Upper Crystal River Valley Community Wildfire Protection Plan

Prepared in cooperation with:

Carbondale & Rural Fire Protection District
Gunnison County Emergency Management
Montrose Interagency Fire Management Unit
Colorado State Forest Service

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Prepared for:

Carbondale & Rural Fire Protection District and Gunnison County

Signed Copies on File with Montrose Interagency Fire Management Unit, the Colorado State Forest Service and the Carbondale & Rural Fire Protection District

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Canopy Bulk Density (CBD) The mass to volume ratio of forests in the forest canopy.

Chain A unit of linear measurement equal to 66 feet.

Chimney A steep gully or canyon conducive to channeling strong convective currents, potentially resulting in dangerous increases in rates of fire spread and fireline intensity.

Clearcutting The removal of all trees in a single harvest from a sufficiently large area that the "forest influence" is removed from at least 50% of the harvest area.

Climax The final stage of succession that is relatively stable over several generations of the dominant plant species.

Crown Fire The movement of fire through the crowns of trees or shrubs relatively independent of the surface fire.

Dead Fuels Fuels with no living tissue in which moisture content is governed almost entirely by atmospheric moisture (relative humidity and precipitation), dry-bulb temperature, and solar radiation.

Defensible Space An area, either natural or manmade, where material capable of causing a fire to spread has been treated, cleared, reduced, or changed to act as a barrier between an advancing wildland fire and values at-risk, including human welfare.

Dominant Trees with crowns extending above the general level of crown cover. Larger than average tree with a well developed crown.

Even Aged Stand A stand of trees comprised of one or two age classes, often resulting from a stand replacing event such as a fire or a clear cut.

Fire Behavior The manner in which a fire reacts to the influences of fuel, weather, and topography.

Fire Danger The broad-scale condition of fuels as influenced by environmental factors.

Fire Hazard The presence of ignitable fuel coupled with the influences of terrain and weather.

Fire Intensity A general term relating to the heat energy released by a fire.

Fireline Intensity The level of heat radiated from the active flaming front of a fire, measured in British thermal units (BTUs) per foot.

Fire Regime The characterization of fire's role in a particular ecosystem, usually characteristic of particular vegetation and climatic regime, and typically a combination of fire return interval and fire intensity.

Flame Length The distance from the base to the tip of the flaming front. Flame length is directly correlated with fire intensity.

Flaming Front The zone of a moving fire where combustion is primarily flaming. Light fuels typically have a shallow flaming front, whereas heavy fuels have a deeper front.

Fuel Combustible material that includes vegetation such as grass, surface litter, plants, shrubs, and trees that feed a fire. Not all vegetation is necessarily

	considered fuel. Deciduous vegetation such as aspen actually serve more as a barrier to fire spread and many shrubs are only available as fuels when they are drought-stressed.
Fuelbreak	An easily accessible strip of land of varying width (depending on fuel and terrain), in which fuel density is reduced, thus improving fire control opportunities.
Fuel Loading	The amount of fuel present expressed in terms of weight of fuel per unit area.
Fuel Model	Simulated fuel complex (or combination of vegetation types) for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.
Ground Fire	Fire that consumes the organic material beneath the surface litter ground, such as a peat fire.
Ground Fuel	Combustible materials below the surface litter, including duff, tree or shrub roots, decomposing wood, and peat that normally support glowing combustion without flame.
Ladder Fuels	Fuels that provide vertical continuity between strata, allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. Ladder fuels help initiate and ensure the continuation of crowning.
Overstory	The forest canopy.
Patch Cut	A small scale clearcut, generally no more than five to ten acres in area.
Regeneration	The new growth within a forest.
Risk	The probability that a fire will start from natural or human-caused ignition.
Sanitation Cut	Removal of trees designed to eliminate trees that have been attacked or appear in imminent danger of attack by dangerous insects or pathogens in order to prevent their spread.
Salvage Cut	Removal of trees designed to save the wood in dead or damaged trees, often following large scale mortality resulting from a fire or epidemic.
Stand Replacement	An event that kills the majority of the mature trees in a forest stand such as a crown fire or clear cut.
Surface Fire	Fire that burns loose debris on the surface, which includes dead branches, leaves, and low vegetation.
Surface Fuels	Surface litter normally consisting of fallen leaves, needles, cones, and small branches. It also includes grasses, forbs, shrubs, tree seedlings, heavier branchwood, downed logs, and stumps interspersed with or partially replacing the litter.
Torching	The burning of the foliage of a single tree or a small group of trees, from the bottom up. Passive crown fire.
Understory	Vegetation growing on the forest floor, under the canopy.
Wildfire	An unplanned and unwanted wildland fire that is not meeting management objectives and thus requires a suppression response.
Wildland Fire	Any fire burning in wildland fuels, including prescribed fire, fire use, and wildfire.

EXECUTIVE SUMMARY

The Upper Crystal River Valley Community Wildfire Protection Plan was developed for the Carbondale & Rural Fire Protection District with guidance and support from the Gunnison County Emergency Services, Colorado State Forest Service, Bureau of Land Management and U.S. Forest Service (through the Montrose Interagency Fire Management Unit). This effort was supported by a grant from the Montrose Interagency Fire Management Unit. This Community Wildfire Protection Plan (CWPP) was developed according to the guidelines set forth by the Healthy Forests Restoration Act (2003) and the Colorado State Forest Service's Minimum Standards for Community Wildfire Protection Plans (2009).

The prescribed elements of a CWPP that are included in this plan are:

- Stakeholder collaboration;
- Public agency and local community engagement;
- Hazard Mapping;
- Risk assessment – fuels, historical ignitions, infrastructure, structural ignitability, local resources, and firefighting capability;
- Recommended hazard mitigation action items

The objectives addressed by this plan are:

- Identify and describe the Upper Crystal River Valley's (UCRV) areas of wildland-urban interface
- Determine community hazards and risks associated with this wildland-urban interface
- Provide recommendations for mitigating those risks including strategies for fuels management and reduction of structure ignition potential
- Provide an Action Plan for implementing recommendations & identify lead entity

The communities that are identified as distinct planning units within the UCRV are Chair Mountain Ranch, Hermits Hideaway, Serpentine Trail, West 5th Street, Marble Mountain Ranch, and the Town of Marble. These areas were evaluated in terms of exposure to hazardous fuels and vulnerability to wildfire. The fuel hazards throughout these areas are predominately moderate and high. While brush fuels and drier conifer stands in the south facing and lower areas have the highest potential for problematic fire behavior, the aspen stands, riparian areas, and more mesic conifer stands will generally support moderate fire behavior in dry and windy conditions. A lack of defensible space and home combustibility are issues throughout all of these communities, while water supply and access/egress concerns are pronounced in all areas with the exception of the Town of Marble.

The proposed action items are designed to address current and future community vulnerabilities to wildfires and facility emergency response. Recommendations specifically address community wide improvement of defensible space, improvement of access, and reducing ignition potential at construction sites.

Throughout this plan, the need for community involvement and action are emphasized. The majority of mitigative actions to preserve life and property lie in the hands of individual residents. While this plan and its leadership group must provide guidance for improving wildfire safety, it is the action of the individual that will ensure success.

1 INTRODUCTION

1.1 Purpose and Need

The Upper Crystal River Valley (UCRV) CWPP is a strategic planning document, developed with and approved by the Carbondale & Rural Fire Protection District (CRFPD), which identifies specific wildland fire risks facing communities and neighborhoods and provides prioritized mitigation recommendations that are designed to reduce those risks. Once the CWPP is finalized and adopted, it is the responsibility of the community or neighborhood to move forward and implement the action items. This may require further planning at the project level, acquisition of funds, or simply motivating individual homeowners.

The objectives of this CWPP are to:

- Identify and describe the UCRV's areas of wildland-urban interface
- Determine community hazards and risks associated with this wildland-urban interface
- Provide recommendations for mitigating those risks including strategies for fuels management and reduction of structure ignition potential
- Provide an Action Plan for implementing recommendations

This CWPP is not a legal document. There is no legal requirement to implement the recommendations herein. However, treatments on private land may require compliance with county land use codes, building codes, and local covenants, and treatments on public lands will be carried out by appropriate agencies and may be subject to federal, state, and county policies and procedures such as adherence to the Healthy Forests Restoration Act (HFRA) and National Environmental Policy Act (NEPA).

The wildland-urban interface (WUI) may be defined as the area where development encroaches on undeveloped natural areas and represents the zone of greatest potential for loss due to wildfire. The Upper Crystal River area includes 6 distinct WUI areas that were identified based on geography, fuels and neighborhood characteristics. A hazard/risk assessment was performed for each area to help establish mitigation priorities.

Natural resource management policies, changing ecological conditions and community expansion into wildlands have converged to exacerbate hazardous fuel situations throughout the assessment area. Shrubs have become decadent with an abnormally high loading of dead material, increasing fuel loading and flammability. In many areas these fire-dependent ecosystems have grown unchecked by fire for more than a century. The collective result is a pronounced increase in the potential for wildfire.

The forest, shrublands, and grasslands in the UCRV have adapted to a mixture of low and high severity fires along a broad range of historic frequencies. While the UCRV is generally considered a relatively moist area with low wildfire potential, it is commonly acknowledged that the steep south-facing slopes and lack of vegetation management and defensible space clearing has exacerbated the potential for high-intensity wildfire by allowing fuels to build up and facilitating the maturation and decadence of fuels, especially in the deciduous shrub types and aspen stands. Historic clearing of the Marble town site initiated very dense coniferous and deciduous regeneration, which has produced heavy fuel loading with significant ladder fuels.

Weather plays a critical role in determining fire frequency and behavior. A dry climate and available fuels in an area prone to strong gusty winds can turn an ignition from a discarded cigarette, vehicle parked over dry grass, or spark from a construction site into a major wildfire event in a matter of several minutes. The UCRV is characterized by a combination of a relatively low-density population scattered on narrow, winding roads, with a somewhat unique situation of many homes being in various states of construction and remodel. The remote nature of many homes lends itself to being populated by many "do-it-yourself" residents, which in some situations can extend construction projects to multiple seasons and years. Construction activities are often cited as being a potential starting point for wildfires, due to equipment use, tools which throw sparks, and other use of potential ignition sources. The response time of local fire fighters can be rapid, but due to rough, narrow roads, low staffing levels, and continuous fuel profiles, initial attack can easily extend into longer duration suppression events. This can expose multiple homes to fire, putting firefighters and residents at extreme danger. Buildings that are under construction are also more vulnerable to fire. These factors combine a degree of hazard, ignition risk, and values at risk that require evaluation in developing a mitigation strategy.

The CWPP provides a coordinated assessment of neighborhood wildfire risks and hazards and outlines specific mitigation treatment recommendations designed to make the UCRV a safer place to live, work, and play. The CWPP development process can be a significant educational tool for people who are interested in improving the environment in and around their homes. It provides ideas, recommendations, and guidelines for creating a defensible space around the house and ways to reduce structural ignitability through home improvement and maintenance.

1.2 CWPP Process

The CWPP is a community based approach to planning wildfire mitigation and preparedness. It combines objective analysis, stakeholder input, and community involvement in the development of action items. A leadership team should participate in the development of the CWPP. Organizing and maintaining this team is often the most challenging component of the CWPP process. It is, however, essential in the process of converting the CWPP from a strategic plan into action. The CRFPD will oversee the implementation and maintenance of the CWPP by working with community organizations, private landowners, and public agencies to coordinate and implement hazardous fuels treatment projects management and other mitigation projects.

The Healthy Forest Restoration Act of 2003 is the origin of the CWPP process at the national level. Specific guidelines for the CWPP are provided in *Preparing a Wildfire Protection Plan* (Society of American Foresters 2004) and further elaborated on in the Colorado State Forest Service's Minimum Standards for Developing Community Wildfire Protection Plans (11/13/2009 revision). This CWPP addresses such factors as:

- Stakeholder collaboration;
- Public agency and local community engagement;
- Hazard Mapping;
- Risk assessment – fuels, historical ignitions, infrastructure, structural ignitability, local resources, and firefighting capability;
- Recommended hazard mitigation action items

The success of any CWPP hinges on community participation. Although important during the writing of the report, this type of involvement is critical when it comes to implementing recommended actions. The CRFPD hosted two public meetings (2007 and 2009) regarding wildfire concerns and CWPP planning in the Marble area. These meetings were attended by BLM staff from Grand Junction, and also provided an opportunity for the public to share concerns and ideas regarding wildfire with the CRFPD, which were incorporated into the CWPP process.

The National Fire Protection Association (NFPA) Form 1144, Standards for Protection of Life and Property from Wildfire, 2002 Edition, was utilized by CRFPD staff to assess the level of risk and hazard to individual neighborhoods. Form 1144 provides a means to assess predominant characteristics within individual neighborhood communities as they relate to structural ignitability, fuels, topography, expected fire behavior, emergency response, and ultimately human safety and welfare. Scores are assigned to each element and totaled to determine the overall level of risk. Low, moderate, high, and extreme hazard categories are determined based on the total score. This methodology provides a standardized basis for wildfire hazard assessment and a baseline for future comparative surveys (see **Appendix B**).

In addition to the utility and infrastructure treatments recommended in this report, the most effective wildfire hazard reduction depends largely on the efforts of individual landowners making common sense modifications to their own homes and property. The creation of effective defensible space and the utilization of fire-resistant construction materials significantly reduce the risk of life and property loss in the event of a wildfire. When these common sense practices become the predominant model in a neighborhood the entire community benefits.

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1.3 Wildland Fire Primer

A basic understanding of wildland fire is essential for understanding the analysis and conclusions of this report. This section provides an introduction to wildland fire behavior, ecology, and the WUI as pertinent to this document.

Wildland fire is defined as any fire burning in wildland fuels and includes wildfire, prescribed fire, and wildland fire use (WFU). Wildfires are unwanted and unplanned fires that result from natural ignition or human-caused fire. Prescribed fires are planned human-ignited fires for specific natural resource management objectives. Natural ignitions that are allowed to burn for natural resource benefits under specific conditions are termed WFU.

