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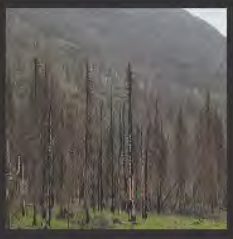
DRAFT December 2021

SWCA
ENVIRONMENTAL CONSULTANTS

Kenai Peninsula
Community Wildfire Protection Plan



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EXECUTIVE SUMMARY

Placeholder. Executive Summary will be added post-review.

STORY MAP

The Borough opted to develop a story map (online web content) to disseminate information to the public and provide an opportunity for the public to provide input into the plan content. In addition to facilitating information sharing, the story map also provides the Borough with a platform that can be readily revised to keep the CWPP document current. The CWPP is shared on the Kenai Peninsula Borough webpage: https://kenai-cwpp-hub-kpb.hub.arcgis.com/apps/kenai-peninsula-borough-community-wildfire-protection-plan/explore

ACKNOWLEDGEMENTS

We would like to formally thank the Core Team and all stakeholders for contributing their time and expertise throughout the planning process. Your participation has contributed to creating resilient landscapes, implementing public education, reducing structural ignitability, and ensuring safe and effective wildfire response.

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CHAPTER 1 – INTRODUCTION

PURPOSE

Wildfire is the leading disturbance in Alaskan boreal forests, and roughly 80% of Alaskans reside in areas potentially at risk from wildland fire (University of Alaska Fairbanks [UAF] 2018). Communities within the Kenai Peninsula Borough (KPB or Borough) planning area are familiar with community fire planning, having developed 17 community wildfire protection plans since the early 2000s, covering 33 communities (KPB 2019a). Because wildfire does not respect political boundaries, however, the KPB and other land management entities have been working together collaboratively for more than 15 years to treat fire management as a landscape effort, forming the All Lands/All Hands (ALAH) interagency organization, comprising a comprehensive body of land and resource managers across all jurisdictions, who collaborate on landscape-scale planning efforts, housed in the ALAH Action Plan (KPB Interagency 2018).

In support of this collaborative management approach, the purpose of the 2022 community wildlife protection plan (CWPP) update is to

1. provide a peninsula-wide scale of wildfire risk and protection needs,
2. bring together all the responsible wildfire management and suppression entities in the planning area to address the identified needs, and
3. provide a framework for future planning and implementation of necessary mitigation measures.

This CWPP update process involves looking at past fires and treatment accomplishments using the knowledge and expertise of the land and resource managers who work for the various agencies and governing entities in the planning area. This update process incorporates a new assessment of wildfire risk and hazard and supplements local knowledge with relevant science and literature from the northwest region.

NAVIGATION

The plan provides background information, a risk assessment, and recommendations to reduce or mitigate wildfire risk to communities. The CWPP is designed to be used by the residents of the Borough, as well as stakeholders tasked with forest, fire, and emergency management. Some information is therefore highly technical in order to provide sufficient detail to aid in project implementation.

This CWPP is organized into several chapters with more detailed information compiled into appendixes. Chapter 1 provides an overview of CWPPs and describes the need for a plan; Chapter 2 gives an overview of the fire environment and introduces the reader to fire history information as well as fire response; Chapter 3 describes the methodology used in development of the risk assessment (completed as a separate project from the CWPP); Chapter 4 outlines the mitigation strategies that could be implemented to reduce wildfire risk under the umbrella of the National Cohesive Wildland Fire Management Strategy (Cohesive Strategy), including action plans that outline priorities and recommendations for reducing fuels, initiating public education and outreach, reducing structural ignitability, and improving fire response capabilities; and Chapter 5 provides suggested approaches to monitoring actions.

The CWPP does not require implementation of any of the recommendations; however, these recommendations may be used as guidelines for the implementation process if funding opportunities become available. The recommendations for fuels reduction projects are general in nature; site-specific planning that addresses location, access, land ownership, topography, soils, and fuels would need to be employed upon implementation. Also, it is important to note that the recommendations are specific to wildland urban interface (WUI) areas and are expected to reduce the loss of life and property. All recommendation tables are provided within Chapter 4.

In developing the CWPP, a large amount of background information on the Borough is compiled and analyzed, including the CWPP planning process, fire policy, past planning efforts, location and land use data, population, and demographics, climate and weather data, and other supporting background information. This information is presented in Appendix A, Community and CWPP Background Information.

Additional appendices to this CWPP include the Chugach All-Lands Wildfire Risk Assessment in Appendix B; the Core Team contact list in Appendix C; community descriptions and hazard ratings in Appendix D; the National Fire Protection Association (NFPA) Wildfire Fire Risk and Hazard Severity Form 1144 in Appendix E; funding opportunities in Appendix F; additional resources in Appendix G; community outreach in Appendix H, and project recommendations in Appendix I.

OVERVIEW OF COMMUNITY WILDFIRE PROTECTION PLANS

BACKGROUND

In response to a landmark fire season in 2000, the National Fire Plan (NFP) was established to develop a collaborative approach among various governmental agencies to actively respond to severe wildland fires and ensure sufficient firefighting capacity for the future fuels (U.S. Department of the Interior [USDI] and U.S. Department of Agriculture [USDA] 2000). The NFP was followed by a report in 2001 entitled *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: A 10-*

year Comprehensive Strategy, which was updated in 2002 to include an implementation plan. This plan was updated once more in 2006, with a similar focus on using a collaborative framework for restoring fire-adapted ecosystems, reducing hazardous fuels, mitigating risks to communities, providing economic benefits, and improving fire prevention and suppression strategies. The 2006 implementation plan also emphasizes information sharing and monitoring of accomplishments and forest conditions, a long-term commitment to maintaining the essential resources for implementation, a landscape-level vision for restoration of fire-adapted ecosystems, the importance of using fire as a management tool, and continued improvements to collaboration efforts (Forests and Rangelands 2006). Progress reports and lessons learned reports for community fire prevention are provided annually.

In 2003, the U.S. Congress recognized widespread declining forest health by passing the Healthy Forests Restoration Act (HFRA), and President Bush signed the act into law (Public Law 108–148, 2003). The HFRA was revised in 2009 to address changes to funding and provide a renewed focus on wildfire mitigation (H.R. 4233 - Healthy Forest Restoration Amendments Act of 2009). The HFRA expedites the development and implementation of hazardous fuels reduction projects on federal land and emphasizes the need for federal agencies to work collaboratively with communities. A key component of the HFRA is the development of CWPPs to facilitate collaboration between federal agencies and communities in order to develop hazardous fuels reduction projects and place priority on treatment areas identified by communities. A CWPP also allows communities to establish their own definition of the WUI, which is used to delineate priority areas for treatment. In addition, priority is placed on municipal watersheds, critical wildlife habitat, and areas impacted by wind throw, insects, and disease. Communities with an established CWPP are given priority for funding of hazardous fuels reduction projects carried out in accordance with the HFRA.

ALIGNMENT WITH THE NATIONAL COHESIVE STRATEGY

In 2014, the final stage of the development of a national cohesive strategy for wildfire was developed: *The National Strategy: The Final Phase in the Development of the National Cohesive Wildland Fire Management Strategy* (Forests and Rangelands 2014). The national strategy takes a holistic approach to the future of wildfire management:

To safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire.

In order to achieve this vision, the national strategy goals are:

> **Restore and maintain landscapes**: Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.
>
> **Fire-adapted communities**: Human populations and infrastructure can withstand a wildfire without loss of life and property.
>
> **Wildfire response**: All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions. (Forests and Rangelands 2014:3)

Like the 2014 national strategy, the NFP, state fire plans, 10-year comprehensive strategy, and Federal Emergency Management Agency (FEMA) Disaster Mitigation Act of 2000, all mandate community-based planning efforts with full stakeholder participation, coordination, project identification, prioritization, funding review, and multiagency cooperation. This collaboration aligns with the mission and goals of the ALAH Plan (KPB Interagency 2018). In compliance with Title 1 of the HFRA, a CWPP must be mutually agreed upon by the local government, local fire departments, and the state agency responsible for forest

management (Alaska Department of Natural Resources [ADNR], Division of Forestry [DOF]). As outlined in the HFRA, this CWPP is developed in consultation with interested parties and the federal agencies managing land surrounding the at-risk communities.

As part of the 2022 update to the CWPP, the plan has been aligned with the Cohesive Strategy and its Phase III Western Regional Action Plan by adhering to the nationwide goal "*to safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire*" (Forests and Rangelands 2014:3).

For more information on the Cohesive Strategy, please visit: https://www.forestsandrangelands.gov/strategy/documents/strategy/CSPhaseIIINationalStrategyApr2014.pdf

Alignment with these Cohesive Strategy goals is described in more detail in Chapter 4, Mitigation Strategies.

GOAL OF A COMMUNITY WILDFIRE PROTECTION PLAN

The goal of a CWPP is to enable local communities to improve their wildfire-mitigation capacity, while working with government agencies to identify high fire risk areas and prioritize areas for mitigation, fire suppression, and emergency preparedness. Another goal of the CWPP is to enhance public awareness by helping residents better understand the natural- and human-caused risks of wildland fires that threaten lives, safety, and the local economy. The minimum requirements for a CWPP, as stated in the HFRA, are

Collaboration: Local and state government representatives, in consultation with federal agencies or other interested groups, must collaboratively develop a CWPP (Society of American Foresters [SAF] 2004).

Prioritized Fuel Reduction: A CWPP must identify and prioritize areas for hazardous fuels reduction and treatments and recommend the types and methods of treatment that will protect one or more communities at risk (CARs) and their essential infrastructures (SAF 2004).

Treatments of Structural Ignitability: A CWPP must recommend measures that homeowners and communities can take to reduce the ignitability of structures throughout the area addressed by the plan (SAF 2004).

CWPP PLANNING PROCESS

The SAF, in collaboration with the National Association of Counties and the National Association of State Foresters, developed a guide entitled *Preparing a Community Wildfire Protection Plan: A Handbook for Wildland-Urban Interface Communities* (SAF 2004) to provide communities with a clear process in developing a CWPP. The guide outlines eight steps for developing a CWPP, which have been followed in preparing the Kenai Peninsula Borough CWPP:

Step One: Convene Decision-makers. Form a Core Team made up of representatives from the appropriate local governments, local fire authorities, and state agencies responsible for forest management.

Step Two: Involve Federal Agencies. Identify and engage local federal representatives and contact and involve other land management agencies as appropriate.

Step Three: Engage Interested Parties. Contact and encourage active involvement in plan development from a broad range of interested organizations and stakeholders.

Step Four: Establish a Community Base Map. Work with partners to establish a base map(s) defining the community's WUI and showing inhabited areas at risk, wildland areas that contain critical human infrastructure, and wildland areas at risk for large-scale fire disturbance.

Step Five: Develop a Community Risk Assessment. Work with partners to develop a community risk assessment that considers fuel hazards; risk of wildfire occurrence; homes, businesses, and essential infrastructure at risk; other community values that may be at risk from wildfire and local preparedness capability. Rate the level of risk for each factor and incorporate this information into the base map as appropriate.

Step Six: Establish Community Priorities and Recommendations. Use the base map and community risk assessment to facilitate a collaborative community discussion that leads to the identification of local priorities for treating fuels and reducing structural ignitability, as well as other issues of interest, such as improving fire response capability. Clearly indicate whether priority projects are directly related to the protection of communities and essential infrastructure or to reducing wildfire risks to other community values.

Step Seven: Develop an Action Plan and Assessment Strategy. Consider developing a detailed implementation strategy to accompany the CWPP as well as a monitoring plan that will ensure its long-term success.

Step Eight: Finalize Community Wildfire Protection Plan. Finalize the CWPP and communicate the results to the community and key partners.

Background and Process for Developing the Kenai CWPP Update

The CWPP update is built on a body of work completed by the ALAH interagency group beginning in 2004 and continuing through today. The ALAH interagency group, formerly called the Kenai Forest, Wildfire Protection and Fuels Management Coordinating Committee, led the charge to proactively develop plans to address wildfire risk in the Kenai Peninsula Borough (KPB). Spruce forests throughout the peninsula experienced a spruce bark beetle (SBB) outbreak beginning in the 1990s, which led to substantial increased risk of catastrophic wildfire.

In 2003, the enactment of the HFRA provided an incentive to communities to engage in comprehensive forest planning across the United States. This community-based forest planning and prioritization led to the formation of the Kenai Forest, Wildfire Protection, and Fuels Management Coordinating Committee, comprised of federal, state, local and tribal governments. The committee's goal was to increase collaboration and coordination for strategic and project-level planning to address the impacts of SBB, that had been ravaging the KPB for years. In November 2003, the committee met to develop an ALAH 5-Year Action Plan, which is frequently updated to serve as a guiding document for forest and wildfire management within the KPB.

In 2004, the first ALAH 5-Year Action Plan was developed. The purpose of the plan was to introduce a collaborative interagency approach to mitigating wildfire risk through a "from the back porch out" philosophy that emphasizes the need to implement fuel reduction, defensible space, and other mitigation efforts from the back porch outward (KPB Interagency 2018). Since 2004, the ALAH Action Plan has been updated in 2012 and 2018, with both updates reflecting lessons learned, new land management approaches, and project implementation guidance. The framework for all ALAH plans was shaped by the NFP and associated HFRA. The 2018 ALAH Action Plan update considers past KPB CWPPs, the FEMA-approved KPB Hazard Mitigation Plan (2019 update), the 2018 Comprehensive Plan, and the 2009 FLAME2 Act,

and was developed in alignment with the 2014 National Cohesive Wildland Fire Management Strategy and associated goals (KPB Interagency 2018).

Guidance from the 2003 HFRA combined with KPB's high-risk status resulted in the 2004 ALAH Action Plan designating a need for communities within the KPB to develop CWPPs (KPB Interagency 2018). This need triggered the development of the original 17 CWPPs.

Based on guidance provided by the ALAH group in the 2018 ALAH Update, the KPB and the DOF led the initiative to update the original 17 CWPPs located throughout the KPB. The KPB successfully applied for and received funding from the U.S. Forest Service (USFS) to support this planning effort. Rather than updating 17 unique plans, the KPB engaged in a substantially different approach and will develop one landscape-level plan for the entire KPB.

Both high-level and small-scale assessment of hazard and risk, as well as recommendations, are provided within this plan. In 2019, the Chugach National Forest contracted the development of a Chugach All Lands Quantitative Wildfire Risk Assessment (QWRA, known as ARRA) that includes the Chugach National Forest and surrounding federal and non-federal land totaling approximately 30 million acres in south-central Alaska (Pyrologix 2021). This comprehensive assessment encompassed the entire peninsula, and therefore, the KPB chose to integrate the assessment into the development of the CWPP. The ARRA provides a landscape-level model of potential losses associated with fire, based on fire behavior throughout the KPB and the location and density of values at risk. To complement this broad risk assessment, an on-the-ground community assessment was completed to identify hazards and risks locally and to provide a summary for each WUI community in the KPB. Additionally, any recommendations made in the original CWPPs that prove still relevant have been incorporated in the 2022 CWPP.

Why a CWPP is Needed

The United States is facing urgent forest and watershed health concerns. Reducing human vulnerability to the impacts of uncharacteristically severe wildfires depends not only on our ability to understand the science, but also upon our ability to integrate that knowledge to residents, fire and emergency managers, and local, state, and federal agencies. While fires are a natural phenomenon across much of the western United States, the presence of humans living, working, and recreating within the WUI means that every year people face the impacts of wildfire within their communities, and as fires are becoming more severe, those impacts are harder to recover from. While the number of annual wildfires has been slightly decreasing (67,700 fires in 2016 vs. 59,000 fires in 2020), the number of acres burned has been on the rise (Congressional Research Service [CRS] 2021). An average of 7 million acres burn every year due to wildfire, more than doubling the annual average of acres burned in the 1990s (CRS 2021). Communities are experiencing the most destructive wildfire seasons in history. The 2015 fire season had the most acreage impacted in a single year since 1960 at 10.13 million acres. 2020 came in second with 10.12 million acres, and 2017 was not far behind at 10.03 million acres (CRS 2021). Furthermore, with increased fires comes increased suppression costs; 2018 beat all previous records, with federal firefighting costs hitting $3,143,256,000 (National Interagency Fire Center 2021).

Alaska is no stranger to wildfire, but the state is facing an intensified pattern of wildfire due to rapidly escalating temperatures and extended growing seasons triggered by climate change. Regardless of season-to-season variability, evidence suggests that wildfire is burning more acres and expanding into new regions of the state (International Arctic Research Center [IARC] 2021). This has statewide consequences, including increased wildfire risk for people, property, and natural resources. Residents of Alaska are especially vulnerable, with an estimated 80% of the population living in areas at risk of wildfire

(IARC 2021). The KPB alone has over 10.25 million acres of forested lands with 65% of communities located in areas of extreme wildfire risk (KPB 2019a). Population growth and continued expansion in conjunction with dispersed settlement patterns on the Borough create a large WUI (USFS 2017). The total value of structures (e.g., homes, businesses) on private land is expected to increase by 66% during the next five decades—increasing the wildfire vulnerability of the Borough (USFS 2017). Moreover, population dynamics and distribution combined with insect and disease impacts on vegetation are further escalating wildfire risk. Therefore, planning and management regarding climate change, the WUI, and vegetation is a significant need within the Borough (KPB Interagency 2018).

The average annual number of large wildfires has nearly doubled in recent years, from approximately 23 (1950s–1980s) to 40 (1990s–2010s) (IARC 2021). In addition to this increase in the quantity of wildfires, the annual average number of acres burned doubled from 1 million during 1990–2000 to 2 million during 2001–2010. Furthermore, 2001–2010 set a new record for acres burned at 20 million acres (IARC 2021). With increased fire events comes increased suppression costs. 2019 was Alaska's costliest fire season, with costs exceeding $300 million. The 2019 Swan Lake Fire alone cost $46 million (IARC 2021). However, this figure does not include the cost to Alaskans who had their land scorched and homes burned. In addition to economic impacts, wildfires cause loss of life and injury, health problems related to smoke, and ecosystem changes (IARC 2021).

As wildfire severity increases, communities need a plan to help prepare for, reduce the risk of, and adapt to wildland fire events. CWPPs help accomplish these goals. A CWPP provides recommendations that are intended to reduce, but not eliminate, the extreme severity or risk of wildland fire, and seek to build natural and social resilience to wildfire impacts.

> *Wildfire is considered to be 'bad' or in most cases catastrophic, whenever homes and other structures are involved; timber values are lost; critical wildlife habitat is degraded; or other values are lost depending on the location, extent, and intensity of the wildfire. Wildfire can also be 'good' and have positive effects, mainly environmental, such as creating an environment for fire-dependent or fire-tolerant plant species to flourish, enhancing wildlife habitat by diversifying vegetation species and age classes, or removing surface fuels and other downed woody debris to limit the intensity of future wildfires* (KPB Interagency 2018:9).

Story Map

The KPB and DOF decided to develop an interactive website called a story map (online web content) to disseminate information to the public and provide an opportunity for the public to provide input into the plan content. In addition to facilitating information sharing, the story map also provides the Borough with a platform that can be readily revised to keep the CWPP document current. The story map is hosted on the KPB website and acts as a 1-stop shop source of information for all Borough residents.

CORE TEAM

The ALAH group, along with some others representing additional communities or entities, served as the Core Team for the CWPP update. The Core Team list is provided in Appendix C.

Building on the existing ALAH group membership, the Core Team continued to evolve and expand. The Core Team consists of the following:

- KPB
- Alaska Division of Forestry

- KPB Office of Emergency Management
- KPB Bear Creek Fire
- KPB Central Emergency Services
- KPB Nikiski Fire
- KPB Kachemak Emergency Services
- KPB Western Emergency
- KPB Land Management
- U.S. Fish and Wildlife Service (USFWS), Kenai National Wildlife Refuge
- USFS
- Alaska Department of Fish and Game (ADFG)
- Cities of Homer, Kachemak, Kenai, Seldovia, Seward, Soldotna
- Chugachmiut
- Seldovia Village Tribe
- Volunteer Fire Departments
- Cooper Landing Emergency Services
- Homer Electric
- SWCA Environmental Consultants
- Incident Response Group
- Residents

The Core Team drives the planning process in its decision making, data sharing, experience, and communication with community members who are not on the Core Team. SWCA and the KPB had a project kickoff meeting in February 2020. SWCA facilitated the first Core Team meeting in person on March 12, 2020, and the second Core Team meeting virtually via Zoom on May 14, 2020. Due to the COVID-19 pandemic in 2020, the KPB decided to tactically pause the project from May 2020 through May 2021. In May 2021, the KPB and SWCA re-started the project. SWCA facilitated the third Core Team meeting in person on July 26, 2021, and the fourth Core Team meeting virtually in October 25. All other Core Team communications were limited to email and conference calls. SWCA and the KPB contacted the 10 entities representing Native Alaskan interests to inquire about their community values at risk, project recommendations, and fire response capabilities (see the Community Assessments sections for more information).

PROJECT AREA

The project area includes the entire KPB as delineated by its geographic and political boundaries. The project boundary encompasses several communities that were included in the original round of CWPPs (Figure 1.1). The most populated municipality is the census-designated area of Kalifornsky.

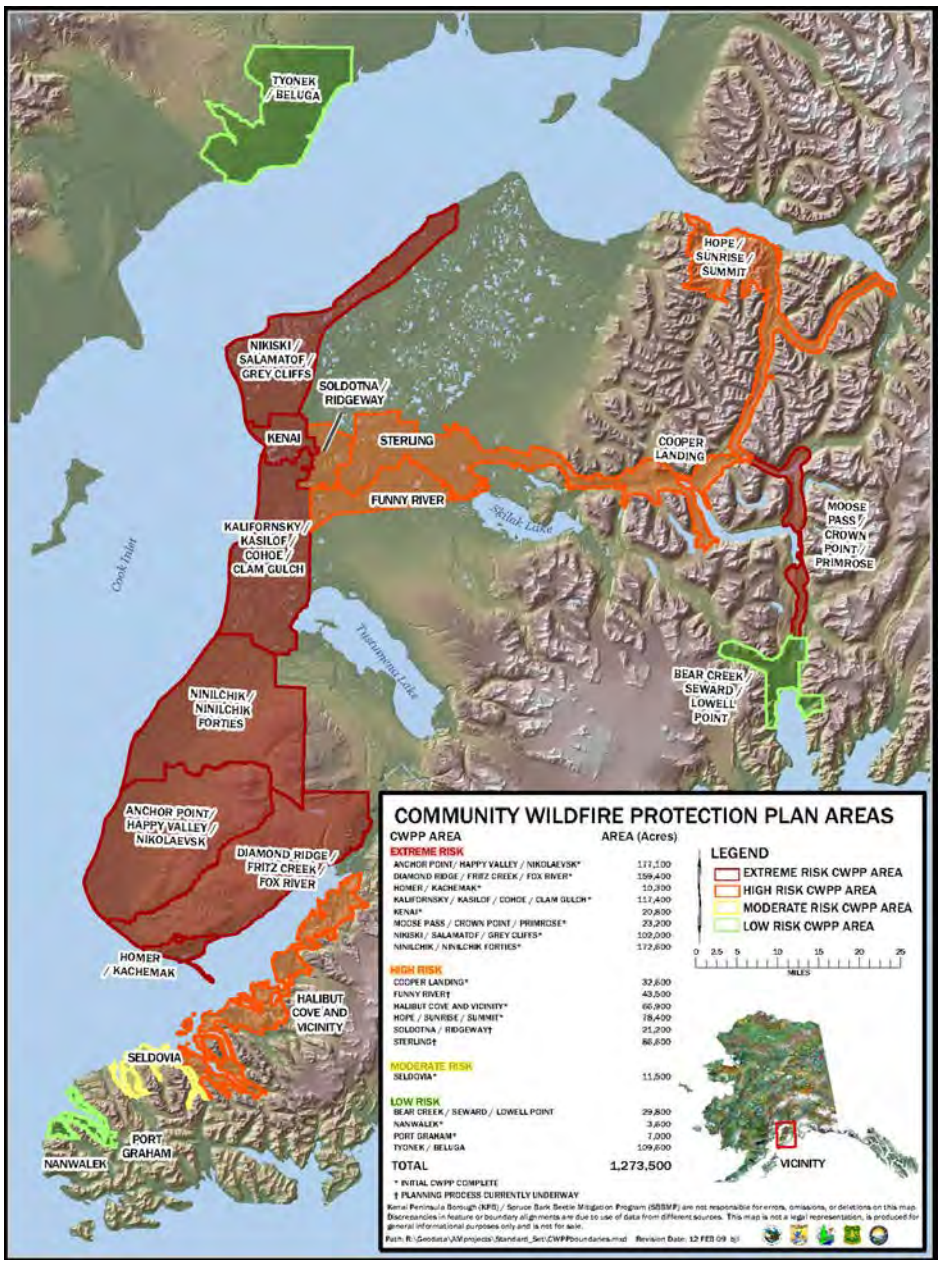


Figure 1.1. Community CWPP project area boundaries.

Source: KPB.

LAND OWNERSHIP

The KPB has varied land ownership, including large areas of USFS, National Park Service (NPS), USFWS, Bureau of Land Management (BLM), tribal, state, and municipal land (Figure 1.2). Alaska natives have a unique structure of ownership and management in Alaska, which is different from the system used in the lower 48 states. There are 12 geographic regions in Alaska identified by the Alaska Native Claims Settlement Act of 1971 (ANCSA) as both ethnic and geographic Native regions. Native entities that were created were first in the form of Tribes, next regional Native corporations, and finally Native village corporations. Each region created a non-profit organization to assume the federal responsibilities for the health and welfare of the Alaska Native peoples by use of a compact agreement with the federal government. The village corporations hold title to land.

Additional information regarding land ownership is provided in Appendix A.

PUBLIC INVOLVEMENT

The Core Team offered multiple public engagement opportunities throughout the planning process. Detailed information regarding public involvement is provided in Appendix H.

Engaging interested parties is critical in the CWPP process; substantive input from the public will ensure that the final document reflects the highest priorities of the local community. A key element in the CWPP process is the meaningful discussions it generates among community members regarding their priorities for local fire protection and forest management (SAF 2004).

The Core Team engaged in outreach using a multimedia approach, using the story map created for the project, social media posts, community surveys, radio interviews, and information distributed through mass emails. The Core Team hosted five public meetings from July 20 through July 24, 2021, throughout the Borough (see Table H.1 in Appendix H for dates and locations). The public meetings were designed using an open house format to encourage interactive communication with stakeholders. In some communities that had not received significant previous wildfire mitigation outreach, a public presentation about the project was held prior to the open house. This two-way communication was intended to increase understanding and build trust, rather than simply provide information. The goal of the public engagement was to inform the public about the KPB CWPP update and to gather feedback about specific topics related to this project, as well as general wildfire concerns. In addition to the open house style of public meetings, the Core Team also hosted an informational booth at a community festival.

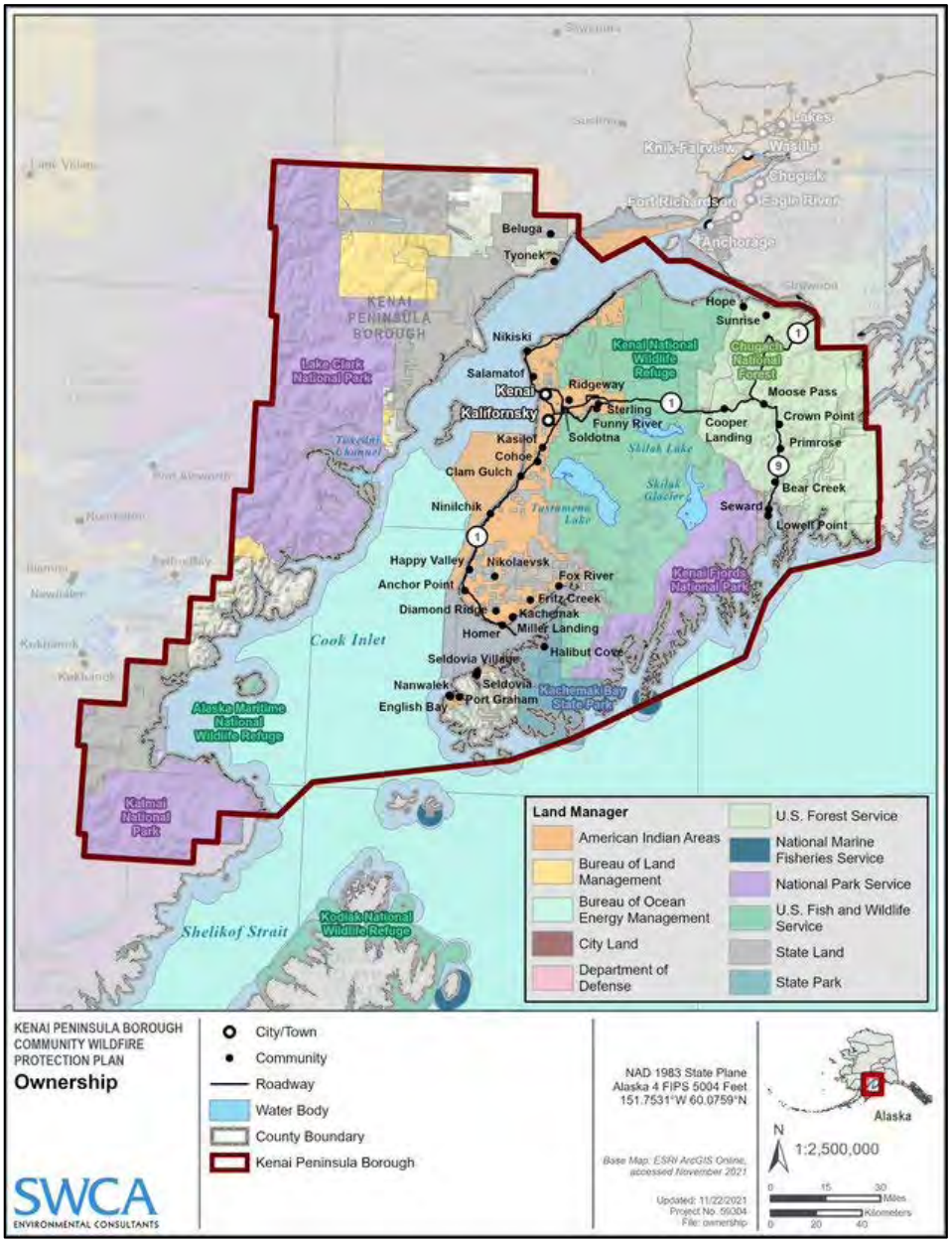
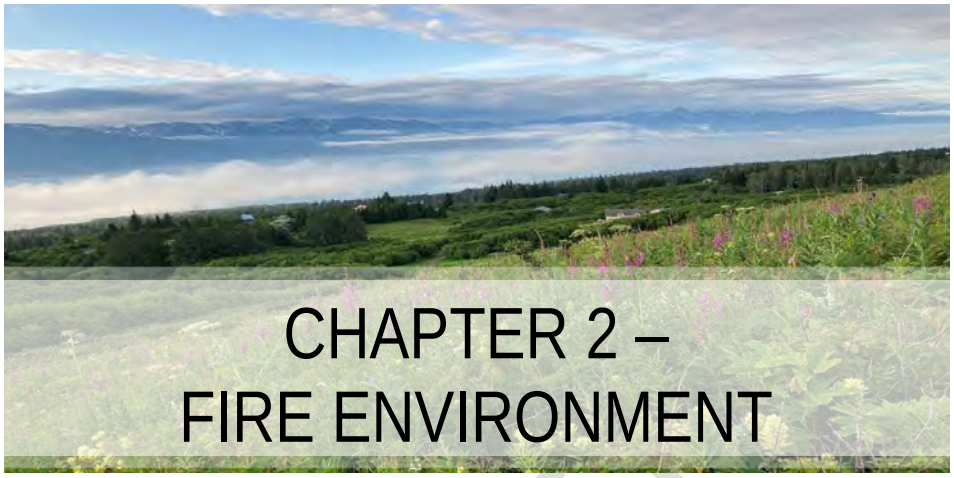


Figure 1.2. KPB land ownership.



CHAPTER 2 – FIRE ENVIRONMENT

WILDLAND URBAN INTERFACE

A WUI is composed of both interface and intermix communities and is generally defined as areas where human habitation and development meet or intermix with wildland fuels (U.S. Department of the Interior and USDA 2001:752–753). Interface areas include housing developments that meet or are in the vicinity of continuous vegetation. Intermix areas are those areas where structures are scattered throughout a wildland area where the cover of continuous vegetation and fuels is often greater than cover by human habitation.

The WUI creates an environment in which fire can move readily between structural and vegetative fuels, increasing the potential for wildland fire ignitions and the corresponding potential loss of life and property. Human encroachment upon wildland ecosystems within recent decades is increasing the extent of the WUI throughout the country as a whole, which is having a significant influence on wildland fire management practices. Combined with the collective effects of fire management policies, resource management practices, land use patterns, climate change, and insect and disease infestations, the expansion of the WUI into areas with high fire risk has created an urgent need to modify fire management practices and policies and to understand and manage fire risk effectively in the WUI (Pyne 2001; Stephens and Ruth 2005). Mitigation techniques for fuels and fire management can be strategically planned and implemented in WUI areas; for example, with the development of defensible space around homes and structures (Figures 2.1 and 2.2).

Figure 2.1. Example of a coastal WUI in the Borough.

Figure 2.2. Example of forested WUI in the Borough.

A CWPP offers the opportunity for collaboration of land managers to establish a definition and a boundary for the local WUI; to better understand the unique resources, fuels, topography, and climatic and structural characteristics of the area; and to prioritize and plan fuels treatments to mitigate fire risks. At least 50% of all funds appropriated for projects under the HFRA must be used within the WUI area.

This CWPP update aligns the WUI definition and delineation with those previously defined in the existing 17 community CWPPs (Figure 2.3). Those community plans align their WUI delineation with the HFRA as comprising "areas within or adjacent to at-risk communities."

Under HFRA Section 101(1), an at-risk community is one that:

- Comprises a group of homes and other structures with basic infrastructure and services
- Has conditions conducive to a large-scale wildland fire
- Faces a significant threat to human life or property as a result of a wildland fire

WUI fires challenge suppression agencies in Alaska just as they do in other parts of the country. The most acute increase in population and subsequent increased housing density at the interface, on the road system, is occurring on the Kenai Peninsula, in the Matanuska-Susitna Borough, and near Anchorage and Fairbanks. These areas have the classic WUI problems associated with rapid population growth without adequate zoning or fire planning (KPB 2009a).

FIRE HISTORY

HISTORIC FOREST USE

Since the last Ice Age, Alaska Native peoples and Alaskan forests have played an integral part in each other's lives. As the original forest stewards, Alaska Native peoples place significant cultural and spiritual value, in addition to subsistence value, on the forest land. The most noticeable forest management tool used by Alaska Natives was fire. Fire was used in boreal forests to control insects, preserve wildlife habitat, and maintain crops (DOF 2020a). Historical records note the Native people set fires along the Copper River across Alaska in the late nineteenth century and early twentieth century (Fryer 2014).

The Kenai Peninsula has been the home of the Kenaitze Indians for centuries and was developed by non-Natives for its plentiful resources, including oil, timber, fish, coal, gold, and wildlife (USFWS 2014). Early settlement brought increased population and infrastructure development; increased human activity and development resulted in fire regime changes, with many fires occurring along roadways and towns. Through the nineteenth and twentieth centuries, the population of the Kenai Peninsula continued to grow, increasing population increased dramatically following World War II. The population boom post-WWII gave rise to intensive development and other land use changes such as oil and gas development, increased recreational use, vegetation control, and infrastructure expansion (USFWS 2014).

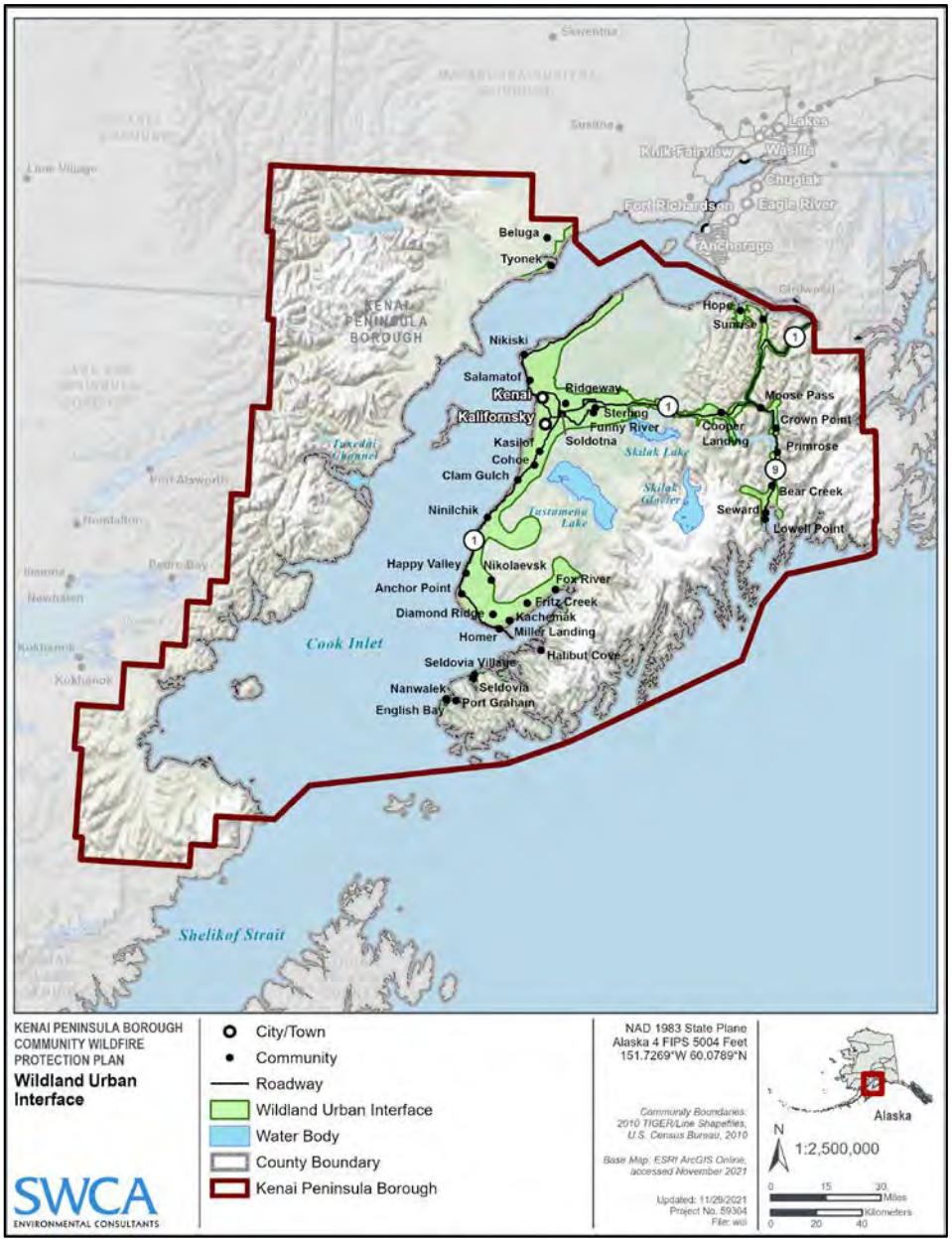


Figure 2.3. WUI delineation for the KPB.

