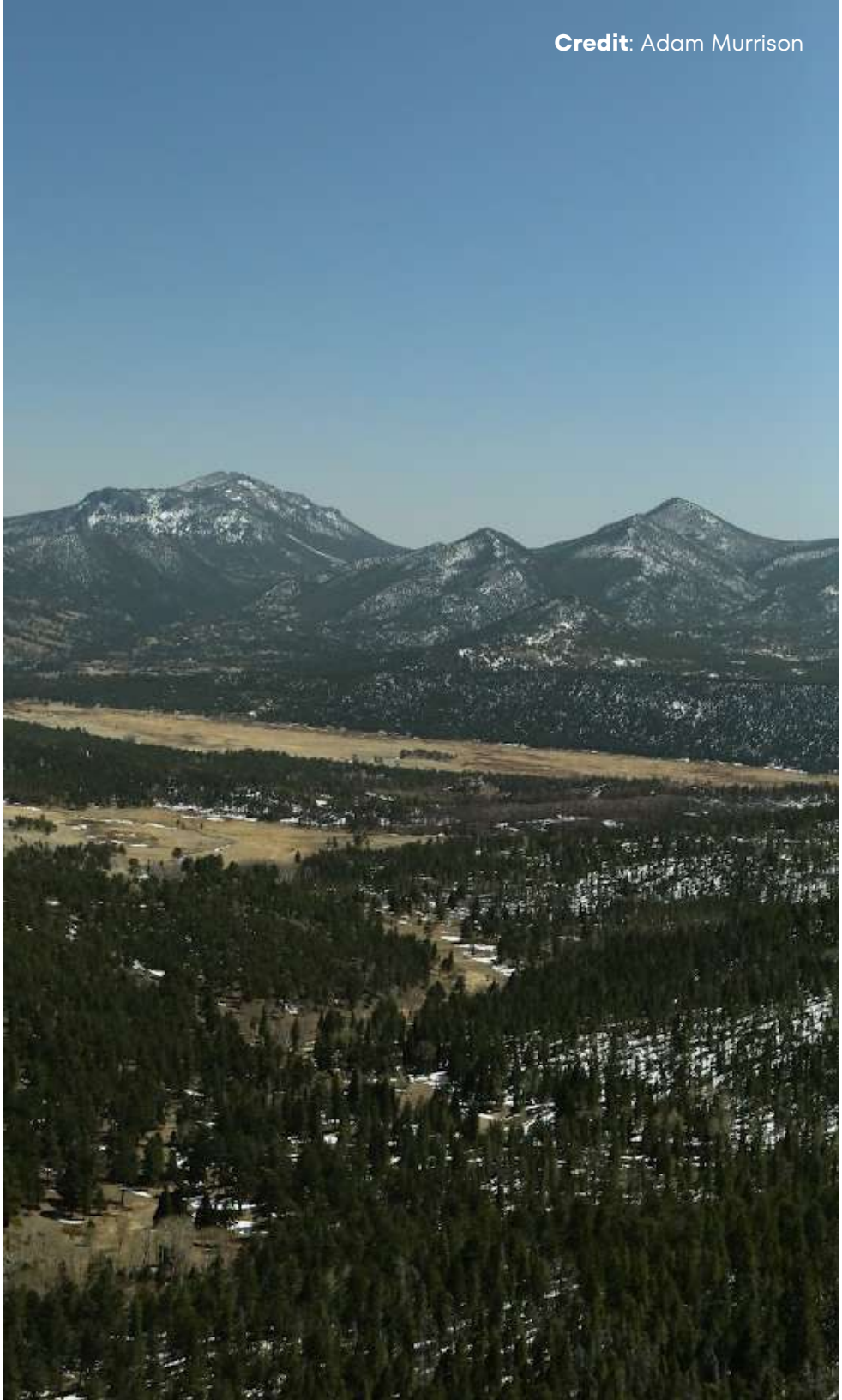
The current Community Wildfire Protection Plan is being updated to account for the recent rise in wildfires, and once finalized, will be the new framework that will guide decisions regarding the reduction of wildfire risk. Community Wildfire Protection Plans, such as the one currently in effect in Larimer County, assist local fire districts in anticipating certain fire risks while also assessing critical infrastructure and evacuation protocols within the community. Various evaluations of the community including fuel assessments, wildland fire hazard assessments, and fire history maps are all created to assist in the analysis of the fire risk within the community.

Fuel assessments help local fire districts, and specifically Estes Park officials, understand areas of improvement to reduce future fire risks, prioritize and locate effective fuel treatments, and invest in future projects to assist in watershed protection efforts. These fuel assessments also aid in determining fire categories in which specific geographic areas are outlined based on the strategy to control potential wildfire events. Based on the most recent CWPP (Larimer County Fire Plan Strategy Map), Estes Park is surrounded by what is known as the USFS Direct Control and RMNP Suppression Zones. These zones are areas in which wildland fires are either highly undesirable (USFS Direct Control), or are undesirable under current conditions (USFS Direct Control and RMNP Suppression Zones). For undesirable zones, "suppression and prevention and education actions will be aggressive to keep ignition to a minimum and restrict fires that do start to a small size" (Larimer County Fire Plan, n.d.). For undesirable fires due to current conditions, "fuel accumulations have created conditions under which wildland fires are likely to burn with unacceptable intensity and duration,"

and "rapid fire spread may present serious threats to public safety or fire containment," but prescribed burns are manageable under the correct conditions (Larimer County Fire Plan, n.d.).

Wildland fire hazard assessments help these fire districts and landowners identify potential risk areas and create plans to reduce the impact of these types of risks. An analysis of the vegetation types, habitat and structures in the area, the proportion of the forest covered by the tops of trees, and slope and elevation change in the area all lay the foundation for new building construction and land development requirements (Larimer County Fire Plan, n.d.). These codes and regulations can assist in these mitigation practices, and are important in understanding Estes Park's current mitigation strategies and policies. Based on the most recent CWPP (Hazard Map), large amounts of land in Estes Park are categorized at a very high hazard level.

With the severe wildfires that are being seen and discussed, and the potential impacts on watershed resources from the "loss of tree and vegetation cover (...) [to] rapid runoff, severe soil erosion, and sediment movement," it is important to recognize these negative impacts, and take steps to combat these issues (Larimer County Fire Plan, n.d.). The 2009 plan, which is currently being updated, outlines how "all new building construction and new land development must meet wildland fire mitigation codes and regulations," however these current codes fall short in mitigating these fire risks.



Credit: Adam Murrison

2.2.2 EQUITY CONSIDERATIONS IN WILDFIRE PLANNING

Following a disastrous event, a town or community develops policies that utilize fire resistant materials, as described in Appendix A, and processes that will limit the spread of a future wildfire. CWPPs typically focus on homeowners and do not adequately take into account the needs of renters and other parties (Norton, Wiliams, MacClune, Donahue, Fetterman & Schneider, 2019).

INSURANCE GAPS

Currently, many home or business owners cannot afford to rebuild or update structures with fire resistant materials to protect themselves against a future wildfire. This is a result of insurance not covering all the gaps following a disaster. Homeowners often sought the cheapest option when purchasing insurance which may not cover the full extent of their needs (Norton et al., 2019). When renewing their insurance, homeowners may not upgrade to fully cover their property and belongings because of the steep increases (about 20% within the past few years), in insurance costs due to increased wildfires in the area. Following a wildfire when homeowners make a claim to rebuild what they have lost or make renovations their policies do not cover the full amount needed to rebuild due to increased building costs and rises in property values.

Construction and labor costs increase following a disaster due to supply and demand (Norton et al., 2019). Fire resistant products and other materials are in demand because communities need to rebuild. Building and construction materials such as lumber, ready-mix concrete, gypsum products such as plaster and drywall, and steel mill products such as sheets have seen a steady increase in price monthly and annually (Logan, 2021) For example, ready-mix concrete has increased 25.7% since October 2020 and steel products have increased by 116.9% in 2021 (Logan, 2021). Other fire resistant materials such as double paned windows, for example, are the best option to limit the probability your window will shatter in a wildfire, however they can cost up to $300 more than a single paned window (Mueller, 2020).

EQUITY IN FUEL TREATMENTS

The federal, state, and local governments provide aid to put out wildfires while they burn, but also provide resources and aid following a wildfire during the rebuilding stages. Fuel treatments are a method of fire resilience that work to reduce the intensity and damage of future fires (Anderson, S., Plantinga, A., & Wibbenmeyer, M, 2016). Communities with a population that is predominately white, high income, and well educated tend to receive more fuel treatments compared to their counterparts (Anderson, S. et al., 2016).

Also, while a fire is burning, fire response managers are 6.2% more likely to stop a fire that is approaching an inhabited area if the value of the homes increases from $200,000 to $400,000 (Plantinga, A., Walsh, R., & Wibbenmeyer, M., 2020). This demonstrates a discrepancy between wealthier areas that are more likely to be held as a priority compared to low income homes when fighting wildfires.

FINANCIAL AID FOLLOWING WILDFIRES

After the wildfire has been put out, aid can be dispersed to help communities and individuals rebuild or relocate. A paper titled, Inequality in Agency Responsiveness: Evidence from Salient Wildfire Events, concluded that there are discrepancies in how this financial aid is dispersed. Rebuilding efforts focus on rebuilding properties that were destroyed instead of ensuring there are immediate places to house people who lost their accommodation (Jacquelyn Chase & Peter Hansen, 2021). When aid is distributed, it typically goes to the property owner to rebuild, and the renter will not be financially compensated (Anderson, S. et al., 2016). Renters were underrepresented in the population that first received financial aid from wildfire recovery grants; however, they are over-represented in the population that go for charity aid and public assistance (Jacquelyn Chase et al, 2021).

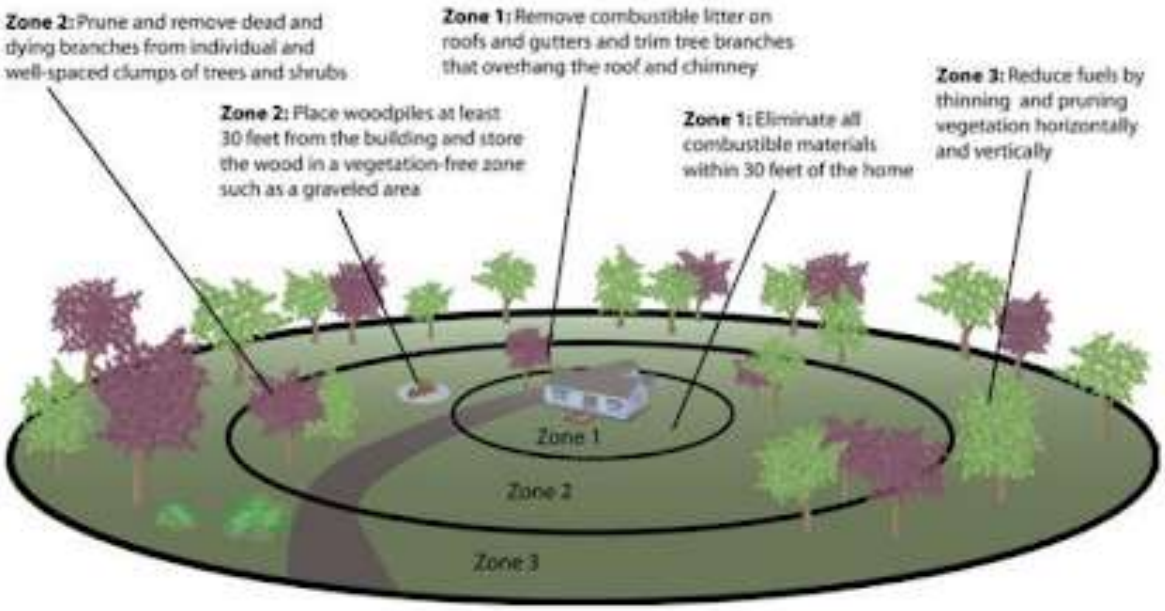
Also, populations who are low-income property owners, the uninsured, and those living in assisted living homes are often underrepresented in aid dispersion because they do not have the means to lobby for themselves. Areas with larger populations and wealthier individuals tend to receive the most aid because they have the resources to lobby government officials for adequate aid (Anderson, S. et al., 2016). To build fire resistance, wildfire planning initiatives typically encourage property owners to meet new codes and utilize fire retardant materials when they rebuild or retrofit their properties. It is argued that programs that provide aid for fire resistance supplies should include renters in the deliberations in addition to property owners because they too are stakeholders (Jacquelyn Chase et al, 2021). The costs will be reflected in their rent and they are the ones who have to commit to pay. Ignoring those who are socially vulnerable can have repercussions in the future because buildings may not meet more stringent fire codes or have defensible space which could increase the intensity and spreading of future fires.

2.2.3 PRACTICING DEFENSIBLE SPACE AND MITIGATION

As a homeowner, the best way to protect belongings and family is to practice fire mitigation policies around your property (FEMA). Utilizing concepts such as the zone concept or defensible space and fire retardant materials around the home or business can help increase resilience for the future (Norton et al., 2019; CA, 2010). Defensible space is a concept according to which residents are called to remove debris and fire ignitable materials from around their property, and which can minimize the damage to a property and decrease the spread in the case of a wildfire (Norton et al., 2019). The zone concept, or building defensible space, can protect your survivable space from a wildfire and is broken down into three zones: zone 1, zone 2, and zone 3 (FEMA).

As seen in Figure 7, and more detailed in Appendix I, Zone 1 is a 30 foot minimum radius around one's home that is well irrigated and contains minimal vegetation and litter (FEMA). Zone 2 is about 30 feet out from the home and can contain low lying shrubs or trees that are at least 10 feet apart with no limbs. It should be well maintained for all dead vegetation that can act as fuel for a wildfire (FEMA). Finally, Zone 3 includes the most natural area around the property, furthest from the home, that contains trees, shrubs and other vegetation but still needs to be maintained to remove any dead vegetation or fuels (FEMA).

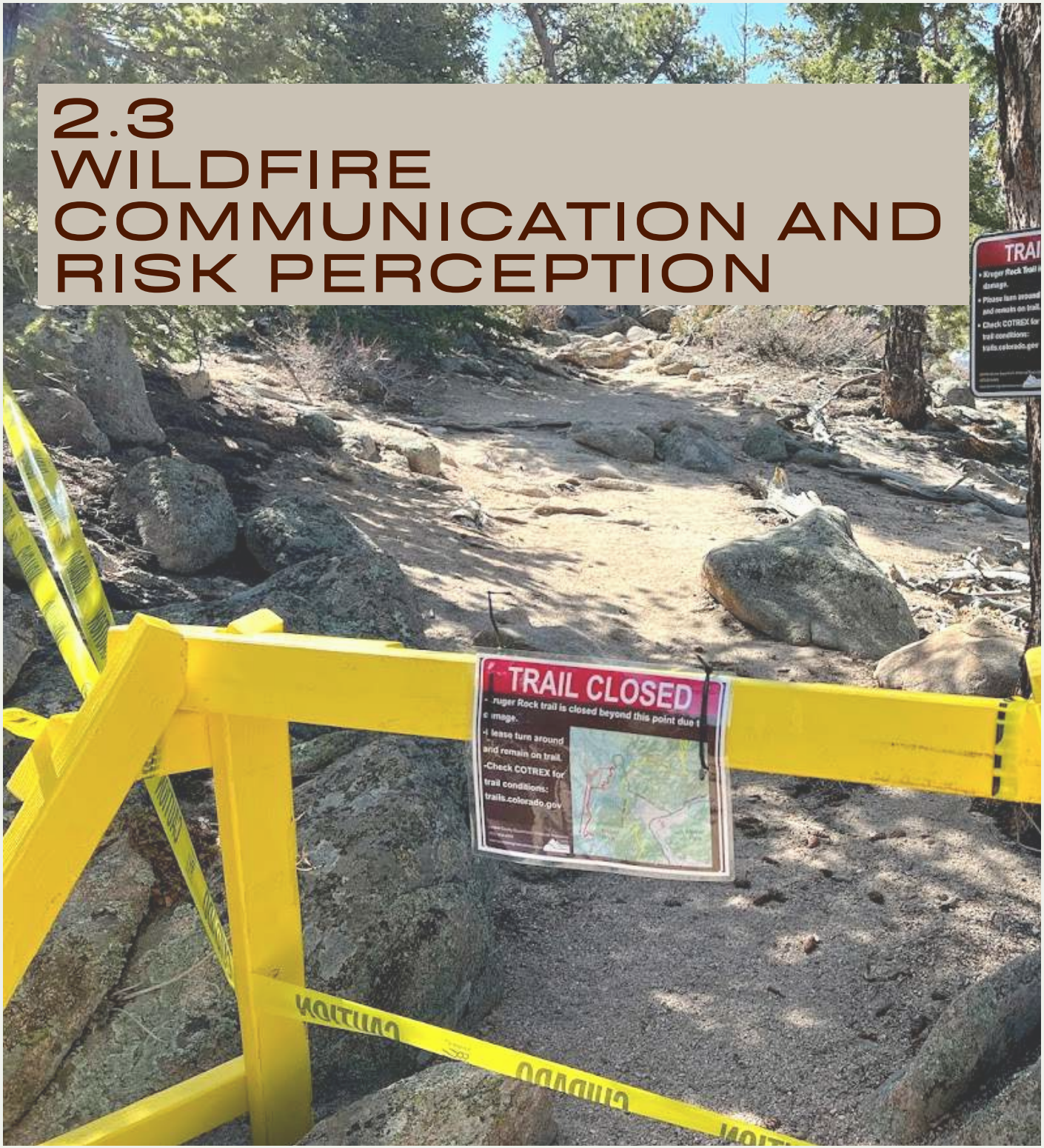
Figure 7: Defensible space around a property is broken up into 3 zones FEMA).



Currently, the Estes Park Fire Department is running voluntary mitigation assessments for homeowners to take part in. Raina Eshleman, a Fire Inspector in the Prevention Division through the Estes Park Fire Department, assists in community risk reduction for new construction and existing businesses, as well as promoting public education. Her job is to examine participating properties through a mitigation assessment program, which gives a score on how well a property is prepared. The inspectors focus on giving residents the freedom to choose which mitigation strategies fit for them in the forms of: "Good, Better, or Best" (Raina Eshleman, personal communication, March 22, 2022). The "best" options are to mitigate all three zones surrounding your house (30-200 feet around your home or property line), creating an effective defensible space. The "good" option, and probably the cheapest, aims for the first zone or the 5 feet around your home and property line. This zone typically requires no extra costs to the homeowner and just requires raking up brush and dry fuels, as well as trimming any overhanging branches to a distance of 10 feet. How to create defensible space can be further examined in Appendix I. Residents can email Prevention@EstesValleyFire.org to have one of their Fire Mitigation Specialists to tour properties or HOAs.

Credit: Estes Park Fire District

2.3 WILDFIRE COMMUNICATION AND RISK PERCEPTION



Credit: Hannah Rodenbush

One of the necessary dimensions of wildfire **preparedness** and **resilience** is the ability of officials to effectively communicate to the community that they serve. This includes education on wildfire preparedness before a wildfire event occurs, as well as crisis communication during and after a wildfire event.

Effective communication also requires trust between communities and officials, which depends on both the community and officials having a shared understanding of wildfire risk, which depends in part on how people make judgements about the frequency and severity of a natural hazard such as wildfires.

2.3.1 HEURISTICS AND APPLICATIONS TO RISK PERCEPTION

Many of the decisions that humans make every day are based on subjective assessments of the likelihood of events. Any time we make a decision without an objective knowledge of the outcomes involved, using language such as "I think that..." or "It is unlikely that...", these judgements are based on a number of mental heuristics (Tversky & Kahneman, 1973). These heuristics, or rules of thumb, can lead to predictable biases in decision-making that can be systematically analyzed (Kahneman, 2011).

THE AVAILABILITY HEURISTIC

One of the most important such heuristics is the availability heuristic, in which individuals tend to prioritize information that is available to them when making decisions.

In Kahneman's book, Thinking Fast and Slow, he presents a simple example of the availability heuristic: this simple experiment asks respondents if the letter K is more likely to appear as the first or third letter of an English word. Since it is easier to come up with words beginning with a certain letter than words with a certain third letter, most respondents will answer the first letter, however in reality the letter K is much more commonly the third letter of a word (Kahneman, 2011). This idea, in which people make judgements based on information available to them, is fundamental to risk perception.

PERSONAL RISK ASSESSMENT

One of the central problems in an analysis of the impact of a catastrophic event, such as wildfire, is an understanding of the perceived levels of risk within the community.

Personal risk assessment is affected by various forms of the availability heuristic. An example of a judgment that may be affected by the availability heuristic in the context of wildfire is: if someone's property has historically been untouched by wildfires in the area, they may feel less at risk of future wildfires even if this is not statistically the case. Another heuristic relevant to wildfire risk perception is the "illusion of validity" (Tversky & Kahneman, 1973). If a homeowner's property is safe relative to a certain set of wildfire risk conditions, they will be likely to feel that they are safe at home even if this set of conditions is incomplete or outdated.

ADDITIONAL HEURISTICS

The availability heuristic and illusion of validity are two out of a large set of heuristics that are applied frequently by humans, particularly when risk assessment is involved. Other significant examples of heuristics include retrievability bias, in which more familiar or well-known information will factor more heavily into a

ADDITIONAL HEURISTICS

The availability heuristic and illusion of validity are two out of a large set of heuristics that are applied frequently by humans, particularly when risk assessment is involved. Other significant examples of heuristics include retrievability bias, in which more familiar or well-known information will factor more heavily into a perception or decision, and imaginability bias, in which people are more likely to form perceptions based on scenarios that they have had personal experience with or can imagine. (Tversky & Kahneman, 1973). Imaginability bias, in particular, plays a significant role in risk perception as people are more likely to feel that they are in danger from a certain catastrophic event if they have already experienced a similar event.

Credit: Hannah Rodenbush

2.3.2 SOCIAL AMPLIFICATION OF WILDFIRE RISK

Understanding shortcuts and mental heuristics that are used when evaluating probabilities and risks makes it possible to evaluate how risk perception is amplified in a social context. According to Kasperson et al, there is no objective "true" or "distorted" risk, and risk as a whole is instead inherently tied to the social situations surrounding it. In this view, risk is a series of signals that are amplified by social stations such as scientists, media, social organizations, and personal networks; ultimately making it to individuals with a certain level of amplification (Kasperson, 1988).

SECONDARY IMPACTS

Social amplifications of risk will generally lead to behavioral changes in a population, creating what Kasperson et al. call secondary impacts of risk amplification. This can include impacts on business, politics and social pressure, changes in the physical risk, and changes in education. These effects can be either positive or negative. Crucially, these impacts also have the potential to have secondary impacts of their own, leading to an increasing "ripple" of social change through a society. In this way, a singular risk event such as a wildfire can have a significant and wide-ranging effect on a society (Kasperson, 1988).

ROLE OF PERSONAL EXPERIENCE

Social amplification applies to both personal experiences with risk, such as experiencing a wildfire evacuation directly, as well as indirect or secondary experience through information. Information flow is thus one of the most important forms of risk amplification through a form of the representativeness heuristic in which a large amount of information is likely to affect an individual's perception of risk independent of whether the information is complete or accurate (Kasperson, 1988). For example, if an individual sees numerous news stories in multiple outlets about the devastating impact of the East Troublesome fire, that individual may be more likely to have a higher perception of the risk of a small wildfire that develops in the area whether this comparison is physically valid or not. News stories play an important role in this form of amplification particularly when their contents are sensationalized, but informal communication within family, friends, and neighborhoods also plays an important role (Kasperson, 1988).

Building on this framework, a study by Brenkert-Smith et al. (2013) conducted a survey to qualify the various factors involved in the social amplification process and whether they had positive or negative impacts on risk perception. Figure 8 illustrates the factors that were considered within the experiment, falling broadly into the categories of information flow, social interaction, and personal characteristics.

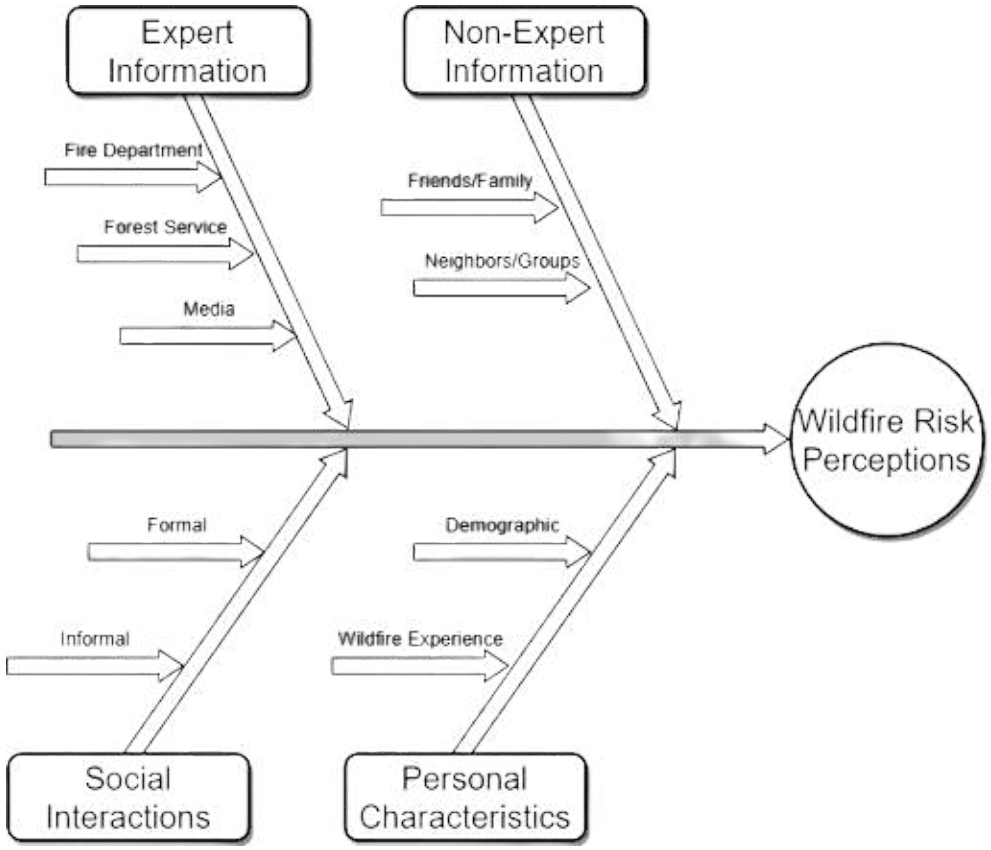


Figure 8: Diagram of risk perception factors (Brenkert-Smith, 2013)

Various findings from the survey are useful to understand the way in which communities construct risk related to wildfires. One such finding was that social amplification applies significantly more to the perceived probability of wildfires than the perceived consequences of a given wildfire. This is consistent with empirical findings since wildfires are common in the western United States, but the risk to any individual home is still relatively low. The authors also found that increased availability and use of information - both from experts and non-experts - generally caused individuals to perceive a greater threat from wildfire, which is consistent with the discussion of the availability heuristic above. Additionally, the study found that informal social interactions about wildfire such as discussions with friends, family, or neighbors, had a stronger positive impact on personal risk perception than formal social interactions such as town halls and PSAs, although both types of interactions had positive correlations (Brenkert-Smith, 2013). This study demonstrates many of the important characteristics and information sources to consider when conducting a comprehensive review of wildfire resilience.