While wildland fire bears many ecological benefits, this plan is largely concerned with mitigating its negative impacts on human society. The threat of wildland fire can be described in a variety of ways. Fire risk is the probability that wildfire will start from natural or human-caused ignitions. Fire hazard is the presence of ignitable fuel coupled with the influences of topography and weather, and is directly related to fire behavior. Fire severity, on the other hand, refers to the effects a fire has on vegetation and soils. Fire intensity generally refers to the amount of energy released by the flaming front. Rate of spread and flame length are often used as key measures of fire behavior.

Wildland Fire Behavior

Fire behavior is the manner in which a fire reacts to the influences of fuel, weather, and topography. Vegetative fuels are characterized by size, shape, and quantity and are classified in terms of fire behavior fuel models (FBFM). These fuel characteristics determine responsiveness to weather conditions and ignition. Important weather elements include temperature, relative humidity, and wind. Temperature and relative humidity help determine how easily fuels will ignite and burn, while wind is the dominant force in determining a fire's rate and direction of spread. Topography also influences spread rate and direction, and also influences wind and the reception of sunlight.

Wildland fires may be classified as ground, surface, or crown fires. Ground fire involves smoldering materials such as duff and roots. Surface fire includes the burning of forest litter, down woody materials, grass, low shrubs and small trees. Crown fire moves through the canopy of trees or shrubs and can be further classified as active or passive. In passive crown fire, often called "torching", individual or small groups of trees are ignited by surface fire on an isolated basis. Fuels that support fire spread from the surface to the canopy, such as low branches or tall shrubs, are called ladder fuels. Active crown fire spreads through the forest canopy as a flaming front. High intensity surface fires and crown fires pose the greatest challenge to suppression resources and the greatest threat to community values.

Fuels, weather, and topography are used as inputs for modeling potential fire behavior. Fire behavior is typically modeled at the flaming front of the fire and described most simply in terms of fireline intensity (flame length), the rate of forward spread, and the potential for developing into a passive or active crown fire. Passive crown fire is largely determined by flame height relative to crown base height, essentially how close the fire comes to the tree crowns. Active crown fire is modeled as a function of canopy bulk density, or how much fuel is in a given volume of forest canopy. This sort of modeling can help guide fire preparedness, suppression planning, and mitigation activities.

Fire Ecology

Fire is an essential component of most vegetated ecosystems in the western United States. Some vegetative communities, such as Southwest ponderosa pine woodlands, experience relatively frequent fire, burning every ten to thirty years. Other forest types, like the local spruce-fir forests, may go for hundreds of years without burning. The frequency of burning is determined by the continuity of vegetation, dryness of fuels, and prevalence of ignition sources as well as other factors.

Wildland fire also varies in terms of its severity. In very general terms, where fire is more frequent it tends to burn with less severity. Frequent burning inhibits the build-up of large amounts of fuel. Areas that burn less frequently often have heavy concentrations of surface fuels and/or dense canopies that can sustain more severe burning. There are also vegetative communities that fall into intermediate or mixed fire frequency and severity categories. The characteristic fire behavior and frequency is referred to as the fire regime.

Agriculture, human development, and fire suppression have effectively reduced fire frequency across much of the American landscape. In areas with high frequency – low severity fire regimes, these activities have led to fuel build-ups outside of the historic norm, resulting in abnormally severe fires. For low frequency fire regimes, there has been little or no impact. The mixed conifer and aspen forests of the Upper Crystal River Valley are classified as a low frequency - moderate severity fire regime, essentially meaning that severe fires can be expected to burn patches or portions of the forest on order of every 100 to 300 years (Landfire 2009). In other words, given the high diversity of fuel profiles and relatively mesic forest conditions, wildfire events are expected to burn small to moderate patches of the forests on a relatively infrequent time frame. While mixed mountain shrublands and Gambel's oak shrublands are generally considered to be more flammable, the patchy nature of fuels results in patchy fire behavior. Due to severe drought cycles (such as 2000-2002), all fuel profiles within the area may burn with relatively high severity and intensity.

Wildland Urban Interface (WUI)
The highest potential for negative and even deadly impacts of wildland fire is where communities abut or mix with forests and open spaces. This zone is most commonly known as the wildland – urban interface (WUI) and is the central focus of this report.

Every fire season catastrophic losses from wildfire plague the WUI. Homes are lost, businesses are destroyed, community infrastructure is damaged, and, most tragically, lives are lost. Precautionary action taken before a wildfire strikes often makes the difference between saving and losing a home. Creating a defensible space around a home is an important component in wildfire hazard reduction. This involves reducing combustible vegetation around the structure.

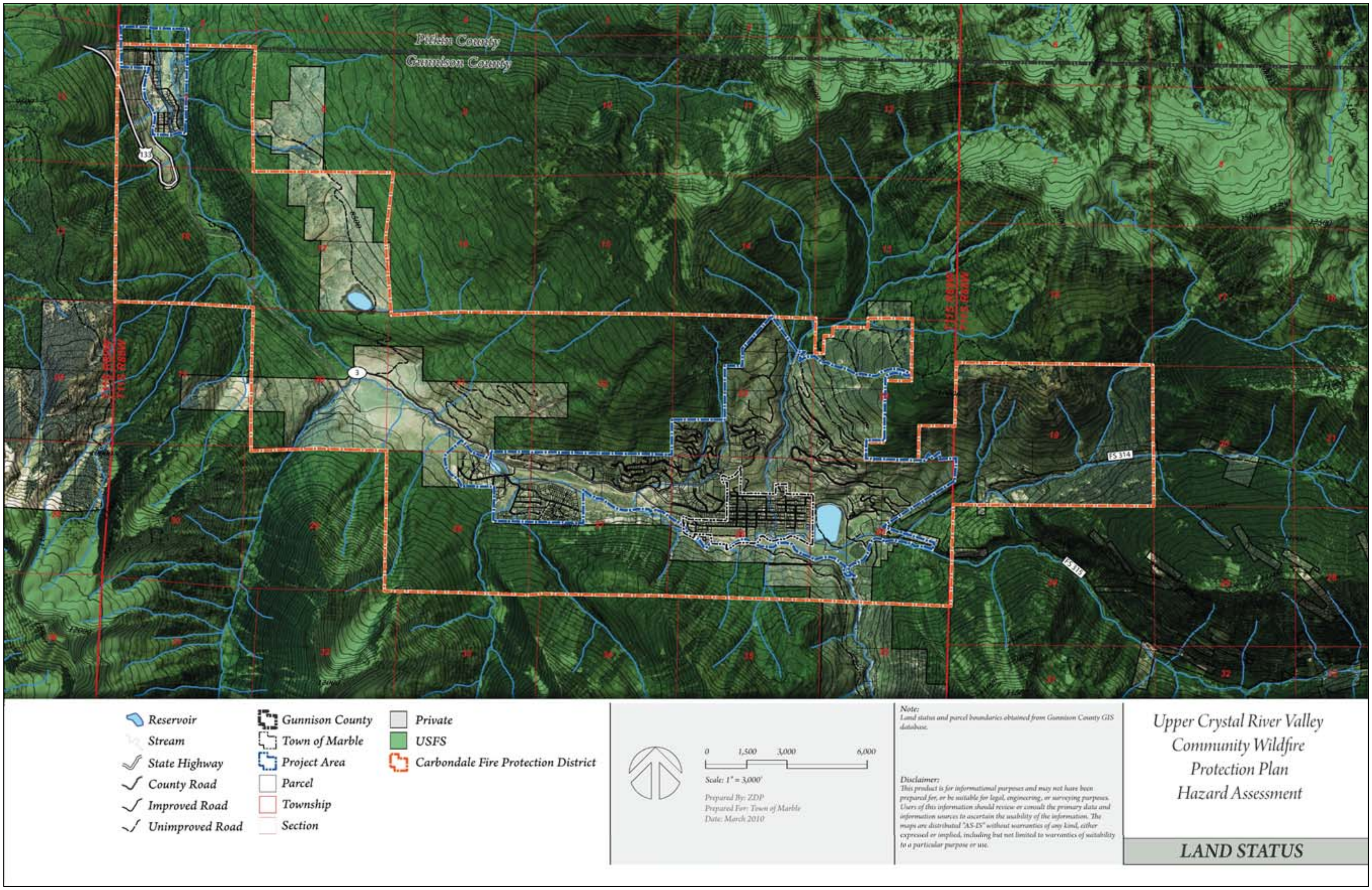
The attributes of the structure itself are also essential to determining survivability during a wildfire. Experiments indicate that even the intense radiant heat of a crown fire is unlikely to ignite a structure that is more than 30 feet away as long as there is no direct flame impingement (Cohen and Saveland 1997). Post fire home survivability studies determined that homes with noncombustible roofs and a minimum of 30 feet of defensible space had an 85% survival rate. Conversely, homes with wood shake roofs and less than 30 feet of defensible space had a 15% survival rate (Foote and Gilles 1996).

Hazardous Fuels Mitigation
Wildfire behavior and severity are dictated by fuel type, weather conditions, and topography. Because fuel is the only variable of these three that can be practically managed, it is the focus of many mitigation efforts. The objectives of fuels management may include reducing surface fire intensity, reducing the likelihood of crown fire initiation, reducing the likelihood of crown fire propagation, and improving forest health. These objectives may be accomplished by reducing surface fuels, limbing branches to raise canopy base height, thinning trees to decrease crown density, and/or retaining larger fire-resistant trees.

By breaking up vertical and horizontal fuel continuity in a strategic manner, fire suppression resources are afforded better opportunities to control fire rate of spread and contain wildfires before they become catastrophic. In addition to the creation of defensible space, fuelbreaks may be utilized to this end. These are strategically located areas where fuels have been reduced in a prescribed manner, often along roads. Fuelbreaks may be strategically placed with other fuelbreaks or with larger-area treatments. When defensible space, fuelbreaks, and area treatments are coordinated, a community and the adjacent natural resources are afforded an enhanced level of protection from wildfire.

Improperly implemented fuel treatments can have negative impacts in terms of forest health and fire behavior. Aggressively thinning forest stands in wind-prone areas may result in subsequent wind damage to the remaining trees. Thinning can also increase the amount of surface fuels and sun and wind exposure on the forest floor. This may increase surface fire intensity if post-treatment debris disposal and monitoring are not properly conducted. The overall benefits of properly constructed fuelbreaks are, however, well documented.

Figure 1: Upper Crystal River Valley CWPP Area & Land Ownership



2 UPPER CRYSTAL RIVER VALLEY PROFILE

2.1 Area Description

This CWPP provides wildfire hazard and risk assessments and mitigation recommendations for the Town of Marble and five subdivisions within the UCRV. The developed areas of this watershed encompass approximately fifteen square miles along Gunnison County Road 3 which extends south for six miles from Colorado State Highway 133 at the base of McClure Pass. Marble, Chair Mountain Ranch, and Hermits Hideaway lie along the Upper Crystal River Valley floor between the elevations of 7,500 feet and 8,000 feet above sea level. The neighborhoods of Serpentine Trail, West 5th Street, and Marble Mountain Ranch wind up the northern slopes of the valley up to approximately 9,000 feet.

These communities fall within the Carbondale & Rural Fire Protection District (CRFPD), which serves Carbondale, Redstone, and significant areas on Missouri Heights. The 320 square miles encompassed by the fire district also includes significant portions of undeveloped public lands. The district has relatively small commercial development areas, but is home to several historic sites and a number of television and radio transmission towers.

2.2 Climate

The UCRV climate is relatively moist with the majority of precipitation occurring with winter snows and much less precipitation in the form of summer monsoons (Table 1). Weather observations were taken from the nearest station located at a similar elevation, in similar terrain, and with over ten years of data (Redstone weather station). This station is located approximately 8 miles to the northeast of Marble at an elevation of approximately 7,000 ft. The area receives more than 180 days of sunshine per year and an average of 28.7 inches of annual precipitation of which almost 70% occurs in the form of snow. Winter high temperatures are typically in the mid low 20s (degree Fahrenheit [F]) and summer highs are in the low 70s. The low precipitation months are typically January, June and August. The south facing slopes above the Town of Marble receive more solar heating, and conditions are warmer and drier than in the valley bottom and on cooler and more mesic north facing slopes.

Table 1: Monthly Climate Summary for Upper Crystal River Valley (1979-1994)

	Month												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
Average Maximum Temperature (F)	33.1	36.2	42.7	51.1	60.5	71.8	76.4	74.6	67.0	55.3	39.2	31.5	***Avg. 53.3***
Average Total Precipitation (inches)	1.78	2.41	3.09	2.04	2.30	1.48	2.23	1.67	2.98	3.02	2.64	2.03	***Total 27.66***

Source: Western Regional Climate Center (http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?co6970)

Weather and fuel moisture inputs specifically required for fire behavior modeling were available from the McClure Pass remote access weather station (RAWS) dating back to 1990 (Table 2). This station is located six miles to the northwest of the town of Marble at 8980 feet and records weather data at 13:00 mountain standard time. Data from this station was used to define average (50th percentile) and severe (90th percentile) case scenarios for the peak of the fire season. Twenty foot wind speeds of 17 and 7 mph were used for the modeling of 90th and 50th percentile conditions respectively.

Table 2: Average and Severe Case Fire Weather and Fuel Moisture Conditions for June – August, McClure Pass, Colorado (1990-2009)

Percentile	Max Temp	1-Hour Fuel Moisture	10-Hour Fuel Moisture	100-Hour Fuel Moisture	Herbaceous Fuel Moisture	Woody Fuel Moisture
50th	72ºF	5%	7%	10%	30%	74%
90th	82ºF	3%	3%	6%	30%	69%

2.3 Topography

Topography and elevation play an important role in dictating existing vegetation, fuels, and wildland fire behavior. Topography also dictates community infrastructure design, further influencing overall hazard and risk factors. The elevation of the UCRV CWPP area ranges from 7,560 to 9,200 ft with most of the homes located around 8,200ft. The entire area is comprised of mountainous terrain with slopes ranging from 10% to over 50%. Most homes are in areas exposed to slopes of 20% or steeper. Defensible space zones need to be expanded to accommodate steep slopes. Most of the homes are located on south-facing slopes, with some homes located in the valley bottoms on more northerly aspects. More detailed descriptions of topography occur later in this document under representative neighborhood descriptions.