HISTORIC FREQUENCY

Fire frequency is influenced by an interplay between numerous factors, including season, temperature, precipitation, lightning occurrence, forest health, topography, elevation, wind, aspect, and forest species composition and distribution. Therefore, how repeatedly a particular forest burns is determined by location-specific conditions (Fryer 2014).

Forest fires have been prevalent throughout the history of development of Alaska's boreal forests. Studies of the paradigms of big, historic fires in Alaska's taiga indicated that wildfire frequency was episodic, with most fires taking place during brief periods of high fire years (KPB 2006a). In Alaskan taiga, mean fire-return intervals since the eighteenth century vary from 40 to 200 years. Fire frequency data from 1708 through 2004 indicate that historic fire frequency on the Kenai Peninsula ranged from 25 to 185 years, with an average of 89 years (Fryer 2014).

Anthropogenic activity is another important factor in determining how often a forest will burn. Studies conducted in Alaska's taiga, including the Kenai Peninsula, indicate that before the European settlement of Alaska, the fire regime was distinguished by small fires (≤50,000 acres) and infrequent larger fires. Post European settlement, the Kenai Peninsula underwent an increase in the occurrence and acreage of fires linked to the increased presence of people (Ecology and Environment 2006).

FIRE SEASON

The majority of wildfires in the Alaskan boreal forests occur in summer; however, variation in fire season is significant. The fire season in the Kenai Peninsula usually extends from the beginning of April to the end of September, with May through late August being the most active fire months. This is because the period from May through late August has the highest average temperatures and lowest average humidity and precipitation (Fryer 2014). Fire season for the state of Alaska is defined as April 1 through August 31 by state law (Alaska Interagency Coordination Center [AICC] 2021a). However, it should be noted that climatic shifts have been implicated in the earlier arrival and extension of the fire season.

A multitude of studies have reached the conclusion that the Earth's climate is getting warmer. This warming trend has been especially profound in recent decades. In the early 2000s, in Alaskan boreal forests, increases in mean annual air temperatures were accompanied by a trend toward larger, more frequent fires (Fryer 2014). In addition to increased fire frequency and severity, climatic warming has also been responsible for retreating glaciers, shrinking icefields, and decreasing lake levels and ponds (KPB 2006a).

Global warming has also increased fire risk on the Kenai Peninsula by creating conditions favorable to problematic insects. SBB thrive in warmer temperatures, and spruce trees weakened by the effects of climate change are more susceptible to infestations and fire. In the 1990s there was an unusually dry and warm trend in Alaska, which was accompanied by an exponential increase in SBB (KPB 2006a). Specifically, Alaska's Kenai Peninsula and Copper River Valley experienced an SBB outbreak that had infested about 2.3 million acres, killing most large-diameter spruce trees (NPS 2021a).

The warmer climate pattern has also triggered the onset of earlier-than-average snow-free events, which brings the premature arrival of the fire season. Under such circumstances, the desiccation of vegetation occurs more readily and for longer periods of time. Additionally, the shifting climate patterns create conditions that amplify the occurrence of lightning strikes. The combination of increased lightning strikes and ample fuels increases the risk of catastrophic wildfire on the Kenai Peninsula (KPB 2006a).

RECENT FIRE OCCURRENCE

Recent wildfire history for the Kenai Peninsula suggests that the risk of destructive wildfire remains elevated. Recent fires include the 2004 Glacier Creek Fire (8,600 acres), 2005 Fox Creek Fire (25,500 acres), 2005 Tracy Avenue Fire (5,400 acres), 2005 King County Creek Fire (10,000 acres), 2007 Caribou Hills Fire (55,000 acres), 2009 Shanta Creek Fire (13,000 acres), 2014 Funny River Fire (196,000 acres), 2015 Card Street Fire (8,900 acres), and the 2017 East Fork Fire (1,000 acres) (KPB 2006a).

More recently, in 2019, southcentral Alaska had an extraordinarily hot, dry spring and summer season. June (2019) was the second-warmest month in the state's history, which, combined with higher-than-average lightning strikes created ideal conditions for extreme wildfires (National Oceanic and Atmospheric Administration [NOAA] 2021a). Consequently, the 2019 wildfire fire season was the second-most destructive in Alaska (ADNR 2019). One of the largest fires of the 2019 fire season was the Swan Lake Fire (Figure 2.4). The Swan Lake Fire was a lightning-caused wildfire that burned approximately 170,000 acres between Sterling and Cooper Landing on the Kenai Peninsula.

Figure 2.4. Swan Lake burned area, showing extensive landscape-scale of the fire.

Historic data indicate that most wildfires in Alaskan black spruce communities, including those on the Kenai Peninsula, are ignited by summer lightning. Yet, humans are increasingly the culprit of ignitions in black spruce communities. Human-caused fires from 1956 through 2000 averaged at 131 fires per year; in comparison, lightning strikes caused an average of 136 fires per year (Fryer 2014). More recent fire management records also demonstrate an increasing trend of human-caused fires. The records from 1990 through 2005 for the Kenai Peninsula show that a total of 1,079 fires were recorded; of those, 1,052 (97.5%) were determined to be human-caused fires (Ecology and Environment 2006).

The Borough's recent wildland fire history (1990–2020) shows that fire occurrence follows a cyclical pattern, with brief periods of elevated fire events and longer periods with fewer fire events (Figure 2.5). For the period of 1990 through 2020, the top two causes of fire events were lightning and human activity (Figure 2.6). Human-caused fires represent 95% of the fire causes; however, it should be noted that human-caused fires are generally smaller than lightning-caused fires (Fryer 2014). In addition, there has been an increasing trend toward fires larger than 5 acres; the period of 1990 through 2020 is anomalous compared with the historic pattern (Figure 2.7).

Moreover, for a period of 80 years (1940–2020), a total of 946,052 acres have burned in areas throughout the Borough (Figure 2.8 and Figure 2.9). The decadal graph also shows a recent trend toward increasing acreage burned in the 2010 through 2020 period (see Figure 2.8).

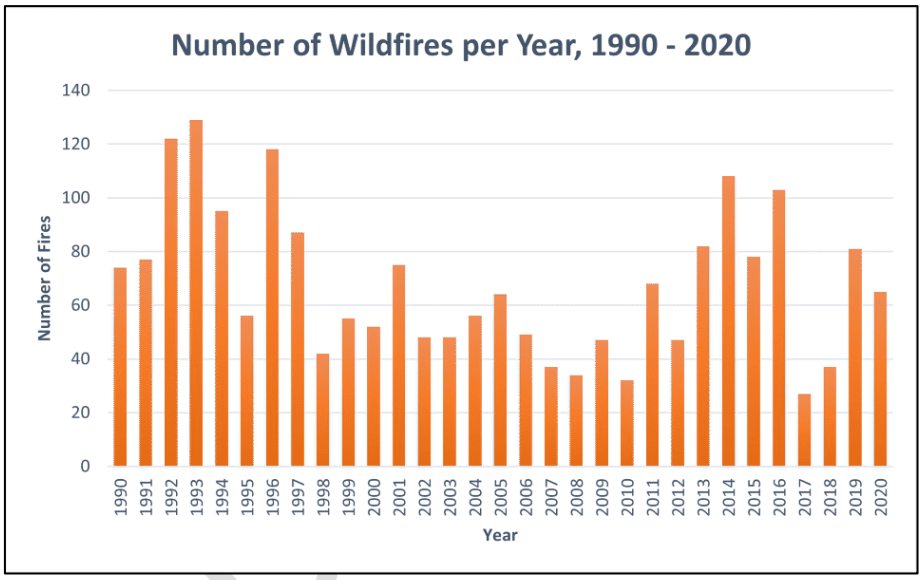


Figure 2.5. Annual wildfire frequency in the Borough from 1990 through 2020.
Source: BLM Alaska Fire Service.

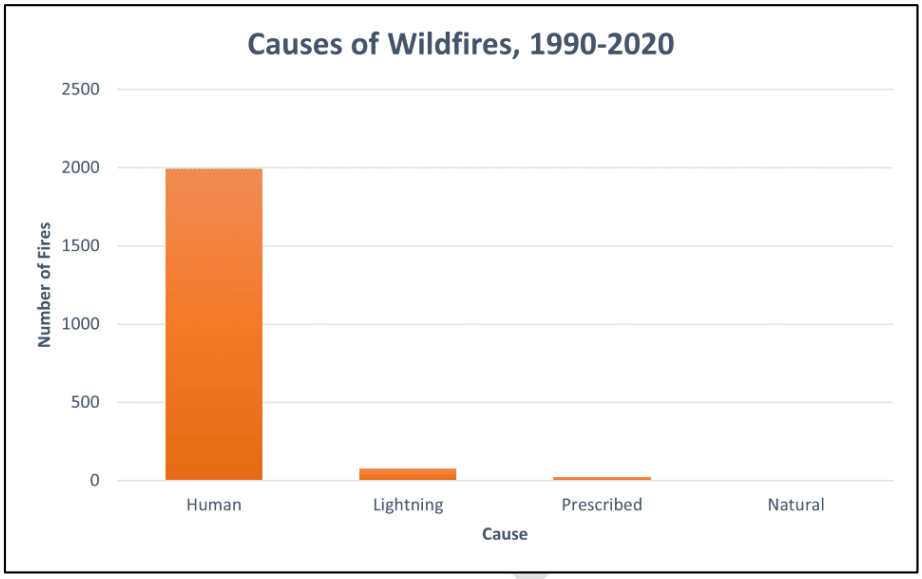


Figure 2.6. Fire causes for the Borough from 1990 through 2020.

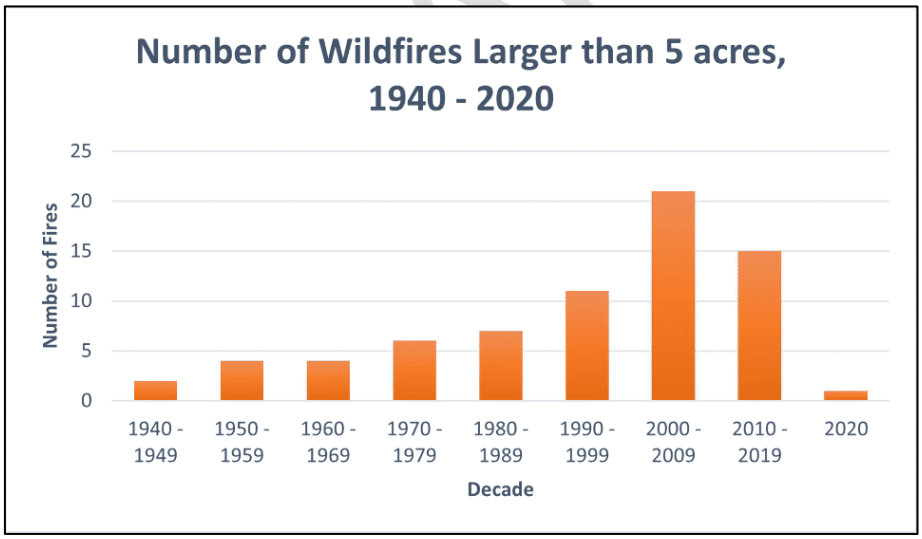


Figure 2.7. Number of wildfires larger than 5 acres in the Borough based on data from 1940 through 2020.

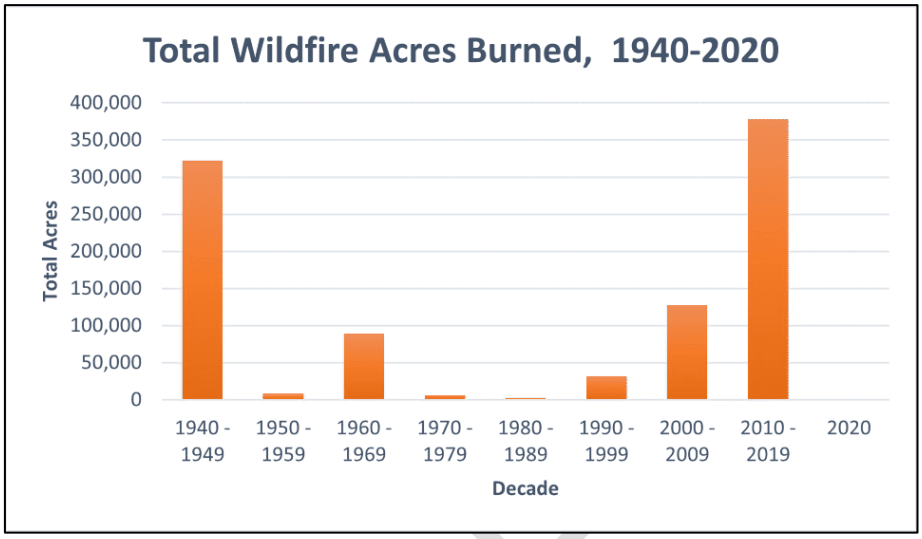


Figure 2.8. Fire size statistics for the Borough based on fire history data from 1940 through 2020.

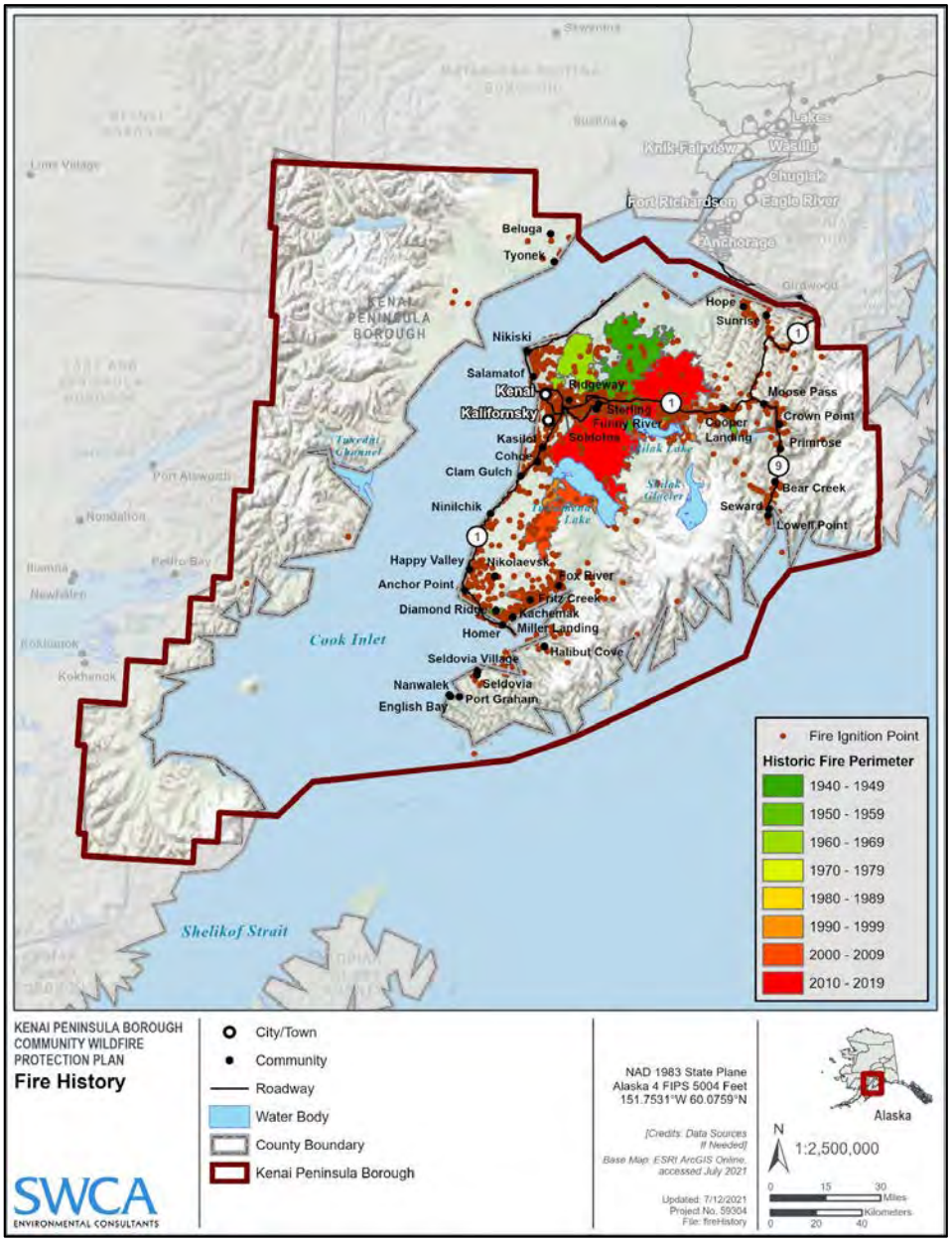


Figure 2.9. Fire history for the KPB from 1940 to 2019.

VEGETATION AND FIRE ECOLOGY

Vegetation zones within the KPB are primarily a function of elevation, slope, aspect, substrate, and associated climatic regimes. Since a broad range in elevation and topography exists across the Borough, characteristics in vegetative communities are quite variable from site to site (Figure 2.10).

The KPB is predominantly composed of spruce (needleleaf) and hardwood (broadleaf) forests (Table 2.1). Black, white, Sitka, and hybrid Lutz spruce present volatile fuels due to high needle resin content and branch configuration. Hardwood species include paper birch, balsam poplar, quaking aspen, and green alder (tall shrub), which are less flammable than spruce species. Forests on the KPB can be composed of individual species as well as mixed-species communities (mixed forest).

Fire plays an important role in in the ecology of spruce forests in Alaska and is the main catalyst of change in the boreal forest system. Fires clear the ground from organic layers and expose fertile ground that promotes seed germination. Both black and white spruce are dependent on fire for optimal regeneration. Although black spruce are easily damaged by fire, black spruce seedlings prosper in post-fire conditions. Fire assists in opening cones, and the open seedbed prepared by the fire provides conditions for optimal growth (KPB 2006a).

The USFS, in collaboration with other land management organizations, including federal, state, borough, tribal, and non-profit partners, prepared an existing vegetation map for the Kenai Peninsula (USFS 2020a). The map covers all the Kenai Peninsula; however, it omits a small part of the Borough—the Tyonek and Beluga communities across the Cook Inlet (see Figure 2.10). Vegetation data for the omitted areas can be accessed through the National Land Cover Database (U.S. Geological Survey 2019). Vegetation in and surrounding Tyonek and Beluga is composed primarily of mixed and deciduous forest, sedge/herbaceous communities, and wetlands. Minor vegetation types in the area include dispersed patches of evergreen forest and shrub/scrub communities.

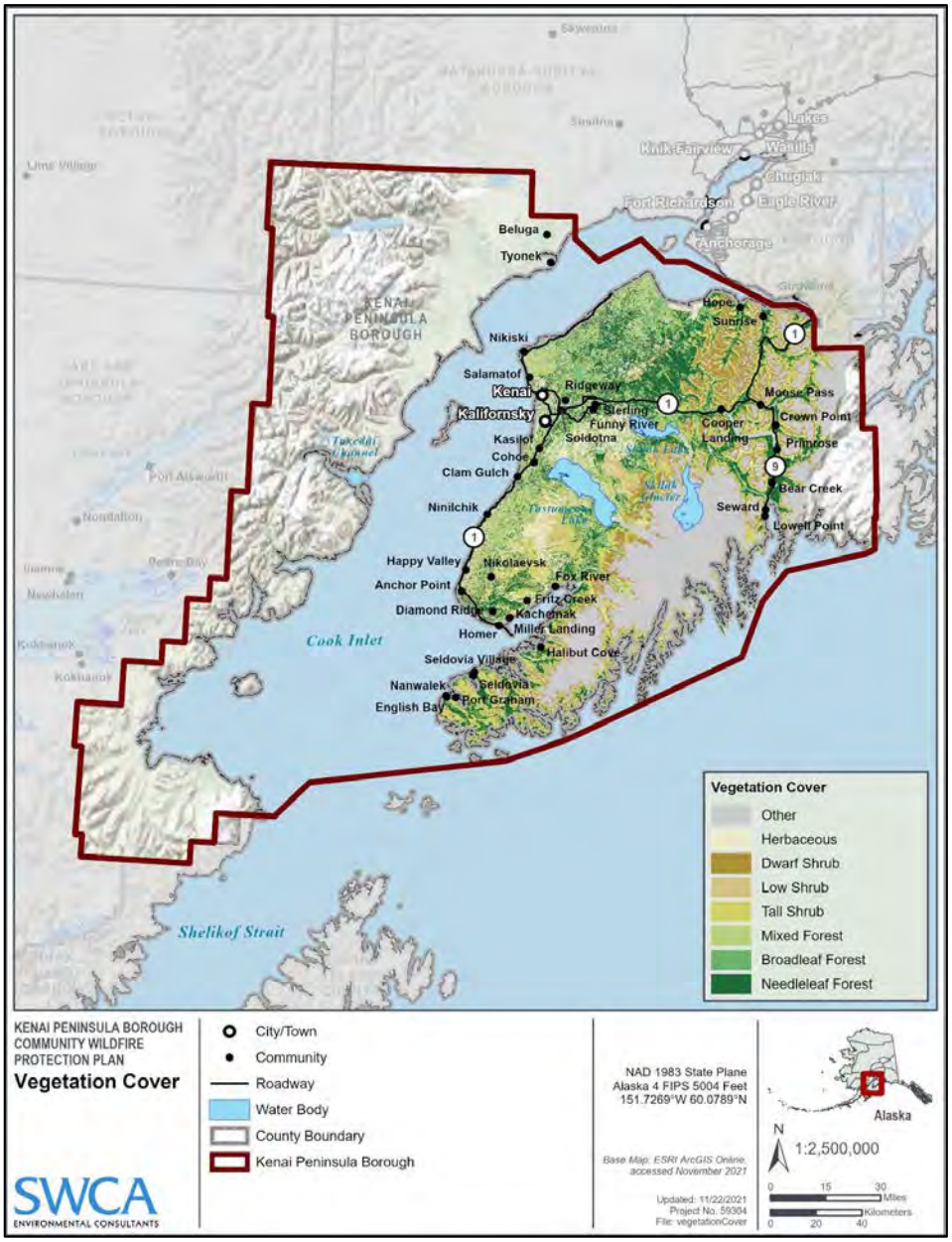


Figure 2.10. Existing vegetation cover within the Kenai Peninsula Borough.

Table 2.1. Major Vegetation Types within the Borough

Existing Vegetation Type*	Acres	Percent
Other	1,956,370	36%
Needleleaf Forest	1,052,638	19%
Tall Shrub	580,651	11%
Mixed Forest	506,055	9%
Dwarf Shrub	483,065	9%
Herbaceous	469,115	8%
Low Shrub	247,041	5%
Broadleaf Forest	153,351	3%

*Based on data from the USFS story map (USFS 2020a)

Spruce Forests

Black spruce is the most common type of forest in the Kenai Peninsula. However, other species of spruce trees are also present, including white spruce, Sitka spruce, and the hybrid Lutz spruce. The multilayered structure—branches covering the trunk from top to bottom, with twigs angled downward—and chemical composition of black spruce make them highly flammable (NPS 2015a). Additionally, recurring infestations of SBB have altered the forest composition; downed trees open the canopy and allow for light, flammable fuels, e.g., Canada bluejoint reedgrass, to colonize the forest floor. Light and flammable fuels, such as grasses, combined with weakened or beetle-killed trees create the perfect conditions for intensified fire risk (KPB 2006a).

Black Spruce Forests

Black spruce is the most common forest type in Alaska. When compared with other Alaskan vegetation types, black spruce forests have short to medium mean fire-return intervals (MFRIs). MFRIs since the 1700s in black spruce range from 40 to 200 years. How often black spruce stands burn is determined by the site's stand composition, solar insulation, altitude, slope, drainage, presence and thickness of permafrost, and fires history. Fire return intervals of less than 30 years can result in black spruce recruitment failure. On the Kenai Peninsula, studies have demonstrated at least 35 years between fires in black spruce forests. Small fires are more common in black spruce stands; however, large fires occasionally do occur. All fires are typically crown fires with associated surface and ground fire. Live black spruce trees are very flammable because the needles contain low moisture levels and are dense. Furthermore, a thick forest floor of detritus and resinous shrubs in the understory typically are associated with black spruce stands. Fine fuels on the black spruce forest floor react quickly to dry conditions and increase extreme fire behavior. Black spruce is partially dependent on stand-replacing fires because cones are opened by canopy fire, exposing the seeds (Fryer 2014).

Human-caused fires are more common recently in the WUI on the Kenai Peninsula. In the early 2000s, there was a shift toward larger, more frequent fires compared with the last half of the twentieth century. These increases have been attributed to increase temperature, resulting in drought stress in black spruce.

White/Lutz Spruce Forests

White spruce is widespread in Alaska, particularly in the interior regions. The distribution of white spruce stands is influenced by elevation, soil drainage, fire history, topography, presence of permafrost, and climate. Upland white spruce communities occur on warm, well-drained, south-facing slopes. White spruce typically displays less intense fire behavior than black spruce. Historically, MFRIs in white spruce communities range from 40 to over 250 years. Fire return intervals of 40 years or less can result in white spruce recruitment failure. Floodplain, stringer, and treeline white spruce may have longer MFRIs. Ground, surface, and crown fires can all occur in white spruce stands, but crown fires are less typical in white spruce than they are in black spruce. On Kenai lowlands, fires burning in black spruce often stop upon reaching white spruce forests. When white spruce does burn, canopy mortality is high. White spruce stands experience less frequent crown fire than black spruce due to an absence of ladder fuels and lower needle resin content. Most fires in white spruce are stand-replacing (Abrahamson 2014).

On the Kenai Peninsula, only two fires over 10,000 hectares have been recorded in white spruce as of 2014, one fire occurring in the late 1800s and the other in 2014. Although lightning was the historical source of ignition in the Alaskan boreal forest, lightning-caused fires are rare on the Kenai Peninsula. Climate change may increase the size and severity of fires as a result of increase fire season, drought, and higher ignition rates.

Sitka Spruce Forests

On the Kenai Peninsula, Sitka spruce dominates valley bottoms and lower side slopes. Along the eastern coast of the Kenai Peninsula, Sitka spruce forests occur at all elevations. However, Sitka spruce stands are more abundant at low elevations and in areas with periodic disturbances such as water movement, wind, soil mass movement, and salt spray. Sitka spruce is often favored post-fire, as it is well adapted to large openings, and when mineral soil is exposed. Generalized studies of fire in costal Sitka spruce forests describe large, stand-replacing fires. However, these fires in Sitka spruce stands are rare on the Kenai Peninsula (Zouhar 2017).

Hardwood Forests

Hardwood species common on the Kenai Peninsula include paper birch, balsam polar, quaking aspen, and green alder. These species are less flammable than the spruce species. Hardwood species do not burn with high intensity but, when they do burn, can be difficult to extinguish due to deep leaf litter and longer intervals between fires. Quaking aspen is a minor but widespread forest type in Alaska. Aspen generally occupy warm slopes lacking permafrost. Quaking aspen generally succeed to spruce forests in the absence of stand-replacing fire. Quaking aspen MFRIs range from 40 to over 200 years in Alaska. Fires are low severity and typically stay on the surface, but stand-replacing fires can occur infrequently. Climate warming may favorite quaking aspen at the expense of spruce forests due to decreasing fire return intervals. Another common hardwood species, Balsam poplar, is confined to floodplains and is succeeded by white spruce in the absence of stand-replacing fire. Balsam poplar forests have infrequent, low-severity surface and infrequent stand-replacing fires (Fryer 2014).

Grasslands and Shrublands

Grasslands on the Kenai Peninsula, particularly where there have been disturbances, consist primarily of bluejoint reedgrass and *Festuca altaica*. These species occur particularly where stands of white spruce were attacked by SBB. Additionally, repeated, severe fires may result in replacement by shrub or herb communities such as bluejoint reedgrass sedge meadows. This species shift raises concerns regarding

increased fuel loads and altered fuel characteristics that increase the risk of severe fire. Bluejoint reedgrass is the primary carrier of wildland fire in south-central Alaska due to dangerous fire behavior. High winds can quickly spread a small grass fire over a large area, often spreading hundreds of acres before first responders can arrive. Alaska sub-boreal mesic subalpine alder shrublands can be intermixed with bluejoint reedgrass and other fireweed communities (Zouhar 2017).

FUTURE CHALLENGES FOR FIRE REGIMES

Impact of Spruce Bark Beetle

The SBB (*Dendroctonus rufipennis*) is a category of bark beetle. Bark beetles bore through a tree's bark to feed on its carbohydrate-rich phloem tissue and to nest in the galleries created by boring. Significant disruption in the trees vascular tissue (phloem), such as a large number of beetles feeding, starves the tree and can result in tree mortality. SBB also carry a blue-stain fungus that blocks the water-transporting tissue (xylem), accelerating tree mortality (NPS 2021a).

As a natural component of Alaska's forest habitats, the native SBB has a history of initiating large spruce die-off occurrences in many areas of the state. They primarily infest white, Sitka, and Lutz spruce, and rarely black spruce. In the 1990s, the Kenai Peninsula and Copper River Valley experienced a SBB outbreak that affected close to 2.3 million acres by 1996, killing nearly all large-diameter spruce trees. In 2016, another outbreak was recorded. A 2016 aerial detection study mapped 190,000 acres of SBB damage (NPS 2021a). Since the 2016 outbreak began, more than 1 million acres in south-central Alaska have been impacted, with 145,000 acres of SBB damage recorded in 2020 alone (USFS 2021d). Beetle-killed trees are a complex fuel type and pose an escalated risk for wildfire (Figure 2.11.). The needles remain on the branches an entire season after the tree dies and make the tree relatively more flammable during this period. As the tree dries, branches and crowns are perfect fuel ladders for surface fires. Deceased trees combined with forest surface debris (needles, grasses, and organic layers) result in a particularly dangerous fuel complex (KPB 2009a).

In its Alaska Forest Health Conditions report, the USFS's aerial surveys detected about 115,000 acres of SBB activity, of which 108,00 acres were recent mortality (USFS 2021d); 96% of the damage mapped is within south-central Alaska. On the Kenai Peninsula, 18,330 acres of SBB activity was detected. Specifically, SBB activity increased substantially in the Cooper Landing area in 2020, with patches of damage observed along the Sterling Highway and the Kenai River from around Quartz Creek campground to Skilak Lake Road. SBB-caused mortality was also dispersed along the Russian River several miles upstream from its confluence with the Kenai River. Moreover, SBB activity continued to expand in the Kenai and Soldotna areas, with activity continuing in the Kenai National Wildlife Refuge and in the vicinity of the Kenai Spur Highway from Soldotna to Kenai. Equally extensive damage was noted in the Soldotna vicinity, particularly along the south side of the Kenai River and continuing to Kasilof. Additional areas with SBB activity include Tustumena Lake in Caribou Hills, Port Dick Creek, the Rocky River, Seldovia Lake, and on Perl and Elizabeth Islands (USFS 2021d).

SBB outbreaks tend to affect forest composition and soil properties. Forest canopy reductions via diseased or killed trees causes the canopy to open, which can allow for an entirely different community of plants to emerge. For example, Canada bluejoint reedgrass is a plant that thrives with the increased light penetration allowed by reduced or absent canopies. The grass grows thick and tall in areas of the Kenai Peninsula where there are many dead trees. The cover of dense grass decreases soil temperatures, altering the growing environment for understory plants. Some plants, such as shrubs, prosper in these new environments (ADFG 2021a). Shrubs and grasses are light and flashy fuels that colonize affected

areas. For instance, one survey found that grass coverage in the understory had increased from about 5% to above 55%, five years following SBB infestation. Mixed grass, shrubs, and beetle-killed trees provide abundant fuels for wildfires (KPB 2006a).

Temperature is one of the major controls on SBB population numbers. For example, during abnormally warm springs, SBB may become active sooner in the season. Contrarily, an extreme winter may kill SBB wintering above the snowline (NPS 2021a). As a result, SBB outbreaks are associated with warmer temperatures. Berg et al. (2006) determined that SBB outbreaks on the Kenai Peninsula are attributed to relatively long periods of elevated summer temperatures that enhance both rapid growth of SBB and extensive drought stress of host trees. With the warming trend persisting, SBB outbreaks will likely continue to increase in their frequency and severity and expand their geographical and host ranges (Berg et al. 2006).

Figure 2.11. Spruce Bark Beetle killed trees visible along this roadside

Impact of Climate Change

In Alaska, global warming trends have been especially dramatic; the rate at which Alaska's temperature has been increasing is two times as fast as the global average since the middle of the 20th century (U.S. Global Change Research Program [USGCRP] 2018). Average temperatures throughout the state for 2014, 2015, and 2016 were exceptionally warmer relative to the last few decades, with 2016 being the warmest on record. In 2019, the record was set again when an average temperature of 58.1 degrees Fahrenheit (°F) was recorded for the month of July (NOAA 2019). The trend toward hotter temperatures is projected to increase; climate models indicate that by mid-century (2046–2065) the highest daily maximum temperature is expected to increase 4°F to 8°F relative to the average for 1981 through 2000 (USGCRP 2018). However, climate shifts are not evenly distributed throughout the state. Interior regions, along with the Arctic, are expected to warm faster than the southern and coastal regions of Alaska. Additionally, maximum 1-day precipitation is also projected to increase by 5% to 10% in southeastern Alaska and by more than 15% in the rest of Alaska, yet the longest dry and wet spells are not expected to

change over much of the state. Therefore, long periods of dry weather are expected to persist (USGCRP 2018).

The shifting climate patterns have broad implications on wildfire occurrence and susceptibility. Hotter temperatures drive the early disappearance of snow, reduced fuel moisture content, higher surface heating, longer fire seasons, shrinking permafrost layers, and shifts in forest composition. The longest fire season on record was recorded in 2016, beginning with a wildfire in April and ending with a WUI fire in (UAF 2018). In addition, the changing weather also creates conditions conducive to the occurrence of lightning strikes (KPB 2006a). In June 2015, a cascade of lightning in Alaska ignited 295 fires over a period of 7 days, which eventually consumed 5.1 million acres and 80 homes. State and federal fire expenditures in Alaska in 2015 alone were $188 million (UAF 2018).

Climate warming is impacting fire potential on the Kenai Peninsula and in Alaska overall. The annual area burned by wildfires varies significantly on an annual basis, but the frequency of big fire years (>2 million acres) has been increasing—since the year 2000, three out of the top four fire years (in terms of acres burned) have occurred (USGCRP 2018). Models suggest that this trend will persist and amplify; predictions gauging the area burned for 2006 through 2100 are estimated at 120 million acres under a high scenario and 98 million acres under a low scenario (USGCRP 2018).

While black spruce trees are fire adapted, dramatic changes in fire regimes undermine resilience and often result in recruitment failure (Baltzer et al. 2020). Consequently, forest composition in many regions of Alaska have changed; there has been a general shift toward shrubs and less acreage of older spruce forest. Additionally, shrubs and other light fuels have been expanding their range with the warming temperatures—increasing the spatial extent of areas susceptible to severe wildfires (USGCRP 2018).

A recent study, *Climate Change Vulnerability Assessment for the Chugach National Forest and the Kenai Peninsula*, by the USFS evaluates the impacts of future climate change on a set of ecosystems in the Kenai Peninsula and Chugach National Forest regions (USFS 2017). The study highlights the potential effects of climate change on the fire environment, among other things. With respect to assessing future vulnerability to wildfire they found that 1) most of the area in the southwestern Kenai Peninsula is projected to change from forest to grassland, which is currently composed of beetle-killed spruce and blue joint grass, and 2) the distribution of land cover types dominated by black spruce is projected to remain similar to the current distribution. Therefore, vegetation types currently classified as high hazard will likely remain high over the next 50 years. Furthermore, the total value of structures (e.g., homes, businesses) on private land is expected to increase by 66% over the next 50 years. Population growth and expansion in conjunction with dispersed settlement patterns on the peninsula create a large WUI. As such, the wildfire vulnerability of the Kenai Peninsula is expected to increase (USFS 2017).

FIRE RESPONSE

Alaska fire management planning, preparedness, suppression operations, prescribed fire, and related activities are coordinated on an interagency basis with the full involvement of state, federal, and local government cooperators. The Alaska Interagency Wildland Fire Management Plan, 2021 (AIWFMP) details operational guidance under the Alaska Master Cooperative Wildland Fire Management and Stafford Act Response Agreement (Alaska Master Agreement) and the Alaska Statewide Operating Plan (AICC 2021a). Its purpose is to "*promote a cooperative, consistent, cost-effective, interagency approach to wildland fire management; and it is the interagency reference for wildland fire operational information*" (AICC 2021a:1).

The AIWFMP does not supersede any individual agency fire policies and requirements and, therefore, must be applied in conjunction with individual land and resource management plans and fire management plans when they exist (AICC 2021a).

The collaborative nature of the interagency wildland fire organization allows fire response agencies to coordinate response for enhanced public safety as well as coordinate other fire management activities for the purpose of enhancing ecosystem health. It also enables fire response agencies to serve communities that do not have their own fire departments or have very limited fire response capabilities, such as Nanwalek, Port Graham, Seldovia, Tyonek, Beluga, Razdolna, Voznesenka, Kachemak-Selo, and others.

By Alaska statute, the DOF has fire protection responsibility for state, private, and municipal land; and the BLM, USFWS, and the USFS have legal responsibility for fires on federal land.

The DOF also has cooperative agreements with numerous local governments, as well as tribal and volunteer fire departments, throughout the Borough. Fire protection, as well as emergency medical services, is also provided by the KPB in geographic service areas, by city fire departments, and by volunteer fire departments in areas outside of KPB service areas. Local fire service areas have established mutual-aid agreements, whereby a neighboring service area may dispatch resources to assist during an emergency (KPB 2006a).

