AGENDA ITEM or FINAL CONTRACT REVIEW SUBMITTAL FORM

Agenda Item: CPAW Presentation

Action Requested: Discussion

Parties to the Agreement:

Term Begins: **Term Ends:** **Grant Contract #:**

Summary:

Community Planning Assistance for Wildfire; Wildfire Policy Recommendation Draft

Fiscal Impact:

Submitted by: Liz Mense for Cathie Pagano **Submitter's Email Address:** EMense@gunnisoncounty.org

Finance Review: ○ Required ◉ Not Required

Comments:

Reviewed by: Discharge Date:

County Attorney Review: ○ Required ◉ Not Required

Comments:

Reveiwed by: Discharge Date: Certificate of Insurance Required

Yes ○ No ○

County Manager Review:

Comments:

Reveiwed by: GUNCOUNTY1\emense Discharge Date: 11/8/2019

○ Consent Agenda ○ Regular Agenda ○ Worksession Time Allotted: 45

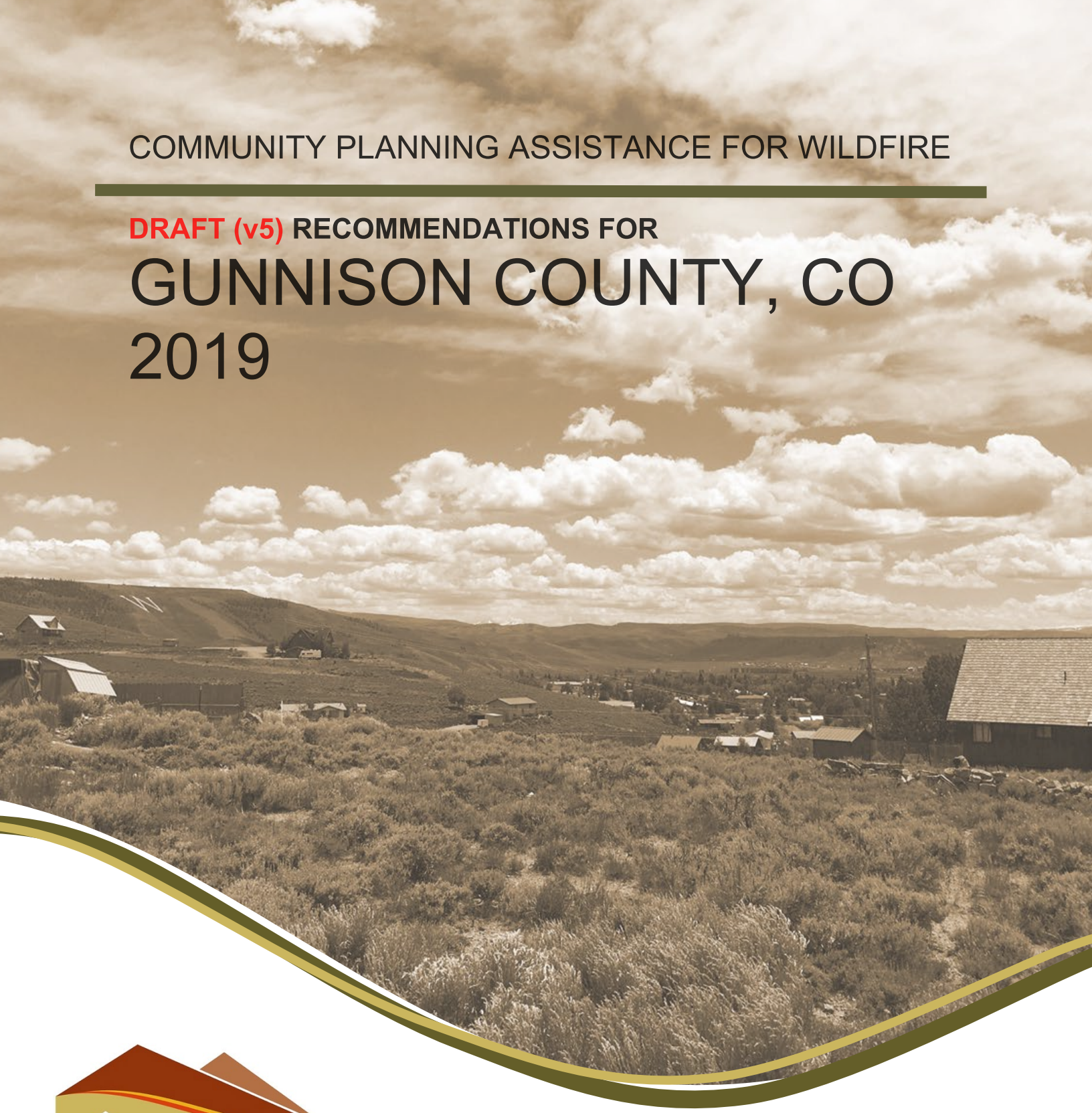
Agenda Date: 11/12/2019

Revised April 2015

COMMUNITY PLANNING ASSISTANCE FOR WILDFIRE

DRAFT (v5) RECOMMENDATIONS FOR

GUNNISON COUNTY, CO
2019



COMMUNITY PLANNING ASSISTANCE FOR WILDFIRE

PREPARED BY:

Wildfire Planning International, LLC

Wildland Professional Solutions, Inc.

ABOUT

Community Planning Assistance for Wildfire Program

The Community Planning Assistance for Wildfire (CPAW) program works with communities to reduce wildfire risks through improved land use planning. The CPAW program is a joint partnership between Headwaters Economics and Wildfire Planning International. It is funded by grants from the USDA Forest Service and private foundations.

Author Information

CPAW engages qualified professionals with expertise in land use planning, forestry, risk modeling, and fire behavior. This report was produced by:

Kelly Johnston, RPF, FBAN – Wildfire Professional Solutions, Inc.

Molly Mowery, AICP – Wildfire Planning International, LLC

Additional authors and contributors included: Eva Karau – USDA Forest Service, Rocky Mountain Research Station, Darrin Punchard, AICP – Punchard Consulting, LLC, and Hannah-Hunt Moeller. For questions related to this report, please contact: info@wildfireplanning.com

Acknowledgments

CPAW relies on collaboration with local stakeholders to provide meaningful feedback throughout the process. Our team would like to thank everyone who contributed their time to our CPAW activities in the Gunnison County community, including members of the Gunnison County Community and Economic Development and Emergency Management Departments, Gunnison Fire Protection District, Crested Butte Fire Protection District, Colorado State Forest Service, West Region Wildfire Council, USDA Forest Service, City of Gunnison, and Gunnison County Board of Commissioners. Any omissions are solely the responsibility of the authors and are not intended to reflect the value of other participants.

P.O. Box 7059
Bozeman, MT 59771
https://planningforwildfire.org

Cover photos provided by CPAW.

In accordance with Federal law and the U.S. Department of Agriculture policy, this institution is prohibited from discriminating on the basis of race, color, national origin, sex, age, or disability. (Not all prohibited bases apply to all programs.) To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 1400 Independence Avenue, SW, Washington, DC 20250-9410 or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

CONTENTS

INTRODUCTION **1**

Community Planning Assistance For Wildfire 3
Gunnison County Planning Context 4
Gunnison County Community Analysis 10

SUMMARY OF RECOMMENDATIONS **13**

RECOMMENDATION 1 ..... **14**

Define the Wildland-Urban Interface (WUI) and Implement a WUI Risk Assessment Program 14
Overview 14
Implementation Guidance 16
Tips and Additional Resources 25

RECOMMENDATION 2 ..... **26**

Adopt the WUI Code and Update Land Use Regulations to Create a Resilient Approach to Development in the WUI 26
Overview 26
Implementation Guidance 26
Tips and Additional Resources 30

RECOMMENDATION 3 ..... **32**

Leverage Existing Plans to Support Wildfire Hazard and Regulatory Priorities Across Gunnison County 32
Overview of Current Plans 32
Analysis of Plans 33
Recommendations 34
Resources 35

IMPLEMENTATION **37**

Update Materials and Provide Resources to Support Actions in the Home Ignition Zone 37
Recognition Programs 37
Funding Options 38

CONCLUSION AND NEXT STEPS **42**

APPENDIX A: HAZARD ASSESSMENT **43**

Overview 43
Wildfire Hazard Characterization for Gunnison County 44
Final Considerations 62
References 63

APPENDIX B: DEFINITIONS **64**

ACRONYMS

BRIC	Building Resilient Infrastructure and Communities
COWRAP	Colorado Wildfire Risk Assessment Portal
CPAW	Community Planning Assistance for Wildfire
CRS	Colorado Revised Statutes
CSFS	Colorado State Forest Service
CWPP	Community Wildfire Protection Plan
DMA	Disaster Mitigation Act
DRRA	Disaster Recovery Reform Act
FEMA	Federal Emergency Management Agency
FMAG	Fire Management Assistance Grant
GNA	Good Neighbor Authority
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
ICC	International Code Council
IWUIC	International Code Council Wildland-Urban Interface Code
LUR	Land Use Resolution
NHMP	Natural Hazard Mitigation Plan
NFPA	National Fire Protection Association
PDM	Pre-Disaster Mitigation
RMRS	Rocky Mountain Research Station
SIZ	Structure Ignition Zone
SME	Subject Matter Expert
SRS	Secure Rural Schools
USDA	United States Department of Agriculture
USFS	United States Forest Service
WRWC	West Region Wildfire Council
WUI	Wildland-Urban Interface

INTRODUCTION

In 2018, more than 25,000 structures were destroyed from wildfires that occurred in the United States.[1] This staggering figure is a result of several factors, including long-term changes to the fire environment and landscapes, and increased exposure of development in areas known as the wildland-urban interface (WUI, pronounced “WOO-EE”).

Wildfires in the WUI can threaten communities in different ways (Figure 1). Dispersed, rural development patterns on the edge of a community can experience wildfire from adjacent wildland areas. Suburban and urban areas with more dense development may be subject to home-to-home ignitions. Embers can make contact with any development pattern, and likewise wildfires can quickly overwhelm local fire protection resources.

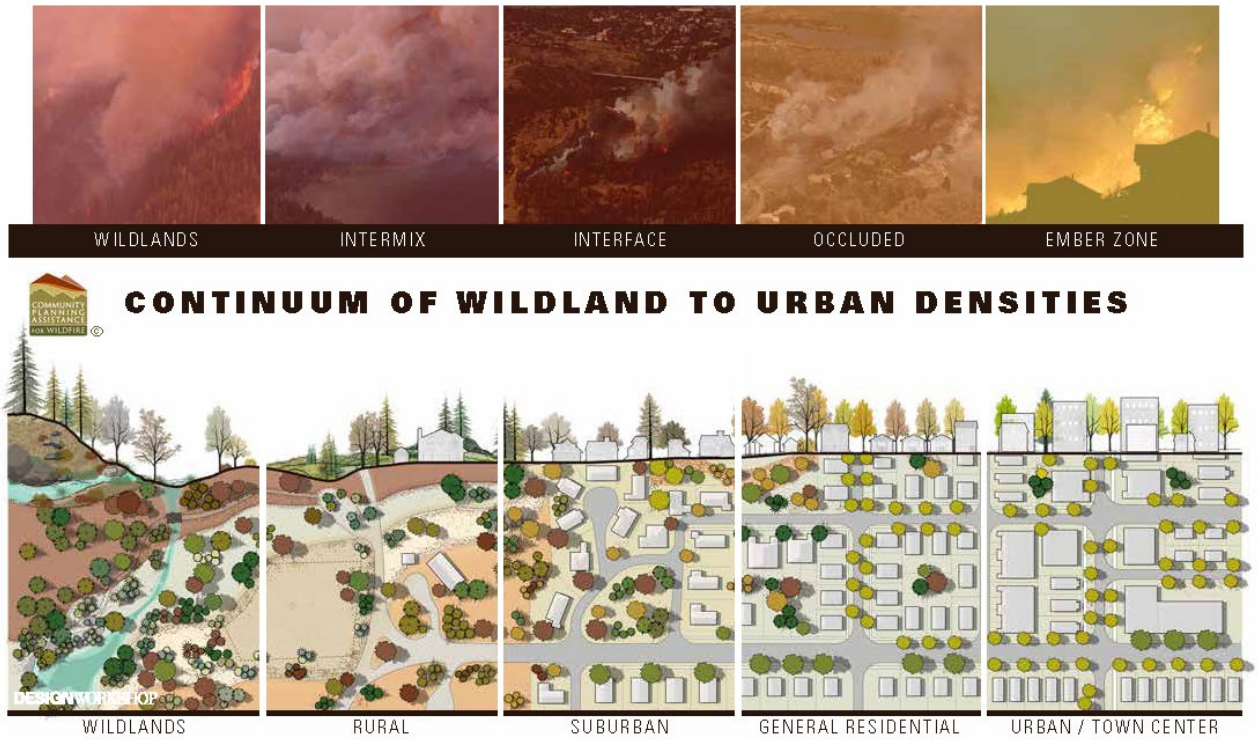


Figure 1. Communities in the wildland-urban interface can be affected by wildfire in different ways, depending on their development patterns and other factors of wildfire susceptibility.

[1] National Interagency Coordination Center 2019 Annual Wildfire Statistics Report

Development location and density of structures are just two features that contribute to how a wildfire may affect a community. Other influences include the type of land use, landscaping decisions at the property and community scale, choice of building materials and construction, access and egress, available resources for response, and level of preparedness. These factors form the basis for how land use planning decisions can shape WUI communities.

Communities have a variety of planning tools available to address challenges associated with the WUI (Figure 2). These tools include plans and policies (e.g., growth management plans, neighborhood plans, open space management plans), and codes and regulations (e.g., subdivision regulations, landscaping ordinances, steep-slope ordinances, zoning codes, building codes, and wildland-urban interface codes).

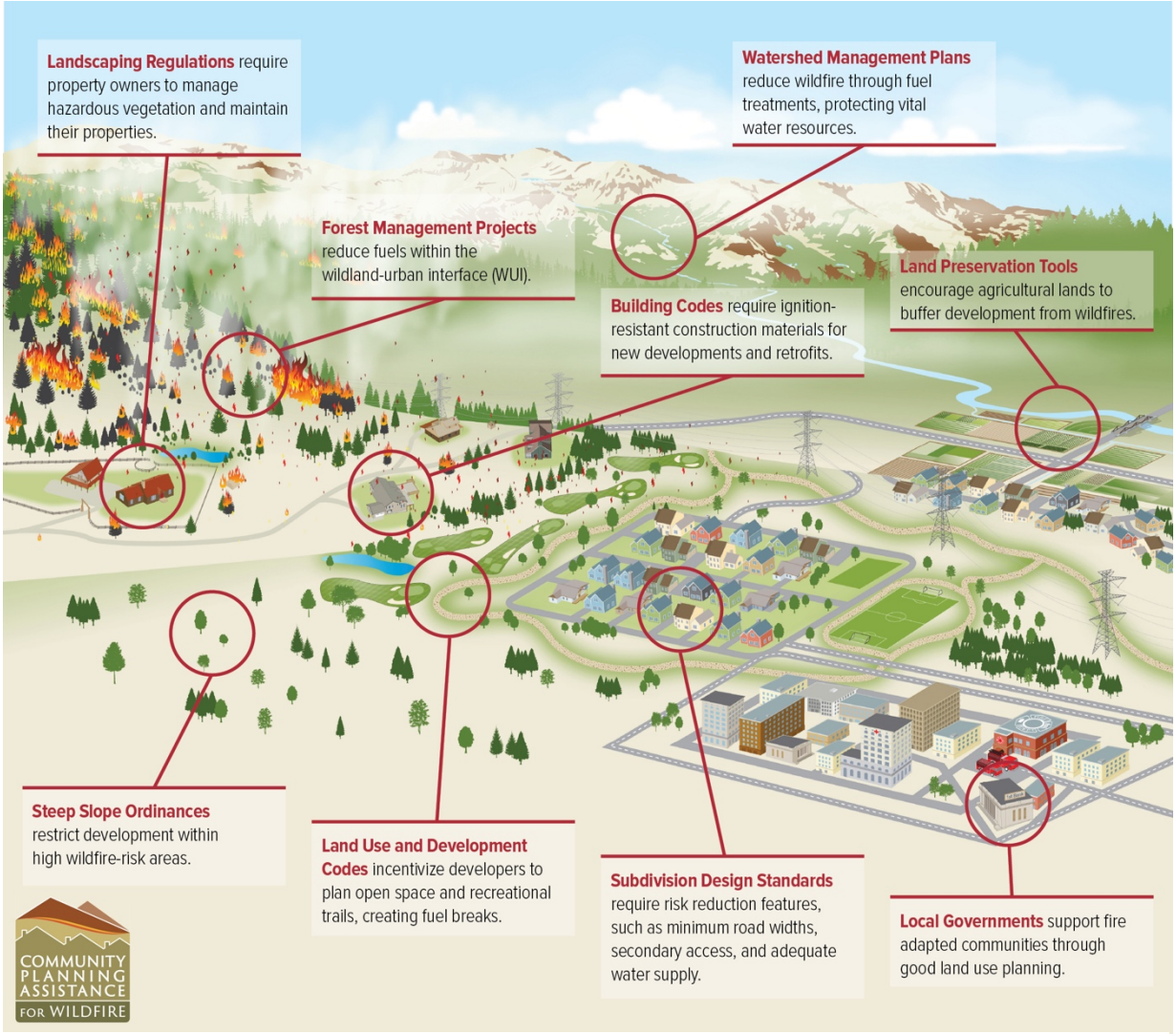


Figure 2. Examples of different policy and regulatory options available to communities when planning for wildfire.

Community Planning Assistance For Wildfire

Identifying appropriate land use planning tools to result in more resilient WUI communities was the catalyst for the Community Planning Assistance for Wildfire (CPAW) program. The CPAW program helps communities make more informed decisions about current and future development to better integrate wildfire-resilience into the planning process. CPAW was established by Headwaters Economics and Wildfire Planning International in 2015 and is funded by the USDA Forest Service and private foundations. Since its inception, CPAW has worked with communities of varying sizes, capacities, and geographical locations across the United States (Figure 3).

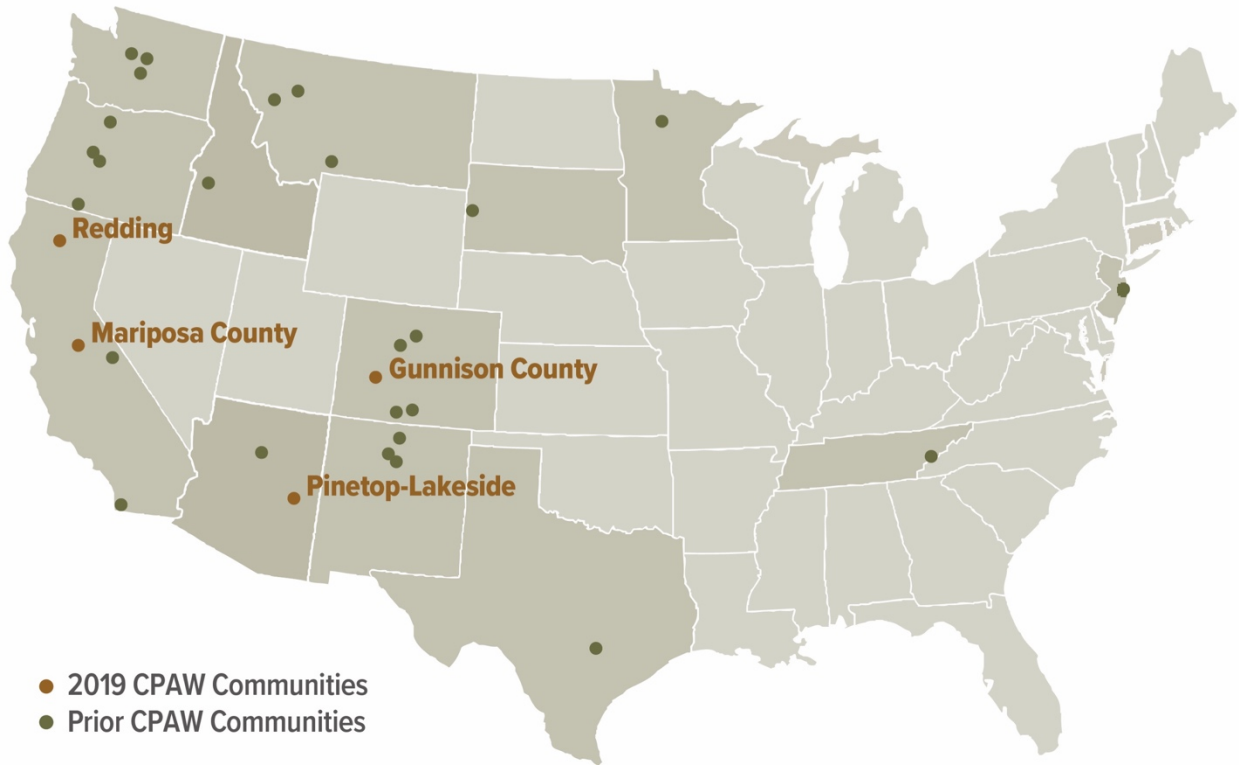


Figure 3. In 2018, Gunnison County was one of four communities selected to receive customized technical land use planning assistance during the 2019 calendar year.

Communities voluntarily apply and are competitively selected to participate in the program on an annual basis. Communities must show commitment and engagement from both the planning and fire departments to reflect the collaborative nature required for CPAW success. If selected, communities receive customized technical consulting services from CPAW's team of professional land use planners, foresters, risk modelers, and researchers. Specific services vary based on community needs, and may include capacity-building trainings on WUI planning topics, risk modeling and spatial analysis, guidance on wildfire mitigation plans and policies, and other strategies to address local wildfire risk.

Stakeholder Engagement

Community members engaged in the process play a critical role to project success. While services are provided at no charge to the community, each community signs a Memorandum of Understanding with CPAW to outline their mutual understanding of roles and responsibilities

and project commitments. CPAW teams engage with a variety of local stakeholders who may serve as steering group members, local experts, or interested parties. These stakeholders provide valuable input and feedback, represent diverse wildfire and community development interests, and act as communication channels to other local groups.

CPAW Process and Recommendations

The CPAW community planning process occurs over the course of one year. During that time, CPAW team members meet with stakeholders to discuss local issues, conduct several field tours to learn about unique wildland-urban interface and wildfire mitigation challenges, and provide presentations to help the community understand CPAW's program goals (Figure 4). Team members also review community planning documents to identify gaps and opportunities for strengthening wildfire policies and regulations. The CPAW team delivers a final set of recommendations by the end of the assistance year. Follow-up implementation assistance may also be available to communities depending on their needs and CPAW's program funding.

Figure 4. Team members on a site tour of Gunnison County with local stakeholders during their first site visit.

