JEFFERSON COUNTY
COMMUNITY WILDFIRE PROTECTION PLAN

1 INTRODUCTION

1.1 CWPP Purpose

The Community Wildfire Protection Plan (CWPP) is a strategic plan that identifies specific wildland fire risks facing communities and neighborhoods and provides prioritized mitigation recommendations that are designed to reduce those risks. The purpose of the fire behavior analysis and community wildfire hazard rating is to provide a comprehensive, scientifically-based assessment of the wildfire hazards and risks within Jefferson County. This CWPP is not a legal document. There is no legal requirement to implement the recommendations herein. Once the CWPP is adopted, it is the community's responsibility to move forward and implement the action items. This may require further planning at the project level, acquisition of funds, and motivating individual home owners.

Dramatic natural and human-caused changes to forested areas occurred throughout the 20th century. In many cases, these changes led to a high accumulation of naturally occurring flammable forest fuels. Decades of fire suppression and fire exclusion in fire-adapted ecosystems have removed a critical natural process from the vegetation regeneration cycle. In addition, years of persistent drought have resulted in a weakened forest infrastructure and regional epidemics of disease and insect infestation. At the same time, demographic trends continue to shift the nation's population growth centers to western and southwestern states where fire-adapted forest ecosystems are predominant, resulting in fragmented forested landscapes. The region where human development is pushing into previously undeveloped expanses of wildland is known as the wildland-urban interface (WUI). This is the area where risk of loss to life and property due to wildfire is the greatest. The potential consequences of severe wildfires are devastating and costly, and in recent years spurred Congress to pursue an effective solution.

Precipitated by over a decade of increasing wildfire activity, related losses, and spiraling suppression costs, the National Fire Plan was developed by the federal government in 2000. The Healthy Forests Restoration Act (HFRA) of 2003 provides the impetus for wildfire risk assessment and planning at the County and community level and helps implement the core components of the plan. HFRA refers to this level of planning as the CWPP. This empowers the participating community to take advantage of wildland fire and hazardous fuel mitigation opportunities offered under HFRA legislation including a framework for hazard evaluation and strategic planning, prioritized access to federal grant funding supporting identified hazard reduction projects, and a basis for collaboration with local, state, and federal land management agencies.

The CWPP can be a useful tool for people who are interested in improving the environment in and around their homes. It provides a coordinated assessment of neighborhood wildfire risks and hazards. 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 immediate effect a fire has on vegetation and soils. This CWPP addresses fire hazard and makes recommendations to reduce wildfire hazard in Jefferson County in order to make it a safer place to live, work, and play.

1.2 Jefferson County's need for a CWPP

Jefferson County encompasses much of the western Denver, Colorado metropolitan area (Map 1, Appendix A). It currently has a population of about 545,000. The communities here occur in the wildland-urban interface (WUI) and Intermix. According to the Federal Register, Interface is defined as a community that directly abuts wildland fuels. Intermix communities exist where structures are scattered throughout a wildland area. Both interface and intermix require fire hazard mitigation.

As is typical of Colorado Front Range WUI zones, neighborhoods often extend into foothill valleys, canyons, and mountain slopes with restricted access and limited emergency water supplies. They are common examples of the WUI and each presents emergency responders with unique, identifiable, and addressable hazards and risks. Outlying ranches, homesteads, and individual homes are not specifically addressed by the CWPP process and are best served through individual home hazard and risk assessments. However, recommended improvements to home ignition zones and defensible space apply to all properties, including those not within the delineated community areas.

A particularly important value at risk in this County is the Upper Platte Watershed, which has suffered from severe erosion and sedimentation following past fire events, and could be further compromised by severe fires in the future. The watershed encompasses approximately 1,000 square miles and supplies the Denver metropolitan area with 80 percent of its water. It is well known for its vast recreation opportunities. Cheesman and Strontia Springs Reservoirs, major water sources for the Denver area are also located in North Fork Fire Protection District, in southern Jefferson County.

A large portion of the County's WUI occupies the montane zone, which extends between the grasslands and shrublands of the lower elevations to sub-alpine forests at higher elevations. Much of this region is a fire-dependent ecosystem that historically experienced frequent natural ignitions that maintained an open forest stand structure and diverse vegetation composition. Natural resource management policies and changing ecological conditions have interacted in ways that resulted in hazardous fuel conditions throughout the County. Continuous and rapid urban development has created the expansion of the WUI, coupled with the accumulation of hazardous fuels in a fire-prone region suffering from prolonged drought has set the stage for catastrophic wildfires with significant risk to life and property. Steep topography and narrow dead end roads complicate an already potentially catastrophic scenario.

Jefferson County has experienced several large fire events in recent history in and near the County, including the 10,761-acre Hi Meadow Fire in 2000, the 138,114-acre Hayman Fire in 2002, and the 11,853-acre Buffalo Creek Fire in 1996. In March of 2011, the Indian Gulch fire

burned 1570 acres, and came within less than 1 mile of the city of Golden. In neighboring Boulder County, the Four Mile fire burned 6200 acres in September of 2010, destroying 163 homes in the WUI outside of Boulder, CO. Although a fraction of the size of the Hayman Fire, Four Mile became the costliest wildfire in Colorado history, due to the high concentration of the values at risk in the WUI zone.

Much of the Colorado Front Range, particularly in Jefferson County, has similarly heavily forested areas and high accumulations of hazardous fuels throughout WUI communities. The conditions to have a catastrophic wildfire in Jefferson County are present, and need to be mitigated. According to the Front Range Fuel Treatment Partnership Rountable's Findings and Recommendations, Jefferson County has nearly 93,000 acres of forested land that require fire risk mitigation treatment; 73% of forested land in need of treatment is privately owned. Therefore, fuels reduction in communities on private land is particularly important.

Given the significant fire risk and hazards across Colorado, each county in the state is required to have a CWPP with specific mitigation recommendations, as stated in senate bill 09-001. Although most WUI communities are currently covered under a current fire protection County-wide CWPP, there are several WUI areas known as "no-man's lands" that do not fall within the jurisdiction of a FPD but are rather covered under the jurisdictional responsibility of the County Sheriff's Office. Additionally, communities may fall within WUI areas that are mostly urban or developed, and do not a have County-wide CWPP, such as Arvada and West Metro. The Jefferson County (or county-wide) CWPP therefore covers these areas and makes specific hazard mitigation recommendations that can apply to Jefferson County communities on a larger scale. This plan meets the SB 09-001 mandate and the 2009 minimum standards set by the Colorado State Forest Service.

1.3 CWPP Process

The HRFA designed the CWPP to be a flexible process that can accommodate a wide variety of community needs and scales of plans. This CWPP is tailored to meet specific goals, following the standardized steps for developing a CWPP as outlined in "Preparing a Community Wildfire Protection Plan, A Handbook for Wildland-Urban Interface Communities" and the 2009 Colorado State Forest Service Minimum Standards for Community Wildfire Protection Plans (Table 1).

Table 1. CWPP Development Process

Step	Task	Description
One	Convene Decision Makers	Form a Core Team made up of representatives from local governments, fire authorities, and Colorado State Forest Service (CSFS).
Two	Involve Federal Agencies	Engage local representatives of the U.S. Forest Service (USFS) and other land management agencies as appropriate.
Three	Engage Interested Parties	Contact and encourage participation from a broad range of interested organizations and stakeholders.
Four	Establish a Community Base Map	Develop a base map of the County that provides a better understanding of communities, critical infrastructure, and forest/open space at risk.
Five	Develop a Community Risk Assessment	Develop a risk assessment that considers fuel hazards, community and commercial infrastructure, resources, and preparedness capability. Rate the level of risk and incorporate into the base map as appropriate.
Six	Establish Community Priorities and Recommendations	Use the risk assessment and base map to facilitate a collaborative public discussion that prioritizes fuel treatments and non-fuel mitigation practices to reduce fire risk and structural ignitability.
Seven	Develop an Action Plan and Assessment Strategy	Develop a detailed implementation strategy and a monitoring plan that will ensure long-term success.
Eight	Finalize the CWPP	Finalize the County CWPP and communicate the results to interested parties and stakeholders.

The core team (Table 2) consists of representatives from local government, local fire authorities, and the CSFS. For the purposes of this CWPP, a small core team was formed to facilitate the plan's development. These entities guide the development of the CWPP as described in the HFRA and must mutually agree on the plan's final contents. Collaboration between agencies and communities is an important CWPP component because it promotes sharing of perspectives, priorities, and other information that are useful to the planning process.

Table 2. CWPP Core Team Members and Affiliations

Team Member	Organization
Allen Gallamore	Colorado State Forest Service
Travis Griffin	Colorado State Forest Service
Rocco Snart	Jefferson County Sheriff's Office
Robin Keith	Jefferson Conservation District
F Scot Fitzgerald	Jefferson Conservation District

Geographical information system (GIS) data and information from the numerous existing FPD plans were used to develop the community base map. The community base map identifies and delineates communities on a landscape scale within fire protection Countys, encompassing relatively homogenous communities or subdivisions. A comprehensive risk assessment was conducted at the neighborhood or community level in order to determine relative levels of wildfire risk to better address fuels treatment prioritization. A standardized survey methodology was utilized in order to create an addressable rating benchmark for comparative future assessments and project evaluations. These existing community hazard ratings were synthesized for the County-wide plan. On the coarser, county-wide scale, we analyzed GIS data to build a fire-propensity index to assess areas that had not been previously covered in existing CWPPs.

CWPP fuel treatment recommendations are derived from the risk assessment. Mitigation recommendations are prioritized through an open and collaborative effort with the core team stakeholders. Prioritized treatments target wildfire hazard reduction in these WUI communities and neighborhoods, including reducing structural ignitability and protecting critical supporting infrastructure. An action plan guides treatment implementation for high priority projects over the span of several years.

The finalized CWPP represents a strategic plan that provides prioritized wildfire hazard reduction treatment projects, preferred treatment methods, a base map of the WUI, defensible space recommendations, and other information relevant to the scope of the project.

There are several federal legislative acts that set policy and provide guidance to the development of the CWPP:

- Healthy Forests Restoration Act (HFRA) (2003) – Federal legislation to promote healthy forest and open space management, hazardous fuels reduction on federal land, community wildfire protection planning, and biomass energy production.

- National Fire Plan and 10-year Comprehensive Strategy (2001) – Interagency plan that focuses on firefighting coordination, firefighter safety, post-fire rehabilitation, hazardous fuels reduction, community assistance, and accountability.

- Federal Emergency Management Agency (FEMA) Disaster Mitigation Act (2000) provides criteria for state and local multiple-hazard and mitigation planning.

- Colorado State Forest Service minimum standards for the development of CWPPs in Colorado (2009), per HFRA.