Under the ANCSA, the federal government is directed to provide wildland fire suppression on land conveyed to Native regional and village corporations. ANCSA [43 United States Code 1620(e)] provides for forest fire protection services from the United States at no cost to Native individuals or to Native groups, villages, and regional corporations organized under ANCSA, as long as there are no substantial revenues from such land (USFWS 2013).

The KPB Office of Emergency Management (OEM) implements evacuation and communication plans for the Borough and, in partnership with DOF, oversees the development and maintenance of CWPPs.

FIRE MANAGEMENT OPTIONS

Wildfire response across the state is guided by the AIWFMP and fire management options. Firefighter and public safety is of the highest priority for all options. The various suppression strategies include critical protection, full protection, modified protection, and limited protection and provide a full range of suppression responses, from aggressive control to surveillance (Figure 2.12). The fire management options are described as follows (AICC 2021a):

Critical Protection

Suppression action provided on a wildland fire that threatens human life, inhabited property, designated physical developments and structural resources such as those designated as National Historic Landmarks. The suppression objective is to provide complete protection to identified sites and control the fire at the smallest acreage reasonably possible. The allocation of suppression resources to fires threatening critical sites is given the highest priority.

Full Protection

Suppression action provided on a wildland fire that threatens uninhabited private property, highly valued natural resource areas, and other highly valued areas such as identified cultural and historical sites. The suppression objective is to control the fire at the smallest acreage reasonably possible.

The allocation of suppression resources to fires receiving the full protection option is second in priority only to fires threatening a critical protection area.

Modified Protection

Suppression action provided on a wildland fire in areas where values to be protected do not justify the expense of full protection. The suppression objective is to reduce overall suppression costs without compromising protection of more highly valued adjacent resources. The allocation of suppression resources to fires receiving the modified protection option is of a lower priority than those in critical and full protection areas. A higher level of protection may be given during the peak burning periods of the fire season than early or late in the fire season.

Limited Protection

Lowest level of suppression action provided on a wildland fire in areas where values to be protected do not justify the expense of a higher level of protection, and where opportunities can be provided for fire to help achieve land and resource protection objectives. The suppression objective is to minimize suppression costs without compromising protection of more highly valued adjacent resources.
The allocation of suppression resources to fires receiving the limited protection option is of the lowest priority. Surveillance is an acceptable suppression response as long as more highly valued adjacent resources are not threatened.

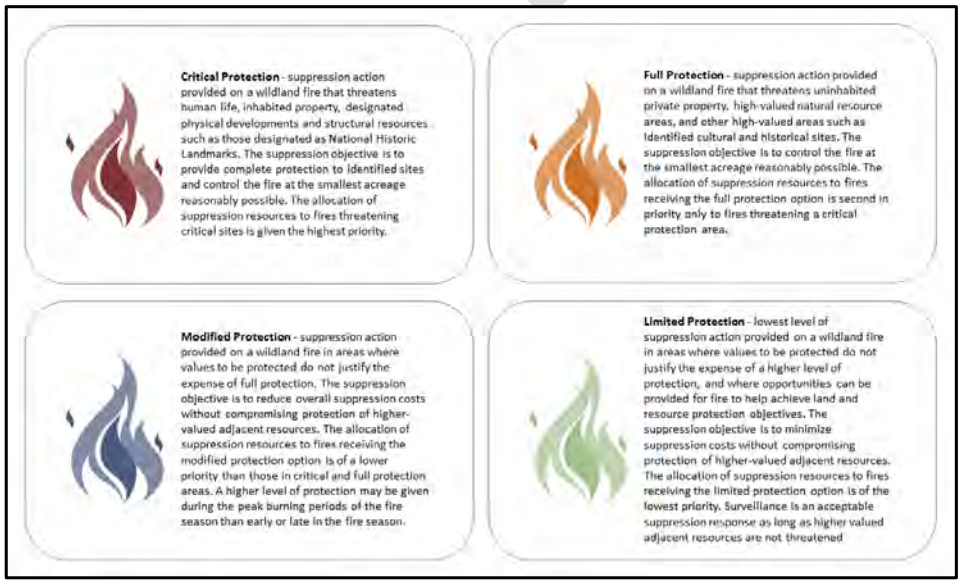


Figure 2.12. Alaska fire management options.

Costs associated with wildfires are contingent on response zones. More resources are used on wildfires in the full and critical zones due to the elevated risk to human health and property. However, there are patches within the limited and modified zones that necessitate a suppression response. For instance, Alaskan Native allotments are usually located in areas that are difficult to access. Still, fire protection is

legally mandated in these areas. Although most wildfires in isolated Alaskan wilderness are permitted to burn under supervision, any wildfire threatening an Alaskan Native land allotment must be suppressed with state or federal firefighting resources (UAF 2018). Fire response resources are depicted in Figure 2.13.

MUTUAL AID AND AGREEMENTS

The wildland fire community is well known for its development of mutual aid agreements at the federal, state, and local levels. Aid agreements allow for closest forces to respond to an incident as quickly as possible regardless of jurisdiction. Such agreements may also describe how reimbursement will be conducted; state resources responding to wildfires on federal land may have their associated costs reimbursed by the responsible federal agency, and the reverse is true for federal resources suppressing a wildfire on state land. There are three main types of aid agreements within the planning area (FEMA 2017):

1. **Local Mutual Aid:** Local mutual aid agreements between neighboring jurisdictions or organizations involve a formal request for assistance and generally cover a larger geographic area than local automatic mutual aid agreements do. Under these agreements, local resources may be used to assist federal departments and agencies in fulfilling their missions under special circumstances, and vice versa. Incorporating private sector, nongovernmental organizations, and community- and faith-based organizations into the mutual aid network provides parties with access to significant additional resources.
2. **Local Automatic Aid:** Local automatic mutual aid agreements permit the automatic dispatch and response of requested resources without incident-specific approvals or consideration of entity boundaries. These agreements are usually basic contracts between or among neighboring local entities (local entities may include nearby governments (including federal government installations), private sector facilities, nongovernmental organizations, and faith-based organizations) and are used under conditions when time is of the essence to save lives, prevent human suffering, or mitigate property damage following an incident.
3. **Regional, Intrastate, or Statewide Mutual Aid:** Sub-state regional mutual aid agreements are between multiple jurisdictions that are often sponsored by a council of governments or a similar regional body. Statewide/intrastate mutual aid agreements are often coordinated through the state and incorporate both state and local governmental and nongovernmental assets in an attempt to increase preparedness statewide. This approach can help reduce the number of local and jurisdiction-to-jurisdiction mutual aid agreements. In some instances, state law requires participation in an intrastate mutual aid system.

The ADNR operates under the Master Cooperative Wildland Fire Management and Stafford Act Agreement (the agreement), which documents the coordination and exchange of personnel, equipment, supplies, services, and funds between land management agencies. The agreement details wildland fire management activities such as prevention, preparedness, communication and education, fuels treatment and hazard mitigation, fire planning, response strategies, tactics and alternatives, suppression and post-fire rehabilitation and restoration. Agencies participating in the agreement include the BLM (Region 11 [Alaska]), NPS (Region 11), Bureau of Indian Affairs (Alaska Region), USFWS (Region 11), USDA (Region 10 [Alaska]), and the ADNR. This agreement does not supersede individual agency policies and requirements.

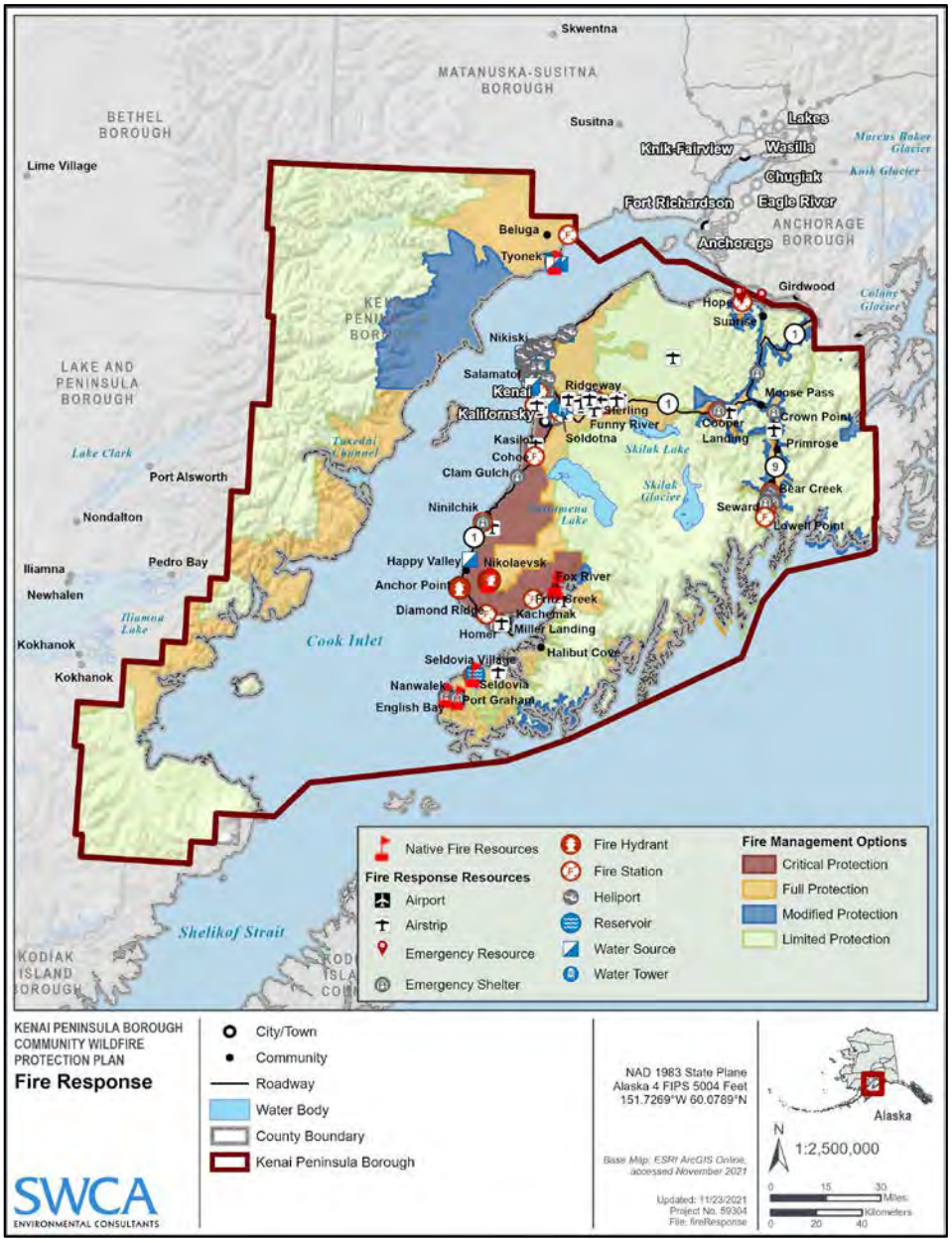


Figure 2.13. Fire management options and response resources.

LOCAL RESPONSE RESOURCES

Local Fire Departments

There are X fire departments in the Borough serving a population of 58,799 people. Departments include KPB departments, volunteer departments, and more regional departments, like the Central Emergency Services, which includes six stations and serves several communities. In addition to responding to calls for fire suppression, local fire departments respond to medical emergencies, incidents involving hazardous materials, rescue calls, and motor vehicle or other accidents. Due to the remote nature of some communities and varied road conditions, fire response on the peninsula can sometimes be more complicated than in other regions (Figure 2.14 and Figure 2.15).

Commented [VA1]: Brenda- we are seeing varying numbers reported. Please can you confirm.

Volunteer and career firefighters at the community level have similar capabilities throughout the entire year, while state and federal responders are affected by fire season. In spite of the continuous level of capabilities, ebbs and flows occur within the volunteer service. Recruiting and retaining volunteers is challenging due to people's lifestyles and the training requirements one must follow to be a volunteer firefighter. Although several volunteer firefighters are present in the Borough, not all are available to respond to every fire.

Figure 2.14. Narrow unsurfaced road that may make fire response difficult.

Figure 2.15. Very remote communities may only be accessible by ATV or UTV, requiring the fire departments to have suitable apparatus and equipment in order to serve these areas.

Local firefighting capabilities, resources, and apparatuses are described in detail in Appendix D.

STATE RESPONSE RESOURCES

Alaska Division of Forestry

The DOF's Fire and Aviation Program aims to provide safe, cost-effective, and efficient fire protection services and management on state, private, and municipal land, and land negotiated through agreement. By Alaska statute, the DOF is responsible for fire response and protection on state, private, and municipal land. In addition, the DOF also provides fire protection services to American Indian land through mutual aid agreements (AICC 2021a). Under the "closest forces" principle, applying cooperative agreements, agencies are permitted to respond to fire events within their protection areas regardless of land ownership. This approach reduces response time and duplicated efforts, thereby increasing safety, effectiveness, and cost efficacy (KPB 2006a). The DOF is not bound by federal fire management policies on land under state jurisdiction (AICC 2021a).

For most of the KPB, dispatch, coordination, and logistical support is provided via the Kenai-Kodiak Area Office in Soldotna (AICC 2021b), which operates under the AICC. The Chugach National Forest Office serves the northeastern portion of the KPB, which also operates under the AICC. The AICC functions as the focal point for initial attack resource coordination and logistics support for all state and federal agencies involved in wildland fire management and suppression in Alaska. The AICC is a collaborative effort between various agencies, including the DOF, BLM, USFS, NPS, Bureau of Indian Affairs, and USFWS (AICC 2021b).

Fire response resources within the Kenai-Kodiak Area Office include 12 seasonal fire technicians and one contract helicopter (from the third week of April through the first week of August).

Success in fire-suppression efforts is influenced by an effective initial response. In turn, the effectiveness of an initial response is determined by the level of training and experience of the labor force as well as the availability of firefighting equipment. The DOF attempts to train extra staff to respond during emergencies. Emergency firefighters are hired as needed to supplement the workforce in all aspects of firefighting duties. The DOF also aims to train sufficient emergency firefighters to keep a 16-person handcrew that is ready to immediately respond to wildland fires. Extra emergency firefighters are hired to serve as heliattack or engine crewmen, aviation assistants, or warehouse employees during a wildland fire event (KPB 2006a).

The DOF usually contracts two air tankers in preparedness for the fire season. Air tanker support bases are typically located at the Palmer Airport and the Kenai Airport. The BLM in Fairbanks also contracts aircraft for dispatch to the KPB contingent on the statewide fire activity level. Additionally, on-call water-scooping air tankers may be operated out of the lakes on the KPB and the Cook Inlet. Other aerial firefighting resources include aircraft rental companies on the KPB, which may have available helicopters for heliattack operations and water drops. Statewide tactical resources may be strategically positioned at the Kenai Airport base during periods of high fire danger (KPB 2006a).

Firefighting resources for the DOF include (DOF 2021a):

- Wildland Fire and Resource Technicians
- Division of Forestry Agency Fire Crews
- Pioneer Peak Interagency Hotshot Crew
- Gannett Glacier Type 2 Initial Attack Crew
- White Mountain Type 2 Initial Attack Crew
- Type 2 EFF Crews
- Support Positions
- Alaska Incident Management Teams
- Interagency Resources

Fire Department Statistics: Department of Forestry		
Communities Served:		
Fulltime Firefighters:	On-call Firefighters:	Dispatch Centers:
Hand Crews: -		
Wildland Engines: -		
Other resources: -		

Commented [BP2]: Diane Campbell / or DOF representative - please complete this table.

TRIBAL RESPONSE RESOURCES

Yukon Fire Crew

Chugachmiut started the Yukon Fire Crew, originally based out of McGrath, Alaska, in 2005. In 2009, the crew moved to Soldotna Alaska and have been fighting fire on the Borough since that time. The Yukon Fire Crew is typically assembled between late May and October each fire season and is the only standing wildland fire crew located on the KPB. When not fighting fires, the crew spends time conducting hazard fuel mitigation projects. Projects the Yukon Fire Crew have worked on include the Funny River Fuel Break, the Sterling Fuel Break, hazard tree mitigation at the Russian River Campground, Firewise treatments on elders' homes, and Firewise treatment on KPB schools.

Jurisdictional agencies have land management responsibility for a specified geographical area as designated by federal, state, or local law. Jurisdictional agencies are required to create and implement agency planning documents detailing wildland fire and fuels management programs at the unit level. In 1971, the ANCSA transferred 45 million acres to Native corporations. However, some lands are pending conveyance; jurisdiction for the pending lands remains with the federal government. Surface and subsurface jurisdiction for a parcel of land may differ. Generally, the surface jurisdiction is responsible for fire planning and management (AICC 2021a).

Fire Department Statistics: Yukon Fire Crew		
Communities Served:		
Fulltime Firefighters:	On-call Firefighters:	Dispatch Centers:
Hand Crews: -		
Wildland Engines: -		
Other resources: -		

Commented [BP3]: Nathan Lojewski please complete this table.

Chugachmiut

Chugachmiut, a non-profit Native consortium, works as an agent for the Native landowners—both Native allotment owners and Trust townsite lot owners—associated with Nanwalek and Port Graham, Alaska. The consortium has been involved in developing fire fuel breaks around Sterling, Soldotna, Kenai, Nikiski, Cooper Landing, and the Moose Pass area on Native corporation, USFS, USFWS, and various state, and private lands, especially if Native lands.

FEDERAL RESPONSE RESOURCES

U.S. Department of Agriculture: U.S. Forest Service

The USFS is responsible for fire response on all National Forest land and grasslands. Overall, the USFS provides wildfire response and management for over 193 million acres of National Forest System land (CRS 2021).

Chugach National Forest

The USFS furnishes wildfire protection services for land and inholdings within the Chugach National Forest boundary. This may involve cooperative agreements with local volunteer fire departments for mutual aid support as well as local incident requests. The Chugach National Forest facilitates the coordination and exchange of personnel, equipment, supplies, and services in sustaining wildland fire management activities such as prevention, preparedness, communication and education, fuels treatment and hazard mitigation, fire planning, response strategies, tactics and alternatives, suppression, and post-fire rehabilitation and restoration.

Fire response within the Chugach National Forest is dispatched by the Chugach National Forest Office. The USFS maintains mutual aid agreements with the BLM and DOF (AICC 2021a).

Fire Department Statistics: Chugach National Forest
Communities Served: **Chenega Bay, Cooper Landing, Cordova, Girdwood, Hope, Moose Pass, Seward, Tatitlek, Valdez, and Whittier.**
Fulltime Firefighters: 17 On-call Firefighters: 40+ Chugach Wildfire Dispatch Centers: 7
Hand Crews: - 1, 10-Person Suppression Module - 1 (on call), 20-Person Type 2 Initial Attack
Wildland Engines: - 2, Type 6 (4x4)
Other resources: - Fire Boat/Skiff: 1 - Port-a-Tanks: 2 - Portable Pumps: 8 - Type 3 Fire Cache: 1

Commented [VA4]: Mark Cahur or USFS rep, please complete this table.

U.S. Department of the Interior: U.S. Fish and Wildlife Service and National Park Service

The BLM Alaska Fire Service is assigned the lead role as the Wildland Fire Protecting Agency for the U.S. Department of the Interior agencies in Alaska (USFWS 2013). The State of Alaska established a wildland fire suppression organization in the DOF and began to gradually assume suppression responsibilities in southwest Alaska, including the KPB, starting in the 1970s. The Master Agreement, with its exhibits, defines the roles and responsibilities of the jurisdictional and protection agencies, as well as operating procedures (USFWS 2013).

Kenai National Wildlife Refuge

The Kenai National Wildlife Refuge Fire Management Plan (USFWS 2013) guides all fire management operations on and for the refuge. The refuge is in the process of transitioning fire planning to a spatial format under the Wildland Fire Decision Support System. The fire management plan addresses a full range of potential wildfires and considers a full spectrum of tactical options (from monitoring to intensive management actions) for wildfires in order to meet Fire Management Unit objectives (USFWS 2013).

The DOF is the designated fire protection agency for the Kenai National Wildlife Refuge per the Master Agreement (AICC 2021a). However, the refuge is responsible for collaboration with fire response and prevention activities. The Refuge Fire Management Officer is required to be available by phone or radio to respond to the DOF and other cooperating emergency management agencies at all times during fire season. In addition, qualified refuge staff commonly take part in prevention patrols during periods of high fire danger and will contribute to initial and extended attack suppression efforts on refuge fires (USFWS 2013).

Fire response in the refuge is dispatched and coordinated by the Kenai-Kodiak Area Office (USFWS 2013).

Fire Department Statistics: Kenai National Wildlife Refuge		
Communities Served:		
Fulltime Firefighters:	On-call Firefighters:	Dispatch Centers:
Hand Crews: -		
Wildland Engines: -		
Other resources: -		

Commented [BP5]: Jeff Bouscher, please complete this table.

Kenai Fjords National Park

The DOF is responsible for fire protection in the Kenai Fjords National Park (KFNP) (AICC 2021a), while the NPS manages the land (NPS 1984). Dispatch, coordination, and logistical support is provided via the Kenai-Kodiak Area Office (AICC 2021b).

There is no existing fire management plan for the KFNP; this is because the NPS is required to have fire management plans only for parks with burnable vegetation (NPS 2021c). The KFNP is generally not vulnerable to severe fires; the glaciers, streams, and fjords serve as natural fire barriers (NPS 1984).

Lake Clark National Park and Preserve

The DOF is responsible for fire response in the Lake Clark National Park and Preserve (AICC 2021a). However, the NPS is responsible for other fire management activities. NPS fire professionals and staff reduce the risk around park structures by clearing flammable vegetation. NPS personnel also monitor the impacts of fires. In addition, the NPS shares responsibilities with the DOF to protect life, property, and natural and cultural resources. They also collaborate with communities, and local, state, federal, and Native organizations to keep people and ecosystems healthy (NPS 2020b).

There is no current fire management plan for the Lake Clark National Park and Preserve.

Fire response in the Lake Clark National Park is dispatched and coordinated by the Southwest District Office, which operates under the AICC (AICC 2021b).

EVACUATION RESOURCES

The KPB OEM implements evacuation and communication plans for the KPB. The latest evacuation guide can be found here: https://radiokenai.net/wp-content/uploads/2019/08/KPB-Wildland-Fire-Emergency-Evacuation-Guide_updated_07072019.pdf

As part of emergency management protocols, the KPB has adopted the Ready, Set, Go! protocols for community evacuation. The Kenai wildfire preparedness webpage is here: https://www.kpb.us/emergency-mgmt/disaster/fire.

To increase public safety and awareness, tsunami evacuation signs are posted on evacuation routes throughout the peninsula (Figure 2.16). The OEM utilizes the Community Alert Network to telephone residents within a specified zone to convey evacuation procedures. The Community Alert Network can also dial emergency responders and assign tasks based on the results of an automated query. The OEM has pinpointed potential emergency shelters. However, emergency evacuation routes have not been designated due to the distinct nature of each wildfire event (Ecology and Environment 2006)

Figure 2.16. Tsunami evacuation signage in Lowell Point.

Livestock and Pets

Some homes on the KPB have horses and other large animals and livestock, and pets are common in homes throughout the planning area. In the event of a wildfire, it is important that residents and fire responders have a plan for evacuation of pets and livestock. Evacuation planning often neglects to describe how animals will be evacuated and where they will be taken. The loading of horses, for example, during a fire and smoke situation, and transport of stock vehicles down narrow roads under stressful situations, can be very difficult.

Commented [BP6]: Brenda, could you please help me confirm animal/pet evacuation procedures?

The 2019 wildfire evacuation guide says to take pets to a designated pet evacuation center. However, I can't find any list of those centers, and all the other pet information from the KPB states that residents need to find a safe place to bring pets as they may not be allowed in evacuation centers.

We also found this pet shelter annex, but I am not sure if it is still relevant? http://www2.borough.kenai.ak.us/AssemblyClerk/Assembly/Resolutions/2013/R2013-021%20Annex%204%20Pet%20Shelter.pdf

Thank you!

The Borough recommends developing an emergency plan for animals, including a safe place to bring animals during an emergency, an emergency to-go kit with supplies such as food, water, medication, first aid kid, familiar items, and photographs in case residents and pets become separated (KPB 2021).

Kenai Pet Preparedness information is here: https://www.kpb.us/emergency-mgmt/disaster/pets

The Kenai Pet Plan checklist can be viewed here: https://www.kpb.us/images/KPB/OEM/Pet_Plan.pdf

There is a need to pre-identify where animals can be taken, such as using fairgrounds as a large animal shelter. Similarly, locations where small animals such as dogs and cats picked up in the fire area should also be pre-identified, as well as the lead agencies, such as humane societies, coordinating this work.

Commented [BP7]: Brenda, we will update this text based on your response to the comment above.

WATER AVAILABILITY AND SUPPLY

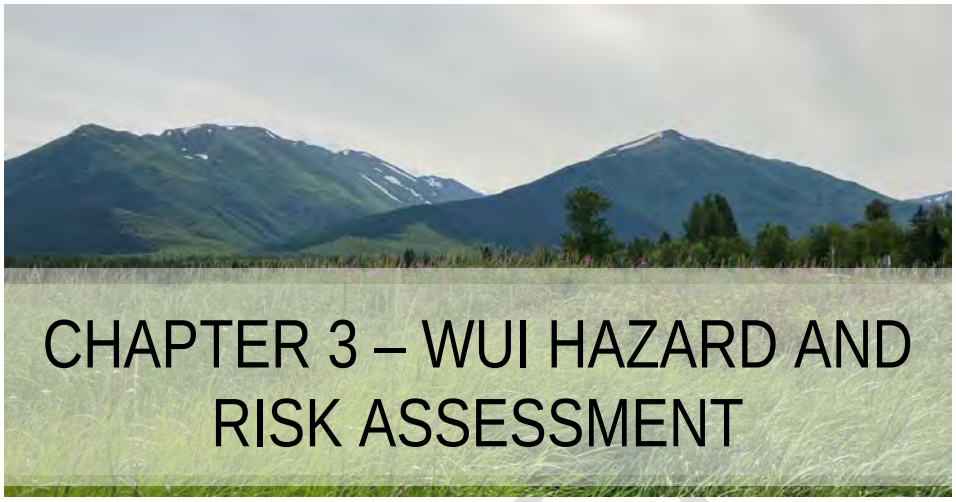
Water supply is variable around the Borough and may be provided by hydrants, wells, lakes, sprinklers, and pumps. Many rural and unincorporated communities lack water for fire suppression. Upgrades are currently being implemented in some communities, including installation of additional water lines and hydrants. Additional water storage is still needed in many areas.

In some cases, ponds and rivers are suitable alternatives for sources of water supply for suppression. However, it is not clear which fire stations have appropriate equipment or abilities to use these sources of supply.

Limited water supply can impact International Standards Organization (ISO) ratings for fire departments, so improvements to water infrastructure have been identified as a priority for this CWPP update.
The hydrant location dataset for the KPB is incomplete, and therefore, mapping is identified as a needed project in this CWPP update.

PUBLIC EDUCATION AND OUTREACH PROGRAMS

Public education and outreach programs are a common factor in virtually every agency and organization involved with the wildfire issue. Detailed information on these programs is provided in Appendix A.



CHAPTER 3 – WUI HAZARD AND RISK ASSESSMENT

PURPOSE

The WUI hazard and risk assessment for the CWPP is based on the Chugach All-Lands Wildfire Risk Assessment (known as ARRA), developed between 2019 and 2021 by Pyrologix, under contract to the USFS.[1] The purpose of the ARRA is to provide foundational information about wildfire hazard and risk to highly valued resources and assets (HVRAs) for the Chugach National Forest and surrounding areas in south-central Alaska (Pyrologix 2021). The ARRA provides a quantitative analysis of the assets and resources across the landscape and how they are potentially impacted by fire. The analysis is described in detail in the final ARRA report, but in summary it considers (Pyrologix 2021):

- Likelihood of fire burning
- Intensity of a fire if one should occur
- Exposure of assets and resources based on their locations
- Susceptibility of those assets and resources to wildfire

The assessment defines assets as "human-made features, such as commercial structures, critical facilities, housing etc., that have specific importance or value", while resources are defined as "natural features such as wildlife habitat, vegetation type, or water, that also have specific value or importance" (Pyrologix 2021).

The ARRA is based on a risk modeling framework that is a function of two main factors: 1) wildfire hazard and 2) HVRA vulnerability (Figure 3.1).

Commented [VA8]: Mark Cahur- do you have a preferred citation for the ARRA? Should it be Pyrologix, or Napoli et al. 2021, or something else?

[1] ARRA is an acronym for the original title of the project – Alaska Region Risk Assessment (Pyrologix 2021).

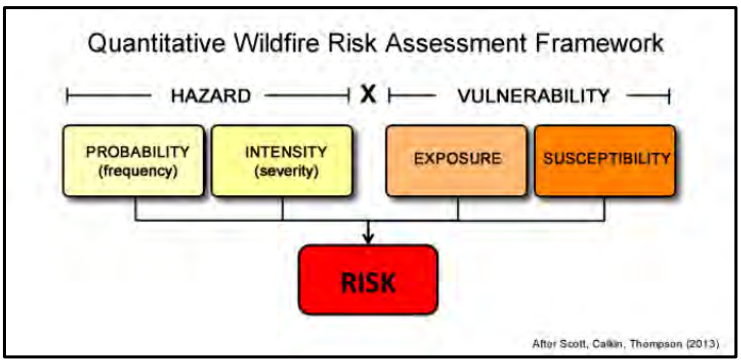


Figure 3.1. The components of the QWRA framework used for the ARRA.
Source: Pyrologix (2021)

Wildfire hazard under the QWRA framework is measured by burn probability (likelihood of burning) and fire intensity (flame length, fireline intensity, etc.) (Thompson et al. 2013). Vulnerability to identified HVRAs is composed of exposure and susceptibility. Exposure is the placement of an HVRA in a hazardous environment (e.g., a home in a flammable landscape), and susceptibility is how easily an HVRA is damaged by wildfire (e.g., some homes or structures might be hardened to mitigate wildfire damage).

The ARRA assessment is a tool that allows land use managers, fire officials, planners, and others to identify high-risk/hazard areas on the landscape and prepare strategies and methods for reducing the threat of wildfire, as well as work with community members to educate them about methods for reducing the damaging consequences of fire.

The QWRA framework and the ARRA process is described in detail in the ARRA report (located in Appendix B). The following provides a synopsis of some of the main features of the report that are pertinent to the CWPP.

RISK ASSESSMENT COMPONENTS

The ARRA uses the FSim large-fire simulator to quantify the likelihood of a large fire (a fire that would grow to over 100 acres) occurring across the Analysis Area based on current fuelscape and historical weather conditions (Finney et al. 2011; Pyrologix 2021).

FUELSCAPE

The fuelscape represents the vegetative fuels and topography across the analysis area. Several geospatial datasets comprise the fuelscape, including fuel models, canopy characteristics of trees and other vegetation, and topographical characteristics. A significant degree of data compilation occurs during development of the fuelscape, as well as calibration to address disturbances from recent wildfires, mortality resulting from insect and disease, wind damage, and mechanical or prescribed fire treatments. The fuelscape development also integrated findings from the Kenai Peninsula Vegetation Mapping project, which provided information on tree cover and vegetation height.

WILDFIRE OCCURRENCE

Wildfire occurrence across the analysis area was based on data gathered from the Fire Occurrence Database for a period from 1992 through 2017. The analysis focuses only on historic fires that grew to over 100 acres. These data are used in FSim to generate the most accurate estimate of wildfire likelihood.

HISTORICAL WEATHER

FSim incorporates weather inputs for wind speed, fuel moistures, and Energy Release Component collected from Remote Automated Weather Stations (RAWS) located throughout the analysis area.

WILDFIRE SIMULATION

Figure 3.2 shows the components that go into the wildfire simulation and outputs of those simulations in FSim.

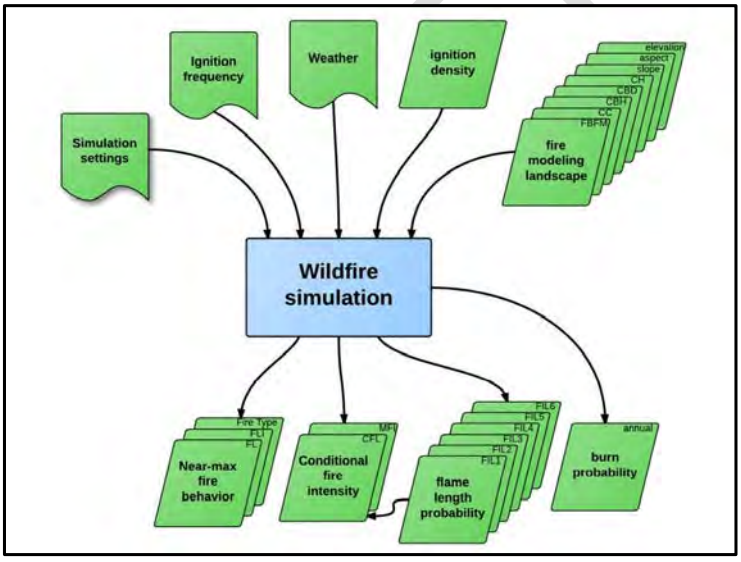


Figure 3.2. The primary elements used to derive burn probability in FSim.
Source: Pyrologix (2021)

HVRA CHARACTERIZATION

HVRAs are the resources and assets on the landscape most likely to warrant protection if found to be at risk of wildfire (Pyrologix 2021). The identification and compilation of HVRAs was a collaborative effort by stakeholders in the region. In order to be included in the ARRA, an HVRA must be of greatest importance to the region, the spatial data must be readily available, and the spatial extent of the identified HVRA

must be complete (Pyrologix 2021). Eleven HVRAs were selected for the ARRA under the major categories of people and property, infrastructure, carbon, and watershed (Table 3.1).

Each HVRA selected is also assigned a response function, meaning how that HVRA responds to wildfire, whether positive or negative.

Table 3.1. HVRA and sub-HVRA identified for the ARRA

HVRA & Sub-HVRA	Data Source
People and Property	
People and Property	Represents housing unity density data produced by Pyrologix using the building footprints and U.S. Census - Census Block population data. Data depicting building locations was provided by Chugach NF and adjusted by Pyrologix.
Native Allotments	The data was provided by the Bureau of Land Management, Alaska State Office, representing areas designated as 'Conveyed Native Allotments' within Alaska.
Infrastructure	
Electric transmission lines – high & low voltage	The provided linear features represent electric power transmission lines. Data was provided by Chugach NF and supplemented with data from the Homeland Infrastructure Foundation-Level Data (HIFLD) program.
Communication Sites	Data represents the location of communication sites. Data was provided by Chugach NF and supplemented with data from the Homeland Infrastructure Foundation-Level Data (HIFLD) program.
Power: Power Plants & Substations	The provided data represents the locations of power plants and substations. Data was provided by Chugach NF and supplemented with data from the Homeland Infrastructure Foundation-Level Data (HIFLD) program.
Oil & Gas Wells	The data contains the location of surface wells & structures. Well locations were limited to those designated as active wells; structures were limited to items designated as oil/gas buildings. Data was provided by Chugach NF.
Pipelines	The data depicts pipeline locations in Alaska as digitized from USGS maps. Ancillary source documentation was provided by the AK DNR and used as necessary for updates.
Fish Hatcheries	These sport subsistence sites represent the known locations of sport and commercial fish rearing facilities (commercial salmon fishery) located in Southcentral AK. Data was provided by Chugach NF.
Recreation & Administrative Sites	The data contains the locations of administrative buildings, offices, recreation sites, and service/utility structures on lands owned by Alaska State Parks, USDA (Forest Service) lands, and the National Park Service. Data was provided by Chugach NF.
Carbon	
Carbon Credits	Mapped areas represent forested land used in carbon trading markets and identify areas of biomass (forest) marketable as carbon credits. Data provided by Chugach NF.
Watershed	
Critical Watersheds	Surface drinking water protection areas (Zone C, G boundaries) were delineated from local topography and anticipated effects on the drinking water source intake. Data provided by Chugach NF and Alaska DEC Open Data.

Source: Pyrologix (2021)

During the stakeholder workshops, each HVRA was also assigned a relative importance or rank (Figure 3.3). Each HVRA and sub-HVRA, and its response function and relative importance, is described in detail in Section 3.4 of the ARRA report. That section describes the impacts that might occur to each HVRA as a result of varying levels of fire intensity (based on modeled flame length). Some HVRAs are expected to experience increasing potential loss with increasing fire intensities; for example, recreation and administrative sites are vulnerable to higher flame lengths, and therefore, the negative response function increases with flame length. Other HVRAs that are more hardened to wildfire with established defensible space (for example, oil well pads) have a very low response to fire and low potential loss. Forested carbon sequestration areas are very susceptible and sensitive to wildfire and therefore exhibit a strong negative response and potential loss at fire intensities over 8 feet.

Sometimes, within HVRAs there may be varying response functions based on the sub-HVRA type; for example, low-voltage power distribution lines constructed with wooden poles have a higher potential loss from fire compared with higher-voltage transmission lines that are constructed on metal pylons. Drinking water protection areas and their associated water facilities contributed 11% to the overall relative importance in the ARRA, demonstrating the importance that this resource has to communities. At high wildfire intensities, these resources have a very high potential for loss due to the potential post-fire impacts on the watershed.

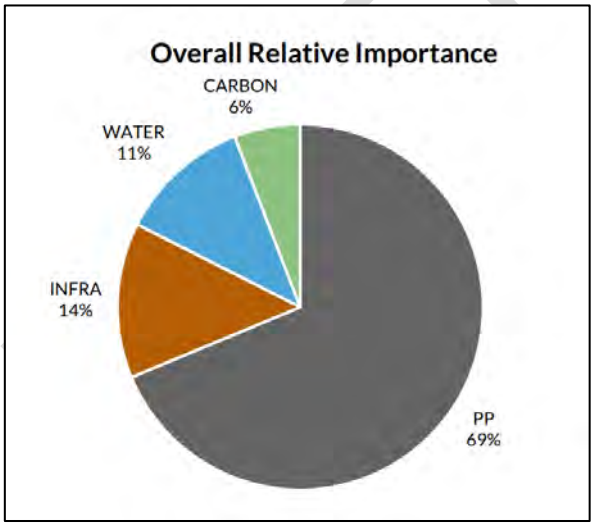


Figure 3.3. Overall HVRA relative importance included in the ARRA.