CPAW recommendations are customized to each local community based on field visit data gathering, stakeholder feedback, research, science, best practices, and national expertise in planning, forestry, hazard mitigation and wildfire risk reduction. All recommendations are voluntary. Local governments retain sole authority for the decision to implement any recommendations delivered by CPAW.

Gunnison County Planning Context

Gunnison County is a predominantly rural county situated in the Rocky Mountains of central-western Colorado. The county is known for its striking scenery of mountainous terrain, deep valleys, rivers, recreational open space, and wilderness. The county seat is the City of Gunnison, the county's most populated municipality with just over 6,000 residents, which is settled in a wide valley at the confluence of Tomichi Creek and Gunnison River. Other incorporated jurisdictions include the Town of Crested Butte, a popular tourist destination, and the smaller towns of Marble, Mt. Crested Butte, and Pitkin.

Figure 5. Gunnison County is located in south-central Colorado just west of the Continental Divide.

Gunnison County is Colorado's fifth largest county in terms of total area, but it ranks only 44th in terms of population density. It is far from Colorado's more populated Front Range region, and nearly 200 driving miles from the metropolitan cities of Colorado Springs and Denver. Despite its remote location, Gunnison County and other parts of the Rocky Mountains started to become popular vacation destinations for skiing in the late 1960s, and more recently its communities have pushed to become popular summer tourism destinations. Today, the economic base of Gunnison County is rooted primarily in tourism, education, health care, ranching, and recreation.[2]

Geographic Location and Significant Features

Gunnison County rests along Colorado's Western Slope formed by the Continental Divide, the principal hydrological divide in North America which coincides with the county's eastern boundary. The Gunnison National Forest cover the majority of the eastern portion of the county. Other significant features of the Gunnison Basin include a wide range of preserved open spaces that include Collegiate Peaks Wilderness to the northeast, Maroon Bells-Snowmass Wilderness and White River National Forest to the north, and the West Elk Wilderness to the west.[3]

The county's unique mountainous landscape contributes to a topography and terrain with no regularity. Elevation in the County ranges from roughly 5,880 feet in the Somerset area to over 14,285 feet at Castle Peak, the highest point in the county. Approximately 40 percent of the county is forested, and local vegetation primarily includes timber, grasslands and shrublands. The area is also highly mineralized (part of the "Colorado Mineral Belt") and figured in the gold and silver mining industry of early Colorado, though Gunnison's wealth as a mining area was short lived, lasting only a few years.[4]

Gunnison County is home to the Blue Mesa Reservoir, an artificial reservoir located on the upper reaches of the Gunnison River, approximately 30 miles below Gunnison, and within the Curecanti National Recreation Area. Considered the largest lake located entirely within the state, the reservoir was created by the construction of Blue Mesa Dam, a 390-foot tall earthen fill dam built by the U.S. Bureau of Reclamation in 1966 for the generation of hydroelectric power.5 The Taylor Park Reservoir is another sizeable man-made lake in the county which was created in 1934 by damming the Taylor River, a tributary of the Gunnison River.

Figure 6. Gunnison County is home to the threatened Gunnison Sage-Grouse whose prime mating habitat is low sagebrush.

---

[2] Gunnison County Multi-Hazard Mitigation Plan Update. Chapter 2: Community Profile. Public Review Draft, January 2019.
[3] Gunnison Basin Public Lands. Colorado: Forest Service Series Map, 2008. United States Department of Agriculture.
[4] Gunnison County Multi-Hazard Mitigation Plan Update. Chapter 2: Community Profile. Public Review Draft, January 2019.
[5] U.S. Department of the Interior, Bureau of Reclamation. Blue Mesa Dam. Accessed on April 22, 2019. Available at: https://www.usbr.gov/projects/index.php?id=62.

Special Planning Consideration: Sage-Grouse

The Greater Sage-Grouse is an iconic bird of the American West. The Sage-Grouse prime habitat is undisturbed sagebrush in semi-arid treeless landscapes. Development by ranchers, oil and gas operations, and urban sprawl have drastically reduced its historic territory. The Sage-Grouse population has plummeted since the 1990s, triggering a solicitation by advocates to register the Sage-Grouse under the Endangered Species Act (ESA). The U.S. Fish and Wildlife (FWS) listed the bird as threatened in 1998 which motivated significant habitat protections and conservation efforts by regional land managers. In 2010, the USDA launched the Sage-Grouse Initiative to prioritize conserving habitats with the largest bird population. These efforts allowed the FWS to announce in 2015 that the Sage-Grouse did not warrant ESA listing and removed its 'threatened' status. Eschewing the listing indicated a healthy population size and efficacy of conservation efforts, but also circumvented restrictions to economic activities occurring on public land. In March 2019, the Bureau of Land Management announced the removal of over 80% of habitat protections to sage-brush focal areas, further rolling back required federal protections.[6] Environmentalists view the changes as a direct affront to Sage-Grouse habitat while industry recognizes the declaration as a benefit to economic activities occurring on public land.

Gunnison County, Colorado is a locus of grouse habitat advocacy starting in the 1990s. The Gunnison Sage-Grouse was discovered in southwest Colorado and discovered as a new species of grouse in 1995. Later that year, a local working group formed to address concerns about the bird, culminating with the Gunnison Sage-Grouse Conservation Plan in 1997 to recover the rare species. Unlike the Greater Sage-Grouse, the Gunnison Sage-Grouse maintains a 'threatened' listing under the ESA by the FWS.[7] This elicits strict regulations on the grouse and its mating ground, the lek. Critical Gunnison Sage-Grouse habitat currently makes up approximately 30% of Gunnison County's total land area and is centered around the town of Gunnison, resulting in potential conflicts with the built environment.

To protect the bird and its habitat, Gunnison updated its land use guidelines in 2013, appointed a Sage-Grouse Conservation Coordinator to manage new development, formed the Gunnison Basin Sage-Grouse Strategic Committee, and requires new permits to clear a wildlife conservation review. Gunnison County requires new buildings to be >0.6 miles from a lek as mapped by the Colorado Division of Wildlife. If the building is under the 0.6mi threshold, the county mandates minimal disturbance of the natural landscape habitat.

According to the 2013 FWS Conservation Objectives Team (COT), the foremost threat to Sage-Grouse is wildfire. The COT identifies the wildfire following conservation measures for threat reduction:

1) Restrict or contain fire within the normal range of fire activity (assuming a healthy native perennial sagebrush community).
2) Eliminate intentional fires in sagebrush habitats.
3) Design and implement restoration of burned sagebrush habitats to allow for natural succession to healthy native sagebrush plant communities.

---

[6] Further rollback of protections are being proposed and protested: https://www.gjsentinel.com/news/western_colorado/state-protests-blm-s-plan-for-sage-grouse/article_26c18380-b352-11e9-83ef-20677ce05640.html (Updated July 2019)

[7] Gunnison County Development in Wildlife Habitat. Source: https://www.gunnisoncounty.org/DocumentCenter/View/1347/Development-in-Gunnison-Sage-Grouse-Habitat-Information-Sheet (Updated Nov 2013).

4) Implement monitoring programs for restoration activities.
5) Immediately suppress fire in all sagebrush habitats.

Land Area, Ownership, and Distribution

Gunnison County boundaries encompass a total area 3,260 square miles, of which 3,239 square miles is land and 21 square miles is water.[8] Several governmental agencies control vast expanses of land, with approximately 80 percent of the county's land in public ownership. The Federal government owns almost all public land, with the United States Forest Service (1,983 square miles) and the Department of the Interior's Bureau of Land Management (555 square miles) combined holdings totaling 79 percent of county lands. Many of these areas are designated as National Wilderness and Recreation Management Areas.

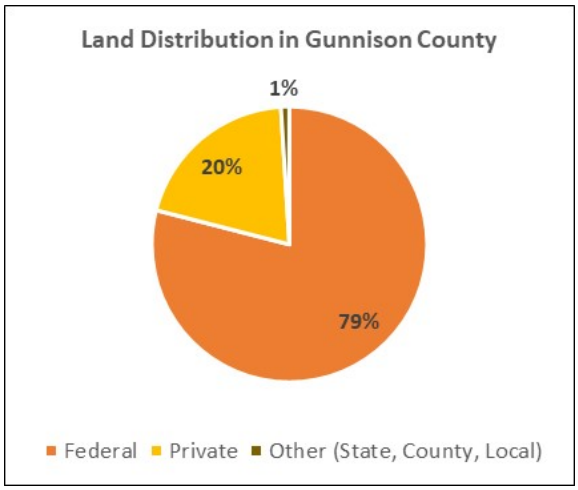


Figure 7. Gunnison Land Ownership (by percentage).

Data Sources: U.S. Geological Survey, Gap Analysis Program. 2016. Protected Areas Database of the United States (PADUS) version 1.4, as reported in Headwaters Economics' Economic Profile System (headwaterseconomics.org/eps).

The large amount of publicly-owned land has significant implications for the county's future development patterns. Most existing development follows relatively low-density patterns in the valley floor and in proximity to primary transportation routes including US Highway 50 and State Routes 133, 135, 92, 149 and 114.[9] The Gunnison Valley is unique among mountain valleys in Colorado and the Rocky Mountains in that development has historically been constrained and restricted to small towns with dense populations. The area has avoided the contiguous development patterns seen elsewhere in the West, primarily due to the county's long-standing agricultural heritage and public-private partnerships which have preserved lands as shared spaces for recreation and traditional western businesses such as forestry and ranching.[10]

If current growth trends remain consistent into the future, the County anticipates existing subdivisions will be built out to accommodate new development. More specifically, future growth is expected to occur in the West Gunnison Neighborhood and Gunnison Rising, a 650-acre property located along Tomichi Creek that was annexed into the City of Gunnison in 2010.[11]

Key Demographics and Economic Trends

Gunnison County's total population has more than doubled since 1970, and it has continued to grow steadily in recent years with an increase of 7.1 percent between 2010 and 2017.[12] This

---

[8] U.S. Census Bureau. 2010.
[9] Gunnison County Comprehensive Plan – Crested Butte/Gunnison Corridor. Introduction and Background Data. October 2005.
[10] Gunnison-Crested Butte Tourism Association. Accessed on April 22, 2019. Available at: https://gunnisoncrestedbutte.com/explore/towns/.
[11] Gunnison County Multi-Hazard Mitigation Plan Update. Chapter 4: Risk Assessment and Hazard Profile. Public Review Draft, January 2019.
[12] U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates.

growth is projected to continue with a forecast of more than 20,000 people by the year 2040.[13] Table 1 describes several key demographic characteristics of the community with some additional notes, including comparisons to statewide statistics.

TABLE 1. DEMOGRAPHIC AND ECONOMIC OVERVIEW		
Statistic	Gunnison County	Colorado
Total Population	16,215[a]	5,436,519[a]
Population Density (ppl/ sq. mile)	4.7[b]	48.5[b]
Median Age	34.5[a]	36.5[a]
Housing Units	11,766[a]	2,319,737[a]
Median Home Value	$313,900[a]	$286,100[a]
Median Household Income	$52,651[a]	$65,458[a]
Poverty Rate	14.1%[a]	11.5%[a]
Unemployment Rate	2.0%[a]	2.8%[a]
Data Sources: a. U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates. b. U.S. Census Bureau. 2010.		

Employment sectors in Gunnison County have fluctuated over time. Historically, the county experienced an early mining boom and bust. Around the turn of the century, economic activities turned to coal mining, ranching, higher education, and recreation.[14] Today, the economic base of Gunnison County is rooted primarily in travel and tourism industries, which support nearly 40 percent of all jobs. The construction industry, education, health care, and government—at the local, state and federal level—also continue to make up significant portions of the local economy.[15]

Fire Environment and Wildfire History

Gunnison County encompasses a range of fuels from open grass and sage fuel types to high elevation forest fuel types. Most fires that occur in Gunnison County do not grow very large[16], primarily due to successful fire suppression efforts. However, successful suppression is a driver in forest encroachment into the open grass lands and increasing fuel loads in the forest fuel types. Compounding the issue are extensive mountain pine beetle spruce bark beetle infestations across the county; resulting in a significant threat of standing dead and down forest fuels capable of supporting extremely aggressive fire behavior if exposed to ignition sources.

---

[13] Colorado Department of Local Affairs, State Demography Office. April 2019.
[14] Pelletier, M. March 2019. Gunnison County Development - Past and Future. Published by Gunnison County Geographic Information Services.
[15] U.S. Department of Commerce. 2018. Census Bureau, American Community Survey Office, Washington, D.C, as reported in Headwaters Economics' Economic Profile System (headwaterseconomics.org/eps).
[16] 2011 Gunnison County Community Wildfire Protection Plan

The additional elements of complex and often steep topography coupled with the dispersed residential home development pattern common throughout the county present an extremely complex wildfire protection challenge. The county regularly experiences the weather conditions that can support extreme fire behavior, with only the ignition source missing. For example, Gunnison County was under the very same weather influences that drove the 2002 Hayman Fire and Missionary Ridge Fires which burned 137,760 acres and destroyed 600 structures; and 71,739 acres and 46 structures respectively. The CWPP cites "construction type, condition, age, the fuel loading of the structure/contents and location as the contributing factors that make many homes in the county more susceptible to ignition, under even moderate burning conditions". The community-level assessment has identified the 32 communities in the study area to fall between moderate and extreme hazard rating.

TABLE 2. SIGNIFICANT RECENT WILDFIRES OF NOTE

Date	Fire Name	Size (acres)	Start Location	Community Impacts
September 15, 2016	Freeman	360	Request input from staff and SMEs	• Request input from staff and SMEs
June 22, 2013	Request input from staff and SMEs	447	Request input from staff and SMEs	• Request input from staff and SMEs
June 20, 2013	Trickle	217	Request input from staff and SMEs	• Request input from staff and SMEs
June 15, 2013	East Fork	447	Request input from staff and SMEs	• Request input from staff and SMEs
June 8, 2013	Ox Cart	1152	Request input from staff and SMEs	• Request input from staff and SMEs
August 10, 2012	East Coal Creek	219	Request input from staff and SMEs	• Request input from staff and SMEs
June 23, 2012	Treasure Mountain	420	Request input from staff and SMEs	• Request input from staff and SMEs
April 6, 2019	Mile Marker 125	117	Request input from staff and SMEs	• Request input from staff and SMEs
March 24, 2012	Doyleville	814	Request input from staff and SMEs	• Request input from staff and SMEs
April 8, 2010	?	350	Request input from staff and SMEs	• Request input from staff and SMEs

TABLE 2. SIGNIFICANT RECENT WILDFIRES OF NOTE				
Date	Fire Name	Size (acres)	Start Location	Community Impacts
September 24, 2008	Jay	115	Request input from staff and SMEs	• Request input from staff and SMEs
July 9, 2008	Clover	147	Request input from staff and SMEs	• Request input from staff and SMEs
Request input from staff and SMEs	Request input from staff and SMEs	Request input from staff and SMEs	Request input from staff and SMEs	• Request input from staff and SMEs

Gunnison County Community Analysis

CPAW identified challenges and opportunities related to wildfire and land use planning in Gunnison County. These findings help inform the most effective recommendations and anticipate potential barriers that could occur during the implementation process.

Local Planning Challenges

- **Existing development.** Pre-existing 35-acre tract developments are excluded from the definitions of subdivision or subdivided land and therefore exempt from the county planning department's review. There are currently few new subdivision applications, but many existing subdivisions were not designed with wildfire safety and protection features, such as adequate water supply, emergency access, and neighborhood scale fuel mitigation.

Figure 8. CPAW team members, county staff and stakeholders discussing wildfire mitigation successes and challenges in the Trapper's Crossing at the Wildcat subdivision.

- **Demographic shifts.** Increases in the number of second homes and rental properties has resulted in more transient populations, including seasonal residents and short-term visitors. Moreover, investments in the outdoors and recreation opportunities have attracted more visitors during the summer months. This results in a transient demographic that may be less familiar with wildfire prevention and safety, such as evacuation routes. In addition, resident turnover has weakened relationships between fire districts and HOAs; in some cases, regular invitations to annual HOA meetings are no longer part of traditional outreach and education opportunities.

- **Regulatory gaps or challenges in enforcement.** Some existing regulations that are intended to address wildfire hazard require more clarity for successful administration. For example, wildfire mitigation plans are required to incorporate applicable methods of fire prevention as recommended by CSFS publications, which can lead to inconsistency and subjectivity during the application review process. In addition, there are no requirements for other risk factors, such as vegetation management on driveways or a standard for the length of driveways.
- **Lack of voluntary engagement.** Throughout the CPAW process, stakeholder input conveyed the general impression that wildfire is not top of mind for many residents and there are not as many instances of voluntary engagement in wildfire mitigation practices as would be desired. Potential reasons likely vary, including past fire history that shows a low fire return interval in the county. However, ecosystem changes such as recent beetle kill and future impacts from climate change may change this dynamic and taking a more proactive approach to fire mitigation and management is necessary to avoid future losses.

Local Planning Opportunities

- **Collaborative partnerships to support mitigation.** Gunnison County is fortunate to have many agencies and organizations willing to support wildfire mitigation and risk reduction solutions, including local fire districts, Colorado State Forest Service, West Region Wildfire Center. Throughout the CPAW process, each agency brought enthusiasm and a willingness to provide appropriate assistance to further implement mitigation practices, such as fuel treatments, technical reviews on development applications, assistance with on-site property assessments, and assistance with Community Wildfire Protection Plan updates.
- **Community sparkplugs.** In addition, there are local sparkplugs and HOAs that have engaged in mitigation activities, such as Firewise. These activities could be further leveraged as examples for other residents.
- **Support for wildfire regulations.** Multiple departments and fire districts expressed support for wildfire regulations that could more comprehensively address the needs of current and future development to make the county more resilient to wildfire. In addition, there is an opportunity to increase the fire protection district's role in conducting property

assessments and their review authority in subdivisions to ensure they meet fire protection standards, such as access routes.

- **New wildfire hazard assessment.** CPAW's delivery of a countywide updated wildfire hazard assessment significantly reduces the burden on county staff to develop this tool that serves as the foundation for future mitigation activities. In addition, the county GIS department was actively engaged in the CPAW process and can serve as a future resource for hazard assessment maintenance and updates.

SUMMARY OF RECOMMENDATIONS

The 2019 CPAW report for Gunnison County provides the county with three recommendations to implement the effective strategies for reducing wildfire risk. Each recommendation, summarized below, includes background information, an analysis of challenges or shortcomings, proposed actions for moving forward, and applicable tips or resources. Following the three recommendations is an implementation section which provides additional information on incentive-based recognition programs and potential funding sources.

TABLE 3. OVERVIEW OF RECOMMENDATIONS

Recommendation	Why This Matters	Key Actions
1. Define the Wildland-Urban Interface (WUI) and Implement a WUI Risk Assessment Program	Gunnison County has multiple wildfire hazard assessments which are dated or do not provide a robust level of local detail. Clearly defining the wildland-urban interface and using an updated hazard assessment offers a defensible decision-support tool for land use policies and regulations.	• Adopt the wildfire hazard assessment process recommended by CPAW. • Undertake and integrate parcel-level assessments to provide a complete risk assessment program. • Integrate into land-use planning and regulatory framework.
2. Adopt the WUI Code and Update Land Use Regulations to Create a Resilient Approach to Development in the WUI	Gunnison County has limited requirements for development in the WUI, including no construction standards for residential homes. Research and best practices show that additional requirements for properties would significantly reduce the potential wildfire losses to the built environment and negative impacts on life safety.	• Adopt the 2018 International Code Council International Wildland-Urban Interface Code (IWUIC) with local amendments within Title 14 Technical Code to establish minimum wildfire safety standards for future development. • Reference the wildfire hazard and risk assessment (see Recommendation 1).
3. Leverage Existing Plans to Support Wildfire Hazard and Regulatory Priorities Across Gunnison County	Gunnison County has multiple plans that inform short- and long-term wildfire risk reduction and mitigation activities. However, many plans contain dated materials or lack connections across policies and actions. Updating and linking existing plans will prioritize wildfire mitigation opportunities and better inform land use planning decisions.	• Leverage the Gunnison County Strategic Plan by including wildfire hazard as a priority in future updates. • Update the county Community Wildfire Protection Plan (CWPP) and encourage continued adoption of local CWPPs. • Link the Natural Hazard Mitigation Plan with the county CWPP and incorporate into the LUR by reference.

RECOMMENDATION 1

Define the Wildland-Urban Interface (WUI) and Implement a WUI Risk Assessment Program

Clearly define the wildland-urban interface within Gunnison County and integrate hazard assessment mapping as a component of the decision support tool for land use policies and regulations. Consider the implementation of a spatially delineated risk assessment program by incorporating property-specific assessment information.

Overview

Initial observations by the CPAW team, along with input from local subject matter experts (SMEs), suggest that wildfire risk within Gunnison County extends throughout the county. The fuel, weather, and topographical conditions under private ownership, and county or federal jurisdiction present a significant fire threat to communities and subdivisions across the county.

Current Wildfire Risk Assessment Methodology and Process

There are three separate hazard assessment methodologies currently in use by Gunnison County:

- The Gunnison County website refers to a wildfire hazard assessment methodology that was developed on 2003. This methodology document identifies land cover/use, species, density, ladder fuels and insect and disease as the factors driving the hazard assessment. An interactive wildfire hazard map is available on the county website that appears to be based on this methodology.
- The 2001 Gunnison County Community Wildfire Protection Plan (CWPP) identifies fuels, topography, structural flammability, availability of water for fire suppression, egress and navigational difficulties, as well as other hazards both natural and manmade, as considerations in determining the overall hazard ranking of 32 individual communities.
- Finally, the County Land Use Resolution (LUR) refers to a CSFS wildfire map and define low hazard, medium hazard, severe tree fire hazard and severe brush fire hazard as the hazard categories and identifies land cover/use, species, density, ladder fuels and insect and disease as the factors driving the hazard assessment.

Having three separate assessment systems results in a significant level of confusion and introduces conflicting guidance where assessments overlap.

What is Wildfire Risk?

Wildfire risk can be visualized as a triangle consisting of three components:

1. Likelihood of a wildfire occurring based on topography, weather, and ignition patterns; this can also include ignition sources from hazardous land uses (e.g., sawmills or propane storage facilities);
2. Predicted intensity of a wildfire (usually measured in flame length) based on vegetation type and weather conditions;

3. Susceptibility of values (for land use planning purposes, values consist of communities, structures, and infrastructure).

Together, these components complete the wildfire risk triangle (Figure 9).