2.4 Historic Fire Occurrence

The greater Upper Crystal River Valley area lies within the Sopris Ranger District of the White River National Forest as well as within the jurisdiction of the CRFPD. Fire records from each jurisdiction were analyzed as available data allowed.

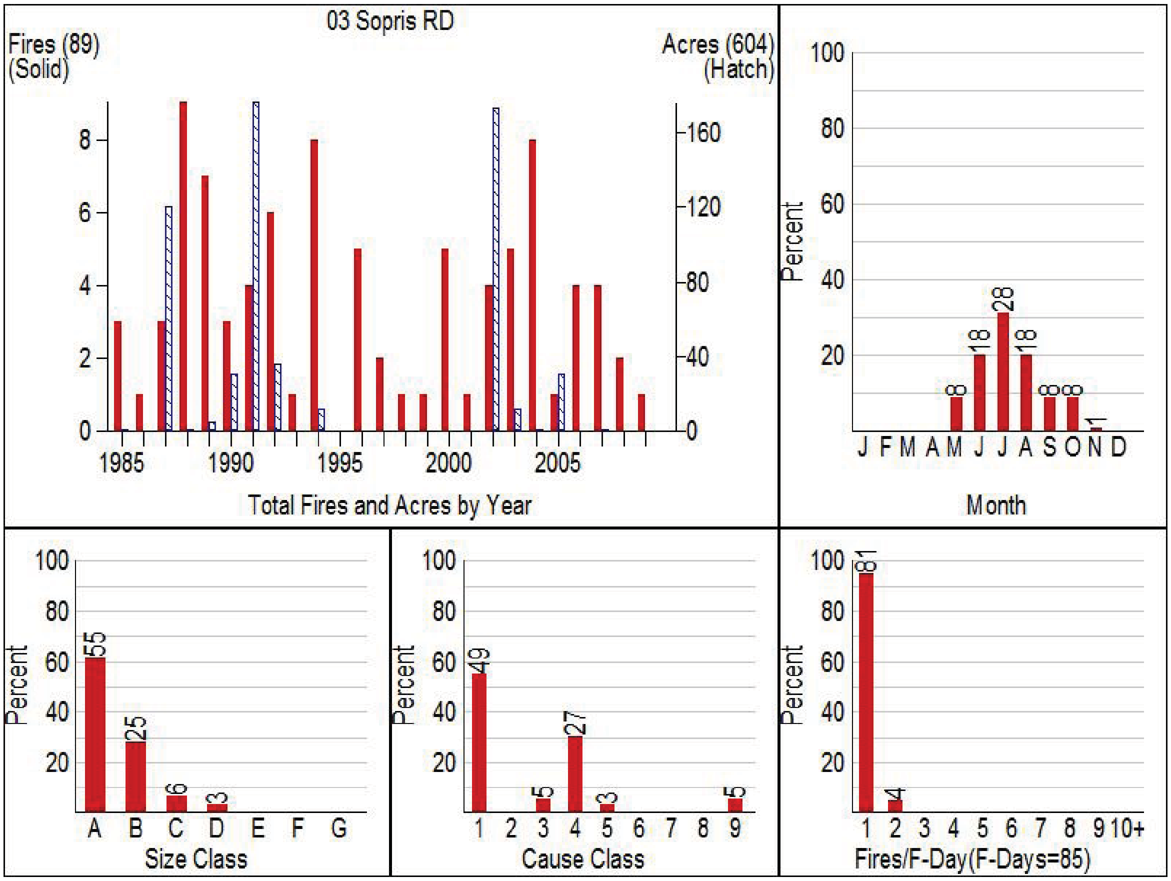
The 2.3 million acre White River National Forest has an active fire history. June through October are the most active months with lighting being the primary cause followed by campfires. The Sopris District reflects the forest wide trends. Of the 89 fires on the Sopris District since 1985, 90% occurred from June through October and 72% occurred in June through August. Lightning caused 54% of these fires, and 32% were caused by escaped campfires (**Figure 2**). Though none of these fires on the Sopris District exceeded 200 acres in size, the White River National Forest had several significant fires in 2002, including the 12,209 acre Coal Seam Fire; the 13,493 acre Spring Creek Fire; and the 17,056 acre Big Fish Fire (USDA 2007). Not included in the

Sopris Ranger District data are fires that occurred on private lands. Of note, the 2008 County Road 100 fire burned nearly 1,000 acres within the CRFPD.

The CRFPD responds to a wide array of emergency calls within its 348 square mile district. From 2002 through 2009 the CRFPD responded to an average of 20 wildland fires per annum, five times the annual average of the surrounding U.S. Forest Service District. This comprises 1.5% of their total calls and 29% of fire calls. It is worth noting that both the Coal Seam Fire and the tragic 2,115 acre South Canyon Fire of 1994 (not accounted for in the Sopris Ranger District statistics), which burned outside of the CRFPD, were responded to and staffed by Carbondale Fire through their mutual aid agreements.

While the UCRV portion of the Sopris Ranger District has not been subjected to large fires in recent history, severe fire years have produced large fires in other portions of the White River National Forest. Wildland fire is a significant concern for the CRFPD, and with approximately 1/3 of wildland fires in the Sopris District attributable to escaped campfires, public education and fire prevention need to be emphasized in throughout the local communities.

Figure 2: Fire History Data, Sopris Ranger District, 1985-2009



- Fire size class: A<1/4ac, B= 1/4 to 9 ac, C= 10 to 99 ac, D= 100 to 999 ac, E= 300 to 999 ac, F= 1000 to 4999 ac, G> 5000 ac
- Fire cause class: 1=lightning, 2= equipment, 3= smoking, 4= campfire, 5= debris burning, 6= railroad, 7= arson, 8= kids, 9= misc

2.5 Wildfire Preparedness

Initial response to all fire, medical, and associated emergencies within the UCRV is the responsibility of CRFPD through mobilization of resources from the Marble Fire Station and Redstone Fire Station. Wildland fire responsibilities of local fire departments, Gunnison County, the Colorado State Forest Service, U.S. Forest Service, Bureau of Land Management, and the U.S. Fish and Wildlife Service are described in the current Gunnison County Annual Operating Plan.

The CRFPD responds from five stations with a staff of 18 career and 65 volunteer personnel within its 320 square mile district. Six of its 18 pieces of apparatus are wildfire units. In the UCRV, the department staffs 2 stations located in downtown Marble, and just north of Redstone off of Highway 133.

The Marble station has the following apparatus:

1. 1993 Type 1 Engine. 750 gallon capacity, 1,100 GPM
2. 1967 Type 3 Wildland Engine. 1,000 gallon capacity
3. 2005 4x4 Rescue Squad vehicle (Ford Excursion)

Additionally, staff is currently trained (carded) to Firefighter 1 level, and up to eight (8) volunteer wildland firefighters are available from this station.

The Redstone Station 8200 has the following apparatus:

1. 1984 Type 1 Engine. 750 gallon capacity, 1,100 GPM
2. 1993 Type 3 Tender. 1,800 gallon capacity
3. 2005 Advanced Life Support Ambulance

Additionally, staff is currently trained (carded) to Firefighter 1 level, and up to six (6) volunteer wildland firefighters are available from this station.

In an effort to prepare for wildland fires, the CRFPD has conducted wildfire risk/hazard assessments throughout the UCRV, and is finalizing a CWPP for the larger Missouri Heights area. Within Pitkin County, all new development or redevelopment requires a Wildfire Hazard Review, and recommendations for defensible space must be implemented per the Land Use Code. The CRFPD has a staffed fuels coordinator, who assists in inspections and implementation of Firewise standards. The CRFPD Fire Marshal assists in enforcing County and municipal codes.

Water supply is provided via a system of 13 fire hydrants throughout the Town of Marble. The Hermits Hideaway neighborhood has a dry hydrant that taps into Island Lake (over 100,000 gallons). Chair Mountain Ranch at the northern portion of the planning area has a 5,000 gallon cistern. Marble Mountain Ranch has a dry hydrant that taps into a 600,000 gallon pond. Serpentine Trail and West 5th Street are without patent fire service water supplies.

2.6 Vegetation and Fuels

The vegetation found in the district is generally typical of the Rocky Mountain montane ecosystem on the western slope. However, some unique local conditions do exist. Vegetation and fuel types can vary dramatically over a short distance, and high variability is the rule rather than exception. Vegetation type and distribution is controlled primarily by available soil moisture, which is closely related to slope aspect. The steeper, more well-drained south-facing slopes in this area support varying densities of mixed mountain shrubs, including Gambel's oak (*Quercus gambelii*), Utah serviceberry (*Amelanchier utahensis*), chokecherry (*Padus virginiana*), snowberry (*Symphorocarpos rotundifolia*), and Saskatoon serviceberry (*Amelanchier alnifolia*), as well as various forbs and grasses. The fuel type for this system is SH5- Moderate Load Dry Climate Shrub (Scott and Burgan 2005).

On more shaley soils, Utah juniper (*Sabina osteosperma*) occurs as a co-dominant with Gambel's oak and serviceberry. Juniper can burn much more readily and hotter than other coniferous fuel types in the area. However, due to the shaley soils, the cover and connectivity of fine surface fuels is tempered by large patches of bare ground, which would likely slow fire spread. The fuel type for this system is still considered to be SH2.

In more mesic sites aspen stands occur. At lower elevations, the understory of aspen is dominated by a very dense layer of chokecherry and serviceberry. While this increases the shrubby fuels component in these aspen stands, it would not likely change fire risk in these stands except under the driest conditions. It would, however, make control or fire suppression in these aspen stands very difficult and time consuming. At higher elevations the shrubby understory falls out, and only grasses, forbs and widely scattered shrubs occur. In these aspen stands fire behavior is expected to be driven by fire fuels (grasses and forbs) and due to the mesic nature of these stands, would likely only burn under the driest conditions or during the fall months. The fuel model that fits best for these stands is TU2- Moderate Load Humid Climate Timber-Shrub.


Drier aspen stand with dense understory shrubs


More mesic stand with grass/forb understory

Within the Town of Marble, historic clearing has resulted in a very diverse coniferous forest type. Engelmann spruce, subalpine fir, ponderosa pine and Douglas-fir all occur mixed together in these stands. The only trend observed is that on drier sites, ponderosa pine can have more of a presence, and conversely in wetter draws Engelmann spruce and subalpine fir can become more dominant- however all species types are generally found throughout the area. Of concern in these stands is the very dense understory shrub layer, as well as the dead branches lower down on the trees. This has created a very robust ladder fuel situation, with high fuel connectivity in the understory and in the lower canopies. The fuel model for these stands is TU5- Very High Load, Dry Climate Timber-Shrub.

In the Hermits Hideaway and Chair Mountain Ranch subdivisions the riparian coniferous forest types dominate the fuels profiles. These stands are comprised mostly of Engelmann spruce, but also have blue spruce (*Picea pungens*) and narrowleaf cottonwood components. While these stands have strong ladder fuel components, their mesic and shaded conditions generally limit wildfire potential to the driest of years. Understory shrubs and 1000-hour fuels are moderately loaded in these stands, giving these stands characteristics similar to the TL3- Moderate Load Conifer Litter. These stands quickly give way to meadows at the western end of Hermits Hideaway. The fuel model for these fields is GR4- Moderate Load Dry Climate Grass (spread rates and flame lengths can be high to very high, but only when grass is cured).

2.7 Mountain Pine Beetle

The mountain pine beetle is native to western lodgepole pine and ponderosa pine forests. It often exists at endemic levels that produce isolated tree mortality, generally in weak or damaged trees. The insect has a one year life cycle that may extend to two years at high elevations. Female beetles initiate attacks on the potential host tree and emit pheromones that attract male beetles into a mass attack. If the adults successfully bore into the tree, they create egg galleries. The beetles' feeding and the introduction of blue stain fungi effectively girdle and kill the host tree (Costello and Howell 2007).

MPB outbreaks occur cyclically, impacting lodgepole pine forests approximately every fifteen to twenty years. Outbreaks may last five to ten years and can spread to ponderosa pine and other pine species. The grip of an epidemic can be broken by severe early (pre-October) or late (May) freezes, or prolonged periods of very cold (<-30° F) temperatures in the winter.

Various studies suggest different limits to MPB activity in lodgepole pine such as stands with basal areas below 100 sq. ft. per acre (McGregor et al. 1987), elevation over

10,000 feet, and stands where the average diameter at breast height (dbh) is <8 inches (Amman et al. 1977). The current epidemic in Colorado is challenging these preconceptions to the point that all lodgepole pine stands and many ponderosa pine stands may be imperiled (Costello and Howell 2007, J. Burke USFS pers. comm. 7/15/2009).

Aerial surveys of western Pitkin County and areas near Marble indicate the size of the MPB infestation increased 740% from 1999 to 2005, from 14,021 acres to 104,293 acres. Within the Marble area, lodgepole pine stands occur in relatively isolated areas, and are often co-dominated by other tress including Douglas-fir (*Pseudotsuga menzeisii*), Engelmann spruce (*Picea engelmannii*), aspen (*Populus tremuloides*) and subalpine fir (*Abies bicolor*). Because of this, mountain pine beetle activity can be locally detrimental to lodgepole pine and ponderosa pine, but the widespread stand mortality seen in other areas of Colorado is tempered by the fact that other trees species occur within the forest stands in the Marble area. J. Burke (USFS pers. comm. 7/15/2009) hypothesizes that MPB in Colorado can be broken down into roughly two infestation types- "source" stands and "sink" stands (or "victim" stands). Large contiguous stands of lodgepole pine can produce an overabundance of MPB, which have formed the huge epidemic populations seen in Grand, Summit and eastern Eagle County. This large population of beetles will then infest small and less suitable stands where the beetles will infest and kill suitable host trees, but as the "sink" stands do not have a propensity of suitable host trees, the MPB infestation will not produce an overabundance of beetles. Within the UCRV, most of the forest stands could be considered to be "sink" stands, however, the unfortunate effects are the same- all or most suitable host trees may succumb to MPB. At the time of this report, MPB is beginning to occur in the Marble area, however it is not known if this infestation is due to endemic population cycles, or if it is possible colonization from larger infestations in central Pitkin County.