2.3.3 DETAILED ASSESSMENT OF WILDFIRE RISK HEURISTICS

RISK PERCEPTION FACTORS

Various factors provide indicators for an individual's level of risk perception. One such factor is demographic, which suggests that wildfire prevention strategies will have different levels of effectiveness for communities based on factors such as age, income level, and education level. Another factor is the opinions of the surrounding group, suggesting that there is a large element of community consensus in regards to wildfire policy (Wang, Peng, Huang & Deng, 2022). This is an expression of the availability heuristic (Tversky & Kahneman, 1973): individuals surrounded by a community with higher risk levels will themselves be more likely to have a higher perception of risk.

PRIOR EXPERIENCE

Another factor that is highly important to consider when evaluating an individual's risk level for wildfire is the individual's prior experience with wildfires. However, the availability heuristic does not simply imply that prior experience with wildfires positively correlates with a higher perception of risk. A 2007 survey by McGee et al. following two large wildfire events in Canada found that many residents had little to no change in their perception of the probability of a wildfire in the aftermath of a large wildfire event; either because they already thought that the probability was high before the event or because their perception of the probability remained consistently low (McGee, McFarlane, & Varghese, 2007).

PROBABILITY AND CONSEQUENCE

These points lead to the idea that risk is defined and perceived by more than just perceived probability alone. Risk is defined as the product of probability and consequence: even if an individual's perception of the probability of a wildfire is not significantly changed, their overall risk perception could change if they gain new perspective on the consequence of a wildfire after such an event (Champ & Brenkert-Smith, 2010).

In a study conducted in Boulder and Larimer County in 2010, Brenkert-Smith et al. measured these two indicators separately, obtaining average probability and consequence indices for the community before and after the significant Fourmile Canyon and Reservoir Road fires. They found that the probability index was almost unchanged, while the consequence index increased significantly. This suggests that information about the probability of wildfire was readily available before the events, but experiencing a wildfire increased understanding and perception of the potential consequences of the event (Champ & Brenkert-Smith, 2010).

Credit: Adam Murrison

2.3.4 GAPS IN RISK PERCEPTION WITHIN THE WILDLAND-URBAN INTERFACE

Risk perception and willingness to participate in mitigation activities have been found in literature to be correlated. In a 2001 study by Winter and Fried, it was found that residents with a heightened sense of wildfire risk were more likely to contribute financially to a hypothetical wildfire prevention program (Winter & Fried, 2001). Additionally, a 2008 study of three WUI communities in the western United States found that homeowners were more likely to undertake risk reduction behaviors if they believed that wildfires posed a significant risk (Martin, Martin & Kent, 2008).

HOMEOWNER SURVEY

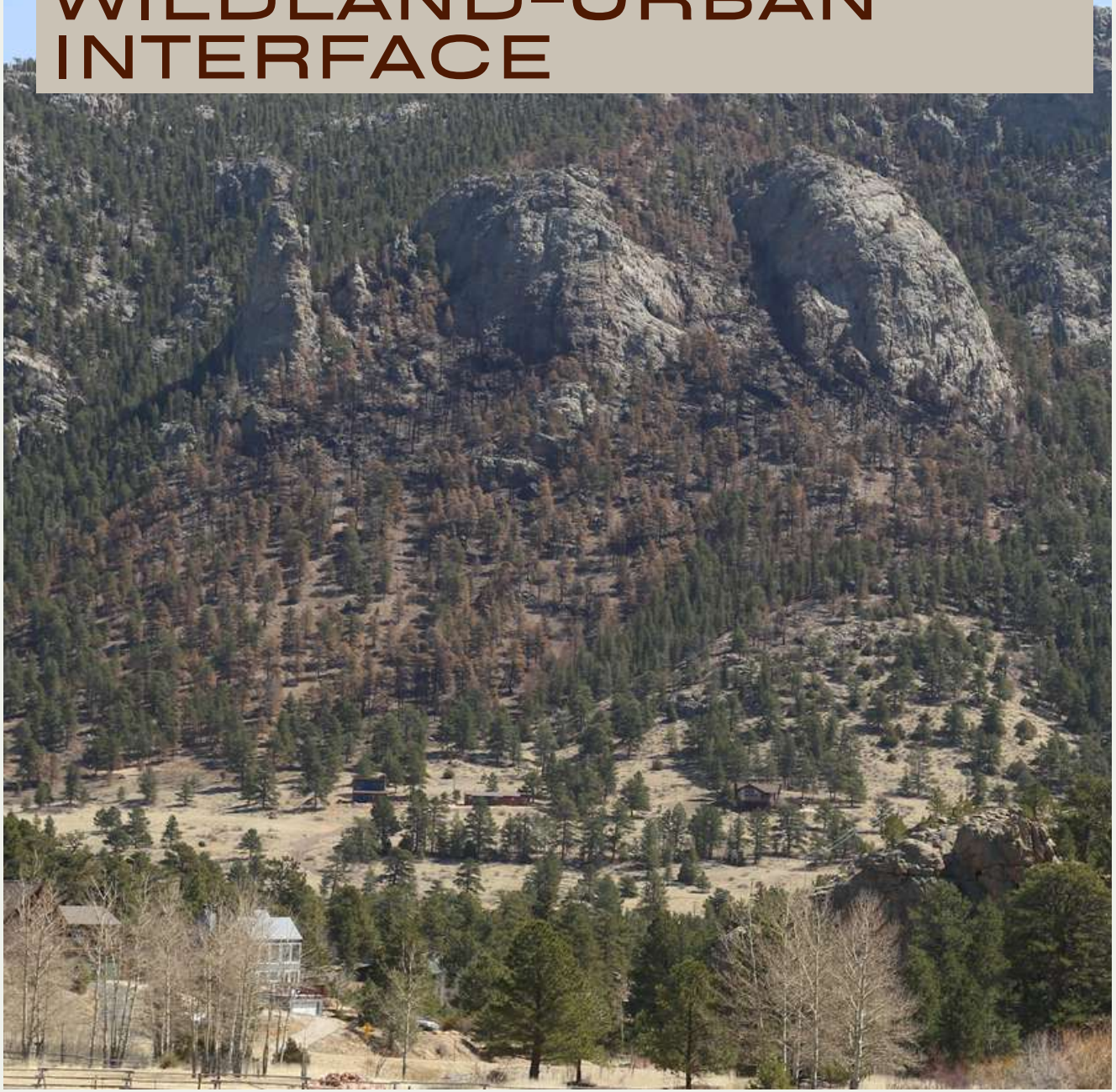
A 2015 study by Meldrum et al. attempted to measure a related gap in risk levels by analyzing a mail survey conducted on homeowners in the WUI area of Log Hill Mesa Fire Protection District in Colorado, along with a similar risk survey given to professionals. The study found that there was a significant gap in risk perception between professionals and residents. For example, more than half of resident respondents rated their personal properties at lower risk than professionals did, and residents were significantly less likely to rate a property as "high risk" compared to professionals.

Further, additional complications included the fact that residents appeared to have relatively different methods of evaluating risk than professionals did. Professionals correlated factors such as material flammability and distance to vegetation more strongly with property risk, while residents correlated background fuels and driveway width more strongly with property risk. These findings suggest that a disconnect exists between WUI wildfire professionals and residents, which acts as a potential barrier to policy improvements (Meldrum et al., 2015).

Credit: Adam Murrison

Credit: Adam Murrison

2.4 ESTES PARK WILDLAND-URBAN INTERFACE



The Wildland Urban Interface (WUI) continues to expand due to the rapid growth of population, new housing developments, and the effect of tourism. As population increases in Estes Park, the amount of new buildings also increases and causes the town to expand. The increase of human to nature interactions in the expanding WUI can cause more threats to wildfire in the future. Most recently, the Kruger Rock fire spread over 133 acres just two miles away from the town of Estes Park in November 2021 due to a tree falling onto nearby power lines (Calfas, J. 2021). More tragically to the residents of Estes Park, The East Troublesome Fire of October 2020 burned simultaneously with the Cameron Peak fire across Rocky Mountain National Park and are two of the largest wildfires in Colorado history (Brasch, S. 2020). These fires coupled with the expansion of the WUI raises questions about the community's level of vulnerability.

2.4.1 ESTES PARK POPULATION

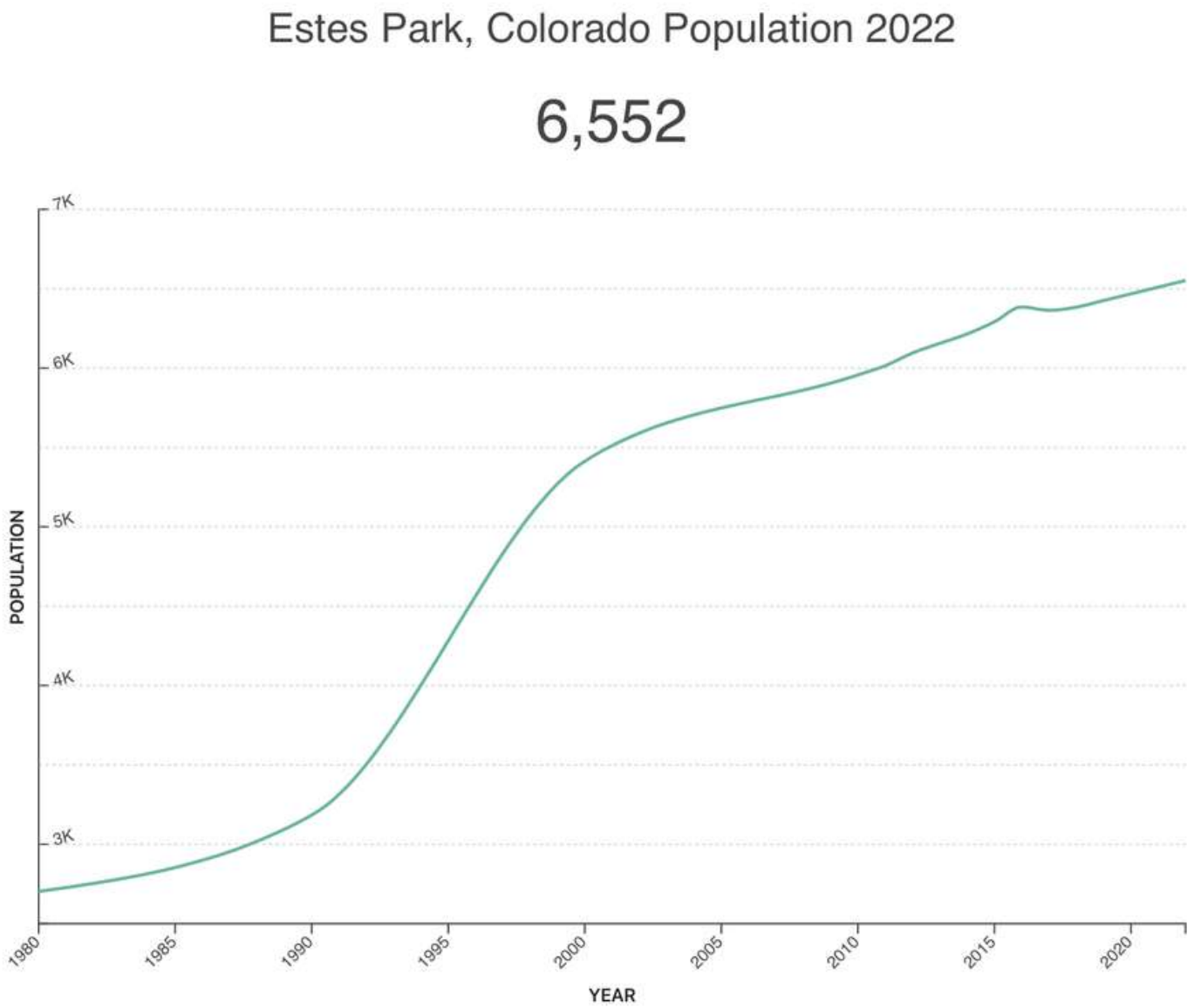


Figure 9: Increasing population of Estes Park (Estes Park, Colorado population, 2022)

Shown in Figure 9, the Estes Park population has steadily grown 11.58% in the last decade from a population of 5,858 to 6,552 people in 2022. This number results in about 962 people per square mile (Estes Park, Colorado population, 2022). Within Estes Park, about 68.6% of the population is considered vulnerable (U.S. Census). Vulnerable populations can consist of, but are not limited to: families in poverty, people with disabilities, people over 65 years old, non-English speaking people, households with no car, and mobile homes (U.S. Census).

A large part of the Estes Park economy relies on tourism. According to The Estes Park Visitor Center, they see over 400,000 visitors each year (Estes Park Visitor Centers, 2022). These numbers, as well as millions of visitors to Rocky Mountain National Park, are crucial when considering Estes Park's risk to wildfires and the role these visitors may play in contributing to this risk. "There is a new and inescapable awareness that each new visitor has the capacity to light the match that starts the fire that destroys their community" (Lincoln, 2021). This can include unintentional mishaps like an unattended campfire lacking the proper tools and materials to extinguish the fire. This lack of fire safety education and communication is a factor in the town's threat to wildfire risk. Another parameter to this is the issue of evacuating thousands of visitors who are unaware of current evacuation protocols and routes.

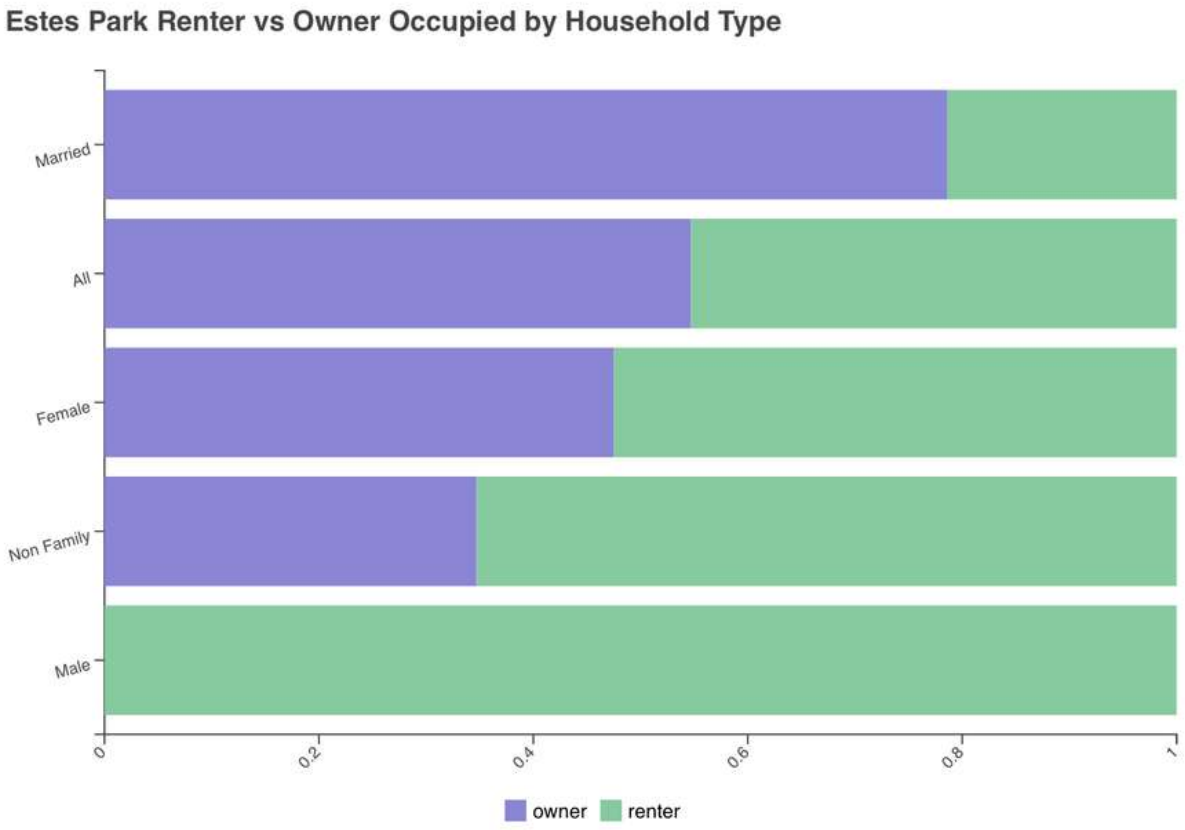


Figure 10: Estes Park Renter vs Owner Occupied by Household Type (Estes Park, Colorado population, 2022)

According to Figure 10, about 55% of Estes Park's 3440 households are owners, while the rest are renters (See Appendix C for more details). The median rental costs equate to $835 a month, whilst the median house value is $413,100 (Estes Park, Colorado population, 2022).

2.4.2 GROWTH IN THE WUI IN ESTES PARK

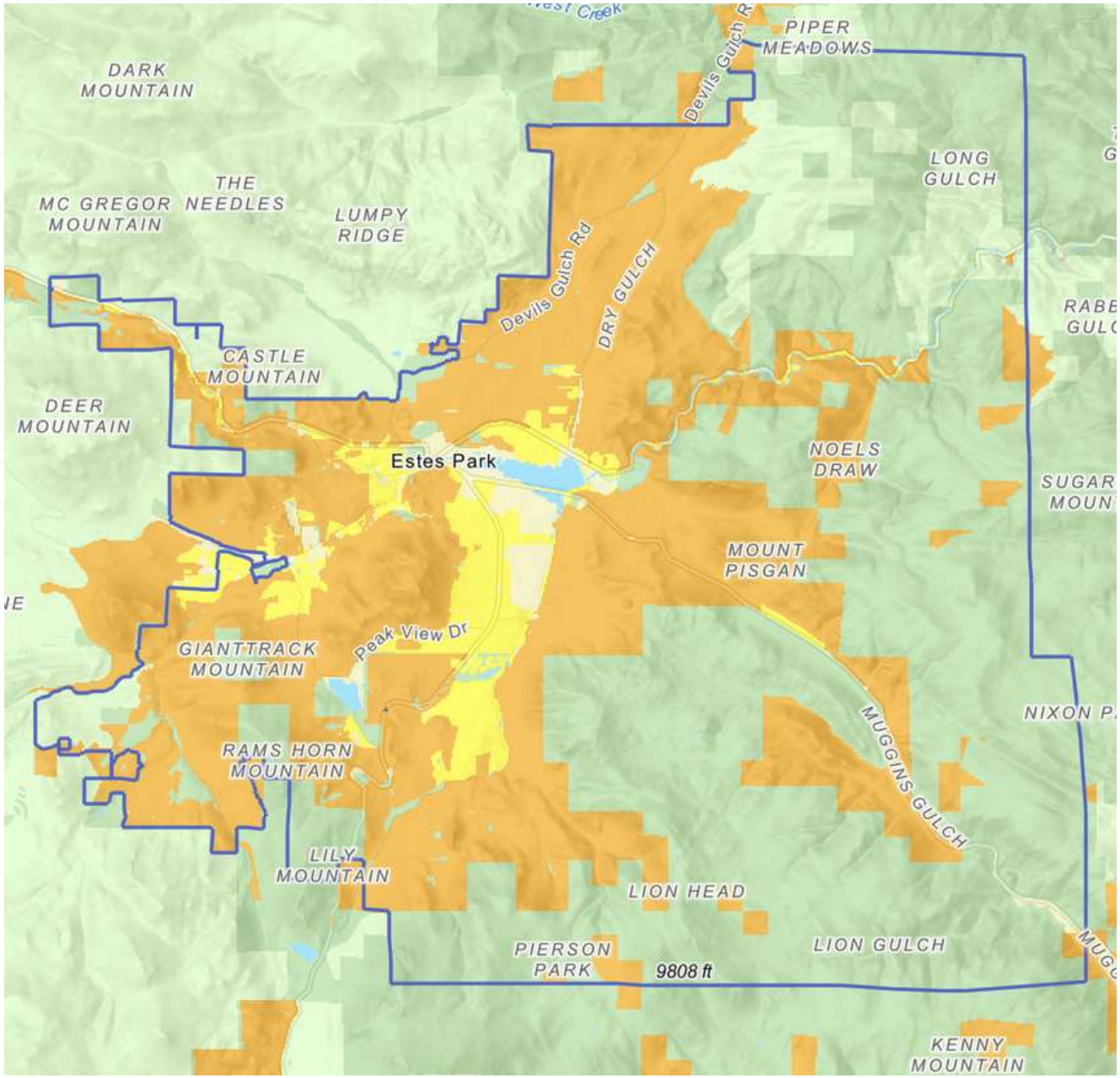


Figure 11: Estes Park WUI (Estes Valley Watershed Coalition, 2022)

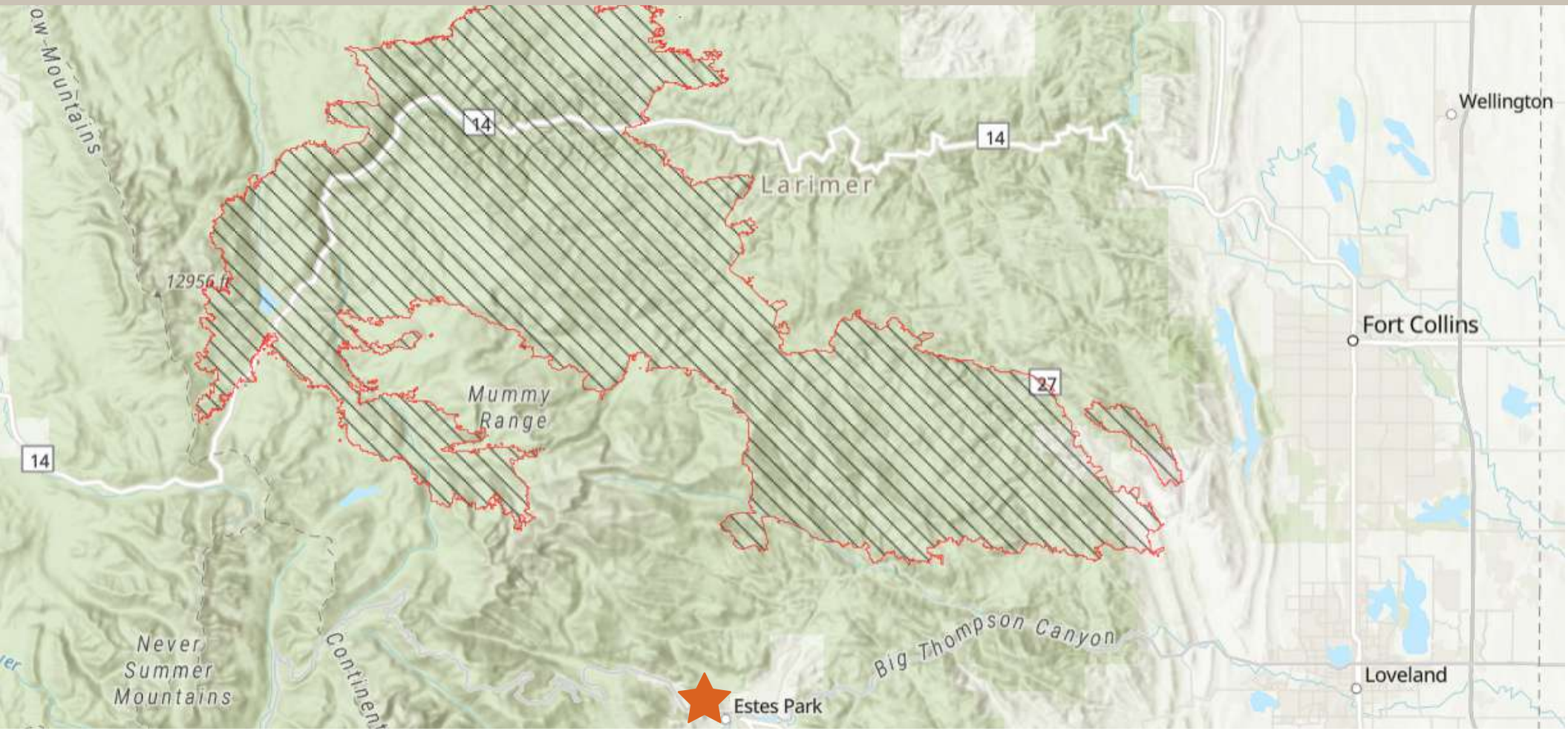
Figure 11 depicts how deeply intertwined the human population is with natural areas, and pinpoints the high risk areas located in Estes Park. There are two layers that should be noted: the Interface - where structures are adjacent to the wildland vegetation, and the Intermix - where structures intermingle with the wildland vegetation (Estes Valley Watershed Coalition, 2022). Because of the increased amount of structures and increased human interactions, the Intermix is more at risk. This raises questions on the impact of growth in population, how it directly has affected the WUI over time, and where this growth will lead in years to come.

INTERFACE

INTERMIX

2.4.3 CAMERON PEAK FIRE

Figure 12: Cameron Peak Fire Perimeter map (Map Courtesy of National USFS)



The Cameron Peak fire, as shown above in Figure 12, was reported as the largest fire in Colorado history. With the cause still under investigation, it started on Thursday, August 13th, 2020 in the early afternoon. The spread of the fire grew "due to extreme temperatures, low humidity, rough terrain and gusty winds reaching over 70 miles per hour" (Inciweb, 2020). The rapid rates of spread were also repercussions of drought, meaning more dry fuel such as "beetle killed trees and drought stricken Ponderosa Pine, Engelmann Spruce and mixed conifer" (Inciweb, 2020). Spreading over 200,000 acres across 112 days, and being the first to do so in Colorado history, it was declared contained on December 2nd. The Cameron Peak fire destroyed over 450 structures and evacuated roughly 20,000 people in surrounding communities, including the entire town of Estes Park (Inciweb, 2020).

2.4.3 CAMERON PEAK FIRE

Credit: Cameron Peak Fire report on InciWeb.nwcg.gov

Pictured here is a fire-fighting aircraft during the Cameron Peak Fire

2.4.4 EAST TROUBLESOME FIRE

Figure 13: East Troublesome Fire Perimeter map (Map Courtesy of National USFS)

Burning simultaneously to the Cameron Peak fire in October 2020, the East Troublesome fire's rapid growth across the western edge of Rocky Mountain National Park was unprecedented. Its intensity redefined "how quickly Colorado wildfires can grow in an era of rapid climate change" (Brasch, S, 2020). It primarily grew from high winds with a warm and extremely dry climate, forcing those near to quickly evacuate. In just a day, nearly 120,000 acres and hundreds of structures burned across its path. Originating from northeast of Kremmling, in Grand County, CO, it blew towards the east direction jumping several highways and most shockingly, the Continental Divide and then burned into the edges of Estes Park. In total the fire burned over 193,000 acres.The fast spreading fire had "over 7,000 structures threatened, and a population of 35,000 placed under mandatory evacuation" (U.S. Forest Service). Being only a few miles away from downtown Estes Park, the fire stopped spreading due to a heavy snowfall and cold temperatures around October 25th, 2020 and was declared contained November 30th, 2020 (U.S. Forest Service). This record breaking fire left people in panic and distraught after the disastrous amount of loss it created.