There are also several sources of information that supports wildfire mitigation and response that provide guidance to the development of the CWPP:

- The CSFS is a valuable resource that provides education and guidance to communities and individual landowners concerned with the threat of wildfire, as well as forest resource management in the WUI (http://csfs.colostate.edu/).

- The Jefferson County Annual Operation Plan (AOP) provides direction on how to work wildland fires in the County. Mutual aid agreements are attached to this document. This pre-plan provides emergency response infrastructure for any large incident support.

1.4 CWPP Goals and Objectives

Table 3 provides a brief summary of the primary goals and objectives for the CWPP.

Table 3. CWPP Goals and Objectives

Goals	Objectives
Conduct a wildfire risk assessment	• Conduct a county-wide wildfire risk assessment. • Identify areas at risk and contributing factors. • Determine the level of risk to structures that wildfires and contributing factors pose.
Develop a mitigation plan	• Identify and prioritize hazardous fuel treatment projects. • Identify and prioritize non-fuels mitigation needs.
Manage hazardous fuels	• Identify communities at highest risk and prioritize hazard reduction treatments. • Develop sustainable initiatives at the homeowner HOA level. • Secure funding and assist project implementation.
Facilitate emergency planning	• Develop strategies to strengthen emergency management, response, and evacuation capabilities for wildfire. • Build relationships among county government, fire authorities, and communities.
Facilitate public outreach	• Develop strategies to increase citizen awareness and action for Firewise practices. • Promote public outreach and cooperation for all fuels reduction projects to solicit community involvement and private landowner cooperation.

As a strategic plan, the real success of any CWPP hinges on effective and long-term implementation of the identified objectives. The public outreach phase of the CWPP development process includes efforts to identify stakeholder groups that can serve as an implementation team, which oversees the execution of prioritized recommendations and maintains the plan as the characteristics of the WUI change over time. Specific projects may be undertaken by individual homeowner associations, while larger scale treatments may require collaboration between multiple homeowner associations, local government, and public land

management agencies. Core team representatives may, but are not required to, assist in the implementation of the CWPP action plan. Overall, however, the key to the success of CWPP implementation is community participation. Continued public meetings are recommended as a means to generate additional support and maintain momentum.

2 WILDLAND FIRE MANAGEMENT OVERVIEW

2.1 Wildland Fire Types and Classification

There are two types of fires that burn in wildland fuels: prescribed fire and wildfire. Prescribed fires are planned fires ignited by land managers to accomplish specific natural resource management objectives. Wildfires are unplanned fires that result from natural ignition, human-caused fire, or escaped prescribed fire. Under certain circumstances wildfires can be managed with minimum suppression to achieve multiple objectives, including resource benefits.

Wildland fires are also classified by how they burn in various fuels. *Ground fire* refers to burning/smoldering materials beneath the surface including duff, roots, decomposing wood, peat, and sawdust that normally support a glowing combustion without flame. *Surface fire* refers to loose fuels burning on the surface of the ground, which includes leaves, needles, small branches, as well as grasses, forbs, low and medium shrubs, tree seedlings, fallen branches, downed timber and slash. Depending on the type of surface fuel, surface fires can range from small and slow-moving to intense, fast-moving, and/or prolonged fires. *Passive crown fire* encompasses a wide range of crown fire behavior, from occasional torching of isolated trees or groups of trees to nearly active crown fire. Passive crown fire is often referred to simply as "torching". Torching occurs when the vegetation that spans the gap between the forest floor and tree crowns (ladder fuel) allows a surface fire to travel vertically into flammable tree crowns. *Active crown fire* is a wildland fire that moves rapidly through the crowns of trees or shrubs independently of a surface fire. Active crown fires are intense, destructive, and can be difficult to suppress.

Wildland fuels comprise both dead and live vegetation, and are described in terms of density, bed depth, continuity, vertical arrangement, and moisture content. For fire to ignite and spread, wildland fuels must meet the conditions of combustion (sufficient heat and oxygen). If the potential fuel does not meet the conditions of combustion, it will not ignite. Conditions of combustion can vary widely across geographic region and among different fuels in an area. This explains why some trees, patches of vegetation or structures may survive a wildland fire and others in the near vicinity are completely burned.

2.2 Wildland Fire Behavior

Fire behavior is a description of the manner in which a fire reacts to the combined influences of fuel, weather and topography. Fire behavior is observed and assessed at the flaming front of the fire and described most simply in terms of fire intensity (in feet of flame length) and in rate of forward spread (Table 4). The implications of observed or expected fire behavior are essential components of suppression strategies and tactics, particularly in terms of the difficulty of control and effectiveness of various suppression resources.

Table 4. Fire Behavior Ratings

Adjective class	Rate of Spread (ch/hr)*	Flame Length (ft)
Very Low	0 - 2	0 - 1
Low	2 - 5	1 - 4
Moderate	5 - 20	4 - 8
High	20 - 50	8 - 12
Very High	50 - 150	12 - 25
Extreme	> 150	> 25

Stubbs T., 2005, Adjective Ratings for Fire Behavior

*ch/hr = chains per hour, where 1 chain = 66 feet; this standard measurement of rate of spread is approximately the same as feet per minute, where 1 chain per hour ~ 1 foot per minute

Potential surface fire behavior may be predicted by classifying vegetation in terms of fire behavior fuel models (FBFM) and using established mathematical models to predict potential fire behavior under specific climatic conditions. In this CWPP, FBFMs were obtained from existing GIS and vegetation data layers obtained from LANDFIRE.

In general, fire burns more rapidly and intensely up slopes. Additionally, topographic features such as narrow drainages and box canyons can funnel warm air upslope, further intensifying fire behavior. However, wind tends to be the most significant factor in the most extreme and destructive fires, driving active crown fires and causing long-range spotting ahead of the main fire front. Strong winds common along the Front Range can override topographic effects on fire behavior, even causing wildfire to be driven rapidly down slope.

2.3 History of Wildfire

Lightning-caused fire is a natural component of Front Range ecosystems, and its occurrence is important to maintaining the health of forest and open space ecosystems. Native Americans used fire as a tool for hunting, improving wildlife habitat and land clearing. For example, ponderosa pine woodlands of the montane zone and lower elevation brushlands and grasslands historically experienced relatively frequent fire return intervals. Extensive research has been conducted in Front Range forests in the assessment area. Fire history reconstruction in ponderosa pine forests in the vicinity of Cheesman Reservoir shows evidence that fire occurred in the area every 20 to 50 years between 1531 and 1880. As such, many of the plant species and communities are adapted to recurring fire through phenological, physiological, or anatomical attributes. In addition, the reproduction and persistence of some plant species, such as lodgepole pine and western wheatgrass, require reoccurring fire.

Beginning in the 19th century, Euro-American settlers in western North America altered the natural fire regime in several interrelated ways. The nature of vegetation (fuel) changed because of land use practices such as homesteading, livestock grazing, agriculture, water development, and road construction. Livestock grazing reduced the amount of fine fuels such as grasses and forbs, which carried low-intensity fire across the landscape. Continuous stretches of forest and open space fuels were broken up by land clearing activities. Additionally, with the significant reduction of naturally occurring fire after 1880, there has been widespread establishment and persistence of trees since 1880, leading to denser forest stands that can carry more intense, severe wildfires.

Although advances in scientific knowledge and land management techniques have improved the way wildland fire is managed in recent years, land managers and firefighters are faced with many challenges when fires burn in the WUI. Present-day land use changes, particularly residential development, have continued to impact wildland ecosystems and hazardous fuel distribution. Since the 1970's, housing growth within less than a mile of national forests and other protected areas has outpaced the rate of growth in urban areas. Increasing population density in the WUI makes wildfires more complex and potentially dangerous for firefighters and the general public.

Jefferson County has experienced several large fire events in recent, including the 138,114-acre Hayman Fire in 2002, the 10,761-acre Hi Meadow Fire in 2000, and the 11,853-acre Buffalo Creek Fire in 1996. These fires have all had significant impacts on the landscape and the affected communities due to their sheer size and severity. In March of 2011, the Indian Gulch Fire burned 1570 acres of Mount Galbraith Open Space Park and adjoining private land in and near the County. Given that the fire burned to US Highway 6 and within less than a mile from the city of Golden, it was a high-profile WUI fire. There have also been numerous wildfires in the WUI in the areas surrounding the County, and the area overall has a relatively high risk of ignitions. As the population in Jefferson County continues to grow, WUI areas will expand and make wildland fires increasingly complex and costly to suppress.

Figure 1. Foothills burned in the Indian Gulch fire in March, 2011. Golden and Denver are shown in the background, exemplifying a fire in the Wildland-Urban Interface. Photo by Judson Miller.

2.4 Fuels Management

Heavy wildland fuel loading and continuity has created hazardous situations for public safety and fire management, especially when found in proximity to communities. These hazardous conditions require an array of mitigation tools, including prescribed fire and mechanical thinning treatments to protect human life, economic values, and ecological values. Objectives of fuels management include (but are not limited to) reducing surface fire intensity, reducing the likelihood of crown fire initiation and spread, and improving forest health. These objectives may be accomplished by various methods of reducing surface fuels and ladder fuels, 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, firefighters and other suppression resources are

afforded better opportunities to control fire rate of spread and contain wildfires before they become catastrophic.

Prescribed fire is commonly used as a resource management tool under carefully planned conditions by many land management agencies. It includes completing a detailed burn plan with burn parameters (prescriptions), pre-treatment of the fuel load, close monitoring of weather, and use of specific ignition patterns to achieve desired results. When implemented correctly, prescribed fire can improve wildlife habitat, help abate invasive vegetation, reduce excess fuel loads, and lower the severity of future wildfires in the treatment area. Prescribed fires are ignited only under favorable weather conditions, and must meet air quality requirements of the Colorado Department of Public Health and Environment (CDPHE) Air Pollution Control Division (CAPCD) in order to ensure the safety of firefighters and the public. Prescribed fires may be conducted either in a defined area as a broadcast burn, or in localized burn piles. Broadcast burns are used to mimic naturally occurring wildfire within pre-prepared control lines by highly trained fire personnel. Burn piles are utilized to dispose of excess woody material after thinning if other means of disposal are not available or cost-prohibitive. Pile burns do not necessarily need to be conducted by trained professionals, but are subject to local permitting and air quality control guidelines. Acceptable burn days are determined by local fire protection Countys.

Mechanical thinning is another management tool that can be used to break up fuel continuity in order to reduce fire intensity and spread. This can be accomplished in a variety of ways, but most commonly with chainsaws and/or masticators. Chainsaws and other hand tools have been traditionally used to mitigate fuels on a smaller scale because it is time-and labor-intensive, but affords the most controlled results. Once the forest is thinned, the slash and wood must be removed from the forest, chipped onto the forest floor, or piled and burned. In some cases, slash can be “lopped and scattered”, where woody debris is thinly (less than one foot depth is best), and distributed on the forest floor to decompose naturally. If too much woody debris is left after thinning, it can have a negative impact on fire hazard. Slash removal can be the most costly and time-intensive phase of forest thinning by chainsaws and hand tools. Therefore, masticators have become a widely used management tool in recent years. A masticator head is mounted on a skid steer or tractor and shreds forest fuels, including whole trees, then leaves the shredded/chipped material on the forest floor (figure 2).