Effects of MPB on Fuels

During the first year of a MPB attack, pine needles remain green. In year two, the needles turn yellow or red, eventually dropping off entirely in year three or four. Beginning about five years post mortem, the dead stems become increasingly susceptible to rot and blow-down. The post epidemic fuel profile will depend on a number of variables including the number of years post mortem, the composition of the forest understory, and subsequent disturbances. The further out from the initial epidemic, the more difficult it becomes to predict the fuel model as more variables are introduced.

Surface Fire Behavior Fuel Models (FBFM) are projected for the relatively short time frame of 10 to 20 years to help provide an understanding of the post epidemic fuel hazard. There is no doubt that an MPB epidemic will greatly increase the amount of dead biomass in lodgepole forests, but predictions that this translates into an immediately drastic increase in the fire hazard is an oversimplification. The cycle is nuanced and complex, and a variety of fuel profiles and fire concerns will emerge.

Development of understory fuel loading (TL5) in lodgepole pine stands

The expected changes in fuels are discussed here in terms of the standard generalized fuel models. In general terms, TU1 (low load timber understory) can be expected to transition into TL5 (high load conifer litter) as dead fall begins to accumulate approximately 10 years post mortem. The fine and course fuel loads increase, but regeneration is slow in establishing itself.

TU5 (very high load, timber and shrub) will experience a release of the existing understory, increase regeneration, and increased dead fuel loads. This may continue to be modeled as TU5 (Green 2007), though it may be more instructive to increase the dead fuel loads to levels similar to those found in SB2 (moderate load activity fuel or low load blowdown). To illustrate this condition, fire behavior runs were made with a TU5 "heavy load" with dead fuel loads increased by 0.25, 0.5, and 1 ton per acre for 1 hour, 10 hour, and 100 hour fuel size classes respectively. As the volume of large down logs increases over time, there may be areas better represented by TL7 (large down logs).

A beetle-killed overstory with a TU5 fuel load comprised of pine and spruce regeneration

Page and Jenkins (2007) developed custom fuel models from field measurements in several Utah stands. When comparing fire behavior predictions between standard models and their own, they found that TL5 generally approximated recently impacted stands while stands were well represented by TL7 approximately 20 years after mortality. Some areas can also be expected to move through a period where grass, seedlings, and shrubs are the dominant surface fuels. This may be especially true in project areas where logs are removed.

Projected post-epidemic FBFMs.

Forest Type	Pre-Epidemic Fuel Model	Potential Fuel Models Approximately 10 to 20 Years Post Mortem
Densely stocked ponderosa pine with grass/low shrub understory	TU1- Low Load Timber Understory	TL5- High Load Conifer Litter TL7- Large Down Logs
Pine (lodgepole or ponderosa) with Mixed Conifer or Heavy Understory Load	TU5- Very High Load, Timber and Shrubs	TU5- Very High Load, Timber and Shrubs or heavier

Effects of MPB on Potential Fire Behavior

There have been many public statements about the expected impacts of the MPB epidemic on fire behavior, but foresters and fire scientists are still trying to develop an understanding of the situation (Page and Jenkins 2007). There are many variables to consider in these diverse and constantly changing stands. It is generally understood that the amount of dead fuels is going to dramatically increase over the next 10 to 20 years and that new vegetation will grow up where the pine stands once were.

Crown bulk density and wind adjustment factors were set to reflect canopy mortality and diminished sheltering as dead trees fall. While foliar moisture content is typically held constant at 100% for modeling purposes, the runs for MPB impacted TU1 and TU5 were made with a foliar moisture content of 30% to reflect tree crowns with dead needles (Page and Jenkins 2007).

BehavePlus Predictions of Fire Behavior

The following table shows results from BehavePlus modeling of fire behavior on 20 Percent Slope for Average and Severe Climatic Conditions in Post-Epidemic Stands. Fire behavior outputs for post MPB epidemic stands with "red needles" are shown in orange cells for comparison. After MPB have killed off the pine components of TU1 and TU5, and these stands begin to establish understory coniferous seedlings and saplings (within 10 years or so), these stands will transition to the post-epidemic TL5 and TU5 "heavy load" models respectively (shown in green cells). After 20 years post-MPB epidemic, we used the TL7 model to illustrate fire behavior with significant deadfall components in the fuels profile.

Fire Behavior Fuel Model	Description	Surface Fire Intensity Required for Torching Btu/ft/sec	Rate of Spread (chains/hr)		Flame Length (feet)		Torching		Able to Support Active Crown Fire	
			Avg	Severe	Avg	Severe	Avg	Severe	Avg	Severe
TU1	Low Load Timber Understory	23	1.8	4.5	1.1	2.5	No	No	No	Yes
TU1 red needles	Moderate Load Conifer Litter: red needled	6	1.8	4.5	1.1	2.5	No	No	No	Yes
TU5 2.5 ft. cbh	Very High Load Timber-Shrub	32	5.4	20.1	5.8	11.2	Yes	Yes	No	Yes
TU5 red needles	Very High Load Timber-Shrub: red needled	8	5.4	20.1	5.8	11.2	Yes	Yes	No	Yes
TU5 green needles	Very High Load Timber-Shrub: heavy load	23	6.4	24.6	6.2	12.2	Yes	Yes	No	Yes
TL5	High Load Conifer Litter	23	3.6	15.4	1.9	4.0	Yes	Yes	No	No
TL7	Large Downed Logs	23	2.9	10.3	2.0	3.9	Yes	Yes	No	No

- Average conditions based on 50th percentile weather and 9 mph 20 ft windspeed
- Severe conditions based on 90th percentile weather and 25 mph 20 ft windspeed

The fire behavior predictions illustrate several important points about the impacts of an MPB epidemic. Torching is dependent upon the proximity of flames to low branches (i.e. fireline intensity vs. cbh). While lowering foliar fuel moisture to simulate dead needles does lower the fire intensity required to ignite tree crowns, there does not appear to be an increase in crown fire activity given the environmental parameters modeled for TU1 and TU5. After MPB killed stands grow seedlings and saplings in the understory (about 10-years post-mortem), flame lengths and rates of spread increase expectedly. Due to the low crown heights in young trees, the potential for torching of the emerging post-epidemic trees is high, but the absence of a contiguous overstory diminishes the threat of active crown fire. As the stands reach maturity over the period of several decades, the crown fire hazard will reemerge with the new overstory.

The modeled fire behavior illustrates the following expectations:

- These runs did not capture an increase in predicted crown fire behavior as a result of dead needles; however the surface fire intensity required for transition to crown fire under red needle conditions is significantly lower.
- Increased dead fuel loads and the release of understory vegetation will support higher rates of spread and higher flame lengths than pre-epidemic conditions.
- Needle loss and tree mortality eventually eliminate canopy continuity, resulting in reduced crown fire activity until a new forest is established.

- The MPB epidemic will produce a pronounced cycle of change in the fuel bed over the next several decades, which will be reflected in the nuanced and shifting nature of the fire hazard.

The drier canopy conditions produced by dead crowns require less fire intensity to propagate combustion. Situations where a low surface fuel load and high canopy base height prevent torching of a live canopy may not be dramatically changed by the presence of a dead canopy. Likewise, where a live canopy was not dense or contiguous enough to support crown fire, the death of the canopy may not significantly alter fire behavior. But, as previously noted, these modeled conditions represent points along a spectrum of conditions. It can be expected that a dead canopy will drive the threshold for crown fire activity down in most situations, with subsequently faster rates of spread, much longer spotting distances, and more receptive fuels for spotting (i.e. dead crowns).

In summary, red needled canopies are more prone to crown fire, though crown fire will not be supported in all situations. The change in potential fire behavior precipitated by an MPB epidemic will be more nuanced than simply a dramatic increase in fire hazard. Because many of the pine stands in Gunnison County around Marble are codominants with spruce/fir and Douglas-fir trees, support or enhancement of crown fire activity may occur under normal or dry times of the year, but during wetter periods of the year, or during wet years (when live fuel moistures are elevated), the presence of the dead pine canopy intertwined with live spruce/fir canopies may support more torching or pockets of crown fire activity, but running crown fire behavior would not likely be supported. Once dead needles fall to the forest floor, the aerial fuels required to carry running crown fires will be significantly reduced and in some cases eliminated, even with the comingled spruce/fir canopies. This will be accompanied by an increase in dead surface fuels as needles and branches accumulate on the ground. The open canopy conditions will subsequently allow the release of brush, grass, and seedlings, creating potential for more intense and severe surface fire under dry conditions. As snags fall to the ground, surface fires will become more severe (longer production of higher heat), though these heavy fuels may not dramatically increase rate of spread or flame length. Higher fuel loading on the surface and the presence of larger fuels (downed logs) will make suppression and fire control more difficult and time consuming. The ability for fire crews to rapidly contain and control surface fires will be reduced, and increased snags and subsequent torching of snags will make suppression and initial attack efforts very time consuming, difficult and dangerous. Spotting distances will also likely increase due to the presence of receptive fuels (including increased grass and forb cover as well as snags and downed logs).

3 WILDFIRE HAZARD AND RISK ASSESSMENT

3.1 Fuel Models

Existing vegetation is the fuel source for wildland fire and has a direct effect on fire behavior. Vegetation types were analyzed in the field and using remote sensing in order to classify them in terms of fuel models. During two days of field assessment, each dominant vegetation type was examined and analyzed for canopy characteristics, surface fuel conditions and was documented with photographs. This data was used to determine which fire behavior fuel models ("FBFMs") best represent the conditions for each fuel type found on site. Overall, the most suitable fuel models were found in the Standard Fire Behavior Fuel Models developed by Scott and Burgan (2005).

3.1.1 Moderate Load, Dry Climate Grass GR4

This fuel type was found in meadows northwest of Hermits Hideaway, and occurred sporadically on the west side of Town, and on ski runs at the old Marble Ski Area. The fuel type will likely only carry fire when it is cured in the fall, or possibly in the spring prior to green-up. During drought events this fuel type may carry fire, but fire suppression and control should be relatively easy. In the fall after grasses have cured, flame lengths can be very high under even moderate wind speeds. Flame lengths from 6 to over 15 feet can be expected under 10 mph winds when grasses have cured.

3.1.2 High Load, Dry Climate Shrub SH5

Fire in Gambel's Oak brush is a major concern in the CRFPD, and much of the Serpentine Trail and Marble Mountain Ranch are dominated by this fuel type. Modeled as FBFM SH5, "high load, dry climate shrub," these dense brush stands can generate flame lengths of over 20 feet and rapid rates of spread. Under severe conditions, fire suppression is very difficult. The oak brush stands in this area can exceed 10 feet in height and have a high load of dead limbs.

These fuels do have natural patchiness due to changes in soil types, incorporation of aspen stands and other shrub types. Nevertheless, mitigation treatments of this combustible fuel type may be warranted in many cases. This fuel type often occurs on steep slopes, making fire suppression extremely difficult and hazardous.

3.1.3 Moderate Load Humid Climate Timber Shrub TU2

The upper elevations around Marble are dominated by aspen stands which exist in a wide array of age classes and conditions. The predominant surface fuels are composed of perennial grasses, forbs, shrubs, and aspen suckers. Understory shrub species include snowberry, chokecherry, serviceberry, Utah juniper, Rocky Mountain juniper, and common juniper. Subalpine fir and Engelmann spruce can be found in both the overstory and understory in widely scattered areas.

Fire is the most important disturbance agent for aspen in Colorado, but aspen stands are generally considered somewhat fire resistant (Romme 2003). The succulent forbs and perennial grass do not support intense fire for much of the fire season, and the high, thin canopy tends to resist crown fire initiation and spread. Fire return intervals for Colorado aspen are believed to be approximately 140 years, but stand health may tend to decline after about 80 years without disturbance (Romme 2005). Fire exclusion may result in the decadence and decline of an aspen stand or conifer encroachment. Both cases jeopardize stand survival and create conditions prone to higher intensity fires.

The aspen stands for this area generally fall under FBFM TU2, "moderate load humid climate timber shrub" due to the dense deciduous shrub understory. Predicted fire behavior approaches 6 feet in severe climatic conditions, and rate of spread is moderate at 40 chains/hour (or 44 feet/minute) but this likely over predicts the rate of spread except under the most severe of conditions. As modeled, the

likelihood of a surface fire transitioning into a crown fire is extremely unlikely.

Though fire in aspen tends to be low intensity with low spread-rates, conifer encroachment, buildup of deadfall, or a dense shrub understory can support problematic fire behavior under dry conditions. Some local aspen stands are beginning to transition into this FBFM TU5, "very high load, dry climate timber-shrub". This fuel model is discussed in detail later, but this fuel profile must be altered/mitigated when it occurs in proximity to structures. Higher elevation aspen stands have more of a grass/forb understory and TU2 will over predict fire behavior in these more mesic aspen types.

3.1.4 Very High Load Dry Climate Timber Shrub TU5

The mixed conifer stands within the Town support Engelmann spruce, Douglas-fir, ponderosa pine, subalpine-fir and Utah juniper in a very unique arrangement. The low branches in these stands allow for the initiation of crown fire which is readily propagated through the dense canopy under the right conditions. FBFM TU5, "high load, dry climate timber-shrub," is used to represent these stands.

Though fires are infrequent in these stands, they have the potential to be high intensity crown fires. Many homes and structures exist within this fuel type and this fuel type covers approximately half of Marble. These stands are close enough to structures to warrant specific mitigation efforts.