2.4.4 EAST TROUBLESOME FIRE

Credit: Tim Buck

Pictured here is smoke over the town of Estes Park due to the East Troublesome fire of 2020

2.4.4
EAST TROUBLESOME FIRE

Credit: Adam Murrison

Pictured here are burn scars located in Rocky Mountain National Park, a year and a half after the East Troublesome fire

2.4.5 KRUGER ROCK FIRE

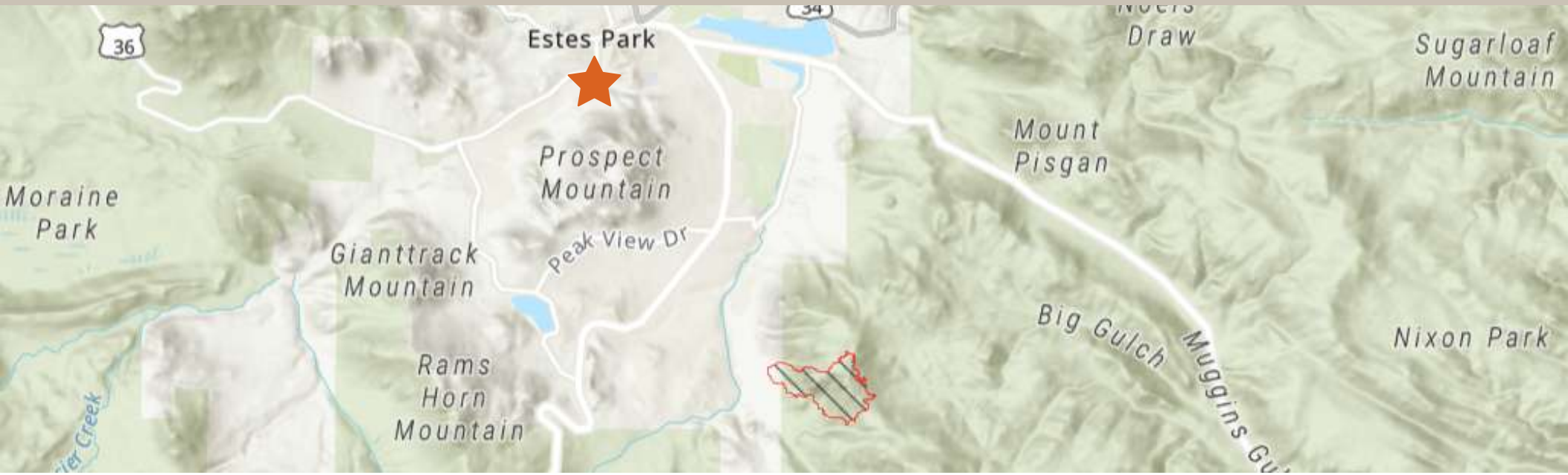


Figure 14: Kruger Rock Fire Perimeter map (Map Courtesy of National USFS)

The Kruger Rock fire was reported to have been started from high winds blowing a tree into a nearby powerline. This caused a spark which grew into larger flames as winds continued at around 45 miles per hour (Larimer, 2021). Larimer County officials stated that the fire posed "immediate and imminent danger" and soon prompted evacuation protocols on the town and its residents (Powell, T., 2021).

In efforts to stop the fire from spreading, it took more than 150 firefighters and emergency services personnel to work on suppressing and containing the fire. Unfortunately this includes a responding aircraft that had crashed, leaving one dead (Calfas, J. 2021). With high winds, relatively low humidity and plenty of dry fuel, it was almost perfect conditions for a wildfire to spread.

These three fires had similar causes of spread. Researchers studying the aftermath of these fires are able to learn more about predicting wildfires and ways to contain them moving forward (Brasch, S. 2020). Looking across a database of past fires shows trends that "10 percent of all fires which grew the fastest accounted for more than half the total acreage burned" (Brasch, S. 2020). Thus meaning the more intense and rapid spreading fires will inevitably cause the most damage. The reason for such rapid spreading fires is due to Colorado's dry climate, especially following an ongoing drought, mixed with plenty of dry fuel to feed the flames.

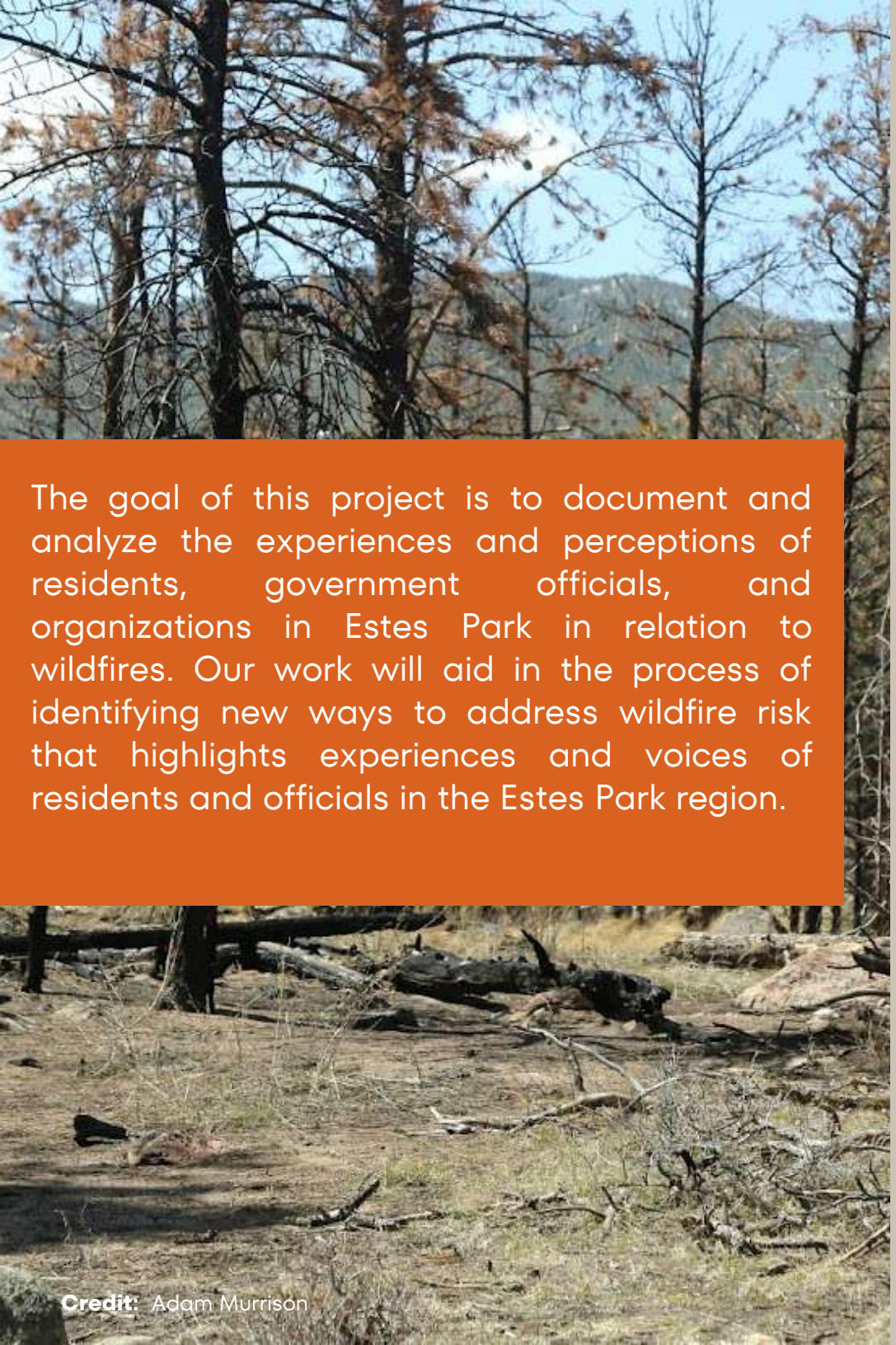
Credit: Adam Murrison

Pictured here are burn scars on Kruger Rock a few months following the Kruger Rock fire of November 2021

Wildfires pose a significant threat to both the population of Estes Park and the population of the western United States as a whole. As climate change continues to exacerbate wildfire conditions, creating longer and more intense wildfire seasons each year, new policies are needed to help communities adapt. Our sponsor, the Boulder Watershed Collective, is currently participating in wildfire planning processes that seek to identify new approaches for Front Range communities. The organization hopes to foster effective public participation in these deliberations that place in the foreground the experiences and perspectives of community residents with wildfires

3.0 APPROACH

Credit: Adam Murrison



Credit: Adam Murrison

The goal of this project is to document and analyze the experiences and perceptions of residents, government officials, and organizations in Estes Park in relation to wildfires. Our work will aid in the process of identifying new ways to address wildfire risk that highlights experiences and voices of residents and officials in the Estes Park region.

Our objectives are as follows:

1. Document experiences and attitudes of residents of Estes Park about wildfire risk.

2. Identify current approaches to wildfire preparedness in Estes Park and Larimer County.

3. Assess opportunities to improve current wildfire mitigation strategies in relation to vulnerable populations in Estes Park.

The project outline containing our objectives and steps we took to reach our final deliverable can be found in Appendix D. In the following sections we discuss each objective in turn.

3.1 DOCUMENTING THE EXPERIENCES AND ATTITUDES OF RESIDENTS OF ESTES PARK CONCERNING WILDFIRE RISK

We documented the experiences and attitudes of residents of Estes Park concerning the threat of wildfires, how they prepare for wildfires, what made them come to Estes Park and what makes them stay, and what they would do if they had to evacuate due to these wildfires. Our interview protocol can be found in Appendix F. We conducted 21 semi-structured interviews with local residents, including renters and property owners, longtime residents and those who have more recently moved to Estes Park, low income households and those that are financially well off, and single residents and families.

To solicit the viewpoints of vulnerable populations, we conducted interviews at Crossroads Ministry of Estes Park and the Good Samaritan Society Estes Park Village, both of which can be found in Appendix E. The interviews were conducted at a variety of locations such as the Estes Park Public Library, local businesses or interviewees' places of work, and local coffee shops.

The goal of the interviews with residents was to gain insight into their personal stories and life experiences in regards to wildfires. During the in-depth semi-structured interviews one group member was the designated interviewer while another was the designated note taker. Our group asked questions that can be found in Appendix F, but went off script to gain an in-depth understanding of the interviewees' experiences.

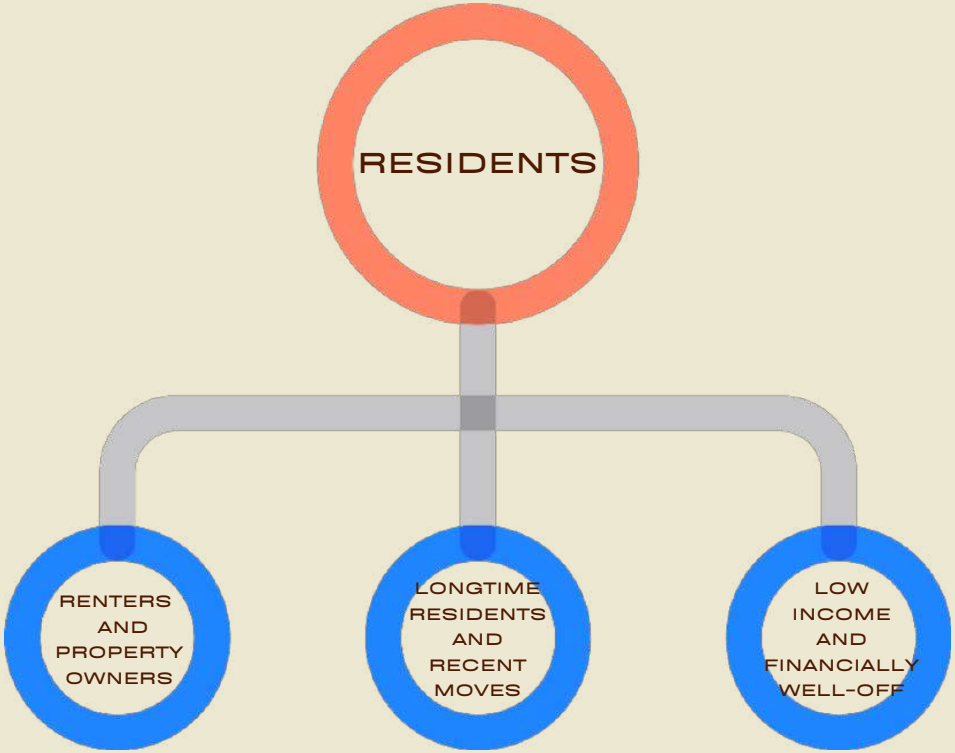
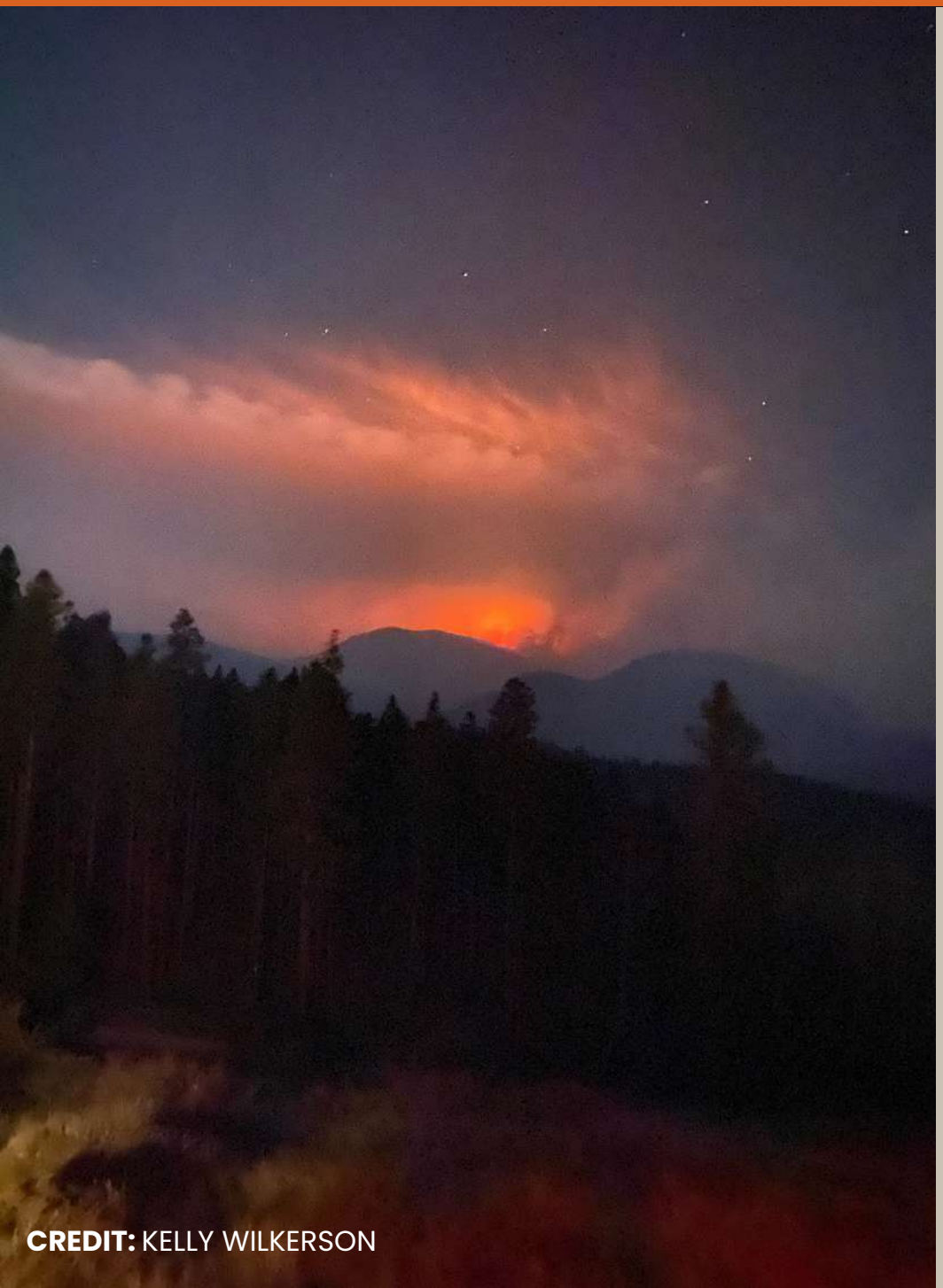


Figure 15: Types of residents interviewed

3.1 DOCUMENTING THE EXPERIENCES AND ATTITUDES OF RESIDENTS OF ESTES PARK CONCERNING WILDFIRE RISK



CREDIT: KELLY WILKERSON

The interviews focused on topics including perceptions of wildfire risks, familiarity with wildfire preparation, and views on possible evacuation and resettlement. Overall, interviews with different residents were conducted until we reached saturation, or until there was an adequate amount of data to gain an understanding of main themes (Hennink & Kaiser, 2019).

We recorded and transcribed the interviews through Premiere Pro software in Adobe after receiving consent from the interviewees. To manage data, we created two common folders, one with transcripts and one with interview strategies. Each interview strategy contained interview questions and any important notes. After each interview the group analyzed the transcriptions and notes and extracted quotes from the interview that provided key information to our research.

A shared spreadsheet was created to keep track of important quotes and timestamps that could potentially be used in our report for the purpose of confirming consent to use these quotes from interviewees. The group then applied a coding strategy (Saldaña, 2016) and reviewed notes from each interview to identify themes which were utilized in our final deliverable, an ArcGIS StoryMaps, which is further explained in Section 3.1.1. Once the group had decided on quotes to use within this report and our team's ArcGIS StoryMap, a team member sent an email to each resident in order to obtain consent for each individual quote that they provided.

3.2 IDENTIFYING CURRENT APPROACHES TO WILDFIRE PREPAREDNESS IN ESTES PARK AND LARIMER COUNTY

We conducted semi-structured interviews with government officials and organizations in Larimer County and the town of Estes Park to understand current wildfire policies and plans and how these plans have been influenced by recent fires (e.g., the Kruger Rock, East Troublesome, and Cameron Peak fires). We interviewed government officials from Larimer County, Estes Park firefighters, town planners, and town administrators.

The goal of the interviews with government officials was to gain insight into mitigation planning and preparedness to better understand what the town envisions would be a step towards a safer, more prepared, community. We also interviewed members of organizations such as the Community Planning Assistance for Wildfire (CPAW), Boulder Watershed Collective, and the Crossroads Ministry to understand how non-profits and groups benefit the town to better prepare for wildfires and during recovery. A complete list of organizations and people we communicated with can be found in Appendix E.

To develop a diverse sampling group, we applied a snowball sampling approach by first contacting sources from organizations and local officials who then directed us to those who can best assist the goal of this project.

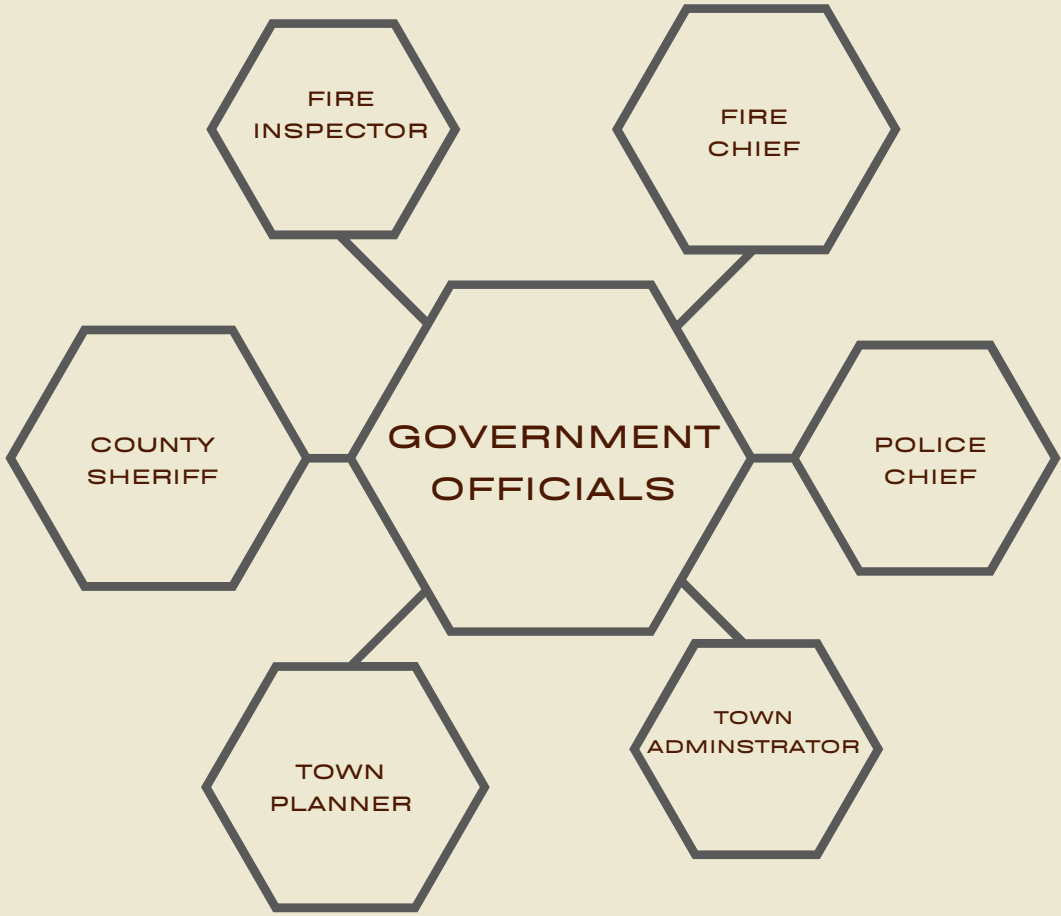


Figure 16: Types of officials we interviewed

3.2 IDENTIFYING CURRENT APPROACHES TO WILDFIRE PREPAREDNESS IN ESTES PARK AND LARIMER COUNTY

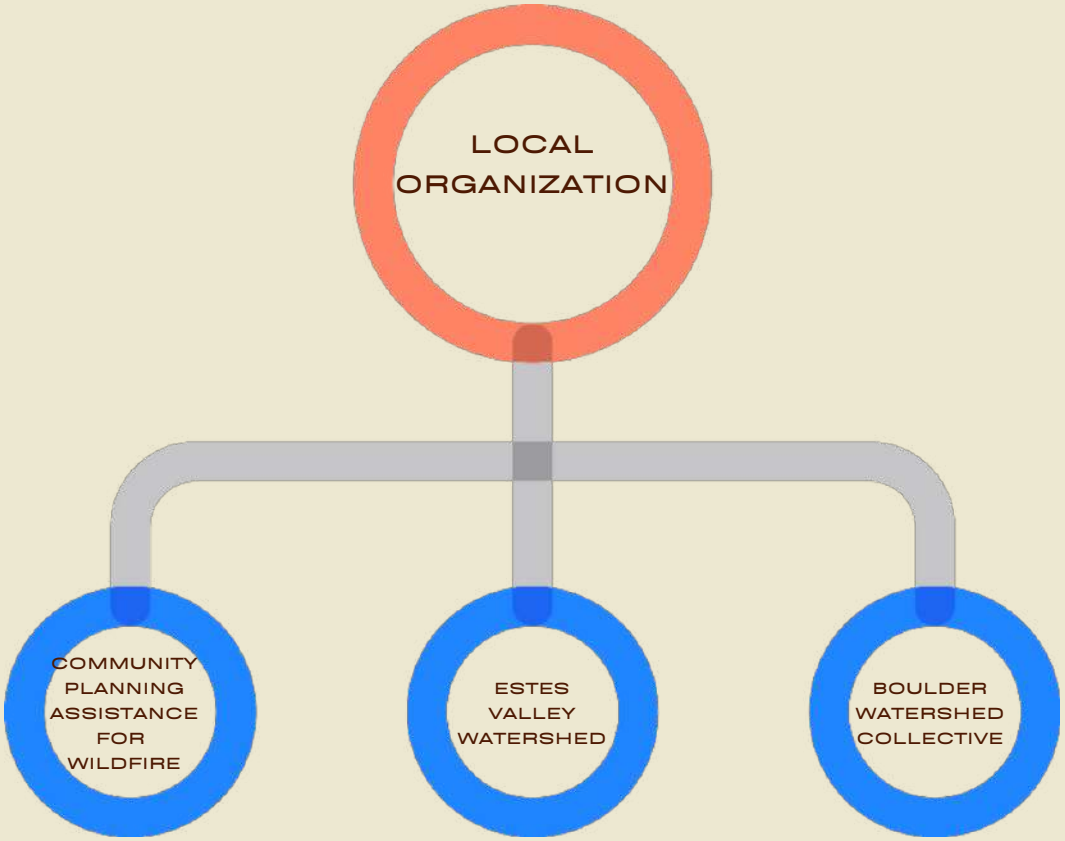


Figure 17: Types of local organizations we interviewed

For example, the fire chief and inspector, police chief, and town administrator of Estes Park provided our team with insight into preparation, mitigation, and evacuation strategies. The representatives from CPAW and Estes Valley Watershed were knowledgeable on planning strategies and available resources to residents and officials. A set of interview questions and an informed consent script can be found in Appendix F. The group again conducted interviews with different officials or organizations until saturation, or there was an adequate amount of data to identify critical themes (Hennink et al., 2019).

Using the method described above, the interviews were transcribed and organized into folders with relevant quotes organized in our shared spreadsheet. All interviews have been recorded with a few exceptions due to too much background noise. A group member reviewed each transcription for coding and accuracy. Once the group had decided on quotes to use within this report and our team's ArcGIS StoryMap, a team member sent an email to each official in order to obtain consent for each individual quote that they provided.

3.3 ASSESSING OPPORTUNITIES TO IMPROVE CURRENT WILDFIRE MITIGATION STRATEGIES IN RELATION TO VULNERABLE POPULATIONS IN ESTES PARK

Finally, the group analyzed and assessed the qualitative data collected in our interviews to consider the extent to which current wildfire planning and hazard reduction policies addresses the needs of vulnerable populations in Estes Park.

We compared the findings from our two sets of interviews to identify potential improvements to wildfire mitigation planning efforts. The results of this comparison are analyzed in Section 5.

CREDIT: KELLY WILKERSON

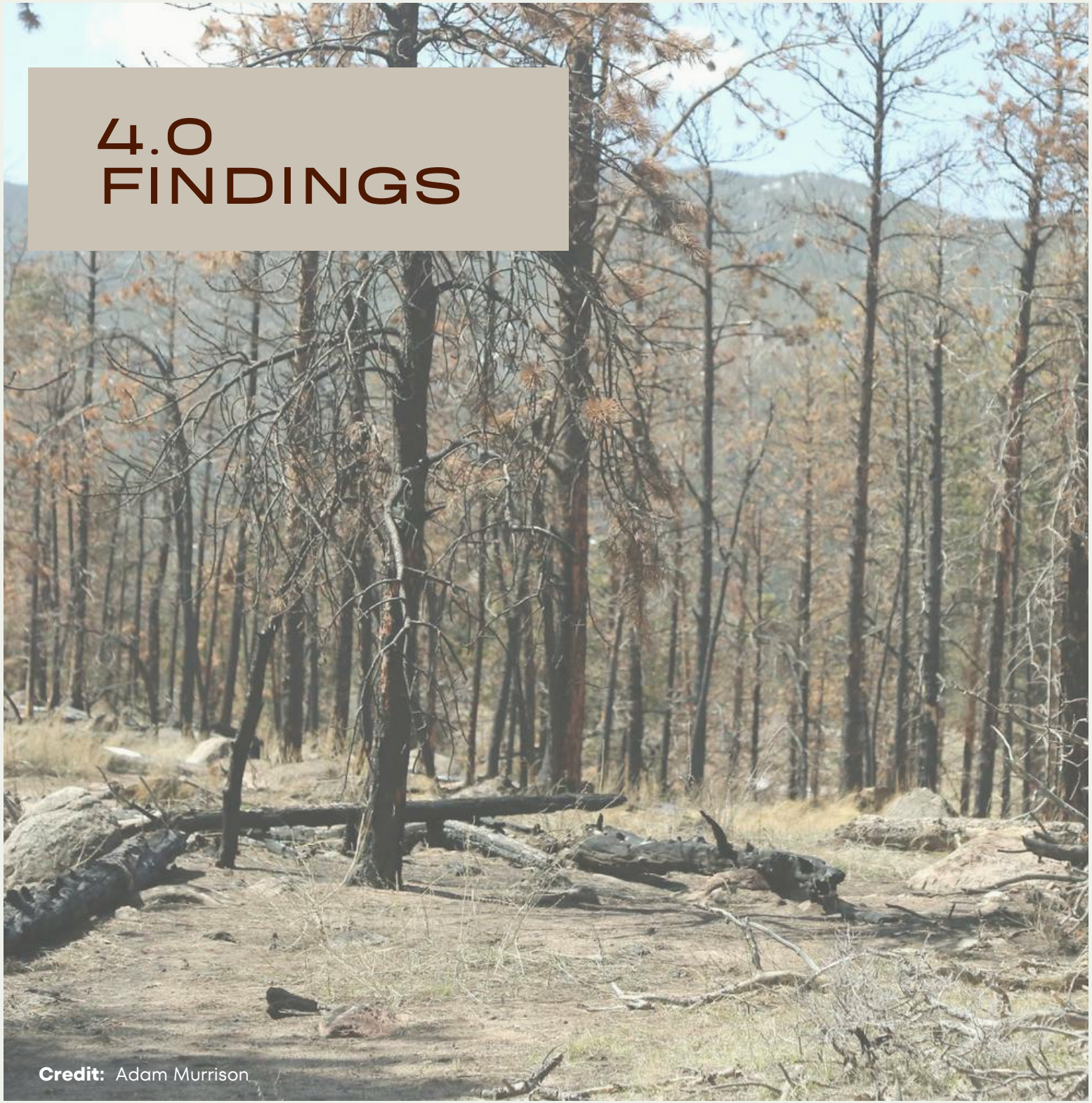
3.4
DELIVERABLE: ARCGIS STORYMAP

Our team produced an ArcGIS StoryMap, titled "Understanding Perceptions of Wildfire Risk". ArcGIS is an online geographic information system that allows users to map and create StoryMaps. The StoryMap platform encourages multimedia storytelling using maps, photographs, digital audio, explanatory texts, timelines, and other features to tell complex stories.