Figure 2. Hydroaxe used for mastication of heavy woody fuels.

Mastication of fuels does not reduce the amount of fuels in a forest stand, but redistributes it in a manner in which it does not contribute to crown fire initiation and spread. Although limited to machine-operable terrain (slopes less than 50%, not rocky, etc.), this method of thinning is generally quicker and more cost-effective than hand-thinning with chainsaws, and large-scale fuel treatments can be completed in a relatively short time.

Land managers often use a combination of these fuel mitigation techniques to achieve management objectives, depending on the vegetation type, terrain, adjacent private lands, or other values at risk. Private landowners should also consider these factors when choosing fuel mitigation tools. Additionally, landowners can improve the effectiveness of their own fuel mitigation treatments by using a combination of tools and using adjacent fuel treatments to their advantage. This topic is discussed in more detail in the action item recommendations.

Figure 3. Prescribed fire west of Evergreen. Photo by Collin Wassink.

3 JEFFERSON COUNTY PROFILE

3.1 Assessment Area

Jefferson County lies on the western edge of the Denver, Colorado metropolitan area. Jefferson County was established in 1861 as one of the original 17 counties created by the Colorado Territorial Legislature with a land base of 774 square miles. The county has the fourth largest population in the state, currently estimated at 545,290 people with approximately 190,440 people living in the incorporated areas.

Boulder County lies to the north, Gilpin, Clear Creek, and Park Counties lie to the West, Douglas and Teller Counties lie to the south, and Adams, Denver, and Arapahoe Counties border on the east. Known as "the gateway to the Rockies", the foothills of the Front Range run the length of the County. The lower elevation plains rise steeply to the mountains in the west. Therefore, Jefferson County has a wide range of elevation, vegetation types, and population distribution. Much of the assessment area can be classified as WUI.

The local economy is dictated by the proximity and ease of access to the Denver metro area. Most working residents commute daily to Golden and Denver. Numerous getaways on nearby county, state, federal and private lands with world-class hunting, climbing, cycling, camping, and fishing areas abound throughout the County.

For this CWPP, "communities" are delineated by fire protection County (FPD). The primarily-WUI FPD's in Jefferson County already have adopted current CWPP's, so we crosswalked the mitigation recommendations from the existing plans into this coarser-scale county-wide plan. Overall, each FPD represents a fairly uniform area of vegetation/fuel type, topography, population concentration, and response resources. Remaining WUI areas not previously covered were analyzed with a GIS-based fire propensity index (see chapter 4.3).

3.2 Climate

The climate of the area is relatively dry with the majority of precipitation occurring in the spring months and late summer monsoons. However, with 4,000 feet of vertical relief within the County, average conditions can vary greatly from one location to another. In the summer months, thunderstorms can occur almost daily and can produce hundreds of lightning strikes in a single storm. The area receives 255 days of sunshine per year and an average of 15 inches of annual precipitation. Winter high temperatures are typically in the mid 30s and summer highs tend to remain in the 70s. The low precipitation months are November through February. Seasonal weather patterns over the region and topographic effects from the continental divide can generate high winds year-round. It is not uncommon for this area to experience winds in excess of 50 miles per hour. These conditions are optimum for wildfire ignition and spread. As the climate has warmed and dried over the past century, it is now possible for wildfires to occur 12 months a year in Jefferson County.

3.3 Topography

Topography refers to the steepness of slope (expressed in percent or degrees) and aspect (expressed as direction the slope faces). The elevation of Jefferson County ranges from about 5300 to 9500 feet. The terrain spans from the rolling plains in the eastern part of the County to steep mountainous terrain. About 28% of the County is covered by plains, and 72% is covered by mountainous terrain. Slopes range from 10 percent to 60 percent or more. Although most of the homes in the WUI and Intermix are on slopes that are less than 30%, almost all of the homes are within 300 feet of steeper slopes. Not only does this affect potentially severe fire behavior, it can limit the type and extent of fuel mitigation that can take place near homes that need it. For example, mechanical fuels reduction with masticators is generally limited to slopes of approximately 30%, on average. Mitigation with chainsaws is the most feasible method for steep slopes, but in general, the more difficult the terrain is, the more costly and dangerous the work is. Therefore, slopes exceeding 40% are usually omitted from implementation plans in favor of more cost-effective areas on easier terrain.

In this CWPP, topography was assessed with a digital elevation model (DEM) in GIS. Both topography and elevation play an important role in dictating existing vegetation and, therefore, fuels and fire behavior. The steep slopes, canyons, draws, and ravines throughout the area channel winds and contribute to severe fire behavior. Topography also dictates community infrastructure design, further influencing overall hazard and risk factors.

3.4 Wildland Vegetation and Fuels of the Assessment Area

The vegetation in the County is typical of the Rocky Mountain Montane zone, which ranges from 5,600 to 9,500 feet. The dominant tree species throughout the assessment area are ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*). The distribution and density of vegetation species are driven primarily by available soil moisture, which is closely related to elevation and slope aspect. This variability is known as the topographic-moisture gradient (Whittaker 1967), one of the key concepts in forest science. Common species of grass in this area include prairie Junegrass (*Koeleria macrantha*), blue grama (*Bouteola gracilis*), western wheatgrass (*Pascopyrum smithii*), little bluestem (*Schizachyrium scoparium*), Timothy (*Phleum pretense*), and cheatgrass (*Bromus tectorum*).

As elevation and moisture availability increase, ponderosa pine (*Pinus ponderosa*) and mixed conifer woodlands with herbaceous and shrub understory are common. Northfacing slopes throughout the County are characterized by denser stands of ponderosa and mixed conifer forests dominated by Douglas-fir (*Pseudotsuga menziesii*). In the upper montane zone, lodgepole pine (*Pinus contorta*) is prevalent. Quaking aspen (*Populus tremuloides*) occurs intermittently where micro-site conditions provide enough moisture for them to thrive in either persistent or seral stands.

Deciduous riparian zones along rivers and creek beds are present throughout the area, with occasional stands of cottonwood (*Populus* spp.) and willow (*Salix* spp.). The vegetation in these

riparian zones are generally not significant carriers of fire, and therefore do not usually require extensive mitigation.

The type of vegetation coupled with disturbance regimes determines the amount and distribution of wildland fuels. For example, dead and down timber and needle litter can be heavy in timber stands and woodlands where disturbance has been absent for many decades. Conversely, grasslands and that lack woody species and can burn more frequently have very low fuel loads. Predicting the potential behavior and effects of wildland fire in different fuels is an essential task in fire management. Mathematical surface fire behavior models and prediction systems are driven in part by fuelbed inputs such as load, bulk density, fuel particle size, heat content, and moisture of extinction.

To facilitate use in models and systems, fuel inputs have been formulated into fire behavior fuel models (FBFM). The FBFM concept was developed in 1972 by Rothermel, and Albini (1976) refined the original 11 fuel models based on a series of fire behavior calculations derived from 13 discrete fuel and vegetation types. Scott and Burgan refined the 13 FBFM system in 2005 to create 40 FBFM, which are now widely used in fire management and considered more accurate than the original 13 fuel model system.

This CWPP update utilizes the Scott and Burgan 40 FBFM methodology in order to best represent the current fire hazards and risks in Jefferson County. The forty FBFMs are divided into seven general fuel categories; grass, grass-shrub, shrub, timber understory, timber litter, slash-blowdown, and non-burnable. Each group comprises four or more fuel models. Of these 40 fuel models, 17 occur in the County in six fuel categories (Table 5). Appendix A contains maps showing distribution of fuel groups and individual fuel models. Appendix E contains information about each FBFM in the area, and can be used as a pull-out reference section.

Table 5. Fuel Models in the County

Fuel Group	Code	Description	% Cover of Area*
Grass	GR1	Short sparse dry climate grass	<1
Grass	GR2	Low load dry climate grass	10
Grass	GR4	Moderate load dry climate grass	<1
Grass-shrub	GS1	Low load dry climate grass-shrub	2
Grass-shrub	GS2	Moderate load dry climate grass-shrub	15
Shrub	SH1	Low load dry climate shrub	3
Shrub	SH2	Moderate load dry climate shrub	<1
Shrub	SH7	Very high load dry climate shrub	2
Timber understory	TU1	Low load dry climate timber-grass-shrub	13
Timber understory	TU5	Very high load dry climate timber-shrub	26
Timber Litter	TL1	Low load compact conifer litter	<1
Timber Litter	TL3	Moderate load conifer litter	6
Timber Litter	TL8	Long needle litter	3
Non-burnable	NB	Non-burnable (open water, urban, agricultural, snow, bare ground)	21

*Disclaimer: Fuel model percent cover has not been ground truthed. Ground truthing may increase data accuracy, as the fuel model data can be imprecise.

Grass; FBFM GR1 and GR2
In these fuel models, grass is the primary carrier of fire. Grass is either naturally sparse, or heavily grazed. For both, flame lengths and rate of fire spread is quite low, and therefore do not significantly contribute to extreme fire behavior. The grass species present are common in open short grass prairie, meadows, or alpine tundra. Historically, at lower elevations, relatively frequent disturbance by wildfire removes dried biomass and woody shrub and tree species before it becomes excessive surface fuels. In fast moving or low-intensity fires, the underground portions of plants are rarely killed, and vegetation (particularly grasses) can resprout quickly. These fuel types cover just over 10% of the assessment area.

Grass-Shrub; FBFM GS1 and GS2
The primary carriers of fire in these fuel models are grasses and shrubs combined. Within the County, shrubs in these fuel models are mostly 1-3 feet in height, mixed with short grass. Shrub and grass species in this fuel type requires disturbance such as fire to reproduce, either by seed or root crown sprouting. Rate of spread is high due to the size and continuity of fuels, and flame lengths are moderate. These fuel types cover approximately 17% of the assessment area.

Shrub; FBFM SH 1, SH 2, and SH7
The primary carriers in this fuel groups are shrubs and shrub litter. Vegetation cover may be multi-layered, with short shrub and herb species in the understory of dominant overstory shrubs. In some cases, Gambel oak can reach small tree size. Rate of spread is moderate to high, and flame lengths are generally moderate. These fuel types cover about 4% of the assessment area.