3.1.5 Moderate Load Conifer Litter TL3

Within the Engelmann spruce/subalpine-fir stands along the riparian areas, these fuel types occur in moist areas. While the high moistures of these stand type generally limit wildfire potential, the low, sweeping branches can encourage torching of individual or small clumps of trees. Aside from under the driest of conditions, these stands are not expected to support difficult suppression scenarios.

3.2 Results of Modeling

A slope of 30% was used for all modeling, this being the more negative average situation in proximity to the existing home sites. For the purpose of modeling potential transition to crown fire, foliar moistures were set to 130% (average) and 100% (severe) per current standard practice (Scott and Reinhardt 2001). Based on field observations, a canopy base height of 3 feet was used for FBFM TU5 and TL3, and 20 feet was used for FBFM TU1. Weather and fuel moisture conditions were obtained from the McClure Pass RAWS as detailed in section 2.2. Hazard ranking was then based on the modeled flame length, rate of spread, potential for crown fire, and resistance to control.

Table 3: Fuel Models and Fire Behavior

Fuel Model	Vegetation Type	Surface Fire Flame Length		Rate of Spread (ft/min)		Transition to Crown Fire	
		Avg.	*Severe*	*Avg.*	*Severe*	*Avg.*	*Severe*
GR4- moderate load dry climate grass	meadows	8	15	62	220	NA	NA
SH5- high load, dry climate shrub	Mixed mountain shrub	12	21	44	127	Yes	Yes
TU2- moderate load, humid climate timber shrub	Aspen stands	3	6	9	28	No	No
TU5- high load, dry climate timber-shrub	mixed conifer	7	11	8	20	Yes	Yes
TL3- moderate load conifer litter	Mesic spruce/fir stands	1	2	1	4	No	No

In order to quantify the risks of wildfire, the potential hazards presented by fuels and topography, and the values at risk from wildfire, we used GIS models to predict wildfire danger within the UCRV planning area.

Values (**Figure 3: Values at Risk**) show areas of high human habitation, where impacts from wildfire would be greatest. Risk mapping (see **Figure 4: Risk Ratings**) shows areas of high lightning strike densities (from 1999-2009 datasets) and areas along roads and near homes (where ignitions are more likely to occur) which illustrate areas where wildfire ignitions are more likely to occur. For these Risk areas, we assigned a weighted ranking system where areas with higher lightning strikes, roads and homes have a higher "risk" of igniting a wildfire.

We then took satellite imagery with a 15m resolution which was used in concert with on-the-ground mapping to develop **Figure 5: Hazard Ratings**. Each fuel type was categorized and ranked according to its predicted hazard (see **3.2 Results of Modeling** above). The slope layer was created by utilizing USGS topographical data and creating slope categories. The slope category was added to the fuel ranking to arrive at a hazard rating, which was categorized using statistically natural breaks.

The hazard map illustrates that the majority of homesites on hillsides around Marble are located in areas of relatively steep terrain with moderate to high hazard fuels in this area. We then combined the GIS layers of Hazard, Risk, and Value to create the predictive model used in **Figure 6: Wildfire Danger Rating**, which shows a graduated scale of wildfire danger classes in the area.

Based on these GIS modeling results, and on-the-ground surveys (CRFPD 2009), each neighborhood was assigned a Community Risk/Hazard Rating (**Table 4**, below).

Table 4: Neighborhood Wildfire Risk and Hazard Rating

Neighborhood	Community Risk/Hazard Rating	Fuel Hazard Rating	Factors
Chair Mountain Ranch	Moderate	Moderate	- Most homes are in relatively level areas, in aspen stands, but some homes back up to high hazard areas. - Multiple access routes, large meadow
Hermits Hideaway	Moderate/High	Moderate/Low	- Relatively flat topography - Very wet site - Large meadows nearby - Primary access limited to one older bridge
Serpentine Trail	High	High	- Slopes approaching 50% in some areas - Areas of heavy fuels - Very narrow, winding road with limited turnouts - No safety zones
West 5th Street	Moderate/High	Moderate	- Very narrow, winding road - Mixed fuel profiles - Dominated by aspen stands - Main access point is poorly signed, very narrow road with heavy fuel loading- a "pinch point" - Only one access road
Town of Marble	Moderate	Moderate/High	- Good access/egress - Dense, overgrown vegetation under many ownerships - High ladder fuel concentrations - Many residents and a school
Marble Mountain Ranch	High	High, Moderate & Low	- One main access road - Heavy fuel loading in some areas, but outcrops of shale intermittently break-up fuel profiles - Large meadows and aspen stands at higher elevations