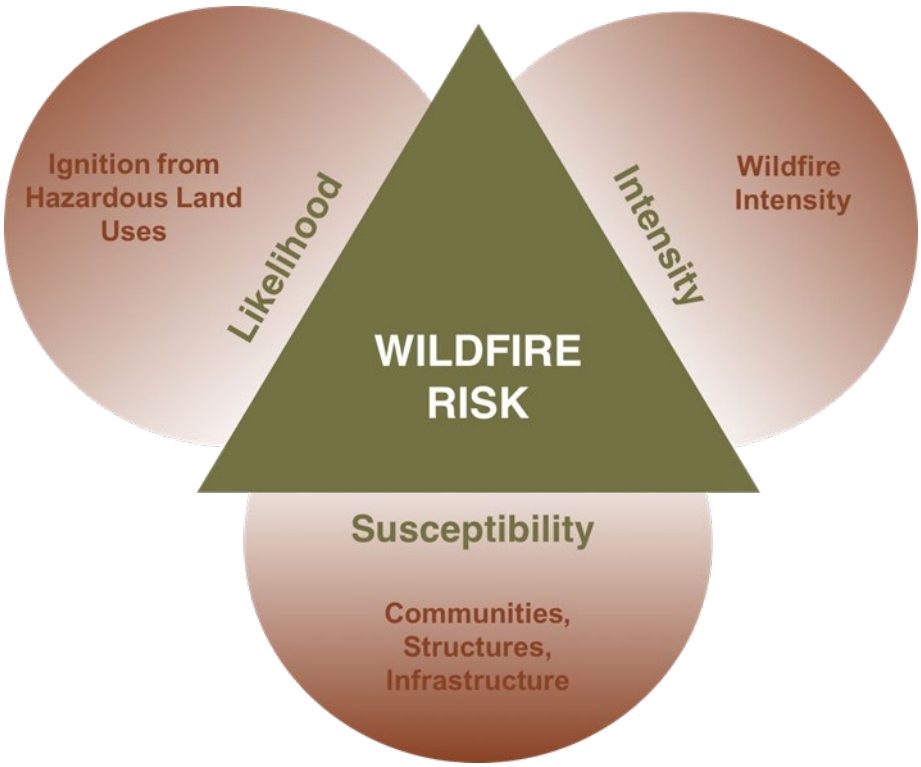


Figure 9. Components of the wildfire risk triangle

Land use planning largely focuses on mitigating the susceptibility portion of the wildfire risk triangle. There are two important susceptibility inputs that should be evaluated to appropriately determine wildfire risk in the context of land use planning:

- The location and density of structures and infrastructure;
- The ignition potential of individual structures and infrastructure.

Implementing this recommendation will provide clear definition of Gunniosn County's wildland-urban interface and integrate a hazard assessment map as a component of the decision support tool for land use policies and regulations. The further incorporation of a property-specific assessment system to complement the hazard assessment with a built environment susceptibility component will provide a comprehensive risk assessment.

USFS Risk and Hazard Assessment

As part of the CPAW program, the USFS Rocky Mountain Research Station (RMRS) provides wildfire risk and hazard assessment support. After assessing the current need, the CPAW team engaged the RMRS to undertake an updated and refined countywide hazard assessment (likelihood and susceptibility) to support this project. As a component of the hazard assessment, the RMRS is also undertaking the SILVIS lab's approach to spatially defining the WUI in Gunnison County.

Parcel-Level Susceptibility Assessments

Individual Parcel-Level Assessments complete the risk triangle by providing the susceptibility component. This focuses on assessing each structure and the immediate surroundings, or Structure Ignition Zone (SIZ). The Colorado State Forest Service (CSFS) and the West Region Wildfire Council (WRWC) currently provide voluntary parcel-level wildfire hazard assessments for landowners who request them. These parcel level assessments do not feed into any of the county level hazard assessments.

Implementation Guidance

As part of the CPAW process, RMRS staff engaged with local wildfire risk SMEs to achieve three main objectives:

1. Validate the RMRS spatial fuels layers.
2. Explore RMRS tools that can be used to develop a single countywide hazard mapping products to better support land use planning and other wildfire risk reduction efforts.
3. Spatially define the WUI.

This collaborative engagement was undertaken in the form of workshops in which local subject matter experts worked with RMRS staff and CPAW team members to determine the appropriate parameters and tools that would be useful in supporting local risk-reduction efforts.

As a result of this collaborative work, RMRS has calibrated the spatial fuel layer and developed a methodology to provide spatial hazard assessment support to the implementation of land use planning policy and regulations.

Wildfire Hazard Assessments and Mapping

To provide an effective decision-support tool for the county and its partners, RMRS developed the following wildfire hazard mapping outputs. Three maps are provided at two scales: the Landscape-Level Wildfire Hazard (120 m pixel resolution), Local Wildfire Hazard (90 m pixel resolution) which includes ember zones, and Mitigation Potential (30 m pixel resolution). A summary of the methodology used to develop these outputs can be found in Appendix A.

Landscape-Level Wildfire Hazard

This scale (120 m pixel resolution) represents the likelihood (probability) of a fire occurring and the intensity of the fire at the landscape level based on the inherent landscape characteristics including broad existing vegetation, biophysical settings, fire regimes, and fire histories. To provide the assessment in a format that is easily interpreted by the expected users (public, developers, land use planners), the pixelated display was summarized to polygon boundaries based on the U.S. Geological Survey Hydrological Unit Code (HUC) 12 (sub-watershed) boundaries. The landscape-level hazard assessment (Figure 10) is delineated into the following rankings:

- MODERATE
- HIGH
- VERY HIGH

The factors influencing these rankings can be used to determine the potential landscape-level exposure that a development will be subject to. The ranking at this scale is difficult to change at

the local/parcel level. Mitigation affecting change at this scale is typically done by large-scale disturbances such as insect mortality, fires, or landscape-level mitigation.

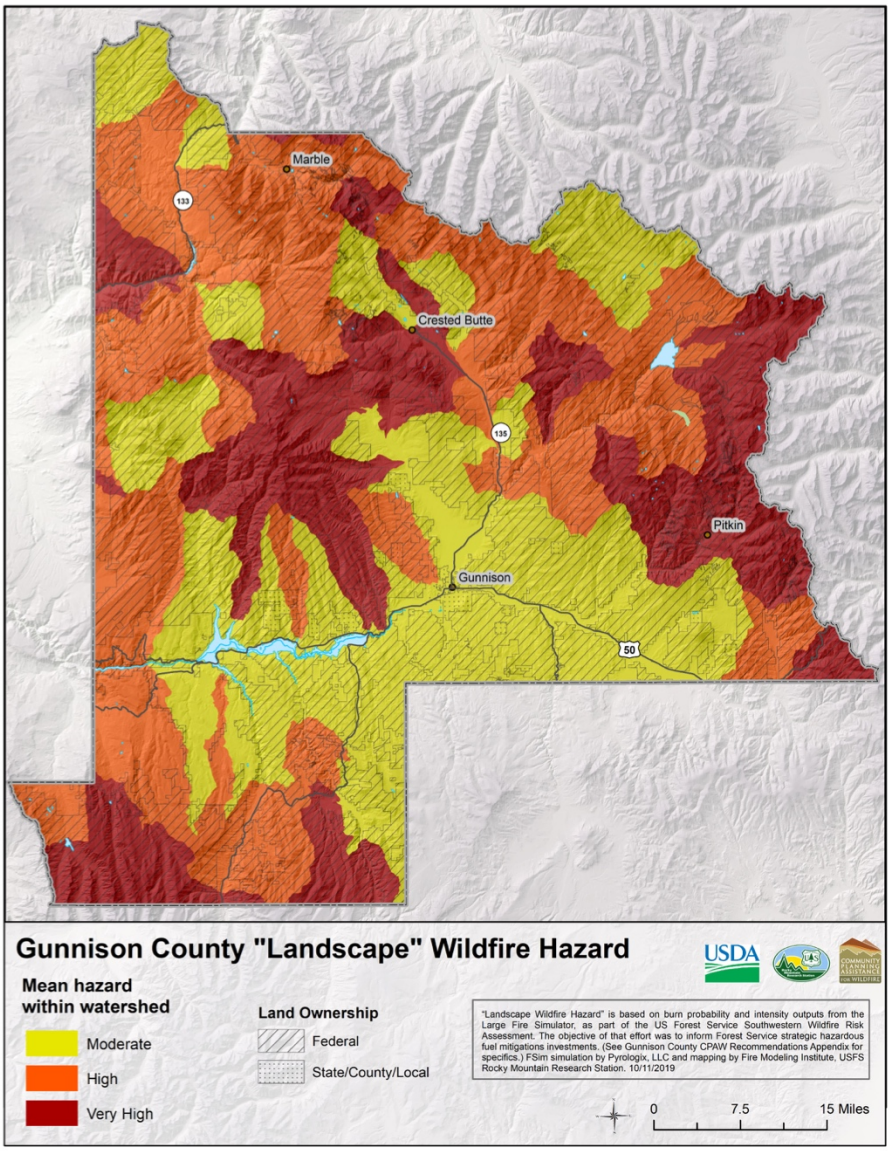


Figure 10. Gunnison County Landscape Wildfire Hazard Map

Land Use Planning Application: This application informs land use planners on the general areas where fires are most likely to occur and where collaborative, multi-agency, large-scale fire management planning and mitigation are necessary.

Local-Level Wildfire Hazard

This scale (90 m pixel resolution) is based on an extreme event (worst fire days). To provide the assessment in a format that is easily interpreted by the expected users (public, developers, land use planners), the pixelated display was summarized to polygon boundaries based on the catchment boundaries within the HUC 12 boundaries (Figure 11). This does not show the likelihood of a fire occurring but does show where fires are likely to burn at high intensity. For example, a fire that starts in an area where the local hazard is high can spread fast and burn at

high intensity creating significant wildfire exposure to any structures in the area. The same rankings used at the landscape scale are used at this local scale:

- MODERATE
- HIGH
- VERY HIGH

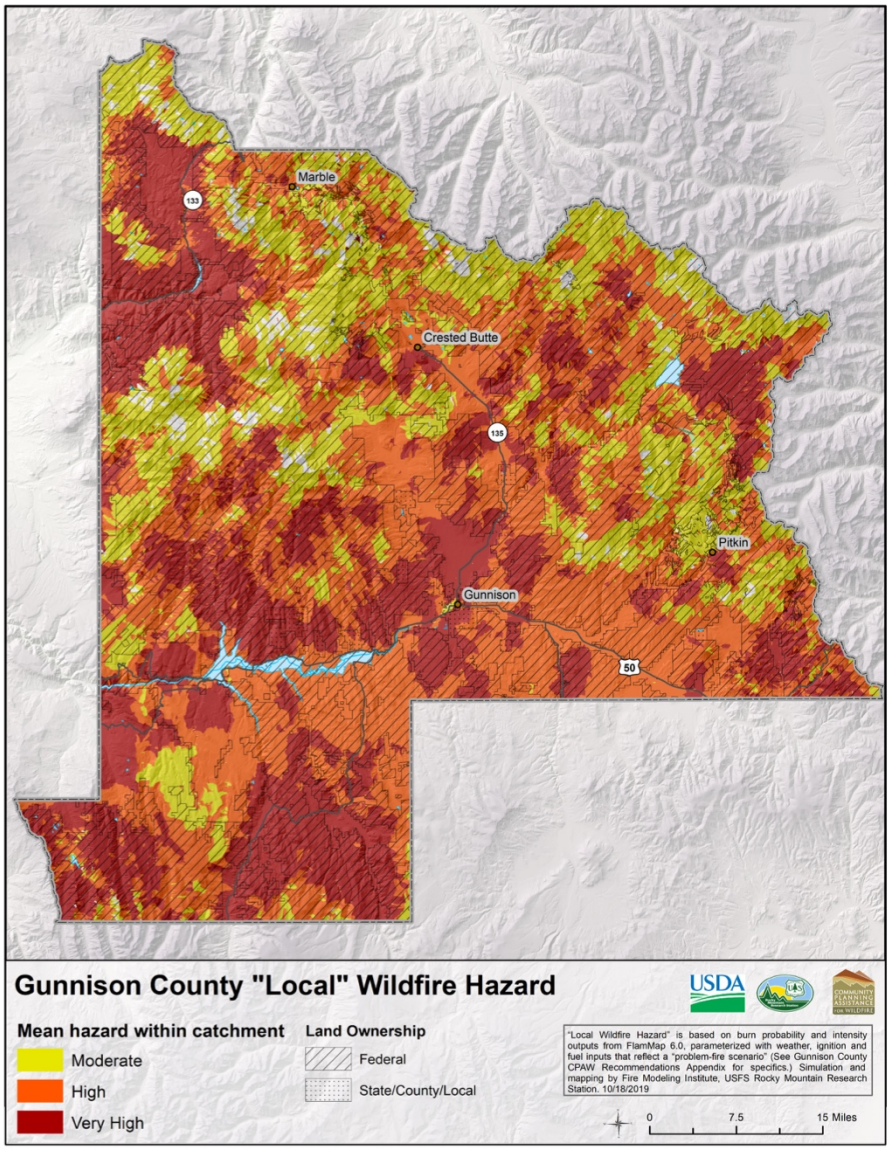


Figure 11. Gunnison County Local Wildfire Hazard Map

Land Use Planning Application: This application informs land use planners on the relative worst-case (hottest, driest, windiest days during a fire season) wildfire exposure (radiant, convective, and ember) that can be expected in any given polygon where development exists or is planned.

Mitigation Difficulty

The Mitigation Difficulty component (30-meter pixel resolution) uses the life form (grass, shrubs, trees), slope, and crown fire potential to classify the potential mitigation success of any given 30-meter pixel on the map (Figure 12). This is represented by nine categories (Table 4).

TABLE 4. MITIGATION DIFFICULTY CLASSES AND DESCRIPTIONS

Class	Characteristics	Mitigation Discussion
1	Sparsely vegetated, or developed, with potential for ember impact	Barren ground/water/developed/ sparse vegetation or land that lies within potential spotting distance of a wildfire. Mitigation will involve appropriate structure ignition zone and structure construction.
2	Herbaceous on a shallow slope (<15%)	Fires are typically easier to suppress in these areas. However, high winds combined with dry conditions lead to potentially dangerous, fast-moving, high-intensity fires. Mitigation may involve a combination of irrigation, mechanical (mowing) treatment, frequent burning, and fuel breaks in conjunction with appropriate structure ignition zone and structure construction.
3	Herbaceous on moderate slope (≥15 to <30%)	Harder to construct fuel breaks, increased difficulty in mechanical (mowing) treatment, increased potential for erosion, increased rate of spread and intensity may make frequent burning and other mitigation more difficult. Focus should be on appropriate slope setbacks, structure ignition zone, and structure construction mitigation.
4	Herbaceous on steep slope (≥ 30%)	Significant challenges in fuel break construction, unlikely option for mechanical (mowing) treatment, significant potential for erosion, high rate of spread and intensity potential may make frequent burning and other mitigation difficult. High winds combined with short-term drying conditions lead to potentially dangerous fast-moving fires with fire fighter access concerns. Mitigation potential may involve a combination of frequent burning and fuel breaks in conjunction with slope set-back, appropriate structure ignition zone, and structure construction.
	Shrub on shallow slope (<15%)	Fires are typically harder to suppress than grassfires in these areas. High winds combined with dry conditions lead to potentially dangerous, fast-moving, high-intensity fires with fire fighter access concerns. Mitigation may involve a combination of frequent burning and fuel breaks in conjunction with appropriate structure ignition zone and structure construction.

TABLE 4. MITIGATION DIFFICULTY CLASSES AND DESCRIPTIONS		
Class	Characteristics	Mitigation Discussion
5	Shrub on moderate slope (≥15 to <30%)	Harder to construct fuel breaks, increased difficulty in mechanical (mastication) treatment, increased potential for erosion, increased rate of spread and intensity may make prescribed burning more difficult. Focus should be on a combination of appropriate mechanical treatment and burning, slope set-backs, structure ignition zone, and structure construction mitigation.
6	Shrubs on steep (≥30%) slopes	Significant challenges in fuel break construction; unlikely option for extensive mechanical (mastication) treatment. Significant potential for erosion or slope instability resulting from treatments is a likely mitigation challenge. Increased rate of spread and significant intensity may make prescribed burning more difficult. Focus should be on a combination of appropriate mechanical treatment and burning, slope set-backs, structure ignition zone, and structure construction mitigation.
	Tree on shallow slope (<15%)	Open canopy must be maintained to prevent increased crown fire potential. Surface fuels must be treated/maintained in a state that reduces the chances of fast-moving surface fires. Mitigation should also include appropriate slope set-backs, structure ignition zone, and structure construction mitigation.
7	Tree on moderate slope (≥15 to <30%)	Open canopy must be maintained to prevent increased crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated/maintained in a state that reduces the chances of fast-moving surface fires. Increased potential for erosion or slope instability resulting from treatments can be a mitigation challenge. Mitigation should also include appropriate slope set-backs, structure ignition zone, and structure construction mitigation.
	Tree on shallow slope (<15%) with potential for crown fire	Dense canopy needs to be thinned to reduce crown fire potential. Surface fuels must be treated to reduce risk of fast-moving surface fires. Mitigation should also include appropriate structure ignition zone and structure construction mitigation.
8	Tree on moderate slope with potential for crown fire (≥15 to <30%)	Dense canopy needs to be thinned to reduce crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated to reduce risk of fast-moving surface fires. Increased potential for erosion or slope instability resulting from treatments can be a mitigation challenge. Mitigation should also include appropriate slope setbacks, structure ignition zone, and structure construction mitigation.

TABLE 4. MITIGATION DIFFICULTY CLASSES AND DESCRIPTIONS		
Class	Characteristics	Mitigation Discussion
8	Tree on steep slope (≥30%)	Open canopy must be maintained to prevent increased crown fire potential, which can be significantly difficult due to the slope. Surface fuels must be treated/maintained in a state that reduces the chances of fast-moving surface fires. Significant potential for erosion or slope instability resulting from treatments is a likely mitigation challenge. Mitigation should also include appropriate slope set-backs, structure ignition zone, and structure construction mitigation.
9	Tree on steep slope (≥30%) with potential for crown fire	Dense canopy needs to be thinned to reduce crown fire potential, which may be extremely difficult if not prohibitive due to the slope. Surface fuels must be treated to reduce risk of fast-moving surface fires. A very high potential for erosion or slope instability resulting from treatments is a likely mitigation challenge. Mitigation should also include appropriate slope setbacks, structure ignition zone, and structure construction mitigation.

Land Use Planning Application: This informs land use planners on the general potential success and challenges of mitigation when aligning with the mitigation requirements of the Wildland-Urban Interface regulatory requirements.

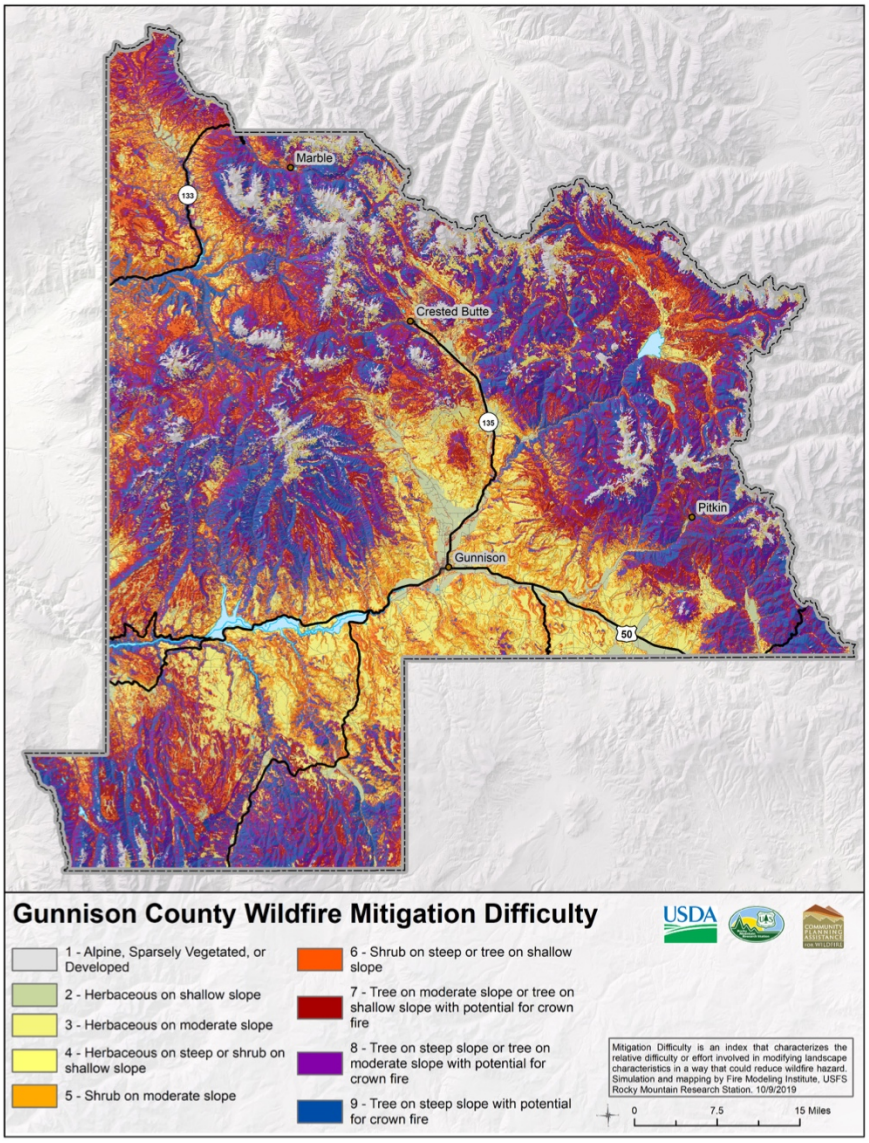


Figure 12Gunnison County Mitigation Difficulty Map

Parcel-Level Assessment

Parcel level wildfire assessment requires a “boots on the ground” approach. Currently, the Colorado State Forest Service and the West Region Wildfire Council are conducting voluntary parcel level assessments. It would be beneficial to the county if a standardized and comprehensive approach were adopted by all partners across the county. In developing or adopting this tool, consideration should be given to:

- Incorporating the assessment of structure component susceptibility into the overall risk assessment.
- Reflecting the most current best practices.
- Collecting data in a format that can: be easily tracked, integrate with and inform the mitigation difficulty and local hazard assessment maps, and provide meaningful risk reduction direction to property owners and land managers.

Defining the WUI

A general WUI definition used across all policies, plans, and regulations should account for the "set of conditions" where vegetation (wildland fuels) and structures or infrastructure (built fuels) are influenced by weather and topography to allow fire to ignite and spread through the WUI environment. To provide the basis for a true understanding of the risk that Gunniosn County faces, the WUI should be more accurately defined as:

Any developed area where conditions affecting the combustibility of both wildland and built fuels allow for the ignition and spread of fire through the combined fuel complex.