Timber Understory; TU1, TU5
The primary carriers of fire in these fuel types are forest litter, grass, shrub, and small tree understory. Spread rate is low to moderate; flame length is low to high. Fire usually does not ladder into tree canopies unless the surface fuels reach vertically to tree crowns. However, active crown fire could spread from adjacent areas to TU fuel types if the forest canopy is continuous. Common species in the TU fuel types in this area include common juniper, Gambel oak, Rocky Mountain juniper, ponderosa pine, and Douglas-fir. These fuel types cover 39% of the assessment area, with TU5 (very high load timber understory) representing about 26% of the assessment area.

Timber Litter; TL1, TL3, TL8
The lower foothill slopes on the western margin of the County support some stands of ponderosa (*Pinus ponderosa)* on saddles and north and west facing slopes. Further west at slightly higher elevation ponderosa stands dominate north facing slopes and typically are dense with some mixed Douglas-fir (*Pseudotsuga menziesii).* Here dead and down woody surface fuels intermingle with the grass and shrub understory. In higher elevation stands on the western side of the County, surface fuels are influenced by long needle timber litter (TL8). These fuel types cover about 9% of the assessment area.

Non-burnable; NB
Non-burnable fuel types include a variety of substrate cover. These include open water, agricultural land, bare ground, and urban. Each non-burnable fuel type has its own code and characteristics, but they are combined in this CWPP for simplicity. Non-burnable areas cover about 21% of the assessment area.

3.5 Values at Risk

In any hazard and risk assessment, human life and welfare are the most important resources to protect. There are also vital socioeconomic, infrastructure, and cultural values that need to be protected in any community at risk. The WUI communities in the assessment area have inherent wildfire hazards: residential development in areas historically prone to fire, hazardous fuels, and limited access. These hazards contribute to fires that have high resistance to control. The actions recommended in this CWPP are geared towards lowering the wildfire hazards to neighborhoods, as well as economic and ecological values at risk to wildfire losses. With these issues in mind, the following values at risk are priorities for protection in the planning area. Any ranking process for these values, however, is inherently subjective. They should be continuously updated and prioritized by community stakeholders as populations grow and other factors change over time. Table 6 lists categories of values at risk, and specific examples of those values within Jefferson County.

Table 6. Values at Risk

Values At Risk	Examples
Life Safety	Nearly 200,000 residents currently living in unincorporated areas of Jefferson County
Homes & Property	Approximately 214,000 residences in or near WUI areas in Jefferson County
Infrastructure	Major roadways: I-70, C-470, US-285, US-6, SR-93; railroads; power lines
Community Facilities	Schools, police stations, fire stations, community granges
Commerce	Lockheed Martin, commercial areas of Morrison, Littleton, Conifer, Aspen Park, and Evergreen
Tourism	State Parks, County Open Space Parks, Denver Mountain Parks, US National Forests
Historic Sites	Meyer Ranch House, Tallman Ranch, North Fork of the South Platte Historic District, Indian Hills Community Hall and Firehouse
Communications	Cell towers, radio towers, phone utility lines
Wildlife Habitat	fisheries; habitat for elk, mule deer, mountain lion, pine marten, red fox; nesting areas for raptors and other birds; habitat for endangered Preble's Meadow Jumping Mouse
Watersheds	Upper South Platte Watershed, Clear Creek Watershed

In the GIS analysis of the values at risk, specific data layers were incorporated to analyze the geographic distribution of values at risk. Schools, historic sites, address density per square mile, and 110 kv power lines were factored into this analysis. Appendix A contains the values at risk map and the data sources and methods for the map's creation.

4 WILDFIRE HAZARD ASSESSMENT METHODS

4.1 Components of Wildfire Hazard Analysis

Wildfire hazard assessment takes into account a variety of factors that ultimately result in a representative hazard ranking of the neighborhoods and subdivisions that have been collaboratively identified within the assessment area by the core team. Hazard rankings provide quantifiable guidance in the determination of mitigation treatment project prioritization. This CWPP uses a combination of community hazard ratings from existing FPD plans and GIS-based analysis.

Factors that contribute to wildfire hazard assessment are fire behavior, community characteristics, and ignition potential. Elements that influence fire behavior include topography, weather conditions, and the type, density and configuration of vegetation and other fuels. Community characteristics are evaluated in terms of emergency response, defensibility, and structural flammability. Ignition potential is influenced by population density, proximity to roads and other infrastructure. Overall, the relationship between expected fire behavior in wildlands and the placement and design of neighborhoods in wildland areas is at the core of an effective community wildfire hazard assessment. From this process, targeted mitigation recommendations are developed that directly address the identified hazards and, if implemented, will reduce the risk of loss from a wildfire for each homeowner as well as the community as a whole.

As part of the assessment, a questionnaire (Appendix D) was posted online and distributed at several community events and public meetings to obtain public opinion information concerning the perceived level of wildfire risk in Jefferson County, understand public values at risk, and assess attitudes about mitigation practices that may be recommended to reduce risk. WUI safety pamphlets and brochures that explained home construction and landscaping practices designed to reduce the risk of wildfire loss were also distributed. The survey was general in its scope, and response was limited. The responses do not represent a statistical sample of Jefferson County residents. The results of the survey can, however, give a broad picture of the overall perception of fire risk and mitigation efforts in the area's WUI communities. Follow-up surveys could target individual communities and/or address specific planned projects.

While fires originating in or near communities are the most immediate concern, wildfires that ignite well beyond the boundaries of the planning area can have profound effects upon the communities and ecosystems in the County. There is a high possibility for rapid rates of spread and long-distance spotting are high for a typical fire in this area.

4.2 Fire Behavior Analysis

Fire behavior, as previously stated in section 2.2, is defined as the manner in which a fire reacts to the influences of fuel, weather, and topography. Two key measures of this behavior are the rate of spread and fire intensity. In fire management, rate of spread is expressed in chains per hour. A chain is 66 ft, and one chain per hour closely approximates a spread rate of 1 foot per minute. Fireline intensity is defined as the rate of heat energy released per unit time per unit

length of fire front, regardless of the depth of the flame zone. It is calculated as the product of available fuel energy and the fires rate of advance.

The FlamMap software program was one tool used in the development of the plan. FlamMap is a fire behavior analysis program that computes potential fire behavior characteristics over a pre-defined geographic area (Landscape) given constant weather and fuel moisture conditions. The Landscape is the data input to be analyzed by FlamMap, using 30-meter GIS data. The GIS data sets that combine to create a Landscape are elevation, slope, aspect, fuel model, canopy cover, stand height, canopy base height, and canopy bulk density. Elevation, slope, and aspect are derived from Digital Elevation Models (DEM; a 3-D representation of a surface). The fuel model and forest stand and canopy data are obtained from LANDFIRE (Landscape Fire and Resource Management Planning Tools) datasets. LANDFIRE data was within the broad map zones used by the U. S. Geological Survey (http://landcover.usgs.gov/pdf/homer.pdf). With LANDFIRE, it is possible to view and download geospatial layers and data products that depict the nation's major ecosystems, wildlife habitat, vegetation or canopy characteristics, landscape features, and wildland fire behavior, effects, and regimes. Appendix A contains the maps that illustrate potential fire behavior under these conditions, and the methodology and data that was used to create them.

To complete a comparison of average- (50^{th} percentile) and severe-case (90^{th} percentile) fire behavior conditions, two different weather streams were developed. Percentile refers to historic occurrences of specified conditions. For example, 50^{th} percentile is considered average conditions, with half the records exceeding recorded conditions and half the records below recorded conditions. Severe weather conditions are expressed as 90^{th} percentile conditions, meaning that within the weather data examined from the remote automated weather stations (RAWS), only 10 percent of the days had more extreme conditions. When these two different weather streams are used, we see the potential fire behavior characteristics at both a “normal” fire season condition and at a “very high severity” fire season condition.

A Fire Behavior Analyst helps determine expected fire behavior in a landscape. Fire behavior models such as FlamMap carry certain assumptions. Typically consistent wind speeds over the entire burning period, consistent fuel bed depth, and fuel bed continuity can produce fire behavior at =/- two times the actual observed fire behavior.

Fire Weather

Average and severe case weather and fuel moisture conditions were determined using records from local RAWS during the summer wildfire season of June through August. Given the large geographic area of the County, and the variability of conditions represented within the County, weather was analyzed in two zones: north and south. Each zone is represented by data averaged from four weather stations.

Data from the Lookout Mountain, Sugarloaf, and Corral Creek stations were used to best represent the climate of the northern part of the County (Table 7), and Cheesman, Polhemus, Bailey, and Waterton North stations were chosen for the southern part of the County (Table 8). Weather was calculated for the typical summer fire season of June through August based on

existing historic data through 2011. Mid-flame wind speeds of 4 and 8 mph were used for the modeling of 50th and 90th percentile conditions, respectively.

Table 7. Average and Severe Case Fire Weather and Fuel Moisture Conditions, North Zone

RAWS Station	Percentile	Max Temp ºF	Relative Humidity %	1-Hour Fuel Moisture %	10-Hour Fuel Moisture %	100-Hour Fuel Moisture %	Herbaceous Fuel Moisture %	Woody Fuel Moisture %
Lookout Mountain	50th	71	24	7	8	12	35	103
2009-2011	90th	83	13	3	4	8	5	59
Sugarloaf	50th	76	22	6	7	10	34	96
1990-2011	90th	89	10	3	4	6	9	60
Corral Creek	50th	71	19	5	6	11	29	85
1990-2011	90th	81	8	2	4	7	3	69

Table 8. Average and Severe Case Fire Weather and Fuel Moisture Conditions, South Zone

RAWS Station	Percentile	Max Temp ºF	Relative Humidity %	1-Hour Fuel Moisture %	10-Hour Fuel Moisture %	100-Hour Fuel Moisture %	Herbaceous Fuel Moisture %	Woody Fuel Moisture %
Cheesman	50th	75	17	5	6	10	30	73
1990-2011	90th	86	7	2	3	6	3	60
Bailey	50th	75	16	5	6	10	32	79
1990-2011	90th	86	6	2	3	6	3	60
Polhemus	50th	73	17	4	6	10	35	77
2004-2011	90th	84	7	2	3	6	3	59
Waterton North	50th	69	23	6	7	11	44	88
2004-2011	90th	80	11	3	4	7	4	59

Additional important fire- and weather-related resources include:

- Fort Collins Interagency Wildfire Dispatch Center Web index for Fire Intelligence, Fire Weather, Fire Danger/Severity, RAWS – http://www.fs.fed.us/r2/arnf/fire/fire.html
- RAWS index for the Rocky Mountain Geographic Coordinating Area – http://raws.wrh.noaa.gov/cgibin/roman/raws_ca_monitor.cgi?state=RMCC&rawsflag=2
- National Fire Weather Page – http://fire.boi.noaa.gov/

Potential Fire Behavior

Fire behavior simulations were conducted for average (50th percentile) and severe (90th percentile) conditions for the critical months of the fire season, June through August (Table 9). Slope steepness was set to 20 percent.