Figure 3: Value Ratings

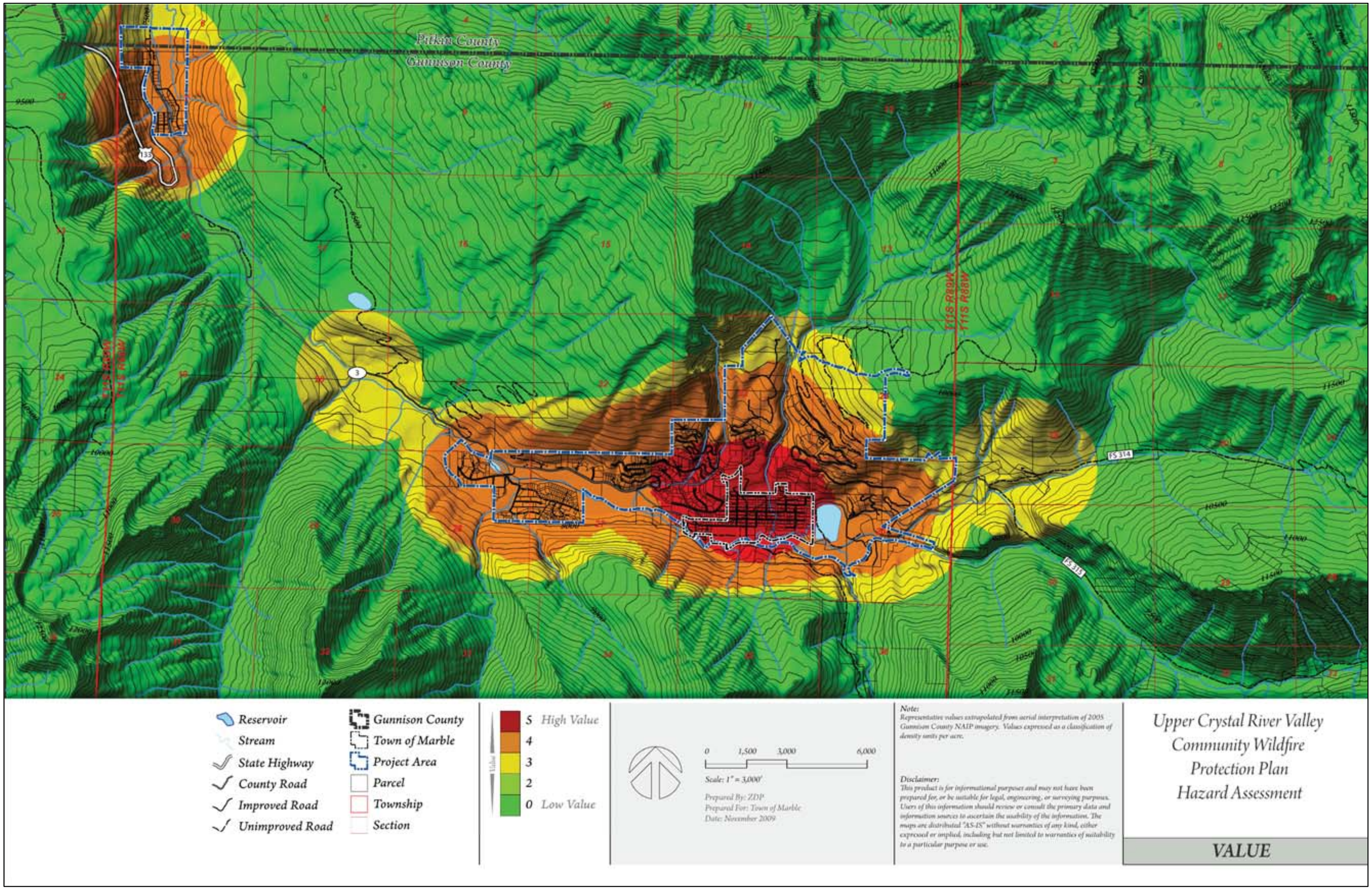


Figure 4: Risk Ratings

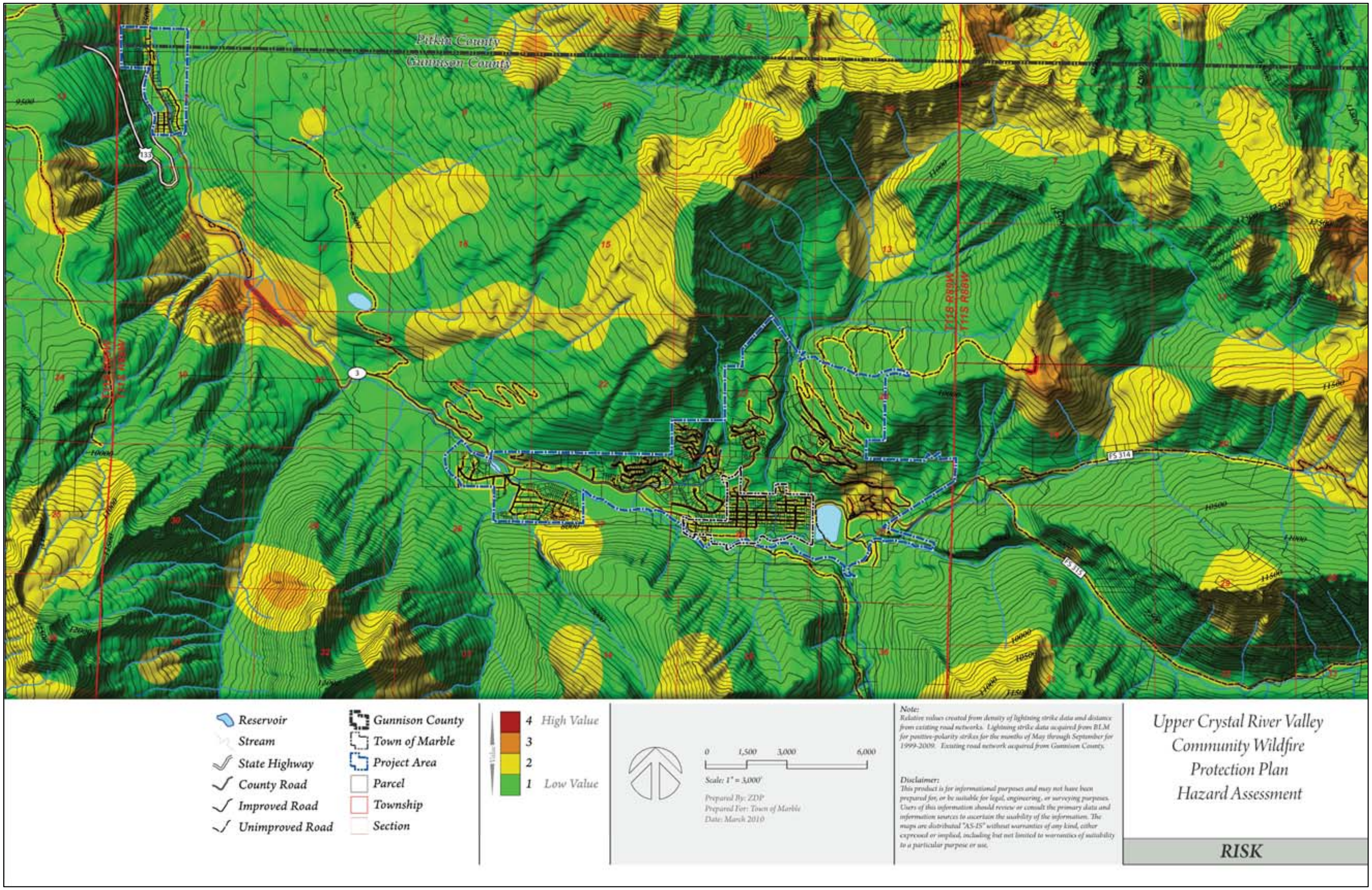


Figure 5: Hazard Ratings- Modeled Results

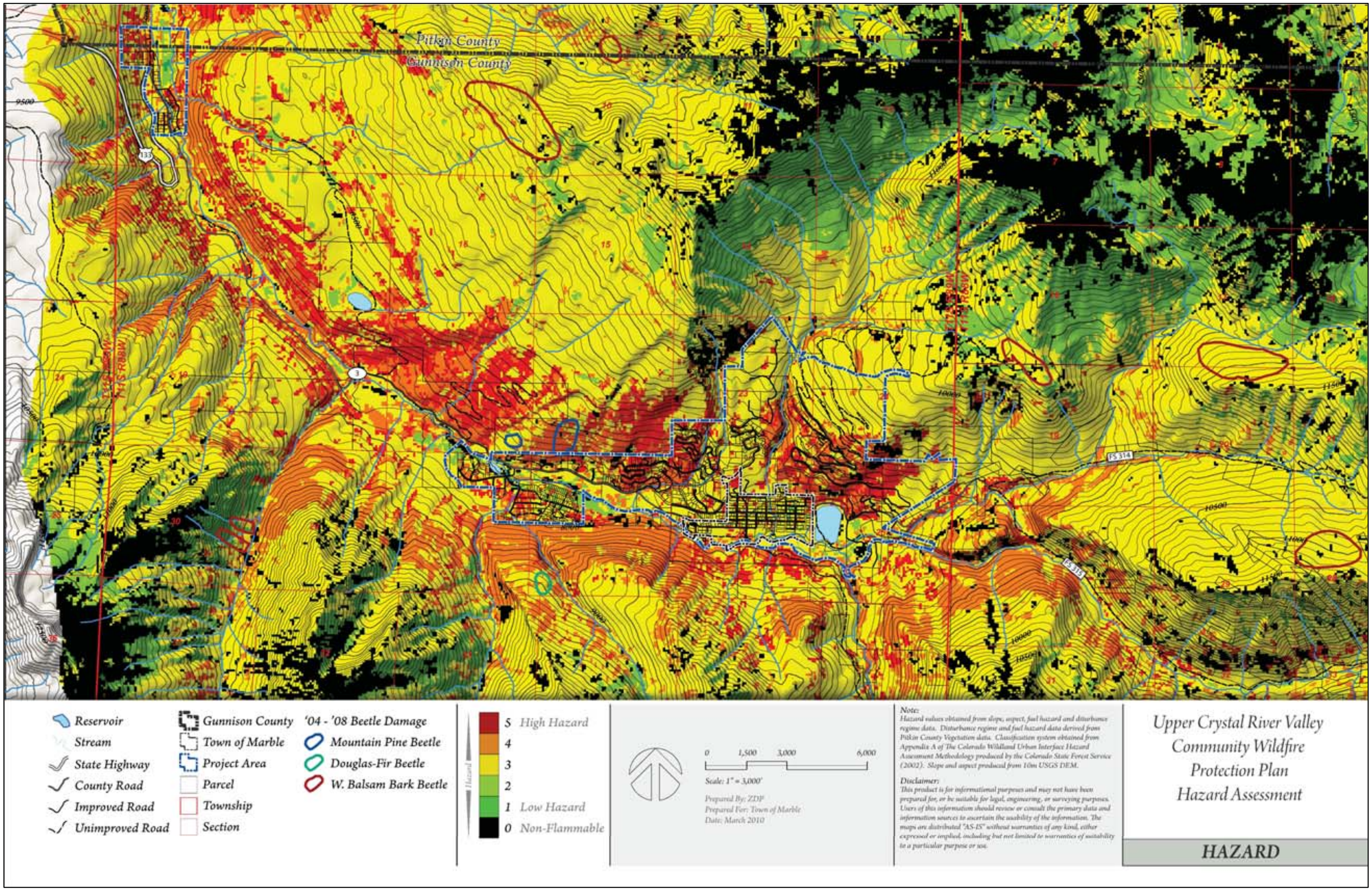
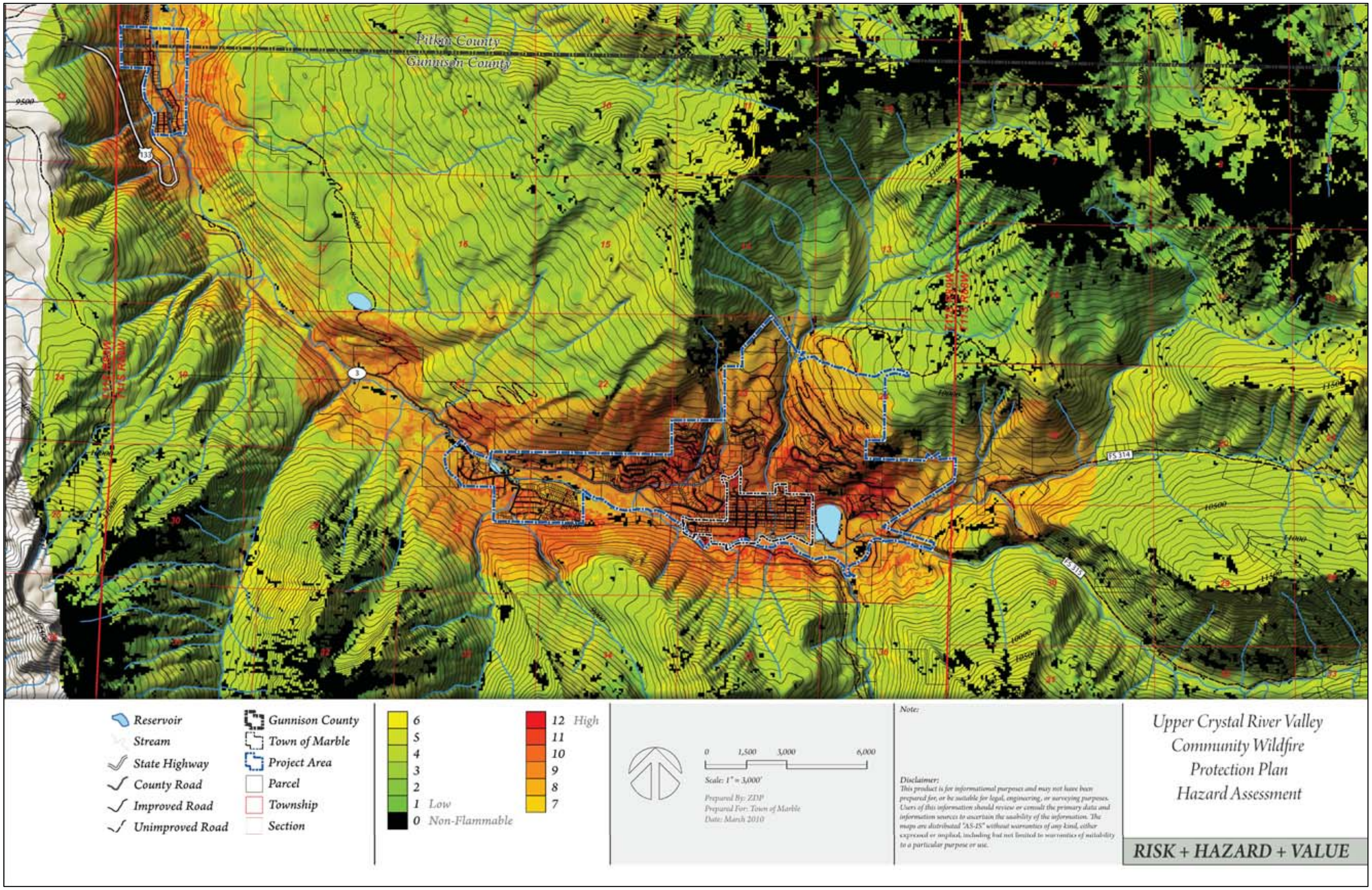


Figure 6: Wildfire Danger Rating Map



4 HAZARD MITIGATION AND PREPAREDNESS RECOMMENDATIONS

Approach to Mitigation Planning and Preparedness

Wildfire mitigation can be defined as those actions taken to reduce the likelihood of loss due to wildfire. Effective wildfire mitigation can be accomplished through a variety of methods including reducing hazardous fuels, managing vegetation, creating defensible space around individual homes and subdivisions, and utilizing fire-resistant building materials. Preparedness actions seek to reduce the loss to wildfire through enhancing response capabilities. This may include upgrading current infrastructure such as water supply and road access, improving a fire department's training and apparatus, and developing programs that foster community awareness and neighborhood activism. Once implemented, these actions will significantly reduce the risk of loss due to wildfire to individual homes, and on a larger implementation scale, for an entire community.

Specific mitigation treatment recommendations for the UCRV were identified through detailed community wildfire hazard assessment surveys that evaluated parameters such as vegetation and hazardous fuels, predicted fire behavior, physical infrastructure, emergency response resources, home flammability, and defensible space characteristics around structures (see **Figure 7: Mitigation Areas** below). All recommendations are to be reviewed by the CRFPD, County emergency response management, affected public land management agencies, and interested community stakeholders. Project prioritization is based on input from these entities, practicality of rapid implementation, and impact to community wildfire hazard and risk reduction.

4.1 Recommended Actions

Action items include specific fuel reduction recommendations such as fuelbreaks along primary and secondary access roads, forest management programs, defensible space around structures and infrastructure, and homeowner assistance to reduce the combustibility of individual homes. Other recommended projects may address infrastructure characteristics such as community access, signage, evacuation routing, and water resources. Recommended actions are divided into the following categories.

<u>Public Education and Outreach</u>: The most effective means to initiate local action is through community education and public outreach. The purpose of a district-wide education program is as follows:

- Identify and clarify wildfire hazards and risks. This could include educating the public on how to report a wildfire properly
- Introduce the benefits of defensible space and Firewise construction principals

- Urge homeowners to take action on their own property and influence neighbors, friends, and HOAs
- Initiate creation of oversight group to drive CWPP implementation and grant application
- Increase awareness of current forest conditions and how hands-on management practices can help restore forest health and reduce wildfire risk

Defensible Space: The creation of defensible space around structures is one of the most effective mitigation measures that can be taken. This effort is inextricably linked to public education and outreach and can be incorporated into local building codes.

- Incorporate with public education and building codes as appropriate
- Use the protection of public facilities and infrastructure as a starting point
- Seek grant funding and promote neighborhood coordination to assist with biomass and slash disposal
- Encourage residents to seek home owner assistance from Colorado State Forest Service

Evacuation and Notification:

- Coordinate a reverse 911 system that is tied into both Pitkin County and Gunnison County's Emergency Management departments
- Widening of the road in certain areas for turn-outs
- Roadside thinning
- Extensive public education & signage
- Designation of potential safety zones where evacuation may be difficult (Please note that the efficacy of a "safety zone" is contingent on many variables and cannot be guaranteed. This should not preclude the designation or improvement of logical potential safety zones as an option of last resort)

Access and Egress: Closely associated with the ability to effectively evacuate the populous, is the need to provide access and patent egress for emergency responders. Many of these action items overlap.

- Widening of the road in certain areas for turn-outs or turn-arounds
- Roadside thinning
- Bridge load limit assessments and posting
- Road signage

Infrastructure Protection: Fuels mitigation efforts should focus around protecting infrastructure. This will reduce wildfire risks while protecting resources critical for fire suppression operations and recovery. These actions can also be utilized as demonstration projects for public education. This includes:

- Thinning and hazard tree removal near powerlines

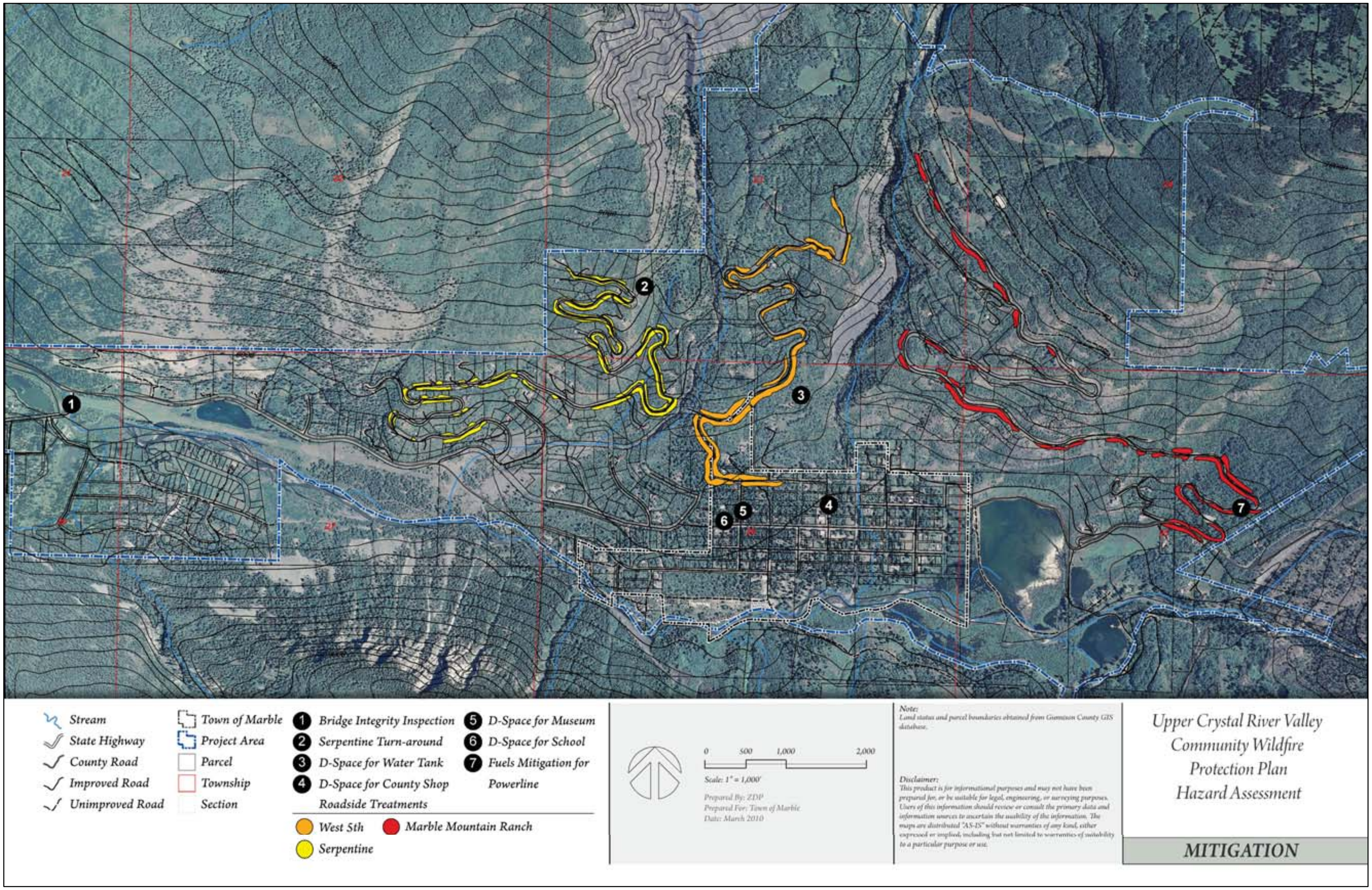
- Defensible space and fuel reduction around water tanks, water treatment facilities, and Town & County facilities
    - Road and Bridge shop
- Protection of bridges
- Historical structures
- Water supply systems should be maintained and improvements should be considered in some areas

Building Code Modification: A review and strengthening of the building code would help incorporation of defensible space creation into construction and remodeling efforts, reducing the hazard to firefighters and first responders, as well as residents. This should include building materials, access/egress, and fuels reduction around homes as dictated by slope and fuel continuity. Ensuring a timely completion of building projects will also reduce the ignition risks and vulnerability of structures to fire.