Source: Pyrologix (2021)

RISK ASSESSMENT RESULTS

The ARRA describes wildfire risk based on the conditional and expected change in value from wildfire disturbance to all HVRAs included in the analysis. The expected net value change (eNVC) has the added utility that it captures the relative likelihood of wildfire disturbance (burn probability), and therefore is the metric that is included in the CWPP. Burn probability is illustrated in Figure 3.4.

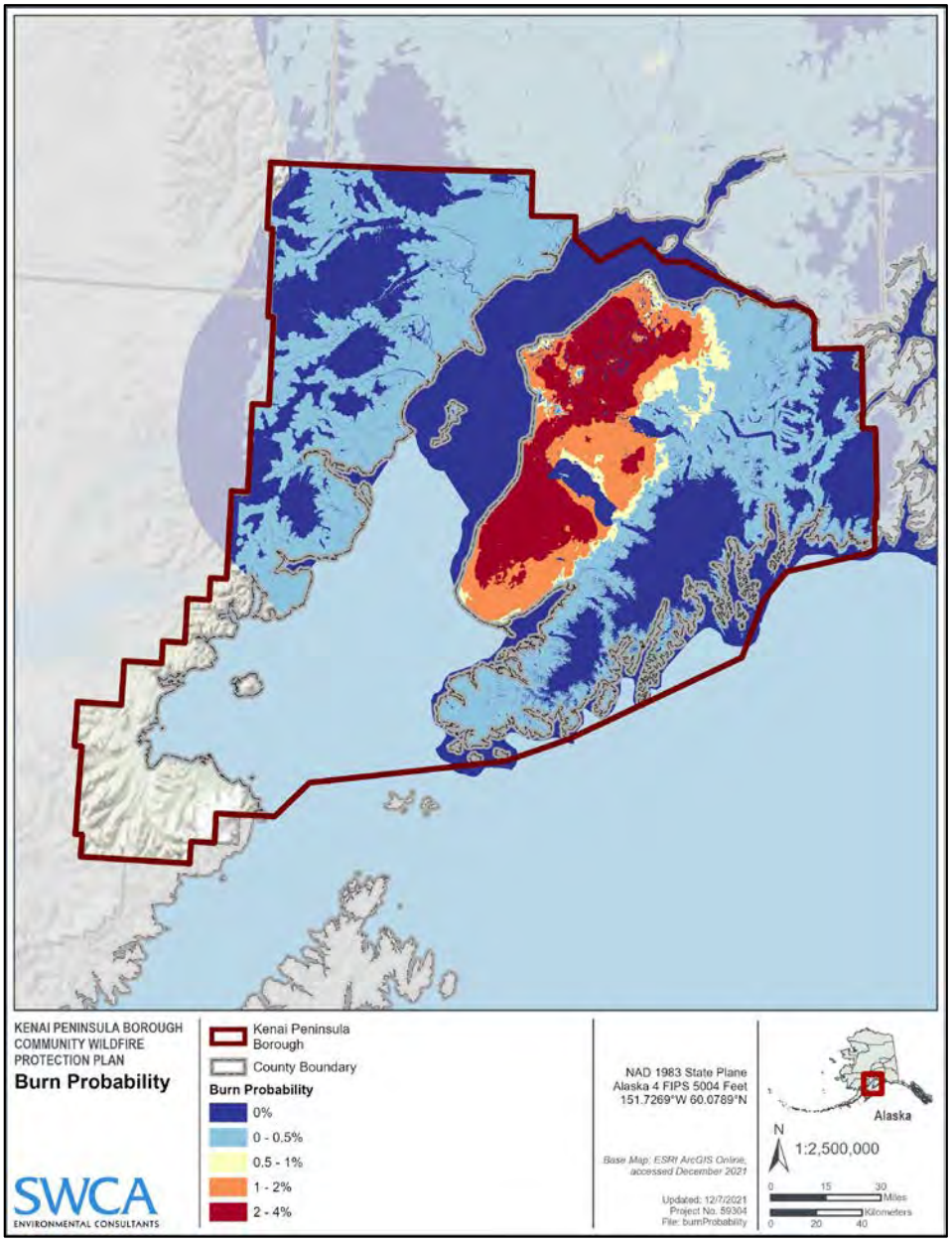


Figure 3.4. Map of integrated FSim burn probability.
Source: Pyrologix (2021)

Cumulative effects of wildfire across the landscape vary by HVRA, with a net negative eNVC for all the HVRAs. People and property show the greatest cumulative wildfire losses, followed by infrastructure, drinking water, and carbon as the HVRAs with the greatest cumulative risk (Pyrologix 2021) (Figure 3.5). Figure 3.6 illustrates the spatial spread of negative outcomes to HVRAs based on the likelihood of an HVRA being impacted by fire (burn probability).

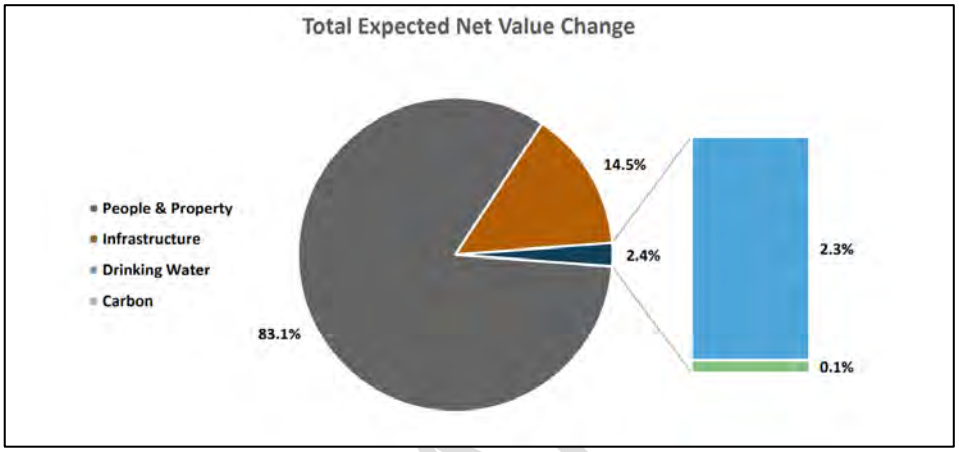


Figure 3.5. Weighted net response for HVRAs in the assessment listed in order of net value change and scaled to eNVC values for the people and property HVRA.
Source: Pyrologix (2021)

The ARRA assessment also provides an assessment of mean eNVC on a watershed scale (Figure 3.7). This metric can help to prioritize mitigation actions across the landscape by showing which watersheds house HVRAs that could experience the greatest potential loss.

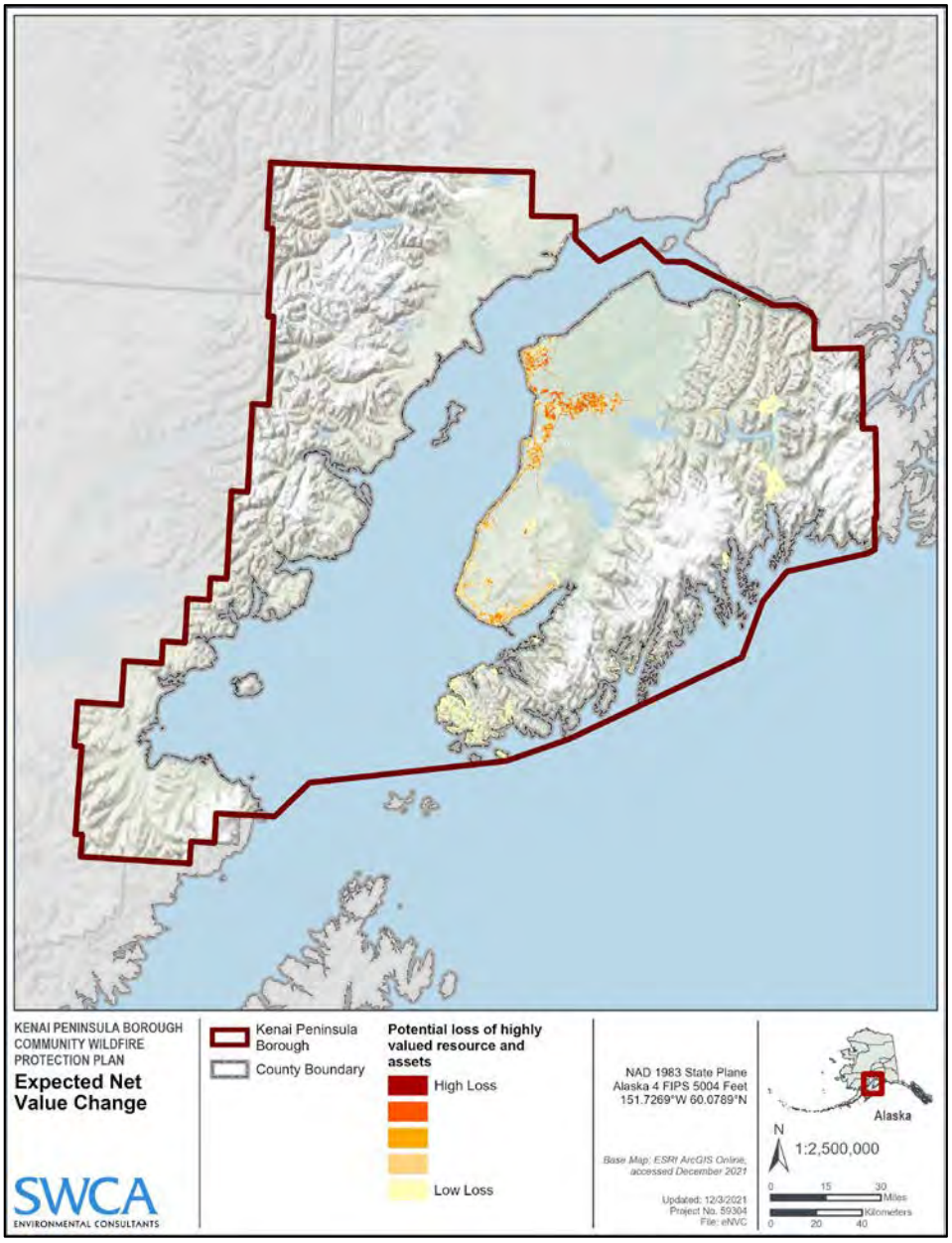


Figure 3.6. Map of eNVC for the KPB CWPP portion of the ARRA analysis area.
Source: Pyrologix (2021)

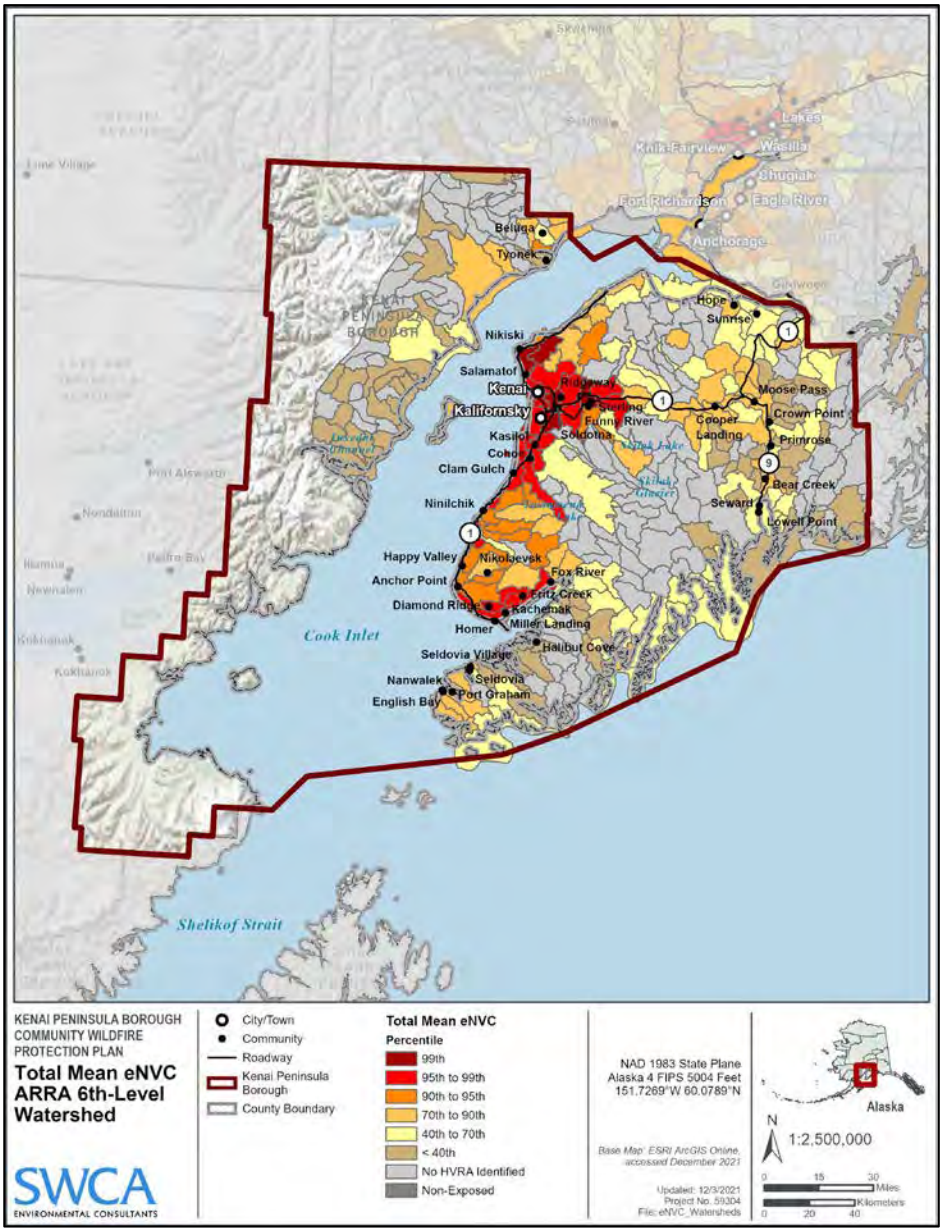


Figure 3.7. Map of total mean eNVC for the KPB CWPP portion of the ARRA Sixth-Level Watersheds.

Source: Pyrologix (2021)

COMMUNITY ASSESSMENTS

In order to properly assess the hazards in and around the Kenai Peninsula communities, several field days were implemented to carry out community assessments.

The assessment was conducted in summer 2021 using the NFPA Wildland Fire Risk and Hazard Severity Form 1144 (Appendix E). This form is based on the NFPA Standard for Reducing Structure Ignition Hazards from Wildland Fire 2013 Edition. The NFPA standard focuses on individual structure hazards and requires a spatial approach to assessing and mitigating wildfire hazards around existing structures. It also includes ignition-resistant requirements for new construction and is used by planners and developers in areas that are threatened by wildfire and is commonly applied in the development of Firewise Communities (for more information, see www.firewise.org).

Each area was rated based on conditions within the community and immediately surrounding structures, including access, adjacent vegetation (fuels), defensible space, adjacent topography, roof and building characteristics, available fire protection, and placement of utilities. Where a range of conditions was less easily parsed out, a range of values was assigned on a single assessment form. Each score was given a corresponding adjective rating of low, moderate, or high. An example of the assessment form used in this plan is in Appendix E.

The purpose of the community WUI assessment and subsequent hazard ratings is to identify fire hazard and risks and prioritize areas requiring mitigation and more detailed planning. These assessments should not be seen as tactical pre-suppression or triage plans. The community assessment helps to drive the recommendations for mitigation of structural ignitability, community preparedness, and public education. The assessment also helps to prioritize areas for fuels treatment based on the hazard rating.

The CAR hazard ratings from the community assessment and the GIS hazard/risk assessment are provided in Appendix D.

Figure 3.8. Example of yard debris, a common finding of the 1144 assessments.

COMMUNITY VALUES

The ARRA incorporated data compilation of several HVRAs across the peninsula. In addition to those datasets, during CWPP meetings, the public and Core Team were invited to share their lists of resources and assets that they value in and around their communities (Figures 3.9 and 3.10). In addition to critical infrastructure, these community values can also include natural, social, and cultural resources. It is important to note that, although an identification of valued resources and assets can inform treatment recommendations, a number of factors must be considered in order to fully prioritize areas for treatment; these factors include appropriateness of treatment, land ownership constraints, locations of ongoing projects, available resources, and other physical, social, or ecological barriers to treatment.

The scope of this CWPP does not allow determination of the absolute natural, socioeconomic, and cultural values that could be impacted by wildfire in the planning area. In terms of socioeconomic values, the impact due to wildfire would cross many scales and sectors of the economy and call upon resources locally, regionally, and nationally.

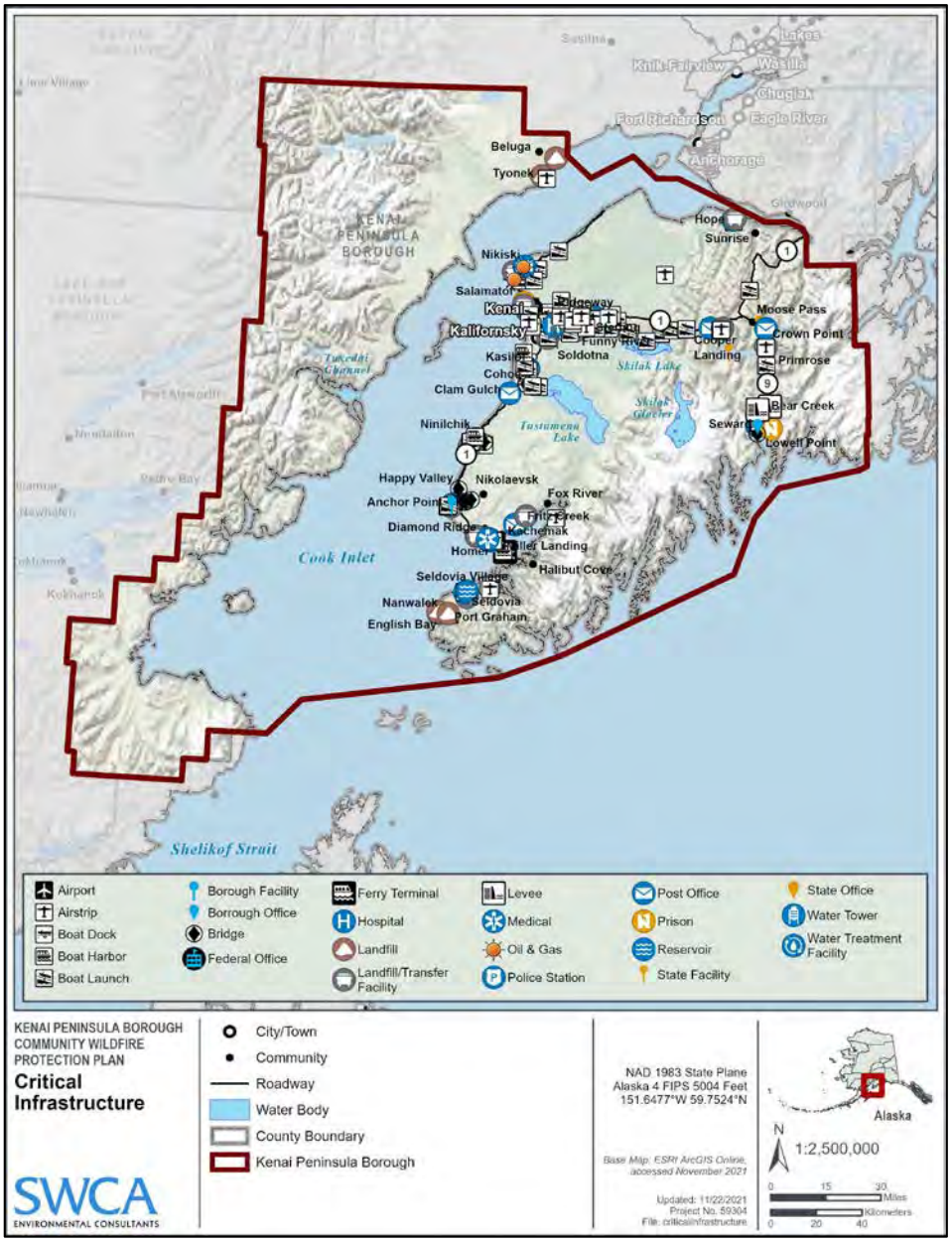


Figure 3.9. Critical infrastructure.

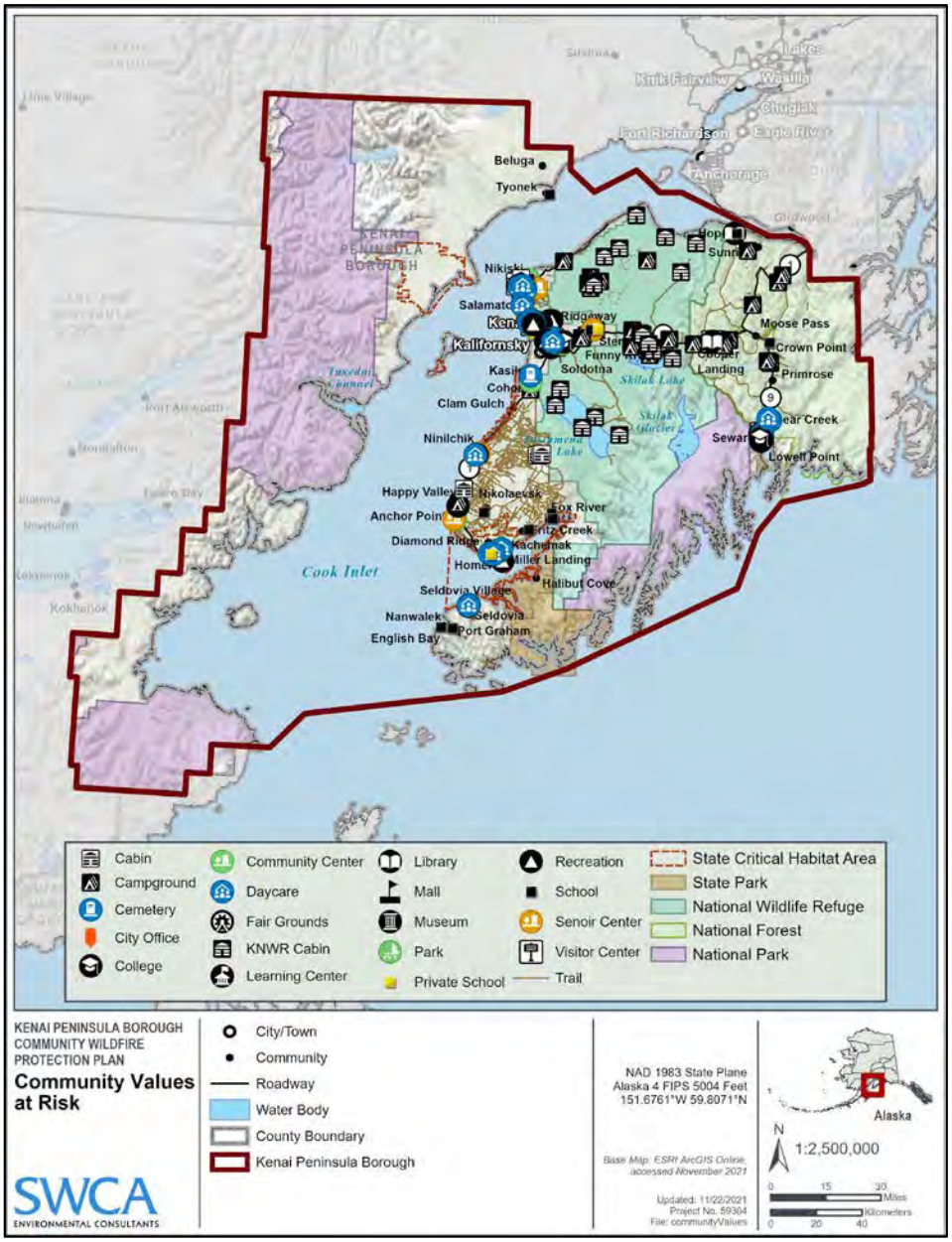


Figure 3.10. Community values across the Kenai Peninsula.

NATURAL VALUES

The CWPP planning area has a variety of natural resources of particular concern to land managers, such as rare habitats and listed plant and wildlife species. Public outreach throughout the planning area has emphasized the importance of natural/ecological values to the general public. Examples of natural values identified by the public and the Core Team include the following:

- Public land
- Hunting areas (Figure 3.11)
- Watersheds and water quality
- Agricultural land
- Forest land
- Wildlife habitat and game species

Figure 3.11. Example of natural values, hunting land and watersheds.

SOCIOECONOMIC VALUES

Socioeconomic values include population, recreation, infrastructure, agriculture, and the built environment. Much of the built environment in the planning area falls within the WUI zones that comprise the community assessments (Appendix D). Examples include the following:

- Pipelines
- Utility facilities
- Tourism (Figure 3.12)
- LMR system facilities
- Staging areas
- Docks and barge landings
- Highways and road systems
- Medical facilities
- Schools
- Water storage
- Fire departments
- Recreation sites

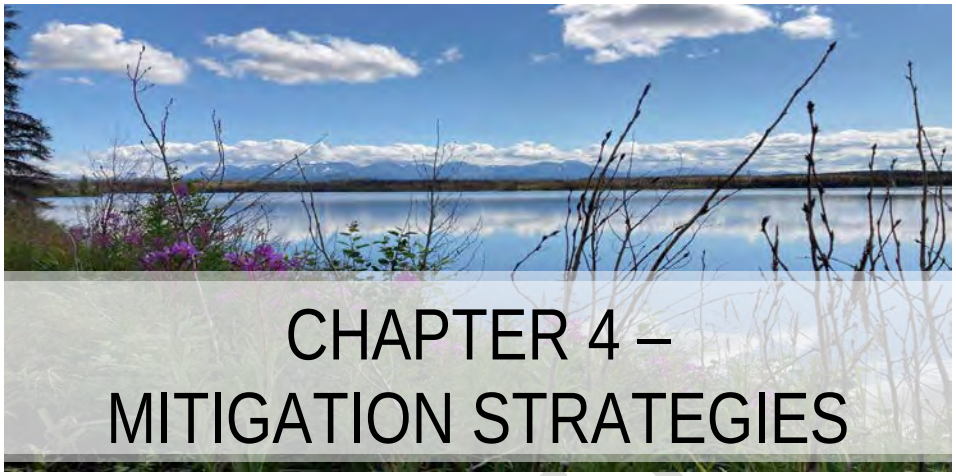
Figure 3.12. Example of a socioeconomic value, a historic café.

CULTURAL VALUES

Many historical landmarks are scattered throughout the planning area. Particular cultural values that have been identified by the Core Team and the public in the CWPP planning area are the following:

- Pit houses
- Gathering centers (e.g., Tribal center)
- Village corporations
- Archeological resources
- Village cemetery
- Coastal fishing camps
- Churches (Figure 3.13)
- Shirley Lodging Facility

Figure 3.13. Example of a cultural value, a church.



CHAPTER 4 – MITIGATION STRATEGIES

In developing this KPB-wide CWPP, the plan has been aligned with the Cohesive Strategy and its Phase III Western Regional Action Plan by adhering to the nationwide goal "*to safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire*" (Forests and Rangelands 2014:3).

In order to do this, the CWPP recommendations have been structured around the three main goals of the Cohesive Strategy: restoring and maintaining landscapes, fire-adapted communities, and wildfire response.

This chapter provides guidance for implementing recommendations under each Cohesive Strategy goal. Recommendations were developed based on input from Core Team, Tribal, and stakeholder meetings, including a unique stakeholder group focused on strategic infrastructure. Many of these community-specific recommendations can be implemented at the homeowner or community level. Projects requiring large-scale support should be prioritized based on the ARRA developed for the Borough.

COHESIVE STRATEGY GOAL 1: RESTORE AND MAINTAIN LANDSCAPES

Goal 1 of the Cohesive Strategy and the Western Regional Action Plan is **Restore and Maintain Landscapes**: Landscapes across all jurisdictions are resilient to fire and other disturbances in accordance with management objectives.

> *"Sustaining landscape resiliency and the role of wildland fire as a critical ecological process requires a mix of actions that are consistent with management objectives. The West will use all available methods and tools for active management of the landscape to consider and conserve a diversity of ecological, social, and economic values. The West will coordinate with all partners and seek continued stakeholder engagement in developing market-based, flexible and proactive solutions that can take advantage of economies of scale. All aspects of wildland fire will be used to*

restore and maintain resilient landscapes. Emphasis will be placed on protecting the middle lands near communities." (Western Regional Strategy Committee 2013:14).

Strategic actions listed within the ALAH Action Plan to serve the goal of **restoring and maintaining landscapes include** (KPB Interagency 2018):

- Develop methods to assist and inform private landowners with managing fuels.
- Promote prescribed fire certification and training to provide safe use of fire.
- Promote landscape-scale fuels management activities, such as prescribed fire and wildland fire, that address the creation and maintenance of resilient landscapes.
- Include fuels reduction and fire risk management activities into existing and future land management programs.
- Promote cost-effective, active forest management.

Forest managers in the region are addressing land management objectives through the use of mechanical and manual treatments to promote more resilient forest land. Figure 4.1 illustrates ongoing fuels management on the peninsula. Private, state, and federal lands are interspersed, creating a matrix of land ownership, which is often a hurdle to implementation of landscape-level treatments. By working with private landowners, forest managers are enhancing landscape-scale efforts to create more resilient forest communities.

In this CWPP, recommendations to restore and maintain landscapes focus on vegetation management and hazardous fuel reduction.

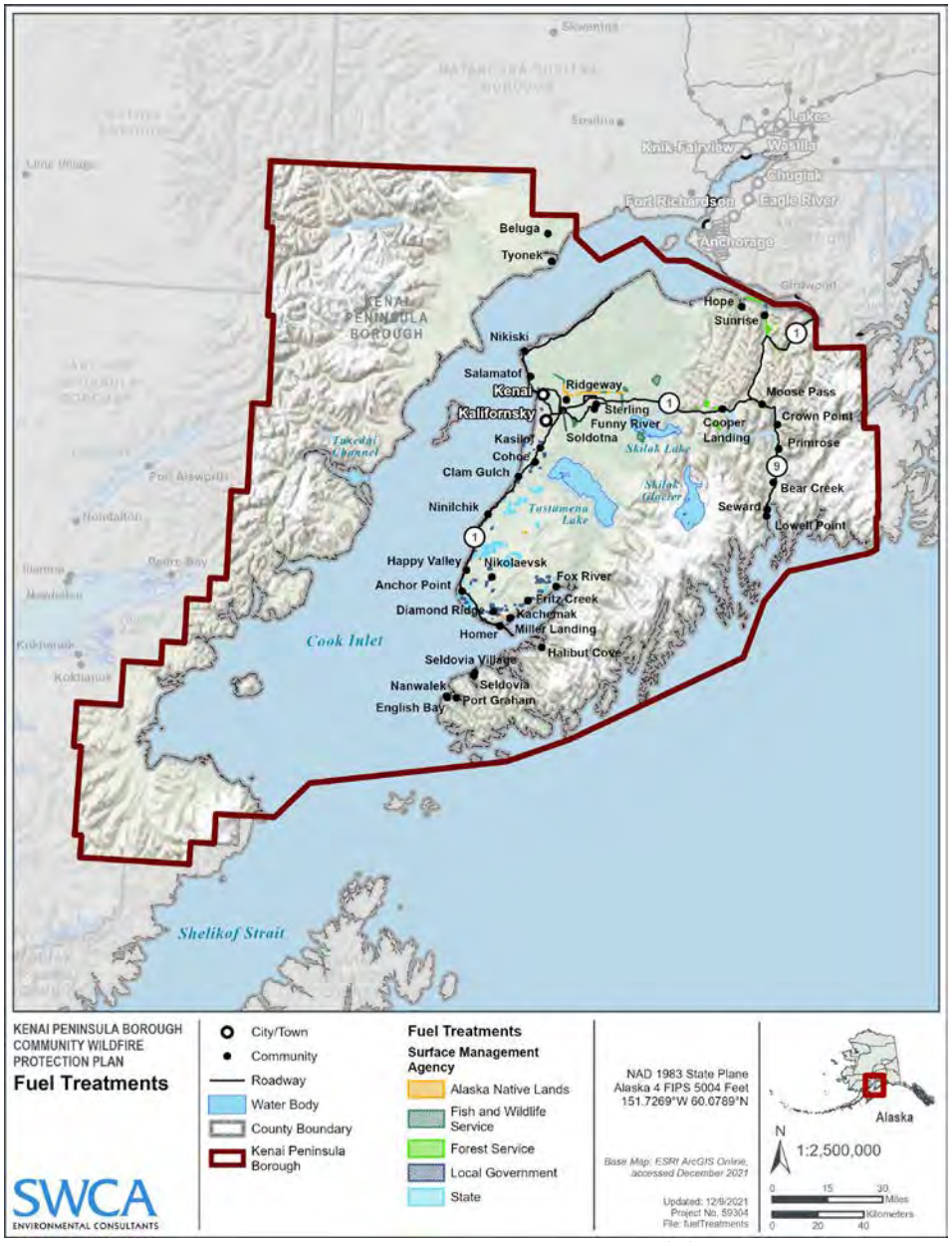


Figure 4.1. Ongoing fuel treatments implemented across the peninsula.

Commented [VA1]: Core Team- we understand at this scale the map is not very helpful. This data will also be presented in the story map, so data viewing will be far superior through that platform. We will likely remove this map from the document following review, we just wanted you all to see that it is available as a dataset. If we remove this map from the document we will add a reference to the story map so people know where to find this dataset.

RECOMMENDATIONS FOR HAZARDOUS FUEL REDUCATION

Fuels management of public and private land is key to the survival of structures during a wildfire event, as well as the means to meet the criteria of Goal 1, creating resilient landscapes. As wildfire frequency, size, destruction, and restoration costs have been on an incline, the need for wildfire mitigation via fuels treatment is at an all-time high (UAF 2018). The importance of fuels management is reflected in forest policy at the federal level, with the HFRA requiring that federal land management agencies spend at least 50% of their fuels reduction funds on projects in the WUI. In addition, various Alaskan studies have proven the success of fuels treatments regarding mitigating wildfire intensity and damage (UAF 2018).

A case study done in 2014 during the Funny River Fire concluded that fuel treatments were imperative in preventing fire spread. In addition, field samples and photographic evidence from the Eagle Trail (2010), Funny River (2014), Card Street (2015), and Nenana Ridge (2009 and 2015) Fires indicate fuel treatments resulted in lower fire behavior, increased accessibility, and decreased visual obstructions (due to fuel treatments such as canopy thinning). Furthermore, those treatments gave firefighters the ability to use treatments, such as fuel breaks, to anchor backfiring operations and burn out other treated areas (UAF 2018). Of the documented cases described in UAF (2018), all showed that fuel breaks in Alaska significantly alter fire behavior; fires in untreated areas grew to active crown fires, then dropped down to surface fire in the treated areas. However, fuel breaks alone may not stop a fire from advancing, so it is important to integrate multiple treatment methods (UAF 2018).

Fuels should be modified with a strategic approach across the planning area to reduce the threat that high-intensity wildfires pose to lives, property, and other values. Pursuant to these objectives, recommendations have been developed in the context of existing and planned fuels management projects. These recommendations initially focus on areas adjacent to structures (defensible space), then near community boundaries (fuel breaks, cleanup of adjacent open spaces), and finally in the wildlands beyond community boundaries (larger-scale forest health and restoration treatments).

While not necessarily at odds with one another, the emphasis of each of these treatment types is different. Proximate to structures, the recommendations focus on reducing fire intensity consistent with Firewise. Further into open space areas, treatments will tend to emphasize forest health and increasing resiliency to catastrophic wildfire and other disturbances, including SBB infestation. Cooperators in fuels management should include federal, state, and local agencies as well as interested members of the public. Federal land management plans focus on these more landscape-level treatments, so the CWPP incorporates most federal land management by reference to those land management planning documents. The CWPP focuses primarily on projects within or adjacent to WUI areas.

Table 4.1 summarizes the types of treatments recommended throughout the planning area, and Figure 4.2 delineates areas of concern where treatments should be prioritized. These areas of concern were delineated collaboratively during the fourth Core Team meeting and areas were identified based on stakeholder knowledge, connecting existing treatments (as illustrated in Figure 4.1) and delineating lands based on the ARRA findings. Areas projected in ARRA to have the greatest potential loss (eNVC) include HVRAs that are susceptible to intense wildfire behavior. Many of these areas are close to communities due to the density of HVRAs in those areas. These areas are delineated as areas of concern in Figure 4.3 so that land managers can prioritize fuel mitigation treatments to protect HVRAs.

Many of these treatment recommendations in Table 4.1 are general across the communities because similar conditions and concerns were raised for all communities that border wildland areas. Community-

specific recommendations can be found in Appendix D, Community Descriptions. Table 4.1 also addresses the requirement for an action plan and assessment strategy by providing monitoring guidelines and a timeline for implementation. This timeline is obviously dependent on available funding and resources, as well as National Environmental Policy Act (NEPA) protocols for any treatments pursued on public land.

The treatment list is by no means exhaustive and should be considered purely a sample of required projects for the future management of the planning area. Many projects may be eligible for grant funds available from federal and/or state sources. A key source of funding for implementing hazardous fuel reduction are funds available through the Western Regional Action Plan, which is the reason this CWPP tiers to those goals. Because much of the wildfire risk is associated with extreme volumes of SBB infested, dead and dying trees, securing funding to address the ongoing outbreaks in these forests should be a significant focus for land managers. For an additional list of funding sources, please refer to Appendix F.

Each land management agency has a different set of policies governing the planning and implementation of fuels reduction projects. A thorough assessment of current fuel loading is an important prerequisite for any fuels prescription (see Figure 4.2 for an example of fuel loading), and all treatment recommendations should be based on the best possible science. When possible, simultaneously planning for the management of multiple resources while reducing fuels will ensure that the land remains viable for multiple uses in the long term. The effectiveness of any fuels reduction treatment depends on the degree of maintenance and monitoring that is employed. Monitoring will also ensure that objectives are being met in a cost-effective manner.

Fire management cannot be a one-size-fits-all endeavor; this plan is designed to be flexible. Treatment approaches and methods will be site-specific and should be adapted to best meet the needs of the landowner and the resources available. Moreover, each treatment recommendation should address protection of valued resources and assets, particularly the protection of threatened and endangered species.