BehavePlus software was used to generally illustrate the potential surface fire behavior given the prevailing fuel types, local topography, and local weather conditions. While any number of

variables and assumptions will affect the modeled outputs, there are several significant general principles to focus on:

- Differences in surface fire behavior under 50th and 90th percentile conditions (drier fuels, windier conditions) are most pronounced in brush and grass fuels.

- The increase in fire behavior is approximately two times for flame length and three to four times for rate of spread.

- Fire behavior for most fuel types under 90th percentile conditions exceeds the 4-foot flame lengths generally considered appropriate for direct line construction with hand crews. When flame length exceed 4 feet, it becomes necessary to use engines, aircraft, or other heavy equipment for fire suppression instead of personnel on the ground.

- If TU1 converts into the denser TU5, the increase in fire behavior is pronounced and conducive to the initiation of crown fire.

Table 9. BehavePlus Predictions of Fire Behavior on 20 Percent Slope*

FBFM	Flame Length (ft), average conditions[1]	Rate of Spread (chains/hr), average conditions**	Flame Length (ft), severe conditions[2]	Rate of Spread (chains/hr), severe conditions**
GR1	2	10	3	38
GR2	4	20	10	153
GR4	7	41	18	307
GS1	1	3	6	42
GS2	2	4	9	58
SH1	1	1	1	4
SH2	1	1	7	15
SH5	9	24	20	115
SH7	8	16	19	74
TU1	1	1	3	6
TU5	5	5	11	19
TL1	1	1	1	2
TL3	1	2	2	5
TL8	3	6	6	17

[1]50th percentile weather conditions: average midflame windspeed = 4mph; fuel moisture percentages: 1-hour=5%, 10-hour = 8%, 100-hour = 10%; Live herbaceous fuel moisture = 75%; live woody fuel moisture = 200%.
[2]90th percentile weather conditions: severe midflame windspeed = 8mph; fuel moisture percentages: 1-hour=2%, 10-hour = 3%, 100-hour = 6%; Live herbaceous fuel moisture = 30%; live woody fuel moisture = 100%.
*All calculations were completed using 20% slope.
**Chains per hour ≈ feet per minute, where 1 chain = 66 feet.

4.3 Community Hazard Assessment Methods

Wildfire hazard assessment takes into account a variety of factors that ultimately result in a representative hazard ranking of the neighborhoods and subdivisions that have been

collaboratively identified within the assessment area by the core team. Hazard rankings provide quantifiable guidance in the determination of mitigation treatment project prioritization. Factors that contribute to wildfire hazard assessment are fire behavior, community infrastructure, and ignition potential. Elements that influence fire behavior include topography, weather conditions, and the type, density and configuration of vegetation and other fuels. Community infrastructure is evaluated in terms of emergency response, defensibility, and structural flammability. Ignition potential is influenced by population density, proximity to roads and other infrastructure.

Overall, the relationship between expected fire behavior in wildlands and the placement and design of neighborhoods in wildland areas is at the core of an effective community wildfire hazard assessment. From this process, targeted mitigation recommendations are developed that directly address the identified hazards and, if implemented, will reduce the risk of loss from a wildfire for each homeowner as well as the community as a whole.

Community hazard ratings were calculated using the National Fire Protection Association (NFPA) 1144 assessment form, and values were obtained from existing FPD CWPPs. Rating factors such as defensible space, driveway access, and building setback from steep slopes were somewhat variable throughout the community, while factors such as severe weather potential, overall topography and road widths were consistent. Each rating factor has an associated numerical value. For example, a community with a single ingress/egress is given 7 points, and a community with more than one ingress/egress is given 0 points. Communities are visually assessed in the field and the rating factor values are recorded. The values are then summed to obtain an overall hazard ranking. The higher the value is, the higher the hazard level. Hazard scores above 112 are “extreme” fire hazard, scores 71-112 are “high” hazard, 41-70 are “moderate” hazard, and scores 40 and lower are “low” hazard.

For this CWPP, we also developed a County-wide map detailing ignition risks and overall composite hazard based on data obtained from the County Spatial Database Engine (SDE). This landscape-scale analysis allows communities as well as land managers and fire personnel to view overall fire hazard in an areas that lie outside the WUI and apply mitigation recommendations accordingly. A detailed description of the methods used to develop these maps is located in Appendix A.

5 WILDFIRE MITIGATION PLAN

5.1 Mitigation Planning

Wildfire mitigation can be defined as those actions taken to reduce the likelihood of loss of life and property due to wildfire. The intent of mitigation is not to completely eliminate the risk of loss nor does it reduce the risk of a wildfire occurring. Effective wildfire mitigation enables residents to evacuate safely, homes to withstand the occurrence of wildfire, and firefighters to safely defend structures and suppress fires where possible. This can be accomplished through a variety of methods, including reducing hazardous fuels, creating defensible space around individual homes, utilizing fire-resistant building materials, enhancing emergency preparedness and response capabilities, upgrading current infrastructure, and developing programs that foster community awareness and neighborhood activism. Once implemented, these actions can significantly reduce the risk of loss due from wildfire to an individual home, and on a larger implementation scale, for an entire community.

Specific mitigation treatment recommendations for Jefferson County were adopted from existing Fire Protection District CWPPs. These recommendations are based on parameters such as wildland fuels, predicted fire behavior, infrastructure, emergency response resources, and structure ignitability. Recommendations were reviewed and approved by the core team. Project prioritization was based on public input, practicality of implementation, and proximity to existing planned and completed mitigation projects.

Communities should seek out and take advantage of opportunities to partner with local agencies or organizations to plan mitigation projects. Working cooperatively can provide communities with a higher level of technical assistance and project management.

5.2 Recommended Actions

Action items include a variety of specific recommendations that reduce ignitability of structures, make ingress and egress safer for residents and emergency personnel, remove hazardous wildland fuels from around homes, and reduce the amount of fuels in strategic locations. Many recommended action items do not involve drastic changes to the forest; simple structural maintenance and pruning are basic, but essential components to effective mitigation. In addition, this plan's recommendations are meant to apply to rural intermix and occluded properties that lie outside the WUI community boundaries. This includes residences and other structures that lie outside of FPD jurisdictions and are covered under the Sheriff's Office authority for fire suppression.

Actions on public lands can be subject to federal, state, and county policies and procedures such as adherence to the HFRA and National Environmental Protection Act (NEPA). Action on private land may require compliance with county land use codes, building codes, and local covenants. While the USFS, CSFS, JCSO, and many fire protection districts have worked hard to promote defensible space and land management, private landowners must accept responsibility for completing work on their own lands. Table 10 lists the recommended action items by category and described in further detail below.

Table 10. Action Items

Category	Action Items
Public Outreach and Education	• Encourage stakeholder participation in community meetings • Distribute Firewise and other informational materials • Assess individual homes
Building Improvements	• Replace shake roofs with fire-resistant roofing materials • Implement Firewise construction principals for new construction and remodels • Cover vents and chimneys with metal screens • Enclose exposed decks and gables, and/or use fire-resistant construction materials
Defensible Space	• Establish a fuel-free zone around homes • Establish a treated second zone that is thinned, pruned, and cleared of excess surface fuels • Extend thinning treatments to property boundary to reduce hazardous fuels • Employ defensible space practices around resources such as cisterns, draft sites, or community safety zones
Access and Egress Improvements	• Where not present, clearly mark roads and addresses with metal, reflective signs • Thin trees along main roads to avoid blockage • Create or widen turnarounds • Widen or improve narrow switchbacks • Create secondary evacuation routes where needed
Shaded Fuelbreaks	• Thin in strategic areas, such as along evacuation routes and utility right-of ways • Coordinate with adjacent public land management agencies • Identify existing breaks in vegetation to expand fuelbreak areas • Remove or treat slash by chipping, burning in piles, or hauling to collection site • Perform periodic maintenance where necessary • Incorporate additional management goals where appropriate (such as bark beetle infestation control)
Fire Department Preparedness	• Own and update County GIS • Update and distribute run books • Verify community water sources • Conduct pre-suppression planning • Conduct ongoing recruitment, training, and certification • Coordinate mutual aid strategic planning • Upgrade apparatus, facilities, and personal protective equipment when appropriate
Supporting Actions	• Explore and support grant funding opportunities • Involve Jefferson County in evacuation route improvements • Revise county statutes addressing defensible space requirements for home sales

- Coordinate with land management agency forest management plans

5.2.1. Public Outreach and Education

The most effective means of initiating local action is through community education and public outreach. Given the significant fire events in and near Jefferson County in recent years, particularly the Indian Gulch fire in the spring of 2011 and the Four Mile Fire in Boulder in September of 2010, most local residents are well-informed of the inherent fire risk in the area, but as more people move to the area, it is necessary to maintain and improve the community's knowledge of the basic principles behind wildland fire, and the actions they can implement to increase their personal safety and that of their home. Through education, homeowners are empowered to take action on their own properties, and coordinate efforts with their neighbors to maximize the efficacy of individual treatments.

Action Item: Conduct annual community meetings each spring. Community meetings held in the spring, just prior to the main fire season, can spur action by individuals and neighborhoods and allow for coordination of cleanup efforts within the community. This can also serve as a forum for presentations by experts in the field who can answer questions, provide technical guidance, and inform community members of available resources.

Action Item: Firewise materials and CSFS publications should be made available to the public at each fire station, post office, HOA, and library on a regular basis.

5.2.2. Building Improvements

The purpose of building improvements is to reduce structural ignitability. Structural ignitability is defined as the flammability of the home and its immediate surroundings. This separates the problem of WUI structure fire loss from other landscape-scale fire management issues, because highly ignitable homes can be destroyed during lower intensity wildfires, whereas homes with low structural ignitability can survive high intensity wildfires. Structural ignitability, rather than wildland fuels, is the principal cause of structural losses during wildland/urban interface fires. While reducing hazardous fuels around a structure is very important to prevent fire loss, recent studies indicate that building materials have a significant influence on whether a structure will survive a wildfire.

Key structural components that increase ignitability are flammable roofing materials (e.g. cedar shingles), flammable decks and/or siding, and the presence of burnable vegetation (e.g. ornamental trees, shrubs, wood piles) immediately adjacent to homes. The area around the home, 100-200 feet, is called the home ignition zone and is the most critical area to prepare and maintain to prevent loss from fire.

Studies of home survivability in wildfire incidents also indicate that homes with noncombustible roofs and a minimum of 30 feet of defensible space had an 85 percent survival rate. Conversely, homes with wood shake roofs and less than 30 feet of defensible space had a 15 percent survival rate. This evidence suggests that investing in building improvements to decrease the structural ignitability of the home is just as important as forest management and fuels thinning on the

property. In areas where tree removal is not desirable or possible, homeowners can still mitigate fire hazard in this way.