Our team intends the StoryMap to be shared by government officials and organizations to residents of Estes Park. It can be utilized by all parties in Estes Park for informational and educational purposes.

Figure 18: QR code for the ArcGIS StoryMap (link: https://arcg.is/1L4fKC0)

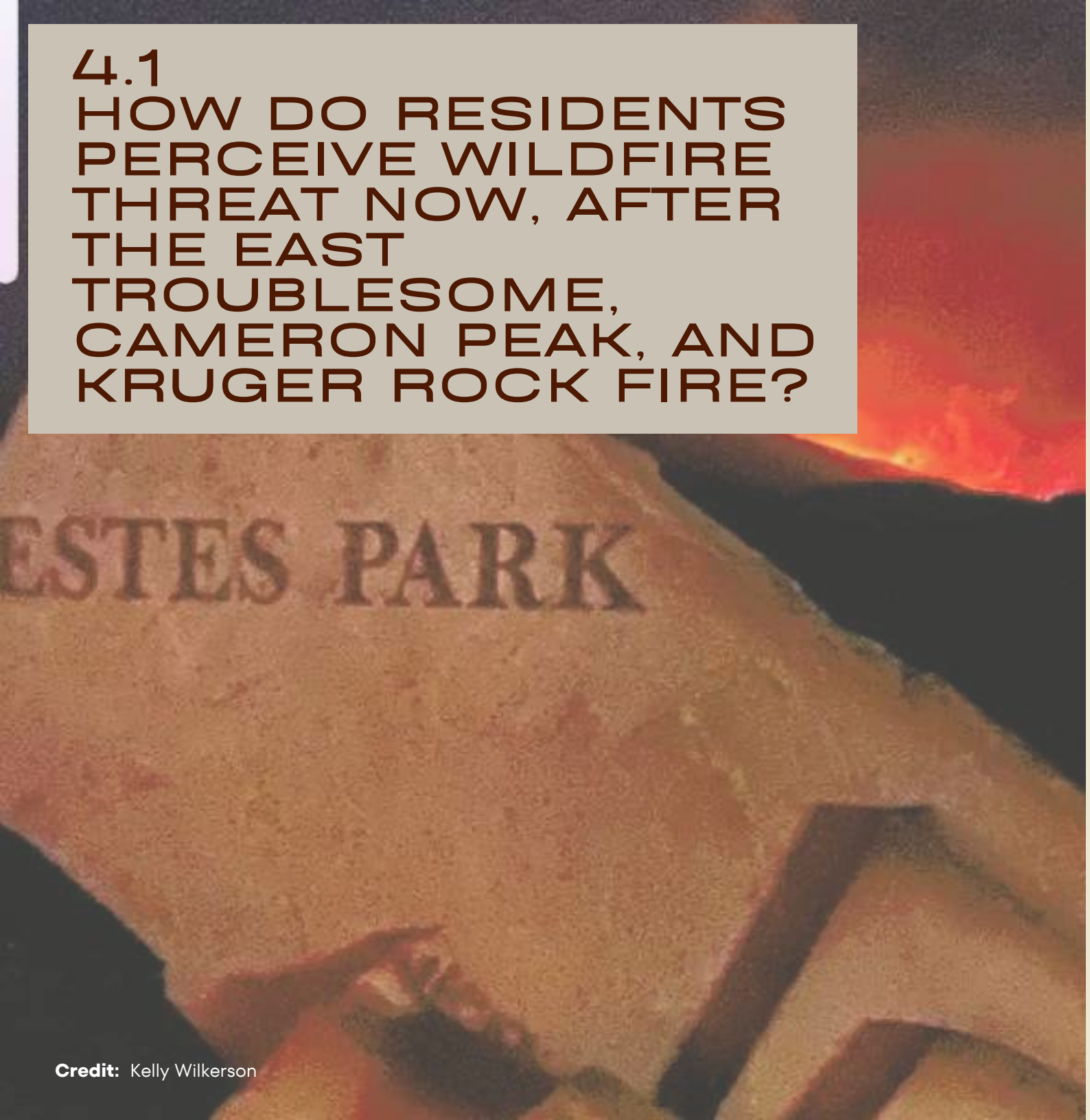
4.0 FINDINGS



Credit: Adam Murrison

This chapter presents the qualitative data and other key information extracted through our interviews with residents, officials, and local organizations. Each section responds to an important question that drove our research and touches upon the following topics: risk perception, mitigation and preparedness, evacuations, communication, and vulnerable populations.

4.1 HOW DO RESIDENTS PERCEIVE WILDFIRE THREAT NOW, AFTER THE EAST TROUBLESOME, CAMERON PEAK, AND KRUGER ROCK FIRE?



Credit: Kelly Wilkerson

Wildfires are a profound consistent threat to WUI areas including the Estes Valley. Particularly in the aftermath of the catastrophic East Troublesome and Cameron Peak wildfire events most residents and officials agree that living with wildfire is part of life in Estes Park today.

4.1 HOW DO RESIDENTS PERCEIVE WILDFIRE THREAT NOW, AFTER THE EAST TROUBLESOME, CAMERON PEAK, AND KRUGER ROCK FIRE?

Wildfires are a profound consistent threat to WUI areas including the Estes Valley. Particularly in the aftermath of the catastrophic East Troublesome and Cameron Peak wildfire events most residents and officials agree that living with wildfire is part of life in Estes Park today. This acceptance of the risk of wildfire is something that is frequently mentioned, and a common theme is that residents and officials of Estes Park feel that it is not a matter of if, but when, the next evacuation-level wildfire event will occur. Most residents that we talked to felt they held deep connections to the community and that the benefits of living in Estes Park were worth the risk of wildfires. Local resident Guy explained how much he appreciates Estes Park, "I wouldn't trade it. This is a pretty beautiful place." (Guy, personal communication, April 12, 2022). Other residents expressed that they would move away from Estes Park due to the risks of wildfires, but mentioned that no matter where they go, there would always be a risk whether it be hurricanes, tornadoes or winter storms.

"It's just about deciding what risk we're willing to tolerate and which ones we're not."

(Fire Chief David Wolf, personal communication, April 5, 2022)

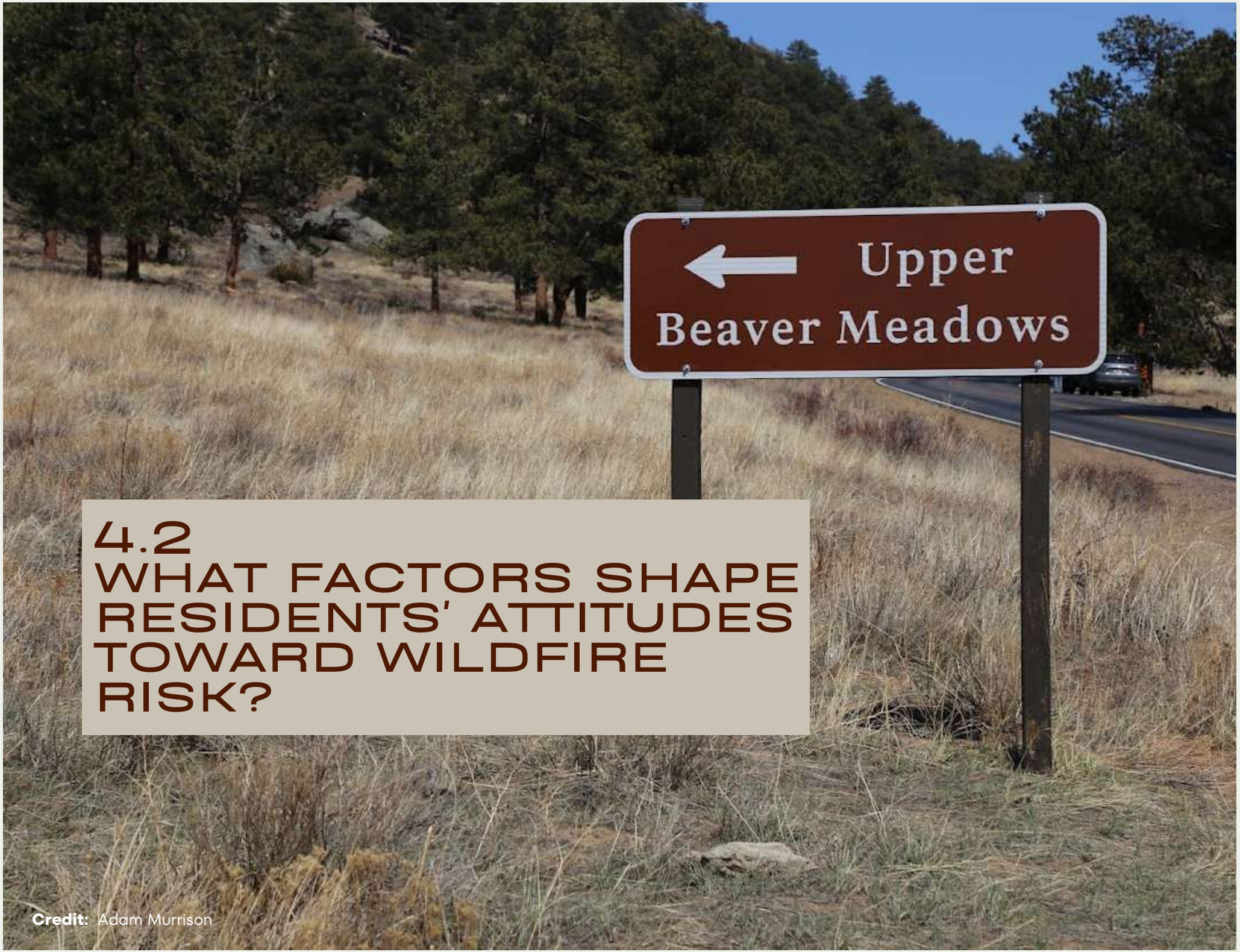
"Living up here is wonderful, but then also comes with risks."

(Danielle R., personal communication, March 21, 2022)

4.1 HOW DO RESIDENTS PERCEIVE WILDFIRE THREAT NOW, AFTER THE EAST TROUBLESOME, CAMERON PEAK, AND KRUGER ROCK FIRE?

One important caveat to this is the distinction between probability and consequence discussed in Section 2.3. All residents that we interviewed agreed that wildfires will continue to occur in the area, but some residents appeared to have a less significant perception of the potential consequences of a wildfire event. This is particularly true given that the main urban area of Estes Park was spared from the worst consequences of the East Troublesome and Cameron Peak fires, which is an influence on resident perceptions of the overall risk of wildfire. As an example, one resident who evacuated during the East Troublesome fire but had no significant stress or loss of property as a result noted that they did not adopt any new significant mitigation measures following the fire. However, in an interview W. Formeller of the Estes Valley Watershed Coalition noted that there is "definitely a chance of wildfire just moving straight through town" (W. Formeller, personal communication, March 28, 2022).

Credit: Hannah Rodenbush



4.2 WHAT FACTORS SHAPE RESIDENTS' ATTITUDES TOWARD WILDFIRE RISK?

Credit: Adam Murrison

WEATHER AND CLIMATE

Weather and climate change affect how residents understand their wildfire risk. The increasing number of wildfires throughout the year, especially in the months not included in the wildfire season, October through April, have raised concerns regarding weather year-round. The East Troublesome fire and Kruger Rock fire both burned through non wildfire season months and have caused residents to wonder if they are getting enough moisture through the winter months. One resident expressed that there has been a psychological toll wondering if they are getting enough snow throughout the winter. Residents are also worried about the water table and whether it is high enough that it would lower the probability of getting a highly destructive wildfire.

Recent wildfires burning outside of wildfire season have caused residents to be aware year round of what they are doing that can possibly trigger a wildfire. Besides the lower water table and decreased snowfall, residents are also concerned with the beetle kill and how this enhances wildfire fuel. Being in a drought, residents and government officials are more aware of weather conditions and the changing climate that they believe will only continue to worsen wildfire risk.

PHYSICAL EXPERIENCE

Residents have a greater understanding of the risks and hazards at play because when they can physically see the smoke and flames for themselves they know they are more at risk, a concept explained earlier as availability heuristic. Seeing the smoke triggers fear and awareness of what is happening around them.

Residents have come to know that there is an increased threat and it comes with living in Estes Park. Fortunately, red flag warnings and prime fire burning conditions drive up the level of awareness, however, they also increase anxiety.

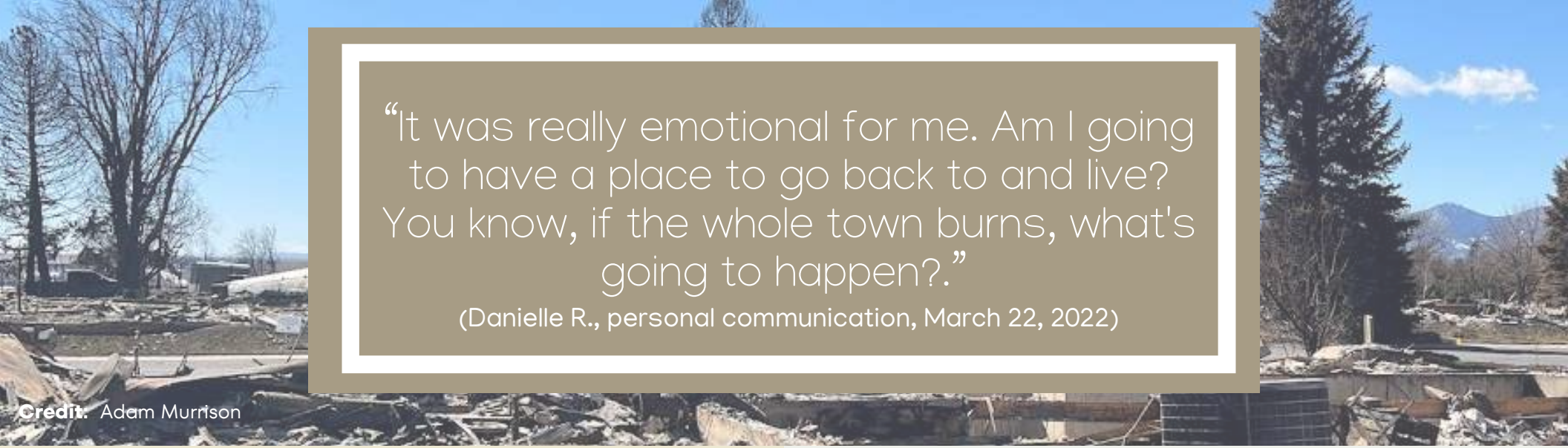
Through all conducted interviews, residents expressed having no reason significant enough to make them stay in their homes through a mandatory evacuation. They trust the local officials' decisions and see no reason to stay when smoke and flames are quickly approaching their home.

According to local resident Shai and her husband Steve, their lives are more important than any home. Shai and Steve explained that can live without their home, but they cannot live without each other; and so, they are keen to evacuate, to save themselves and their loved ones. Local resident Linda explained how she is more alert now that wildfires have hit so close to home. She now has a checklist for Go Bags, pictures of all her belongings, and plans for where to go in case of evacuations. Residents understand they need to be ready to leave at any moment and are more aware of this risk when they can see the smoke or wildfire.

> "We used to think of that as like another world over there. But, you know, now we know that it's just an extension of the same place."
>
> (Darren, personal communication, March 22, 2022)
> Regarding the East Troublesome fire jumping the Continental Divide

EMOTIONAL ATTACHMENT AND PTSD

Returning following an evacuation can trigger disorders such as post-traumatic stress disorder (PTSD) for residents. PTSD affects how residents view their risk because they are traumatized by past events and are more apt to be over prepared and take advanced precautions for the next emergency. Seeing the charred trees can bring about feelings like "walking through a wasteland" (Danielle, personal communication, March 21, 2022). There are PTSD groups that run for both residents and officials who need support following a disaster such as a wildfire. Understanding that an evacuation is probable to happen again can retrigger emotions, even if the wildfire is not as large of a threat. Officials understand this and try to limit the number of evacuations called so as to not bring about optimism bias where residents do not leave because they have never lost anything every time they evacuate.



> "It was really emotional for me. Am I going to have a place to go back to and live? You know, if the whole town burns, what's going to happen?."
>
> (Danielle R., personal communication, March 22, 2022)

Credit: Adam Murrison

TRUST IN OFFICIALS

Officials only call evacuations when necessary to preserve life. Rick Life understands the emotional toll it takes to evacuate your home and that "there's quite a bit of fear out there" (Rick Life, personal communication, March 28, 2022). While residents are fearful, many are also appreciative and grateful to have officials in their town that are responsive and looking to help in communication and evacuation to ensure everyone's safety.

IMPORTANCE OF BELONGINGS

Emotional attachment to homes and belongings affect residents' perception of wildfire risks. Wildfires are destructive to homes, structures and forests; but they also take a toll on the emotional wellbeing of residents and those nearby.

Residents are fearful that they will lose their home or their belongings. Prior to the East Troublesome and Cameron Peak fires, many residents were not prepared, for example, they did not have a Go Bag packed ahead of time. This caused a large amount of stress and anxiety when government officials called for mandatory evacuations that were effective immediately. They were forced to quickly gather things, in many cases forgetting or leaving behind belongings that they had a large emotional attachment to. Items such as wedding photo albums, graduation pictures, or sentimental jewelry had to be left behind for more practical clothing, food or batteries.

Families and homeowners left their properties not knowing if they would ever see them again, an emotion that many could not describe in words, only silence and reflection.

PARENT-CHILD CONCERNS

The anxiety of evacuating led to many other emotional challenges; the stress of staying in contact with their family when it is chaotic with limited cell signals and having to gather belongings, pets and children. When residents are in an emergency, the most practical steps to take may not be clear at the moment, because people tend to be more concerned with the risks to loved ones than themselves. Estes Park is home to about 6,000 full-time residents, many of which have children in the local school system.

When an evacuation is called, for many parents the first reaction is to go gather their children from school. This can be detrimental to the evacuation protocol, as it can cause more backups and traffic congestion. Parents want to first get their children from school, daycare or camp when the most practical next steps would be to gather bags and belongings from homes and then get their kids on their way out of town. The local schools are a safe place in town and students and faculty are protected by fire barriers. Town officials like the fire department have recommended and practiced drills with these steps in mind to speed up the process of evacuating children from schools.

Credit: Estes Park School District R-3

For example, parents are now instructed to collect children on their way out of town, while students wait for them organized across the campus for easy pick up. A school evacuation plan was not necessary during the East Troublesome fire evacuation because students were not in school due to poor air quality. However, rehearsing these practices will be important for future evacuations.

Credit: Hannah Rodenbush

4.3 WHAT STEPS HAVE RESIDENTS TAKEN IN THE LAST FEW YEARS TO REDUCE THEIR RISK FROM WILDFIRES?

4.3.1 RESIDENTS ARE AS PREPARED AS THEIR SOCIAL CIRCLES

Examining the various perspectives, we realized that some residents are more prepared for wildfires than others. Being prepared includes having a packing list and Go Bag ready, on top of implementing fire mitigation strategies around their property. Danielle R., a resident of Estes Park living in a rented apartment, did not have to take any precautions in respect to her property, and instead had to focus only on herself and her belongings - this is something that we found to be common around the younger population who are renting. "I was able to get out relatively easily and there was stop and go traffic for a little while" (Danielle R., personal communication, March 21, 2022). Danielle also mentioned that her awareness has grown since the fires, including making an evacuation list and looking into a fire safety box to ensure a safer and quicker evacuation in the event of disaster.

> "I've since made an evacuation list because that's something that I kind of had, but I needed to do it in more detail. And so if we have to evacuate again, that'll be more helpful. Also, I didn't have a fire box, so that's something I need to look into getting in case there is a situation... something like that would be useful for keeping documents safe...My [current] level of preparedness is just basically from kind of learning from what others do or you know, bringing back to mind things that maybe I hadn't remembered, like the fact that even my dad in Missouri has a fire box in his home"
>
> (Danielle, personal communication, March 21, 2022)

4.3.1 RESIDENTS ARE AS PREPARED AS THEIR SOCIAL CIRCLES

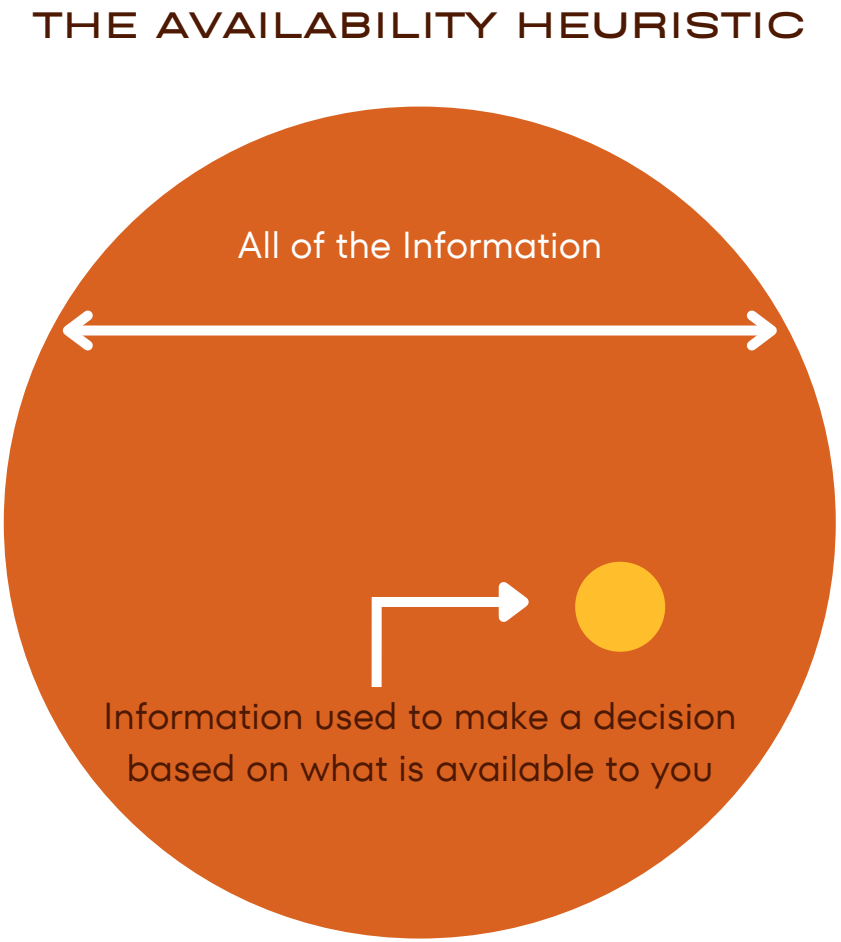


Figure 19: Diagram of the Availability Heuristic

Danielle's level of preparedness relates to the availability heuristic, where someone's sense of readiness aligns with past experiences and what they are familiar with such as her Dad's fire box in his home. The need for proper preparedness is recognized by other residents, as well, Andrea, a resident who rents and is a part of a Hispanic women's group, says her understanding of preparedness comes from this group, their weekly meetings, and their local Facebook groups, where they share evacuation and wildfire resources. Andrea mentioned that her method to evacuate was to grab important items on her way out, but in the future she would like to have a packing list and a bag ready in the event of a wildfire.

4.3.2 MAJORITY OF RESIDENTS DO NOT TYPICALLY ADOPT MITIGATION PRACTICES

Like Danielle and Andrea, younger residents that are renting in Estes Park typically do not follow any property mitigation strategies themselves, such as defensible space, leaving it up to landlords and property owners. Another resident who rents his home, Nick, mentions "mitigation around property is basically up to someone else, not you yourself" (Nick, personal communication, April 12, 2022).

> "One of the first things I did was have that [tree] turned way back because all the branches were down low and actually really close to the house. So I had a tree trimmer come in and now the lowest branches are about 12 feet high... I've also started to do some stone passes all the way around the house so that no fire can creep in"
>
> (Tim, personal communication, April 14, 2022)

Homeowners, including those who live in a homeowners association (HOA), are practicing more mitigation strategies than those who are renting. Homeowner Tim Buck believes in mitigation practices to lower his risk of losing his home to a wildfire.

He says he still has a lot left to do, such as adding more stones around his house, and replacing the roof on his garage. Tim strongly believes in mitigation, and says his current mitigation strategies just come from his own logic (Tim, personal communication, April 14, 2022). Similarly, residents living in HOAs are also practicing mitigation efforts through contracted landscaping companies and neighborhood mitigation programs, which they pay with fees for living in the HOA. Linda, a resident of an HOA, comments "I'd rather be safer and have it done" (Linda, personal communication, April 8, 2022) when speaking about the mitigation practices done around her home.