In order to provide a spatial reference in defining the WUI, the CPAW/ RMRS team modified SILVIS lab's approach for spatially defining the WUI. The SILVIS lab approach originated in the Federal Register[17] report on WUI communities at risk from fire. This approach was modified by the CPAW/RMRS team to the following parameters:

- **WUI Intermix**: Areas with ≥1 house per acre and ≥50 percent cover of wildland vegetation.
- **WUI Interface:** Areas with ≥1 house per acre and ≤50 percent cover of vegetation and within 1.5 mi of area with >= 75% wildland vegetation.
- **Non- WUI Vegetated (no housing):** Areas with ≥50 percent cover of wildland vegetation and no houses (e.g., protected areas, steep slopes, mountain tops).
- **Non-WUI (very low housing density):** Areas with ≥50 percent cover of wildland vegetation and <16 houses per square mile (e.g., dispersed rural housing outside neighborhoods).
- **Non-Vegetated (low and very low housing density):** Areas with ≤50 percent cover of wildland vegetation and 0-8 houses per acre.
- **Non-Vegetated (medium and high housing density):** Areas with ≤50 percent cover of wildland vegetation and ≥8 houses density per acre.

Based on these definitions, most of the developed areas within Gunnison County have been classed as **WUI Intermix** with some small areas of **WUI Interface**, mostly within the City of Gunnison and Town of Crested Butte (Figure 13).

[17] USDA and USDI. 2001. Urban wildland interface communities within vicinity of Federal lands that are at high risk from wildfire. Federal Register 66:751–777.

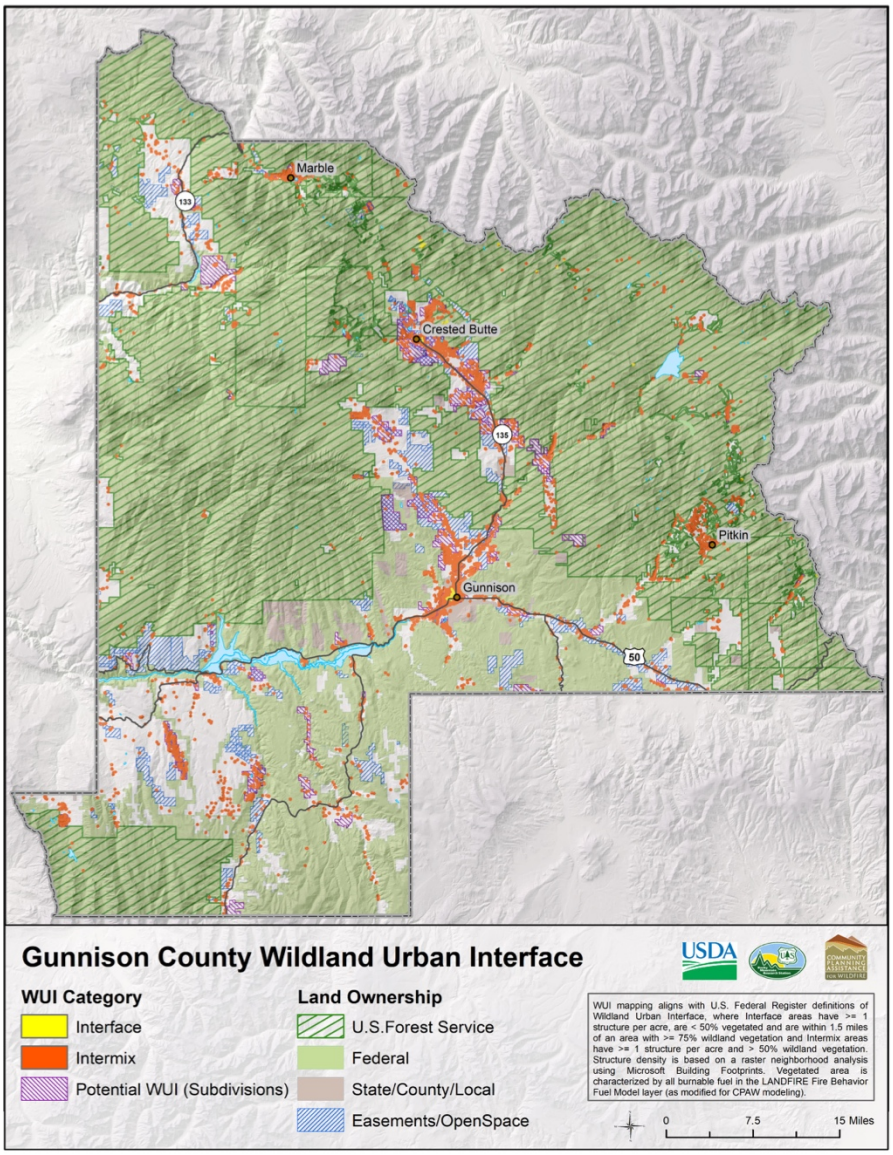


Figure 13. Gunnison County Map of the Wildland Urban Interface and Wildland Urban Intermix

Using the Hazard Assessment to Support Land Use Policy and Regulation

The landscape- and local-scale maps, as well as the mitigation potential wildfire exposure maps, will be supplied as a geodatabase to the town. This will allow the user to explore a hierarchy of hazard/exposure metrics including all of the elements described above. For example, when a user clicks on a watershed polygon or mitigation pixel, the user will see the elements that contribute to the calculation of the final hazard rating. The display of pixel-level model outputs at finer display scales will also provide the ability for end-users to examine the spatial variability of factors contributing to hazard and exposure with any watershed. The local-scale map and mitigation-potential map will provide the opportunity for planners to appropriately assess a future or existing development area for wildfire exposure and require the appropriate mitigation. It will also provide a ranked scale to guide implementation of a wildland-urban interface code with regards to the degree of standards that must apply based on exposure and mitigation and whether the area is within the ember zone.

Tips and Additional Resources

The resulting hazard-assessment tool will be provided in the form of a geodatabase for addition to the county's geomatics servers as an ESRI ARC GIS layer. For the data to be made available to land use planners and the development community, the expertise of a GIS specialist will be required to ensure it is in the appropriate format for access and consumption by these groups.

The hazard assessment tools must be kept up to date to be relevant. A minimum default five-year update schedule is recommended, unless updates are required to occur sooner, based on the following:

- Significant wildland fire activity;
- Significant fuel management activity;
- Significant forest health impacts, or other disturbances that alter large-scale vegetation structure;
- Significant urban growth.

A best practices document (Appendix A) provides guidance to the town and county on the methodology for updating the assessment. The hazard-assessment outputs should be strongly linked as a decision support tool for implementing the proposed WUI requirements and planning policies.

RECOMMENDATION 2

Adopt the WUI Code and Update Land Use Regulations to Create a Resilient Approach to Development in the WUI

Adopt the International Code Council International Wildland-Urban Interface Code (IWUIC) with local amendments to establish minimum wildfire safety standards for future development in Gunnison County.

Overview

Currently, Gunnison County broadly regulates wildfire through the Land Use Resolution (LUR). All new construction, substantial improvement, use, fill, encroachments, alteration, fuel modification or treatment are required to be designed in a manner that does not increase potential intensity or duration of a wildfire. However, there are no specific construction standards are in place, except for the regulation requiring mobile homes to have a weatherproof, fire-resistant skirting. Class A roof materials are also required as a standard to be addressed in a recorded, permanent protective covenant.

In addition to construction standards, the LUR prohibits development on any slope in excess of 30 percent that is also located in an area determined to be a severe wildfire hazard area; as well as in a fire chimney, as identified by CSFS. Additionally, wildfire mitigation plans, including the creation of defensible space, are required for parcels located in wildfire hazard areas; however, the county does not request them as part of the review process. Finally, fuel modifications and fuel breaks are required as a standard to be addressed in a recorded, permanent protective covenant.

The current wildfire references and requirements in the LUR are a good start, but current research and best practices indicate that additional required standards would significantly reduce the potential wildfire losses to the county's built environment and negative impacts on life safety.

When adopted in full, the International Code Council International Wildland-Urban Interface Code (IWUIC) provides jurisdictions with a *minimum* set of special regulations for the "safeguarding of life and property from the intrusion of fire from wildland fire exposures and fire exposures from adjacent structures and to prevent structure fires from spreading to wildland fuels, even in the absence of fire department intervention." In other words, the IWUIC serves as a tool to strengthen the likelihood of a structure's survival and reduce reliance on suppression and response resources.

Implementation Guidance

Many communities adopt the IWUIC with local amendments to better reflect their needs, such as creating a local definition of the wildland-urban interface and referencing a locally appropriate wildfire risk or hazard assessment.

CPAW recommends that the county adopt the IWUIC, with the following modifications:

Replace IWUIC Fire Hazard Severity Rating with CPAW Hazard Assessment Tools

Within the IWUIC, the Fire Hazard Severity methodology is used to determine appropriate mitigation requirements. The critical fire weather threshold within this rating does define all of Gunnison County as "Extreme"; however, within the local environment, it does not account for the differences between heat transfer (radiant, convective, conductive) exposure of individual structures.

Heat transfer exposure and general mitigation guidance can be better demonstrated using the CPAW generated "Local Wildfire Hazard" and "Mitigation Difficulty" maps to support land use planning and regulation within the county. The use of the wildfire hazard assessment for guiding the application of the IWUIC (2018) will link required mitigation actions to expected wildfire exposure (see Recommendation 1). The county should consider integrating the newly developed wildfire hazard assessment to determine the appropriate application of the proposed adopted IWUIC (2018) through the following process**:**

A. Determine the Local Level Wildfire Hazard summarized ranking in which the proposed development is located to understand the likelihood of the building exposure to high-intensity fire.

B. Determine the Mitigation ranking (0 to 9) of the parcel in which the proposed development is located and the parcel(s) immediately adjacent to it.

C. Use the following table (Table 5) to determine the appropriate IWUIC mitigation standards to apply.

TABLE 5: GUNNISON COUNTY CPAW MITIGATION POTENTIAL/ IWUIC HAZARD CROSSWALK

Local Wildfire Hazard	Table 603.2 Minimum Required Defensible Space (site/slope adjustment required)[1]	CPAW Mitigation Difficulty and Slope % category			24.301.181(21) Minimum IR Construction		
		<15	**15≤ to <30**	**>30**	**Non-Conform**[2]	**Conform**	**1.5x Conform**
Moderate	30 ft.	1, 2, 4	1, 2, 3, 5	4	IR1	IR2	IR3
High[3]	50 ft.	6	7	6	IR1 (N.C.)	IR2	IR2
Very High	100 ft.	7	8	8, 9	IR1 (N.C.)	IR1	IR2

Table Notes:

(1) "Distances are allowed to be increased due to site-specific analysis based on local conditions and the fire protection plan" (Figure 603.2- 2012 IWUIC)

(2) **Non-conforming** indicates that the minimum slope-adjusted defensible space distances with appropriate mitigation cannot be achieved from the structure to vegetative fuels, or minimum water supply requirements cannot be achieved; as opposed to **conforming** in which the defensible space distances with appropriate mitigation and minimum water supply requirements can be achieved.

(3) High hazard is also used where non-conforming structures are present within 50 ft of the primary structure.

N.C. = requires rated Non-Combustible materials; including tempered glass.

Adopt IWUIC as a Title 14 Technical Code

The CPAW team recommends adopting the IWUIC with local amendments as a “standalone” code within the Title 14 Technical Codes. This ensures that the regulatory language is based on a tested, current, coordinated set of regulations and best practices. Since the ICWUIC not only addresses construction standards, but also addresses defensible space, fire water supply and access, adding it to Title 14 as a Technical Code provides for the most efficient process for addressing updates in both the building code and the LUR when future IWUIC addresses versions are released.

Wildfire Mitigation to Address Sage-Grouse Habitat Protection Objectives

The FWS seeks to prevent unwanted wildfires in sage-grouse habitat. This objective ideally aligns with other community-based wildfire mitigation efforts in Gunnison County. However, the CPAW team identified potential compatibility issues between maintaining critical habitat and adequately planning for wildfire:

1) providing defensible space for structures through construction and design, vegetation management and non-combustible zone requirements, while maintaining natural lek landscape, and
2) enabling sufficient access to lots and neighborhoods without constructing new roads in prime habitat.

Structure Ignition Zone (SIZ)

Structure Ignition Zone (SIZ) mitigation involves the combined effort of mitigation using appropriate construction design and materials, as well as the Defensible Space surrounding the building. Defensible Space mitigation focuses on intensive surface fuel management within the first 30 feet of a structure, and less intensive vegetation management from 30 feet out to 100 feet (slope adjusted). Mitigation in the first 30 feet typically includes the removal of conifer trees, cutting and maintenance of grass, the use and arrangement of appropriate plants and the mitigation of accessory structures (sheds, decks, fences, etc.) using appropriate construction design and materials. Mitigation between 30 feet and 100 feet (slope adjusted) typically includes the thinning and pruning of conifer trees and the removal of surface and suspended dead and down debris. However, the vegetation characteristics of sage-grouse habitat will typically only require mitigation of the 30-foot defensible space zone. In many cases, where mitigation is required beyond 30 feet, there may be alignments realized where the defensible space tree thinning for wildfire mitigation may also be beneficial in addressing encroachment of sage-grouse habitat.

The IWUIC allows for an “alternative: performance-based approach. In areas where conflict may exist, the combination of addressing mitigation through construction design and materials along with defensible space will often offer the opportunity to integrate sage-grouse habitat protection objectives using a performance based regulatory approach.

Access and Egress

The areas where the county has most concern for access and egress are typically in subdivisions located in dense conifer forests; which likely do not conflict with Sage grouse habitat. As with the SIZ, the desirable vegetation characteristics of sage-grouse habitat will likely align with access and egress mitigation requirements. In cases where they do not align, the use of a performance-based approach can offer opportunity to achieve both objectives.

Update the Gunnison County Land Use Resolution

The Gunnison County Land Use Resolution references wildfire mitigation requirements in several locations. Based on acceptance of CPAW recommendations to adopt the IWUIC and the newly developed wildfire hazard assessment mapping and develop a wildfire risk assessment program, the CPAW team further recommends updating the LUR to reflect these changes (Table 6).

TABLE 6. RECOMMENDED LUR CHANGES

Section	Issue	Proposed Action
§1-112: Use of Maps	• Maps are dated with currently multiple methodologies that may confuse the user • Maps do not necessarily over guidance at the most appropriate scale, or resolution to support land use planning and regulation	• Amend section to refer to the new wildfire hazard assessment maps provided by CPAW
§2-102: Definitions	• Wildland-Urban Interface is not defined in the current document	Wildfire Hazard Area – see terms • Wildfire-Related Terms – review for consistency and add the Wildland-Urban Interface definition as proposed by CPAW
§3-106: Phase of Projects	• Wildfire mitigation is not specifically addressed as a compliance requirement	• Ensure major impact projects subject to wildfire mitigation requirements are phased in a manner that reduces wildfire hazard to adjacent uses
§11-105.B. Development in Areas Subject to Wildfire Hazards - Applicability	• Refers to wildfire hazard maps and in areas determined by the Colorado Forest Service	• Amend section to refer to the new wildfire hazard assessment maps provided by CPAW
§11-105.B. Development in Areas Subject to Wildfire Hazards – Maps Incorporated	• Refers to wildfire hazard maps developed by the Colorado Forest Service	• Amend section to refer to the new wildfire hazard assessment maps provided by CPAW
§12-105: Water Supply	• Refers only to NFPA 1142 Occupancy Hazard Classification Tables • Addresses hazardous vegetation as an acceptable indicator for increased conditions	• Updated fire suppression water supply requirements to refer the IWUIC (2018) Section 404 for regulatory requirements and the entire NFPA 1142 for specific technical guidance. • Amend section to refer to the new wildfire hazard assessment map provided by CPAW, the IWUIC IR

TABLE 6. RECOMMENDED LUR CHANGES		
Section	Issue	Proposed Action
		construction requirements and Section 404.
§12-107: Fire Protection	• Standards for vehicle access, Fire Hydrant, Cistern and Dry Hydrant standards are limited and rely on fire district standards. • Fire district standards vary, or do not exists	• Refer all vehicle access, fire hydrant, cistern and dry hydrant standards to the IWUIC Section 404 (with local amendments) for regulatory direction and NFPA 1141 and 1142 for specific technical direction.

Parcel-Level Assessments and Wildfire Mitigation Plan

The ICWUIC primarily offers regulatory direction through a prescriptive approach. Adopting referencing the hazard assessment maps provided by CPAW (Recommendation 1) to guide the implementation of the IWUIC will provide a streamlined approach in most cases. However, the IWUIC does offer an alternative "performance-based" approach where, either:

1. the specific site conditions do not align with the hazard mapping, or
2. the proposed development cannot comply with the prescribed regulations.

In these cases, an onsite SIZ assessment will have to be performed and a wildfire mitigation plan that outlines the alternative performance-based approach should be required by the county. In order to address capacity, the CPAW team recommends that the county:

- establish minimum qualified professional requirements for the individuals undertaking the assessments and reporting
- determine the best option between, or combining:
    - charging an inspection fee, and providing the qualified professional to undertake the assessment and plan development
    - requiring the proponent to engage in an independent qualified professional to undertake the required assessments and report.

Tips and Additional Resources

Parcel-Level Assessments and Wildfire Mitigation Plan

The West Region Wildfire Council (WRWC) currently provides parcel-level wildfire assessments to property owners on a voluntary "by request" basis. These assessments are conducted by trained staff using a mobile device-based application and online platform with an integrated reporting function. Through this program, the WRWC provides SIZ mitigation advice in the form of an "wildfire mitigation report". Upon the property addressing the mitigation recommendations, the WRWC provides a follow-up "inspection" using the same technology to confirm the work has been completed. The platform also has the ability to issue a certificate recognizing successful completion of the mitigation work. The MyWildfireRisk program aligns with the most current wildfire mitigation research and best practices and the structure of the program is very closely aligned with similar programs being undertaken in Eagle County (realfire.net) and Boulder County (wildfirepartners.org). The latter program is currently directly linked to the county's land use and building code regulatory process. Establishing a working relationship between the

county and the WRWC with regards to the MyWildfireRisk program would likely result in a standardized and comprehensive SIZ assessment that can support the development review process while addressing capacity challenges.

Sage Grouse

Coordination between Gunnison local planning officials and the following list of sage grouse contacts regarding any development and implementation of new WUI guidance or regulations will help better align the proposed regulations with sage grouse habitat protection objectives

Jonathan Hauck
County Commissioner, Gunnison Basin Sage-Grouse Strategic Committee | Gunnison
970-275-9625

Jim Cochron
Biologist | Gunnison County
970-641-7604

Anne Timmerman
U.S. Fish and Wildlife Western Lead Ecosystem Services
970-628-7181

Brandon Miller
U.S. Fish and Wildlife Service Biologist | Gunnison
970-615-0119

RECOMMENDATION 3

Leverage Existing Plans to Support Wildfire Hazard and Regulatory Priorities Across Gunnison County

Gunnison County should leverage existing plans to prioritize wildfire mitigation opportunities, including the Gunnison County Strategic Plan, Gunnison County and local Community Wildfire Protection Plans, and the Gunnison County Natural Hazard Mitigation Plan. These plans should be linked in appropriate ways and some plans can be references by the Land Use Regulations to inform land use planning decisions.

Overview of Current Plans

Gunnison County has multiple planning documents that inform short- and long-term wildfire risk reduction and mitigation activities: Gunnison County Comprehensive Plan, Gunnison County Natural Hazard Mitigation Plan, Gunnison County Community Wildfire Protection Plan, and various local Community Wildfire Protection Plans. Some of these plans have state or federal requirements, and are in various stages of being updated (see Table 7).[18]

TABLE 7. OVERVIEW OF PLANS THAT ADDRESS WILDFIRE IN GUNNISON COUNTY

Plan	Overview	Comments
Gunnison County Comprehensive Plan – Crested Butte/ Gunnison Corridor (2005)	• Natural hazards, including wildfire, are included in the Environment section. A wildfire hazard area map is provided to inform where additional mitigation measures or reduced densities may be necessary. • Primary implementation measure to address hazards is through LUR update and 1041 regulations.	• Limited information and policies on hazards. • Wildfire hazard map is based on a model developed in 2003 and therefore is dated; staff has indicated there is no current intention to update this plan.
Gunnison County Natural Hazard Mitigation Plan (currently undergoing update)[19]	• Meets requirements of Disaster Mitigation Act (DMA) of 2000. • Developed by county and participating jurisdictions and special districts to address multiple hazards that could affect county. • Provides an assessment of potential wildfire hazard impacts on people,	• Currently undergoing a comprehensive update. • Previous mitigation actions support the adoption of more stringent wildfire requirements for defensible space and building construction, including

[18] Additional county plans that may address wildfire but do not directly relate to land use planning and hazard mitigation include the Gunnison County, Colorado Disaster Recovery Plan and the Gunnison County Emergency Operations Plan.

[19] STAFF: please provide any additional updates on the status of the draft HMP

TABLE 7. OVERVIEW OF PLANS THAT ADDRESS WILDFIRE IN GUNNISON COUNTY		
Plan	Overview	Comments
	properties, and critical infrastructure and recommended mitigation actions.	possible adoption of the IWUIC.
Gunnison County Community Wildfire Protection Plan (2011)	• Meets requirements of Healthy Forests Restoration Act (2003), C.R.S.§30-15-401.7, and CSFS Key Components of a CWPP in Colorado. • Identifies values at risk, local preparedness and fire protection district capabilities, areas of special interest and 32 community-level assessments with hazard ratings between moderate and extreme. • Treatment recommendations include defensible space, landscaping, fuel breaks, infrastructure and preparedness planning.	• Comprehensive but some information is likely to be out of date due. • Many of the recommendations for communities are repetitive and could be consolidated in future drafts. • Some overlap and varying degrees of connectivity to local CWPPs.
Local Community Wildfire Protection Plans (various)	• Subdivision or unincorporated community-scale plans for Arrowhead, Blue Mesa, Ohio City, Quartz Creek, Rainbow Service Inc., Star Mountain Rach, Upper Crystal River Valley, Wilderness Streams.	• Due to earlier dates of adoption (before 2011), some local plans lack a connection to the county CWPP and use different methodologies to determine hazard and risk.

Analysis of Plans

The plans summarized in Table 7 contain important information related to wildfire and identify activities to reduce risk throughout the county. However, discussions with local stakeholders and CPAW's internal analysis revealed several key findings that limit the effectiveness of these plans, including:

- **Dated plans and lack of tracking.** Many plans contain dated material related to wildfire hazard. For example: the Gunnison County comprehensive plan includes wildfire hazard maps that were developed with CSFS in 2002; the countywide CWPP was last updated in 2011 with no updates to recommended fuel treatments or other actions and some local CWPPs do not have adoption dates. While this does not mean that no wildfire planning activities have occurred, it makes tracking or communicating any risk reduction activities difficult.
- **Uncoordinated updates.** As a result of some plans being dated or updated on different cycles, the content, policies and proposed actions do not effectively support one another. For example, the previous HMP (2014) wildfire section integrated references to county's CWPP (2011). Because the county CWPP has not been updated since then, the current HMP update will not be relying on older data.
- **Duplicative content.** Some content within or across plans is duplicative, such as the information across local and county CWPPs. Having additional details in every local plan can be beneficial when local communities take ownership of their CWPP, however it can also increase the burden for maintaining and updating these plans.