Action Item: All homeowners should continually keep roofs and gutters clear of leaves and pine needles. Embers from a wildfire can become windborne and travel long distances before settling, and even small amounts fine fuels on a structure can ignite and put a home at risk. Defensible space becomes inconsequential if embers cause ignition on the roof, deck, or in eaves. Clear combustible material such as firewood, trash, or woody debris from the side of the home and underneath exposed decks.

Action Item: Cover openings around the home, such as gutters, attic vents, chimneys, and areas under decks with screens to prevent the accumulation of fuels where embers can ignite the structure.

Action Item: Where possible, propane tanks adjacent or downhill from home should be relocated to a location uphill or at least 30 feet from the home (outside the home ignition zone).

Action Item: Replace wood-shake (cedar shingle) roofing with noncombustible roofing materials. Roofing materials rated as "Class A" include materials that are non-burnable or can withstand a high amount of radiant heat, and are therefore the most appropriate for homes in the assessment area. Jefferson County requires all new and replacement roofs in the WUI to be fire-resistant. Minimum Class "B" roofing material is required in a wildfire hazard area. Prior to receiving a Certificate of Occupancy (CO) for homes and structures with living quarters, and prior to final building inspection for accessory structures, all structures are required to meet the minimum defensible space requirements identified in the on-site assessment at the time of permitting.

5.2.3. Defensible Space

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 a vital component in wildfire hazard reduction. These efforts are typically concentrated within 0 to 75 feet of the home to increase the chance for structure survival and create an area for firefighters to work safely in the event of a wildfire.

Homes and neighborhoods with defensible space are much more likely to be assigned structure defense crews than those without. In general, structures that do not have defensible space do not provide adequate area for firefighters and firefighting apparatus to work efficiently and safely. The risk to human life outweighs any possible benefit of trying to defend an unsafe property. Appendix I shows the Jefferson County Structure Triage Form, which enables firefighters to quickly prioritize structure defense in a wildfire. If a structure has a score greater than 13, it is considered a "last priority" over properties with more clearance, lighter vegetation, and better access.

It is recommended that defensible space be created following the CSFS guidelines set forth in *Creating Wildfire Defensible Space Zones,* Bulletin Number 6. Refer to Appendix G for the complete CSFS defensible space guidelines and treatment area size recommendations.

Action Item: Implement defensible space around all homes and structures in the assessment area. Create a fuel-free zone approximately 15 feet wide directly adjacent to the structure, which reduces structural ignitability and reduces direct flame impingement on the structure. In a secondary zone farther out from the structure, complete pruning of ladder fuels, stand thinning, and removal of dead, dying, or diseased trees for overall stand improvement. Where possible, extend forest treatments out to property line to reduce fuel loading and enhance overall forest health.

before *after*

Figure 4. A home and surrounding property before and after the completion of defensible space action items. Photos from CSFS.

Table 11 outlines a phased 4-year implementation schedule communities can use to complete this action item.

Table 11. Community Defensible Space Implementation Schedule

Year	Project	Actions
1	Annual spring outreach	▪Contact and organize homeowners ▪Hold educational meeting about defensible space
	Annual spring/summer mitigation	▪Clean roofs and gutters ▪Trim limbs and shrubs within 3 to 5 feet of home ▪Rake and mow yard ▪Assist neighbors ▪Organize debris disposal
2	Annual spring outreach	▪Contact and organize homeowners
	Annual spring/summer mitigation	▪Clean roofs and gutters ▪Rake and mow yard ▪Organize debris disposal
3	Annual spring outreach	▪Contact and organize homeowners ▪Identify needed improvements to construction features throughout community
	Annual spring/summer mitigation	▪Where possible, coordinate projects between homeowner groups who have created defensible space and open space managed lands ▪Repeat yard maintenance & debris disposal
4	Annual spring outreach	▪Contact and organize homeowners ▪Follow up with landowners who have not completed defensible space, offer assistance
	Annual spring/summer mitigation	▪Complete any outstanding projects from previous years ▪Begin long-term maintenance (as needed, re-trim shrubs, remove small trees, etc) ▪Initiate construction feature improvements

5.2.4. Access & Egress Improvements

In addition to defensible space, it is essential for communities to have adequate access and egress. Not only does this allow for emergency personnel to access and escape properties in a wildfire, residents are also able evacuate quickly and safely when necessary. In many WUI communities, it is common for driveways, dead-ends, and switchbacks to lack adequate turnaround space for fire trucks, which compromises emergency response to properties. Golden Gate Fire adopted the 2003 International Fire Code, which details the specifications for driveways, turnouts, turnarounds, and access roads.

Clear signage for roads and addresses enable firefighters to navigate through communities they may not be familiar with, or when visibility is compromised. Tenable escape routes are essential to community wildfire safety, and therefore should be considered high-priority action items when recommended.

Action Item: Street signs and address numbers should be clearly marked and visible from the road, preferably with reflective, durable, fire-resistant materials.

Action Item: Where needed, construct or improve turnarounds on dead-end roads and in driveways. Minimum requirements for driveway access are permitted and enforced to obtain safe and reasonable access for every day vehicular use and ingress/egress of emergency vehicles.

5.2.5. Shaded Fuelbreaks

Shaded fuelbreaks are strategically located areas where fuels have been reduced in a prescribed manner in locations that can affect fire behavior on a landscape scale. Fuelbreaks are generally strategically placed where they can be as continuous as possible. To this end, they can be placed contiguously with other fuelbreaks, larger area treatments, along roads, or adjacent to natural breaks in vegetation (such as meadows or bodies of water). When defensible space, fuelbreaks, and area treatments are coordinated, the community and the adjacent natural resources are afforded an enhanced level of protection from wildfire. Fuelbreaks have been completed on several USFS and CSFS parcels within the plan area.

The CSFS provides guidelines on how to determine the width and prescription for fuelbreaks based up the type of fuel and topography. Fuelbreaks need to be tailored to the terrain, fuels, historic fire regimes and expected weather conditions of the landscape in which they are placed. 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 some species of 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. When fuelbreaks are not thinned enough to create sufficient canopy openings, the risk of crown fire is not reduced, and the fuelbreak does not meet its intended objective. The overall benefits of properly constructed fuelbreaks are however, well documented. An area near the Hayman fire that had been recently thinned successfully stopped fire from moving through the tree canopy, which significantly reduced tree mortality in that stand. Untreated areas adjacent to the treatment area burned severely, and had nearly 100% tree mortality.

Figure 5. A WUI neighborhood and forest stand affected by the Hayman fire. The green trees in the foreground with greater canopy spacing were largely unburned, while the denser forest in the background burned more severely. Photo from USFS.

Action item: All access roads flanked by heavy vegetation in WUI communities should be targeted for thinning or seasonal mowing. Treatments may be coordinated with property owners along private roads and with county and state transportation departments for public roads. Conifer regeneration along road margins should be controlled. A qualified forester or fire professional should evaluate the effectiveness and periodic maintenance of roadside mitigation.

Action item: In existing CWPPs, a strategic shaded fuelbreaks have been carefully planned for each WUI community and mapped for this CWPP. These fuelbreaks take into account expected fire behavior, workable terrain, and existing road access. When implemented, these landscape-scale fuelbreaks are meant to protect the community as a whole by reducing potential fire behavior under most weather conditions. Where possible, these fuelbreaks should be placed adjacent to completed mitigation projects.

before *after*

Figure 5. A montane forest stand in Jefferson County before and after completion of a shaded fuelbreak. Note the tree on the right side of the picture with orange flagging and the aspen tree in the background to compare the change in the stand structure. Photo from Jefferson County Emergency Management.

Action item: Natural resource managers for public lands should take into account fire hazard for adjacent WUI communities when developing or updating forest management plans.

Action item: An ecological evaluation of the status of vegetation community recovery and rehabilitation is recommended for areas affected by fires in recent years. Monitoring should focus on the presence of noxious weeds and other invasive non-native species. Reducing the presence of invasive species such as knapweed (*Centaurea* spp.) and Dalmatian toadflax (*Linaria dalmatica)* maintains natural biodiversity. In some cases, it can help maintain historic fire regimes, especially in grasslands and shrublands.

5.3 Treatment Options

Each of the recommended fuel mitigation projects can be achieved by a variety of methods. Selecting the most appropriate, cost effective option is an important planning step. The brief synopsis of treatment options and cost estimates in Table 12 is provided to assist in this process. Cost estimates for treatments should be considered as general guidelines. Costs can vary tremendously based on a variety of factors, including but not limited to:

- Acreage of project
- Proximity to structures
- Fuel costs & other equipment needs
- Treatment techniques used
- Density and type of vegetation
- Steepness of slope
- Area accessibility

Table 12. Treatment Methods

Treatment	Approximate Cost*	Comments
Machine Mowing	$90 - $200 per acre	▪Appropriate for large, flat, grassy areas on relatively flat terrain ▪Usually requires yearly treatment
Prescribed Fire	$100 - $200 per day	▪Cost-effective for larger acreage ▪Implementation requires trained professionals ▪Ecologically beneficial ▪Provides training opportunities for firefighters ▪Inherint risk of escape may be unacceptable in some areas ▪Unpredictable scheduling due to weather and smoke management contstraints
Brush Mastication	$300 - $500 per acre	▪Some brush (shrub) species, such as Gambel oak, resproout vigorously after maechanical treatment ▪Follow-up treatment with herbicides, prescribed fire, grazing, or repeat mechanical treatments are typically necessary ▪Less expensive and faster than manual treatment ▪No need to dispose of slash
Timber Mastication	$700 - $1500 per acre	▪Large diameter trees can be felled quickly over large areas ▪Less expensive and faster than manual treatment ▪No need to dispose of slash ▪Machinery usually limited to slopes <35% ▪Rough, unattractive appearance for first year post-treatment
Manual thinning and felling	$1000 - $3000 per acre	▪Not limited to slopes <35% ▪More control of specific trees removed/left ▪Allows for removal of merchantable/usable wood products, such as firewood ▪Slash must be chipped, hauled away, or burned in piles
Feller Buncher	$800 and up per acre	▪Appropriate for steep slopes with larger-diameter trees ▪Allows for removal of merchantable/usable wood products, such as firewood ▪Generally more expensive than mastication

*Costs per acre are based upon various area contractors' rates for work in the Colorado Front Range and are subject to change.

Figure 7. A feller buncher machine thinning a forest. Photo from USFS.

5.4 Project Support

Several of the recommended actions will require cooperation of various agencies that operate within a given area. Studies, monitoring, and determination of legal jurisdictions are integral to the action items recommended in this CWPP. Although this may add complexity to implementation, it should not discourage communities from pursuing these projects.

Funding and Grants: Due to the high cost of large-scale forestry projects, many landowners and communities are unable to complete complex projects such as shaded fuelbreaks. Grant support may be able to accelerate implementation of treatments. The Jefferson County Office of Emergency Management is an excellent resource for information about available grants. The website *http://www.rockymountainwildlandfire.info/grants.htm* has a searchable grants database, as well as other helpful information about wildfire.