4.3.2 MAJORITY OF RESIDENTS DO NOT TYPICALLY ADOPT MITIGATION PRACTICES

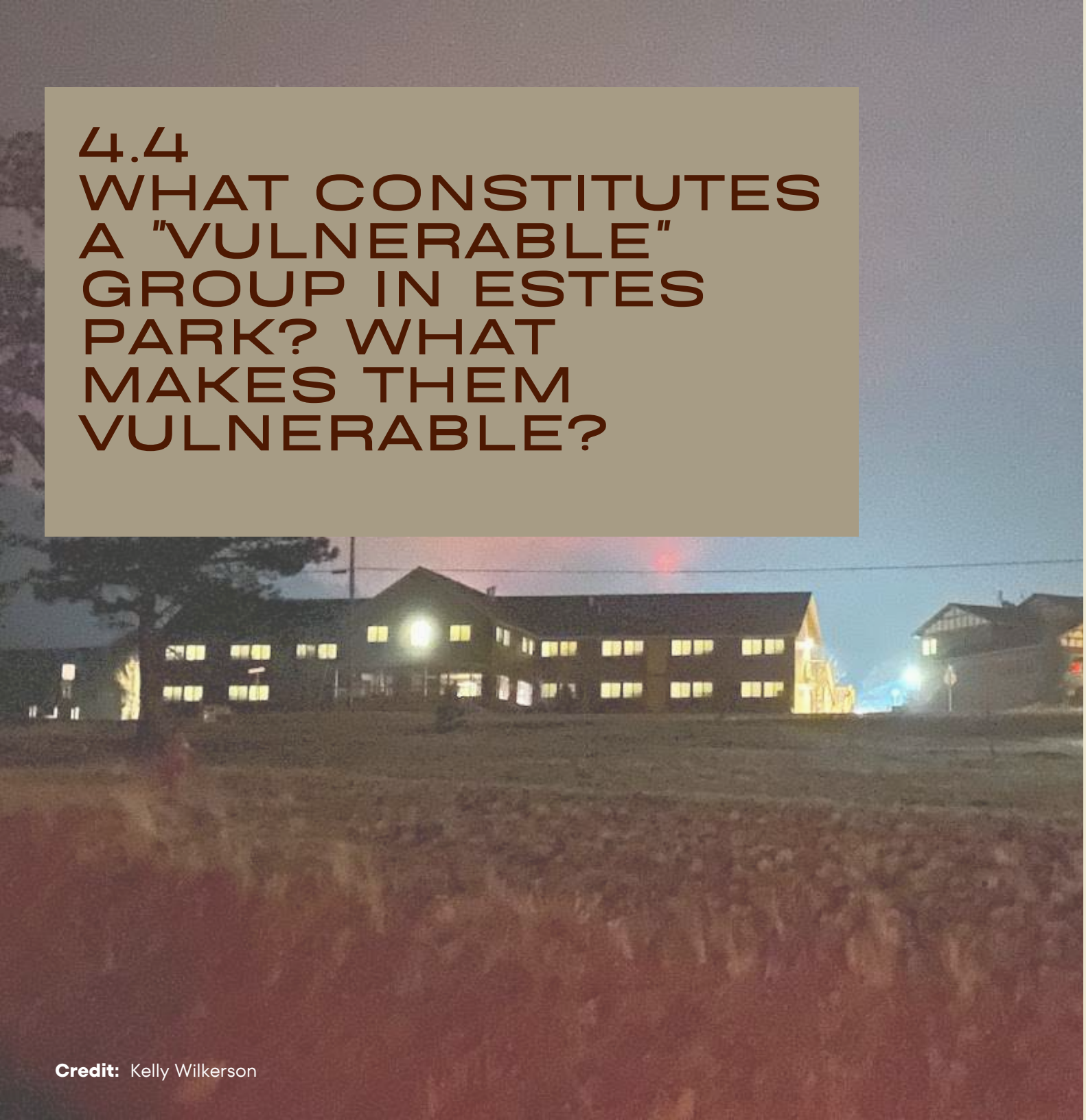
As explained previously, the Estes Park Fire Department is offering voluntary reflections. In discussions with the Fire Inspection, Raina mentioned only 50 home assessments were conducted as of April 2022 reflecting that homeowners seem to lack motivation to participate in voluntary assessments because they lack the knowledge of the potential benefits. One resident mentioned they feel less motivated to create a defensible space around their home because if the threat of wildfire is large enough, there is nothing that can be done to stop it.

Credit: Kelly Wilkerson

COMMUNITY PROFILE

Tim Buck, a local artist and resident, was called for a pre-evacuation about 45 minutes after he received the alert for mandatory evacuations. Luckily he was already prepared as he had his Go Bag packed and his truck loaded with camping gear and essentials. However, he was forced to leave behind priceless personal artwork he had around his home. Tim evacuated his home and went to check in on a friend who was disconnected, to urge him to gather belongings and evacuate together. They left to go to a friend's house in Denver and eventually Tim made his way to Pueblo, where he met with some old friends. When the snow storm stopped the fire, and since the propane was turned off, there was a chance the pipes froze and he would come back to a flooded house. Upon his return the pipes were spared; however he came back to ash everywhere. It got into his garage and covered his yard. In the future, he is looking to extend his mitigation practices around his property because it makes him feel safer for himself and the safety of his home.

4.4 WHAT CONSTITUTES A "VULNERABLE" GROUP IN ESTES PARK? WHAT MAKES THEM VULNERABLE?



Credit: Kelly Wilkerson

One of the important challenges to ensuring an effective response to wildfire is ensuring that communication and information reaches all populations in the Estes Park area. We define a vulnerable population as any social or other group of people that requires additional attention or communication during an evacuation beyond the normal level of communication.

In Estes Park, these populations fall primarily into three categories: those with challenges to mobility, non-English speakers, and visitors.

4.4.1 POPULATIONS WITH MOBILITY CHALLENGES ARE AT RISK DURING FIRE EVACUATIONS

> "So if you're unable to drive because you're 12 or because you're 90, either way you're a population that needs assistance to evacuate - where's our assistance coming from?"
>
> (David Wolf, personal communication, April 5, 2022)

ASSISTANCE FOR ELDERLY RESIDENTS

Particularly during evacuation situations, one of the most important vulnerable populations to reach and assist consists of people who do not have easy access to transportation. Members of this population may be very old, very young, disabled, or lack a vehicle.

In the Estes Park community in particular, of which many residents are children or of retirement age, the older population is a particularly large and important population to reach.

Elderly residents present additional unique challenges due to the fact that many retirement-age people, particularly in a less urban area such as Estes Park, may be less likely to have access to technology that allows them to receive alerts and evacuation orders during a wildfire event.

Some older residents do not have access to broadband internet: Emily, an Estes Park resident, notes that "[I] don't know what the landlines are hooked up to in terms of emergency services. Because I get all mine through Larimer County Emergency Alert" (Emily, personal communication, April 11, 2022). Further, the elderly may no longer drive and thus require assistance, either from friends or the community, in order to efficiently evacuate. For example, an Estes Park resident who worked at the Good Samaritan assisted living facility mentioned that buses were required to evacuate the facility.

4.4.1 POPULATIONS WITH MOBILITY CHALLENGES ARE AT RISK DURING FIRE EVACUATIONS

TRANSPORTATION CONCERNS

Residents without access to transportation additionally provide a unique challenge as they require bussing during an evacuation. David Wolf summarizes: "One thing we learned from the evacuation was that many organizations in town were relying on the school's buses, which is great until the entire town needs to be evacuated at once and there aren't enough buses for that." (David Wolf, personal communication, April 5, 2022).

In the most recent evacuations due to the East Troublesome fire, the high school was used as a hub for bussing which allowed for everyone within the town that did not have transportation to be accounted for. However, officials are concerned about the efficacy of this strategy if a fire were to break out during the tourist season.

One of the strategies currently being used to achieve this is to evacuate visitors early. Police Chief Rick Life notes: "Another thing that helped is we were asking the visitors to leave days before we evacuated" (Rick Life, personal communication, March 28, 2022). Early, phased evacuations are a frequent strategy used by officials to best manage the needs of these populations.

COMMUNITY PROFILE

Emily Pullen, the Housekeeping Director at the YMCA of the Rockies in Estes Park, was working from home in the Reservations Department at the time of the East Troublesome evacuation. Emily has a child who was six months old at the time, and over the course of the many months when the Cameron Peak fire burned, the low air quality led to her child not sleeping well. Emily was concerned about her young child's wellbeing at that time. Along with her child and her cat, she evacuated early and was able to go to her parents' house. Emily's husband was in charge of the evacuation of the YMCA and left later, but they were reunited during their evacuation. Because of their roles at the YMCA, Emily's family is well-prepared for future wildfires and keeps an evacuation list in their house. In the future, Emily would like to see more communication from town officials directed at people with landlines who may not have access to cell phone notifications.

4.4.1 POPULATIONS WITH MOBILITY CHALLENGES ARE AT RISK DURING FIRE EVACUATIONS

EMOTIONAL PREPAREDNESS IN ELDERLY POPULATIONS

Evacuations are a traumatizing event that can leave a lasting effect on the community and those affected in general. The town planner explained how once you are evacuated, it is a feeling of anxiety and fear that will never go away, but force you to grow from it and make a change.

The negative effects of an evacuation can become heightened when pre-existing conditions affect the populations' perception of reality.

At the Good Samaritan, they were very prepared for the evacuation from the East Troublesome fire.

All patients had bags packed and staff were ready to load residents up into buses with their medications to be transported to sister facilities. While they were prepared on paper, patients and residents were emotionally unprepared for the move.

In the midst of the COVID-19 pandemic, many residents could not go out without masking and social distancing, and their families could not come to them. This increased stress levels and confusion for some who did not understand the situation.

Residents with dementia were unaware of what was happening around them and became concerned when they were getting quickly moved to a new place. A former employee of the Good Samaritan said some threatened to call police because they did not want to be removed from their home.

4.4.2 NON-ENGLISH SPEAKING POPULATIONS HAVE LESS ACCESS TO WILDFIRE INFORMATION FROM OFFICIAL SOURCES

Another significant vulnerable population in Estes Park is the non-English speaking population of the region. Estes Park is home to significant populations of Spanish-speaking residents as well as Nepali residents, neither of which speak English as a first language. In particular, the World Population Meter estimates that about 15% of the town's population does not speak English as a first language (World Population Meter, 2022). These communities often form tight-knit groups which may be more likely to receive information from within that group than from outside, as is the case with Andrea, an Estes Park resident who runs a Hispanic women's group. This is further complicated by the fact that some emergency alert systems previously only operated in English – town administrator Jason Damweber notes that "when the emergency notifications went out, they were all in English but they didn't reach everybody anyway" (Damweber, personal communication, March 22, 2022). Despite these challenges, efforts are being made to ensure that these notifications are translated into all languages in order to ensure that all residents have access to comparable information. Further, Damweber mentions that "I don't think that anybody was harmed or injured because they didn't receive notification in the language other than English" (Jason Damweber, personal communication, March 22, 2022).

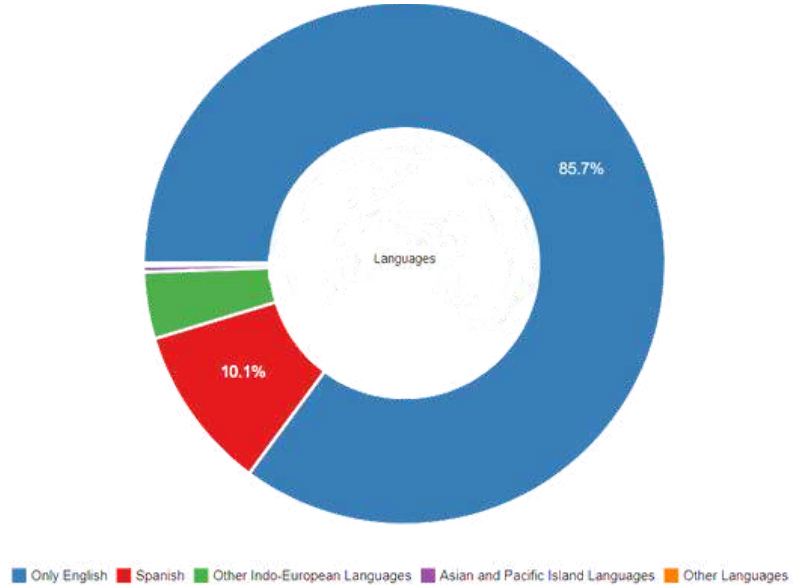


Figure 20: Breakdown of Estes Park population by first language (World Population Meter, 2022).

Officials such as Damweber generally feel that communication to this population has already improved over the last few years. However, in talking to Andrea we found that these communities are largely not signed up for Larimer Emergency Telephone Authority (LETA) alerts, and get most of their information through internal Facebook groups. This suggests that work still needs to be done in order to improve communication to these communities.

4.4.3 VISITOR POPULATIONS HAVE FEWER RESOURCES TO PREPARE FOR WILDFIRES

VISITOR POPULATION

A third vulnerable population for the Estes Park region consists of visitors. The population of Estes Park excluding all tourists and part-time residents is less than 6,500. Over the summer, during peak tourist season, this population can reach or exceed 100,000 with up to 4 million people passing through town each year. The most recent significant evacuation event as a result of the East Troublesome and Cameron Peak fires occurred at a time when relatively few visitors were within Estes Park due to a combination of the winter season and the COVID-19 pandemic, and officials are concerned that a fire occurring during peak tourist season could present additional challenges to evacuation.

One of the most significant challenges for visitors is that they do not necessarily have access to the same channels of communication that residents do. Estes Park is making efforts to target the visitor population with messaging, however this is not always easy. Also, those who are not permanent residents, visitors or renters, have a less significant emotional connection to the region which will make them less likely to participate in mitigation efforts.

> "It was identified as advantageous to make it a rule that in every short term rental like an AirBNB, there should be information on how you can prevent wildfires."
>
> (Bergeron, personal communication, March 23, 2022)

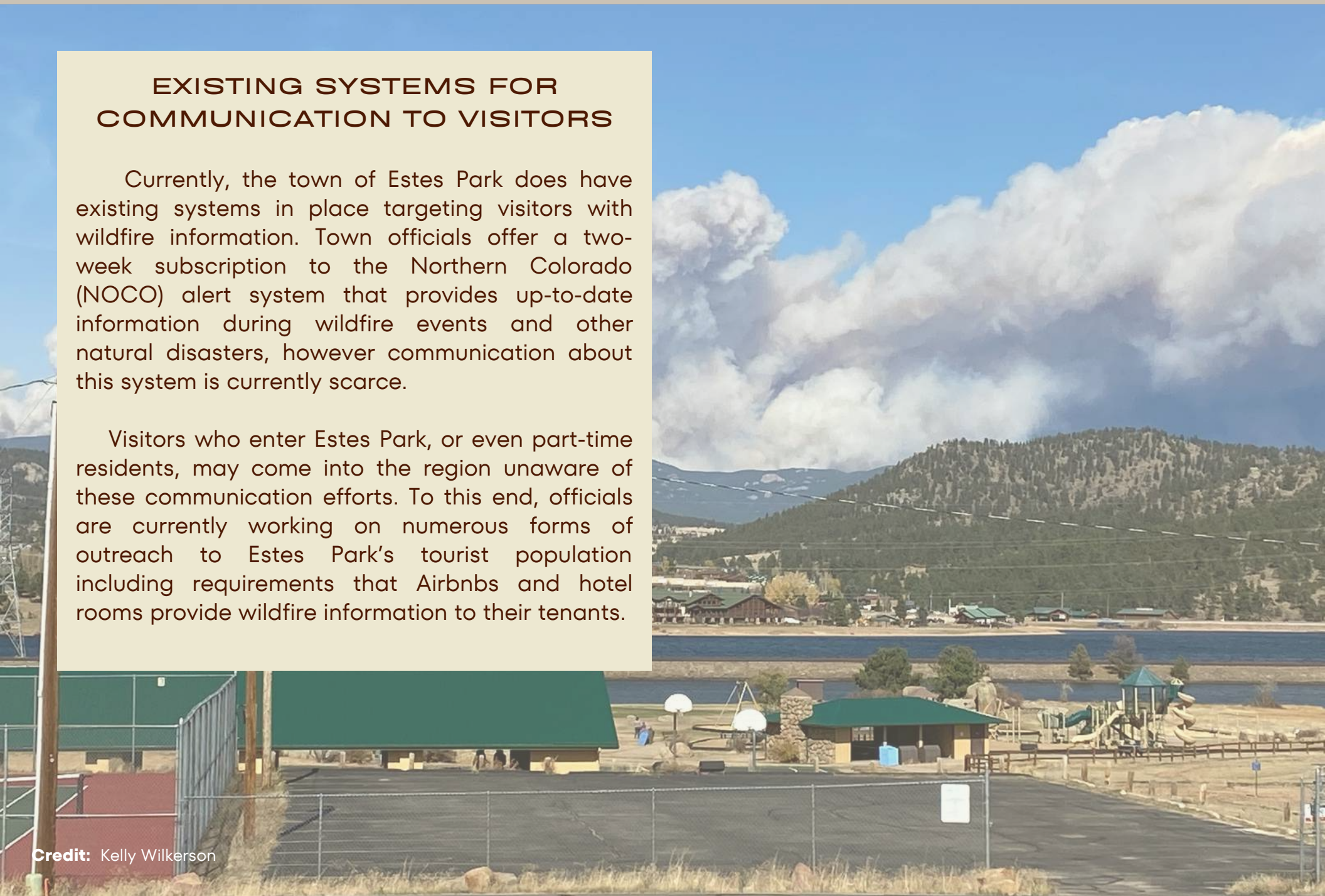
Town Planner Bergeron suggests that "in the context of short term rental use, [visitors] may tend to be people who are more there for a vacation – maybe they're not paying attention." (Bergeron, personal communication, March 23, 2022). These people, in accordance with the availability heuristic discussed in Section 2.4, may have a chance of experiencing fewer negative effects or experiencing them in a less personal capacity as permanent residents from the region as they are not there frequently. As such, they are less likely to invest in efforts to reduce wildfires.

4.4.3 VISITOR POPULATIONS HAVE FEWER RESOURCES TO PREPARE FOR WILDFIRES

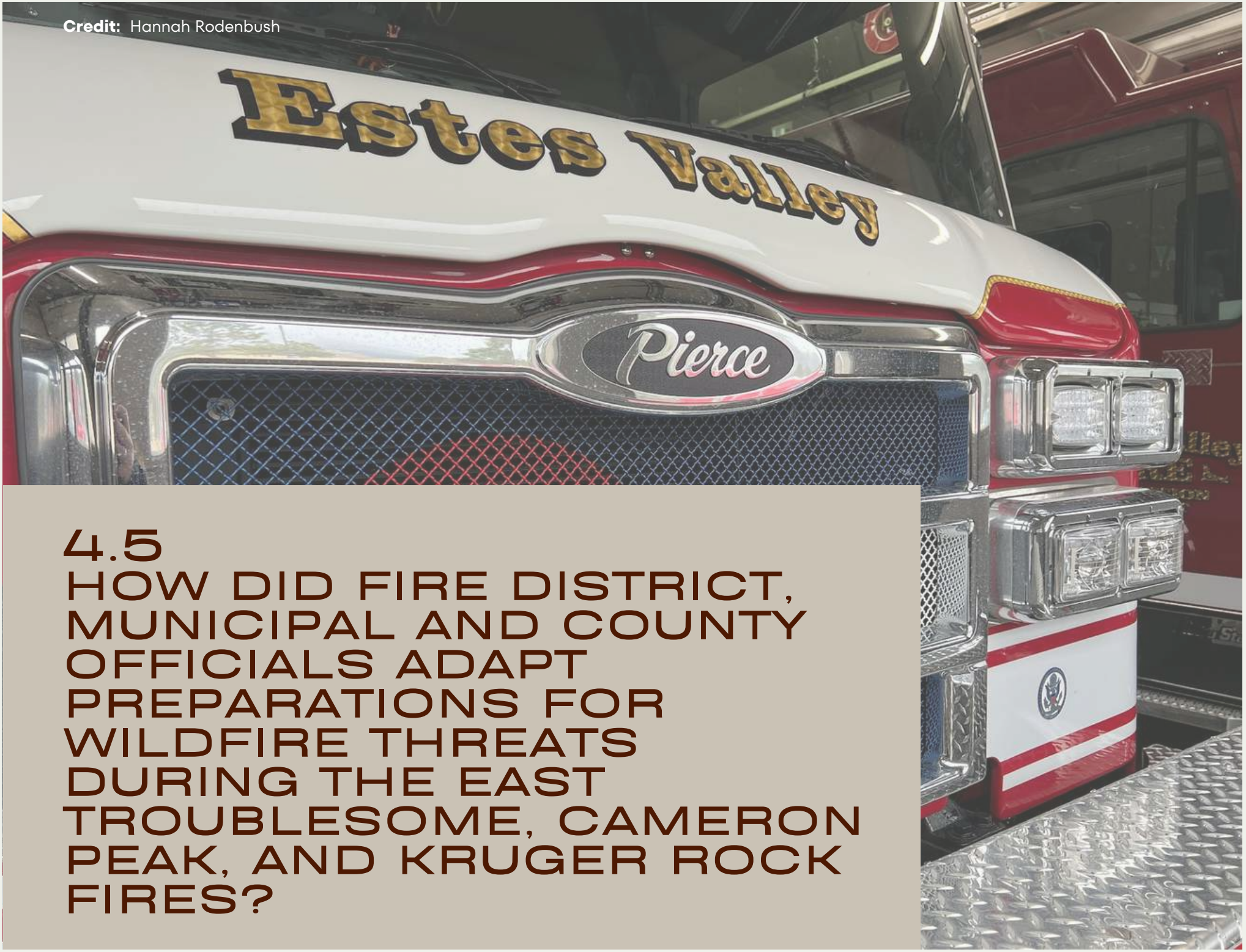
EXISTING SYSTEMS FOR COMMUNICATION TO VISITORS

Currently, the town of Estes Park does have existing systems in place targeting visitors with wildfire information. Town officials offer a two-week subscription to the Northern Colorado (NOCO) alert system that provides up-to-date information during wildfire events and other natural disasters, however communication about this system is currently scarce.

Visitors who enter Estes Park, or even part-time residents, may come into the region unaware of these communication efforts. To this end, officials are currently working on numerous forms of outreach to Estes Park's tourist population including requirements that Airbnbs and hotel rooms provide wildfire information to their tenants.



Credit: Kelly Wilkerson



Credit: Hannah Rodenbush

4.5 HOW DID FIRE DISTRICT, MUNICIPAL AND COUNTY OFFICIALS ADAPT PREPARATIONS FOR WILDFIRE THREATS DURING THE EAST TROUBLESOME, CAMERON PEAK, AND KRUGER ROCK FIRES?

4.5.1 USE OF EVACUATION POLYGONS AND ROUTES WAS IMPORTANT FOR MAJOR FIRE EVACUATIONS

Emergency response teams such as the Estes Park Police and Fire Departments have established a series of polygons to create an efficient way of evacuating different areas of town. These polygons are sections of larger zones, as seen above. When wildfires require evacuating, they determine which polygons are within proximity of the fire, which will then have mandatory evacuations and then voluntary evacuations will apply to polygons surrounding them.

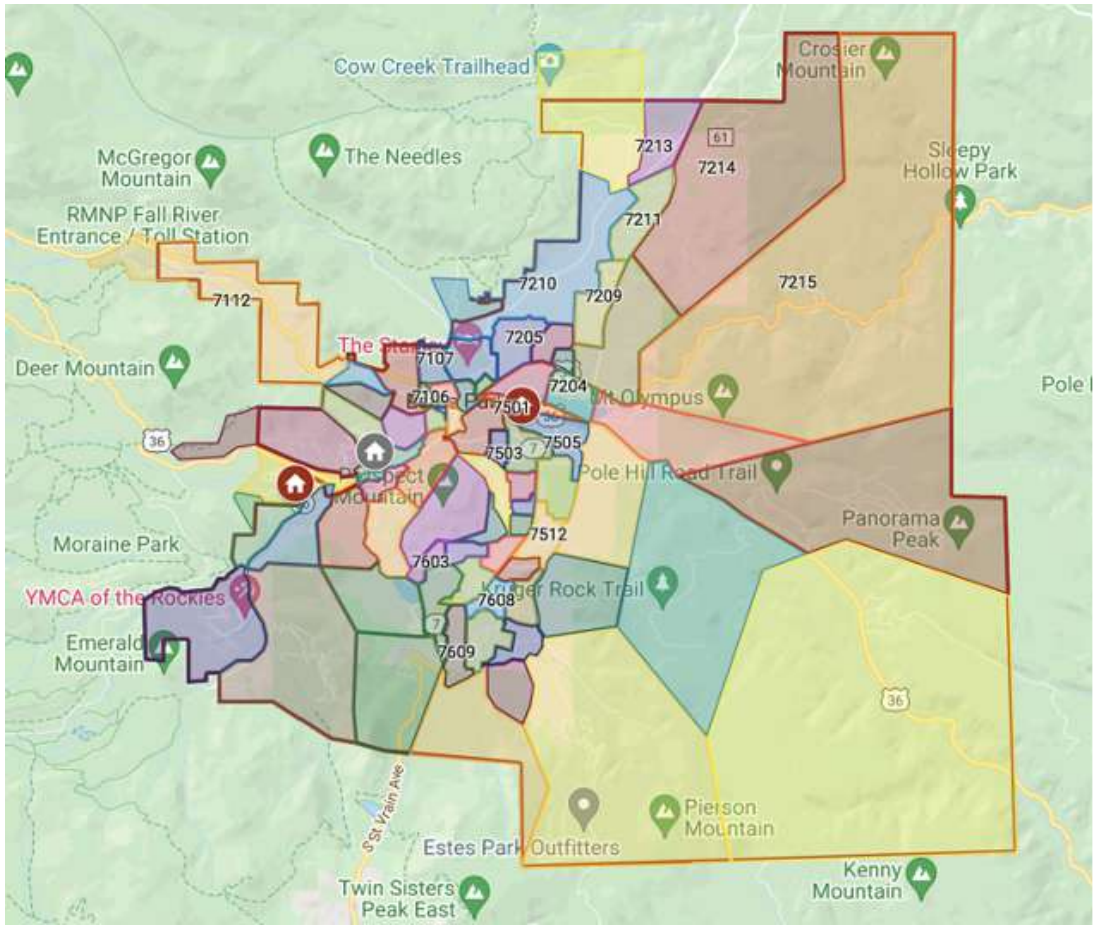


Figure 21: Evacuation polygons in Estes Park (Courtesy of Estes Park Fire Department)

"We used Google My Maps to help build them quickly because we could then look at satellite views and various imagery views. When you draw the polygons, you don't want to draw it down the middle of the road because most likely if one side's being evacuated, the other side should be evacuated. There are some roads where it makes sense like a major highway, but a lot of times you're trying to draw up neighborhoods, so you're trying to go between backyards...So that's how these polygons were drawn"

(David Wolf, personal communication, April 5, 2022)

4.5.1 USE OF EVACUATION POLYGONS AND ROUTES WAS IMPORTANT FOR MAJOR FIRE EVACUATIONS

Figure 22: Evacuation routes out of Estes Park

According to Police Chief Rick Life, Estes Park's evacuation routes are the following:

- Highway 34 towards Loveland
- Highway 34 (Trail Ridge Road) towards Granby (Closed for Winter, October- May)
- Highway 36 towards Lyons
- Highway 7 to Highway 72 (Lyons)
- County Road 43 towards Glen Haven

4.5.1 USE OF EVACUATION POLYGONS AND ROUTES WAS IMPORTANT FOR MAJOR FIRE EVACUATIONS

Only having five evacuation routes is an important consideration for wildfire planning. One of these routes, Trail Ridge Road, is closed for the majority of the year due to snow. This leaves four routes to be used most of the year, which causes concern in cases of emergency. In the past, several of these routes have been closed because of construction and threat of wildfire. Often routes are closed due to the condition and location of the disaster, leaving even fewer ways out than before. This can result in heavy traffic congestion, which in some cases requires contraflow lane reversal, or an altered flow of traffic that opens up both sides of the road to provide more lanes of egress. According to David Wolf, they aim to evacuate "one thousand people, per lane of traffic, per hour" (David Wolf, personal communication, April 5, 2022).

According to authorities we spoke to, the use of the evacuation polygons and specific routes helped significantly while evacuating for the Cameron Peak, East Troublesome, and Kruger Rock fires. Rick Life explained how he was proud that the entire valley was evacuated in about four hours during the East Troublesome fire (Rick Life, personal communication, March 28, 2022). For smaller fires, such as Kruger Rock, the use of the polygons was again really important. They were able to locate the fire, see which polygons surrounded it, and called mandatory evacuations for those who were at risk.