Recommendations

Recognizing that some plans, such as the Comprehensive Plan, do not get updated very frequently nor is there always the political will or resources to undertake this update, CPAW recommends that the county leverage other existing plans to prioritize wildfire mitigation and safety. These plans include the Gunnison County Strategic Plan, Gunnison County and local Community Wildfire Protection Plans, and the Gunnison County Natural Hazard Mitigation Plan.

1. Include Wildfire in Future Gunnison County Strategic Plan Updates

The Gunnison County Strategic Plan, which is updated frequently and was last updated in May 2019, is intended to address community interests, current fiscal and environmental issues, and any anticipated service enhancements. The Strategic Plan does not currently address wildfire, natural hazards, or public safety in any of its priorities. CPAW recommends that during its next review, county staff explore ways in which wildfire hazard could be elevated as a priority in this plan to support implementation of policies, programs, and regulations, including those recommendations in this report.

2. Update Gunnison County Community Wildfire Protection Plan

The Gunnison County CWPP was last updated in 2011. Although there is no state or federal requirement to update CWPPs within a specified timeframe, the plan is intended to be a living document that informs regular discussions and planning activities. As a result, many communities strive to conduct annual updates to their action plan, and perform a more thorough review and update to the entire plan every five years. This maintains a current list of priorities to guide the community in risk reduction activities, strengthens local partnerships, and also provides local residents the opportunity for renewed engagement.

CPAW recommends that the county undertake a CWPP update to address the following:

- Incorporate updated CPAW maps, which have been locally calibrated and will be maintained by GIS department.
- Review and update fuels treatment recommendations; since some recommendations for communities are duplicative, such as guidance on defensible space, consider compiling these recommendations into one central table that partners can easily update.
- Streamline local CWPPs with the county CWPP by adopting local CWPPs as addenda or incorporating by reference.
- Include additional topics that were not previously addressed in the CWPP, such as post-disaster recovery, demographic changes, and emerging environmental issues.

See the implementation section for potential funding mechanisms to support a CWPP update.

3. Encourage Continued Adoption of Local CWPPs

Colorado State Forest Service, USDA Forest Service, and the West Region Wildfire Council have been active partners in working with local communities to develop subdivision-scale CWPPs. These plans promote risk reduction activities on private lands and can influence mitigation on any adjacent public lands. Where local communities have the resources to develop or update their CWPPs, this refined scale is another opportunity to engage residents in the wildfire planning process.

As mentioned above, local CWPPs can also be adopted as addenda to the main CWPP. This can increase the coordination across scales and potentially reduce duplicative information, such as information on response capabilities, county contacts, and resources.

4. Formally Link the County Natural Hazard Mitigation Plan and CWPP

In contrast to the CWPP, the County's Natural Hazard Mitigation Plan is required by FEMA to be updated every five years. The HMP was last updated in 2014 and a draft is being finalized (at time of this report). Maintaining an active plan ensures that the county and participating jurisdictions and special districts remain eligible for federal disaster assistance.

Following the update of the county CWPP (as discussed above), CPAW recommends that the county adopt the CWPP as an appendix to the HMP. This has several benefits, including:

- ensures that both documents are updated on a regular cycle;
- reduces the amount of content that overlaps between the two plans;
- streamlines actions related to wildfire;
- minimizes the amount of time that stakeholders need to spend on major plan updates.

5. Incorporate CWPP and HMP into LUR by reference

Finally, future plan updates (including any new policies) should be integrated and adopted into LURs. Adding language into the LUR can consider how other plans inform wildfire hazard planning and can provide additional direction in land use decisions. For example, the county could modify the following statement and add to appropriate sections in the LUR:

Consideration of the goals and policies set forth in the Gunnison County Community Wildfire Protection Plan, locally-adopted Community Wildfire Protection Plans, and the Gunnison County Hazard Mitigation Plan may be required by the review authority for all [type of development applications] where the wildfire hazard is deemed significant by county staff in consultation with the Colorado State Forest Service, US Forest Service, or local fire protection districts due to topography, aspect, vegetation, access, firefighting infrastructure, or other relevant factors identified in the CWPP.[20]

Resources

Guides and Handbooks

- Colorado State Forest Service: Community Wildfire Protection Plan website provides state information on the creation of CWPPs and related resources: https://csfs.colostate.edu/wildfire-mitigation/community-wildfire-protection-plans/
- The Planning for Hazards website provides helpful information on many wildfire planning tools including Community Wildfire Protection Plans: https://planningforhazards.com/community-wildfire-protection-plan-cwpp

[20] This example language has been modified by similar language that is included the Summit County Subdivisions Regulations §8101 Required Fire Protection Improvements. Additional references to the CWPP have been adopted in Summit County's Zoning Regulations.

- The American Planning Association PAS Report 594 *Planning the Wildland-Urban Interface* provides a chapter on plans, suggested policies, and plan integration tips: https://www.planning.org/publications/report/9174069/

Example CWPPs

- Humboldt County, CA CWPP (2019) developed 14 planning unit action plans which function as "mini-CWPPs" within the larger document. The plan is easily downloadable in separate sections online: https://humboldtgov.org/2431/CWPP-2019
- Marin County, CA CWPP (2016) has a table for tracking plan amendments, guidance on update fuel map generation, definitions, a dedicated section on collaboration, and other user-friendly features for maintenance, readability, and engagement: https://www.firesafemarin.org/cwpp
- Leavenworth, WA CWPP (2018) contains a robust action plan that identifies priorities, timelines, implementation metrics, and actions for post-fire recovery: https://www.dnr.wa.gov/publications/rp_burn_cwpp_leavenworth.pdf?c5s9r2
- Missoula County, MT CWPP (2018) is organized according to the National Cohesive Wildland Fire Management Strategy's three goals: Resilient Landscapes, Fire Adapted Communities, Safe and Effective Wildfire Response. The plan is linked closely to the General Plan and was promoted through a story map: https://www.missoulacounty.us/government/public-safety/office-of-emergency-management/community-wildfire-protection-plan
- Summit County, CO CWPP (2018) establishes a charter for its Summit County Wildfire Council and includes a summary of accomplishments since its last CWPP update: https://www.summitcountyco.gov/909/Wildfire-Protection-Plan

IMPLEMENTATION

Update Materials and Provide Resources to Support Actions in the Home Ignition Zone

Explore recognition programs and funding opportunities to support and incentivize communities and residents in taking action to reduce wildfire risk.

Recognition Programs

Recognition programs are designed to motivate residents to take action on their properties and neighborhoods. These programs are typically voluntary and therefore are also helpful in reaching residents and properties that are not subject to regulatory requirements, or are seeking to go above and beyond minimum WUI requirements. Recognition programs may also offer benefits, such as discounted insurance rates.

Property Assessments

Through their MyWildfireRisk program, the West Region Wildfire Council (WRWC) currently engages with property owners to provide information about parcel-level wildfire hazards in several ways:

1) Undertaking rapid risk assessments and sharing this information to homeowners;
2) Conducting in-depth property assessments and providing a customized report;
3) Offering other educational resources and local trainings.

Other examples of communities in Colorado offering customized parcel-level SIZ assessments are Eagle County's REALFire® program and Boulder County's Wildfire Partners program. Similar to MyWildfireRisk, these programs consist of an assessment and follow-up inspection to provide a resulting customized report to a participating property owner. Upon completion of required actions outlined in the report, the property owner receives a certificate that can be used as proof of mitigation for insurance or real estate transactions. The Wildfire Partners program is part of Boulder County's Land Use Department and is incorporated into Boulder County's building code—property owners that successfully obtain a certificate can use this to show mitigation work has been completed as part of a required building or land use permit.

Firewise USA®

NFPA's Firewise USA® program teaches people how to adapt to living with wildfire and encourages neighbors to work together and take action to prevent home losses. Nationally, there are 1,500 recognized Firewise USA® sites; several sites within or near Gunnison County are recognized, including Rainbow Services Inc., Blue Mesa Recreation Association, Arrowhead Improvement Association, St. Elmo, and Maysville. The Departments of Insurance in seven states, including Colorado, have approved filings by USAA to give homeowners insurance

discounts to USAA members living in communities recognized by the Firewise USA® program.[21] More information and free resources are available on firewise.org.

Funding Options

Secure Rural Schools Act: Title III - County Funds

The Secure Rural Schools and Community Self-Determination Act (SRS Act) was signed into law in 2000. The SRS Act was most recently reauthorized by P.L. 115-141 and signed into law by the President on March 23, 2019. This reauthorization extended the date by which SRS Title III projects (County Funds) must be initiated to September 30, 2020. The date by which Title III funds must by obligated is also extended to September 30, 2021. Authorized uses of Title III funds includes the following activities[22]:

(1) To carry out activities under the Firewise Communities program;

(2) To reimburse the participating county for search and rescue and other emergency services, including firefighting and law enforcement patrols;

(3) To cover training costs and equipment purchases directly related to the emergency service

(4) To develop and carry out community wildfire protection plans (CWPP).

Many counties in the Mountain West have utilized Title III funding for CWPP implementation, including counties in Colorado and Oregon. Gunnison County has elected a 7% allocation for Title III of the total SRS funds available. In 2018, this amounted to approximately $60,000.[23]

The amount of Title III funds allocated nationally to counties has decreased annually since 2008, whereby counties must account for a diminution of monies when budgeting to utilize Title III funds. Additional information about funding allocation and documentation for Title III – County Funds is available at the USDA Forest Service webpage: www.fs.usda.gov/main/pts/countyfunds.

FEMA Grants: BRIC and HMGP - County Funds

The Building Resilient Infrastructure and Communities (BRIC) and Hazard Mitigation Grant Program – Post Fire (HMGP) are federal programs deployed by FEMA's Hazard Mitigation Assistance (HMA) Guidance. In October 2018, the Disaster Recovery Reform Act (DRRA), under Public Law 115-254, which updated the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act).[24] The DRRA authorizes new authorities for FEMA to support disaster recovery and mitigation. BRIC and HMGP are two separate grant programs that communities can apply for to support wildfire preparedness. To date, several counties have set a positive precedent by utilizing these funds, and earlier versions of these funding mechanisms. Summit County, CO; Mariposa County, CA; and Deschutes County, OR

---

[21] More information is available at the Firewise USA website: https://www.nfpa.org/Public-Education/Fire-causes-and-risks/Wildfire/Firewise-USA/Become-a-Firewise-USA-site/Program-benefits/Insurance-discounts-for-USAA-members-in-seven-states

[22] USDA Forest Service Secure Rural Schools Reauthorization webpage: www.fs.usda.gov/main/pts/home (Last updated: April 15, 2019)

[23] USDA Forest Service Rural Schools Title III Regional Summary: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd622642.pdf

[24] Disaster Recovery Reform Act of 2018: https://www.fema.gov/disaster-recovery-reform-act-2018 (Updated July 17, 2019)

previously received FEMA PDM funding for wildfire mitigation and CWPP implementation. Deschutes has also applied for the HMGP grant.

Building Resilient Infrastructure and Communities (BRIC)

Building Resilient Infrastructure and Communities (BRIC) Section 1234 of the DRRA expands upon the previously authorized Pre-Disaster Mitigation (PDM) Grant Program in order to establish the new BRIC grant.[25] BRIC will replace and extend the authorized uses of the PDM funds. The BRIC grant aims to reduce risk nationwide by funding public infrastructure that increases community resilience before a disaster impacts the area. The funds will be available for disbursements in 2020. The projects funded will be ones that drive risk reduction and build community capability in concordance with the three overarching strategic goals in FEMA's 2018-2022 Strategic Plan: Build a Culture of Preparedness, Ready the Nation for Catastrophic Disasters, and Reduce the Complexity of FEMA. Proposed grants funded by BRIC include forest health and wildfire mitigation. Applications for FY2019 funding are forthcoming. Further information about BRIC found at the following: https://fema.ideascale.com/a/ideas/recent/campaignfilter/byids/campaigns/61112/stage/unspecified.

Hazard Mitigation Grant Program – Post Fire (HMGP)

Section 1204 of the DRRA allows FEMA to provide HMGP grants in any area that received a Fire Management Assistance Grant (FMAG) declaration even if no major Presidential declaration was declared.[26] This grant authorizes additional application to the existing HMGP grants. Eligibility for the Post Fire HMGP are available with FMAG declarations, which can be accessed at www.fema.gov/disasters by selecting Fire Management Assistance as the declaration type. Applicants must have a FEMA-approved mitigation plan to receive HMGP funding. As of 2018, communities can apply for HMGP directly as sub-applicants, in addition to states, territories and tribes. Approved uses of HMGP grant funds include:

(1) Activities that benefit the declared county, counties or burned tribal lands, with wildfire hazard mitigation projects such as defensible space measures, ignition resistant construction, hazardous fuels reduction, erosion control measures, slope failure prevention measures, or flash flood reduction measures.
(2) Activities unelated to wildfire hazard mitigation, such as generally allowable HMGP projects within the declared county or counties or burned tribal lands.
(3) Activities related to wildfire hazard mitigation, such as generally allowable HMGP projects, outside of the declared county or counties or burned tribal lands.
(4) Activities unrelated to wildfire hazard mitigation, such as generally allowable HMGP projects outside of the declared county or counties or burned tribal lands.

Each of these FEMA federal grants are available to communities and counties similar to Gunnison. For application information, visit:

- BRIC: https://www.fema.gov/drra-bric
- HMGP: https://www.fema.gov/hazard-mitigation-grant-program-guide-state/local-governments

---

[25] Source: https://www.fema.gov/media-library-data/1538601697477-5a4a055c7600eaddad89348044fb664a/FY_2018_PDM_Fact_Sheet.pdf
[26] Hazard Mitigation Grant Program Post Fire: https://www.fema.gov/hazard-mitigation-grant-program-post-fire (Updated July 24, 2019)

Good Neighbor Authority (GNA) – Federal/State Funds

The Good Neighbor Authority (GNA) was instituted by the 2001 Interior Appropriations Act. The program was launched as a pilot program in Colorado for five years, limited to the USFS and Colorado State Forest Service. In 2014, Congress expanded the program nationally through both the Farm Bill and the Interior Appropriations Act. The 2014 Farm Bill GNA permanently authorizes the program. The GNA intends to expand federal capacity to plan and implement forest, rangeland, and watershed restoration projects by facilitating partnerships between Forest Service, BLM and state agencies. The agreements allow a state to perform restoration services on federal land. Restoration services include: habitat improvement, **fuels management**, **fire related activities**, insect and disease control, project planning, project preparation work, and commercial timber removal.[27]

The authority also allows for the state to administer timber sales and to use the program income for restoration services. The authority precludes wilderness or wilderness study areas. In 2018, proposed changes to the program include the expansion of GNA authority to counties and tribes.[28] GNA projects require agreement between a federal and state agency. These agreements are most commonly structured as Master Agreements by which the U.S. Forest Service identifies eligible participatory state agencies. Under the Master Agreement are Supplemental Project Agreements (SPA) which include specific restoration projects and budgets. This allows for flexibility of geographic scale of project and permits modifications as local projects develop.

Examples of implementing GNA funding include the following:

(1) Colorado: 108-acre Deckers/Fletcher Project **fuel break and restoration forest thinning**; funded at $75,000.[29]
(2) California: **Fuel breaks, fuel reduction,** and treatment of insect mortality in the Eldorado and Sierra National Forest. State partner: CA Natural Resources Agency and CAL Fire.
(3) Oregon: wildlife surveys, timber sales, **fuel reduction,** and habitat restoration in National Forests Deschutes, Fremont-Winema, Malheur, Mt. Hood, Rogue River-Siskiyou, Wallowa-Whitman, and Willamette. State partners: OR Department of Forestry and OR Department of Fish and Wildlife.

GNA funding is an opportunity that can be utilized by Gunnison County. The county can elect to enter into a SPA under Colorado's Master Agreement, or choose to apply for their own Master Agreement under the 2018 revisions. Gunnison County should contact the CSFS in order to apply. Rich Edwards in the Forest Planning & Implementation Division at CSFS is a recommended contact: rich.edwards@colostate.edu.

Countywide Tax: Examples from Chaffee and Summit Counties, Colorado

Countywide taxation provides another method to gain funding for wildfire risk reduction. Two examples are provided below that highlight counties who passed countywide tax ballot measures to help fund ongoing wildfire risk reduction. These ballot measures occur in counties

---

[27] Understanding Good Neighbor Authority: Case Studies From Across the West: https://static1.squarespace.com/static/562e839ee4b0332955e8143d/t/5bb64dde7817f799e3355fed/1538674144568/RVC+GNA+2018_web_.pdf September 2018.
[28] H.R.2 - Agriculture Improvement Act of 2018
[29] Colorado's Good Neighbor Authority Program: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5269069.pdf

that exemplify similar characteristics to Gunnison County: the increasing presence of tourists, rental properties, and recreational activity occurring in the WUI.

- In 2018, Summit County voters passed a mill levy called the Strong Future Fund to support wildfire risk reduction and other public services. The fund allocates $10 million for wildfire mitigation and prevention over the next decade, sunsetting in 2029. The property tax revenue will support additional federal and state forest service staff, CWPP implementation, and landscape-scale risk reduction programs throughout the county. Summit County is a popular destination for second home owners, who often own residences in the wildland-urban interface (WUI). The property tax is aimed at taxing these residents whose presence in the WUI can increase the wildfire risk not only for their property, but for the broader community.
- Chaffee County recently voters passed a sales tax measure to provide funding for countywide wildfire risk reduction. Many tourists visit Chaffee to recreate in the WUI and public lands. This sales tax targets these visitors who bear responsibility for their activities occurring in fire-prone locations. The sales tax will provide an estimated $250,000 annually to be allocated toward wildfire prevention. These funds are earmarked for grants toward landscape-scale county wide treatment projects, including fuel breaks and removal of beetle-infested pine trees.

CONCLUSION AND NEXT STEPS

[TBA in final version]

APPENDIX A: HAZARD ASSESSMENT

Eva Karau, USDA Forest Service, Rocky Mountain Research Station, Fire Modeling Institute

Overview

The U.S. Forest Service's Rocky Mountain Research Station collaborated with the group of planners and analysts leading the Community Planning Assistance for Wildfire (CPAW) effort for Gunnison County, CO to provide spatial wildfire hazard assessments to support CPAW recommendations for wildfire planning codes and regulations.

In this analysis we used current wildfire hazard and risk science to inform our fire behavior modeling, data analysis and mapping methods. We provide two evaluations of wildfire hazard, one intended as a broad scale decision support tool, and one that incorporates customized fire behavior modeling informed by wildfire management experts from Gunnison County. Ancillary products include a community scale Wildland Urban Interface map, and a spatial index that characterizes wildfire mitigation difficulty. This report details those methods and describes all map products, beginning with a brief background of wildfire hazard and risk terminology.

Background – Wildfire Hazard and Risk

How likely is it that a place will burn? How hot is it likely to burn? And, at different fire intensity levels, what would the effects be on something we care about? These questions describe the three fundamental components needed to assess wildfire risk: likelihood, intensity, and effects (sometimes termed "susceptibility"). Scott et al. (2013) conceptualize this as the wildfire risk triangle (Figure A1). If we can gather quantitative information on all three legs of this triangle, then we can quantify the risk to the thing we care about.

Figure A1. Wildfire Risk Triangle

For the purposes of this analysis, we focus on two sides of the wildfire risk triangle: likelihood and intensity. Together, those two pieces of information represent wildfire hazard. To map likelihood and intensity across a landscape, we use outputs from two different, but related, fire behavior models. The fire modeling application most often used for large-scale landscapes is called the Large Fire Simulator, or FSim (Finney et al. 2011). FSim draws upon weather and fire occurrence data from recent decades to generate statistically possible weather for 10,000 or more simulated fire seasons. Within each of these simulated years, ignitions are placed on the landscape informed by observed fire occurrence patterns, fires are spread using spatial data for fuels, topography, and simulated weather, and a set of many thousand possible fire perimeters are generated.

Whereas FSim provides a synoptic, “landscape scale” assessment of fire behavior and estimates annualized probabilities of the occurrence and intensity of large fires, another model, FlamMap (Finney 2006), computes a localized, and specialized view of potential fire behavior under a specific set of environmental conditions. If a user parameterizes FlamMap for conditions representative of when problem wildfires have occurred, fire behavior outputs represent a “problem fire” scenario at a “local scale”. Including characterizations of wildfire hazard at both landscape and local scales affords a two-pronged assessment of potential fire behavior; we see what kind of fire behavior we could experience under a range of conditions that have occurred in recent history, and we also get a picture of fire behavior that could occur under extreme conditions.

Wildfire Hazard Characterization for Gunnison County

Wildfire hazard is a measure of the likelihood that an area will burn and the likely intensity of the burn, given that a fire occurs. For Gunnison County, we present two evaluations of wildfire hazard: landscape level and local level.

Landscape-Level Wildfire Hazard – Modeling and Maps

For the purpose of evaluating wildfire likelihood and intensity for the landscape level analysis, we used FSim modeling work completed for the Bureau of Land Management SW Colorado District, completed in 2018. Though CPAW objectives do not align directly with those of the BLM effort, we chose to incorporate the FSim data, as it was locally calibrated by a BLM Fire Management Specialist to reliably reflect broad scale fire behavior patterns in the region. At the scale of these data, only large disturbances will make noticeable changes in landscape burn probability patterns.

Pyrologix LLC conducted the FSim simulations using spatial input data that reflects fuel conditions as of 2012. For our landscape wildfire hazard assessment, we acquired the 120m-resolution FSim modeling outputs, extracted for a rectangular spatial extent surrounding Gunnison County.

Landscape-Level Summary Zone

To summarize the spatial metrics of likelihood, intensity, and hazard for the landscape-level analysis, we chose sub-watersheds from the national USGS Watershed Boundary Dataset (https://nhd.usgs.gov/wbd.html) as the polygon summary unit. Sub-watersheds are designated by 12-digit hydrologic unit codes and are often referred to as “HUC12” watersheds. The HUC12 summary unit is commonly used to summarize landscape attributes; is devoid of administrative boundaries; and is based on the areal extent of surface water draining to a point. Using a summary unit is important because an individual spot on the landscape will have an individual value, but that one spot is inevitably impacted by the values of its neighbors. Summarizing the

raster FSim outputs and the derived hazard index to these polygons allows for broad-scale patterns to emerge that may not be immediately visible in the raw pixel datasets.