Table 5: Prioritized Action Plan

Priority	Action	Category	Target Area	Responsible Entity
Near Term	Create defensible space around public facilities and use as demonstration projects.	Infrastructure Protection Public Education	Town of Marble	CRFPD/ Town of Marble/ Utilities
Near Term	Reverse 911 coordination	Evacuation	All	GunnCo
Near Term	Bridge Assessments	Access and Egress Infrastructure Protection	Hermits Hideaway Chair Mountain Ranch	GunnCo
Mid Term	Road Signage			GunnCo
Mid Term	Evacuation Plans	Evacuation	All, special emphasis on Serpentine Trail	CRFPD/GunnCo
Mid Term	Safety Zones	Evacuation	Hermits Hideaway Marble Mountain Ranch	CRFPD
Mid Term	Defensible Space	Defensible Space Public Education Infrastructure Protection	All	CRPFD/GunnCo/BLM
Long Term	Fuels treatment near power lines	Infrastructure Protection	Town of Marble Marble Mountain Ranch	CRFPD/Holy Cross Electric
Long Term	Roadside thinning	Evacuation Access and Egress	Serpentine Trail West 5th Street Marble Mountain Ranch	CRFPD/GunnCo
Long Term	Incorporate defensible space and reduce construction through the building code	Building Code Modification	All	CRFPD/ GunnCo
Long Term	Cistern installation study	Infrastructure Protection	West 5th Street	CRFPD/Town of Marble
Long Term	Road widening/turnouts	Evacuation Access and Egress	West 5th Street Serpentine Trail	CRFPD/Ton of Marble

Figure 7: Mitigation Areas



4.2 Neighborhood Descriptions & Mitigation Recommendations

4.2.1 Chair Mountain Ranch

The Chair Mountain Ranch subdivision is located at the eastern base of McClure Pass, approximately 5.7 miles from the Marble Fire Station (#3), and 5.9 miles from the Redstone Fire Station. Access is good, with multiple access/egress routes. Approximately 40 single family homes are located in this area. The topography in this area is relatively flat to moderately sloping where homes are located, but the greater area is characterized by steep slopes to the west and east of the subdivision, and the deeply scoured Crystal River bisecting the area. Fuels are highly varied in the subdivision, including mixed conifer fuels, xeric aspen stands (with strong understory shrub components), and meadows. Most of the homes are located in shrubby aspen stands. Hazard ratings in Chair Mountain Ranch are dominated by Moderate conditions, with some individual lots having High and Low Hazard ratings:

Mitigation Recommendations

1. Encourage defensible space thinning around homes
2. Seek funding for road signage
3. CRFPD/GunnCo to coordinate implementation

4.2.2 Hermits Hideaway

Hermits Hideaway is located approximately 1.75 miles west of the Marble Fire Station on the south side of the Crystal River. Approximately 35 single family homes are within this subdivision. Roads within the subdivision are a bit narrow, but given the presence of multiple turn-outs and road junctions, accessibility throughout the subdivision is considered to be acceptable. A dry hydrant is readily available on the west side of the bridge.

Within the subdivision, fuels are dominated by mesic mixed-conifer stands. While during most years this fuel type would only experience a slow, creeping understory fire, individual trees and clumps of trees may support torching due to significant ladder fuels. Hazard ratings in the subdivision would be Low to Moderate, but the single access/egress point over the bridge brings the rating to Moderate/High.

Mitigation Recommendations

1. Encourage defensible space thinning around homes.
2. Have bridge inspected & posted with weight rating to ensure that it can handle the weight of fire suppression equipment.
3. Post bridge load limit.
4. Establish a community safety zone as a contingency in case of a bridge obstruction during evacuation.
5. CRFPD/GunnCo to coordinate implementation

4.2.3 Serpentine Trail

Serpentine Trail provides access to approximately 42 homes on the west side of Slate Creek. The bottom of Serpentine Trail is only 0.87 miles from the Marble Fire Station, but Serpentine Trail is a total of 2.8 miles long to the last house. It is very narrow with many switchbacks and few turnouts. The top of Serpentine Trail is essentially a dead-end, with an extremely difficult turn around (any fire truck larger than a Type 6 would have significant difficulties turning around).

This neighborhood is dominated by very steep slopes, exceeding 40% in many areas. Fuels are predominately mixed shrublands with dense stands of Gambel's oak, serviceberry and chokecherry. A few xeric aspen stands occur. A few natural fuel breaks exist, including grassy fuels and shale outcrops that break up the fuels continuity. Due to steep slopes and continuous fuels profile, the majority of this neighborhood is considered High Hazard. A few homes lower down on the hill slopes may be considered to be in Moderate Hazard area due to grassy fuel profiles.

Unfortunately, this area exhibits very concerning life safety issues for residents and fire fighters in the event of a wildfire. Fires would easily be able to jump roads, and few homes have defensible space, and no safety zones exist in the neighborhood. Therefore in the event of a wildfire in the Serpentine Trail area, there is a strong likelihood that residents may be caught in their homes, or on the road, and traffic jams may cause residents and responding fire fighters to be forced into a burn-over situation.

The human-caused ignition risk factors are prevalent in this area.

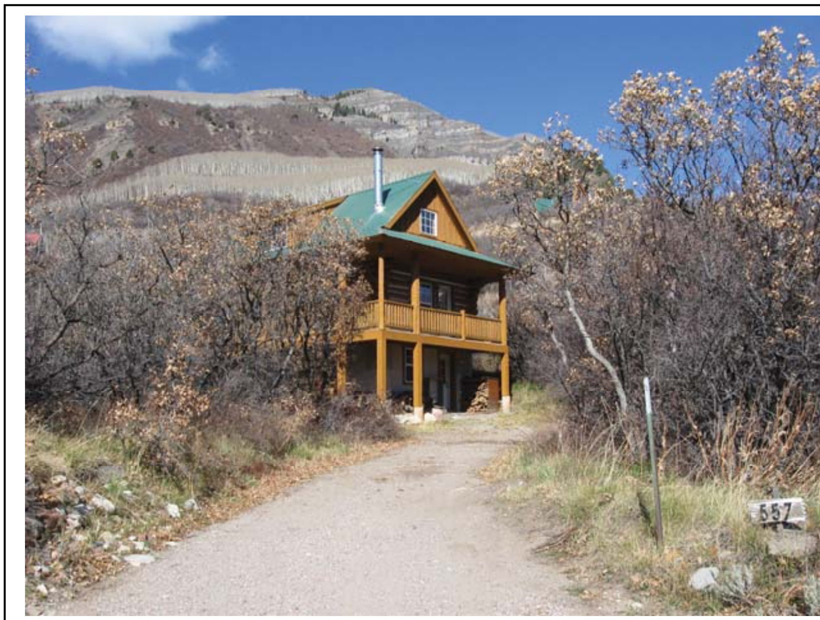
Narrow roads with marginal turn-around and pullouts, and continuous fuels typify Serpentine Trail

Many of the homes are in various states of construction and remodel, which have proven to be problematic for starting wildfires. The position of the subdivision topographically makes lightning-caused fires relatively unlikely. Slate Creek at the base of Serpentine Trail is a wide and spreading flood plane dominated by gravels and mud-flows. The Slate Creek floodplain would work well as a staging/safety zone, if residents can evacuate Serpentine Trail safely.

Mitigation Recommendations-

1. Encourage defensible space thinning around homes and provide defensible space standards for residents to implement appropriate for the hazards on Serpentine Trail. Approximately 12.2 acres has been delineated for treatment in **Figure 7**. Consider a subsidized slash-disposal program.
2. Prepare an evacuation plan handout for residents detailing procedures for leaving the hillside, and appropriate places to let emergency traffic pass.
3. Seek funding for roadside thinning projects by working with Colorado State Forest Service.
4. If possible, construct turn outs on Serpentine Trail.
5. Near the top of Serpentine Trail, install signage indicating the last suitable turn-around spot for larger fire-trucks.
6. CRFPD to initiate projects

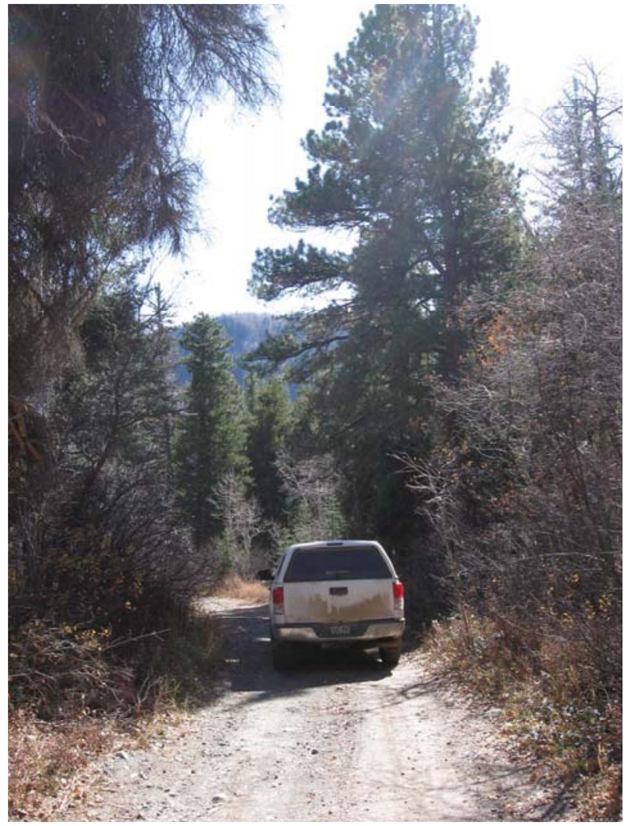
Based on the on-site review, construction of a Safety Zone on Serpentine Trail is not likely feasible.



Most homes have no defensible space

4.2.4 West 5th Street

West 5th Street winds up the south facing mountainside above the Town of Marble for two miles. Along this section it provides access to approximately 15 single family homes. The existing access to this large area is through a very narrow, heavily wooded, and poorly signed section of road. On the hillsides, fuels are dominated by xeric aspen stands, with dense understories comprised of dense chokecherry. There are smaller pockets of open grassy meadows, and mixed mountain shrublands. Overall, the fire hazard rating for this are is Moderate, given the steep slopes and relatively continuous fuels, but the aspen overstory definitely tempers the flammability of the fuels profile. Once up on the hillside, there were various turn-outs and passing areas, however fuels were relatively continuous.



Access to homes is through this narrow, one-lane "pinch-point"

Mitigation Recommendations-

1. Encourage defensible space thinning around homes and provide defensible space standards for residents to implement appropriate for the hazards in the xeric aspen stands and are completed in a timely manner.
2. Widen the narrow road at the bottom of West 5th Street, and conduct roadside fuels thinning. Approximately 12.6 acres has been delineated for roadside

West 5th almost looks like a driveway at this point thinning on **Figure 7**.

3. Install signage to aid with emergency responders who may not be familiar with the area.
4. Investigate installing cistern and dry-hydrant located in the area.
5. CRFPD/GunnCo to coordinate on implementation.

Road are generally wide enough and have adequate pull outs further up on West 5th Street.

4.2.5 Town of Marble

The Town of Marble is, for the most part, dominated by aspen stands and cottonwood forests, with a dense understory of chokecherry and various shrubs. While this may make suppression activities within the Town time consuming, fire behavior would be tempered by the dense deciduous overstory (which shades shrubs and keeps fuel moisture levels higher). In these deciduous forest types, fire hazard is considered to be Moderate. Approximately 1/3 of the Town area is dominated by a large swath of mixed conifer forests, with a dense shrubby understory, and relatively contiguous ladder fuels and high crown connectivity. In these areas the fire hazard rating is High. There are also smaller areas dominated by wetlands and grassy meadows which support Low hazard conditions.

Mitigation Recommendations

Given the high degree of fractured ownership in the Town, any large scale fuel break or fuels mitigation project would be very difficult to implement. Therefore, defensible space around homes is likely to be the most effective and implementable alternative. The creation of defensible space around community facilities and historic structures can be used as demonstration projections for the community.

1. Encourage defensible space thinning around homes and provide defensible space standards for residents to implement appropriate for the hazards in the deciduous and coniferous forest types.
2. CRFPD to work with Gunnison County Building and Planning to enforce that construction and remodeling projects have fire extinguishers on site and are completed in a timely manner.
3. Plan to implement defensible space around important infrastructure areas, including water tanks, power lines, bridges and public facilities
4. Identify historical structures and important community facilities (such as the Marble Charter School), and seek funding for defensible space implementation.

4.2.6 Marble Mountain Ranch

The Marble Mountain Ranch area is characterized by a long, winding road accessing approximately 21 single family residences, and the Marble Ski Area. Unlike the Serpentine Trail, Perry Road is wide with many pull-outs and passable areas. Further, at lower elevations the shale outcrops fragment continuous fuels profiles, especially where these outcrops are expanded by roadside cut-and-fill activities.

Mitigation Recommendations

1. Encourage defensible space thinning around homes and provide defensible space standards for residents to implement appropriate for the hazards in the mixed shrublands. Approximately 11.3 acres has been delineated for thinning on **Figure 7**.
2. Plan to implement defensible space around important infrastructure areas, including power lines.
3. Develop evacuation plan, but recognize that evacuating to the Marble Ski Area may be the safest scenario if lower elevations are on fire.
4. CRFPD & BLM/USFS to work together on development of mitigations.

Typical fuels lower in Marble Mtn. Ranch, where shrubby fuels are intertwined with shaley outcrops.

Protection of infrastructure should be prioritized.

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6 APPENDIX A- PRESCRIPTION SPECIFICATIONS

6.1 Defensible Space around Homes

The following treatment prescriptions were developed for the various fuel types within the Upper Crystal River Valley CWPP area, and are designed for individual home owner implementation around residential structures, as well as public utility structures (buildings). These prescriptions utilize existing guidelines set forth by the Colorado State Forest Service, but have been modified for implementation based on local wildfire behavior in area fuel profiles. The following information can be disseminated to local home owners for their implementation, but may be "fine-tuned" for site specific needs.