> "And it's all how we measure success. For us, never having to evacuate the entire town before our measure of success was going to be minimizing loss of life. There was no guarantee that we weren't going to lose anybody. Now, again, if your success was that I got stuck in traffic so that the evacuation was a disaster, right now we're going to respectfully disagree... One thing that I always like to clarify is that when I talk about a thousand people per hour per lane of travel, that's seven miles an hour so if your expectation is that you can drive highway speeds out of town, you're going to be disappointed"
>
> (David Wolf, personal communication, April 5, 2022)

4.5.2 THE ESTES PARK EMERGENCY OPERATIONS DOCUMENT IS SEEN TO BE A SUCCESSFUL TOOL WITHIN ESTES PARK DURING THE EAST TROUBLESOME AND CAMERON PEAK FIRES BUT HAS ROOM FOR IMPROVEMENTS

Another source used in preparing for the threat of wildfire was the Estes Park Emergency Operations Document. According to an Estes Park town administrator, Jason Damweber, the EOD was a successful tool during evacuations and management of residents during the fire. “It feels like one of these cookie cutter documents that you do for the sake of doing but it's got great information” (Jason Damweber, personal communication, March 22, 2022). The town administrator is responsible for logistics during a wildfire and coordinating communication to all residents. During an interview on March 22, 2022, he explained that "the town and our partnering agencies did about as good of a job with everything as we could have...I think there's room for improvement with respect to easements along power lines" (Jason Damweber, personal communication, March 22, 2022). Easements are the roads that utilities use to access power lines; larger easements act as a barrier for wildfires and protect power lines from sparking. Although there is room for improvement in mitigation, overall the evacuations went smoothly with the help of the Estes Park Emergency Operations Document and the Larimer County CWPP.

COMMUNITY PROFILE

Shai and her husband Steve live within Estes Park and were forced to evacuate during the East Troublesome fire. Steve is involved with the local police department and on the day of the evacuations was running the 2020 Presidential election at the community center. They were forced to call the Larimer County Election Headquarters and then the Secretary of State to close the ballots and call off voting to evacuate. In the meantime, Shai was evacuating to a friend's house in Arvada, where they stayed for about three days. They evacuated on Tuesday, October 20th and the fire was stopped by a winter storm that came through on Saturday, October 24th. Moving forward, they are concerned with insurance if a destructive fire were to come through. Increasing their coverage will bring peace of mind when another evacuation comes.

4.6 WHAT HAVE BEEN THE MAJOR CONCERNS OF RESIDENTS FOLLOWING EVACUATION PROTOCOLS?

Credit: Caitlin Strzegowski

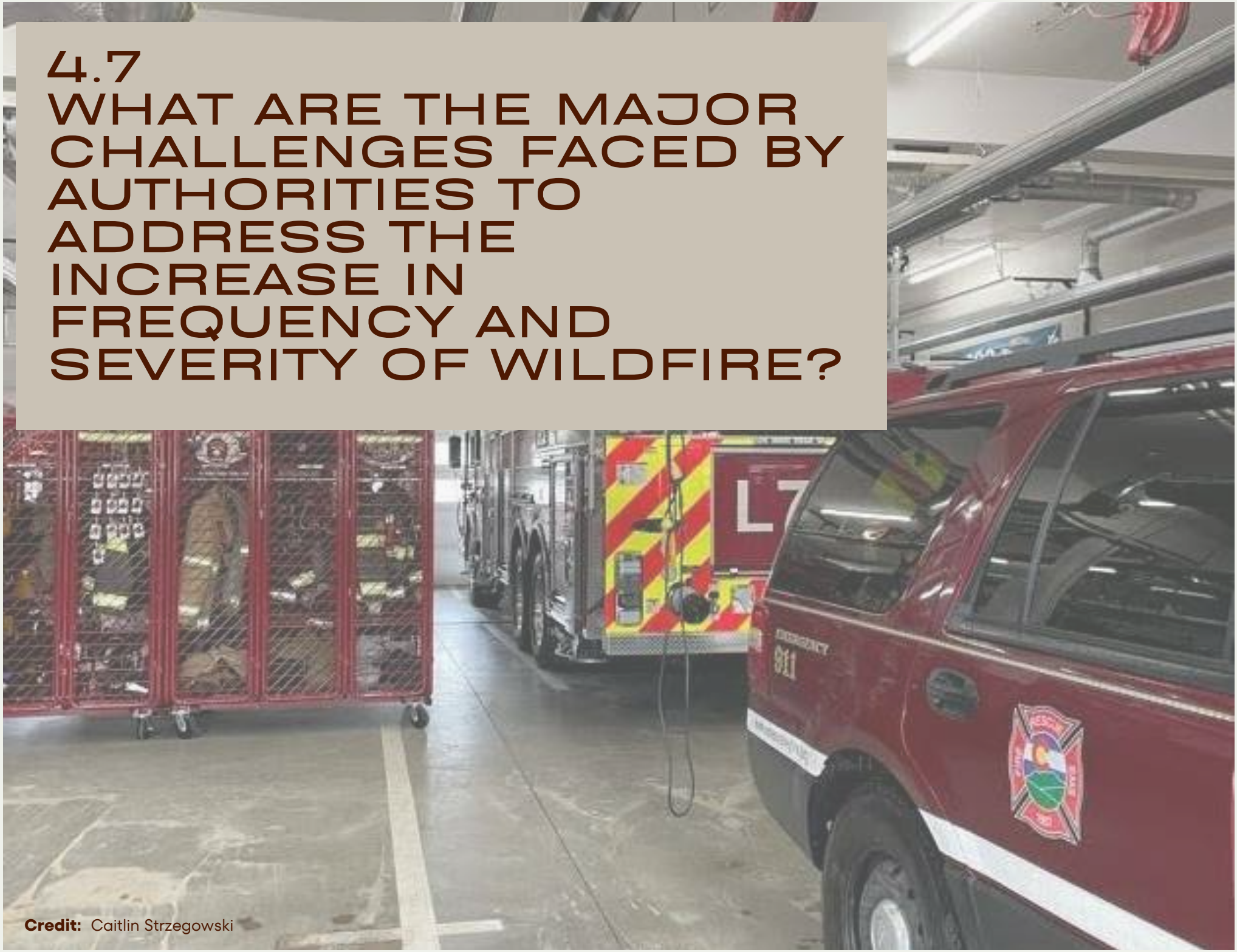
4.6 WHAT HAVE BEEN THE MAJOR CONCERNS OF RESIDENTS FOLLOWING EVACUATION PROTOCOLS?

During an evacuation, many residents will go to friends or family while others will utilize the resources provided by the Red Cross. Friends and family open their doors to those who have been evacuated and reflect the strong sense of community that we have observed through our discussions. Many businesses provide food, clothing, and other supplies to those who have lost their home or those who are unable to return. The Red Cross provides hotel rooms, food stamps and other necessities to those who have been displaced during a wildfire and have nowhere to go. However, these resources are limited and often run out quickly after an evacuation is called. A local resident explained how she evacuated the town later than most and was unable to get a hotel through the Red Cross. She had to drive an extra hour to find a hotel that had openings because most were completely full. Once resources are expended, many residents are forced to spend significant amounts of money on hotel rooms.

Credit: American Red Cross

Another concern that would not have appeared two years ago relates to the global pandemic. The East Troublesome and Cameron Peak fire evacuation took place during the COVID-19 Pandemic, and residents were nervous about evacuating to public housing where spikes in cases could take place. Local resident Nick had to evacuate and explained how "It made it even more complicated that this was during the middle of the pandemic, because this was in October 2020. We were kind of wary of staying at the housing that the Red Cross was providing. We found a relatively inexpensive hotel out past Greeley, Colorado" (Nick, personal communication, April 12, 2022). According to a local bus driver, many of the residents went to the lowlands to evacuate, however upon returning to Estes Park they found that there was a spike in cases.

4.7 WHAT ARE THE MAJOR CHALLENGES FACED BY AUTHORITIES TO ADDRESS THE INCREASE IN FREQUENCY AND SEVERITY OF WILDFIRE?



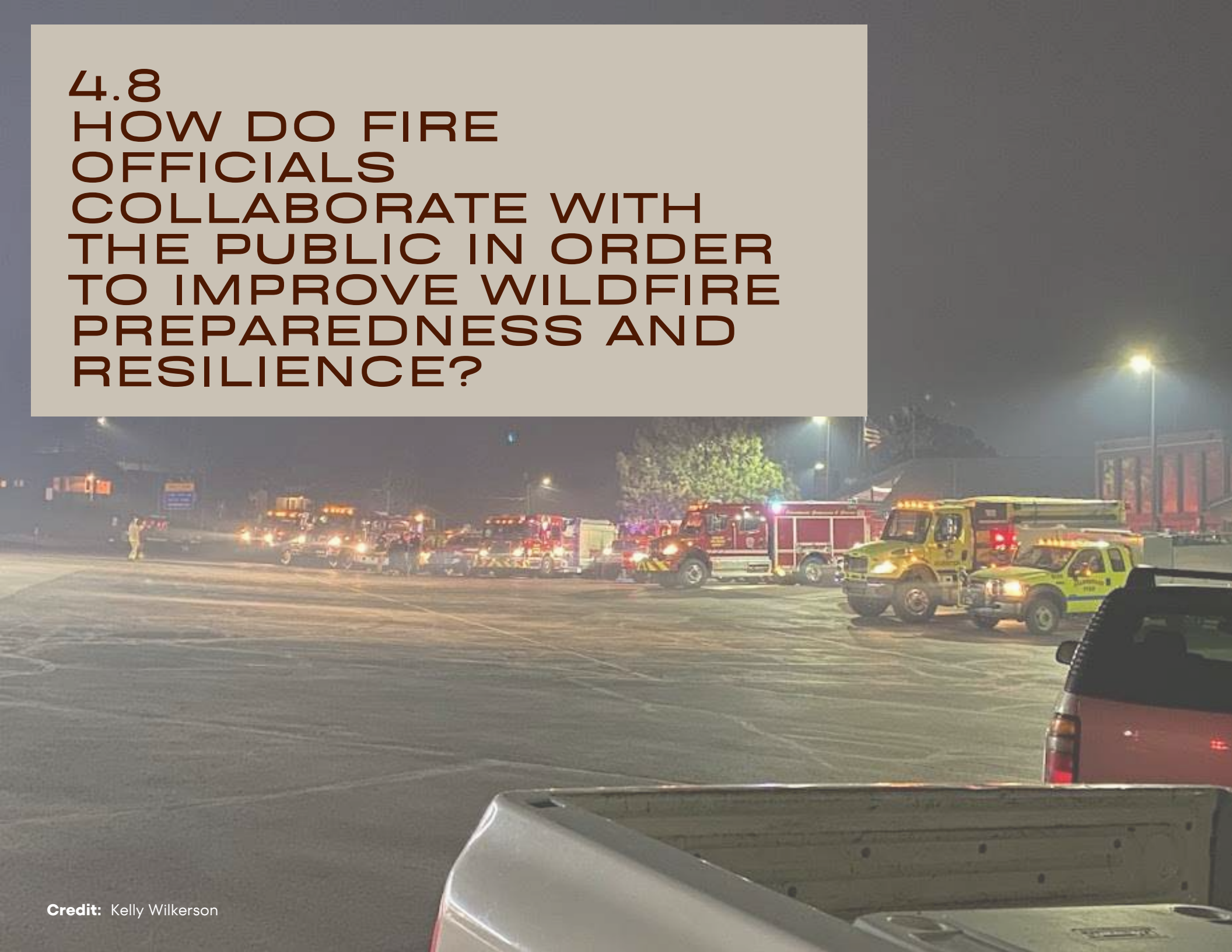
Credit: Caitlin Strzegowski

4.7 WHAT ARE THE MAJOR CHALLENGES FACED BY AUTHORITIES

With more reoccurring wildfires, firefighters and other government officials are forced to be on call and respond more frequently than before. This takes a large toll on the physical and mental health of first responders during an emergency that may last days or weeks. Despite the positive interagency relationship between multiple wildfire agencies, we discovered that more planning, especially long-term planning, could be improved in the future. In talking with David Wolf, we found that during the East Troublesome wildfire there was "a really good plan for the first operational period, the first 24 hours. At hour 96, you realize how tired you are and that you're not going to make good decisions and that we need to have relief. We need to have a plan to get our crews rest, to get someone else up there" (David Wolf, personal communication, April 5, 2022). The wildfires may last long periods of time and responders need the proper rest to stay safe while doing their job. Enabling aid from other towns or counties will provide Estes Park firefighters and officers with the necessary rest and recharge to continue. Limited resources can be detrimental to stopping the spread of wildfires and can lead to dangerous situations for first responders.

Authorities in Estes Park have a thorough plan of what to do in an emergency, for example a wildfire. As previously discussed, this plan is currently getting updated to reflect new policies, practices and improvements. While this document can ensure preparedness, it needs fast and efficient communication among agencies. While the wildfires may be burning in Estes Park, communication goes through Larimer county officials and is then distributed to other officials in nearby towns, as well as local residents of Estes Park. This can pose a challenge if the information is not communicated correctly, timely and efficiently. The wrong information could then be sent out to residents which could cause issues with evacuations, if closed and open roads are not communicated correctly. Misinformation can also prove detrimental and unsafe if talking with other first responders to fight a wildfire and the wrong signals are sent out. For example, if the size, direction or intensity of the wildfire is not properly communicated.

4.8 HOW DO FIRE OFFICIALS COLLABORATE WITH THE PUBLIC IN ORDER TO IMPROVE WILDFIRE PREPAREDNESS AND RESILIENCE?



Credit: Kelly Wilkerson

4.8.1 INCIDENT DEBRIEFINGS ALLOW COMMUNICATION FOLLOWING WILDFIRE EVENTS

Organizations and government officials in Estes Park such as the Fire Department, Police Department, and many others have heavily prioritized debriefing to understand what could be improved for future incidents. The communication networks during these incidents, according to our interviewees, can be improved. Planner Bergeron referred to that that even with room for improvement, local partners are "doing a great job collaborating in an interagency style" (Bergeron, personal communication, March 23, 2022).

Estes Park Fire Chief Wolf argued for the necessity of having pre-defined relationships between different parties, and that everyone cannot "be exchanging business cards once the fire is on the ground."

> "Having the relationships between all the different parties was huge because the mission of the National Park Service and the mission of the Estes Park Fire Protection District is not the same. And having those conversations ahead of time about what expectations are going to be, what everyone's role and responsibilities are as agencies, was really valuable to have"
>
> (David Wolf, personal communication, April 5, 2022)

While the National Park Service focuses on preserving the natural and cultural resources for future generations, the Fire Protection District focuses more on fire protection, fire prevention, and emergency services for the residents and guests of Estes Valley (NPS, 2022; Estes Valley Fire District, 2022). These differences in focus make it necessary for this interagency communication to occur before these wildfire events do, so every organization is on the same page.

While decision makers have met following wildfires for debriefings, resident experiences and opinions are often not considered. Among most of the interviews, residents revealed that they have not been involved in community decisions and policy planning at all. This is due to a lack of communication on the specifics of these debriefings, as well as a lack of motivation from residents to attend these sessions. Residents do not see the benefit in voicing their opinions to local officials because they believe officials did a good job and they do not believe their opinion is going to change anything.

4.8.2 ALERT SYSTEMS ALLOW DECISION MAKERS TO COMMUNICATE WITH RESIDENTS AND VISITORS ABOUT IMPORTANT WILDFIRE UPDATES

With the fast-paced nature of the recent wildfires surrounding Estes Park and the way they progress, it is important for the people in decision-making positions and leadership roles to quickly and effectively communicate with the residents of Estes Park. David Wolf stressed the importance of "making sure we're trying to put things out that are timely, but also accurate," and that "it's very easy to push things out fast and then be wrong." (David Wolf, personal communication, April 5, 2022) This has been an issue with past fires where most evacuation and emergency alert systems originated from Fort Collins officials, and not directly from Estes Park decision-makers. Some messages contained confusing information or inaccurate information regarding evacuation routes due to this lack of communication.

Certain residents agreed with there being confusing information during the East Troublesome evacuation.

Credit: Larimer Emergency Telephone Authority

"Most people were kind of steered down [Route] 34 through the canyon towards Loveland. And then it was a little bit confusing because there was a National Guard person at the corner of 34 and Mall Road, which runs behind the reservoir there. I had to go that way to get my friend out, and he stopped me, and he wouldn't let me do that. I told him that my friend doesn't have a car and I needed to get him out. Then he let me through eventually and then I ended up just going down 36 from there"

(Nick, personal communication, April 12, 2022)

4.8.2 ALERT SYSTEMS ALLOW DECISION MAKERS TO COMMUNICATE WITH RESIDENTS AND VISITORS ABOUT IMPORTANT WILDFIRE UPDATES

On the other hand, some residents, including Linda said the communication efforts from officials regarding the East Troublesome fire "was wonderful."

Credit: Larimer Emergency Telephone Authority

> "we were given advanced knowledge. And there was a website (...) where the fire chief everyday reported to us with maps and all of the people that were involved with the fires (...) gave us fabulous reports every night about where they are, how much they've contained, if they've contained anything, so on, so forth."
>
> (Linda, personal communication, April 8, 2022)

Residents and other guests of Estes Park have access to the LETA system, which has a number of different outlets of communication, some of which include radio, TV, text, email, and call. LETA sends out alerts regarding wildfires, floods, evacuations, missing persons, and other emergencies. Residents and short term visitors can sign up for permanent alerts or a two week visitor period of alerts. Despite this, these emergency alert systems in place are only capable of reaching those in Estes Park if people subscribe and know about these systems. Additionally, for visitors of the area, there is a growing need to communicate more effectively, which is further outlined in the next section.

4.8.3 AWARENESS ON WILDFIRE EVENTS AND UPDATES IS AN IMPORTANT CONSIDERATION FOR ESTES PARK RESIDENTS AND VISITORS

With the rise in population of Estes Park and the frequency and intensity of these wildfires, many groups require more wildfire education. With confusion regarding evacuation routes outlined above and multiple alert systems available, a focus is being put on how to educate all areas of the community.

VISITING POPULATIONS

Access to information for short-term residents of Estes Park is a major focus currently, where resources on wildfire preventions, evacuation routes, and other important wildfire information can be provided to short-term rental locations.

To provide visitors with sufficient access to information, CPAW and other leaders of Estes Park, including the Fire and Police Departments, could require short term rentals, such as Airbnb, to have this information on hand.

> "[Visitors] lack [...] [the] knowledge of wildfire and how it behaves,"
>
> (Rick Life, personal communication, March 28, 2022)

> [Visitors], not being familiar with the terrain or the evacuation routes, might need assistance or guidance in an emergency as well,"
>
> Planner Bergeron, personal communication, March 23, 2022)

GROUPS WITH DISABILITY & MOBILITY CHALLENGES

For groups with disability and mobility challenges, evacuations and new situations were often stressful and difficult. As a result, many senior living centers consistently hold strong communication with the local fire and police departments, where administrators at these communities regularly call the police and fire departments to get updates to relay to their residents, while also focusing on educating their community.

4.8.3 AWARENESS ON WILDFIRE EVENTS AND UPDATES IS AN IMPORTANT CONSIDERATION FOR ESTES PARK RESIDENTS AND VISITORS

Other awareness resources for the Estes Park community have and are continually being added on multiple different organizations' websites, including the Fire Department, the Estes Park Watershed Coalition, and the Police Department.

OTHER AWARENESS RESOURCES & PROGRAMS

Programs are also regularly being added to promote education on wildfires, some of which include the Ready, Set, Go Program, seen in Appendix G and H, and voluntary mitigation assessments through fire inspections, as discussed in Section 4.3.2. With the help of a grant through the Ready, Set, Go program, kiosks will be added around Estes Park in the future to target both the visiting population, as well as the local community. In talking with the Fire Chief, we learned that these kiosks will have specific messaging...

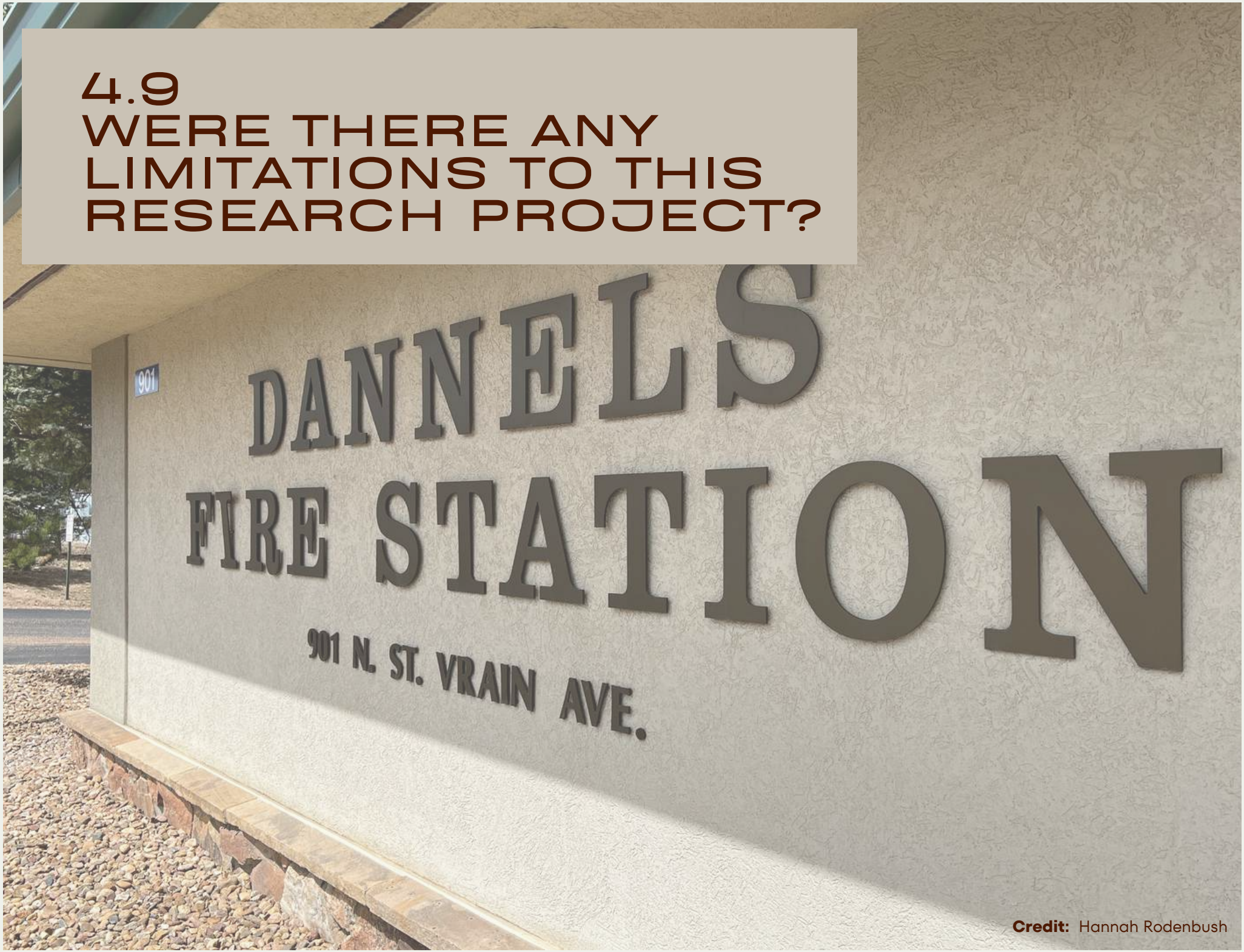
> "we're excited you're visiting. Here's things we need you to know and understand"
>
> (David Wolf, personal communication, April 5, 2022)

With the help of the fire department, fire inspections and mitigation assessments are available for property owners to understand where and how to perform mitigation actions on their properties. The town also incentivizes residents that use these assessments through a significant tax reduction on the work completed.

Educational and awareness seminars, which are further recommended in Section 5.2, have been used to get word out about resources and common practices involving emergency situations. In talking to a few residents in town, we found that there is significant interest in having more of these seminars, specifically focusing on wildfires.

Going back to Section 2.3.1, it is important to note how access to information regarding these wildfire events can impact these individuals to make decisions and change their opinions based on these recent wildfires. Those who have been a part of the evacuation and have experienced the recent wildfires are more likely to change their judgments on wildfire events and practice more mitigation and preparedness efforts. On the contrary, those who are visiting the area or have recently moved to the area after the recent wildfire events are less likely to consider them as much of a risk. Access to information and knowledge of prior events is important because of how these factors can impact their personal risk level.

4.9 WERE THERE ANY LIMITATIONS TO THIS RESEARCH PROJECT?



Credit: Hannah Rodenbush

4.9 WERE THERE ANY LIMITATIONS TO THIS RESEARCH PROJECT

After 38 interviews between local residents and community decision-makers, it is important to note that there is a potential underrepresentation of certain groups in the community, leading to a bias in our collected data. We gained a strong representation from individuals in decision-making roles, as well as residents interested in talking more about what they went through during the most recent wildfires in the area. Residents who may disagree with the decision to evacuate, as well as residents who do not agree with the decisions to add mitigation and other preparatory precautions to future building and zoning codes are less represented. Additionally, a larger sample size could help correct this sampling bias. While following a snowball sampling strategy for our interviews provided contacts we could approach directly, it could have contributed to this bias, leading to following particular social networks and reducing the range of perspectives we encountered. Finally, an important limitation to note is that we were unable to conduct interviews with one of the main groups we defined as vulnerable, visitors, leading to their direct perspectives not being accounted for, and only forming assumptions from the other groups' perceptions of the visitors. With additional resources and time in Estes Park, we would be able to interview a larger and more diverse sample and provide a voice for community members we may have overlooked.

Credit: Adam Murrison

5.0 RECOMMENDATIONS

Credit: Adam Murrison

5.1 IMROVING COMMUNICATION SYSTEMS WILL ALLOW WILDFIRE INFORMATION TO REACH A MORE DIVERSE POPULATION

In spite of the current communication systems in place in Estes Park and Larimer County, including the LETA and NOCO alert systems, government officials and residents repeatedly expressed the need to enhance these communications between officials and the public. The reverse 911 systems that were in place during the East Troublesome, Cameron Peak, and Kruger Rock fires did not effectively reach the entire community because most of the alerts were only put out in English. Due to the non-English speaking populations in Estes Park, it is necessary for these alert systems to cover multiple languages. Since the most recent wildfires, the LETA system has added 27 languages to account for this language deficit. The biggest problem with the LETA system and reaching these non-English speaking communities is there is not enough use, and instead these communities opt to communicate through internal Facebook groups.

More languages need to be continually added, both for the non-English speaking residents, as well as the visitors who may not speak English. Additionally, more of a focus should be on getting these groups to opt into this system as well as the internal Facebook groups. Furthermore, this need for officials and the public to work together, more should be done in collaboration between these groups in revising the 2009 Community Wildfire Protection Plan. By involving the community in these documents and plans, a wider range of viewpoints and ideas will be heard, which would make efforts more effective.

Additionally, residents without cell phones or cell service were often unaware of important communication updates, making it necessary for these alert systems to include communications through landlines.

By making these alert systems output messages in multiple languages through multiple forms of communication, including radio, TV, text, email, and call, government officials would be able to more effectively reach the entire Estes Park community about wildfire risks and updates.

The need to expand on communication efforts between visitors and public officials was repeatedly expressed. With the significant visitor population in the summer when wildfire risk is high, effective forms of communication are necessary through a variety of multimedia. Focusing on educational and awareness resources that are easy to use and do not require extra work are important, that way individuals actually sign-up and participate in them. Officials will be able to communicate more effectively with the majority of the population in Estes Park, by targeting visitors through strategies described in the following section, Section 5.2.