Landscape Wildfire Likelihood

Landscape Fire Likelihood, or burn probability (BP), is the FSim-modeled annual likelihood that a wildfire will burn a given point or area. It is calculated as the number of times a pixel burns during a simulation, divided by the total number of iterations. The landscape-level burn probability map represents the average of all 120-m pixel values within each sub-watershed, classified into four levels, with the chance of a wildfire occurring during any given fire season increasing with each level (Figure A2).

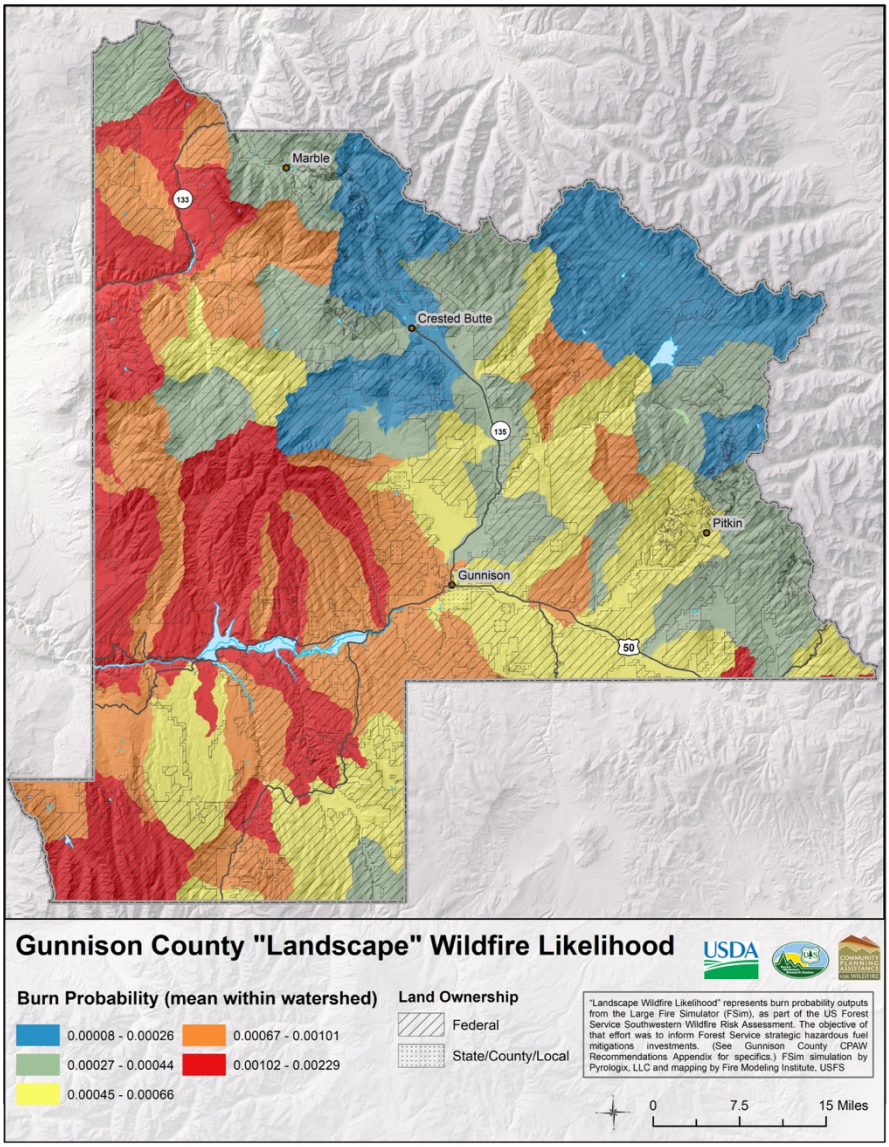


Figure A2. Gunnison County burn probability map

Landscape Wildfire Intensity

FSim can apportion burn probability into fire intensity levels (FILs) and produce estimates of the probability of a certain flame length level (FLP), given a fire burns a pixel. Following Scott et al. (2013), Conditional flame length (CFL) is the sum of all flame length probabilities that FSim simulated for each 180-m pixel, weighted by a flame length category midpoint:

$$CFL = \sum_{i=1}^{n} FLP_i * FL_i$$

where FLP_i is the conditional probability of FIL_i and FL_i is the flame length that characterizes FIL_i. We summarized the pixel-level CFL values within sub-watersheds by calculating the average CFL for each sub-watershed polygon. Map classes represent ranges of conditional flame length (in feet) (Figure A3).

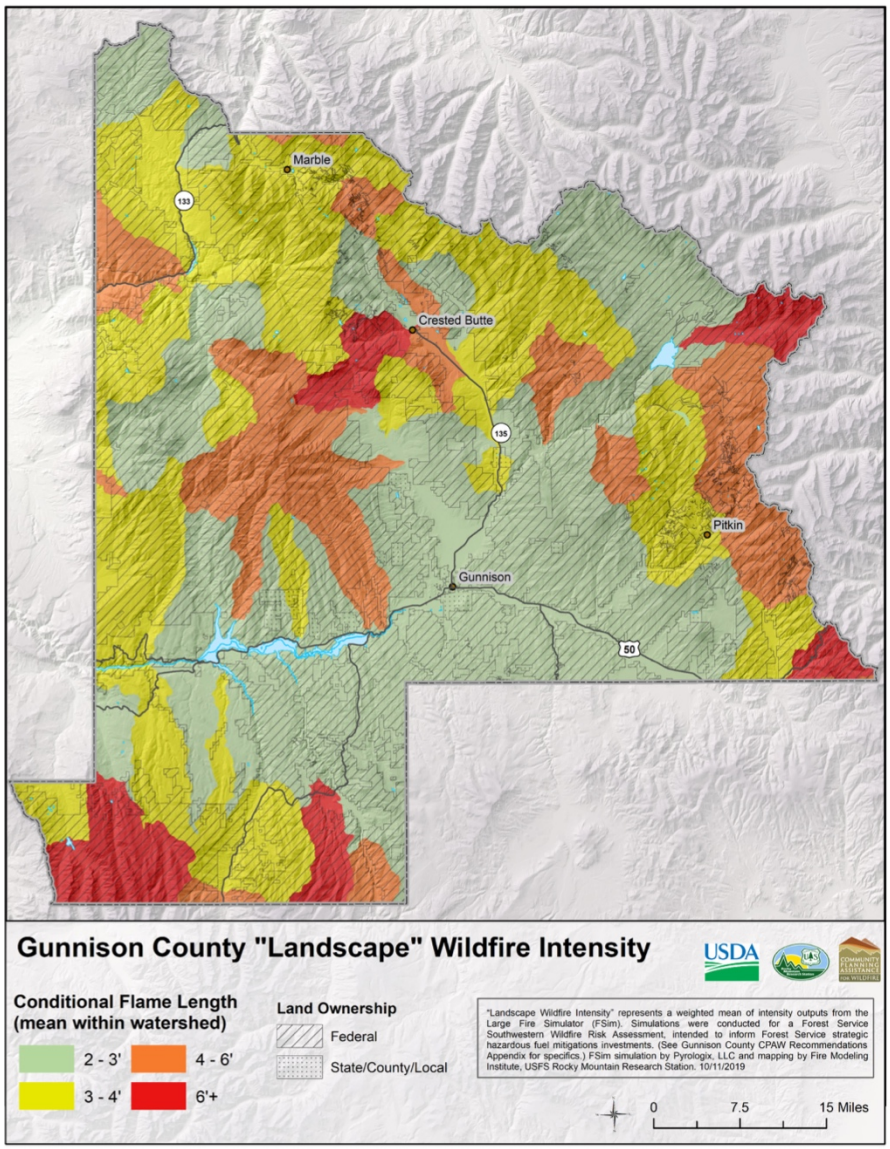


Figure A3. Gunnison County conditional flame length map

Landscape Wildfire Hazard

Wildfire hazard is an integration of likelihood and intensity, quantified as the product of burn probability (BP) and conditional flame length (CFL). We calculated hazard at the pixel scale and then summarized values to the HUC12 sub-watershed scale by calculating the mean hazard in each sub-watershed polygon. We then classified the values into three classes (Moderate, High, and Very High) based on quantiles in the distribution of values in the analysis area (all sub-watersheds that intersect with the Gunnison County boundary) (Figure A4). The actual numeric values of hazard are less directly interpretable than BP or CFL. Instead, they provide a relative depiction of hazard across a landscape.

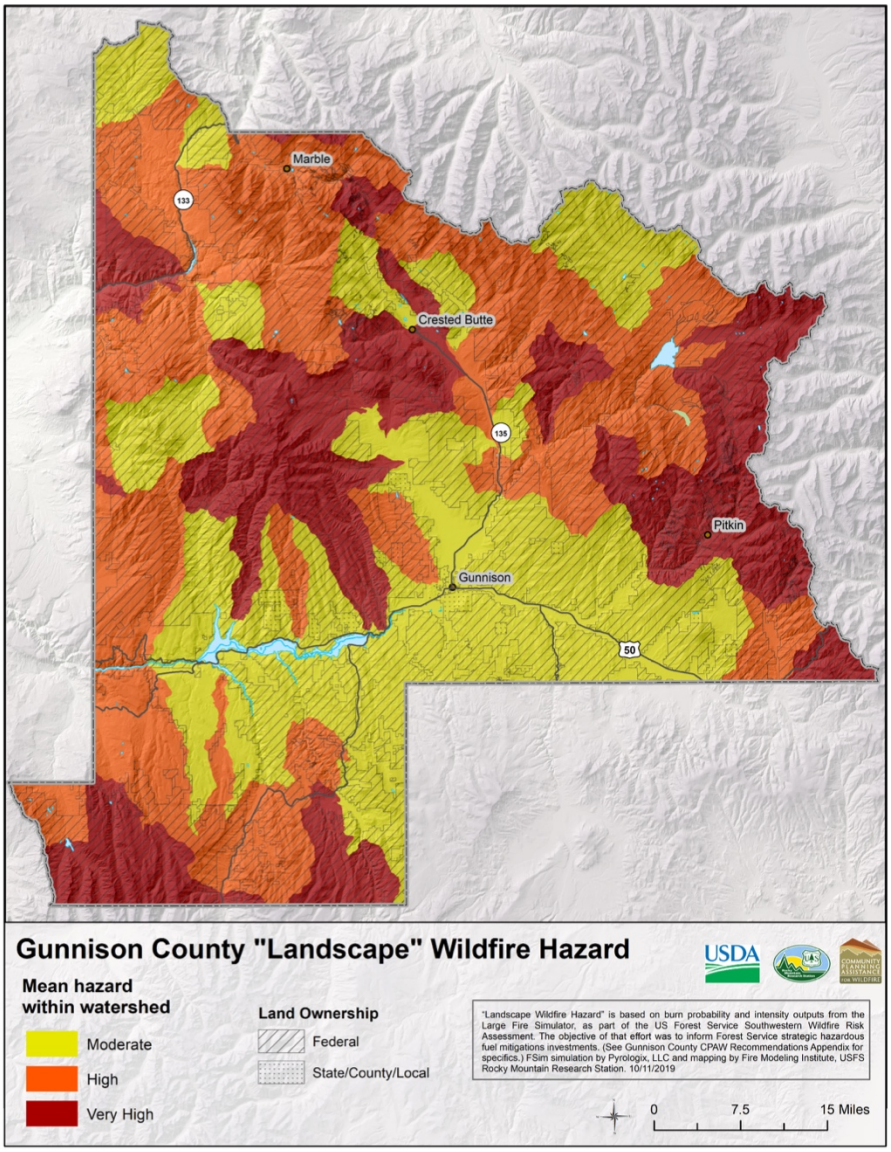


Figure 12

Local Level Wildfire Hazard – Modeling and Maps FlamMap Model Initialization

For the local level hazard assessment, we used FlamMap 6.0 to model wildfire behavior within a ~4.9 million acre simulation extent surrounding Gunnison County. We initialized the Minimum Travel Time (MTT) module within FlamMap with ~25,000 fire ignitions, using:

- WindNinja (embedded in FlamMap) to generate 90-m resolution wind vectors,
- a maximum simulation time of 480 minutes per ignition (equating to an 8-hr burn period),
- a calculation resolution of 90-meters,
- an interval for Minimum Travel Paths of 500-meters, and
- a 0.02 spotting probability.

We executed the simulation twice using the same spatial fuel and topography input layers, but varying the weather and fuel moisture conditions depending on fuel type. We then merged the outputs into a final set of raster and vector maps to characterize "problem fire" hazard. We used the flame length probability output file to generate burn probability, conditional flame length and hazard metrics and spatial layers.

Wind, Weather and Fuel Moisture Parameters

FlamMap needs information regarding fuel moisture, wind and weather to initialize a simulation. Based on information from subject matter experts (SMEs) gleaned during our site visits, as well evaluation of records from weather stations the Gunnison County vicinity, we chose to base our weather and wind-related modeling inputs on records from five Remote Automated Weather Stations (RAWS): Huntsman Mesa, Lujan, Needle Creek, and Taylor Park (Figure A5).

Since Gunnison County includes a mix of high and low elevation fuel types exposed to a range of wind and weather conditions, we chose to run two simulation scenarios to account for some of the climate and fuels variation. We based the scenario zones on life form (forested vs. non-forested): the "Tree" scenario includes all areas that are forested (as mapped by LANDFIRE Remap (LF 2.0.0) Existing Vegetation raster layer), and the "Non-tree" scenario is everywhere else (Figure 5). For fuel moisture parameterization, we chose the relatively moist, higher elevation (10,410 ft.) Taylor Park RAWS to represent the "Tree" scenario and the relatively dry, lower elevation (9,400 ft.) Huntsman Mesa RAWS to represent the "Non-tree" scenario.

Our FlamMap modeling objective for the local wildfire hazard assessment was to represent a "problem fire" scenario. To choose a time period for fuel moisture estimates and the weather records used for fuel moisture conditioning, we evaluated trends in the Energy Release Component (ERC; a fire danger metric with higher values indicating seasonal dryness trends in large fuels, especially in timbered areas), to find conditions that would represent potential for "problem" fire activity. For both the "Tree" and the "Non-Tree" scenarios, we selected June 6-11, 2002 as the fuel conditioning period, as those days are coincident with the beginning of the Hayman and Missionary Ridge fires, with record-setting ERCs at both stations (Figures A6 and A7). We selected initial fuel moisture settings for both modeling scenarios and all fuel categories using relationships established in FireFamilyPlus (Bradshaw 2018) (Table A1).

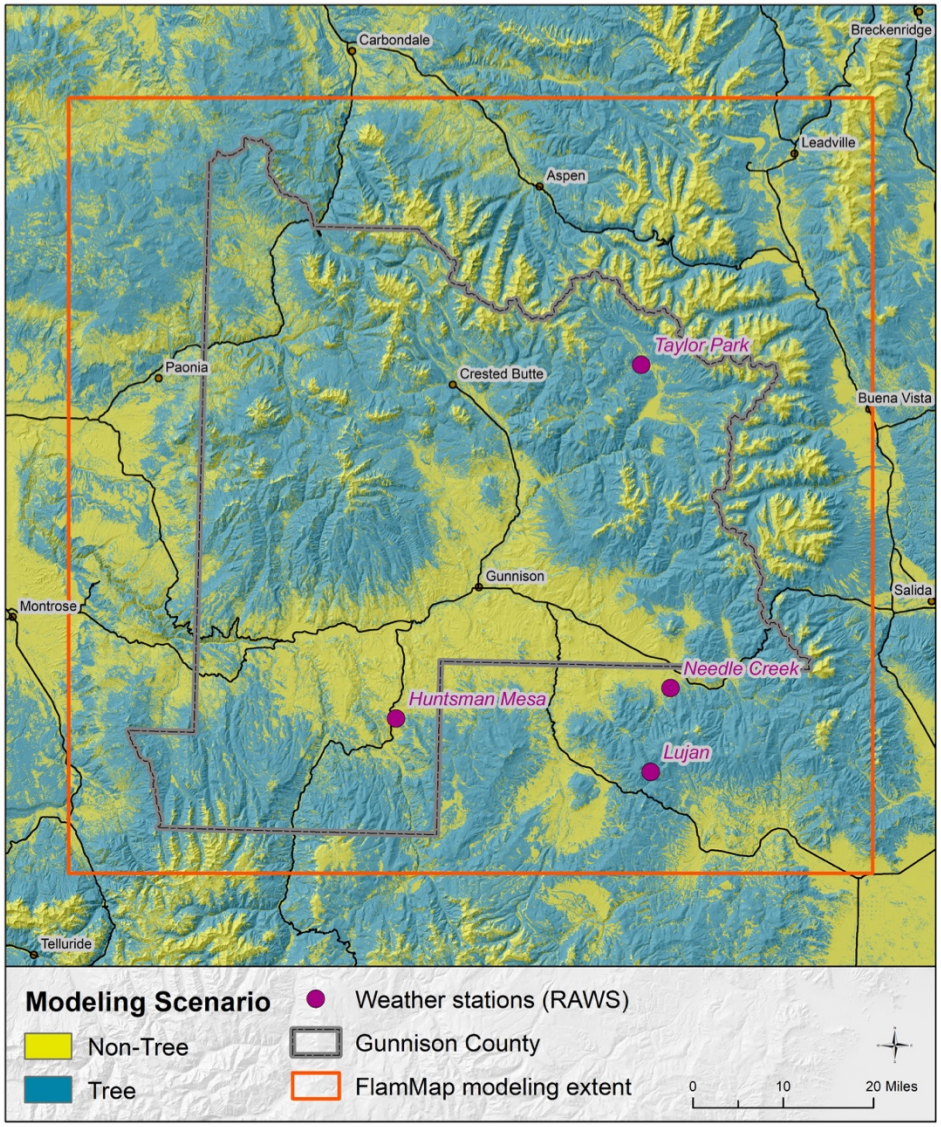


Figure A5. RAWS weather station locations and scenarios used for the Gunnison FlamMap modeling

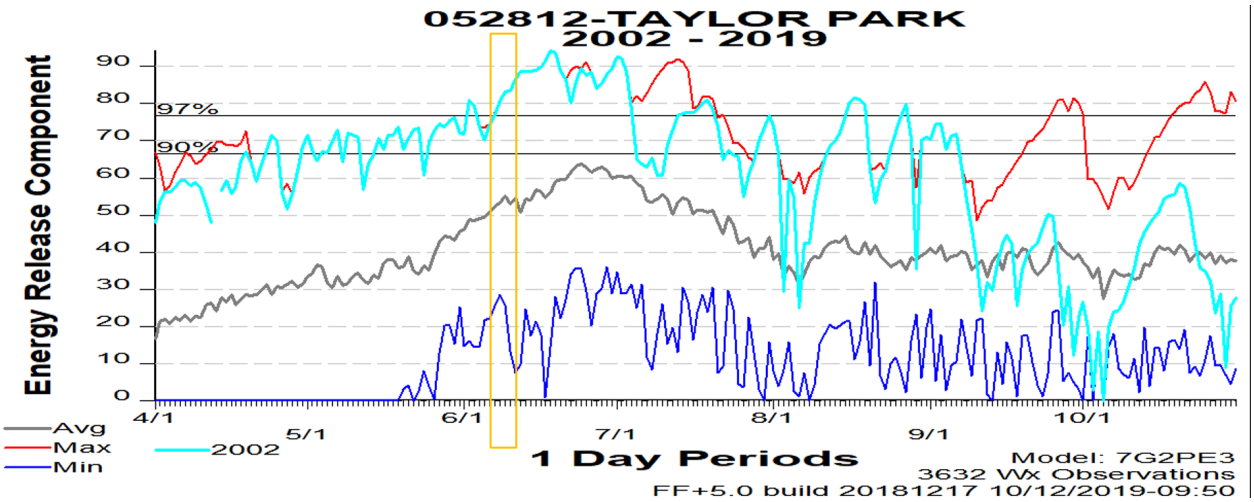


Figure 13

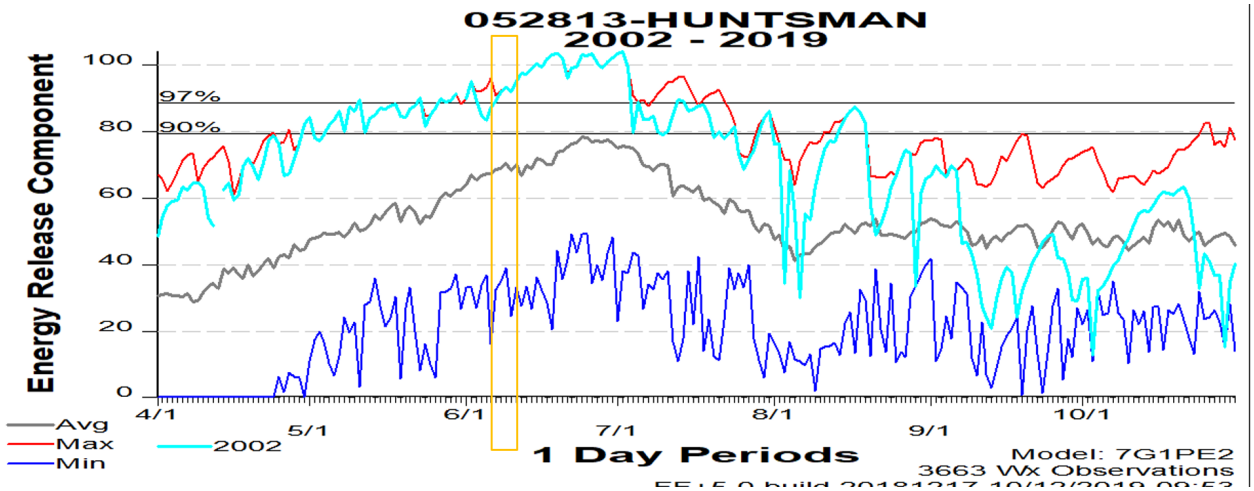


Figure A7. 14

Table A1. Initial fuel moisture values for FlamMap modeling (%)

	RAWS/Modeling Scenario	
Fuel Category	**Taylor Park/ Tree**	**Huntsman Mesa / Non-Tree**
1-hr	2	2
10-hr	2	2
100-hr	4	3
Herb	30	30
Woody	70	60

Local SMEs reported that winds in Gunnison County are predominantly from the southwest, but they noted that NW winds had been responsible for occasional spikes in fire behavior in the region. We analyzed wind roses for ten-minute average winds and gusts for time periods that

we assumed to represent pre-monsoon (01APR-30JUL) and monsoon (01JUL-15OCT) conditions for Taylor Park, Lujan, Needle Creek and Huntsman Mesa RAWS (Table A2).