Access/Egress Improvements: The proposed work on roadways may require further study to address engineering and environmental issues, and may be subject to the consent of adjacent landowners or County Road and Bridge.

Public Land Planning: Jefferson County Open Space, Colorado Parks and Wildlife, and the U.S. Forest Service manage forested wildlands in Jefferson County. The CWPP development process is designed to facilitate dialog with these agencies and coordinate public and private wildfire and forest management strategies. As the CWPP strategic plan is implemented, dialog and collaboration should be maintained with these agencies in order to coordinate strategies and treatments, and make adjustments if necessary. Where possible, strategic fuelbreak recommendations should be tied into completed or planned treatment areas on public lands.

Regulatory Support: One of the major issues confronting defensible space and hazardous fuels mitigation is the need for on-going maintenance of treatment areas and defensible space. County zoning resolution Section 52, page 3, paragraph G requires defensible space for new construction and project maintenance to CSFS standards outlined in the 6.302 guidelines (Appendix F). However, there is currently no system or personnel in place to monitor and enforce project maintenance. A solution could be associated with the sale of an existing home or on period of time since initial treatment. Appendix A contains a map showing the existing defensible space

and fuels mitigation projects on parcels throughout the WUI and rural intermix, symbolized by year completed. The oldest treatments should be evaluated for maintenance in order to ensure continued efficacy. For defensible space treatments to remain effective, regulatory impetus by Jefferson County Planning and Zoning is necessary and strongly recommended. The Zoning resolution is located on the Jefferson County website:
http://jeffco.us/jeffco/planning_uploads/zoning/zr_2_8_11/zr_52.pdf

Community-level Regulation: Although the zoning resolution requires defensible space implementation for new construction, there is no retroactive regulation for existing structures. Additionally, once defensible space is completed and approved by County officials, landscaping is often installed near the home that renders the mitigation ineffective. Communities or HOAs with local statutes or covenants should consider defensible space and mitigation regulations as a means to help drive fire mitigation initiative from the bottom up in the absence of local government requirements. Programs like the National Firewise program administered through the NFPA can provide helpful guidelines for implementing measures at this local level.

Figure 8. Designated Firewise community in Elk Creek Fire Protection District. This community achieved Firewise designation through grassroots effort and cooperation with Elk Creek Fire Department.

Continuing Development and Land Use Changes: Some areas of Jefferson County that are more sparsely populated are not currently included within a WUI community boundary. There are areas that will have continuing development in the coming years, which will convert rural intermix and occluded areas into WUI and subsequently change the values at risk. As these communities grow, additional WUI community boundaries should be added to reflect these changes. Although new construction in Jefferson County requires conforming defensible space, additional actions such as shaded fuelbreaks, access and egress improvements, and improved road signage should be planned and implemented as these communities grow and change in the future. As large parcels are subdivided, Jefferson County Planning and Zoning need to ensure proper implementation of fuels mitigation in new developments.

Insurance: Homeowner's insurance typically covers property losses caused by wildfire. However, individual risk factors can affect insurance premiums and availability, so cost and ability to obtain or continue to hold insurance will vary based on individual company policies. Understand what is and is not covered in your homeowner's insurance policy can affect your

ability to rebuild your home and replace your belongings. It is important to conduct a periodic policy check-up to make sure you keep up with local building costs. Adjust your coverage as needed to cover additions or remodels.

It is also strongly recommended to have a home inventory that includes lists and pictures or video of the home's contents. An up-to-date home inventory will expedite the settlement of insurance claims, verify losses for tax returns, and help determine the appropriate amount of insurance.

6 EMERGENCY OPERATIONS

6.1 Response

There are 29 fire stations in Jefferson County. Most residences in the County are located less than five miles from a fire station, and there are currently sufficient VFD personnel to respond to the numerous emergency calls they receive each year. In wildland areas outside of the WUI zones in the County, response time could be long due to rugged terrain and lack of road access. However, there is currently adequate staff and equipment to effectively handle the majority of fire and medical emergencies. Jefferson County maintains a certified Type 3 Incident Management Team for overhead support in the event of a multiple-day fire event. Should a complex fire event extend past 36 hours, a Type 2 or Type 1 IMT may be brought to the County.

According to the 2011 Jefferson County Annual Fire Operating Plan, the County and fire protection Countys are responsible for suppressing fires on all private and State lands. For initial attack, the agency which is in the best position at the time the fire is reported shall take action to respond. Responses to wildfires located in “no-man’s lands” will be consistent with the Jefferson “County Intergovernmental Agreement for Mutual Aid between Fire Departments" signed by participant fire departments in 1993. The 2011 version is currently being circulated for signing and adoption.

Mutual Aid
In the event of a more complex or extended wildfire incident, smaller fire departments may require assistance from other fire departments and government agencies. It is the responsibility of fire protection districts and other jurisdictional agencies (such as the USFS) to maintain and update their mutual aid agreements as needed. The complete definitions and limitations of local mutual aid agreements are located as an attachment in the Jefferson County Annual Fire Operating Plan.

Training and National Wildfire Coordinating Group Positions
Maintaining or increasing the level of fireline leadership requires considerable commitment from the department and its volunteers. Completion of taskbooks for wildland firefighter/incident management positions is subject to availability of wildfire assignments. Volunteer firefighter participation in prescribed fires managed by the CSFS, JCSO, and USFS provide excellent opportunities for fireline training and maintenance of qualifications and skills. The NWCG standards may be challenging to obtain in a timely manner, but can be used as a general guideline for training targets.

Example of NWCG positions & training targets:
- Year 1: Officers initiate FFT1/ICT5 taskbook. Classes: S-131, S-133
- Year 2: Officers complete FFT1/ICT5 taskbook. Engineers initiate FFT1/ICT5 taskbook.
- Year 3: Officers initiate ENGB taskbook. Engineers complete FFT1/ICT5 taskbook and classes S-290, S-230
- Year 4: Officers complete ENGB taskbook and begin working towards engine strike team leader (STEN) and ICT4. Classes: S-200, S-330. Engineers work towards ENGB as able.

- Additional courses that are not required, but recommended: S-290, S-230 (for ICT5), S- 215 (for ENGB).

Performance Standards
Firefighters that have a National Wildfire Coordination Group (NWCG) wildfire qualification of Firefighter Type 2 (FFT2) or higher must complete a yearly refresher training that includes a simulated deployment of a fire shelter and pass an arduous-level physical fitness test.

6.2 Emergency Procedures and Evacuation

In the event that the County Sheriff orders a community to evacuate because of threatening wildfire, residents should leave in an orderly manner. The Sheriff would proclaim the preferred evacuation routes and evacuation center sites. However, the need for evacuation can occur without notice when a wildfire is imminent. Homeowners should be prepared to evacuate without formal notice.

Before residents leave, they should take every precaution to reduce the chance of structure loss if time allows. Windows and doors should be closed but not locked. Other openings should be covered. A ladder should be placed for roof access by firefighters. A fully charged hose that reaches around the house should also be available for firefighter use. Porch lights should be left on to allow firefighters to find homes at night. Additional actions could include thoroughly irrigating the defensible space, watering down the roof, or removing patio furniture. However, human safety is the number one concern in an evacuation; staying too long could compromise a safe escape. Families should have preplanned meeting locations and phone numbers to call in case family members are separated. Families should take with them important papers, documents, pets, food, water, and other essential items.

Evacuation procedures vary according to subdivision. Every resident should be familiar with these procedures, including primary and secondary routes, and the location of any designated community safety zone. Pre-plans outline available evacuation centers, which are initiated by the County Sheriff's Office. These procedures should be addressed in public or HOA meetings with information eventually being distributed door to door. Agreements would need to be pre-planned with landowners to make use of these as emergency escape routes.

Upon returning to the home, the exterior of the house should be monitored for smoke for several days. Embers may lodge in small cracks and crevices and smolder for several hours or days before flaming.

Given that many Jefferson County residents own horses and other livestock, large animal evacuation centers also need to be identified prior to emergencies. The Jefferson County Horse Evacuation Assistance Team (Jeffco HEAT) is a team of highly trained volunteers that operates in the area to provide large animal evacuations in wildfires and other natural disasters. Information can be found at *http://jeffcoheat.org/.*

7 CWPP MONITORING AND EVALUATION

7.1 CWPP Adoption

The HFRA and FEMA Disaster - Mitigation Act of 2000 requires that the CWPP be formally adopted by the core team. The final draft of the revision was presented to the revision core team for comment before signing. The core team has also ensured that the plan meets CSFS minimum standards for CWPP prior to final signing by State and County officials.

With an adopted CWPP, Jefferson County, fire protection Countys, and local communities will receive additional consideration on future grant applications that can help implement the recommendations in the CWPP. While not required, an adopted CWPP may be a criterion for favorable ranking and/or a grant prerequisite of their applications.

7.2 Sustaining CWPP Efforts

Implementing and sustaining the CWPP is the key to its success. The CWPP process encourages citizens to take an active role as fuel treatment strategies continue to be developed and prioritized. Maintaining the momentum created by this process is critical to successful implementation and ongoing efforts. Local government, fire protection Countys and land management agencies are committed to supporting fire protection and emergency services within the County and surrounding areas. It is important that the County continue to provide support in maintaining hazard assessment information and emergency management coordination. Stakeholders will implement recommended actions by working with fire authorities, community organizations, private landowners, and public agencies.

Building these partnerships is necessary in identifying and prioritizing measures to reduce wildfire hazards. Maintaining this cooperation is a long-term effort that requires the commitment of all parties involved. It is crucial that citizens take an active role in identifying needs, developing strategies, and implementing solutions to address hazards, and participating in fire prevention and mitigation activities.

7.3 CWPP Oversight, Monitoring, and Evaluation

As wildfire hazard reduction efforts continue to be implemented over time, and the characteristics of WUI zones change, neighborhoods should reassess and update the findings of the CWPP. All CWPPs are meant to be living documents that change in response to the changing conditions, values, and needs of the communities. With these changes, action items may be re-prioritized or added.

Fire protection Countys and communities should be responsible for periodic CWPP monitoring and evaluation. This can be accomplished through regular meetings, public involvement, coordination with other County partners and stakeholders. Evaluation can include analysis of the effectiveness of past mitigation projects as well as recent wildfire suppression efforts, if applicable. This ongoing effort helps determine whether the CWPP goals and objectives are being met. Ultimately, the responsibility lies with the community, given that neither the USFS

nor the CSFS mandates completion of mitigation on private property. It is in the best interest of these local stakeholders to follow through and help implement the CWPP for the benefit to their communities. Table 13 provides a suggested schedule with explanation of monitoring and evaluation tasks.