Structure ignition may occur as a result of radiant heat exposure, direct flame impingement, or firebrands. Two leading factors in the ignition of structures are wood shingles or shakes and a lack of defensible space. A study of the Painted Cave fire (in Santa Barbara County, California) (Foote and Gilles 1996) determined that homes having defensible space without wood shake roofs had a 90% survival rate. Research by Cohen (2000) indicates that defensible space of 40 meters is adequate to prevent ignition of wood siding from even very intense radiant heat.

As set forth in CSFS guidelines (Colorado State Forest Service bulletin 6.302 [CSFS 1999]), defensible space is divided into three management zones (see **Figure 8** below).

Zone 1 (15 feet from structure): Within 3 to 5 feet of the structure use only decorative rock or mowed, irrigated grass. Well spaced and pruned "firewise" plants are acceptable if the structure has noncombustible siding. In the remainder of Zone 1, trees should be pruned to 10 feet above the ground (not to exceed 1/3 the tree height). Dead wood, tall grass, and ladder fuels (low limbs, small trees, and shrubs that may carry fire into tree crowns) should be removed from this area.

Zone 2 (75 to 200 feet from structure or to the property line): The size of this zone is dependant upon slope (Figure 2 in **Figure 8** below). Treatment of ground fuels and ladder fuels is generally the same as Zone 1. Trees (or small groups of trees) and shrubs should be thinned to provide 10 feet of clearance between crowns.

Zone 3 (area of forest management): This area outside of Zone 2 should be managed for the appropriate land use objectives, such as forest health, aesthetics, recreation, and wildlife habitat. For this zone, a target treatment of 70 to 90 square feet per acre basal area or 15 feet between crowns of individual trees or small groups of trees is recommended.

Figure 8: Defensible Space Zones (CSFS 1999)

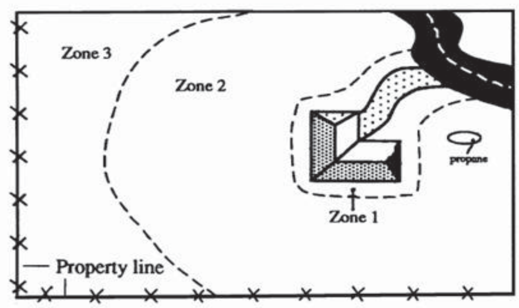


Figure 1: Forested property showing the three fire-defensible zones around a home or other structure.

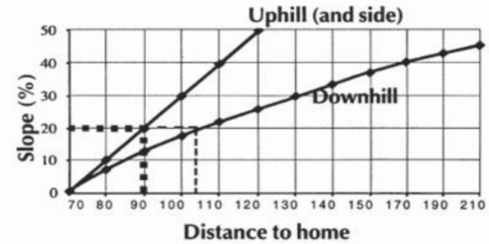


Figure 2: This chart indicates the minimum dimensions for defensible space from the home to the outer edge of Zone 2. For example, if your home is situated on a 20 percent slope, the minimum defensible space dimensions would be 90 feet uphill and to the sides of the home and 104 feet downhill from the home.

6.2 Reduction of Structure Ignitability

Site location: Building sites should avoid terrain traps that are associated with extreme fire behavior, such as steep slopes, narrow ridges or saddles, and narrow canyons. On steeper slopes potential fire behavior can be reduced through fuel treatments. In forested areas construction should generally be avoided on slopes of more than 30% and preferably avoid slopes steeper than 20%.

Vegetation: Existing vegetation and any re-planting or landscaping of vegetation should adhere to the following:

a. Brush, debris and non-ornamental vegetation shall be removed, or not replanted within a minimum ten-foot (10′) perimeter around all structures.

b. Spacing between clumps of vegetation up to thirty (30′) foot perimeters shall be a minimum of one (1) time the height of the fuel. Maximum diameter of the clumps shall be a minimum of 2 times the height of the fuel; however aspen trees are exempt from this restriction. This means that some clumps of shrubby vegetation may remain, but must be clumped to the above specifications. Aspen trees may remain, but shall be thinned to the extent that at least 15′ between tree trunks exist in order to allow for firefighter movement around structures.

c. Flammable mulches (wood chips) are not allowed within 2′ of structures. Aspen trees are allowed near structures, as long as they are not within 10′ of the structure, and are kept limbed to 10′ (unless the trees are less than 10′ tall). No trees of any species may be within 15′ of any window.

d. Evergreen trees are allowed within 30′ of structures should be limbed to 10′, and not have any flammable fuels (shrubs, etc.) underneath these trees. Trees may not be within 15′ of any window, and trees within 30′ should be spaced by at least 20′ feet, unless in tight clumps consisting no more than 5 trees, which must be separated by at least 30′ to the next clump or individual tree.

e. All branches that extend over the roof eaves shall be trimmed and all branches within 15′ of chimneys shall be removed.
f. All deadfall up to a 150′ perimeter (or to property boundaries) shall be removed.
g. The property owners shall be responsible for the continued maintenance of the defensible space vegetation requirements.

Overall design: Reduce heat and ember traps.

Construction Materials: Roofing material is the single most important feature to a structure's survival in a wildfire. Wood shake is not an appropriate roofing material in the WUI. The following roofing standards and general construction standards are some recommendations for various hazard ratings within the communities, and the type of fuels and conditions around the proposed structures:

Low Hazard Areas

a) General Roofing Standards

a. All roof coverings should be constructed of a Class A roof assembly, and if the roof has less than a 3:12 pitch, then the roof covering should be non-combustible.
b. No wood shakes or shingles.
c. Roofs with less than a 3:12 pitch shall have a surface that shall facilitate the natural process of clearing roof debris.
d. Roofs with less than a 3:12 pitch shall not have protrusions above the roofline, such as parapets.
e. Roofs shall be installed as required by the adopted Building Code.
f. All roof designs, coverings, or equivalent assemblies shall be specifically approved by the Fire Marshal prior to submittal of a building permit application.

b) Roof Venting

a. Attic, soffits and other roof venting shall be of non-corrosive metal mesh with maximum ¼-inch openings.

Moderate Hazard Standards

a) **General Roofing Standards**
   a. All roof coverings should be constructed of a Class A roof assembly, and if the roof has less than a 3:12 pitch, then the roof covering should be non-combustible.
   b. No wood shakes or shingles.
   c. Roofs with less than a 3:12 pitch shall have a surface that shall facilitate the natural process of clearing roof debris.
   d. Roofs with less than a 3:12 pitch shall not have protrusions above the roofline, such as parapets.
   e. Roofs shall be installed as required by the adopted Building Code.
   f. All roof designs, coverings, or equivalent assemblies shall be specifically approved by the Fire Marshal prior to submittal of a building permit application.

b) **Roof Venting**
   b. Soffit venting shall be located in the outer 1/3rd portion of the overhang.
   c. Attic, soffit and other roof venting shall be of non-corrosive metal mesh with maximum ¼" openings.

c) **Projections at the Roofline, including Soffits, Rafters, Porch or Deck Roofs, Fascias, or Other:**
   d. Sheath with non-combustible materials, or
   e. Combustible materials underlain with 5/8" Type X gypboard or equal, or
   f. Minimum 4x6 rafters with 2x T&G decking.

d) **Decks, Decking, Cantilevered Floors, or Other Projections Below the Roofline:**
   g. Minimum 6x6 posts, 6x10 beams, 3x8 joists, 3x decking, and 2x railings, or equivalent log construction.

High Hazard Areas

a) **General Roofing Standards**

   Roofs should comply with the following:

   a. All roof coverings shall be constructed of non-combustible materials and installed on a Class A roof assembly.

b. All roof coverings shall have a surface that shall facilitate the natural process of clearing roof debris.
c. Protrusions above the roofline, such as parapets, shall be prohibited.
d. All roof designs, coverings, or equivalent assemblies shall be specifically approved by the Fire Marshal prior to submittal of a building permit application.

b) Decks, Decking, Cantilevered Floors, or Other Projections Below the Roofline:

h. Construction with noncombustible or 1 hour rated material, or material with flame spread <25 (tested to ASTM E84 and listed for exterior use), or
i. Conventionally framed deck with waterproof surface and underside protected with 5/8" Type X gypboard or equal (decking as "a" above), or
j. "Type IV" Heavy Timber materials: joist and beams minimum 6"x10", columns minimum 8"v8", decking minimum 4" in depth, or decking as "a" above, or equivalent log construction, or
k. Enclose projection vertically to ground with 1 hour fire resistive materials (Decking as "a" above).

c) Railings

l. Railings must be constructed of noncombustible or "Type IV" Heavy Timber materials

d) Exterior of the Structure, Including All Walls

m. One hour fire resistive rated materials, or
n. 5/8" gypboard underlying combustible materials, or
o. Cement stucco, minimum ¾" thickness
p. All glazing on windows to be tempered glazing or equivalent to protect windows from shattering under extreme heat, and
q. Doors to be metal or wood 1 ¾" thick minimum, or a tempered glass

e) Foundations

Foundations, skirting, and crawl space opening shall be fully enclosed and constructed with materials approved for 1 hour fire-resistive construction on the exterior side of the walls and shall extend from the top of grade to the underside of the floor decking or walls.

All Hazard Areas- Maintenance and Miscellaneous Requirements

a. Roofs and gutters shall be kept clear of debris.
b. Yards shall be kept clear of all litter, slash and flammable debris.
c. All flammable materials shall be stored on a parallel contour a minimum of fifteen (15) feet away from any structure.
d. Weeds and grasses within the twenty (20) foot perimeter shall be maintained to a height of not more than four (4) inches.
e. Firewood/wood piles shall be stacked on a parallel contour a minimum of thirty (30) feet away from the structure during the spring, summer and fall months.
f. Swimming pools and ponds shall be accessible by the local fire district.
g. Fences shall be kept clear of brush and debris.
h. Wood fences shall not connect to other structures.
i. Fuel tanks shall be installed underground within an approved container.
j. Propane tanks shall be buried, if possible, or installed according to NFPA 58 standards and on a contour away from the structure with standard defensible space vegetation mitigation around any aboveground tank. Enclosures around the tank shall be constructed with materials approved for two (2) hour fire-resistive construction on the exterior side of the walls, or if possible non-combustible materials.
k. Each structure shall have a minimum of one ten (10) pound ABC fire extinguisher.
l. Addresses shall be clearly marked with four (4) inch non-combustible numbers and shall be visible at the primary point of access from the public or common access road and installed on a non-combustible surface.
m. Chimneys should have spark arresting screens over them and all branches cleared 15 feet away.

6.3 Fuel Breaks (Roadside Thinning)

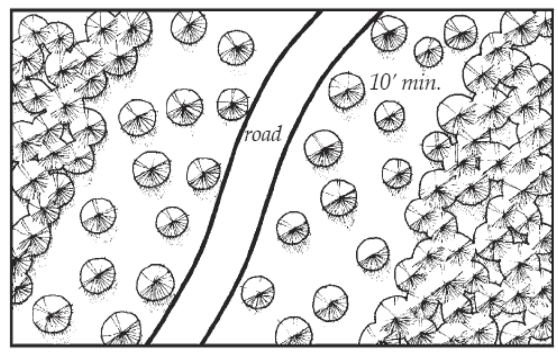
A fuel break is an accessible strip of land where fuels have been modified to reduce potential fire behavior. They will typically require regular maintenance and augmentation by suppression resources during a wildfire. Under severe conditions, even the best defended fuel break may be ineffective in containing a fire. Roads, cat-tracks, and some ski runs provide ideal opportunities to create fuel breaks for the community. Potential drawbacks to thinning treatment include a surge in undergrowth, increased wind and heat on the forest floor (where cut in forested conditions), and the potential for windthrow, any of which can increase fire behavior. Proper implementation and maintenance of the fuel break can reduce these pitfalls.

Wildland fuels may be reduced on both sides of the road similar to defensible space Zone 2 or 3 (Dennis [undated]):

Fuel breaks should be incorporated along Serpentine Trail and along the lower end of West 5th Street in order to provide improved accessibility for emergency response vehicles, and to improve evacuation safety for residents. Given that steepness and fuel types vary between the sites, two different prescriptions will be presented here. CRFPD would need to coordinate with Gunnison County and possibly the BLM/USFS for implementation.

6.3.1 Serpentine Trail & Marble Mountain Ranch

- Total width of fuel break should include at least 30-feet on downhill side of the road, and 20-feet on the uphill side of the road (based on dominant fuels in area). If possible, extend fuel break further down hill, but realizing the challenges of the area, do the best possible.
- Within delineated areas, reduce canopy cover of shrubs to 20% of existing conditions, realizing that some areas will be virtually inaccessible, or very dangerous to treat.
- Reduce surface fuel bed height to 2 feet or lower.
- Remove or grind cut material
- Resprouting will occur, but elevated fuel moistures in young growth will reduce fire intensities and within 10 years areas should be retreated to maintain effectiveness.



Plan view of fuelbreak showing minimum distance between tree crowns.

6.3.2 West 5th Street

At the lower end of West 5th Street, mixed conifers (Douglas-fir, ponderosa pine and Engelmann spruce) occur very close to either side of the road. This has created a "pinchpoint" that would compromise evacuation as well as emergency responder's access.

- Remove understory shrubs within 30-feet of either side of the roadway. Chip or grind, or fully remove cut material.
- Remove trees so that crown separation is at least 10-feet from crown to crown within 50-feet of the roadway
- Limb up remaining trees so that lower branches are at least 10′ off surface.
- Widen road or install turnouts to allow for emergency vehicle access
- Remove rocks and gate at lower road terminus to facilitate access
- Install road sign

These fuel breaks will also require maintenance, especially in cases where vigorous undergrowth may be released by the increased sunlight.

7 APPENDIX B- NEIGHBORHOOD HAZARD ASSESSMENTS (CRFPD)