Figure 4.2. Swan Lake Fire area showing heavy downed trees and fuel loading.

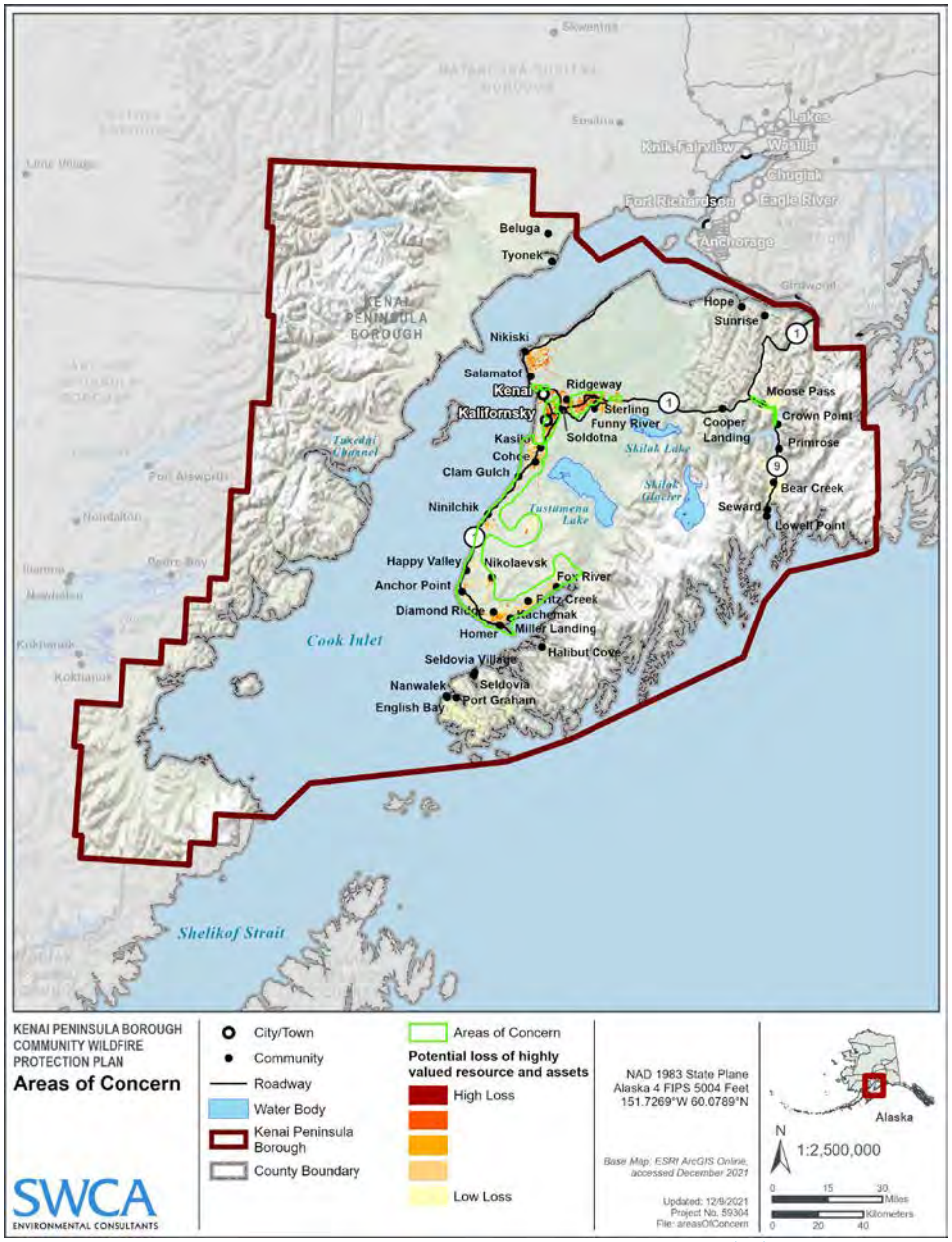


Figure 4.3. Areas of Concern where future fuel treatments should be prioritized.

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Table 4.1. Recommendations for Creating Resilient Landscapes (Hazardous Fuel Treatments)

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Agencies prioritize treatments for hazardous fuel removal	• Kenai Peninsula Borough-wide • Area for high potential loss from the QWRA • Focus cost effective fuel management treatment in critical and full protection level areas identified in the Alaska Wildland Fire Management Plan (*from 2019 KPB HMP*) (Figure 4.2, Chapter 4)	State Forestry, Kenai Peninsula Borough	• Develop and implement a process for all levels of government to collaborate on annual selection of fuel treatment projects in their jurisdictions (*from 2019 KPB HMP*) • Focus cost effective silvicultural treatments in high human use areas to minimize public safety hazards, prevent or control additional SBB impacts and/or restore forest cover *(from 2019 KPB HMP*) • Utilize GIS tools and the QWRA to increase prioritization of treatments based on risk. • Look for opportunities to create landscape level treatments wherever possible. • Use a diverse toolbox of treatment types and tailor plans to specific site conditions. • Look for opportunities to create multiple resource benefits in addition to hazard reduction (wildlife habitat, invasive species control, recreation etc.). • Build in resource protection measures to prescriptions. • Build collaboration to increase potential funding sources and develop ownership. • Develop maintenance plans to ensure sustainability. • Develop monitoring plans and adaptive management to mitigate against harmful impacts on resources. • Promote the retention of hardwoods and desirable species/habitat when possible. • Increase public engagement to build community support for projects and facilitate efficient environmental compliance to advance implementation. • Identify tracks of fuel that are contiguous – address large tracts v individual lots	• Assess hazard mitigation opportunities to protect values at risk within areas of highest exposure potential • Create resilient landscapes	Ongoing	H	• Implement a monitoring program on initiation of each project • Utilize the NFPORS (National Fire Plan Operations & Reporting System) data base to enter, track and report planned and completed projects in KPB (*from 2019 KPB HMP*)	• Internal budgets • Fuel reduction agency grants • Pre-disaster Mitigation (PDM) Grant Program • Hazard Mitigation Grant Program (HMGP) • Hazard Mitigation Grant Program (HMGP) – Post Fire • General Assistance Program • Public Assistance Grant Program • Emergency Forest Restoration Program (EFRP) • Matching Awards Program • U.S. Endowment for Forestry and Communities • Firewise Communities • The Urban Land Institute (ULI) • The National Fire Plan (NFP) • Urban and Community Forestry Program, 2021 National Urban and Community Forestry Challenge Cost Share Grant Program • Serve Alaska • Firewise Communities • National Fire Protection Association • Environmental Systems Research Institute (ESRI) • National Interagency Fire Center, Wildland Fire Prevention/Education • Environmental Education Grants • The Fire Prevention and Safety Grants (FP&S) • Western Wildland-Urban Interface (WUI) Grants • Private Landowner Assistance Grant • Hazard Mitigation Planning Assistance • Community Development Block Grants – Mitigation - Alaska

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Continue to maintain and expand the Strategic Fuel Break (also called the Sterling Fuel Break) across multiple jurisdictions (*Meets several goals of the 2019 KPB HMP- Table 3.5 and 3.6*)	Western extension Nikiski to Grey Cliffs (Figure 4.10, Chapter 4)	Multi-agency, cross boundary projects contingent on public/ private land ownership	• Continue to work with stakeholders and land managers to expand fuel break to serve communities in northern areas (Nikiski etc.). • Consider rebranding name to disassociate just with community of Sterling. • Continue maintenance on existing sections. • Evaluate maintenance schedules based on assessment of conditions. • Utilize the Quantitative Wildfire Risk Assessment (QWRA) in future expansion of the fuel break. Prioritize areas of high and extreme potential for loss. • Enhance community outreach on the fuel break, including regular status updates. Use the story map and other mediums to share information. • Utilize the potential Type 2 crew in fuel break construction, increasing the season for the crew. • Develop fuel break attributes and characteristics based on specific site conditions: assessment of wildfire risk, topography, vegetation communities and existing fuel conditions- ~300 ft break. • Identify costs and plan for long term maintenance (~$1K/acre for development)	• Protect life and property by mitigating extreme fire behavior and creating a barrier to fire spread	Ongoing (likely implementation would be during fall and winter months)	H	• Regular maintenance needed to ensure the fuel break remains clear of vegetation (+/- every 10 years). • Monitor for erosion and invasive species. • Incorporate habitat restoration into planning, especially consideration of impacts on anadromous streams.	• Agency budgets • Internal budgets • Fuel reduction agency grants • Pre-disaster Mitigation (PDM) Grant Program • Hazard Mitigation Grant Program (HMGP) • Hazard Mitigation Grant Program (HMGP) – Post Fire • General Assistance Program • Public Assistance Grant Program • Emergency Forest Restoration Program (EFRP) • Matching Awards Program • U.S. Endowment for Forestry and Communities • Firewise Communities • The Urban Land Institute (ULI) • The National Fire Plan (NFP) • Urban and Community Forestry Program, 2021 National Urban and Community Forestry Challenge Cost Share Grant Program • Serve Alaska • Firewise Communities • National Fire Protection Association • Environmental Systems Research Institute (ESRI) • National Interagency Fire Center, Wildland Fire Prevention/Education • Environmental Education Grants • The Fire Prevention and Safety Grants (FP&S) • Western Wildland-Urban Interface (WUI) Grants • Private Landowner Assistance Grant • Hazard Mitigation Planning Assistance • Community Development Block Grants – Mitigation - Alaska
Disrupt fuel continuity by creating two fuel breaks on lower Peninsula: Tustumena West Fuel Break and Crooked Creek Caribou	•	•	•	•				

Commented [VA3]: Core Team- this was a project identified in the HMP. Lets discuss at the Core Team meeting.

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Remove standing dead trees on public and private property	Kenai Peninsula-wide	Public and Private land AK Dept of Public Safety	• Preferentially remove beetle killed trees that pose a hazard adjacent to homes or structures. • Work from structure outwards to edge of property line. • Remove slash and dispose of appropriately, following beetle slash protocols. • Consult with tree removal specialists (see "KPB Land Management- Kenai Peninsula Forestry Directory for qualified contractors"- Appendix X- Local Resources). • Remove hazard trees along trails and other public ROW. • Utilize best management practices outlined by the University of Alaska Cooperative Extension (see "Spruce Beetles – A Guide to Tree Management Options for Home and Woodlot Owners"- Appendix X- Local Resources). • Identify incentives to promote private operators to remove trees with removed trees as payment.	• Protect life and property by mitigating extreme fire behavior.	Ongoing	H	• Regular maintenance is required.	• Pre-disaster Mitigation (PDM) Grant Program • Hazard Mitigation Grant Program (HMGP) • Hazard Mitigation Grant Program (HMGP) – Post Fire • General Assistance Program • Public Assistance Grant Program • Emergency Forest Restoration Program (EFRP) • Matching Awards Program • U.S. Endowment for Forestry and Communities • Firewise Communities • The Urban Land Institute (ULI) • The National Fire Plan (NFP) • Urban and Community Forestry Program, 2021 National Urban and Community Forestry Challenge Cost Share Grant Program • Serve Alaska • Western Wildland-Urban Interface (WUI) Grants • Private Landowner Assistance Grant • Hazard Mitigation Planning Assistance • Community Development Block Grants – Mitigation – Alaska • Western Bark Beetle Initiative Grant Program

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Enhance road ROW clearance to facilitate safe ingress and egress	Kenai Peninsula-wide	DOT, State Forestry, AK Dept of Public Safety, Kenai Peninsula Borough and municipalities	• Increase removal of dead trees located along State Highways and KPB road ROW to provide for safe egress along evacuation routes. • Utilize a new Type 2 crew or roads crew to carry out ROW treatments. • Tie to the QWRA, targeting areas identified as highest potential loss first. • Focus on main routes first, then move on to side roads based on priority in the risk assessment.	• Protect life and property by mitigating extreme fire behavior.	Start within 1 year, and make this an ongoing project	H	• Annual spring maintenance of ROW • ROW sizes vary. Develop protocols based on type of ROW being treated	• Pre-disaster Mitigation (PDM) Grant Program • Hazard Mitigation Grant Program (HMGP) • Hazard Mitigation Grant Program (HMGP) – Post Fire • General Assistance Program • Public Assistance Grant Program • Emergency Forest Restoration Program (EFRP) • Matching Awards Program • U.S. Endowment for Forestry and Communities • Firewise Communities • The Urban Land Institute (ULI) • The National Fire Plan (NFP) • Urban and Community Forestry Program, 2021 National Urban and Community Forestry Challenge Cost Share Grant Program • Serve Alaska • Hazard Mitigation Planning Assistance • Community Assistance Program • Community Development Block Grants – Alaska • Community Development Block Grants – Mitigation – Alaska • Western Bark Beetle Initiative Grant Program
Increase workforce capacity to respond to hazardous fuel treatment needs	Kenai Peninsula-wide	USFS Kenai Peninsula Borough Chugachmiut/CIRI lands State Forestry	• Carryout a feasibility assessment for the creation of a hazardous fuels crew (State Type II Crew) with primary role of fuels management (secondary fire suppression role). See Fire Response Matrix for details. o Convene working group to complete feasibility assessment and identify administrative structure, budget and scope. • Use existing type 2 fire crews to work on fuel breaks and mitigation pre- and post-fire season to extend the season they work. • Develop industry support and incentives to hire forestry contractors to conduct treatments. • Use workforce development programs to increase supply of trained foresters.	• Increase capacity to address hazardous fuels and built resilient landscapes.	Within 1 year	H	• Annual review of progress, needs and accomplishments.	• Funding for Fire Departments and First Responders • Emergency Management Performance Grant (EMPG) • Regional Catastrophic Preparedness Grants • Volunteer Fire Assistance Program • Staffing for Adequate Fire and Emergency Response (SAFER) • Assistance to Firefighters Grants (AFG) • State and Private Forestry Programs – NASF • National Fire Protection Association • Alaska Firewise • Hazard Mitigation Planning Assistance • Community Assistance Program

Commented [EG4]: Core Team – throughout the entire matrix please review the projects where Kenai Peninsula Borough is listed as a lead agency and note if this is beyond the jurisdiction of the Borough. If this is beyond the jurisdiction, we could note that this recommendation would require a vote.

Brenda - Please note should this say KPB OEM instead of KPB?

Commented [VA5]: Core Team- John Winters provided an excellent summary of the factors that should be considered in forming this type of crew. My suggestion is this document is included as a deliverable with this plan to help move this recommendations forward. Does not need to be included in the document itself but can be included with project files. John, please advise.

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Strategically plan post-fire restoration projects to maximize future wildfire resilience on public and private lands	Kenai Peninsula-wide	State Forestry and Kenai Peninsula Borough	• Promote the use of the Forest Stewardship Program managed by the AK Department of Natural Resources, Division of Forestry, to assist private landowners with forest planning and on-the-groundwork. • Ensure that replanting areas do not unintentionally create fuel hazards in the future by including these projects in Forest Stewardship Plans (these plans have a 10-year outlook and follow the landowner's goals.) • Transplanting and planting • Integrate with Firewise landscaping • Utilize drones to identify areas of need • Utilize cooperative extension service	• Create resilient landscapes and address potential for extreme wildfire behavior in and around communities.	Start within 2 years, and make this an ongoing project	M	• Identify non-traditional participants like Cooperative Extension re UAF, etc.	• Pre-disaster Mitigation (PDM) Grant Program • Hazard Mitigation Grant Program (HMGP) • Hazard Mitigation Grant Program (HMGP) – Post Fire • General Assistance Program • Public Assistance Grant Program • Emergency Forest Restoration Program (EFRP) • Matching Awards Program • U.S. Endowment for Forestry and Communities • Firewise Communities • The Urban Land Institute (ULI) • The National Fire Plan (NFP) • Urban and Community Forestry Program, 2021 National Urban and Community Forestry Challenge Cost Share Grant Program • Serve Alaska • Western Wildland-Urban Interface (WUI) Grants • Private Landowner Assistance Grant • Hazard Mitigation Planning Assistance • Community Development Block Grants – Mitigation – Alaska • Alaska Firewise

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Address existing limitations of slash disposal facilities (*Meets goal of the 2019 KPB HMP- Provide slash disposal sites near high-risk areas- Table 3.6)*	Kenai Peninsula-wide	State Forestry, Kenai Peninsula Borough, Cities and Communities	• Form a multi-agency working group (maybe a committee under the ALAH group) to discuss options and solutions to this problem. • Identify an agency(s) to address slash disposal and build ownership in the solution. • Develop multi-strategy approach to disposal. Consider the following: o Capacity of existing facilities. o Installation of air-curtain incinerator in central location. o Initiating a “chipper days” campaign and schedule. o A mix of options- 1) mobile chipper taken to the community, 2) satellite geographic areas where slash is transported and dropped, 3) fenced/staff operated drop-off with fees, 4) fenced/staff operated drop-off without fees. o Potential need to contract chipper operator (liability concerns). o Potential market/use for chips- landscaping, trails, “mushers” for use in kennels. o Creating role for a new Type 2 team to help man the chipper and slash program. o Budget for managing chipper program. Charge nominal fee for slash disposal. o Utilize chips in trail construction as a means of disposing of green waste	• Create resilient landscapes and address potential for extreme wildfire behavior in and around communities. • Create and maintain accountability with local landowners. • Reduce fuel and debris that can carry ground fire around property where trees may have been removed.	Start within 1 year, and make this an ongoing project	H	• Regular review needed to determine whether facilities are meeting demand	• Pre-disaster Mitigation (PDM) Grant Program • Hazard Mitigation Grant Program (HMGP) • Hazard Mitigation Grant Program (HMGP) – Post Fire • General Assistance Program • Public Assistance Grant Program • Emergency Forest Restoration Program (EFRP) • Matching Awards Program • U.S. Endowment for Forestry and Communities • Firewise Communities • The Urban Land Institute (ULI) • The National Fire Plan (NFP) • Urban and Community Forestry Program, 2021 National Urban and Community Forestry Challenge Cost Share Grant Program • Serve Alaska • Community Assistance Program • Community Development Block Grants – Alaska

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Agencies to increase defensible space around publicly owned structures and infrastructure	Kenai Peninsula-wide	State Forestry, Kenai Peninsula Borough, Cities and Communities	• Develop and adopt local land use plans and ordinances that provide maintenance of defensible space and fuel management on municipal and public property (*from 2019 KPB HMP*) • Defensible space will help increase protection of values at risk and to act as demonstration site for increasing public engagement in structure ignitability mitigation. • Utilize the QWRA to prioritize protection of areas modeled has having greater potential for loss. • Utilize the CWPP and public engagement to identify values at risk that they would like to see protected. • Identify state parcels that are located near strategic infrastructure and plan treatment near roadways and property lines.	• Create resilient landscapes and address potential for extreme wildfire behavior in and around communities.	Within 2 years	H	• Carry out a 2-year review of accomplishments in improving defensible space across the Borough	• Pre-disaster Mitigation (PDM) Grant Program • Hazard Mitigation Grant Program (HMGP) • General Assistance Program • Public Assistance Grant Program • Emergency Forest Restoration Program (EFRP) • Matching Awards Program • U.S. Endowment for Forestry and Communities • Firewise Communities • The Urban Land Institute (ULI) • The National Fire Plan (NFP) • Urban and Community Forestry Program, 2021 National Urban and Community Forestry Challenge Cost Share Grant Program • Serve Alaska • National Fire Protection Association • National Interagency Fire Center • Hazard Mitigation Planning Assistance • Community Assistance Program • Community Development Block Grants – Alaska • Community Development Block Grants – Mitigation - Alaska

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Initiate campaign to encourage defensible space actions on private lands	Kenai Peninsula-wide	State Forestry, Kenai Peninsula Borough, Cities and Communities to promote action by residents	• Defensible space will help increase protection of life and property. • Utilize the QWRA to outreach to the public the areas that should be prioritized for protection based on modeled potential loss. • Provide educational materials and outline available resources. • Consider use of incentives to encourage participation in campaign (i.e., tax incentives, working with insurance agents on reduced premiums etc.)	• Create resilient landscapes and address potential for extreme wildfire behavior in and around communities. • Building fire adapted communities • Facilitate safe deployment of fire suppression resources	Within 2 years	H	• Carry out a 2-year review of accomplishments in improving defensible space in WUI areas across the Peninsula.	• Firewise Communities • National Fire Protection Association • Environmental Systems Research Institute (ESRI) • National Interagency Fire Center, Wildland Fire Prevention/Education • Environmental Education Grants • The Fire Prevention and Safety Grants (FP&S) • Urban and Community Forestry Program, 2021 National Urban and Community Forestry Challenge Cost Share Grant Program • Serve Alaska • The National Fire Plan (NFP) • Western Wildland-Urban Interface (WUI) Grants • Private Landowner Assistance Grant • Hazard Mitigation Planning Assistance • Community Development Block Grants – Mitigation – Alaska Firewise
Plan for increased grass fuel fire regimes	Kenai Peninsula-wide	State Forestry, Kenai Peninsula Borough	• Build into long-term planning the potential for the Borough to exhibit more of a grass fuel fire regime as large areas of timber are removed in large fires. This cover type change would increase fire frequency and fire suppression resource needs and tactics. • Identify how these new fuels will impact fire season (longer) or months of year this fuel is susceptible to extreme fire spread	• Prepare for more resilient landscapes and address potential for extreme wildfire behavior in and around communities.	Start within 1 year, and make this an ongoing project	M	• Identify as an agenda item for discussion annually by the ALAH group.	• Pre-disaster Mitigation (PDM) Grant Program • General Assistance Program • Multipurpose Grants to States and Tribes • Environmental Quality Incentives Program (EQIP) • Urban and Community Forestry Program, 2021 National Urban and Community Forestry Challenge Cost Share Grant Program • Catalog of Federal Funding Sources; Land Resources • Matching Awards Program • U.S. Endowment for Forestry and Communities • Hazard Mitigation Planning Assistance

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Increase capacity for use of prescribed fire	Kenai Peninsula-wide	ADGF State Forestry	• Form a working group to explore options for collaboration and increased application of fire into existing management practices and strategies (maybe a committee under the ALAH group). • Prescribed fire needs to occur at same time as wildfire for optimum benefits. • Develop and train interagency prescribed burn team (*from 2019 KPB HMP*) • Increased crew capacity would allow prescribed fires to continue even during active fire seasons. • Expand the use of crews beyond the Peninsula. • Utilize inter-agency burn crews (include local FD's and VFD's).	• Create resilient and fire adapted landscapes and address potential for extreme wildfire behavior in and around communities.	Within 5 years	H	• Review progress annually • Number of acres treated • Number of agencies collaborating	• Funding for Fire Departments and First Responders • Emergency Management Performance Grant (EMPG) • Volunteer Fire Assistance Program • Staffing for Adequate Fire and Emergency Response (SAFER) • Assistance to Firefighters Grants (AFG) • State and Private Forestry Programs – NASF • National Fire Protection Association • Matching Awards Program • Serve Alaska • Hazard Mitigation Planning Assistance • Community Development Block Grants – Mitigation - Alaska
Continue to promote wildlife habitat improvements through forest management	Kenai Peninsula-wide	ADGF State Forestry	• Increase promotion of the use of prescribed fire for moose habitat • Utilize science-based literature from agencies • Utilize literature that shows multiple wildlife benefits • Reforest/restore burn areas for wildlife habitat improvements. • Address "shrubification" concerns- shrubs moving to higher elevations and encroaching on alpine tundra. • Highlight the perils of returning to a suppression era on wildlife habitat. • Utilize science on beetle infestations. • Continue to buffer WUI communities so that wildfire can play a larger role in the broader landscape.	• Protection of wildlife habitat	Ongoing	H	• Review progress annually • Identify metrics and monitor accomplishments in promoting wildlife habitat	• Pre-disaster Mitigation (PDM) Grant Program • General Assistance Program • Multipurpose Grants to States and Tribes • Environmental Quality Incentives Program (EQIP) • Urban and Community Forestry Program, 2021 National Urban and Community Forestry Challenge Cost Share Grant Program • Catalog of Federal Funding Sources; Land Resources • Emergency Forest Restoration Program (EFRP) • The National Fire Plan (NFP) • Matching Awards Program • U.S. Endowment for Forestry and Communities • Hazard Mitigation Planning Assistance • Community Development Block Grants – Mitigation – Alaska • Western Wildland-Urban Interface (WUI) Grants • Western Bark Beetle Initiative Grant Program • Community Development Block Grants – Disaster Recovery - Alaska

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Collaboratively plan for vegetation management treatments that serve a demand for increasing recreation opportunities	Kenai Peninsula-wide	ADGF State Forestry USFS State Div. of Parks City rec depts.	• Plan for mutually beneficial goals by coordinating fire and vegetation management with recreation to build public support. • Work with utility companies to seek opportunities to create recreational spaces in existing or proposed ROW. • Utilize dozer lines (fire suppression actions) for recreation and increased access for fire protection. • Develop new recreational trails strategically to provide for increased access for fire suppression. • Integrate with stewardship planning • Address hazard trees on trails and ROW to enhance public safety • Identify and work with communities interested in recreational use and fuel breaks- Cooper Landing, Moose Pass, Hope, Sunrise, Seward, Homer.	• Create mutual benefits for hazardous fuels treatments.	Ongoing	H	• Review progress annually • Update and revise plans annually	• State Parks funding • NRCS EQUIP • Pittman-Robinson dollars can be used on trails and fuel breaks • Look for cost-match opportunities- i.e., utilizing Chugachmiut crews. • The National Fire Plan (NFP) • Urban and Community Forestry Program, 2021 National Urban and Community Forestry Challenge Cost Share Grant Program • Serve Alaska • Pre-disaster Mitigation (PDM) Grant Program • Staffing for Adequate Fire and Emergency Response (SAFER) • Assistance to Firefighters Grants (AFG) • State and Private Forestry Programs – NASF • Firewise Communities • National Fire Protection Association • National Interagency Fire Center, Wildland Fire Prevention/Education • Western Wildland-Urban Interface (WUI) Grants • Private Landowner Assistance Grant • Hazard Mitigation Planning Assistance • Community Development Block Grants – Mitigation – Alaska • Alaska Firewise
Reinvigorate timber industry to provide market for lumber removed through treatments. (*Meets goal of the 2019 KPB HMP- Decrease fuels in high-risk areas-Table 3.6*)	Kenai Peninsula-wide	Commercial Industry KPB Planning Dept	• Form a working group to explore options for building and maintaining a forest industry (maybe a committee under the ALAH group). • Complete a feasibility study for markets, infrastructure, and transportation. • Improve technical assistance program to promote commercial uses for fuel reduction materials (*from 2019 KPB HMP*) • Look for market options for beetle killed trees- i.e., harvest dead white spruce prior to rot so as to maximize value. • Develop plan for shipping/transit out of state. • Coordinate federal, state, and local efforts to provide public firewood cutting areas as a means to reduce potential wildfire fuel sources by taking dead and downed trees (*from the 2019 KPB HMP*)	• Reduce hazardous fuel loads and increase future resiliency against continued beetle outbreaks.	Over next 10 years	M	• Incentives likely at first to develop the system	• Funds: federal infrastructure spending • Pre-disaster Mitigation (PDM) Grant Program • Building Resilient Infrastructure and Communities (BRIC) program • RAISE Discretionary Grants • Rural Opportunities to Use Transportation for Economic Success (ROUTES) • Matching Awards Program • U.S. Endowment for Forestry and Communities • Western Bark Beetle Initiative Grant Program • Community Assistance Program

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Work with utilities/ infrastructure entities to address wildfire risk along utility/infrastructure ROW (see Strategic Infrastructure Recommendation Matrix [Table X] for more recommendations related to infrastructure resilience).	Along ROWs & utility easements	Utilities, Energy Industry and associated landowners	• Developed fire management plans for utilities focused on vegetation management, infrastructure hardening, situational awareness etc. • Look for opportunities to provide multiple benefits from ROW clearance and maintenance – recreation, fire suppression access etc. • Index different types of ROW's & develop specific treatment protocols • Accompany fire management and fuels treatment plans with strategies to address debris removal and maintenance. • Deploy resources to ensure ROW and utilities are maintained • Identify policy incentives for utilities to invest in aggressive ROW clearing	• Increase security afforded by transportation, electricity, communications & natural gas. • Reduce potential ignitions in the WUI. • Enhance fire suppression tactics	Within 1 year	H	• Maintenance and monitoring plans	• Company budgets • Pre-disaster Mitigation (PDM) Grant Program • Hazard Mitigation Grant Program (HMGP) • General Assistance Program • Public Assistance Grant Program • Emergency Forest Restoration Program (EFRP) • Matching Awards Program • U.S. Endowment for Forestry and Communities • Firewise Communities • The Urban Land Institute (ULI) • The National Fire Plan (NFP) • Urban and Community Forestry Program, 2021 National Urban and Community Forestry Challenge Cost Share Grant Program • Serve Alaska • Environmental Quality Incentives Program (EQIP) • Hazard Mitigation Planning Assistance • Community Assistance Program • Community Development Block Grants – Alaska • Community Development Block Grants – Mitigation - Alaska
Streamline grant management	Kenai Peninsula-wide	Kenai Peninsula Borough State Forestry Conservation Districts	• Develop and implement consistent and effective procedures for procurement, contracting, grants and agreements to support interagency projects (*from 2019 KPB HMP*) • Use one agency to manage grants for fuels treatments on all lands instead of having each agency competing for grant monies • Establish KPB internet-based information system to ID funding opportunities (*from 2019 KPB HMP*) • Assign 1 person or agency to monitor funding opportunities, prepare application assistance for grant monies and coordinate with other agencies	• Increase capacity and leverage agency resources	Within 2 years	H	• Annual review of progress, needs and accomplishments.	• Agency Budgets • Community Assistance Program

Commented [VA6]: Core Team, we have developed a separate matrix that focuses specifically on infrastructure protection.

Fuels Treatment Scales

Defensible Space

Defensible space is perhaps the fastest, most cost-effective, and most efficacious means of reducing the risk of loss of life and property. Although fire agencies can be valuable in providing guidance and assistance, creating defensible space is the responsibility of the individual homeowner (Figure 4.4).

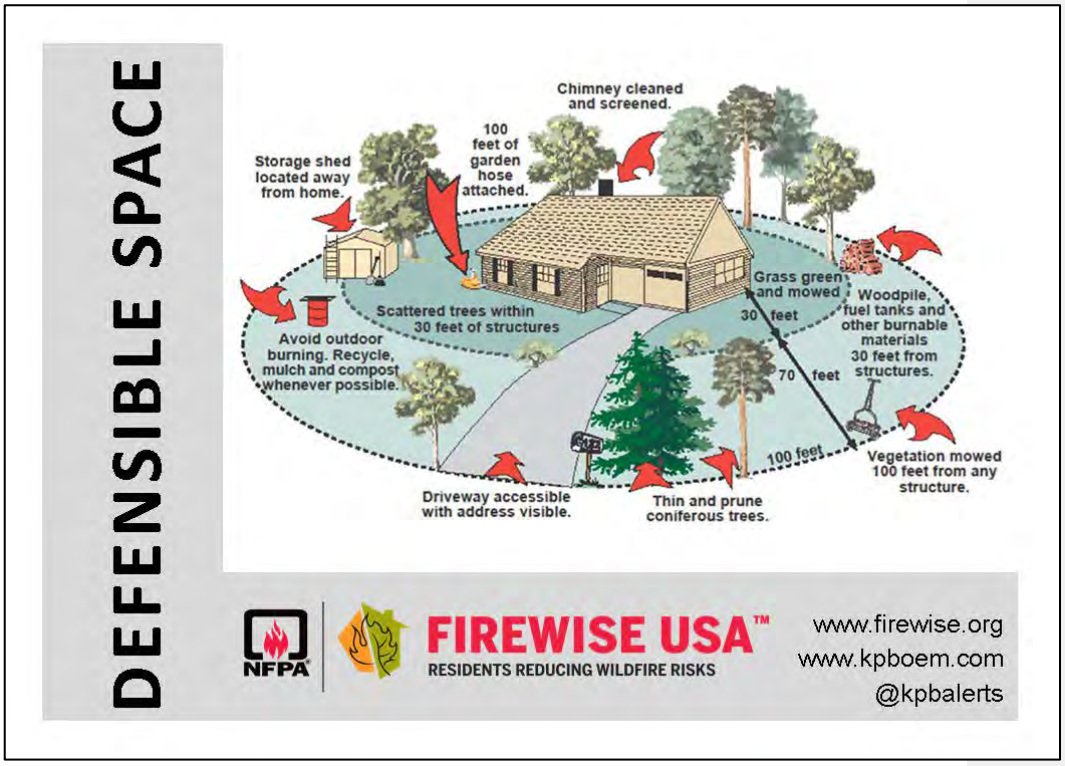

Figure 4.4. Defensible space providing clearance between a structure and adjacent woodland or forest fuels.

Source: Alaska Firewise

Effective defensible space consists of creating an essentially fire-free zone adjacent to the home, a treated secondary zone that is thinned and cleaned of surface fuels, and (if the parcel is large enough) a transitional third zone that is basically a managed forest area. These components work together in a proven and predictable manner. Zone 1 keeps fire from burning directly to the home; Zone 2 reduces the adjacent fire intensity and the likelihood of torching, crown fire, and ember production; and Zone 3 does the same at a broader scale, keeping the fire intensity lower by maintaining a more natural, historic condition (Figures 4.4 and 4.5).

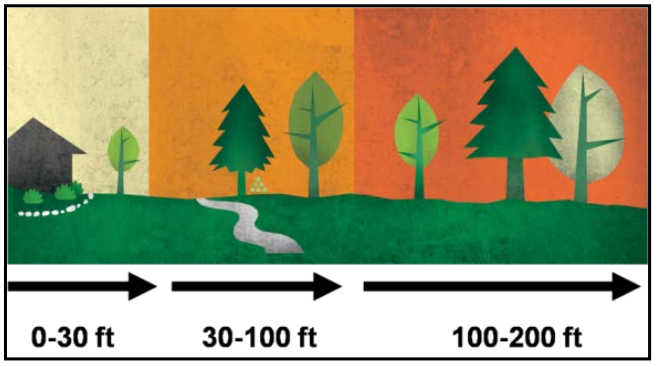

Figure 4.5. Defensible space zones.
Source: www.firewise.org.

Three zones for defensible space actions are described below:

Zone 1: This zone, which consists of an area of 0 to 30 feet around the structure, features the most intense modification and treatment. This distance is measured from the outside edge of the home's eaves and any attached structures, such as decks. Do not plant directly beneath windows or next to foundation vents. Frequently prune and maintain plants in this zone to ensure vigorous growth and a low growth habit. Remove dead branches, stems, and leaves. Do not store firewood or other combustible materials in this area. Enclose or screen decks with metal screening. Extend gravel coverage under the decks. Do not use areas under decks for storage. Prune low-lying branches (ladder fuels that would allow a surface fire to climb into the tree) and any branches that interfere with the roof or are within 10 feet of the chimney. In all other areas, prune all branches of shrubs or trees up to a height of 10 feet above ground (or one-third the height, whichever is the least).

Zone 2: This zone features fuel reduction efforts and serves as a transitional area between Zones 1 and 3. The size of Zone 2 depends on the slope of the ground where the structure is built. Typically, the defensible space should extend at least 100 feet from the structure. Remove stressed, diseased, dead, or dying trees and shrubs, following guidance from forestry professionals (Appendix G). Thin and prune the remaining larger trees and shrubs. Be sure to extend thinning along either side of your driveway all the way to your main access road. These actions help eliminate the continuous fuel surrounding a structure while enhancing home site safety and the aesthetics of the property. Keep grass and wildflowers under 8 inches in height. Regularly remove leaf and needle debris from the yard.

Zone 3: This area extends from the edge of your defensible space to your property boundaries. The healthiest forest is one that has multiple ages, sizes, and species of trees where adequate growing room is maintained over time, so maintain a distance of at least 10 feet between the tops of trees. Remove ladder fuels, creating a separation between low-level vegetation and tree branches to keep fire from climbing up trees. A greater number of wildlife trees can remain in Zone 3, but regularly remove dead trees and shrubs. Ensure trees in this area do not pose a threat to power lines or access roads.

It should be emphasized that defensible space is just that—an area that allows firefighters to work effectively and with some degree of safety to defend structures. While defensible space may increase a home's chance of surviving a fire on its own, a structure's survival is not guaranteed, with or without

firefighter protection. Nevertheless, when these principles are consistently applied across a neighborhood, everybody benefits.

Specific recommendations should be based on the hazards adjacent to a structure such as slope steepness and fuel type. Firewise guidelines and the Homeowner's Guide (Appendix G) are excellent resources but creating defensible space does not have to be an overwhelming process. The National Fire Protection Association (NFPA) offers a free Community Wildfire Risk Assessment Tutorial and an online learning module, Understanding the Wildfire Threat to Homes. Both tools are great resources for learning about, and implementing, defensible space.

Assisting neighbors in defensible space activities may be essential in many cases in order to expand the extent of treatments on private lands. Homeowners should consider assisting the elderly, sharing ladders for gutter cleaning, and assisting neighbors with large thinning needs. Homeowner actions have been found to also motivate neighbors to act, increasing the scope of the wildfire mitigation across a community (Evans et al. 2015). The DOF has been tracking homeowners' activities related to defensible space. Figure 4.6 shows the number of completed homeowners' defensible space activities beginning in 2015 and through 2021. This information conveys that many residents are already taking responsibility for mitigating their own properties, but more work is needed in order to provide greater effect on fuels in the WUI (Figure 4.7).