5.1 IMROVING COMMUNICATION SYSTEMS WILL ALLOW WILDFIRE INFORMATION TO REACH A MORE DIVERSE POPULATION

With the shutoff of power during wildfire events, the fire district should put in place backup systems to ensure that emergency personnel can remain in contact with the rest of the town, similar to how tornado sirens are used in other parts of the country. In conversations with residents, it was suggested that implementing a siren or bell with different messages could allow these emergency responders to warn residents and effectively communicate with the rest of the town. These more robust systems could aid in communication even if the power has been shut off, and would reach people that do not have the cell phones or cell service required to receive existing forms of updates.

Following these wildfire disasters, it has been expressed that more equal communication is needed between the town and its residents to evaluate what went well during the event and what could be improved in the future. This will be important to implement when revising the 2009 version of the CWPP and future CWPPs and wildfire plans. In regard to residents, it has been made clear that they want a voice and a say in what decisions are made about wildfire planning. For officials, more efforts need to be made to reach all groups within the community. By combining all groups affected during the most recent wildfires, the plans and policies generated from this collaboration would be more effective.

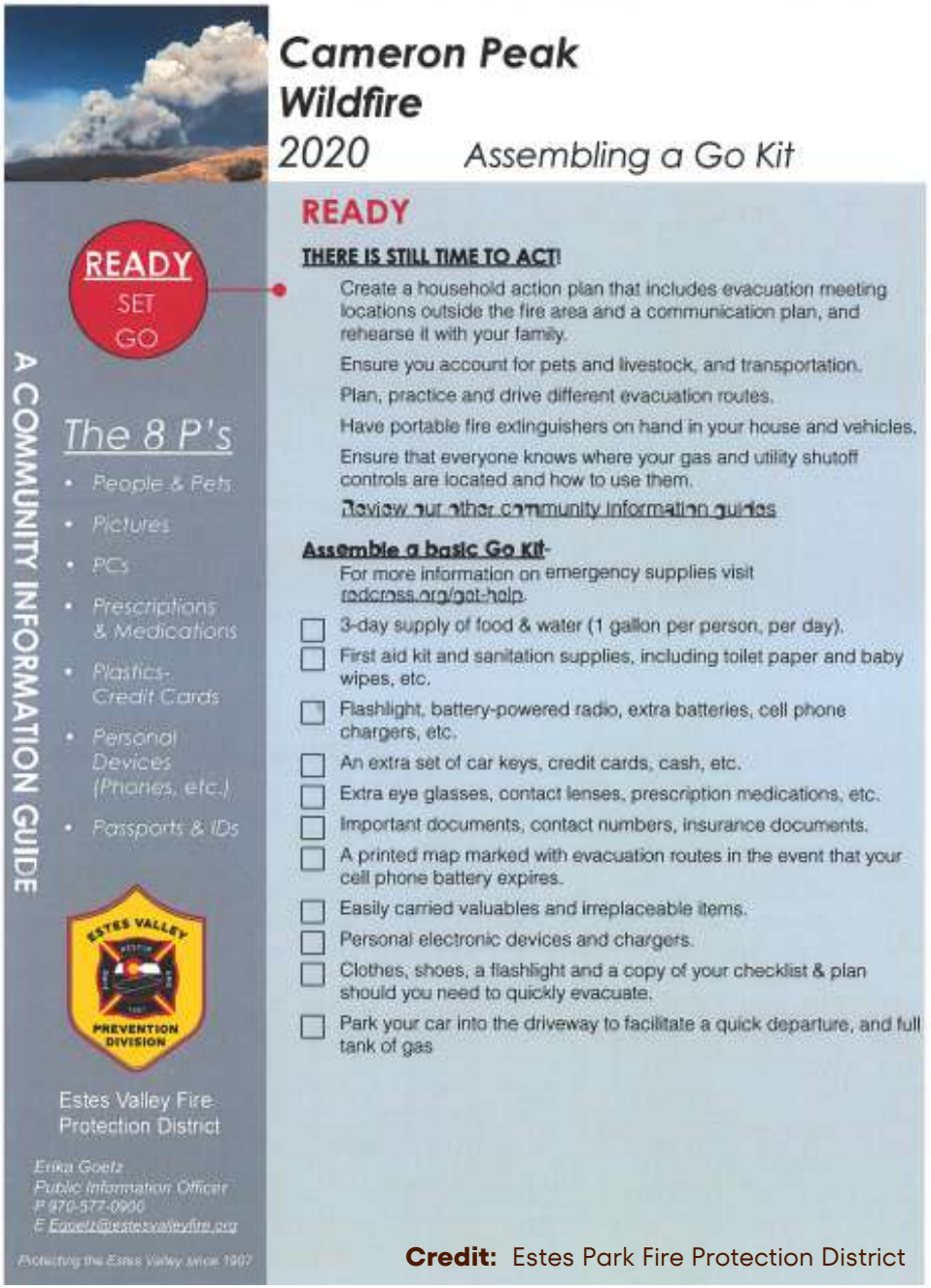
Credit: Adam Murrison

5.2 MULTIPLE MEDIA TOOLS CAN HELP BUILD AWARENESS OF WILDFIRE THREATS AND HEIGHTEN PREPAREDNESS

Credit: Caitlin Strzegowski

For residents of high-risk areas, one of the important factors when mitigating property or evacuating during a wildfire is having the necessary preparedness and awareness. Mitigation will minimize the damage a wildfire has on property and can limit the spread to other homes. Without preparation for an evacuation, individuals cannot leave as quickly and have a risk of forgetting important valuables. This can lead to deaths during wildfires during which individuals go back for belongings they missed and end up getting stuck in the blaze. In order to prevent tragic events like this from occurring, it is important to educate as much of the public as possible on strategies such as packing a Go Bag, familiarizing with evacuation routes, and general details pertaining to evacuating (such as how to leave your garage with no power on). While it is understood that not all individuals will embrace such efforts eagerly, it is important to provide the resources to those who are willing to participate. A large percentage of the interviews we conducted indicated that, if the opportunity presents itself, the Estes Park resident population is willing to be engaged because they care deeply about their town. The sense of community in Estes Park is strong and many community members hold a personal sense of responsibility to better protect their community. This sense of personal responsibility provides an opportunity to encourage participation and spread knowledge on preparedness in Estes Park.

5.2 MULTIPLE MEDIA TOOLS CAN HELP BUILD AWARENESS OF WILDFIRE THREATS AND HEIGHTEN PREPAREDNESS



Cameron Peak Wildfire
2020 *Assembling a Go Kit*

READY
SET
GO

A COMMUNITY INFORMATION GUIDE

The 8 P's

- *People & Pets*
- *Pictures*
- *PCs*
- *Prescriptions & Medications*
- *Plastics- Credit Cards*
- *Personal Devices (Phones, etc.)*
- *Passports & IDs*

ESTES VALLEY PREVENTION DIVISION

Estes Valley Fire Protection District

Erika Goetz
Public Information Officer
P 970-577-0900
E Egoetz@estesvalleyfire.org

Protecting the Estes Valley since 1907

READY

THERE IS STILL TIME TO ACT!

Create a household action plan that includes evacuation meeting locations outside the fire area and a communication plan, and rehearse it with your family.

Ensure you account for pets and livestock, and transportation.

Plan, practice and drive different evacuation routes.

Have portable fire extinguishers on hand in your house and vehicles.

Ensure that everyone knows where your gas and utility shutoff controls are located and how to use them.

Review our other community information guides

Assemble a basic Go Kit-

For more information on emergency supplies visit redcross.org/get-help.

- ☐ 3-day supply of food & water (1 gallon per person, per day).
- ☐ First aid kit and sanitation supplies, including toilet paper and baby wipes, etc.
- ☐ Flashlight, battery-powered radio, extra batteries, cell phone chargers, etc.
- ☐ An extra set of car keys, credit cards, cash, etc.
- ☐ Extra eye glasses, contact lenses, prescription medications, etc.
- ☐ Important documents, contact numbers, insurance documents.
- ☐ A printed map marked with evacuation routes in the event that your cell phone battery expires.
- ☐ Easily carried valuables and irreplaceable items.
- ☐ Personal electronic devices and chargers.
- ☐ Clothes, shoes, a flashlight and a copy of your checklist & plan should you need to quickly evacuate.
- ☐ Park your car into the driveway to facilitate a quick departure, and full tank of gas

Credit: Estes Park Fire Protection District

Educational tools can come in many forms: brochures or pamphlets, seminars, or posters. Regarding mitigation, fire officials have begun to advertise tax cuts for volunteering, and free assessments by fire inspectors. Flyers, postings to social media, and mass mailings can effectively get the word to many populations to further advertise volunteer mitigation assessments of the possible incentives. The town of Estes Park has already begun to send out informational emails to tourists and visitors upon booking a stay at a local hotel. While these emails are beneficial to preparing before the trip, they seem to not be utilized in the event of an emergency as explained by local officials. When flustered in an emergency, people do not remember to look through their phone for an email sent two weeks ago. Instead, it might be more beneficial to have a pamphlet or brochure available in every hotel room, rental property, Airbnb or VRBO listing. This brochure could include a simple list with suggestions for quick packing and a Go Bag checklist, main evacuation routes out of both the property and the town, or a radio frequency they can tune in to get live updates. The Go Bag will explain what visitors should take in terms of food and necessary supplies like batteries that they may not have brought with them originally. The evacuation routes explain every road to take out of town which provides other escape options if the route they entered by is closed which they will determine from the temporary LETA alerts.

5.2 MULTIPLE MEDIA TOOLS CAN HELP BUILD AWARENESS OF WILDFIRE THREATS AND HEIGHTEN PREPAREDNESS

To include all populations and ethnicities, a few different languages should be included such as English and Spanish. This is a feasible task since many of the components included in the brochure are already in existence and are available to the community. The Estes Park Fire Department has already made a Go Bag assembly poster that is available on their website. It is in two languages, English and Spanish, and is still applicable after the Cameron Peak fire. Assembling this list as well as the evacuation routes and small tips on how to leave the property would be a small task that could have ample benefits. Local officials providing visitors the knowledge on how to leave efficiently will lighten the load on the first responders because they are not responding to calls on how to open a garage door when there is no electricity. Instead, they can focus efforts on controlling traffic, fighting the wildfire, or evacuating residents.

Another key type of educational tool to invest further on would pertain to seminars. Seminars have been held in the past regarding general emergencies, but it would be beneficial to both residents and town officials to conduct seminars that are specific to wildfire mitigation practices. These seminars can be organized so residents share what they have done to best prepare themselves and give suggestions on how their fellow residents can apply these same practices to their properties and belongings. Residents can share their worries or fears with local officials so their voices are amplified and their risks can be addressed.

Credit: Adam Murrison

5.2 MULTIPLE MEDIA TOOLS CAN HELP BUILD AWARENESS OF WILDFIRE THREATS AND HEIGHTEN PREPAREDNESS

These seminars can be in person or on zoom and would be available at a variety of times to account for the working and retired populations. A manager at the Good Samaritan, a local nursing home and senior living center, explained that they regularly put on a variety of seminars to inform their residents on how to pack and prepare for different emergencies. It has proven effective, as every resident now has a Go Bag packed and is ready for a mandatory evacuation. The town wide workshops would have a similar goal: to raise awareness on emergency practices and mitigation strategies while also highlighting the voices of residents. Many residents expressed in their interviews an interest in attending such events and are excited about the possibilities to learn more mitigation incentives and how to better prepare themselves. Some felt unprepared or were only prepared because of research they had done on their own, and would like to hear from people with more authority and experience on the subject. The topics that would be covered in the seminar parallel those in the suggested brochures, through in detail and with potential demonstrations: packing a Go Bag, identifying different evacuation routes, mitigating fire risk around your home, as well as miscellaneous helpful tips pertaining to evacuations and insurance policies tied to them. The difference between the brochures and the seminars is that the latter could operate with a commitment to community and collaboration. These seminars could happen with a high frequency, or offer recorded sessions, for those residents unable to attend a seminar in person.

Providing accessible tools and putting the experiences of residents at the center of the workshop may be crucial aspects to an awareness campaign. If residents cannot access or do not know how to access the information it is useless to them. Creating tools that residents will use and can find is the key to informing the general public. Posting tools on social media, holding seminars, and hanging posters are all examples of how to make information accessible to different demographics.

Credit: Adam Murrison

5.3 ENFORCING MITIGATION PRACTICES WILL LEAD TO MORE READINESS FOR WILDFIRES IN THE FUTURE

Credit: Adam Murrison

To further improve Estes Park's wildfire readiness, mitigation practices and assessments should be enforced by the town by adopting the international WUI code (IWUIC) as suggested by the EP Fire Department. The IWUIC requires existing buildings and new developments to follow code addressing "fire spread, accessibility, defensible space, water supply and more for buildings constructed near wildland areas" (ICC, 2021). According to chapter 1 of the IWUIC, or the scope and general requirements, "buildings or conditions in existence at the time of the adoption of this code are allowed to have their use or occupancy continued, if such condition, use or occupancy was legal at the time of the adoption of this code, provided that such continued use does not constitute a distinct danger to life or property. Buildings or structures moved into or within the jurisdiction shall comply with the provisions of this code for new buildings or structures" (ICC, 2021). This code would establish minimum requirements to mitigate hazards to property and life from fires in the wildland-urban interface. This includes ignition-resistant construction materials, as well as requirements for creating defensible space around buildings.

5.3 ENFORCING MITIGATION PRACTICES WILL LEAD TO MORE READINESS FOR WILDFIRES IN THE FUTURE

Current voluntary mitigation assessments examined by the Fire Department would become mandatory and allow the town to expand its idea on how prepared they are as a community. Within enforcing the IWUIC through authority officials, the town would need to involve programs that make mitigation practices more cost effective for residents who cannot afford it. This could involve town-wide chipper programs, where residents leave slash piles of brush and timber on their sidewalk, and the town could come and chip it on site and haul it away. Programs like these may exist in private HOAs, but expanding it would benefit the residents in town who do not have access to pre-existing programs. This not only creates an environmentally friendly way of disposing and recycling debris, but allows residents to participate in mitigation practices even if they cannot afford to do so on their own.

The benefit to enhancing mitigation practices is receiving tax credit from the state. According to the General Assembly of the State of Colorado, the Wildfire Mitigation Income tax credit "allows a landowner a credit of 25% of the costs incurred in performing wildfire mitigation measures, not to exceed $2,500. Any amount in excess of the landowner's tax liability in the year the credit is first claimed may be carried forward to offset the landowner's future tax liability for 5 years" (Wildfire mitigation, n.d.). This tax credit would give residents incentive to do mitigation work.


Credit: Adam Murrison

6.0 CONCLUSION

Credit: Adam Murrison

CONCLUSION

Wildfires are one of the most serious threats to the Estes Valley. As climate change leads to warmer, drier conditions and longer fire seasons, rising to this challenge will be one of the most difficult long-term efforts that this community faces. Based on our research, we conclude that Estes Park residents and town officials have partially risen to this challenge in the aftermath of the East Troublesome and Cameron Peak fires. Officials are analyzing and updating policies to improve the community's resilience, and residents of Estes Park largely have taken to heart the fact that the next wildfire is a matter of when, not if, and taken measures to prepare themselves for this eventuality.

However, this project represents only the first step in understanding the Estes Park community's perspectives on the threat of wildfire. Future research could include a more diverse sample of Estes Park residents, and visitors. Additionally, a survey sent to the Estes Park population targeting numerous residents in order to obtain quantitative data about the community's perspective would be a useful complement to our team's largely qualitative, interview-focused approach. Such a survey could also reach a larger sample than our interviews were able to as filling out a survey requires less time and planning than participating in an interview. Finally, as the town of Estes Park prepares to approve a new comprehensive plan in 2022 that contains an updated Community Wildfire Protection Plan, an analysis of this updated plan from the perspective of wildfire resilience would further shed light on the town's goals in the future.

As discussed above, the town of Estes Park still has work to do in order to improve the community's resilience towards wildfire. However, as both officials and residents generally understand, wildfires will continue to burn in the region, and their frequency and destructiveness is likely to increase. For this reason, giving residents the tools they need to reduce their own risk when fires inevitably occur and building new wildfire policies that take the public into account are crucial next steps. Residents of Estes Park we have talked to have a genuine love for their community, and they are ready and willing to come together and face the challenges caused by wildfire.


Credit: Adam Murrison

APPENDIX A: FIRE RETARDANT MATERIALS

Whether or not defensible space can be maintained, for example in an urban environment, utilizing fire retardant materials when building or renovating a home can protect it from sparking when surrounded by a wildfire (FEMA; CA, 2010). It is first important to make a distinction between noncombustible, fire resistance, ignition resistance, and combustible. Non-combustible is the best option for protecting a home or business because it means a material has the best performance when preventing a spread or penetration (Quarles, 2019). Fire resistance can limit the penetration from the exterior materials into the building, but the spread limitations can vary with materials and are not as efficient as non-combustible materials (Quarles, 2019). Ignition resistance materials perform better than combustible materials, but not as good as non-combustible materials (Quarles, 2019). Finally, combustible materials will not perform well under extreme heat and flame and will quickly catch fire (Quarles, 2019). The difference in materials can be reflected in the price as well as the efficiency in being fire retardant. The more expensive materials tend to be non-combustible, but they are the most fire retardant.

Fire retardant materials include the siding, doors, vents, roofing, outside materials and windows. An example is utilizing double or single paned glass to prevent windows from shattering under the pressure of heat (CA, 2010; FEMA). Also, according to California Building Codes, the exterior walls should be built with a material that is one of the following: noncombustible material, ignition-resistant material, heavy timber exterior wall assembly, log wall construction assembly, or wall assemblies that follow policy SFM Standard 12-7A-1 (CA, 2010). In general, other materials such as slate or clay tile, metal, cement, or concrete should be utilized throughout the home and property replacing more combustible supplies (FEMA). While these options are fire retardant to protect one's home, they come with a price compared to alternatives, as expressed previously.

APPENDIX B: FIRE MITIGATION PRACTICES IN OTHER STATES

To understand how Estes Park can improve their fire mitigation and preparedness strategies it is important to consider what other fire-prone States have done to better prepare themselves.

California**:** California has been hit by a multitude of wildfires in which they have responded to educate the public by creating a website with all necessary information. The website, titled CalFire, is also in app form that relays information based on preparing, preventing, and acting upon an emergency (CalFire, 2019). Between both platforms there is a wealth of information that is presented as infographics, videos, and webpages. The detailed analysis of before, during and after a wildfire begins with preparing your property for a wildfire. Preparation before explains how to build defensible space, harden your home, or utilize fire retardant materials, and fire resistant landscaping (CalFire, 2019). Examples of these preparation practices are included in the California building codes and material requirements (CA, 2010). In order to prevent future wildfires practices are brought to attention such as removal of dead vegetation and the required permits, practicing fire safety around campfires, and vehicle safety (CalFire, 2019). Following a wildfire there are a wide variety of government programs for debris removal, grants and federal or state aid, and environmental agencies that can aid in the rebuilding process for monetary aid or professional opinions (CalFire, 2019). California has become proactive in their fight against wildfires with a variety of resources combined into a website or app that sends out text message updates and warnings and is a one-stop place to get pre, during, or post wildfire information. It is important to incorporate public opinions in order to meet the needs of all community members and assess all risks including lives, property, air quality, and recreational areas (CalFire, 2019). California officials have evaluated all needs and encouraged members to speak out when they feel the need.

FLAG OF CALIFORNIA
CREDIT: 50STATES.COM

APPENDIX B: FIRE MITIGATION PRACTICES IN OTHER STATES

Washington**:** Washington State developed a wildland fire protection 10 year strategic plan to prepare, protect and strengthen the state against wildfires. The plan establishes four goals: efficient sustainable systems, resilient landscapes, fire-adapted communities, and safe and effective responses (Washington State Department of Natural Resources, 2019). The first goal of sustainable preparedness, response and recovery systems will be accomplished by providing leadership and guidance, utilizing risk management to establish priorities, sustain a capable workforce, and develop sustainable funding (Washington State Department of Natural Resources, 2019). Resilient landscapes can be maintained by enhancing practices to manage fuel and vegetation (Washington State Department of Natural Resources, 2019). Developing fire-adapted communities will be accomplished by establishing fire adapted communities, reducing human caused wildfires, and building upon post fire capacities (Washington State Department of Natural Resources, 2019). Safe and effective responses will be maintained by developing precautions for all types of lands and improving operations and infrastructure (Washington State Department of Natural Resources, 2019). The detailed plan goes into depth about each goal and how it has been researched and how it will be implemented across the period of 10 years. To reevaluate the plans in Washington, government officials look for public comment and new ideas to improve forest health, suppression, and aftermath support. Public hearings are held for residents to have a voice that will be heard.

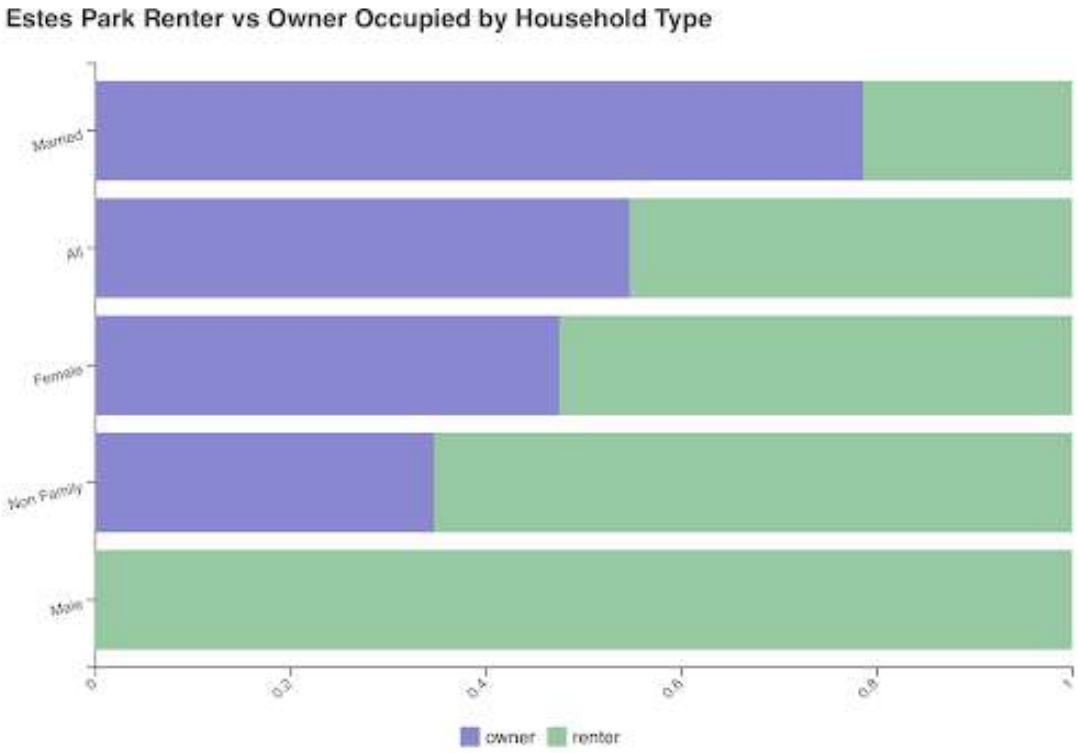
FLAG OF WASHINGTON
CREDIT: 50STATES.COM

APPENDIX B: FIRE MITIGATION PRACTICES IN OTHER STATES

Oregon**:** In Oregon the Governor's Wildfire Economic Recovery Council developed key findings and recommendations following the wildfires in 2020. Their findings focused on three main subjects: housing and sheltering, debris and cleanup, and recovery and rebuilding (Governor's Wildfire Economic Recovery Council, 2021). Out of the 23 total recommendations, the three main subjects focused on how they can alleviate barriers and be more effective. Within housing and sheltering it is recommended to build back communities equitably, support federal and state aid groups such as Oregon Community Foundation's $30 million Project Turnkey Wildfire Response investment, and check that every community member is accounted for with suitable housing (Governor's Wildfire Economic Recovery Council, 2021). Debris and cleanup can be ensured by providing adequate aid, ensuring every property is taken care of regardless of FEMA eligibility and reviewing the State Debris Management Plan (Governor's Wildfire Economic Recovery Council, 2021). To ensure proper recovery and rebuilding the council determined they must utilize all forms of aid such as FEMA's Hazard Mitigation Grant Program, expand on staff focusing on wildfire recovery and planning, and develop community involvement so that residents have a voice in plans that affect them (Governor's Wildfire Economic Recovery Council, 2021). In order to respond to an increase in wildfires, Oregon's Governor Brown enacted a Governor's Council on Wildfire Response to gain resident opinions and assess risks and populations at risk, and update existing policies or develop new plans.