Table A2. Predominant wind directions recorded at weather stations in the Gunnison County vicinity

		10 Minute Average		Gusts	
Modeling Scenario	**RAWS**	**01 APR – 30 JUN**	**01JUL – 15OCT**	**01 APR – 30 JUN**	**01JUL – 15OCT**
Tree	Taylor Park	NNW, SW	NW, NNW	SW, NNW	NNW, SW
	Lujan	NNW, SW	NNW, SSE	NNW, SSE	NNW, SSE
Non-Tree	Needle Creek	WNW, W	WNW, W	W	W
	Huntsman Mesa	WNW, W	WNW, W	WNW, W	WNW, W

For each RAWS in our analysis, wind speeds were faster in the pre-monsoon period than the monsoon period (Table A3). Wind speeds recorded at weather stations in the “Tree” areas were generally slower than those at stations in the “Non-Tree” zone, for both the pre-monsoon and monsoon time periods.

Table A3. 97th percentile wind speeds recorded at weather stations in the Gunnison County (mph)

Modeling Scenario	**RAWS**	**01APR -30JUN**	**01JUL - 15OCT**
Tree	Taylor Park	15	14
	Lujan	12	10
Non-Tree	Needle Creek	20	15
	Huntsman Mesa	32	21

Because wind direction varied between and within modeling scenarios, we selected a primary and secondary wind direction for each scenario, ran FlamMap for each combination, and selected the maximum value for model output variables, within scenario. We then assigned the appropriate output value based on where each pixel resides (in the Tree or Non-Tree scenario zone). We selected NNW and SW winds for FlamMap simulations for the “Tree” scenario, as those were direction were predominant for Taylor Park and Lujan RAWS, with the exception of the Lujan RAWS, which recorded some SSE winds. For the “Non-Tree” scenario, we chose WNW and W for simulations, as one or the other of those directions was dominant for 10-minute average winds and gusts, for both pre-monsoon and monsoon seasons. We selected the maximum 97th percentile wind speed recorded at the weather stations within each scenario (15 and 32 mph for the “Tree” and “Non-Tree” scenarios, respectively) (Table A4).

Table A4. Wind inputs for FlamMap modeling scenarios

Modeling Scenario	Wind Direction	Wind Speed (mph)
Tree	NNW	15
	SW	15
Non-Tree	WNW	32
	W	32

Spatial input file layers

FSim and FlamMap fire modeling systems require a set of raster geospatial layers that characterize landscape topography (elevation, slope and aspect) and fuels attributes (fuel model, canopy cover, canopy height, crown base height, and crown bulk density). A local level analysis allows for fine-scale modifications of the landscape file (surface and canopy fuel attributes) to represent the current landscape conditions with more specificity than is possible in a broader scale analysis. For Gunnison County, we acquired 30-meter resolution fuels and topography spatial data from LANDFIRE Remap (LF 2.0.0) and we modified those layers to reflect SME input about local conditions.

LANDFIRE Remap (LF 2.0.0) represents circa 2016 ground conditions and accounts for disturbances that occurred prior to satellite image collection. To render the LF 2.0.0 landscape current to 2019 conditions, we did our best to incorporate fuel disturbances occurring after 2016 into our FlamMap input landscape.

Because we used the LANDFIRE Total Fuel Change Tool (LFTFC 2019) to implement the fuel modifications, we created a raster file to spatially delineate fuel disturbances following the framework used by LANDFIRE, whereby each disturbance is classified by type (fire, mechanical add, mechanical remove, wind throw, insects-disease, exotics), severity (low, moderate, or high), and time since disturbance (1 year, 2-5 years, or 6-10 years). We delineated disturbances, as follows:

- Wildfires – We obtained burn severity data from Rapid Assessment of Vegetation Condition (RAVG; https://fsapps.nwcg.gov/ravg/) for fires that occurred in 2017 and 2018. We used the RAVG Canopy Cover Percent Change layer to assign fire severity levels, as follows: pixels with canopy loss
    - less than 25% were assigned low severity,
    - between 26 – 75% were assigned moderate severity, and
    - greater than 75% were assigned high severity.

For 2017 and 2018 fires not included in the RAVG database, we gathered fire perimeters from the Wildfire Decision Support System (WFDSS; https://wfdss.usgs.gov/wfdss.) Because we did not have specific information about fire severity for these fires, we assigned all pixels within the perimeter to moderate severity.

- Mechanical treatments and prescribed fires – we obtained polygon data delineating hazardous fuels and timber activities from the US Forest Service Forest Activity Tracking System to account for fuels treatments that impacted

U.S. Forest Service lands. We included treatments completed in 2017 and 2018 and coded them with disturbance type and severity level for the LFTFC disturbance file (Table A5.)

- Insects and disease – we acquired polygon data delineating forest insect and disease damage from the USDA Forest Health Protection program (https://www.fs.fed.us/foresthealth/applied-sciences/mapping-reporting/detection-surveys.shtml). The PERCENT_AFFECTED attribute characterizes the percent of forested area in the polygon that is affected by damage. We this attribute to assign insect and disease severity levels, as follows: polygons with PERCENT_AFFECTED ratings of
    - Very Light or Light were assigned low severity,
    - Moderate were assigned moderate severity, and
    - Severe or Very Severe were assigned high severity.

Table A5. Mechanical treatments and prescribed fires incorporated into LFTFC disturbance file

Disturbance Type	Description	Severity
Fire	Burning of Piled Material	high
	Broadcast Burning	high
	Jackpot Burning - Scattered concentrations	moderate
	Planned Treatment Burned in Wildfire	moderate
	Wildfire - Natural Ignition	moderate
	Wildlife Habitat Prescribed fire	moderate
Mechanical Add	Compacting/Crushing of Fuels	moderate
	Chipping of Fuels/Mastication	low
	Piling of Fuels, Hand or Machine	low
	Rearrangement of Fuels	low
Mechanical Remove	Commercial Thin	high
	Precommercial Thin	high
	Salvage Cut	high
	Sanitation Cut	high
	Patch Clear-cut	high
	Overstory Removal Cut	high
	Stand Clear-cut	high
	Thinning for Hazardous Fuels Reduction	high
	Yarding – Removal of Fuels by Carrying or Dragging	high
	Group Selection Cut	moderate
	Pruning to Raise Canopy Height	moderate
	Site Preparation for Natural Regeneration	low
	Single-tree Selection Cut	low

We added the 2017 and 2018 disturbance information (coded as described above) to the LANDFIRE Remap FDist (Fuel Disturbance) file, one of the critical inputs to LFTFC.

During our second Gunnison County CPAW site visit, SMEs suggested that agricultural lands should be considered burnable fuels, as those areas could carry fire, especially at times when fields are not irrigated. To account for this, we edited rules in LFTFC to assign existing vegetation types coded as agriculture to grass fuel model (GR1; Scott and Burgan 2005).

During wildfire hazard mapping review in other CPAW communities, SMEs were concerned that model results underestimated wildfire hazard in urban areas. We address this concern in our Gunnison County modeling by allowing fire to move into developed areas where LANDFIRE may exclude canopy fuels and code fuel model pixels as "non-burnable." Though no standard fuel model currently exists to represent structures, and FlamMap was designed as a wildland fire model (rather than a structure fire model), we considered this method an acceptable approach to approximate fire behavior through urban areas, given available data and modeling limitations. We made the following changes to spatial input layers, with the intention of better representing model inputs and consequent fire behavior:

- For pixels with surface fuel model coded as 91 (Developed, Non-burnable) we used the ArcGIS Nibble tool (ESRI 2017) to:
    - assign the fuel model value of the raster cell of the nearest neighbor
    - assign values for the input canopy fuels rasters (canopy cover, canopy base height, canopy height, canopy bulk density) the value of the raster cell of the nearest neighbor in that canopy raster category.
- In areas modified as described above, we changed major roads and structures (delineated by Microsoft Building Footprint data) back to a surface fuel model of 91 (Non-burnable) and canopy fuel grid value of 0 (no canopy present). We included this step to reduce overestimation of burnable fuels in urban areas.

The end result of these modifications was a more refined mapping of "non-burnable" pixels in urban areas within the county.

Ignitions

Using the MTT module, FlamMap generates fire perimeters from a set of ignition points. We parameterized Gunnison County FlamMap simulations with a fire list file that includes random start locations, along with locations influenced by local fire occurrence. First, we created an ignition density grid based on locations of wildfires that burned between 1992 and 2017 (Short 2018) within the modeling extent. We then generated 13,244 ignition points using a method that weights selection based on the density grid, so that areas with historically higher ignition density values were more likely to produce points. Next, we generated 12,057 completely random points and finally combined all points (25,301) to comprise the FlamMap fire list file.

Local level summary zone

To summarize the spatial metrics of likelihood, intensity, and hazard for the "local level" analysis, we used catchments from the USEPA and USGS National Hydrography Dataset Plus V2 (https://www.epa.gov/waterdata/nhdplus-national-hydrography-dataset-plus). Catchments are local level drainage areas and typically subdivide HUC12 watersheds into smaller polygon units. Using a summary unit is important, because an individual spot on the landscape will have an individual value, but that one spot is inevitably impacted by the values of its neighbors; summarizing the raster FlamMap outputs and the derived hazard index to these polygons allows for broad-scale patterns to emerge that may not be immediately visible in the raw pixel datasets.

Local Wildfire Likelihood

Local Fire Likelihood, or burn probability (BP), is the FlamMap-modeled likelihood that a wildfire will burn a given point or area. It is calculated as the number of times a pixel burns during a simulation, divided by the total number of iterations. Because we parameterized FlamMap with a “problem fire” scenario, BP from our FlamMap run represents those specific conditions. The local level burn probability map represents the average of all 90-m pixel values within each catchment, classified into four categories (based on quantiles), with the chance of a wildfire occurring during any given fire season increasing with each class level (Figure A8).

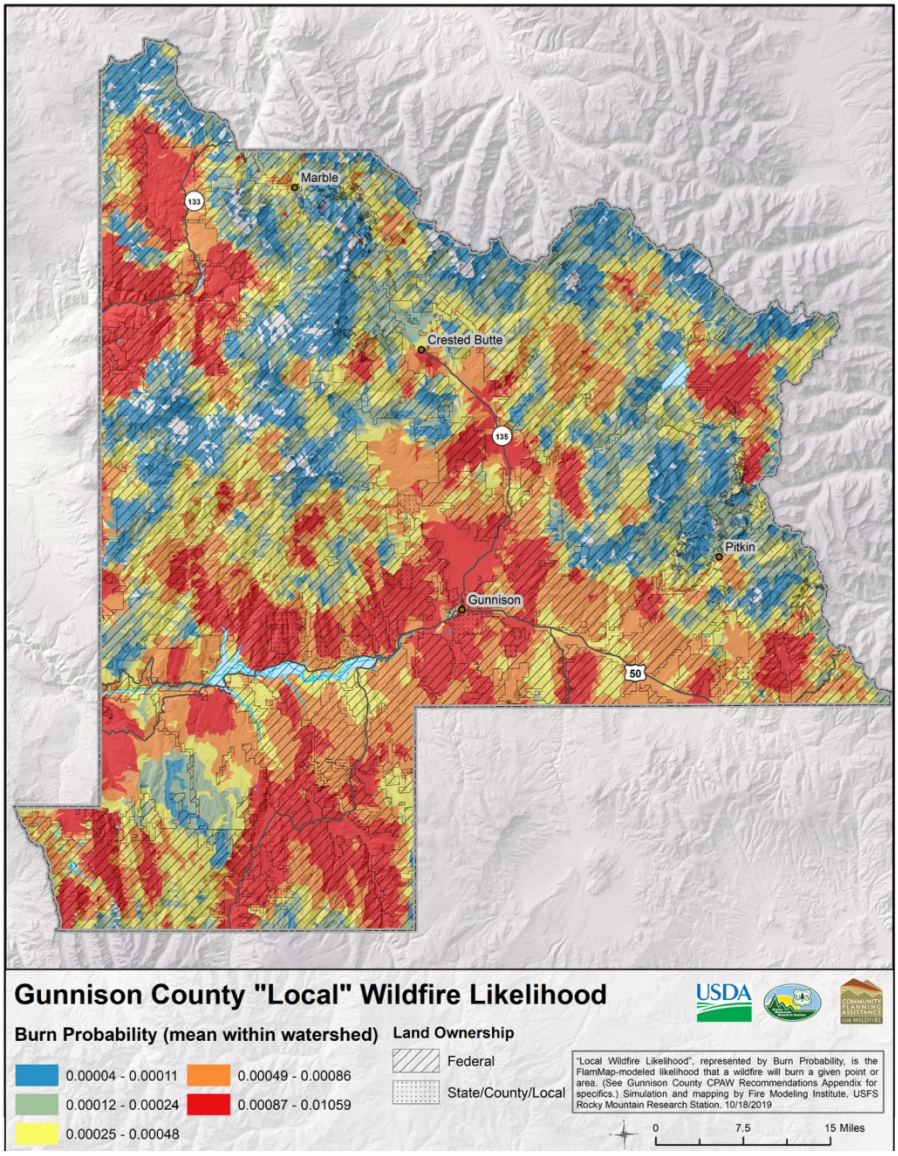


Figure A8. Gunnison mean burn probability likelihood

Local Wildfire Intensity

Like FSim, FlamMap can apportion burn probability into wildfire intensity levels and produce estimates of the probability of a certain flame length level, given a fire burns a pixel. Local Conditional Flame Length (CFL) is the average of all flame length probabilities that FlamMap simulated for each 90-m pixel, calculated as in Equation 1. We summarized the pixel level CFL values within catchments by calculating the average CFL for each catchment polygon. Map classes represent ranges of conditional flame length (in feet) (Figure A9).

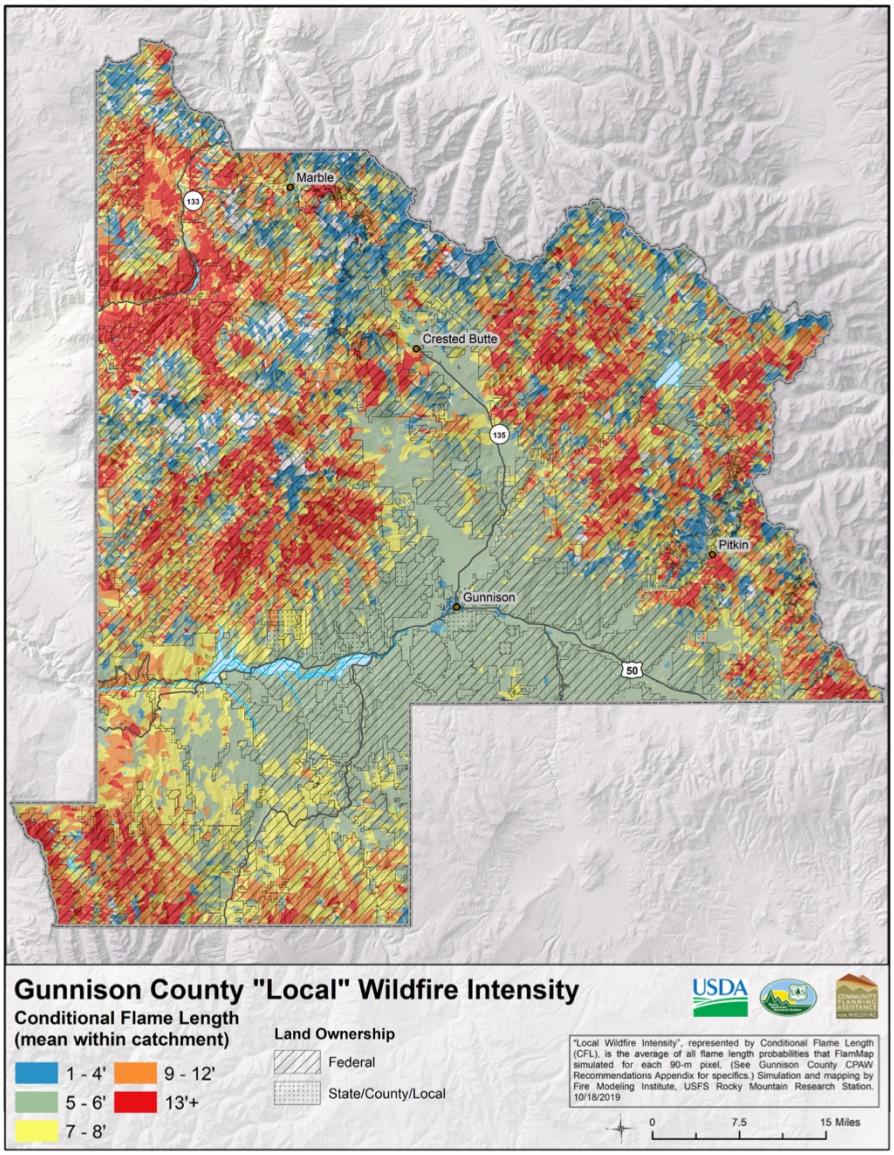


Figure 15map

Local Wildfire Hazard

Wildfire hazard is an integration of likelihood and intensity, and we calculated it as the product of BP and CFL. We calculated local hazard at the pixel scale and then summarized values to the catchment scale by calculating the mean CFL in each catchment polygon. We then classified the values into three categories (Moderate, High, and Very High) based on quantiles in the

distribution of values in the analysis area (Figure A10). The actual numeric values of hazard are less directly interpretable than BP or CFL. Instead, they provide a relative depiction of hazard across a landscape.

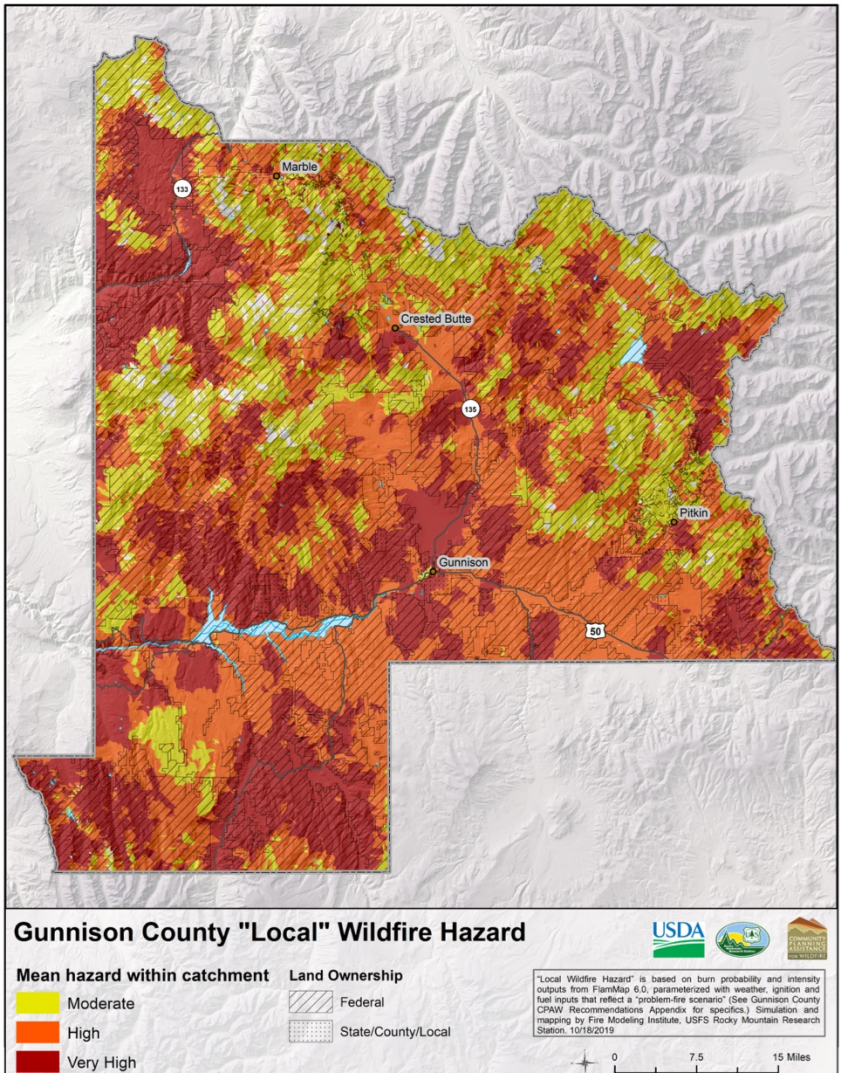


Figure A10. Gunnison local wildfire hazard assessment map

Wildland Urban Interface Zones

We mapped categories of structure density integrated with wildland vegetation to characterize where structures are in or near burnable vegetation in Gunnison County (Figure A11).

Though we generally followed methods that mimic Federal Register Wildland Urban Interface (WUI) definitions as adapted by Martinuzzi et al. 2015, we customized our WUI mapping to represent rural developed areas with more precision. To avoid bias introduced when using a summary zone for population density calculations, we used an approach based on structure locations to create a structure density surface (Bar-Massada et al 2013), using Microsoft Building Footprint polygons (converted to points) to represent individual structures.

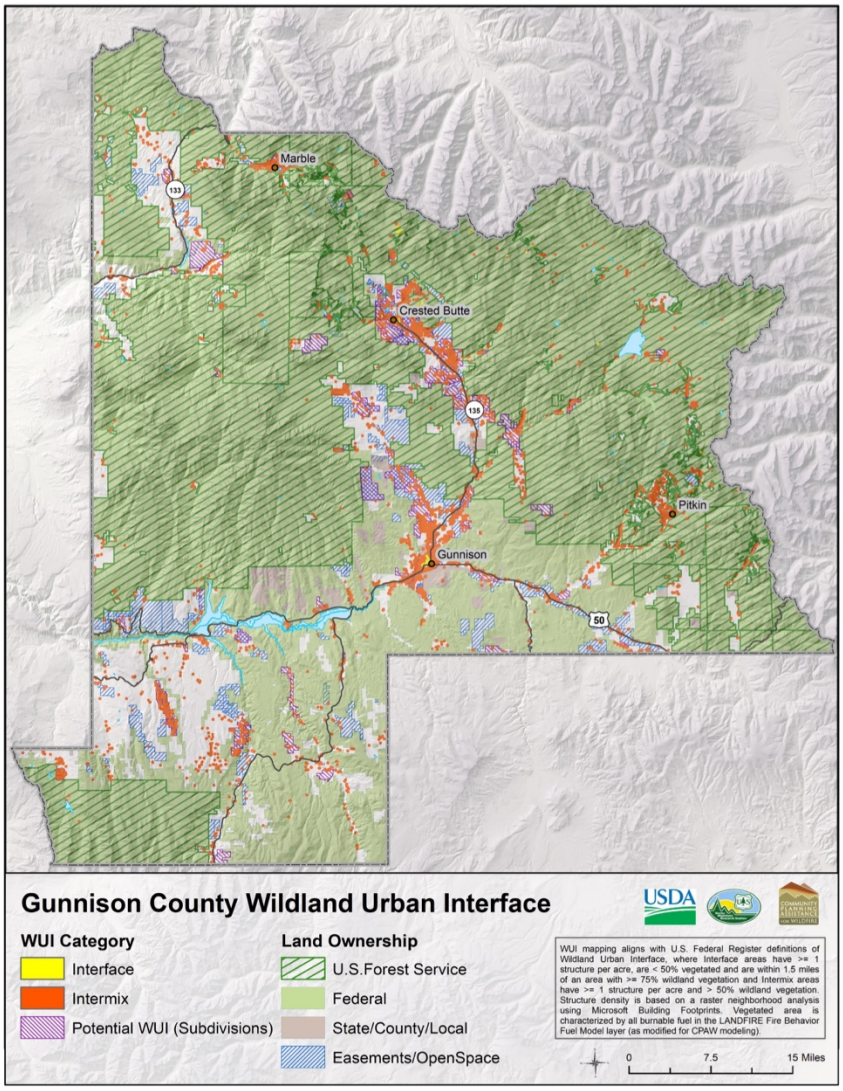


Figure A11. Gunnison wildland-urban interface map

We defined wildland vegetation as anything that is classed with a “burnable” fuel model in the same fuel model raster data that we used in our FlamMap modeling. Non-burnable fuel model categories include urban, snow/ice, agriculture, water, and barren surfaces. To quantify the percentage of vegetation within an area, we used the ArcGISFocal Statistics tool (ESRI 2017) to calculate the percentage of burnable fuel within a 40-acre moving window around each pixel, and assign that value to the center pixel. We reclassified the percent vegetated raster into three categories: greater than 50%, less than or equal to 50% and greater than or equal to 75%, to then build the vegetation density categories necessary for Federal Register WUI classes.