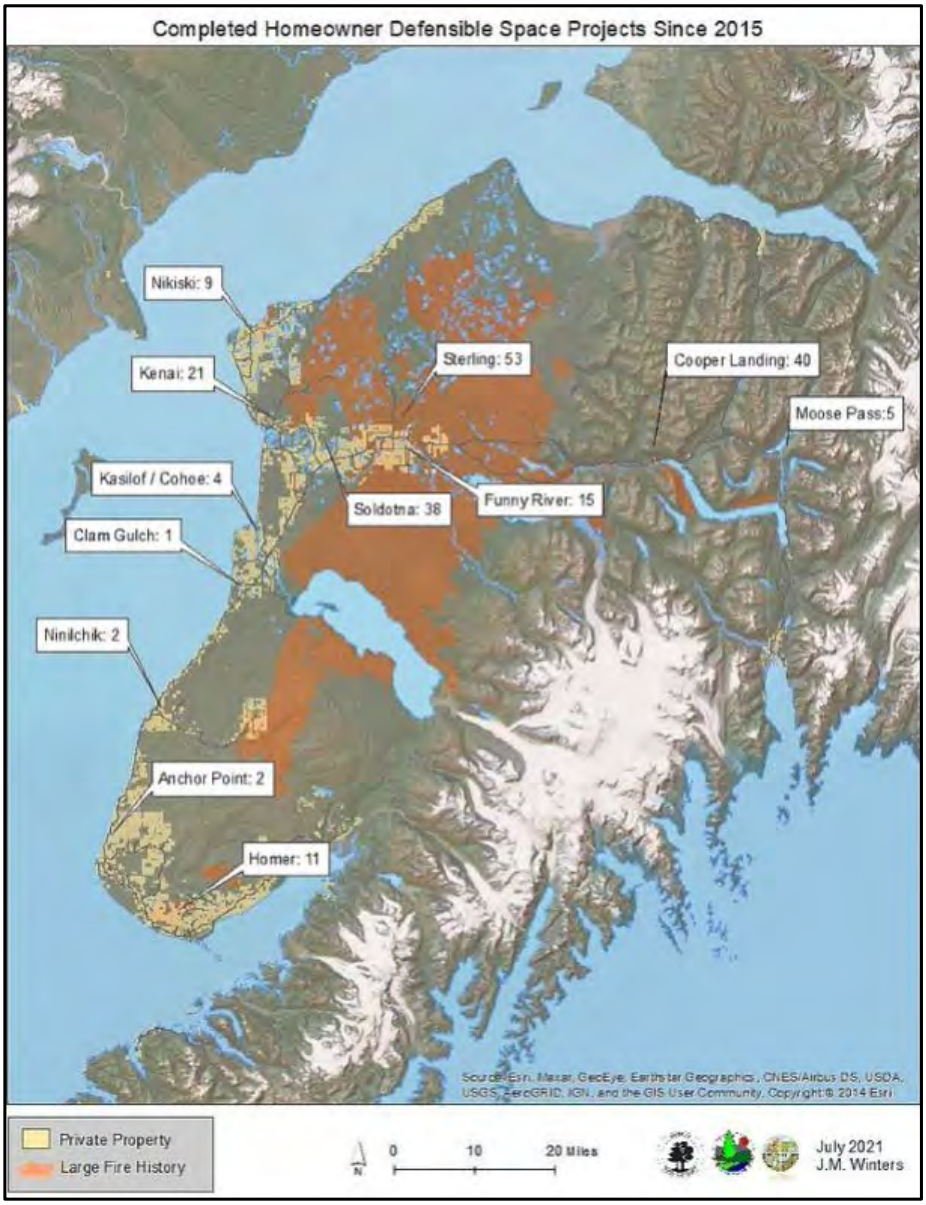

Figure 4.6 Homeowner Defensible Space from 2015 through 2021.
Source: DOF.

Figure 4.7. Example of poor defensible space.

Adopting a phased approach to home hardening can make the process more manageable and encourage maintenance (Table 4.2).

Table 4.2. Example of a Phased Approach to Mitigating Home Ignitability

Year	Project	Actions
1	Basic yard cleanup (annual)	Dispose of clutter in the yard and under porches. Remove dead branches from yard. Mow and rake. Clean off roofs and gutters. Remove combustible vegetation near structures. Coordinate disposal as a neighborhood or community. Post 4-inch reflective address numbers visible from road.
2	Understory thinning near structures	Repeat basic yard cleanup. Limb trees up to 6–10 feet. Trim branches back 15 feet from chimneys. Trim or cut down brush. Remove young trees that can carry fire into forest canopy. Coordinate disposal as a neighborhood or community.
3	Understory thinning on private property along roads and drainages	Limb trees up to 6–10 feet. Trim or cut down brush. Remove young trees that can carry fire into forest canopy. Coordinate disposal as a neighborhood or community.
4	Overstory treatments on private property	Evaluate the need to thin mature or diseased trees. Prioritize and coordinate tree removal within neighborhoods to increase cost effectiveness.

Year	Project	Actions
5	Restart defensible space treatment cycle	Continue the annual basic yard cleanup. Evaluate need to revisit past efforts or catch those that were bypassed.

Fuel Breaks

Fuel treatments are methods for controlling live and dead vegetation with the purpose of minimizing the negative impacts of an area burning during a wildfire. While fuel breaks are a suitable tool for mitigating fire spread in this fuel type, land managers are cautioned that fuel breaks will not always stop a fire under extreme fire behavior or strong winds; these should only be seen as a mitigating measure and not a fail-safe method for fire containment. Furthermore, fuel break utility is contingent upon regular maintenance, as regrowth in a fuel break can quickly reduce its effectiveness and vegetation in this ecosystem is known to quickly re-sprout and reestablish. Maintenance of existing breaks could be more cost efficient than installation of new features.

Well-managed fuels reduction projects often result in ecological benefits to wildlife and watershed health. Simultaneously, planning and resource management efforts should occur when possible while reducing fuels to ensure that the land remains viable for multiple uses in the long term. For example, fuel breaks could be aligned with existing areas of ROW clearance by working with utility companies and combining resources. Similarly, fuel breaks could be developed in conjunction with recreational trails to serve multiple purposes and provide access to the community. The effectiveness of any fuels reduction treatment will increase over time with a maintenance and monitoring plan. Monitoring will also ensure that objectives are being met in a cost-effective manner.

It is not possible to provide a standard treatment prescription for the entire landscape because fuel break dimensions should be based on the local fuel conditions and prevailing weather patterns. For example, in some areas, clearing an area too wide could open the landscape to strong winds that could generate more intense fire behavior and/or create wind throw. Fire behavior in the CWPP planning area has been modeled as part of the QWRA. This assessment provides estimates of flame length and other fire behavior; the information should be used by land managers when prescribing treatments.

Strategic placement of fuel breaks is critical to prevent fire from moving from wildland fuels into adjacent neighborhoods. For effective management of most fuels, fuel breaks should be prescribed based on the conditions in each particular treatment area. Some examples of this would be to place fuel breaks in areas where fuels are heavier or in areas with easy access for fire crews. In areas where the vegetation is discontinuous, fuel treatments may not be necessary. In this situation it is best to leave the site in its current condition to avoid the introduction of more flammable, exotic species which may respond readily following disturbance.

Fuel Breaks on the Peninsula

The use of fuel breaks is well practiced across the Borough, with several large fuel break projects in place or in planning. The majority of fuel treatments in Alaskan communities have been inserted as firebreaks (a section of bare, open space to stop the spread of fire) or fuel breaks (a section of vegetation that has been modified to decrease fire behavior) (UAF 2018). The idea is that fuel treatments that reduce fuel loading or alter fuel properties can result in modifications in fire behavior such as limiting a fire to the surface as opposed to a canopy fire (UAF 2018). Lower intensity surface fires may even be beneficial to the ecosystem and allow for improved firefighter access.

Fuel treatments can have a wide range of impacts on the local ecosystem, including unintended impacts. For instance, a study by the UAF and USFS, *Evaluating Fuel Treatments in Alaska* (the study) (UAF 2018), found that a couple sites receiving cleared fuel breaks experienced surface drying, increased flammable surface fuels, and higher mid-flame windspeeds. Another important finding of the study was that fuel breaks can result in unintended tree damage and loss. Pruning punctures and thinning shock increase susceptibility to insect infestation and increases the risk of tree mortality. Additionally, the degree of change in understory plant communities is influenced by fuel treatment type. For example, the study found that significant vegetation shifts occurred with a higher frequency in cleared breaks than in shaded breaks.

Removing or significantly reducing canopy cover alters the ecology of the treated landscape. Negative impacts such as the growth of light and flashy fuels, thawing of the permafrost layer, and increasing tree susceptibility to wind and insect infestation have been noted in treated areas. Therefore, fuel treatments should be planned to keep as much of the canopy cover as possible to shade the understory, decrease wind speeds, and decrease the potential growth of light and flashy fuels. The study determined that a maximum spacing of 8 × 8 feet with pruning from below in interior Alaskan black spruce forests could decrease the potential negative ecological effects of fuel treatment while maintaining the positive benefits of lowering canopy fire potential and allowing for easier fire response access. The study also discovered that rates of spread were often higher in cleared breaks (canopy removal) relative to shaded fuel breaks in white spruce hardwood stands. They also detected the shift from timber understory to a grass and shrub community, with the associated increased rates of spread and flame lengths due to the nature of the new fuels.

Models gauging the effect of fuel breaks on fire behavior indicate that changes to fire behavior persist as much as 14 years post treatment, specifically in interior Alaskan black spruce forests. (UAF 2018). The models were executed under average summer conditions and drier summer conditions; both scenarios showed that fuel treatment lowered fire behavior properties, including rate of spread, flame length, and Fireline intensity (UAF 2018). Overall, the study found that fuel treatments minimize fire behavior potential under a range of weather conditions; however, benefits start decreasing with increasing wind speed. It should also be noted that fuel treatments, particularly around communities, should not be expected to stop a fire without human intervention. Instead, fuel treatments should be planned and implemented within a cohesive fire suppression plan or CWPP that details how the treated area will be utilized to assist fire suppression efforts.

Maintenance of fuel treatments on a consistent schedule will allow for treatments to retain the properties required for reducing fire behavior potential. UAF's 2018 modeling results indicate that changes to fire behavior remain as long as 14 years after treatment, particularly in interior Alaskan black spruce forests. Therefore, UAF (2018) recommends fuel treatments maintenance on a 10- to 15-year period, although slow-growing interior black spruce stands may necessitate longer maintenance periods. UAF (2018) also recommends fuel treatments to be arranged and maintained within a broad fire management plan that details how the treated areas will be utilized by fire personnel in the event of advancing wildfires and the frequency of treatment maintenance.

An example of a recent fuel break on the KPB is the Sterling Fuel Break. The fuel break has been under construction since 2016, and in 2020, the fuel break covered approximately 12 miles along the WUI between Sterling and the Kenai Wildlife Refuge. The fuel break is around 300 feet wide and was constructed using an assortment of methods, equipment, and resources. The next phase of the project is a proposed extension, named the Kenai Fuel Break. This break would be around 8 miles long and 300 feet wide, situated on Kenai Wildlife Refuge land roughly 8 miles northwest of the community of Kenai, and connecting an area between Marathon Road and Spirit Lake, buffering the Homer Electric

and Enstar natural gas utility corridor. The proposed area for the Kenai Fuel Break is unique in that the area has a large amount of beetle-killed spruce trees; treatment of these areas would require felling of dead trees (USFWS 2020a).

Fuel Breaks and Open Space Cleanup

The next location priority for fuels treatments should be where the community meets the wildland. This may be the outer margins of a town or an area adjacent to occluded open spaces such as a park. Fuel breaks (also known as shaded fuel breaks) are strips of land where fuel (for example living trees and brush, and dead branches, leaves or downed logs) has been modified or reduced to limit the fire's ability to spread rapidly (Figure 4.8). Fuel breaks should not be confused with firebreaks, which are areas where vegetation and organic matter is removed down to mineral soil. Shaded fuel breaks may be created to provide options for suppression resources or to provide opportunities to introduce prescribed fire. In many cases, shaded fuel breaks may be created by thinning along roads. This provides access for mitigation resources and firefighters, as well as enhancing the safety of evacuation routes.

Figure 4.8. Shaded fuel break area with deciduous regrowth.

Larger-scale Treatments

Farther away from WUI communities, the emphasis of treatments often becomes broader. While reducing the buildup of hazardous fuels remains important, other objectives are often included, such as forest health and resiliency to catastrophic wildfire and climate change considerations. Wildfires frequently burn across jurisdictional boundaries, sometimes on landscape scales. As such, these larger treatments need to be coordinated on a strategic level. This requires coordination between projects and jurisdictions, as is currently occurring. Land managers have carried out numerous forest restoration projects across the Borough and have ongoing projects planned on public land that are designed to reduce hazardous fuels to protect communities and resources, while restoring fire-adapted communities (see Figure 4.1).

SBB infestation is the top cause of death for mature spruce trees in Alaska and is currently responsible for about 900,000 acres of deceased and dying trees in the southcentral portion of the state. Trees that have been overwhelmed by SBB can begin falling within 1 to 3 years. The buildup of dead and downed trees on the surface can impact wildfire behavior. As such, SBB mitigation efforts are in progress in the Chugach National Forest. The mitigation efforts are being implemented in five USFS campgrounds: Cooper Creek, Quartz Creek, Russian River, Crescent Creek, and Tenderfoot. Mitigation methods are focused on removing dead and dying trees to minimize the risk of wildfire hazards. Contingent on the degree of SBB infestation, treatment options include removal of entire stands of infected trees, thinning infected areas of dense stands, or applying inhibitory agents to protect healthy trees from SBB infestation (USFS 2021e).

Another large-scale treatment currently in progress on the Kenai Peninsula is the Kenai Peninsula Habitat Enhancement (KPHE) project. The KPHE project area comprises over 117 acres and is located on the southern Kenai Peninsula in the Anchor River/Fritz Creek critical habitat area. The project focuses on enhancing moose habitat by stimulating willow regeneration. Treatment consists mainly of mowing mature willows to stimulate regeneration from the base of plants. Other treatments include top-killing or felling of hardwood trees, such as cottonwoods, to encourage stump sprouting (ADFG 2021b).

Fuel Treatment Methods

Since specifics of the treatments are not provided in detail in Table 4.1, different fuels reduction methods are outlined in the following narrative.

Several treatment methods are commonly used, including manual and mechanized treatments and targeted treatments to address hazard trees and beetle kill (Appendix G); prescribed fire is another treatment option that is being considered for additional use in forest and fuels management (Table 4.3). This brief synopsis of treatment options is provided for general knowledge; specific projects will require further planning. The appropriate treatment method and cost will vary depending on factors such as the following:

- Diameter of materials
- Proximity to structures
- Acreage of project
- Fuel costs
- Steepness of slope
- Area accessibility
- Density of fuels
- Project objectives

It is imperative that long-term monitoring and maintenance of all treatments is implemented. Post-treatment rehabilitation such as seeding with native plants and erosion control may be necessary.

Table 4.3. Summary of Fuels Treatment Methods

Treatment	Comments
Machine mowing	Appropriate for large, flat, grassy areas on relatively flat terrain.

Treatment	Comments
Prescribed fire	Not widely used on the Borough but could be integrated into vegetation management through further interagency coordination. Can be very cost effective. Ecologically beneficial. Introducing fire back into a fire adapted ecosystem. Can be used as training opportunities for firefighters. May require manual or mechanical pretreatment. Carries risk of escape, which may be unacceptable in some WUI areas. Unreliable scheduling due to weather and smoke management constraints.
Brush mastication	Brush species tend to re-sprout vigorously after mechanical treatment. Frequent maintenance of treatments are typically necessary. Mastication tends to be less expensive than manual (chainsaw) treatment and eliminates disposal issues.
Timber mastication	Materials up to 10 inches in diameter and slopes up to 30% can be treated. Eliminates disposal issues. Environmental impact of residue being left on site is still being studied.
Manual treatment with chipping or pile burning	Requires chipping, hauling, pile burning of slash in cases where lop and scatter is inappropriate. Pile burning must comply with smoke management policy.
Feller buncher	Mechanical treatment on slopes more than 30% or of materials more than 10 inches in diameter may require a feller buncher rather than a masticator. Costs tend to be considerably higher than masticator.

Manual Treatment

Manual treatment refers to crew-implemented cutting with chainsaws. Although it can be more expensive than mechanized treatment, crews can access many areas that are too steep or otherwise inaccessible with machines. Treatments can often be implemented with more precision than prescribed fire or mechanized methods allow. Merchantable materials and firewood can be removed, while non-merchantable materials are often lopped and scattered, chipped, or piled and burned on-site. Care should be exercised to not increase the fire hazard by failing to remove or treat discarded material in a site-appropriate manner.

Strategic timing and placement of fuels treatments is critical for effective fuels management practices and should be prescribed based on the conditions of each particular treatment area. Some examples of this would be to place fuel breaks in areas where the fuels are heavier and in the path of prevailing winds and to mow grasses just before they cure and become flammable. Also, burning during the hotter end of the prescription is important since hotter fires are typically more effective at reducing heavy fuels and shrub growth. In areas where the vegetation is sparse and not continuous, fuels treatments may not be necessary to create a defensible area where firefighters can work. In this situation, where the amount of fuel to carry a fire is minimal, it is best to leave the site in its current condition to avoid the introduction of exotic species.

Mechanized Treatments

Mechanized treatments include mowing, mastication (ground-up timber into small pieces), and whole tree felling. These treatments allow for more precision than prescribed fire and are often more cost-effective than manual treatment (Figures 4.9–4.13).

Figure 4.9. Fire crew burning out a treated area.
Photo Credit: USFWS 2014

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Figure 4.10. Sterling Fuel Break.
Photo Credit: Inciweb

Figure 4.11. Yukon Fire Crew.
Photo Credit: Chugachmiut Forestry

Figure 4.12. Example of treated stand.
Photo Credit: Chugachmiut Forestry

Figure 4.13. Sterling Fuel Break.
Photo Credit: USFWS (2017)

Mowing, including ATV- and tractor-pulled mower decks, can effectively reduce grass fuels adjacent to structures and along highway rights-of-way (Figure 4.14) and fence lines. For heavier fuels, a number of different masticating machines can be used, including drum- or blade-type masticating heads mounted on machines and ranging in size from a small skid-steer to large front-end loaders. Some masticators are capable of grinding standing timber up to 10 inches in diameter. Other masticators are more effective for use in brush or surface fuels. Mowing and mastication do not actually reduce the amount of on-site biomass but alter the fuel arrangement to a less combustible profile.

In existing fuel break areas, maintenance is crucial especially in areas of encroaching shrubs or trees. In extreme risk areas more intensive fuels treatments may be necessary to keep the fire on the ground surface and reduce flame lengths. Within the fuel break, shrubs should be removed, and the branches of trees should be pruned from the ground surface to a height of 4 to 8 feet, depending on the height of the fuel below the canopy, and thinned with a spacing of at least two to three times the height of the trees to avoid movement of an active fire into the canopy.

Mechanical shears mounted on feller bunchers are used for whole tree removal (Figure 4.15). The stems are typically hauled off-site for utilization while the limbs are discarded. The discarded material may be masticated, chipped, or burned in order to reduce the wildfire hazard and to speed the recycling of nutrients.

Figure 4.14. Example of fuels along roadways.

Figure 4.15. Feller buncher used to remove whole trees.

Prescribed Burning

Prescribed burning is also a useful tool to reduce the threat of extreme fire behavior by removing excessive standing plant material, litter, and woody debris while limiting the encroachment of shrubby vegetation. While not commonly practiced currently on the Borough, in the future, the reintroduction of fire through prescribed methods, would provide ecological benefit to many vegetation communities. Land managers are currently strategizing to increase prescribed burning within the Borough.

If a prescribed burn program is introduced, all prescribed fire operations would be conducted in accordance with federal and state laws and regulations. Public safety would be the primary consideration in the design of any prescribed burn plan so as to not negatively impact the WUI. Agency use of prescribed fire on public lands would be carried out within the confines of the agency's fire management planning documents and would require individual prescribed burn plans that consider smoke management concerns, air quality criteria, and sensitive receptors within the WUI. All burn plans must be approved by the Agency Administrator (AICC 2021a). In addition, all prescribed burn operations must be in accordance with the latest Alaska Department of Environmental Conservation (ADEC) Enhanced Smoke Management Plan. The Interagency Prescribed Fire Planning and Implementation Procedures Guide may be used to supplement burn planning. Furthermore, under Alaska regulation, permits are required for prescribed burn operations depending on the burn size and/or time of year. The ADEC administers permits for burns 40 acres or larger, and the ADNR administers permits for burns 40 acres or less from April 1 through September 1.

Following any type of fuels reduction treatment, post-treatment monitoring should ensure that management actions continue to be effective throughout the fire season. The vegetation within this ecosystem can change rapidly in response to drought or moisture from year to year and during the course of the season, so fuels treatments should be adjusted accordingly.

Several re-entries may be needed to meet full resource management objectives, so a solid maintenance plan is needed to ensure success.

Impacts of Prescribed Fire on Communities

Managing smoke from prescribed fires is an important part of planning for prescribed burning. The ADEC, Division of Air Quality, has smoke management guidelines to protect the health and welfare of Alaskans from the impacts of smoke (AICC 2021a). Smoke from burning vegetation produces air pollutants that are regulated by both the U.S Environmental Protection Agency and the State of Alaska.

More information regarding open burn regulations is provided here: https://dec.alaska.gov/air/air-permit/open-burn-info

Thinning and Prescribed Fire Combined

Combining thinning and prescribed fire can be the most effective treatment (Graham et al. 2004). In forests where fire exclusion or disease has created a buildup of hazardous fuels, prescribed fire cannot be safely applied, and pre-burn thinning is required. The subsequent use of fire can further reduce residual fuels and reintroduce this ecologically imperative process.

Management of Non-Native Plants

The ADNR, Division of Agriculture, maintains a list of noxious weeds rated from A to C based on the current degree of infestation of the species and the potential for eradication (ADNR 2021a). Fuel treatment approaches should always consider the potential for introduction or proliferation of invasive non-native species as a result of management actions.

The list of noxious weeds is available here: http://plants.alaska.gov/invasives/noxious-weeds.htm

The Strategic Plan for Invasive Weed & Agricultural Pest Management and Prevention in Alaska is located here: http://plants.alaska.gov/invasives/strategic-plan.htm

Wildlife Habitat and Species Protections

Alaska contains 365.5 million acres of land, 28.8 million acres of freshwater lakes, rivers and ponds, and 6,640 miles of coastline. Around 88% of the state is in public ownership and many areas are set aside to protect their natural features, including a broad variety of fish and wildlife habitats. These areas differ in their specific purposes and include sanctuaries, critical habitat areas, state wildlife refuges, and waters important to anadromous fish (ADFG 2021c).

Many of the rivers, lakes, and streams in Alaska support a variety of anadromous fish, including Pacific salmon, several species of trout, char, whitefish, lamprey, and smelt. Due to the importance of these fish to Alaska's economy and environment, these waters receive special protections to ensure they keep supporting abundant runs of fish. These protections require that individuals or governmental agencies seeking to construct a hydraulic project or use, divert, obstruct, pollute, or change the natural flow or bed of a specified river, lake, or stream must notify the ADFG (ADFG 2021d).

Critical habitat areas, state wildlife refuges, and wildlife sanctuaries are designated as special areas by the Alaska State Legislature. These areas were created to protect fish and wildlife habitats. Most recreational activities such as fishing, hunting, and wildlife viewing on these lands do not require a permit. However, many other activities that have the potential to impact fish, wildlife, or habitats require a permit. Activities requiring a permit include, but are not limited to, clearing or disturbing vegetation, construction or placement of structures, streambank or shoreline modifications, and any activity that is likely to have a significant effect on vegetation, drainage, water quality, soil stability, fish, wildlife, or their habitat (ADFG 2021e).

Because stream crossing and water withdrawals during wildland fire suppression activities constitute a disruption to fish and their habitat, the DOF has obtained a permit from the ADFG for fire response activities on the peninsula. The permit is valid from December 21, 2020, through December 31, 2025. The permit applies to waterbodies throughout the state and allows for the following (ADFG 2020):

- Crossing all resident fish waterbodies and the extents of catalogued waterbodies not designated as spawning habitat for anadromous fish with vehicles and heavy equipment.
- The potential construction of reinforced crossing structures, aerial scooping, and subsurface pumping of water from waterbodies during wildland fire–related suppression activities.

In addition, the permit stipulates that projects proposed by the DOF should not have adverse impacts on anadromous fish or their habitat and should not obstruct the free passage of fish, in accordance with the Anadromous Fish Act and Fishway Act (ADFG 2020).

There are several special areas within the KPB managed by a number of agencies that may require special treatment.

More information about ADFG protected areas can be found here:
https://www.adfg.alaska.gov/index.cfm?adfg=conservationareas.locator

The ADFG protected waters on the Kenai Peninsula can be found in the Anadromous Water Catalog:
https://www.adfg.alaska.gov/sf/SARR/AWC/index.cfm?ADFG=maps.displayViewer

Information about protected areas on federally managed land is provided in Appendix A.

Land treatments that are used to reduce fuels are also potentially beneficial to wildlife and their habitats. Crushing and burning vegetation may not appear to be ecosystem enhancements, but wildland fires are a natural part of the interior Alaska ecosystem, and animals and plants have adapted to periodic fires.

Plants like willow, fireweed, aspen, and birch are nutritious, high-quality forage for moose. These plants typically regenerate and thrive after specific kinds of disturbances, such as fire or smashing. Renewing growth isn't the only benefit of fire. Standing dead trees provide roosts for birds of prey and homes for cavity nesters such as woodpeckers. Downed trees provide cover for hares, voles, and marten—shelter that is critically needed in winter (ADFG 2015).

Another process that stimulates plant growth is the large chunks of ice that are rafted down rivers and rake riverbanks and gravel bars. Mechanical crushing imitates the process and encourages plant regeneration as well. For instance, when aspen are cut down, they resprout quickly by producing root suckers. Different age classes of aspen provide varied resources to ruffed grouse throughout the year. Older aged aspens provide breeding and wintering habitat. Younger, denser aspen stands provide cover for clutches of chicks in summer, shielding them from predators (ADFG 2015).

COHESIVE STRATEGY GOAL 2: FIRE ADAPTED COMMUNITIES

Goal 2 of the Cohesive Strategy/Western Regional Action Plan is: Fire-Adapted Communities: Human populations and infrastructure can withstand a wildfire without loss of life and property. The basic premise of this goal is:

> *"Preventing or minimizing the loss of life and property due to wildfire requires a combination of thorough pre-fire planning and action, followed by prudent and immediate response during a wildfire event. Post-fire activities can also speed community recovery efforts and help limit the long-term effects and costs of wildfire. CWPPs should identify high-risk areas and actions residents can take to reduce their risk. Fuels treatments in and near communities can provide buffer zones to protect structures, important community values and evacuation routes. Collaboration, self-sufficiency, acceptance of the risks and consequences of actions (or non-action), assisting those who need assistance (such as the elderly), and encouraging cultural and behavioral changes regarding fire and fire protection are important concepts. Attention will be paid to values to be protected in the middle ground (lands between the community and the forest) including: watersheds, viewsheds, utility and transportation corridors, cultural and historic values, etc."* (Western Regional Strategy Committee 2013:15).

Strategic actions listed within the ALAH Action Plan that serve the goal of **creating fire adapted communities** include (KPB Interagency 2018) the following:

- Inform and support communities that want to participate as a FAC that shares the responsibility for wildland fire mitigation practices.
- Collaboratively update and implement CWPPs.
- Promote fire resilient structures and defensible space practices advocated through nationally recognized programs.
- Support local response agencies with the capability to help communities prepare for and respond to wildland fires, including but not limited to establishing and promoting evacuation procedures and routes.
- Ensure that cooperative agreements among response agencies are current.
- Influence governing codes or ordinances that guide development within the WUI.

- Include as many stakeholders as possible in the design and implementation of fuel breaks to ensure a community-wide approach to fuels reduction projects.

In this CWPP update, recommendations for fire-adapted communities include public education and outreach actions and actions to reduce structural ignitability.

RECOMMENDATIONS FOR PUBLIC EDUCATION AND OUTREACH

Just as environmental hazards need to be mitigated to reduce the risk of fire loss, so do the human hazards. Lack of knowledge, lack of positive actions, and negative actions all contribute to increased risk of loss in the WUI.

Many residents understand the risk that wildfire poses to their communities. However, it is important to continually raise awareness of fire risk and improve fire education, particularly because the Borough is composed of such a vast area of forested public land that has been experiencing an intensified wildfire pattern (IARC 2021a). Table 4.4 lists recommendations for improving public education and outreach.

There are currently no Firewise certified communities within the Kenai Peninsula Borough. The Borough would benefit from greater exposure to the Firewise Communities (NFPA 2021), Fire Adapted Communities (Fire Adapted 2021), and Ready, Set, Go! (International Association of Fire Chiefs 2021) programs. Firewise programs have been found to motivate residents to carry out defensible space and other actions within their community, empower residents to take control of addressing wildfire risk, improve community cohesion through collective actions, and encourage coordination of outside agencies (Evan et al. 2019). Continuing enthusiasm over long periods is difficult however, particularly if a community "spark plug" or active coordinator leaves or steps down (Evans et al. 2015). Greater participation in these programs could improve local understanding of wildfire and, in turn, improve protection and preparedness.

Other methods to improve public education could include increasing awareness about fire department response and fire department resource needs; providing workshops at demonstration sites showing Firewise Communities landscaping techniques or fuels treatment projects; organizing community cleanups to remove green waste; publicizing availability of government funds for thinning and prescribed burning on private lands; and, most importantly, improving communication between homeowners and local land management agencies to improve and build trust, particularly because the implementation of fuel treatments and better maintenance of existing treatments needs to occur in the interface between public and private lands.

Considering the shared nature of wildfire risk experienced by numerous WUI communities, getting homeowners to implement fuel treatments on their property is usually a challenging task. However, it has been suggested that willingness to private wildfire risk mitigation activities is influenced by the presence and category of fuel treatment on adjacent public lands. A survey conducted by UAF (2018) found that homeowners were more likely to perform fuel treatments on their property if the neighboring lands had been treated. Homeowners were also more likely to execute the fuel treatment if the type was shaded fuel breaks as opposed to cleared fuel breaks. Furthermore, fuel breaks around communities endow a sense of protection in the event of a wildfire; thus, allowing communities to respond calmly in the event of a potentially dangerous situation (UAF 2018).

Table 4.4 lists public education and outreach projects recommended for implementation in the Borough.

RECOMMENDATIONS FOR REDUCING STRUCTURAL IGNITABILITY

Table 4.4 also provides a list of community-based recommendations to reduce structural ignitability that should be implemented throughout the CWPP planning area. Reduction of structural ignitability depends largely on public education that provides homeowners the information they need to take responsibility for protecting their own properties. A list of action items that individual homeowners can follow can be found below. Carrying out fuels reduction treatments on public land may only be effective in reducing fire risk to some communities; however, if homeowners have failed to provide mitigation efforts on their own land, the risk of home ignition remains high, and firefighter lives are put at risk when they carry out structural defense.

Preparing for wildland fire by creating defensible space around the home is an effective strategy for reducing structural ignitability. Studies have shown that burning vegetation beyond 120 feet of a structure is unlikely to ignite that property through radiant heat (Butler and Cohen 1996), but fire brands that travel independently of the flaming front have been known to destroy houses that had not been impacted by direct flame impingement. Hardening the home to ignition from embers, including maintaining vent coverings and other openings are also strongly advised as measures to protect a home from structural ignitability. Education about managing the landscape around a structure, such as removing weeds and debris within a 30-foot radius and keeping the roof and gutters of a home clean, are maintenance measures proven to limit combustible materials that could provide an ember bed and ignite the structure. Educating people about the benefits of proper maintenance of their property that includes pruning and trimming trees and shrubs and, where warranted, the removal of trees and other vegetation, and using Firewise Communities landscaping methods on their property is also essential for successful household protection.

It is important to note that no two properties are the same. Homeowners and communities are encouraged to research which treatments would have the most effect for their properties. Owners of properties on steep slopes, for example, should be aware that when constructing defensible space, they have to factor in slope and topography, which would require extensions to the conventional 30-foot recommendations. More detailed information on reducing structural ignitability can also be found in Appendix G (Additional Resources).

Some structural ignitability hazards are related to homes being in disrepair, vacant or abandoned lots, and minimal yard maintenance. In order to influence change in homeowner behavior, county ordinances may be needed.

In addition to protection of residences and other values, the Core Team convened a focus group meeting with KPB utility providers and fire responders, to discuss protection of strategic infrastructure. Those recommendations are provided in Table 4.4.

Table 4.4. Recommendations for Creating Fire-Adapted Communities (Public Education and Outreach and Structural Ignitability)

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Increase understanding of the importance that fire plays in maintaining resilient landscapes	Kenai Peninsula-wide	FWS - Kenai Refuge Kenai Peninsula Borough ADGF State Forestry USFS	• Create interpretative trails in burn areas. • Place education signage at strategic turnouts along highways that show history / recovery, etc. • Build upon existing efforts to educate residents and visitors on the benefits of wildfire for forest health, wildlife habitat and resilience to insect and disease. • Project for ALAH group.	• Create resilient landscapes and address potential for extreme wildfire behavior in and around communities.	Ongoing	H	• Review progress annually • Number of educational initiatives	• National Interagency Fire Center • Firewise Communities • Serve Alaska • Matching Awards Program • Western Wildland-Urban Interface (WUI) Grants • Private Landowner Assistance Grant • Hazard Mitigation Planning Assistance • Community Development Block Grants – Mitigation - Alaska • Alaska Firewise
Promote publicly the use of a mixed mosaic of fuel types and structures for wildfire risk reduction in the WUI	Kenai Peninsula-wide	State Forestry, Kenai Peninsula Borough ADGF Kenai Peninsula Builders Association Watershed Forum, Nature Conservancy, others	• Create mosaic landscapes in public places (demonstration site) to serve as example of vegetation management actions for wildfire mitigation and wildlife habitat improvement- i.e., refuge around high valued infrastructure. • Promote using a multi-media outreach campaign to build understanding and support. • Develop vegetation graphic that can be shared across multiple agencies on the use of vegetation management to create resilient landscapes in the WUI. Build on existing educational materials developed by State Forestry. • Cooperative Extension education outreach, tree / shrub giveaways	• Create resilient landscapes and address potential for extreme wildfire behavior in and around communities.	Start within 1 year, and make this an ongoing project	H	• Review progress annually	• National Interagency Fire Center • Firewise Communities • Serve Alaska • The National Fire Plan (NFP) • Matching Awards Program • Environmental Education Grants • The Fire Prevention and Safety Grants (FP&S) • Environmental Systems Research Institute (ESRI) • Western Wildland-Urban Interface (WUI) Grants • Private Landowner Assistance Grant • Hazard Mitigation Planning Assistance • Community Development Block Grants – Mitigation - Alaska • Alaska Firewise
Build self-assessment (“self-planning”) tools into existing forest stewardship planning.	Kenai Peninsula-wide	State Forestry	• Create self-assessment protocol. Consider NFPA 1144 (or similar) protocols. • Create a train-the-trainer methodology for assessment. Train the fire departments, HOAs etc. • Post to stewardship website (State Forestry) • Utilize consistent literature for defensible space etc. • Utilize consistent literature for structure hardening. • Capitalize on elevated interest in structural ignitability and stewardship plans due to bark beetle concerns and increased fire activity.	• Increase adoption of measures to reduce structural ignitability	Start within 1 year, and make this an ongoing project	H	• Annual review of number of assessments completed	• Firewise Communities • National Fire Protection Association • Hazard Mitigation Grant Program (HMGP) • Alaska Firewise • Hazard Mitigation Planning Assistance • Community Assistance Program • Community Development Block Grants – Alaska

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Target fire prevention efforts to "younger" or first-time homeowners	Kenai Peninsula-wide	Kenai Peninsula Borough Area banks, mortgage companies, local realtor assn.	• Capitalize on a thirst for knowledge from younger generation of land/homeowners. Show them to protect their investments. Build messaging around following patterns: o Younger demographic of landowners o Market to seasonal properties owners • Provide the resources residents need to take action: 1) stewardship self-assessment 2) creating a toolbox (house within the Story Map)	• Build capacity of residents to address their own wildfire risk.	Start within 1 year, and make this an ongoing project	H	• Annual review of materials developed and assess future needs	• Firewise Communities • National Fire Protection Association • National Interagency Fire Center • Environmental Education Grants • Alaska Firewise
Encourage Firewise participation (*Meets goal of the 2019 KPB HMP- Protect residents and structures in the WUI- Table 3.5*)	Kenai Peninsula-wide	Multi-agency	• Restore the Firewise Program (*from the 2019 KPB HMP*) • Capitalize on elevated interest in structural ignitability and stewardship plans due to bark beetle concerns and increased fire activity. • Increase number of Firewise certified communities. • Provide education for citizens on defensible space and encourage self-assessment	• Build visibility of fire prevention efforts.	Start within 1 year, and make this an ongoing project	H	• Document the number of new Firewise communities.	• Firewise Communities • National Fire Protection Association • Environmental Systems Research Institute (ESRI) • National Interagency Fire Center • Environmental Education Grants • The Fire Prevention and Safety Grants (FP&S) • Community Development Block Grants – Mitigation - Alaska • Alaska Firewise
Increase promotion/ awareness of agency actions (*Meets goal of the 2019 KPB HMP- Shared public messaging to reduce human caused fires- Table 3.6*)	Kenai Peninsula-wide	Kenai Peninsula Borough	• Form a working group to develop consistent and continuous messaging to the public on ongoing activities related to forestry, fuels and fire mitigation (maybe a committee under the ALAH group). • Post maps of treatments on the story map. • Provide updates on ongoing initiatives online and through public meeting formats- i.e., Sterling Fuel Break progress. • Create a video series to communicate that forest crews are working on activities. • Encourage community engagement through regular meetings to gather input. • Encourage community participation in fuel load education and planning.	• Build visibility of fire prevention efforts and benefits. • Improve understanding of ongoing work to protect communities and infrastructure	Start within 1 year, and make this an ongoing project	H	• Review of number of meetings held • Review of number of posts provided on online media • Assess understanding of public through surveys.	• Firewise Communities • National Fire Protection Association • Environmental Systems Research Institute (ESRI) • National Interagency Fire Center • Environmental Education Grants • The Fire Prevention and Safety Grants (FP&S) • Serve Alaska • Alaska Firewise • Community Assistance Program • Hazard Mitigation Planning Assistance
Promote and utilize a range of outreach types (*Meets goal of the 2019 KPB HMP- Notify landowners in high-risk areas- Table 3.7*)	Kenai Peninsula-wide	All agencies	• Bring awareness beyond social media – utilize brick and mortar venues and other media like prints (post offices, grocery stores, utility flyers) chamber of commerce, senior citizen centers • Provide in-person and radio education and outreach for people that do not engage in "online" activities • Promote all existing multi-media educational materials- i.e., Chugachmiut video series, Division of Forestry media, outreach videos (created by John Winters) and other materials • Utilize PSA's when appropriate	• Enhance education and outreach	Start within 1 year, and make this an ongoing project	M	• Assess effectiveness of messaging through surveys	• Firewise Communities • Environmental Systems Research Institute (ESRI) • National Interagency Fire Center • Environmental Education Grants • The Fire Prevention and Safety Grants (FP&S) • Alaska Firewise