FLAG OF OREGON
CREDIT: 50STATES.COM

APPENDIX C: ESTES PARK RENTER VS OWNER OCCUPIED BY HOUSEHOLD TYPE

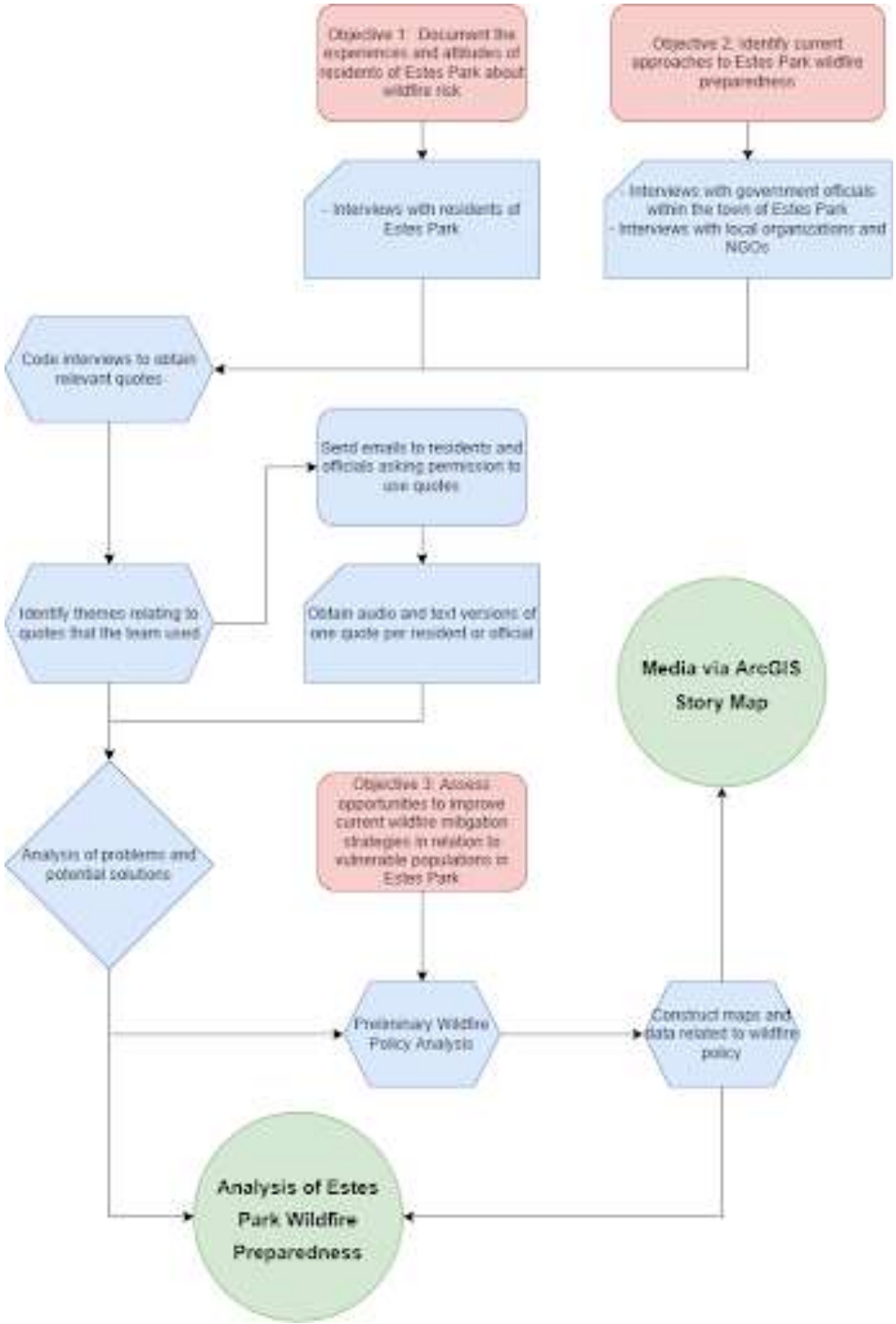


Type	Owner ▲	Renter
Male	0%	100%
Non Family	34.7%	65.3%
Female	47.5%	52.5%
All	54.7%	45.3%
Married	78.6%	21.4%

54.7% Rate of Home Ownership

(ESTES PARK, COLORADO POPULATION, 2022)

APPENDIX D: PROJECT OUTLINE



APPENDIX E: INTERVIEWEES

Categories	Organization	Contacts
Larimer County Officials	Emergency Management Coordinator	Stephen Decatur
	Emergency Operations Director, Sheriff's office	Justin Whitesell
Estes Park Town Officials	Planner II	Planner Bergeron
	Flight Paramedic	Guy Beesley
	Police Chief	Rick Life
	Town Administration	Jason Damweber
	Local Reporter	Jason Van Tatenhove
Fire District (Town Level)	Estes Park Fire Rescue - Fire Inspector	Raina Eshleman
	Estes Park Fire Rescue - Fire Chief	David Wolf
	Estes Park Fire Rescue	Alyse Averdick
NGOs	CPAW (Community Planning Assistance for Wildfire)	Doug Green
	Estes Park Valley Watershed Collective	W. Formeller
	Boulder Watershed Collective	Maya MacHamer
Residents	Kind Coffee	Michaela Ferguson
	Kind Coffee	Amy Hamrick
	Kirk's Flyshop	Darren Christiansen
	Awesome Shirtworks	Danielle R.
	Macdonald Book Shop	Terri
	Local	Tim Buck
	Local	Shai & Steve
	Local	Andrea Machado
	Estes Park Shuttle	Linda Amos
	Local	Nick W.
Other	YMCA Estes Park	Emily Pullen
	YMCA Estes Park	Kelly Wilkerson
	Good Samaritan Senior Living Center	Julie Lee
	HOA President	Peter Simonson
	Estes Park Crossroads Ministry	Brian Schaffer

APPENDIX F: INTERVIEW OUTLINES

A] CONSENT SCRIPT

We hosted a series of interviews with residents of Estes Park along with government officials and local organizations. The goal of these interviews was to gain insight into their thoughts and opinions on current wildfire preparedness and risks. Their participation in the interviews was voluntary and they could withdraw at any point. The interviews lasted approximately an hour and all responses were kept confidential, unless permitted otherwise. Unless they gave consent, no names or information was published with the report.

B] RESIDENT INTERVIEW OUTLINE

1. How long have you lived in Estes Park?
2. How have recent wildfires affected you?
3. Did you evacuate? If so, where did you go, and what was your experience?
4. What was it like to be here during the fire?
5. What has been your experience with the cleanup and building back process in Estes Park?
6. What were your concerns then vs. now? Have they changed?
7. What is your risk level on a scale from 1-10 (risk of loss/life)?
    a. What is this based on?
    b. What would make this value increase?
    c. What would cause you to not evacuate?
8. What have you done to protect or prepare yourself and your property from wildfire damage?
9. How has availability to risk and readiness resources changed over the past few years?
10. Have you heard about community planning and/or risk management? If so, have you participated?
11. (conclusion) What are your thoughts on Estes Park readiness and preparedness to wildfires? Do you think there is anything the town should focus on moving forward? What went well during the evacuation process and after the fire was under control?

APPENDIX F: INTERVIEW OUTLINES

C] TOWN OFFICIAL INTERVIEW OUTLINE

1. What are the fire resilience policies/protocols in Estes Park before, during and after a wildfire?
2. How have these policies changed over the past few years?
3. How successful were these plans? What would have made them more successful?
4. How did the fire department help local residents during the fire?
5. What are the current protocols surrounding evacuations?
6. What recovery steps have been taken to aid the public following a wildfire?
7. What has been your role in protecting town property or reducing wildfire threats?
8. What was it like during the fires, what were your personal experiences?
9. What would you like to be seen done to help reduce risk of damage from wildfires? What would be the next steps in better preparing Estes Park against the next wildfire?
10. What would you define as a vulnerable population? How have you ensured that all populations are helped?

D] COMMUNITY ORGANIZATION INTERVIEW OUTLINE

1. What has been your organization's role in protecting town property from wildfire damage?
2. What are the threats in terms of wildfires in Estes Park? How have wildfire risks changed since you've been here?
3. What has your organization done to help wildfire strategies and risks in Estes Park on a county level?
4. What has been done to help residents and property owners of Estes Park?
5. What are your thoughts on Estes Park readiness and preparedness to wildfires?
6. What would you like to be seen done to help reduce risk of damage from wildfires? What would be the next steps in better preparing Estes Park against the next wildfire?

APPENDIX G: CREATING A DEFENSIBLE SPACE AND MITIGATION ZONES AROUND YOUR HOME

Ready Create Defensible Space

Defensible space is the area around your home in which vegetation, debris, and other combustible fuels have been removed to slow the spread of fire to and from the home.

It can better protect the home from igniting due to direct flame contact and radiant heat. Defensible space is essential to help protect a structure and create a safer area for firefighters during a wildland fire.

You should create defensible space by removing weeds, brush, and firewood, and by spacing out vegetation around your property.

Although this might seem like a daunting task, we recommend starting in Zone 1 and working your way out. Follow the considerations below for each zone and your property can become safer with each step.

ZONE 1

0-5 feet around your home or to property line

- Use hard scape such as concrete or noncombustible rock mulch around your home.
- Clean roofs and gutters of dead leaves, debris, and pine needles.
- Store firewood and other combustible materials away from your home, garage, or attached deck.
- Prune away touching or over-hanging branches from the roof to a distance of at least 10 feet.
- Replace or repair any loose or missing shingles or roof tiles to prevent ember penetration.
- Rake and remove flammable vegetation, such as leaves and needles or wood mulch, from underneath your deck and away from your home.
- Use non-wood, low-growing herbaceous vegetation. Succulents or other fire-resistant plants are recommended choices.

ZONE 2

5-30 feet around your home or to property line

- Create vegetation groups or islands to break up continuous fuels around your home.
- Remove ladder fuels to create a separation between low-level vegetation and tree canopies to keep fire from climbing into trees.
- Remove leaf and needle debris from the yard.
- Keep lawns, native grasses, and wildflowers less than four inches in height.
- Store firewood and other combustible materials away from outbuildings such as a shed or barn.
- Move trailers, recreational vehicles, storage sheds, and other combustible structures out of this zone and into Zone 3. If unable to move, create defensible space around them as if they were a part of your home.

ZONE 3

30-200 feet around your home or to property line

- Create and maintain a minimum of 10 feet between the tops of trees.
- Safely remove ladder fuels up to a height of 10 feet, while retaining at least 75 percent of the foliage, to create separation between the ground and tree branches. This keeps fire from climbing into the tree canopies.
- Store firewood in this area, keeping it a safe distance from your structure.
- Create space between shrubs and trees to eliminate a continuous fuel bed at the ground level.
- Remove dead trees, shrubs, and all other dead or dry vegetation.
- Create separation between your property and your neighbors. Consider that your trees may pose a greater risk to your neighbor's home than to your own.

Remember the Ember Zone

Embers are burning pieces of airborne material that can be carried more than a mile by the wind. Research points to embers and small flames as the main ways homes ignite in wildland fires.

APPENDIX H: COMMUNITY INFORMATION GUIDE TO PREPARING FOR AN EVACUATION DURING THE CAMERON PEAK WILDFIRE

Cameron Peak Wildfire

2020 *Preparing for Evacuation*

READY SET GO

A COMMUNITY INFORMATION GUIDE

SET *Prepare and be aware*

INSIDE YOUR HOME, If Time Allows-

- Close all windows and doors.
- Remove all shades and curtains from windows and ensure blinds remain open, unless you have metal blinds -close metal blinds.
- Move furniture to the center of rooms and away from windows and doors.
- Turn off pilot lights and air conditioning units.
- Leave your lights on so firefighters can see your house under smoky conditions.

OUTSIDE YOUR HOME, If Time Allows-

- Relocate any combustible items so they are a safe distance from the house, including firewood, door mats, patio furniture, child toys, etc. If time allows, place these items inside a garage or your home.
- Turn off propane tanks or natural gas at the meter.
- Cover all exterior foundation, soffit and attic vents to prevent entry from wildfire embers.
- Leave garden hoses connected for firefighters, and well pumps on.
- Leave exterior lights on.
- Park your cars in your garage, or back your car into the driveway to facilitate a quick departure. Ensure doors and windows are shut.

IF YOU ARE TRAPPED- *Survival tips*

- If you have become trapped and cannot evacuate, call 9-1-1.
- Stay in your home, sheltering away from walls, until fire passes or emergency personnel tell you differently. Follow their instructions and commands.
- Look for spot fires and extinguish if found inside the house.
- Stay hydrated and wear cotton clothing.
- Ensure that you can still exit the home if it catches fire, remembering that it is likely much hotter outside -be aware.
- Fill sinks and tubs for an emergency water supply.
- Place wet towels under doors to keep smoke and embers out.
- After the fire has passed, check your roof and attic and extinguish any fires, sparks or embers if you are able to do so safely.
- Don't give up! Be a survivor and have a survivor's mindset!

Estes Valley Fire Protection District

Erika Goetz
Public Information Officer
P 970-577-0900
E Egoetz@estesvalleyfire.org

Protecting the Estes Valley since 1907

BIBLIOGRAPHY

1. Abatzoglou, J.T., Battisti, D.S., Williams, A.P. Projected increases in western US forest fire despite growing fuel constraints. Commun Earth Environ 2, 227 (2021). https://doi.org/10.1038/s43247-021-00299-0
2. Abrams, J. B., Knapp, M., Paveglio, T. B., Ellison, A., Moseley, C., Nielsen-Pincus, M., & Carroll, M. S. (2015). Re-envisioning community-wildfire relations in the U.S. West as adaptive governance. Ecology and Society, 20(3). http://www.jstor.org/stable/26270246
3. Agee, J. K., & Skinner, C. N. (2005, March 7). Basic principles of forest fuel reduction treatments. Forest Ecology and Management. https://doi.org/10.1016/j.foreco.2005.01.034
4. Anderson, S., Plantinga, A., & Wibbenmeyer, M. (2016, December 16). Inequality in agency responsiveness: Evidence from salient wildfire events. Resources for the Future. https://www.rff.org/publications/working-papers/inequality-agency-responsiveness-evidence-salient-wildfire-events/
5. Bacciu, V., Sirca, C., & Spano, D. (2022). Towards a systemic approach to fire risk management. Environmental Science and Policy, 129, 37-44
6. Barrett, K. J., Cannon, J. B., Schuetter, A. M., & Cheng, A. S. (2021). Effects of collaborative monitoring and adaptive management on restoration outcomes in dry conifer forests. Forest Ecology and Management, 488, 119018. https://doi.org/10.1016/j.foreco.2021.119018
7. Brasch, S. (2021, January 26). Colorado's East Troublesome Wildfire may signal a new era of big fire blow-ups. Colorado Public Radio. https://www.cpr.org/2021/01/25/colorados-east-troublesome-wildfire-may-signal-a-new-era-of-big-fire-blow-ups/
8. Brenkert-Smith, H., Dickinson, K. L., Champ, P. A., & Flores, N. (2012). Social amplification of wildfire risk: The role of Social Interactions and information sources. Risk Analysis, 33(5), 800–817. https://doi.org/10.1111/j.1539-6924.2012.01917.x
9. Calder, W. J., & Shuman, B. (2017). Extensive wildfires, climate change, and an abrupt state change in subalpine ribbon forests, Colorado. Ecology, 98(10), 2585–2600. http://www.jstor.org/stable/26601118 Steelman, T. (2016). U.S. wildfire governance as social-ecological problem. Ecology and Society, 21(4). http://www.jstor.org/stable/26270036
10. Calfas, J. (2021, Nov 17). Wildfire near Rocky Mountain National Park forces evacuations; Kruger Rock Fire in Colorado has grown rapidly since sparking Tuesday, threatening structures near Estes Park. Wall Street Journal http://ezproxy.wpi.edu/login?url=https://www.proquest.com/newspapers/wildfire-near-rocky-mountain-national-park-forces/docview/2598098566/se-2?accountid=29120
11. CalFire. (2021, December 14). Wildfire is coming...are you ready? Ready for Wildfire. https://www.readyforwildfire.org/
12. California. (2010, June 18). Chapter 7A [SFM] materials and construction methods for Exterior Wildfire Exposure. California Building Code. https://hcd.ca.gov/building-standards/state-housing-law/wildland-urban-interface/docs/2010-part-2-cbc-ch7a.pdf
13. Champ, P. A., & Brenkert-Smith, H. (2015). Is seeing believing? perceptions of wildfire risk over time. Risk Analysis, 36(4), 816–830. https://doi.org/10.1111/risa.12465
14. Colorado State University. (2022, January 25). Colorado's forests in a changing climate. Colorado State Forest Service. https://csfs.colostate.edu/colorados-forests-changing-climate/
15. Community wildfire protection plan for Estes Park. (2009). https://static.colostate.edu/client-files/csfs/documents/EstesParkCWPP.pdf

BIBLIOGRAPHY

16. Cordner, A., & Schwartz, E. (2018). Covering wildfires: Media emphasis and silence after the Carlton and Okanogan Complex wildfires. Society & Natural Resources, 32(5), 489–507. https://doi.org/10.1080/08941920.2018.1530816
17. CPAW. (n.d.). CPAW Memorandum of Understanding – Estes Park, CO. https://drive.google.com/file/d/1pwkK5wgM7WrOnloV-L44-LADm1B-TLUx/view
18. Dennison, P. E., S. C. Brewer, J. D. Arnold, and M. A. Moritz, 2014: Large wildfire trends in the western United States, 1984–2011. Geophysical Research Letters, 41, 2928–2933, doi:10.1002/2014GL059576.
19. Edgeley, C. M. (2022). Exploring the social legacy of frequent wildfires: Organizational responses for community recovery following the 2018 Camp Fire. International Journal of Disaster Risk Reduction, 70(102772). https://doi.org/10.1016/j.ijdrr.2021.102772
20. Effectiveness of Colorado Community Wildfire Protection Plans: A Plan Quality Review (n.d.).
21. https://dpla.wisc.edu/wp-content/uploads/sites/1021/2017/06/Flohr-Colorado-Wildfire-paper_0.pdf
22. Estes Park, Colorado population 2022. Estes Park, Colorado Population 2022 (Demographics, Maps, Graphs). (2022). https://worldpopulationreview.com/us-cities/estes-park-co-population
23. Estes Park Visitor Centers: Estes Park Main Offices. Estes Park Visitor Centers | Estes Park Main Offices. (2022). https://www.visitestespark.com/plan/visitor-centers/
24. Estes Valley Watershed Coalition. (2022, March 11). Estes Valley Community wildfire protection plan update. ArcGIS StoryMaps. https://storymaps.arcgis.com/stories/f76be4ef9ff8423ca7efc92fed3e5a2f
25. FEMA. (n.d.). Rebuilding after a wildfire - fema.gov. Federal Insurance and Mitigation Administration. https://www.fema.gov/sites/default/files/documents/rebuilding-after-a-wildfire_2016.pdf
26. Governor's Wildfire Economic Recovery Council. (2021, January 4). Recovering & rebuilding from Oregon's 2020 wildfires. State of Oregon. https://www.oregon.gov/gov/policy/Documents/WERC-2020/Wildfire%20Report%20FINAL.pdf
27. Headwaters Economics. (2016, January). Boulder, Colorado: Balancing regulation and education to reduce wildfire risk. Headwaters Economics. https://headwaterseconomics.org/wp-content/uploads/Planning_Lessons_Boulder_Manuscript.pdf
28. Hennink, M., & Kaiser, B. (2019). Saturation in Qualitative Research. In P. Atkinson, S. Delamont, A. Cernat, J.W. Sakshaug, & R.A. Williams (Eds.), SAGE Research Methods Foundations. https://dx.doi.org/10.4135/9781526421036822322
29. Hui, I., Zhao, A., Cain, B. E., & Driscoll, A. M. (2021). Baptism by wildfire? wildfire experiences and public support for wildfire adaptation policies. American Politics Research, 50(1), 108–116. https://doi.org/10.1177/1532673x211023926
30. (ICC), I. C. C. (n.d.). 2021 International Wildland-Urban Interface Code (IWUIC): ICC Digital Codes. 2021 INTERNATIONAL WILDLAND-URBAN INTERFACE CODE (IWUIC) | ICC DIGITAL CODES. https://codes.iccsafe.org/content/IWUIC2021P1/copyright
31. InciWeb developed and maintained by USDA Forest Service, F. and A. M. (2021). Cameron Peak fire. Cameron Peak Fire Information - InciWeb the Incident Information System. https://inciweb.nwcg.gov/incident/6964/
32. InciWeb developed and maintained by USDA Forest Service, F. and A. M. (2021). East troublesome fire. PIO Map East Troublesome Fire Nov 9 - InciWeb the Incident Information System. Retrieved April 1, 2022, from https://inciweb.nwcg.gov/incident/map/7242/0/
33. Insurance Information Institute. (2021). Facts + Statistics: Wildfires. III. https://www.iii.org/fact-statistic/facts-statistics-wildfires#top
34. Intersectional Environmentalist. (n.d.). About Us. Intersectional Environmentalist. https://www.intersectionalenvironmentalist.com/about-ie#

BIBLIOGRAPHY

35. Kahneman, D. (2013). Thinking, fast and slow. Farrar, Straus and Giroux.
36. Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., Goble, R., Kasperson, J. X., & Ratick, S. (1988). The social amplification of risk: A conceptual framework. Risk Analysis, 8(2), 177–187. https://doi.org/10.1111/j.1539-6924.1988.tb01168.x
37. Larimer County Fire Plan - Colorado State Forest Service. (n.d.). https://csfs.colostate.edu/media/sites/22/2019/02/Larimer_County_CWPP-2009.pdf
38. Larimer County Sheriff's Department. (2021, November 16). Kruger Rock Fire Update (sheriff). Kruger Rock Fire Update | Larimer County. https://www.larimer.org/spotlights/2021/11/16/kruger-rock-fire-update
39. Lincoln, A. (2021, June 22). The threat of wildfire in the West arrives alongside tourists. High Country News – Know the West. https://www.hcn.org/articles/climate-desk-the-threat-of-wildfire-in-the-west-arrives-alongside-tourists
40. Loesche, D. (July 12, 2017). Wildfires in the United States [Digital image]. https://www.statista.com/chart/10243/wildfires-and-acres-burnt-in-the-unites-states/
41. Logan, D. (2021, November 19). Building Materials Prices Post record year-to-date increase through October: Eye On Housing. Eye On Housing | National Association of Home Builders Discusses Economics and Housing Policy. https://eyeonhousing.org/2021/11/building-materials-prices-post-record-year-to-date-increase-through-october/#:~:text=The%20price%20of%20all%20goods,(%2B7.1%25%20in%202008).
42. Martin, W. E., Martin, I. M., & Kent, B. (2009). The role of risk perceptions in the risk mitigation process: The case of wildfire in high risk communities. Journal of Environmental Management, 91(2), 489–498. https://doi.org/10.1016/j.jenvman.2009.09.007
43. McGee, T. K., McFarlane, B. L., & Varghese, J. (2009). An examination of the influence of hazard experience on wildfire risk perceptions and adoption of mitigation measures. Society & Natural Resources, 22(4), 308–323. https://doi.org/10.1080/08941920801910765
44. Meldrum, J. R., Champ, P. A., Brenkert-Smith, H., Warziniack, T., Barth, C. M., & Falk, L. C. (2015). Understanding gaps between the risk perceptions of wildland-urban interface (WUI) residents and wildfire professionals. Risk Analysis, 35(9), 1746–1761. https://doi.org/10.1111/risa.12370
45. Moody, J.A. and Martin, D.A. (2001), Initial hydrologic and geomorphic response following a wildfire in the Colorado Front Range. Earth Surf. Process. Landforms, 26: 1049-1070. https://doi.org/10.1002/esp.253
46. Mueller, L. (2020, March 12). Should you go for a single pane or double pane window? Moving.com. https://www.moving.com/tips/should-you-go-for-a-single-pane-or-double-pane-window/#:~:text=According%20to%20HomeAdvisor%2C%20the%20initial,require%20a%20larger%20upfront%20investment
47. National Interagency Fire Center. (2021). Acres burned by wildfires in the United States from 1983 to 2020. National Interagency Fire Center. Nifc.gov
48. NOAA. (n.d.). Colorado. National Integrated Drought Information System. Retrieved April 21, 2022, from https://www.drought.gov/states/colorado
49. Norton, R., Wiliams, A., MacClune, K., Donahue, W., Fetterman, C., & Schneider, J. (2019, December). California fires: Building resilience from the ashes. Flood Resilience Portal. https://floodresilience.net/resources/item/california-fires-building-resilience-from-the-ashes/

BIBLIOGRAPHY

50. Parks, S. A., & Abatzoglou, J. T. (2020). Warmer and drier fire seasons contribute to increases in area burned at high severity in western US forests from 1985 to 2017. Geophysical Research Letters, 47(22). https://doi.org/10.1029/2020gl089858
51. Plantinga, A., Walsh, R., & Wibbenmeyer, M. (2020, December). Priorities and Effectiveness in Wildfire Management: Evidence from Fire Spread in the Western United States. Resources for the Future. https://media.rff.org/documents/WP_20-21.pdf
52. Powell, T. (2021, November 17). Kruger Rock Wildfire in Colorado poses "immediate and imminent danger," threatening homes and businesses. CBS News. https://www.cbsnews.com/news/kruger-rock-fire-colorado-danger/
53. Prats, S.A., Sierra-Abrain, P., Morana-Fontan, A., Zas, R. (2021). Effectiveness of community-based initiatives for mitigation of land degradation after wildfires. Science of the Total Environment(810).
54. Quarles, S. (2019, August 27). Fire ratings for construction materials. Surviving Wildfire. https://surviving-wildfire.extension.org/fire-ratings-for-construction-materials/
55. Quinton, S. (2019, January 2). As wildfire risk increases in Colorado and the West, home insurance grows harder to find. The Denver Post. https://www.denverpost.com/?returnUrl=https%3A%2F%2Fwww.denverpost.com%2F2019%2F01%2F02%2Fwildfire-risk-homeowners-insurance%2F%3FclearUserState%3Dtrue
56. Radeloff Volker C., Helmers David P., Kramer H. Anu, Mockrin Miranda H., Alexandre Patricia M., Bar-Massada Avi, Butsic Van, Hawbaker Todd J., Martinuzzi Sebastián, Syphard Alexandra D., & Stewart Susan I. (2018). Rapid growth of the US wildland-urban interface raises wildfire risk. Proceedings of the National Academy of Sciences, 115(13), 3314–3319. https://doi.org/10.1073/pnas.1718850115
57. Running, S. W. (2006). Is Global Warming Causing More, Larger Wildfires? Science, 313(5789), 927–928. http://www.jstor.org/stable/3846966
58. Sanchez, J., Holmes, T., Loomis, J., & Gonzalez-Caban, A. Homeowners willingness to pay to reduce wildfire risk in wildland urban interface areas: Implications for targeting financial incentives. International Journal of Disaster Risk Reduction(68). https://doi.org/10.1016/j.ijdrr.2021.102696.
59. Saldaña Johnny. (2016). The coding manual for qualitative researchers. Simon Fraser University. https://www.sfu.ca/~palys/Saldana-CodingManualForQualResearch-IntroToCodes&Coding.pdf
60. Stevens Rumann, C. S., Kemp, K. B., Higuera, P. E., Harvey, B. J., Rother, M. T., Donato, D. C., Morgan, P., & Veblen, T. T. (2017). Evidence for declining forest resilience to wildfires under climate change. Ecology Letters, 21(2), 243–252. https://doi.org/10.1111/ele.12889
61. Summit County Government. (2018). Summit County Community Wildfire Protection Plan. Summit County Government. Retrieved from https://www.summitcountyco.gov/DocumentCenter/View/403/Summit-County-CWPP---Revised-2016?bidId=
62. Taylor, D. B. (2021, November 18). Colorado wildfire kills one, signaling fire season is far from over. The New York Times. Retrieved January 19, 2022, from https://www.nytimes.com/2021/11/18/us/colorado-wildfire-kruger-rock.html
63. The Boulder Watershed Collective. (n.d.). https://www.boulderwatershedcollective.com/
64. The Colorado State Forest Service. (2020). Colorado Forest Action Plan. Colorado State Forest Service. https://csfs.colostate.edu/forest-action-plan/
65. The University of Adelaide. (2014). Mind mapping - university of adelaide. The University of Adelaide. https://www.adelaide.edu.au/writingcentre/sites/default/files/docs/learningguide-mindmapping.pdf

BIBLIOGRAPHY

66. Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and Biases. Science, 185(4157), 1124–1131. https://doi.org/10.1126/science.185.4157.1124
67. U.S. Census. (n.d.). Vulnerable Populations. Wildfire risk to communities. https://wildfirerisk.org/explore/3/08/08069/0800025115/
68. U.S. Department of the Interior. (n.d.). Wildland fire strategic plan. National Parks Service. https://www.nps.gov/subjects/fire/upload/wildland-fire-strategic-plan-20-24.pdf
69. U.S. Forest Service. (2021). East troublesome fire. East Troublesome Fire Information - InciWeb the Incident Information System. https://inciweb.nwcg.gov/incident/7242/
70. Wang, X., Peng, L., Huang, K., & Deng, W. (2022). Identifying the influence of disaster education on the risk perception of rural residents in geohazard-prone areas: A propensity score-matched study. International Journal of Disaster Risk Reduction(71). https://doi.org/10.1016/j.ijdrr.2022.102795.
71. Washington State Department of Natural Resources. (2019, August). WASHINGTON STATE WILDLAND FIRE PROTECTION 10-YEAR STRATEGIC PLAN. Washington State Department of Natural Resources. https://www.dnr.wa.gov/publications/rp_wildfire_strategic_plan.pdf
72. Wildfire maps (emergency management). Larimer County. (2000, October 11). https://www.larimer.org/emergency/fires/maps
73. Wildfire mitigation income tax credit. Wildfire Mitigation Income Tax Credit | Colorado General Assembly. (n.d.). https://leg.colorado.gov/bills/hb16-1052
74. Wildfire Planning International, LLC. Punchard Consulting, LLC. (2020, January). Community Planning Assistance For Wildfire (CPAW): Implementation resources. https://cpaw.headwaterseconomics.org/wp-content/uploads/2020/01/FINAL_CPAW-Implementation-Resources_2020.pdf
75. Wildfire prevention: How to prevent & control forest fires. EARTH OBSERVING SYSTEM. (2021, September 24). https://eos.com/blog/wildfire-prevention/