Structure density and vegetation raster layers were combined to map the WUI, with the map categories as described in Table A5. One modification that we made to rules outlined in Martinuzzi et al. 2015 was to include the “Vegetated Very Low Density” category with the WUI Intermix category. This decision reflects the Federal Register statement that “intermix exists where structures are scattered throughout a wildland area” (USDA and USDOI 2001) and our intent to include isolated structures in rural areas as WUI.

Table A5. Description of mapping ruleset for Wildland Urban Interface zones

WUI Category	Structure Density Description	Structure Density Range (structures/ac)	Vegetation Description
Interface	Very Low to High Density	>= 1	Wildland vegetation <= 50% and within 1.5-mi of area with >= 75% wildland vegetation
Intermix	Very Low to High Density	>= 1	Wildland vegetation > 50%
Non-Vegetated	Medium or High Density	> 8	Wildland vegetation <= 50%
	No, Very Low, or Low Density	0 - 8	
Vegetated	Uninhabited	0	Wildland vegetation > 50%

Though the scientific community is still working on a way to quantify the probability of wildfire ember impact to structures, in the Gunnison County mapping extent with fuels mapped as described for our FlamMap modeling, virtually every structure is within a distance from wildland fuels that could produce embers. Since the entire community could possibly be impacted by embers, we did not include an “ember zone” as it would add no substantial value to the final WUI map.

Mitigation Difficulty

As a complement to the landscape and local wildfire hazard assessments, we calculated an index that characterizes the relative difficulty or effort involved in modifying landscape characteristics in a way that could reduce wildfire hazard. To create the components necessary to map mitigation difficulty, we developed three 30-meter resolution spatial datasets, as follows:

Vegetation Life Form – We integrated the fuel model data set (initially built to parameterize our FlamMap modeling), with the Fuel Vegetation Type (LANDFIRE 2.0.0) data set to produce four life form classes: 1. Barren/Developed/Sparsely Vegetated/ Irrigated Agriculture, 2. Grass, 3. Shrub, and 4. Tree.

Slope – We classified the same slope dataset that was used to parameterize our fire behavior modeling landscape (LANDFIRE 2.0.0) into three classes: 1. Steep slopes - Slopes greater than or equal to 30%, 2. Moderate slopes – slopes greater than or equal to 15% and less than 30%, and 3. Shallow slopes – slopes less than 15%.

Crown Fire Activity – We used the Crown Fire Activity (CFA) raster output layer from our FlamMap modeling to represent potential for crown fire. The logic used in calculating CFA within FlamMap takes into account the potential for fires burning in surface fuels to transition into tree crowns, and then it uses mapped tree crown characteristics and modeled wind speeds to determine whether that pixel could experience passive (fire is limited to individual tree torching) or active (fire spreads through crowns from tree to tree) crown fire. For the mitigation index, we collapsed the CFA raster into two categories: 1. No crown fire potential, 2. Potential for either passive or active crown fire. As with other FlamMap outputs for

Gunnison County, we selected CFA values for the appropriate modeling scenario zones ("Tree" and "Non-Tree") to create the CFA grid for mitigation difficulty analysis.

We integrated the spatial layers described above to create map categories representing the difficulty to mitigate wildfire hazard within the Gunnison County mapping extent (Figure A12). Map classes range from 0 to 9, increasing with difficulty to mitigate wildfire hazard:

1 – Sparsely vegetated or developed:
Barren ground, sparse vegetation or developed surfaces.

2 – Herbaceous on a shallow slope:
Fires are typically easier to suppress in these areas. However high winds combined with dry conditions leads to potentially dangerous fast moving high intensity fires. Mitigation potential may involve a combination of irrigation, mechanical (mowing) treatment, frequent burning, and fuel breaks in conjunction with appropriate structure ignition zone and IR structure construction.

3 – Herbaceous on moderate slope:
Harder to construct fuel breaks, difficulty in mechanical (mowing) treatment, increased potential for erosion, increased rate of spread and intensity may make frequent burning more difficult. Focus should be on appropriate slope setbacks, structure ignition zone and IR structure construction mitigation.

4 – Herbaceous on steep slope:
Fires are typically harder to suppress than grassfires in these areas. High winds combined with dry conditions leads to potentially dangerous fast moving high intensity fires with fire fighter access concerns. Mitigation potential may involve a combination of mechanical (mastication) treatment, moderately frequent burning, and fuel breaks in conjunction with appropriate structure ignition zone and IR structure construction.

4 – Shrub on shallow slope:
Harder to construct fuel breaks, difficulty in mechanical (mastication) treatment, increased potential for erosion, increased rate of spread and intensity may make frequent burning more difficult. Focus should be on a combination of appropriate mechanical treatment or burning, slope set-backs, structure ignition zone and IR structure construction mitigation.

5 – Shrub on moderate slope:
Open canopy must be maintained to prevent increase crown fire potential. Surface fuels must be treated/maintained in a state that reduces the chances of fast moving surface fires in conjunction with appropriate structure ignition zone and IR structure construction mitigation.

6 – Shrub on steep slope:
Open canopy must be maintained to prevent increased crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated/maintained in a state that reduces the chances of fast moving surface fires. Mitigation should also include appropriate slope set-backs, structure ignition zone and IR structure construction mitigation.

6 – Tree on shallow slope:
Dense canopy needs to be thinned to reduce crown fire potential. Surface fuels must be treated to reduce risk of fast moving surface fires. Mitigation should also include appropriate structure ignition zone and IR structure construction mitigation.

7 – Tree on moderate slope:
Dense canopy needs to be thinned to reduce crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated to reduce risk of fast

moving surface fires. Mitigation should also include appropriate slope setbacks, structure ignition zone and IR structure construction mitigation.

7 – Tree on shallow slope with potential for crown fire:

Dense canopy needs to be thinned to reduce crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated to reduce risk of fast moving surface fires. Mitigation should also include appropriate slope setbacks, structure ignition zone and IR structure construction mitigation.

8 – Tree on moderate slope with potential for crown fire:

Dense canopy needs to be thinned to reduce crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated to reduce risk of fast moving surface fires. Mitigation should also include appropriate slope setbacks, structure ignition zone and IR structure construction mitigation.

8 – Tree on steep slope:

Dense canopy needs to be thinned to reduce crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated to reduce risk of fast moving surface fires. Mitigation should also include appropriate slope setbacks, structure ignition zone and IR structure construction mitigation.

9 – Tree on steep slope with potential for crown fire:

Dense canopy needs to be thinned to reduce crown fire potential, which may be more difficult due to the slope. Surface fuels must be treated to reduce risk of fast moving surface fires. Mitigation should also include appropriate slope setbacks, structure ignition zone and IR structure construction mitigation.

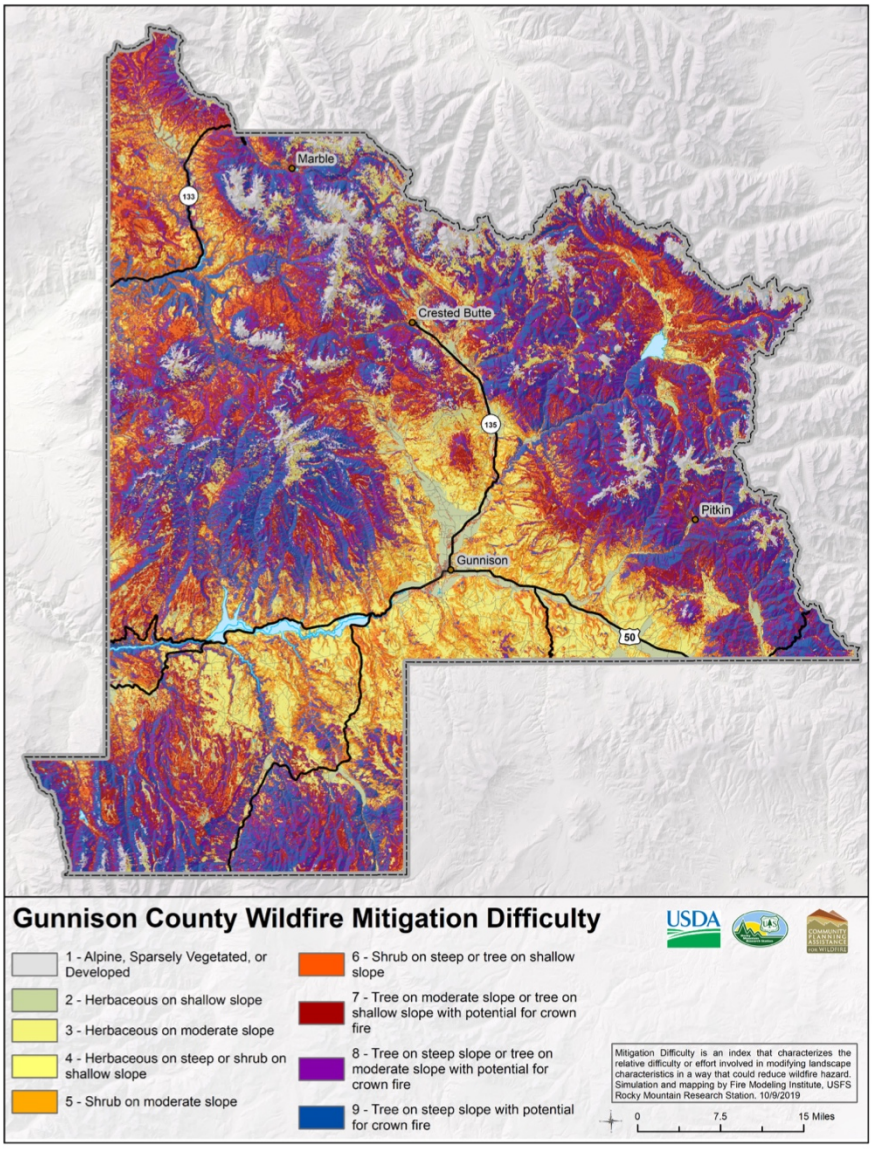


Figure A12. Gunnison mitigation difficulty map

Final Considerations

In this report, we presented two complementary representations of wildfire hazard in Gunnison County. The landscape level assessment addresses the question of "what is the annual chance of a fire occurring?" anywhere on a landscape. As such, this part of the assessment sets the context for a broad picture of wildfire hazard. The local level assessment used a more focused approach to model fire behavior under a "problem fire" scenario. It brings the benefit of integrating local stakeholder input that customizes the modeling landscape and represents the potential for local fire behavior at a finer spatial resolution. The local hazard map indicates where wildfire could cause a problem in a community, given the specific set of weather conditions selected for our modeling scenarios.

We encourage users to consider this hazard assessment as "living data." Now that we have established the methodology for mapping the local wildfire hazard, there is opportunity for local analysts to implement the methods on updated or modified datasets, either to refine the current

picture of hazard or to compare current vs. past assessments to assess progress toward landscape changes that decrease hazard in the community.

References

Bar-Massada A, Stewart S, Hammer I, Mockrin M, Radeloff V. 2013. Using structure locations as a basis for mapping the wildland urban interface. Journal of Environmental Management. 128:540-547.

Bradshaw L. 2018. FireFamilyPlus (v. 5.5). Available: https:/www.firelab.org/project/firefamilyplus.

ESRI. 2017. ArcGIS for Desktop. Version 10.5.1. Redlands, CA: Environmental Systems Research Institute.

Finney M, "An overview of FlamMap fire modeling capabilities," in Proceedings of the Fuels Management-How to Measure Success, pp. 213–220, Portland, OR, USA, March 2006.

Finney M, McHugh C, Grenfell I, Riley K, Short K. 2011. A simulation of probabilistic wildfire risk components for the continental United States. *Stochastic Environmental Research and Risk Assessment*. 25: 973-1000.

LANDFIRE Total Fuel Change Tool for ArcGIS (v. 0.316). 2019. National Interagency Fuels Technology Transfer: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station; LANDFIRE Fuels Development Team, SGT, Inc.; and U.S. Geological Survey.

Martinuzzi S, Stewart S, Helmers D, Mockrin M, Hammer R, Radeloff V. 2015. The 2010 wildland-urban interface of the conterminous United States. Research Map NRS-8. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 124.

Scott J, Thompson M, Calkin, D. 2013. A wildfire risk assessment framework for land and resource management. Gen. Tech. Rep. RMRS-GTR-315. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Scott J and Burgan R. 2005. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. General Technical Report RMRS-GTR-153. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Short, Karen C. 2018. Spatial wildfire occurrence data for the United States, 1992-2017 [FPA_FOD_2017508]. 4th Edition. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2013-0009.4.

USDA and USDI. 2001. Urban wildland interface communities within vicinity of Federal lands that are at high risk from wildfire. Federal Register 66:751–777.

APPENDIX B: DEFINITIONS

The following list of definitions is intended to aid understanding of terms associated with CPAW recommendations.

Aerial Fuels - Standing and supported live and dead combustible materials not in direct contact with the ground and consisting mainly of foliage, twigs, branches, stems, cones, bark, and vines.[30]

Built Fuels - Combustible structures, including buildings and infrastructure.

Burn Probability - The probability or effect of a wildland fire event or incident, usually evaluated with respect to objectives.

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.[31]

Community Wildfire Protection Plan (CWPP) - A plan developed in the collaborative framework established by the Wildland Fire Leadership Council and agreed to by state, tribal, and local government, local fire department, other stakeholders and federal land management agencies managing land in the vicinity of the planning area. A Community Wildfire Protection Plan (CWPP) identifies and prioritizes areas for hazardous fuel reduction treatments and recommends the types and methods of treatment on federal and non-federal land that will protect one or more at-risk communities and essential infrastructure and recommends measures to reduce structural ignitability throughout the at-risk community. A CWPP may address issues such as wildfire response, hazard mitigation, community preparedness, or structure protection—or all the above.[32]

Conduction Heat - Transfer of heat through direct contact of material.

Convection Heat - The movement caused through the rising of a heated gas or liquid.

Critical Facilities - FEMA defines critical facilities as "facilities/infrastructure that are critical to the health and welfare of the population and that are especially important following hazard events. Critical facilities include, but are not limited to, shelters, police, fire stations, and

[30] National Wildfire Coordinating Group. 2018. "Glossary A-Z." Available at www.nwcg.gov/glossary/a-z.
[31] National Wildfire Coordinating Group. 2018. "Glossary A-Z." Available at www.nwcg.gov/glossary/a-z.
[32] National Wildfire Coordinating Group. 2018. "Glossary A-Z." Available at www.nwcg.gov/glossary/a-z.

hospitals." In addition, CPAW recognizes emergency water pumping stations, egress routes, communication facilities, and backup power supplies as critical facilities.

Crown Fire - A fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as running or dependent to distinguish the degree of independence from the surface fire.[33]

Defensible Space - The selection, location, grouping, and maintenance of vegetation on the property in such a manner that the opportunity for fire to burn directly to a structure is minimized.[34]

Ecosystem-Based Fire Management - The incorporation of the natural or desired ecological role of fire into the management and regulation of a community's natural areas.

Effects - The anticipated benefits and losses associated with exposure to a hazard or event, in this case fire.

Embers - *See firebrand.*

Exposure - The contact of an entity, asset, resource, system, or geographic area with a potential hazard. Note: In incident response, fire responder exposure can be characterized by the type of activity.[35]

Fire Adapted Community (FAC) - A human community consisting of informed and prepared citizens collaboratively planning and taking action to safely coexist with wildland fire.[36]

Fire Effects - The physical, biological, and ecological impacts of fire on the environment, or the physical, safety, health, social, and economic impacts of fire on humans and human development. This is often expressed as first order (immediate effects) and second order (subsequent effects as a result of first order effects).

Fire Intensity - Commonly referred to as fire line intensity, this is the amount of heat energy that is generated by burning materials.

Fire Weather - Weather conditions that influence fire ignition, behavior, and suppression.[37]

---

[33] National Wildfire Coordinating Group. 2018. "Glossary A-Z." Available at www.nwcg.gov/glossary/a-z.
[34] National Fire Protection Association. 2018. NFPA 1144: *Standard for Reducing Structure Ignition Hazards from Wildland Fire.* Available at https://catalog.nfpa.org/NFPA-1144-Standard-for-Reducing-Structure -Ignition-Hazards-from-Wildland-Fire-P1414.aspx?icid=B575.
[35] Thompson, Matthew P., Tom Zimmerman, Dan Mindar, and Mary Taber. 2016. *Risk Terminology Primer: Basic Principles and A Glossary for the Wildland Fire Management Community.* Gen. Tech. Rep. RMRS- GTR-349. Fort Collins, Colo.: USDA Forest Service Rocky Mountain Research Station. Available at www.fs.usda.gov/treesearch/pubs/50912.
[36] Fire Adapted Communities Coalition. 2018. "What is a Fire-Adapted Community?" Available at https://fireadapted.org.
[37] National Wildfire Coordinating Group. 2018. "Glossary A-Z." Available at www.nwcg.gov/glossary/a-z.

Firebrand - Any source of heat, natural or human made, capable of igniting wildland fuels; flaming or glowing fuel particles that can be carried naturally by wind, convection currents, or by gravity into unburned fuels.[38]

Firewise USA - A program administered by the National Fire Protection Association that teaches people how to adapt to living with wildfire and encourages neighbors to work together and take action to prevent losses. Some communities have applied the term "firewise" more broadly to refer to wildfire mitigation activities.

Frequency - The number of occurrences of an event per a specified period of time.

Fuel Treatment - Manipulation or removal of fuels to reduce the likelihood of ignition or to lessen potential damage and resistance to control (e.g., lopping, chipping, crushing, piling, and burning).[39]

Fuels - All combustible materials in the wildland-urban interface, including but not limited to vegetation and structures.[40]

Ground Fuel - All combustible materials below the surface litter, including duff, tree or shrub roots, punky (rotted) wood, peat, and sawdust, that normally support a glowing combustion without flame.[41]

Hazard - Any real or potential condition that can cause damage, loss, or harm to people, infrastructure, equipment, natural resources, or property.[42]

Hazard Reduction - Coordinated activities and methods directed to reduce or eliminate conditions that can cause damage, loss, or harm from real or potential hazards.

Home Ignition Zone (HIZ) - Also see *structure ignition zone.* The area where the factors that principally determine home ignition potential during extreme wildfire behavior (high fire intensities and burning embers) are present. The characteristics of a home and its immediate surroundings within 100 feet comprise the HIZ.[34]

Hydrophobic Soils - Resistance to wetting exhibited by some soils, also called water repellency.[43]

---

[38] National Wildfire Coordinating Group. 2018. "Glossary A-Z." Available at www.nwcg.gov/glossary/a-z.
[39] National Wildfire Coordinating Group. 2018. "Glossary A-Z." Available at www.nwcg.gov/glossary/a-z.
[40] National Fire Protection Association. 2018. NFPA 1144: Standard for Reducing Structure Ignition Hazards from Wildland Fire. Available at https://catalog.nfpa.org/NFPA-1144-Standard-for-Reducing-Structure -Ignition-Hazards-from-Wildland-Fire-P1414.aspx?icid=B575.
[41] National Wildfire Coordinating Group. 2018. "Glossary A-Z." Available at www.nwcg.gov/glossary/a-z.
[42] Thompson, Matthew P., Tom Zimmerman, Dan Mindar, and Mary Taber. 2016. *Risk Terminology Primer: Basic Principles and A Glossary for the Wildland Fire Management Community*. Gen. Tech. Rep. RMRS- GTR-349. Fort Collins, Colo.: USDA Forest Service Rocky Mountain Research Station. Available at www.fs.usda.gov/treesearch/pubs/50912.
[43] National Wildfire Coordinating Group. 2018. "Glossary A-Z." Available at www.nwcg.gov/glossary/a-z.

Infill Development - Development characterized by development or redevelopment of undeveloped or underutilized parcels of land in otherwise built-up areas, which are usually served by or have ready access to existing infrastructure and services.

Infrastructure - The basic physical structures and facilities (e.g., buildings, roads, and power supplies) needed for the operation of a community.

Initial Attack (IA) - A preplanned response to a wildfire given the wildfire's potential. Initial attack may include sizing up, patrolling, monitoring, holding action, or suppression.[44]

Ladder Fuels - Fuels that provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. They help initiate and assure the continuation of crowning.[45]

Landscape Scale - A large spatial scale, which addresses multiple land uses, ecosystem services, and conservation objectives. Landscape-scale approaches focus on achieving multiple environmental, economic, and social objectives across the defined area.

Mitigation - The act of modifying the environment or human behavior to reduce potential adverse impacts from a natural hazard. Mitigation actions are implemented to reduce or eliminate risks to persons, property, or natural resources, and can include mechanical and physical tasks, specific fire applications, and limited suppression actions.[46]

Natural Hazard - Source of harm or difficulty created by a meteorological, environmental, or geological event.

Preparedness - Activities that lead to a safe, efficient, and cost-effective fire management program in support of land and resource management objectives through appropriate planning and coordination.[47]

---

[44] National Wildfire Coordinating Group. 2018. "Glossary A-Z." Available at www.nwcg.gov/glossary/a-z.
[45] National Wildfire Coordinating Group. 2018. "Glossary A-Z." Available at www.nwcg.gov/glossary/a-z.
[46] National Wildfire Coordinating Group. 2018. "Glossary A-Z." Available at www.nwcg.gov/glossary/a-z.
[47] National Wildfire Coordinating Group. 2018. "Glossary A-Z." Available at www.nwcg.gov/glossary/a-z.