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Invest in workforce training for forestry and wildfire careers	Kenai Peninsula-wide	Kenai Peninsula Economic Development District Multi-agency working group	• Build capacity and interest in forest-based careers through development and maintenance of youth forestry/fire programs • Utilize existing programs to support youth development – i.e. Student Conservation Association, Forest Service Pathways Program. • Work with Peninsula based academic institutions to identify potential opportunities for associate degree programs in fire management and fire ecology • Work with KPBSD to have a fire danger component added to curriculum in spring, prior to leaf out (*from 2019 KPB HMP*)	• Enhance and build future workforce to manage wildfire management and fuels concerns • Increase opportunities for Peninsula youth	Within next 5 years	M	• Annual program review	• Agency budgets • Firewise Communities • Environmental Systems Research Institute (ESRI) • National Interagency Fire Center • Environmental Education Grants • The Fire Prevention and Safety Grants (FP&S) • Alaska Firewise • Community Assistance Program
Build consistent messaging for wildfire mitigation actions	Kenai Peninsula-wide	Kenai Peninsula Borough CWPP Story Map	• Utilize the CWPP Story Map as a one-stop shop for education materials and literature. • Create an inventory (database) of existing materials • Create a QR code list of literature • Work with ALAH group to determine consistent messaging and outreach	• Build capacity for fire adapted communities	Ongoing	H	• Ensure maintenance and update of Story Map. • Refresh messaging as policies changes.	• Agency budgets • Alaska Firewise
Increase scope and frequency of outreach (*Meets goal of the 2019 KPB HMP- Encourage fire adapted communities- Table 3.6*)	Kenai Peninsula-wide	Kenai Peninsula Borough CWPP Story Map	• Review existing programs (Ready-Set-Go, Firewise, FAC) for suitability of existing fire prevention materials and where necessary fund development of unique adapted materials and presentations to highlight how a fire might affect particular groups within the community while promoting the fire adapted community framework. • Increase number and frequency of face-to-face opportunities to engage with the public in wildfire mitigation education and activities. • Highlight the fact that fire is impacting protection of values at risk and sensitive environmental concerns like habitat management. • Consider hiring a communications officer for the Peninsula who should pursue continuous and repeat interactions with residents to generate greater mitigation actions. • Utilize local events for outreach on wildfire mitigation. • Increase community education and outreach about climate change hazards, emergency preparedness and sheltering options. • Develop educational messages that are locally relevant to help residents be more prepared for wildfire, including a defensible space checklist specific to local structural and wildland fuel considerations. • Continue to emphasize message of personal responsibility for hazard reduction in regard to structural ignitability.	• Engage a broad cross-section of the population instead of attracting only those residents who are already engaged in fire prevention and risk reduction activities. • Social science has shown that face-to-face engagement is the most effective way to generate action. • Deliver a clear and consistent message that impacts of wildfire are far-reaching and that it is in the best interest of a diverse set of stakeholders to become involved in planning and preparing for fire.	Initiate focus on this task within 3 months of completion of CWPP	H	• Develop a regular meeting cadence	• Agency budgets • Firewise Communities • Environmental Systems Research Institute (ESRI) • National Interagency Fire Center • Environmental Education Grants • The Fire Prevention and Safety Grants (FP&S) • Hazard Mitigation Planning Assistance • Community Assistance Program • Community Development Block Grants – Alaska • Alaska Firewise

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Develop education campaign for beetle kill tree removal	Kenai Peninsula-wide	State Forestry, Kenai Peninsula Borough, Cities and Communities	• Provide directions on best management practices for the treatment and removal of dead trees. • Develop multi-media education materials for distribution. • Develop printed materials for distribution. • Example content- Inform citizens to only cut dead trees if they have a plan to remove them. o If they are unable to remove them, the cut trees present a greater risk than leaving them standing. • Use “sleeves up for the summer” as an example campaign • Have a familiar face or someone who is trusted by the public to deliver the message • Develop campaigns year-round to continue to raise awareness	• Protect communities and infrastructure through increasing public awareness	Within next 6 months	H	• Review annually the success of campaign and additional information needs	• Agency budgets • Firewise Communities • Environmental Systems Research Institute (ESRI) • National Interagency Fire Center • Environmental Education Grants • The Fire Prevention and Safety Grants (FP&S) • Western Bark Beetle Initiative Grant Program • Hazard Mitigation Planning Assistance
Increase messaging to the public about the potential for slow response times at distance from fire departments.	Kenai Peninsula-wide	Fire Departments State Forestry, Kenai Peninsula Borough, Cities and Communities	• Greater transparency and facts are needed regarding fire dept capacity to respond to fires that are located in rural areas. • Emphasize the importance of personal responsibility in these areas. • Provide list of realistic measures homeowners can implement to be more prepared for fire in areas with slow response times.	• Increase education to enhance homeowner capacity to address fire risk	Start within 1 year, and make this an ongoing project	H	• Review annually the success of campaign and additional information needs	• Agency budgets • Firewise Communities • Alaska Firewise • Community Assistance Program
Increase education and outreach on Fire Management Options	Kenai Peninsula-wide	State Forestry, State Forestry, Kenai Peninsula Borough, ADGF, USFS Kenai Refuge	• Create public outreach campaign that avoids terminology and jargon as much as possible. • Multi-agency effort and messaging needed. • Utilize the story map and share via a range of platforms. • Use models from large companies, such as Marathon, to spread the word to employees. • Possibly hire a marketing group to help with messaging to the public. • People understand critical response but have inadequate understanding of “limited and moderate” response. Focus on these issues.	• Increase education to enhance understanding and trust between public and fire response agencies.	Start within 1 year, and make this an ongoing project	H	• Review annually and update as needed	• Agency budgets • Firewise Communities • Environmental Systems Research Institute (ESRI) • National Interagency Fire Center • Environmental Education Grants • The Fire Prevention and Safety Grants (FP&S)
Provide liability insurance education	Kenai Peninsula-wide	Insurance companies in partnership with Kenai Peninsula Borough and Fire Depts.	• Provide information for homeowners about liability insurance and wildfire. • Look for incentives by insurance companies for implementation of defensible space.	• Protect communities and infrastructure through increasing public awareness	Start within 2 years, and make this an ongoing project	M	• Update frequently as insurance policies and requirements change • Market incentives widely.	• Agency budgets
Increase awareness about burn permits	Kenai Peninsula-wide, especially in communities located on the east side	State Forestry	• Need to increase people’s awareness about the importance of burn permits and why they are needed. • Increase outreach through different channels- fire dept, dispatch, community events, printed materials in utility bills, etc. • Use permit interactions to also emphasize Firewise actions. • Need to address the (unintended) consequence of online burn permits. • People are no longer calling the fire departments when they start a fire, but fire departments still need this information. • Have a “closed” season for debris burning • Ensure funding accounts for personnel time for CES, Dispatch, Municipalities	• Protect communities and infrastructure through increasing public awareness	Start within 1 year, and make this an ongoing project	M	• Assess awareness annually and restructure outreach as needed. • Ensure more continuous boots-on-the-ground messaging	• Agency budgets • Firewise Communities • National Interagency Fire Center • Environmental Education Grants • The Fire Prevention and Safety Grants (FP&S) • Funding for Fire Departments and First Responders • Alaska Firewise

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Develop educational messages for recreationist (*Meets goal of the 2019 KPB HMP- Notify public and visitors of fire danger and procedures- Table 3.7*)	Kenai Peninsula-wide	State Forestry, Kenai Peninsula Borough, Cities and Communities	• Target public outreach to recreationist • Install signage at popular recreation sites • Educate recreationists about risk of fire, particularly in the spring when there is a greater risk of grass fire • Provide reader board type signs at highly visible Borough locations (highway or main thoroughfare locations such as the Solid Waste site, transfer facilities, highway fronting schools) showing hazard danger as needed (*from 2019 KPB HMP*).	• Protect communities and infrastructure through increasing public awareness	Start within 1 year, and make this an ongoing project	H	• Assess awareness annually and restructure outreach as needed if ignitions increase	• Agency budgets • National Interagency Fire Center • Environmental Education Grants • The Fire Prevention and Safety Grants (FP&S) • Alaska Firewise
Increase structure hardening of public buildings and structures	Kenai Peninsula-wide	All government agencies	• Number of wooden bridges on KPB lands • Harden for long term use, maintain more often • Retrofit/replace flammable roofs on public buildings	• Increase structure resilience to wildfire	Start within 1 year, and make this an ongoing project	H	• Document accomplishments	• RAISE Discretionary Grants • Infrastructure For Rebuilding America • Pre-disaster Mitigation (PDM) Grant Program • Building Resilient Infrastructure and Communities (BRIC) program • Hazard Mitigation Planning Assistance • Community Assistance Program • Community Development Block Grants – Alaska • Community Development Block Grants – Mitigation - Alaska
Identify vulnerable populations who may require assistance during fire prevention, fire response and post fire recovery phases.	Kenai Peninsula-wide	Kenai Peninsula Borough, Cities and Communities	• Convene a working group to collectively identify and document vulnerable populations (elderly, disabled, low income, indigenous populations) who may need additional assistance to carryout defensible space treatments, structure hardening, enhancing ingress/egress, preparing their family for evacuation, safely navigating evacuation processes, and returning post-fire. • Identify and evaluate funding needs to provide sufficient support.	• Reduces hurdles for residents to achieve fire prevention • Provides for public safety in the event of an incident	Within 2 years	H	• Document number of meetings held to address these issues.	• Agency budgets • Serve Alaska • Firewise Communities • National Fire Protection Association • Environmental Systems Research Institute (ESRI) • National Interagency Fire Center • Private Landowner Assistance Grant • Alaska Firewise • Hazard Mitigation Planning Assistance • Community Development Block Grants – Mitigation - Alaska

Action Items for Homeowners to Reduce Structural Ignitability

Low or No Cost Investment (<$50)	Regularly check fire extinguishers and have a 100-foot hose available to wet perimeter.
	Maintain defensible space for 30 feet around home. Work with neighbors to provide adequate fuels mitigation in the event of overlapping property boundaries.
	Make every effort to keep lawn mowed and green during fire season.
	Screen vents with non-combustible meshing with mesh opening not to exceed nominal ¼-inch size.
	Ensure that house numbers are easily viewed from the street.
	Keep wooden fence perimeters free of dry leaves and combustible materials. If possible, non-combustible material should link the house and the fence.
	Keep gutters free of vegetative litter. Gutters can act as collecting points for fire brands and ashes.
	Store combustible materials (firewood, propane tanks, grills) away from the house; in shed, if available.
	Clear out materials from under decks and/or stacked against the structure. Stack firewood at least 30 feet from the home, if possible.
	Reduce your workload by considering local weather patterns. Because prevailing winds in the area are often from the west-southwest, consider mitigating hazards on the west corner of your property first, then work around to cover the entire area.
	Seal up any gaps in roofing material and enclose gaps that could allow fire brands to enter under the roof tiles or shingles.
	Remove flammable materials from around propane tanks.
Minimal Investment (<$250)	When landscaping in the home ignition zone (HIZ) (approximately 30 feet around the property), select non-combustible plants, lawn furniture, and landscaping material. Combustible plant material like junipers and ornamental conifers should be pruned and kept away from siding. If possible, trees should be planted in islands and no closer than 10 feet to the house. Tree crowns should have a spacing of at least 18 feet when within the HIZ. Vegetation at the greatest distance from the structure and closest to wildland fuels should be carefully trimmed and pruned to reduce ladder fuels, and density should be reduced with approximately 6-foot spacing between trees crowns.
	Box in eaves, attic ventilation, and crawl spaces with non-combustible material.
	Work on mitigating hazards on adjoining structures. Sheds, garages, barns, etc., can act as ignition points to your home.
	Enclose open space underneath permanently located manufactured homes using non-combustible skirting.
	Clear and thin vegetation along driveways and access roads so they can act as a safe evacuation route and allow emergency responders to access the home.
	Purchase or use a National Oceanic and Atmospheric Administration weather alert radio to hear fire weather announcements.

Moderate to High Investment (>$250)	Construct a non-combustible wall or barrier between your property and wildland fuels. This could be particularly effective at mitigating the effect of radiant heat and fire spread where 30 feet of defensible space is not available around the structure.
	Construct or retrofit overhanging projections with heavy timber that is less combustible.
	Replace exterior windows and skylights with tempered glass or multilayered glazed panels.
	Invest in updating your roof to non-combustible construction. Look for materials that have been treated and given a fire-resistant roof classification of Class A. Wood materials are highly combustible unless they have gone through a pressure-impregnation fire-retardant process.
	Construct a gravel turnaround in your driveway to improve access and mobilization of fire responders.
	Treat construction materials with fire-retardant chemicals.
	Install a roof irrigation system.
	Replace wood or vinyl siding with nonflammable materials.
	Relocate propane tanks underground.

COHESIVE STRATEGY GOAL 3: WILDFIRE RESPONSE

Goal 3 of the Cohesive Strategy/Western Regional Action Plan is Wildfire Response: All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions:

> *"A balanced wildfire response requires integrated pre-fire planning with effective, efficient, and coordinated emergency response. Pre-fire planning helps tailor responses to wildfires across jurisdictions and landscape units that have different uses and management objectives. Improved prediction and understanding of weather, burning conditions, and various contingencies during wildfire events can improve firefighting effectiveness, thereby reducing losses and minimizing risks to firefighter and public health and safety. Wildfire response capability will consider the responsibilities identified in the Federal Response Framework. Local fire districts and municipalities with statutory responsibility for wildland fire response are not fully represented throughout the existing wildland fire governance structure, particularly at the NWCG, NMAC, and GACC levels."* (Western Regional Strategy Committee 2013:15).

Strategic actions listed within the ALAH Action Plan to serve the goal of **safe and effective wildfire response** include (KPB Interagency 2018):

- Develop and implement standards and protocols that strengthen national mobilization capabilities.
- Invest in the wildland firefighting workforce at all levels (federal, state, tribal, territorial, and local) to meet the increasing complexities and demands of firefighting in the wildland urban interface.
- Manage wildfires to both protect values and accomplish resource management objectives

RECOMMENDATIONS FOR IMPROVING FIRE RESPONSE CAPABILITIES

Educating the public so they can reduce dependence on fire departments is essential because these resources are often stretched thin due to limited personnel and the scale of the response area. Table 4.5 provides recommendations for improving firefighting capabilities. Many of these recommendations are general in nature with more specific community related recommendations presented in Appendix D.

Table 4.5. Fire Response Capability Recommendations

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Enhance situational awareness and communications	Peninsula Wide	ALAH group	• ALAH provides a model for interagency cooperation • Continue to encourage open communication • Pursue annual updates • Utilize the QWRA to guide treatments • Develop a master spreadsheet to track accomplishments	• Add more capacity	Ongoing	H	• Regular meetings and email updates	• Agency budgets • Emergency Management Performance Grant (EMPG) • Community Assistance Program
Support additional wildland crews with increased Peninsula-wide capacity	Kenai Peninsula-wide	State Forestry USFS	• In addition to the Yukon Crew, add another State sponsored Type 2 crew (See Resilient Landscape Matrix – feasibility study). • Type 2 crews would: o Receive training for fire response and fuels management o operate seasonally (April-October) o would serve in a fuel's role initially until fire suppression quals are expanded o Once qualified, crew members could be "farmed out" to local initial attack crews, for training etc. • Need to carefully consider the evolution of a new type 2 crew. • Closely plan out crew qualifications. • Budget sufficient funds for administration and oversight. • Fully consider budget line items.	• Add more capacity and provide for safe and effective wildfire response	Start within 1 year, and make this an ongoing project	H	• Closely assess accomplishment, needs, budgetary constraints annually. • Plan goals each year as part of multi-agency meeting.	• Funding for Fire Departments and First Responders • ~~Volunteer Fire Assistance~~ Program • Staffing for Adequate Fire and Emergency Response (SAFER) • Assistance to Firefighters Grants (AFG) • State and Private Forestry Programs – NASF • National Fire Protection Association • GSA-Federal Excess Personal Property • Community Assistance Program • Community Development Block Grants – Alaska
Improve fire notifications and coordination between Alaskan Native Villages and Incident Command Teams	Kenai Peninsula-wide	Fire response agencies and Alaskan Native Villages	• Need to improve fire notifications and coordination between Alaskan Native village lands and incident management teams to make sure cultural values are considered when developing suppression strategies. Encourage use of MIST (minimum impact suppression strategies) on Village lands.	• Use of MIST tactic to limit harmful impacts to cultural resources	Ongoing	H	• Annual review and update of contacts at Alaskan Native Villages	• Pre-disaster Mitigation (PDM) Grant Program • Building Resilient Infrastructure and Communities (BRIC) program • General Assistance Program • Regional Catastrophic Preparedness Grants • Community Development Block Grants – Alaska
Increase the number of "red-carded" individuals in each fire department	Kenai Peninsula-wide	All fire departments	• NWCG Basic Wildland Fire Fighting and Fire Behavior, S-130/ S-190 classes to VFDs every Fall with an option to attend on weekends. • Possible incentives needed to encourage attendance. • Use online forum to facilitate scheduling. • Work with State and federal agencies to develop evening and weekend courses for volunteers (volunteers on fire line can be a liability and labor law problem). • Pursue online training programs and have trainees work with an in-house trained mentor to complete training. • Utilize available funds for volunteers to participate in annual Wildfire Academy. • Educate fire departments on the availability of volunteer fire assistance grants that could be used to purchase equipment and support training. • Seek funding to increase availability of state training specialists	• Add more capacity to the local fire departments and provide for safe and effective wildfire response • Not just suppression staff but others like: staging area / supply, Ground Support, PIO, LOFR, Logistics support, admin positions	Ongoing	H	• Annual review of training opportunities and barriers to attendance	• VFA • Funding for Fire Departments and First Responders • Emergency Management Performance Grant (EMPG) • Regional Catastrophic Preparedness Grants • Volunteer Fire Assistance Program • Staffing for Adequate Fire and Emergency Response (SAFER) • Assistance to Firefighters Grants (AFG) • State and Private Forestry Programs – NASF • National Fire Protection Association • GSA-Federal Excess Personal Property • Community Assistance Program

Commented [VA8]: Core Team- as noted above, John Winters provided a list of considerations when moving this project forward.

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
								• Community Development Block Grants – Alaska
Need better preparation for emerging fire and fuels issue, fire behavior and climate change	Kenai Peninsula-wide	USFS (have climate assessment)	• WUI is growing, but fire resources are not. • Need climate vulnerability assessment for resource needs. Utilize and expand upon Chugach NF climate vulnerability assessment to identify vulnerable areas to prioritize treatments and strategies.	• Increase capabilities of existing personnel	Within next 3 years	H	• Review progress of discussions annually.	• Urban and Community Forestry Program, 2021 National Urban and Community Forestry Challenge Cost Share Grant Program • Leonardo DiCaprio Foundation Grants • Community Development Block Grants – Mitigation – Alaska • Hazard Mitigation Planning Assistance • Western Wildland-Urban Interface (WUI) Grants • Alaska Climate Change Impact Mitigation Program
Develop and coordinate a Peninsula wide comprehensive online emergency preparedness, response, and recovery plan. (*Meets goal of the 2019 KPB HMP- Maintain a viable and functional response plan- Table 3.5*)	Kenai Peninsula-wide	Collaborative effort, led by Kenai Peninsula Borough OEM	• Create an online dashboard for use by emergency management agency decision support. • Dashboard would be created in a Story Map or "Hub" format and would include: o Break dashboard into sections of the emergency management cycle: preparedness, response, recovery o Identify roles and responsibilities for each agency/partner under each section of the cycle o Include BMPs for each section of the cycle o Include coordination plan for interagency communications before, during and after an event o Include a tracking module to track actions needed and status o include a funding matrix to support implementation of actions o align actions as closely as possible with the Peninsula and State HMP	• Improve fire response and readiness across the Peninsula. • Could be used to initiate an assessment of Peninsula-wide emergency management protocols.	Within 2 years	H	• Would be an active and live platform, updated in real time and reviewed on an annual basis	• FEMA • Agency budgets • Emergency Management Performance Grant (EMPG) • Regional Catastrophic Preparedness Grants • Hazard Mitigation Planning Assistance • Community Assistance Program • Community Development Block Grants – Alaska • Alaska Firewise
Complete inventory of available equipment for inter-operations	Kenai Peninsula-wide	All agencies	• Inventory apparatus and equipment across Peninsula to assess agency sharing options. • Identify apparatus needs that could be fulfilled through sharing agreements- i.e., UTV for accessing inaccessible areas, boat for coastal access. • Identify non-suppression support services such as caterers, camp support, car / truck rental, etc. (i.e., local oil field support contractors do this)	• Improve fire-fighting response when available equipment is identified	Start within 1 year	H	• Annual inventory of equipment needs, including assessment of equipment condition	• Agency budgets • Emergency Management Performance Grant (EMPG) • Regional Catastrophic Preparedness Grants • GSA-Federal Excess Personal Property • Funding for Fire Departments and First Responders • Community Assistance Program • Community Development Block Grants – Alaska

Project Description	Location	Land Ownership/ Lead Agency	Methodology/Approach	Serves to:	Timeline for Action	Priority (H, M, L)	Monitoring or Maintenance Requirements	Funding Sources
Facilitate greater preparedness for evacuations (*Meets goal of the 2019 KPB HMP- Evacuation and Response Routes- Table 3.5*)	Kenai Peninsula-wide	Kenai Peninsula Borough Fire Departments Department of Transportation? Dept. of Public Safety (Troopers) Local PD's.	• Identify and map alternate routes for ingress/egress for WUI areas as a specific part of the KPB Transportation Plan (*from 2019 KPB HMP*) • Prioritize capital improvement projects (CIPs) based on need for response and evacuation routes (*from 2019 KPB HMP*) • Encourage all residents to sign-up to KPB alert system. • Utilize pre-season planning to identify roles for departments to address evacuation. • Draft up scenarios and contingencies in the event of slow response times. • Identify vulnerable populations who may require assistance during evacuation (i.e., critical facilities – daycare, medical facilities, school, mass care center, elderly housing) • Seek grant opportunities to support assistance for vulnerable populations. • Develop contingency plans. • Build in plan for livestock and animal evacuation, including transportation needs and shelter options.	• Improve safe and effective wildfire response	Start within 1 year	H	• Annual review of how many residents are registered for KPB Alert. • Test system annually • Annual review of activities	• Firewise Communities • Emergency Management Performance Grant (EMPG) • Regional Catastrophic Preparedness Grants • Pre-disaster Mitigation (PDM) Grant Program • Hazard Mitigation Grant Program (HMGP) • Infrastructure For Rebuilding America • Building Resilient Infrastructure and Communities (BRIC) program • Western Wildland-Urban Interface (WUI) Grants • Private Landowner Assistance Grant • Hazard Mitigation Planning Assistance • Community Development Block Grants – Mitigation - Alaska • Alaska Firewise
Increase water availability for suppression	Kenai Peninsula-wide	Kenai Peninsula Borough Public Water Systems Fire Departments ADF&G – waterway / lake drafting sites / permits	• Initiate a detailed study of feasible locations for water development improvements. • Map all water fill sites and hydrants across jurisdictions. • Update any existing inventories. • Incorporate wildlife habitat concerns into inventory to avoid potential impacts- i.e., anadromous streams. Integrate statewide permits into planning. • Incorporate information on avoidance of aquatic invasives into inventory. • Utilize inventory to stage fire tanks in areas with limited water availability. • Install dry hydrants to pump pond water for firefighting. • Install hand pumps or other methods independent of the grid for accessing private well water. • Pre-identify and address permit issues for natural waterbody drafting sites	• Improve fire-fighting response if water is more readily available or closest locations could be identified on a GIS map on a tablet/computer. • Alleviates public and agency concern for limited water supply in remote areas	Start within 1 year	H	• Review number of water improvements annually and remaining needs.	• Pre-disaster Mitigation (PDM) Grant Program • Building Resilient Infrastructure and Communities (BRIC) program • Emergency Management Performance Grant (EMPG) • Multipurpose Grants to States and Tribes • Emergency Watershed Protection (EWP) Program • Fire Management Assistance Grant (FMAG) • Catalog of Federal Funding Sources; Water Resources • Hazard Mitigation Planning Assistance • Community Assistance Program • Community Development Block Grants – Alaska • Community Development Block Grants – Mitigation - Alaska
Continued support on VFA grant	Kenai Peninsula-wide	State Forestry	• Need to continue to fund it over time to follow through with financial commitments previously made • Use funding to increase training	• Increase capabilities of existing personnel	Already in progress, continue as long as possible.	H	• Annual review	• N/A

POST-FIRE RESPONSE AND REHABILITATION

The recent increase in severe fires has highlighted the numerous complexities of post-fire response. Fires, especially severe fires, have significant impacts on vegetation and soil. The major soil physical properties affected by a fire are structure stability, water repellency, texture, temperature, and amount of surface organic matter. Erosion is typically associated with postfire effects because of its impact on water quality and the potential for debris flows (USFS 2011c). Following a fire, heavy rains may result in widespread floods carrying trees, boulders, and soil through canyons, ultimately damaging communities and critical infrastructure—particularly in landslide prone areas such as the Kenai Peninsula (Alaska Division of Geological & Geophysical Surveys 2021).

The extensive impacts of wildfires are illustrated in a recent large fire that occurred on the Kenai Peninsula. The 2019 Swan Lake Fire was a lightning-caused fire that burned roughly 170,000 acres between Sterling and Cooper Landing. Main concerns for the burned area consisted of (National BAER Team 2020):

- The threat of invasive species to the recovery of the native vegetation
- The threat of increased runoff and potential debris flow to public safety and highway infrastructure
- The threat of excess runoff and sediment reaching streams and deteriorating fish habitat in anadromous streams
- Damage to recreational areas and associated hazards
- Damage to historic structures, archaeological sites, and traditional cultural properties

The time needed for a forest to recover following a fire is contingent on three factors: whether vegetation survives a fire, seedling recruitment from either seed banks in the soil or transported to the site, or sprouting new growth from roots (USFS 2011c). However, each forest is unique in how it recovers following a wildfire. The degree to which a forest can recover following a fire is contingent on the forest composition, soils, fire frequency, and climate. For instance, birch has seeds that disperse long distances; aspen has prolific roots that allow sprouting after a fire; black spruce has cones that open when exposed to heat; and white spruce produces large seed crops following a hot, dry summer (USFS 2011c).

Figure 4.16. Vegetation recovery in the Swan Lake burn area.

Creating a plan that outlines steps for agencies, municipalities, and the county to follow will streamline post-fire recovery efforts and reduce the inherent stress to the community.

There are many facets to post-fire recovery, including but not limited to:

- Ensuring public health and safety—prompt removal of downed and hazard trees, addressing watershed damage, and mitigating potential flooding.
- Rebuilding communities and assessing economic needs—securing the financial resources necessary for communities to rebuild homes, business, and infrastructure.
- Restoring the damaged landscape—restoration of watersheds, soil stabilization, and tree planting.
- Reducing fire risk in the future—identifying hazard areas and implementing mitigation.
- Prioritizing the needs of vulnerable and disadvantaged communities during response and disaster recovery efforts.
- Reducing post fire recovery time by replanting native species.
- Ensuring fire protection measures enhance sustainability of restoration projects.
- Retaining downed logs for erosion control and habitat maintenance.
- Evaluating and updating disaster recovery plans every 5 years to respond to changing needs and characteristics of the community.
- Coordinating with planning, housing, health and human services, and other local, regional or state agencies to develop contingency plans for meeting short-term, temporary housing needs of those displaced during a catastrophic wildfire event.
- Incorporating forecasted impacts from climate change intro trends and projections of future risk and consideration of policies to address identified risk.

Recovery of the vegetated landscape is often more straightforward than recovery of the human environment. Assessments of the burned landscape are often well-coordinated using interagency crews who are mobilized immediately after a fire to assess the post-fire environment and make recommendations for rehabilitation efforts.

For the community impacted by fire, however, there is often very little planning at the local level to guide their return after the fire. Residents impacted by the fire need assistance making insurance claims; finding temporary accommodation for themselves, pets, and livestock; rebuilding or repairing damaged property; removing debris and burned trees; stabilizing the land for construction; mitigating potential flood damage; repairing infrastructure; reconnecting to utilities; and mitigating impacts to health. Oftentimes, physical impacts can be mitigated over time, but emotional impacts of the loss and change to surroundings are long-lasting and require support and compassion from the community.

AFTER THE FIRE

Returning Home

First and foremost, follow the advice and recommendations of emergency management agencies, fire departments, utility companies, and local aid organizations regarding activities following the wildfire. Do not attempt to return to your home until fire personnel have deemed it safe to do so.

Even if the fire did not damage your house, do not expect to return to normal routines immediately. Expect that utility infrastructure may have been damaged and repairs may be necessary. When you return to your home, check for hazards, such as gas or water leaks and electrical shorts. Turn off damaged utilities if you did not do so previously. Request that the fire department or utility companies turn the utilities back on once the area is secured. Similarly, water supply systems may have been damaged; do not drink from the tap until you have been advised that it is safe to do so. Finally, keep a “fire watch”; look for smoke or sparks in houses and other buildings.

When returning home after a wildfire (FEMA 2021a):

- Avoid hot ash, charred trees, smoldering debris, and embers. The ground may have hot spots that can burn you or ignite another fire.
- Use a respirator to limit your exposure to dust particles; wet debris to minimize aerosolization. People with asthma, chronic obstructive pulmonary disease, or other lung ailments should take precautions in areas with poor air quality.
- Send text messages or use social media to contact family and friends. Phone lines are often busy following a disaster. Limit calls to emergencies only.

Once at home conduct the following (Alaska Wildland Fire Coordinating Group [AWFCG] 2009):

- Check the roof and perimeter of the home right away; extinguish any smoldering debris and sparks.
- Be aware of downed power lines and other hazards.
- Check propane tanks, regulators, and lines before turning on gas. Only a qualified technician should turn on utilities.
- Check the house carefully for hidden embers or smoldering fires.
- Check inside the attic for embers.

- Check the yard for burning vegetation, woodpiles, fences, or other materials.
- Keep doors and windows closed.
- Document property damage with photographs. Conduct an inventory of damaged or missing items and contact your insurance company for assistance.

Wildland fire smoke is particulate matter, a mixture of micro solids and liquid droplets suspended in air. The size of the particles is linked to their potential for causing health issues. Particles less than 2.5 micrometers in diameter present the greatest issues, since they can penetrate deep into the lungs, or even the bloodstream. Wildland fire smoke particles are generally smaller than 0.5 microns in diameter. Exposure to these particles can impact both lung and heart health. Particles larger than 10 micrometers in diameter are less of a concern; however, they can irritate eyes, nose, throat, and skin. Follow these tips to reduce your exposure to smoke (ADEC 2021):

- Pay attention to local air quality reports and stay alert to any health warnings related to smoke.
- Use common sense. If it's smoky outside, limit time outdoors and do not allow children to play outdoors.
- Close windows and doors when smoky.
- Clean air filters and vents in home.
- Plan activities away from dense smoke.

Insurance Claims

Preparedness is a crucial factor in the event of a catastrophe. Reviewing your insurance policy now can prevent total loss later. Once there is an imminent disaster, insurance carriers may decide against adding or amending coverage. Be aware whether you have adequate coverage—if you have replacement cost or actual cash value coverage. Replacement cost is the amount it would take to rebuild or replace your home and its contents with similar materials or goods. Actual cash value is replacement cost minus depreciation (Alaska Department of Commerce, Community, and Economic Development [ADCCED] 2021).

Tips for knowing your insurance coverage (ADCCED 2021):

- Carefully read and understand your insurance policy, particularly all endorsements/riders.
- Verify that your policy covers additional living expenses, including temporary housing, if you can't return home.
- Consider adding increased cost of construction or building ordinance coverage. This pays for any increased cost to replace or repair the home to meet requirements of current laws or ordinances.
- Consider special coverage for valuables. This covers jewelry, furs, coins, guns, stamps, computers, antiques, musical instruments, and other high-value possession that exceed normal policy limits.

Your insurance agent is the best source of information for submitting a claim. It is recommended you take photos of your home in preparation of an emergency and keep the photos in a safe place as this will make the insurance claim process easier. Most of the expenses incurred during the time you are forced to live elsewhere may be reimbursed, so be sure to keep all receipts.

Tips for streamlining insurance claims (ADCCED 2019):

- Keep copies and records of all communication between you and the adjuster.
- Take photos and videos of the damage before things are repaired to present to the adjuster.
- Prepare a detailed list of the destroyed or damaged items.
- Wait on making repairs until your insurance company has inspected the property and you have reached an agreement on the cost of repairs.
- If it's safe, make temporary repairs to prevent further damage by covering leaking roofs, broken windows, and damaged walls. Keeps receipts for the adjuster.
- If you can't stay in your home due to damage, most policies have coverage for additional living expenses while repairs are being made.
- Save all receipts, including food and hotel as well as any other necessities.

Community Safety: Post-Fire Floods and Debris Flows

Large-scale wildfires significantly modify the terrain and surface conditions. Usually, vegetation absorbs rainfall, reducing the amount of runoff. However, wildfires leave the ground, barren, charred, and unable to absorb water, creating the perfect conditions for flash flooding, mudflows, and debris flows. Floods are the most common and costly natural hazard in the nation. Flash floods are particularly common after wildfires and can occur within minutes after the beginning of a rainstorm. Even areas that are not usually susceptible to floods are at risk, due to the altered landscape (FEMA 2021b).

Factors that contribute to flooding and debris flows are steep slopes, heavy rainfall, weak or loose rock and soil, and improper construction and grading. Even small rainfall can cause a flash flood, transporting debris and damaging homes and other structures. Flood risk remains significantly higher until vegetation is restored, which can be up to 5 years after a wildfire. Flooding and flood damage is likely more extreme, as debris and ash left from the fire can form mudflows. As rainwater moves across barren terrain, it can also pick up and transport soil and sediment—causing greater damage (FEMA 2021b).

A post-fire flood doesn't have to be a catastrophic event to bring high damage expenses, and it is not necessary to live in a high-risk flood area to incur flood damage. In fact, from 2014 to 2018, policyholders not residing in high-risk flood areas filed over 40% of all National Flood Insurance Program claims (FEMA 2021b).

Property owners should remember to (FEMA 2021b):

- Be prepared. Develop an evacuation plan, keep important papers in a safe, waterproof place, and itemize and record (take photos) of valuables and other possessions inside and outside the home.
- Buy flood insurance. Most standard policies do not cover flood damage.
- Plan ahead. Gather supplies in case of a storm, upgrade your home against damage, and review insurance coverage.

Mobilizing Your Community

Several factors make the KPB face significant emergency management challenges. Some of the factors include the lack of a widespread interconnected road system; unusual and unpredictable weather;

geographic isolation; an aging community infrastructure; and communication issues. In some cases, it may take up to a week for disaster assistance to reach impacted communities. Thus, it is important to create local community response and recovery teams. The local Emergency Manager will collaborate with state and federal partners to manage disaster response and urgent needs. Still, mobilizing a response and recovery team or a group of teams in a community can function as a vital part of the recovery procedure (Alaska Division of Homeland Security & Emergency Management [DHSEM] 2011).

Objectives for response and recovery teams include (DHSEM 2011):

- Safety/damage assessment of homes, businesses, and public infrastructure.
- Identity people in shelters who require special care and those who need to be relocated into specialized-care facilities.
- Locating and opening relief-supply food-distribution points.
- Produce, update, and distribute a disaster fact sheet. Include critical public information to aid emergency responders, residents, and the media.
- Track costs for local responders. This will help recovering costs if determined eligible for state or federal disaster assistance.
- Monitor and address hazardous environmental situations such as air quality, mudslides, and weakened trees.
- Assess the need to identify specific routes and timeframes for critical relief supplies.

Residents throughout Alaska are encouraged to join forces to create local Alaskan Firewise Communities (AFCs) to minimize and prevent wildfire losses. AFCs are community-based organizations that mobilize residents to protect their properties, communities, and environments from disastrous wildfires. AFCs educate homeowners about community wildfire preparedness activities while collaborating with local fire officials to plan and implement projects that increase the wildfire resilience of their communities (AWFCG 2009).

The following resources may be helpful for the post-fire and volunteer coordinators (ADHSEM 2011):

- Alaska Housing Finance Corporation
- Food Bank of Alaska
- Alaska Division of Forestry (DOF)
- AICC
- American Red Cross
- Salvation Army
- Federal or state temporary disaster housing
- FEMA
- Tribal nonprofits
- Churches and other faith-based organizations
- Voluntary organizations active in disaster
- National Flood Insurance Program

- Individual and family grant programs

Communication

After a team is assembled and immediate tasks are identified, find the best way to spread information in your community. You may distribute flyers, set up a voicemail box, work to find pets or livestock that have been displaced, develop a mailing list for property owners, hold regular public meetings, etc. It is important that a long-term communications plan is developed (FEMA 2011). Applying the following steps can aid in successful communication (FEMA 2011):

- Convey post-wildfire hazards to the public.
- Develop and maintain emergency notification systems that allow authorized official to alert residents of emergency situations.
- Public meetings to inform the public about programs and services available in the community.
- Determine the best way to relay information, e.g., phone calls, radio, TV, or social media.
- Find out how emergency response teams, local officials, and volunteers will communicate with the community.

Post-Fire Rehabilitation and Resources

Wildfires that cause extensive damage necessitate dedicated efforts to avert issues afterwards. Loss of vegetation increases soil susceptibility to erosion; water runoff may increase and lead to flooding; sediments and debris may be transported downstream and damage properties or saturate reservoirs putting endangered species and water reserves at risk (USFS 2021b). Following a fire, the primary priority is emergency stabilization to prevent additional damage to life, property, or natural resources. The soil stabilization work starts immediately and may proceed for up to a year. The rehabilitation effort to restore damage caused by the fire starts after the fire is out and may persist for various years. For the most part, rehabilitation efforts focus on the lands not likely to recover naturally from wildfire damage (USFS 2021b).

The USFS's post-fire emergency stabilization program is called the Burned Area Emergency Response (BAER) program. The goal of the BAER program is to discover post-wildfire threats to human life and safety, property, and critical natural or cultural resources on USFS lands and take appropriate actions to mitigate unacceptable risks (USFS 2021c). BAER groups are composed of trained professionals in different fields: soil scientists, engineers, hydrologists, biologists, botanists, archaeologists, and others who quickly assess the burned area and advise emergency stabilization treatments (USFS 2021c).

The Natural Resources Conservation Service (NRCS) Emergency Watershed Protection (EWP) program aids communities recover from natural disasters by providing technical and financial services for watershed repair on public (state and local) and private land. The goal is reduced flood risk via funding and expert advice for land treatments. The EWP program can provide up to 75% of funds; local sponsors must acquire the remaining 25% in cash or in-kind services (NRCS 2021a).

Examples of potential treatments include (USFS 2021c):

- Hillside stabilization (for example, placing bundles of straw parallel to the slope to slow erosion)
- Hazard tree cutting
- Felling trees perpendicular to the slope contour to reduce runoff

- Mulching areas seeded with native vegetation
- Stream enhancements and construction of catchments to control erosion, runoff, and debris flows
- Planting or seeding native species to limit spread of invasive species

A comparison of potential hillside, channel, and road treatments is available at https://www.afterwildfirenm.org/post-fire-treatments/which-treatment-do-i-use.

The effectiveness of various treatments is described at https://www.fws.gov/fire/downloads/ES_BAR/Post-Fire_Hillslope_Treatment_Synthesis.pdf.

Specific Treatment Details

Hillslope Treatments

Cover Applications:

- Dry mulch provides immediate ground cover with mulch to reduce erosion and downstream flow.
- Wet mulch (hydromulch) provides immediate cover to hold moisture and seeds on slopes using a combination of organic fibers, glue, suspension agents, and seeds (most effective on inaccessible slopes).
- Slash spreading provides ground cover to reduce erosion by felling trees in burned areas.
- Seeding reduces soil erosion over time with an application of native seed mixtures (most successful in combination with mulching). Breaking up and loosening topsoil to break down the hydrophobic layer on top of the soil is also effective.

Erosion Barrier Applications:

- Erosion control mat: organic mats staked on the soil surface to provide stability for vegetation establishment.
- Log erosion barrier: trees felled perpendicular to the hillslope to slow runoff.
- Fiber rolls (wattles): rolls placed perpendicular to the hillslope to reduce surface flows and reduce erosion.
- Silt fencing: permeable fabric fencing installed parallel to the slope contour to trap sediment as water flows down the hillslope.

Channel Treatments

- Check dam: small dams built to trap and store sediment in stream channels.
- In-channel tree felling: felling trees in a staggered pattern in a channel to trap debris and sediment.
- Grade stabilizer: structures made of natural materials placed in ephemeral channels for stabilization.
- Stream bank armoring: reinforcing streambanks with natural materials to reduce bank cutting during stream flow.

- Channel deflector: an engineered structure to direct flow away from unstable banks or nearby roads.
- Debris basin: constructed to store large amounts of sediment moving in a stream channel.

Road and Trail Treatments

- Outsloping and rolling dips (water bars) alter the road shape or template to disperse water and reduce erosion.
- Overflow structures protect the road by controlling runoff and diverting stream flow to constructed channels.
- Low water stream crossing: culverts replaced by natural fords to prevent stream diversion and keep water in the natural channel.
- Culvert modification: upgrading culvert size to prevent road damage.
- Debris rack and deflectors: structure placed in a stream channel to collect debris before reaching a culvert.
- Riser pipes filter out debris and allow the passage of water in stream channels.
- Catchment-basin cleanout: using machinery to clean debris and sediment out of stream channels and catchment basins.
- Trail stabilization: constructing water bars and spillways to provide drainage away from the trail surface.

These treatments and descriptions are further detailed at https://afterwildfirenm.org/post-fire-treatments/treatment-descriptions.

For more information about how to install and build treatments, see the Wildfire Restoration Handbook at https://www.rmfi.org/sites/default/files/hero-content-files/Fire-Restoration-HandbookDraft_2015_2.compressed_0.pdf.

Timber Salvage

Many private landowners may decide to harvest trees killed in the fire, a decision that can be highly controversial. Any remaining trees post-fire can be instrumental for soil and wildlife habitat recovery. Furthermore, burned soils are especially susceptible to soil compaction and erosion. Therefore, timber salvage must be performed by professionals. Several programs assist landowners with timber salvage, including the NRCS Environmental Quality Incentives Program (EQIP) (NRCS 2021b).

Invasive Species Management and Native Revegetation

The BLM has identified more than 27,000 invasive weed infestations in Alaska. Further complicating the invasive weed problem are more frequent and intense wildfires. Wildfire provides opportunity for many invasive species to dominate the landscape because many of these species thrive on recently burned landscapes. Therefore, it is imperative that landowners prevent invasive establishment by eradicating weeds early, planting native species, and limiting invasive seed dispersal (BLM 2021).

Planting native seeds is an economical way to restore a disturbed landscape. Vegetation provides protection against erosion and stabilizes exposed soils. To be successful, seeds must be planted during

the proper time of year and using correct techniques. Use a native seed mixture with a diversity of species and consider the species' ability to compete with invasive species. Before planting, the seedbed must be prepared with topsoil and by raking to break up the hydrophobic soil layer. If you choose to transplant or plant native species, consider whether the landscape has made a sufficient recovery to ensure the safety of the individuals (ADNR, Division of Agriculture [DOA] 2008).

A comprehensive revegetation manual for Alaska can be found here: http://dnr.alaska.gov/ag/akpmc/pdf/RevegManual.pdf

Long-Term Community Recovery

On non-federal land, recovery efforts are the responsibility of local governments and private landowners. Challenges associated with long-term recovery include homes that were severely damaged or were saved but are located in high-severity burn areas. Furthermore, homes saved but located on unstable slopes or in areas in danger of flooding or landslides present a more complicated challenge. Economically, essential businesses that were burned or were otherwise forced to close pose a challenge to communities of all sizes. Given these complications, rebuilding and recovery efforts can last for years, with invasive species control and ecosystem restoration lasting even longer (CUSP 2016). It is critical that a long-term plan is in place and there is sufficient funding and support for all necessary ecosystem and community recovery. To learn about more post-fire recovery resources, visit the After the Flames website here: https://aftertheflames.com/resources/

CHAPTER 5 – MONITORING AND EVALUATION STRATEGY

Developing an action plan and an assessment strategy that identifies roles and responsibilities, funding needs, and timetables for completing highest-priority projects is an important step in organizing the implementation of the CWPP. Table 4.1 in the previous section identifies tentative timelines and monitoring protocols for fuels reduction treatments, the details of which are outlined below.

All stakeholders and signatories to this CWPP desire worthwhile outcomes. We also know that risk reduction work on the ground, for the most part, is often not attainable in a few months—or even years. The amount of money and effort invested in implementing a plan such as this requires that there be a means to describe, quantitatively or qualitatively, if the goals and objectives expressed in this plan are being accomplished according to expectations.

This section will present a suite of recommended CWPP monitoring strategies intended to help track progress, evaluate work accomplished, and assist planners in adaptive management.

The strategies outlined in this section take into account several variables:

- Do the priorities identified for treatment reflect the goals stated in the plan? Monitoring protocols can help address this question.
- Can there be ecological consequences associated with fuels work? We may be concerned about soil movement and/or invasive species encroachment post-treatment. Relatively cost-effective monitoring may help clarify changes.
- Vegetation will grow back. Thus, fuel break maintenance and fuels modification in both the home ignition zone and at the landscape scale require periodic assessment. Monitoring these changes can help decision-makers identify appropriate treatment intervals.

As the CWPP evolves over time, there may be a need to track changes in policy, requirements, stakeholder changes, and levels of preparedness. These can be significant for any future revisions and/or addendums to the CWPP.

Table 5.1 identifies recommended monitoring strategies, both quantifiable and non-quantifiable, for assessing the progress of the CWPP. It must be emphasized that these strategies are 1) not exhaustive (new strategies and protocols can evolve with new CWPP action items) and 2) dependent on available funds and personnel to implement them.

There are many resources for designing and implementing community based, multi-party monitoring that could support and further inform a monitoring program for the CWPP (Egan 2013). Multiparty monitoring involves a diverse group consisting of community members, community-based groups, regional and national interest groups, and public agencies. This approach increases understanding of the effects of restoration efforts and trust among restoration partners. Multiparty monitoring may be more time-consuming due to the collaborative nature of the work; therefore, a clear and concise monitoring plan must be developed.

Table 5.1. Recommended Monitoring Strategies

Strategy	Task/Tool	Lead	Remarks
Photographic record (documents pre- and post-fuels reduction work, evacuation routes, workshops, classes, field trips, changes in open space, treatment type, etc.)	Establish field global positioning system (GPS) location; photo points of cardinal directions; keep photos protected in archival location	Core Team member	Relatively low cost; repeatable over time; used for programs, and tracking objectives
Number of acres treated (by fuel type, treatment method)	GPS/GIS/fire behavior prediction system	Core Team member	Evaluating costs, potential fire behavior
Number of home ignition zones/defensible space treated to reduce structural ignitability	GPS	Homeowner	Structure protection
Number of residents/citizens participating in any CWPP projects and events	Meetings, media interviews, articles	Core Team member	Evaluate culture change objective
Number of homeowner contacts (brochures, flyers, posters, etc.)	Visits, phone	Agency representative	Evaluate objective
Number of jobs created	Contracts and grants	Core Team member	Evaluate local job growth
Education outreach: number, kinds of involvement	Workshops, classes, field trips, signage	Core Team member	Evaluate objectives
Emergency management: changes in agency response capacity	*Collaboration*	Agency representative	Evaluate mutual aid
Codes and policy changes affecting CWPP	Qualitative	Core Team	CWPP changes
Number of stakeholders	Added or dropped	Core Team	CWPP changes
Wildfire acres burned, human injuries/fatalities, infrastructure loss, environmental damage, suppression and rehabilitation costs	Wildfire records	Core Team	Compare with 5- or 10-year average

An often overlooked but critical component of fuel treatment is monitoring. It is important to evaluate whether fuel treatments have accomplished their defined objectives and whether any unexpected outcomes have occurred. In addition to monitoring mechanical treatments, it is important to carry out comprehensive monitoring of burned areas to establish the success of fuels reduction treatments on fire behavior, as well as monitoring for ecological impacts, repercussions of burning on wildlife, and effects on soil chemistry and physics. Adaptive management is a term that refers to adjusting future management

based on the effects of past management. Monitoring is required to gather the information necessary to inform future management decisions. Economic and legal questions may also be addressed through monitoring. In addition, monitoring activities can provide valuable educational opportunities for students.

The monitoring of each fuel's reduction project would be site-specific, and decisions regarding the timeline for monitoring and the type of monitoring to be used would be determined by project. Monitoring and reporting contribute to the long-term evaluation of changes in ecosystems, as well as the knowledge base about how natural resource management decisions affect both the environment and the people who live in it.

The most important part of choosing a monitoring program is selecting a method appropriate to the people, place, and available time. Several levels of monitoring activities meet different objectives, have different levels of time intensity, and are appropriate for different groups of people. They include the following:

Minimum—Level 1: Pre- and Post-project Photographs

Appropriate for many individual homeowners who conduct fuels reduction projects on their properties.

Moderate—Level 2: Multiple Permanent Photo Points

Permanent photo locations are established using rebar or wood posts, global positioning system (GPS)-recorded locations, and photographs taken on a regular basis. Ideally, this process would continue over several years. This approach might be appropriate for more enthusiastic homeowners or for agencies conducting small-scale, general treatments.

High—Level 3: Basic Vegetation Plots

A series of plots can allow monitors to evaluate vegetation characteristics such as species composition, percentage of cover, and frequency. Monitors then can record site characteristics such as slope, aspect, and elevation. Parameters would be assessed pre- and post-treatment. The monitoring agency should establish plot protocols based on the types of vegetation present and the level of detail needed to analyze the management objectives.

Intense—Level 4: Basic Vegetation Plus Dead and Downed Fuels Inventory

The protocol for this level would include the vegetation plots described above but would add more details regarding fuel loading. Crown height or canopy closure might be included for live fuels. Dead and downed fuels could be assessed using other methods, such as Brown's transects (Brown 1974), an appropriate photo series (Ottmar et al. 2000), or fire monitoring (Fire Effects Monitoring and Inventory System [FIREMON]; Lutes et al. 2006) plots.

IDENTIFY TIMELINE FOR UPDATING THE CWPP

The HFRA allows for maximum flexibility in the CWPP planning process, permitting the Core Team to determine the time frame for updating the CWPP; it is suggested that a formal revision be made on the fifth anniversary of signing and every 5 years following. The Core Team members are encouraged to meet on an annual basis to review the project list, discuss project successes, and strategize regarding project implementation funding. If possible, the CWPP revision should coincide with the revision of the Borough HMP. A goal of the 2018 ALAH Plan is to maintain and implement the CWPP, including project recommendations.

IMPLEMENTATION

This CWPP makes recommendations for prioritized fuels reduction projects and measures to reduce structural ignitability and carry out public education and outreach. Implementation of fuels reduction projects need to be tailored to the specific project and will be unique to the location depending on available resources and regulations. On-the-ground implementation of the recommendations in the CWPP planning area will require development of an action plan and assessment strategy for completing each project. This step will identify the roles and responsibilities of the people and agencies involved, as well as funding needs and timetables for completing the highest-priority projects (SAF 2004). Information pertaining to funding is provided in Appendix F.

ABBREVIATIONS AND ACRONYMS

°F	degrees Fahrenheit
ADCCED	Alaska Department of Commerce, Community, and Economic Development
ADEC	Alaska Department of Environmental Conservation
AICC	Alaska Interagency Coordination Center
AIWFMP	Alaska Interagency Wildland Fire Management Plan, 2021
ALAH	All Lands/All Hands
ANCSA	Alaska Native Claims Settlement Act of 1971
ARRA	Alaska Region Risk Assessment
ATV	all-terrain vehicle
AWFCG	Alaska Wildland Fire Coordinating Group
BAER	Burned Area Emergency Rehabilitation
BLM	Bureau of Land Management
BSM	battered sallow moth
BTU/ft/sec	British thermal units per foot per second
CAR	community at risk
ch/hr	chains per hour
CIG	Conservation Innovation Grants
CIRI	Cook Inlet Region, Inc.
Cohesive Strategy	National Cohesive Wildland Fire Management Strategy
CRS	Congressional Research Service
County	Dukes County
CVARs	Community Values at Risk
CWA	Clean Water Act
CWPP	Community Wildfire Protection Plan
DEM	digital elevation model
DHS	Department of Homeland Security
DHSEM	Alaska Division of Homeland Security & Emergency Management
EAS	Emergency Alert System
EBC	European bird cherry
EMS	Emergency Management System
eNVC	expected net value change
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentives Program

ESRI	Environmental Systems Research Institute
EWP	Emergency Watershed Protection
FAC	fire-adapted community
FEMA	Federal Emergency Management Agency
FLAME	Federal Land Assistance, Management and Enhancement Act
FMU	Fire Management Unit
FP&S	Fire Prevention and Safety
FRI	fire return interval
GAID	Geographic Area Interagency Division
GIS	geographic information system
GOPR	Governor's Office of Planning and Research
GPS	global positioning system
HFRA	Healthy Forest Restoration Act
HIZ	Home Ignition Zone
HMP	Hazard Mitigation Plan
HVRA	highly valued resource and asset
IARC	International Arctic Research Center
IBHS	Institute for Business and Home Safety
ICC	International Code Council
IFTDSS	Interagency Fuel Treatment Decision Support System
ISO	International Standards Organization
JPA	Joint Powers Agreement
KFNP	Kenai Fjords National Park
LCNPP	Lake Clark National Park and Preserve
MA	Management Area
MFI	mean fire interval
NEPA	National Environmental Policy Act
NFP	National Fire Plan
NFPA	National Fire Protection Association
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NWCG	National Wildfire Coordinating Group
PERI	Public Entity Risk Institute
PPE	personal protective equipment
QWRA	Quantitative Wildfire Risk Assessment

RAWS	remote automated weather station
RFA	Rural Fire Assistance
SAF	Society of American Foresters
SAFER	Staffing for Adequate Fire and Emergency Response
SHPO	State Historic Preservation Office
SWCA	SWCA Environmental Consultants
UAA	University of Alaska Anchorage
ULI	Urban Land Institute
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
VCC	Vegetation Condition Class
VDEP	Vegetation Departure
WUI	wildland urban interface

GLOSSARY OF TERMS

Aspect: Cardinal direction toward which a slope faces in relation to the sun (National Wildfire Coordinating Group [NWCG] 2021a).

Active Crown Fire: A crown fire in which the entire fuel complex is involved in flame, but the crowning phase remains dependent on heat released from surface fuel for continued spread. An active crown fire presents a solid wall of flame from the surface through the canopy fuel layers. Flames appear to emanate from the canopy as a whole rather than from individual trees within the canopy. Active crown fire is one of several types of crown fire and is contrasted with **passive crown fires**, which are less vigorous types of crown fire that do not emit continuous, solid flames from the canopy (SWCA).

Available Canopy Fuel: The mass of canopy fuel per unit area consumed in a crown fire. There is no post-frontal combustion in canopy fuels, so only fine canopy fuels are consumed. We assume that only the foliage and a small fraction of the branchwood is available (Twisp 2021).

Available Fuel: The total mass of ground, surface and canopy fuel per unit area available fuel consumed by a fire, including fuels consumed in postfrontal combustion of duff, organic soils, and large woody fuels (Twisp 2021).

Backfiring: Intentionally setting fire to fuels inside a control line to contain a fire (Twisp 2021).

Biomass: Organic material. Also refers to the weight of organic material (e.g., biomass roots, branches, needles, and leaves) within a given ecosystem (Twisp 2021).

Burn Severity: A qualitative assessment of the heat pulse directed toward the ground during a fire. Burn severity relates to soil heating, large fuel and duff consumption, consumption of the litter and organic layer beneath trees and isolated shrubs, and mortality of buried plant parts (SWCA).

Canopy: The more or less continuous cover of branches and foliage formed collectively by adjacent trees and other woody species in a forest stand. Where significant height differences occur between trees within a stand, formation of a multiple canopy (multi-layered) condition can result (SWCA).

Chain: Unit of measure in land survey, equal to 66 feet (20 M) (80 chains equal 1 mile). Commonly used to report fire perimeters and other fireline distances. Popular in fire management because of its convenience in calculating acreage (example: 10 square chains equal one acre) (NM FFA 2021).

Climate Adaptation: Adaptation is an adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (Governor's Office of Planning and Research [GOPR] 2020).

Climate Change: A change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (GOPR 2020).

Community Assessment: An analysis designed to identify factors that increase the potential and/or severity of undesirable fire outcomes in wildland urban interface communities (SWCA).

Communities at Risk: Defined by the Healthy Forest Restoration Act of 2003 as "Wildland-Urban Interface Communities within the vicinity of federal lands that are at high risk from wildfire" (GOPR 2020).

Community Emergency Response Team (CERT): The CERT program educates volunteers about disaster preparedness for the hazards that may impact their area and trains them in basic disaster response skills, such as fire safety, light search and rescue, team organization, and disaster medical operations. CERT offers a consistent, nationwide approach to volunteer training and organization that professional responders can rely on during disaster situations, allowing them to focus on more complex tasks.

Community Wildfire Protection Plan (CWPP): A planning document that seeks to reduce the threat to life and property from wildfire by identifying and mitigating wildfire hazards to communities and infrastructure located in the WUI as developed from the Healthy Forest Restoration Act of 2003. Addresses issues such as wildfire response, hazard mitigation, community preparedness, or structure protection (SWCA).

Conditional Surface Fire: A potential type of fire in which conditions for sustained conditional surface fire active crown fire spread are met but conditions for crown fire initiation are not. If the fire begins as a surface fire, it is expected to remain so. If it begins as an active crown fire in an adjacent stand, it may continue to spread as an active crown fire (Twisp 2021).

Contain: A tactical point at which a fire's spread is stopped by and within specific contain features, constructed or natural; also, the result of stopping a fire's spread so that no further spread is expected under foreseeable conditions. For reporting purposes, the time and date of containment. This term no longer has a strategic meaning in Federal wildland fire policy (Twisp 2021).

Control: To construct fireline or use natural features to surround a fire and any control spot fires therefrom and reduce its burning potential to a point that it no longer threatens further spread or resource damage under foreseeable conditions. For reporting purposes, the time and date of control. This term no longer has a strategic meaning in Federal wildland fire policy (Twisp 2021).

Cover Type: The type of vegetation (or lack of it) growing on an area, based on cover type minimum and maximum percent cover of the dominant species, species group or non-living land cover (such as water, rock, etc.). The cover type defines both a qualitative aspect (the dominant cover type) as well as a quantitative aspect (the abundance of the predominant features of that cover type) (Twisp 2021).

Creeping Fire: A low intensity fire with a negligible rate of spread (Twisp 2021).

Crown Fire: A fire that advances at great speed from crown to crown in tree canopies, often well in advance of the fire on the ground (National Geographic Society 2021).

Defensible Space: An area around a structure where fuels and vegetation are modified, cleared, or reduced to slow the spread of wildfire toward or from a structure. The design and distance of the defensible space is based on fuels, topography, and the design/materials used in the construction of the structure (SWCA).

Duff: The layer of decomposing organic materials lying below the litter layer of freshly fallen twigs, needles, and leaves and immediately above the mineral soil (SWCA).

Ecosystem: An interacting natural system including all the component organisms together with the abiotic environment and processes affecting them (SWCA).

Environmental Conditions: That part of the fire environment that undergoes short-term changes: weather, which is most commonly manifest as windspeed, and dead fuel moisture content (Twisp 2021).

Escape Route: A preplanned and understood route firefighters take to move to a safety zone or other low-risk area. When escape routes deviate from a defined physical path, they should be clearly marked (flagged) (SWCA).

Evacuation: The temporary movement of people and their possessions from locations threatened by wildfire (SWCA).

Fire-Adapted Communities: A fire-adapted community collaborates to identify its wildfire risk and works collectively on actionable steps to reduce its risk of loss. This work protects property and increases the safety of firefighters and residents (USFA 2021a).

Fire Behavior: The manner in which fuel ignites, flame develops, and fire spread and exhibits other related phenomena as determined by the interaction of fuels, weather, and topography (Frames 2021).

Fire Break: Areas where vegetation and organic matter are removed down to mineral soil (SWCA).

Fire Environment: The characteristics of a site that influence fire behavior. In fire modeling the fire environment is described by surface and canopy fuel characteristics, windspeed and direction, relative humidity, and slope steepness (Twisp 2021).

Fire Frequency: A broad measure of the rate of fire occurrence in a particular area. For historical analyses, fire frequency is often expressed using the fire return interval calculation. For modern-era analyses, where data on timing and size of fires are recorded, fire frequency is often best expressed using fire rotation (SWCA)

Fire Hazard: Fire hazard is the potential fire behavior or fire intensity in an area, given the type(s) of fuel present – including both the natural and built environment – and their combustibility (GOPR 2020).

Fire Hazard Severity Zones: Fire hazard severity zones are defined based on vegetation, topography, and weather (temperature, humidity and wind), and represents the likelihood of an area burning over a 30- to 50-year time period without considering modifications such as fuel reduction efforts (GOPR 2020).

Fire History: The chronological record of the occurrence of fire in an ecosystem or at a specific site. The fire history of an area may inform planners and residents about the level of wildfire hazard in that area (SWCA).

Fire Intensity: A general term relating to the heat energy released in a fire (SWCA).

Fireline Intensity: Amount of heat release per unit time per unit length of fire front. Numerically, the product of the heat of combustion, quantity of fuel consumed per unit area in the fire front, and the rate of spread of a fire, expressed in kilowatts per minute (SWCA). This expression is commonly used to describe the power of wildland fires, but it does not necessarily follow that the severity, defined as the vegetation mortality, will be correspondingly high (Twisp 2021).

Fire Prevention: Activities such as public education, community outreach, planning, building code enforcement, engineering (construction standards), and reduction of fuel hazards that is intended to reduce the incidence of unwanted human-caused wildfires and the risks they pose to life, property or resources (GOPR 2020).

Fire Regime: A measure of the general pattern of fire frequency and severity typical to a particular area or type of landscape: The regime can include other metrics of the fire, including seasonality and typical fire size, as well as a measure of the pattern of variability in characteristics (SWCA).

Fire Regime Condition Class: Condition classes are a function of the degree of fire regime condition class departure from historical fire regimes resulting in alterations of key ecosystem components such as composition structural stage, stand age, and canopy closure (Twisp 2021).

Fire Return Interval: Number of years (interval) between two successive fires in a designated area (SWCA).

Fire Risk: "Risk" takes into account the intensity and likelihood of a fire event to occur as well as the chance, whether high or low, that a hazard such as a wildfire will cause harm. Fire risk can be determined by identifying the susceptibility of a value or asset to the potential direct or indirect impacts of wildfire hazard events (GOPR 2020).

Fire Severity: A qualitative measure of the immediate effects of fire on the fire severity ecosystem. It relates to the extent of mortality and survival of plant and animal life both aboveground and belowground and to loss of organic matter. It is determined by heat released aboveground and belowground. Fire Severity is dependent on intensity and residence time of the burn. For trees, severity is often measured as percentage of basal area removed. An intense fire may not necessarily be severe (Twisp 2021).

Flammability: The relative ease with which fuels ignite and burn regardless of the quantity of the fuels (SWCA).

Flame Length: The length of flames in the propagating fire front measured along the slant of the flame from the midpoint of its base to its tip. It is mathematically related to fireline intensity and tree crown scorch height (Twisp 2021).

Foliar Moisture content: Moisture content (dry weight basis) of live foliage, foliar moisture content expressed as a percent. Effective foliar moisture content incorporates the moisture content of other canopy fuels such as lichen, dead foliage, and live and dead branchwood (Twisp 2021).

Forest Fire: uncontrolled burning of a woodland area (National Geographic Society 2021).

Fuel Break: A natural or manmade change in fuel characteristics which affects fire behavior so that fires burning into them can be more readily controlled (NWCG 2021b).

Fuel Complex: The combination of ground, surface, and canopy fuel strata (Twisp 2021).

Fuel Condition: Relative flammability of fuel as determined by fuel type and environmental conditions (SWCA).

Fuel Continuity: A qualitative description of the distribution of fuel both horizontally and vertically. Continuous fuels readily support fire spread. The larger the fuel discontinuity, the greater the fire intensity required for fire spread (Twisp 2021).

Fuel Loading: The volume of fuel in a given area generally expressed in tons per acre (SWCA). Dead woody fuel loadings are commonly described for small material in diameter classes of 0 to 0.25, 0.25 to 1, and 1 to 3 inches and for large material greater than 3 inches (Twisp 2021).

Fuel Management/Fuel Reduction: Manipulation or removal of fuels to reduce the likelihood of ignition and to reduce potential damage in case of a wildfire. Fuel reduction methods include prescribed fire, mechanical treatments (mowing, chopping), herbicides, biomass removal (thinning or harvesting or trees, harvesting of pine straw), and grazing. Fuel management techniques may sometimes be combined for greater effect (SWCA).

Fuel Model: A set of surface fuel bed characteristics (load and surface-area-to- fuel model volume-ratio by size class, heat content, and depth) organized for input to a fire model (Twisp 2021).

Fuel Modification: The manipulation or removal of fuels (i.e., combustible biomass such as wood, leaves, grass, or other vegetation) to reduce the likelihood of igniting and to reduce fire intensity. Fuel modification activities may include lopping, chipping, crushing, piling and burning, including prescribed burning. These activities may be performed using mechanical treatments or by hand crews. Herbicides and prescribed herbivory (grazing) may also be used in some cases. Fuel modification may also sometimes be referred to as "vegetation treatment" (GOPR 2020).

Fuel Moisture Content: This is expressed as a percent or fraction of oven dry fuel moisture content weight of fuel. It is the most important fuel property controlling flammability. In living plants, it is physiologically bound. Its daily fluctuations vary considerably by species but are usually above 80 to 100 percent. As plants mature, moisture content decreases. When herbaceous plants cure, their moisture content responds as dead fuel moisture content, which fluctuates according to changes in temperature, humidity, and precipitation (Twisp 2021).

Fuel Treatment: The manipulation or removal of fuels to minimize the probability of ignition and/or to reduce potential damage and resistance to fire suppression activities (NWCG 2021g). Synonymous with fuel modification.

Grazing: There are two types of grazing: 1) traditional grazing, and 2) targeted grazing. Traditional grazing refers to cattle that are managed in extensive pastures to produce meat. Targeted grazing involves having livestock graze at a specific density for a given period of time for the purpose of managing vegetation. Even though both kinds of grazing manage fuel loading in range- and forested lands, targeted grazing is different in that its sole purpose is to manage fuels. Targeted grazing is done by a variety of livestock species such as sheep, goats, or cows (UC, Agriculture and Natural Resources 2019).

Ground Fire: Fire that burns organic matter in the soil, or humus; usually does not appear at the surface (National Geographic Society 2021).

Ground Fuels: Fuels that lie beneath surface fuels, such as organic soils, duff, decomposing litter, buried logs, roots, and the below-surface portion of stumps (Twisp 2021).

Hazard: A "hazard" can be defined generally as an event that could cause harm or damage to human health, safety, or property (GOPR 2020).

Hazardous Areas: Those wildland areas where the combination of vegetation, topography, weather, and the threat of fire to life and property create difficult and dangerous problems (SWCA).

Hazardous Fuels: A fuel complex defined by type, arrangement, volume, condition, and location that poses a threat of ignition and resistance to fire suppression (NWCG 2021h).

Hazardous Fuels Reduction: Any strategy that reduces the amount of flammable material in a fire-prone ecosystem. Two common strategies are mechanical thinning and controlled burning (Twisp 2021).

Hazard Reduction: Any treatment that reduces the threat of ignition and spread of fire (SWCA).

Highly Valued Resources and Assets (HVRAs): Landscape features that are influenced positively and/or negatively by fire. Resources are naturally occurring, while Assets are human-made (Interagency Fuel Treatment Decision Support System [IFTDSS] 2021).

Ignition: The action of setting something on fire or starting to burn.

Incident: An occurrence or event, either natural or person-caused, which requires an emergency response to prevent loss of life or damage to property or natural resources (Twisp 2021).

Influence Zone: An area that, with respect to wildland and urban fire, has a set of conditions that facilitate the opportunity for fire to burn from wildland fuels to the home and or structure ignition zone (NWCG 2021).

Initial Attack: The actions taken by the first resources to arrive at a wildfire to protect lives and property, and prevent further extension of the fire (SWCA).

Ladder Fuels: Fuels that provide vertical continuity allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease (SWCA).

Litter: Recently fallen plant material that is only partially decomposed and is still discernible (SWCA).

Manual Treatments: Felling and piling of fuels done by hand. The volume of material generated from a manual fuel treatment is typically too small to warrant a biomass sale therefore collected material is disposed of by burning or chipping. The work can be performed by either a single individual or a large organized crew with powered equipment (UC, Agriculture and Natural Resources 2021a).

Mechanized Treatments: Mechanical treatments pulverize large continuous patches of fuel to reduce the volume and continuity of material. Mechanical treatments can be applied as either mastication or chipping treatments. Both treatments shred woody material, but mastication leaves residue on-site while chipping collects the particles for transportation off site. Similar to hand treatments, mechanical treatments can target specific areas and vegetation while excluding areas of concern. In addition, mechanical treatment is easily scalable to large areas (>30 acres) with little added cost. (UC, Agriculture and Natural Resources 2021b).

Mitigation: Action that moderates the severity of a fire hazard or risk (SWCA).

Mutual Aid: Assistance in firefighting or investigation by fire agencies, irrespective of jurisdictional boundaries (NWCG 2021j).

National Cohesive Strategy: The National Cohesive Wildland Fire Management Strategy is a strategic push to work collaboratively among all stakeholders and across all landscapes, using best science, to make meaningful progress towards the three goals:

- Resilient Landscapes
- Fire Adapted Communities
- Safe and Effective Wildfire Response

Vision: To safely and effectively extinguish fire when needed; use fire where allowable; manage our natural resources; and as a nation, to live with wildland fire (Forests and Rangelands 2021).

Native Revegetation: The process of replanting and rebuilding the soil of disturbed land (e.g., burned) with native plant species (USDA 2005).

Native Species: A species that evolved naturally in the habitat, ecosystem, or region as determined by climate, soil, and biotic factors (USDA 2005).

Overstory: That portion of the trees in a forest which forms the upper or uppermost layer (SWCA).

Passive Crown Fire: A type of crown fire in which the crowns of individual trees or small groups of trees burn, but solid flaming in the canopy cannot be maintained except for short periods. Passive crown fire

encompasses a wide range of crown fire behavior, from occasional torching of isolated trees to nearly active crown fire. Passive crown fire is also called torching or candling. A fire in the crowns of the trees in which trees or groups of trees torch, ignited by the passing front of the fire. The torching trees reinforce the spread rate, but these fires are not basically different from surface (SWCA).

Prescribed Burning: Any fire ignited by management actions under specific, predetermined conditions to meet specific objectives related to hazardous fuels or habitat improvement. Usually, a written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition (USFS 2021g).

Rate of Spread: The relative activity of a fire in extending its horizontal dimensions. It is expressed as rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information. Usually, it is expressed in chains or acres per hour for a specific period in the fire's history (NWCG 2021d).

Resilience: Resilience is the capacity of any entity – an individual, a community, an organization, or a natural system – to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience (GOPR 2020).

Response: Movement of an individual firefighting resource from its assigned standby location to another location or to an incident in reaction to dispatch orders or to a reported alarm (SWCA).

Safety Element: One of the seven mandatory elements of a local general plan (a county plan that forms the foundation for future development), the safety element must identify hazards and hazard abatement provisions to guide local decisions related to zoning, subdivisions, and entitlement permits. The element should contain general hazard and risk reduction strategies and policies supporting hazard mitigation measures (GOPR 2020).

Slash: Debris left after logging, pruning, thinning, or brush cutting. Slash includes logs, chips, bark, branches, stumps, and broken trees or brush that may be fuel for a wildfire (SWCA).

Slope Percent: The ratio between the amount of vertical rise of a slope and horizontal distance as expressed in a percent. One hundred feet of rise to 100 feet of horizontal distance equals 100 percent (NWCG 2021e).

Suppression: The most aggressive fire protection strategy, it leads to the total extinguishment of a fire (SWCA).

Surface Fire: fire that typically burns only surface litter and undergrowth (National Geographic Society 2021).

Surface Fuel: Fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low stature living plants (SWCA).

Structural Ignitability: The ability of structures (such as homes or fences) to catch fire (SWCA).

Topography: The arrangement of the natural and artificial physical features of an area.

Total Fuel Load: The mass of fuel per unit area that could possibly be consumed in a hypothetical fire of the highest intensity in the driest fuels (Twisp 2021).

Tree Crown: The primary and secondary branches growing out from the main stem, together with twigs and foliage (SWCA).

Understory: Low-growing vegetation (herbaceous, brush or reproduction) growing under a stand of trees. Also, that portion of trees in a forest stand below the overstory (SWCA).

Understory Fire: A fire burning in the understory, more intense than a surface fire with flame lengths of 1 to 3 m (Twisp 2021).

Values and Assets at Risk: The elements of a community or natural area considered valuable by an individual or community that could be negatively impacted by a wildfire or wildfire operations. These values can vary by community and can include public and private assets (natural and manmade), such as homes, specific structures, water supply, power grids, natural and cultural resources, and community infrastructure, as well as other economic, environmental, and social values (GOPR 2020).

Vulnerable Community: Vulnerable communities experience heightened risk and increased sensitivity to natural hazard and climate change impacts and have less capacity and fewer resources to cope with, adapt to, or recover from the impacts of natural hazards and increasingly severe hazard events because of climate change. These disproportionate effects are caused by physical (built and environmental), social, political, and/ or economic factor(s), which are exacerbated by climate impacts. These factors include, but are not limited to, race, class, sexual orientation and identification, national origin, and income inequality (GOPR 2020).

Wildfire: A "wildfire" can be generally defined as any unplanned fire in a "wildland" area or in the WUI (GOPR 2020).

Wildfire Exposure: During fire suppression activities, an exposure is any area/property that is threatened by the initial fire, but in National Fire Incident Reporting System (NFIRS) a reportable exposure is any fire that is caused by another fire, i.e., a fire resulting from another fire outside that building, structure, or vehicle, or a fire that extends to an outside property from a building, structure, or vehicle (USFA 2020).

Wildfire Influence Zone: A wildland area with susceptible vegetation up to 1.5 miles from the interface or intermix WUI (GOPR 2020).

Wildland: Those unincorporated areas covered wholly or in part by trees, brush, grass, or other flammable vegetation (GOPR 2020).

Wildland Fire: Fire that occurs in the wildland as the result of an unplanned ignition (GOPR 2020).

Wildland Fuels (aka fuels): Fuel is the material that is burning. It can be any kind of combustible material, especially petroleum-based products, and wildland fuels. For wildland fire, it is usually live, or dead plant material, but can also include artificial materials such as houses, sheds, fences, pipelines, and trash piles. In terms of vegetation, there are 6 wildland fuel types (Fuel Type: An identifiable association of fuel elements of distinctive species, form, size, arrangement, or other characteristics that will cause a predictable rate of spread or resistance to control under specified weather conditions.) The 6 wildland fuel types are (NWCG 2021f):

1. Grass
2. Shrub
3. Grass-Shrub
4. Timber Litter
5. Timber-Understory
6. Slash-Blowdown

Wildland Urban Interface (WUI): The WUI is the zone of transition between unoccupied land and human development. It is the line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels (USFA 2021b). In the absence of a Community Wildfire Protection Plan, Section 101 (16) of the Healthy Foresters Restoration Act defines the wildland urban interface as " (I) an area extending ½ mile from the boundary of an at-risk community; (II) an area within 1 ½ miles of the boundary of an at-risk community, including any land that (1) has a sustained steep slope that creates the potential for wildfire behavior endangering the at-risk community; (2) has a geographic feature that aids in creating an effective fire break, such as a road or ridge top; or (3) is in condition class 3, as documented by the Secretary in the project-specific environmental analysis; (III) an area that is adjacent to an evacuation route for an at-risk community that the Secretary determines, in cooperation with the at-risk community, requires hazardous fuels reduction to provide safer evacuation from the at-risk community." A Community Wildfire Protection Plan offers the opportunity to establish a localized definition and boundary for the wildland urban interface (USFS 2021h)

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