Table 13. Monitoring and Evaluation Tasks

Objective	Tasks	Timeline
Risk & Hazard Assessment	▪Use reliable data that is compatible among partner agencies	Ongoing
	▪Update CWPP as new information becomes available	As needed
	▪Periodically assess wildfire risks and hazards in communities	Biennial
Fuels Reduction	▪Identify and prioritize fuels treatment projects on public land through development of a 5-year plan	As needed
	▪Track fuels reduction and defensible space projects on private land	Annual
	▪Monitor fuels redution projects along evacuation routes	Annual
	▪Track grants and other funding sources and submit appropriate applications	Ongoing
Emergency Management	▪Provide training opportunities for firefighters	Annual
	▪Review suiability and need for additional fuels reduction	Biennial
Public Outreach	▪Plan and hold Firewise education week	Annual
	▪ProvideFirewise pamphlets at public events	Ongoing
	▪Evaluate techniques used to motivate and educate private landowners	Annual

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APPENDIX A

PROJECT MAPS

Map 1. Community Base Map; Fire Protection Districts
Map 2. Infrastructure Overview and Historic Sites
Map 3. Fire Stations
Map 4. Water Features
Map 5. Community Hazard Map; WUI Community Boundaries and Ratings
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Map 21. Rate of Spread, 50^{th} Percentile Weather Conditions
Map 22. Rate of Spread, 90^{th} Percentile Weather Conditions

Map Methodology

General Information:

Data Dictionary:

Map Layers	Data Type	Source	Notes
Managed Lands State	polygon	CSFS	Kept Separate due to wildly different attributes
Documented Historic Fires	point	CSFS	Point file created and displayed with Polygons
Elevation	raster	DEM from JeffCO SDE	Symbolize in 1,000 foot incriments
Slope	raster	DEM from JeffCO SDE	Used Spatial Analyst to create layer
Aspect	raster	DEM from JeffCO SDE	Used Spatial Analyst to create layer
Firefighting water Sources	points	FPD Chiefs	Digitized or Geocoded for each region then merged
FBFM Fire Behavior Fuel Model	raster	http://www.landfire.gov/	Symbolized and displayed
Managed Lands County	polygon	JeffCO	Kept Separate due to wildly different attributes and to show origin
Flame Length 50th Percentile	raster	JeffCO Fire Modeling/Rocco Snart	Complete and maps made
Flame Length 90th Percentile	raster	JeffCO Fire Modeling/Rocco Snart	Complete and maps made
Crown fire 50th Percentile	raster	JeffCO Fire Modeling/Rocco Snart	Complete and maps made
Crown fire 90th Percentile	raster	JeffCO Fire Modeling/Rocco Snart	Complete and maps made
Rate of Spread 50th Percentile	raster	JeffCO Fire Modeling/Rocco Snart	Complete and maps made
Rate of Spread 90th Percentile	raster	JeffCO Fire Modeling/Rocco Snart	Complete and maps made
Streams	polyline	JeffCO SDE	Critical overview information
Lakes	polygon	JeffCO SDE	Critical overview information
Railroads	polyline	JeffCO SDE	Critical overview information/used in Values to protect Calculations
Roads	polyline	JeffCO SDE	Critical overview information/used in Values to protect Calculations
Trails	polyline	JeffCO SDE	Critical overview information/used in Values to protect Calculations
Historic Sites	polygon	JeffCO SDE	Critical overview information
Fire Protection Districts	polygon	JeffCO SDE	Critical overview information
Fire Stations	points	JeffCO SDE	Critical overview information
Addresses: JeffCO	points	JeffCO SDE	Critical overview information
County Boundary	polygon	JeffCO SDE	Critical overview information
Schools	points	JeffCO SDE	Critical overview information
Specific Look at FBFM TU5	raster and polygon	Raster to Point to Raster Analysis	Complete
5 mile county buffer	polygon	User Created	Used for spatial and visual extent in analysis and visualization
Managed Lands Federal	polygon	USFS	Kept Separate due to wildly different attributes
Documented Historic Fires	polygon	USFS and JeffCO	Merged and combined attribute tables
Lightning Point Density Analysis	point to raster	USGS points to KD raster analysis	Kernel Density of Point Data, Highlighting areas of high concentration
WUI- Wildland Urban Interface	polygon	Walsh CWPP's and JCD user created	Compiled from previous plans and current plans, all attribute tables and data are matched to plan attributes

Map Details:
NAD 83, State Plane Central 502
February 2010 – September 2011
County Wide CWPP project in conjunction with the Jefferson
Conservation district and Jefferson County Emergency Management

Map 1, Fire Protection Districts:

This map was created using information readily available in the Jefferson County maintained SDE. The features were imported and displayed using ArcGIS and then exported to jpegs. Fire Protection Districts are symbolized and labeled in this map to give the location of each for interpretation and visualization.

Map 2, Infrastructure overview:

This map was created using information readily available in the Jefferson County maintained SDE. The features were imported and displayed using ArcGIS and then exported to jpegs. Each of these maps contains pertinent information for Fire responders, planning officials, and the general public alike. They provide access, major roads, bridges, historical sites, railroads, and power line information for anyone who might be affected by a wildfire.

Map 3, Fire Stations:

This map was created using information readily available in the Jefferson County maintained SDE. The features were imported and displayed using ArcGIS and then exported to jpegs. Fire stations are illustrated here with Fire Protection Districts to show the distribution of stations throughout the county.

Map 4, Water Features:

Many of these features were also in past CWPP's and merged similarly to the WUI layers. Many were updated depending on the FPD's returning the latest changes provided from the latest updates. The man made water availability features had wildly different attributes and had to be merged based upon similar characteristics. These were standardized based upon the most pertinent available information and from past CWPP documents and then merged using the ArcToolbox tools.

Map 5, WUI Hazard Base Map:

Some of these features existed in the previous CWPP projects, but before this project they had never been combined into comprehensive county wide feature sets. These were standardized based upon the available information and from past Walsh CWPP shapefiles and then merged using the ArcToolbox tools. The WUI layers were merged and the hazard attributes were retrieved from past CWPP documents and updated in the attributes. They are symbolized on this map based upon their NFPA 1144 rankings.

Map 6, Past Fire Events:

The point data represented in this map was complied largely by Allen Gallamore, District Forester for the CSFS Golden District and Rocco Snart, the Jefferson County Fire Management officer. This data consisted of: name, date, location description, size, and cause. These were then located by Robin Keith and Rocco Snart and digitized and the data merged in the attribute table. The polygon layer of past fire scars was developed from a compilation of data from past CWPP's, and the JeffCO SDE. The Indian Gulch fire scar was added from March 2011 data completed during the fire.

Map 7, Managed Lands Base Map:

The data represented in this map comes from multiple sources. There are areas that were pulled from past CWPP development within Jefferson County in the WALSH plans. These were then combined with the North Fork CWPP recommendations, Jefferson county Open Space treatments, USFS treatments, and CSFS treatments. It should be noted that the Open Space and USFS treatments are in various stages from planned to complete.

Map 8, Defensible Space:

This map was completed by obtaining a database of past Defensible Space Projects, importing the excel spreadsheet into ArcMap 9.3, joining the excel to the Parcel information for Jefferson County, and then exporting the matching geography to its own shapefile. This information was then symbolized based on the year in which it was completed. The older properties should be reevaluated.

Maps 9 and 10, Slope and Elevation:

For the mapping and analysis methodology, Digital Elevation Models (DEM's) were used to create the Slope map using the Spatial Analyst extension in ArcGIS 9. The SDE had a 10 Meter DEM, but it only extended to the Jefferson County boundary and a 30 Meter DEM was obtained from Douglas County and that was used instead. The Elevation map was created just by symbolizing the 30 DEM. The 30 meter data extended beyond the Jefferson County boundary and is comparable to the LANDFIRE Data spatial accuracy of 30 Meter pixels. Having this information can be beneficial to determine areas just to the west of Jefferson County that could have conditions that would allow for catastrophic wildfire spread into the county.

Map 11, Lightning Strike Density:

This point vector data was made available as a joint effort between Douglas County, Jefferson County and the USGS. The data consists of about 225,000 points that represent the capture of latitude, longitude, and amplitude of cloud to ground strikes from 1990 – 2009. The ArcToolbox/Spatial Analyst tool/Kernel Density (points per square mile) was then used to find the areas that had concentrations of strikes over this 20 year period. This information is important because the resulting data can then be used to determine areas of high density and viewed in conjunction with other factors to determine areas of highest Fire Ignition Propensity.

Map 12, Ignition Propensity (Risk):

Ignition propensity takes into account proximity to roads, railroads, trails, and lightning density in given areas. Each of the buffers needed for roads, railroads, and trails were created using the Arctoolbox/Analysis/Proximity/Multiple Ring Buffer tool. The dissolve feature was selected to dissolve them into their own large polygon. Then these shapefiles were converted to rasters using the Arctoolbox/Conversion tools/to Raster/Polygon to Raster tool. Once converted, the distance values were converted using the Arctoolbox/Spatial Analyst Tools/Reclass/Reclassify feature. See the box below for further features. Once reclassified, the Arctoolbox/Spatial Analyst Tools/Overlay/Weighted Sum tool was used to add these various layers together into one raster dataset that has all weights added as seen in the map: Ignition Propensity. The redder areas are higher values. **Thank you to Douglas County's GIS department for their methodology. Some changes were made and different datasets used.

Ignition Risk

Distance From Rail Road	ReclassValue
>1320' or >1/4 mile	0
1320' or 1/4 mile	2
660' or 1/8 mile	3
330' or 1/16 mile	4

Lightning Density per Square Mile	Reclass Value
0 to 140	1
140 to 180	2
180 to 220	3
>220	4

Distance From Trail	Reclass Value
>330' or 1/16 mile	0
330' or 1/16 mile	3

Distance From Road	Reclass Value
>1/8 mile	0
660' or 1/8 mile	2
330' or 1/16 mile	3

Map 13, Values to Protect (Values at Risk):

The values to protect are critical infrastructure that have a "value" and need to be protected in the event of a wildfire. By doing very similar analysis as above, with different datasets, we created a density map that points out areas of high to low value to protect. The details of the datasets used are listed below. Future Analysis should include the Watershed zones of concern. **Thank you to Douglas County's GIS department for their methodology. Some changes were made and different datasets used.

Values

Address Density per Square Mile	**Reclass Value**
0 to 10	1
10 to 20	2
20 to 40	3
>40	4

Historic Sites	**Reclass Value**
>1/8 mile	0
660' or 1/8 mile	2
330' or 1/16 mile	3

Schools	**Reclass Value**
>1/8 mile	0
660' or 1/8 mile	2
330' or 1/16 mile	3

110kv Powerlines	**Reclass Value**
>1/8 mile	0
660' or 1/8 mile	2
330' or 1/16 mile	3

Maps 14 and 15, FBFM 40 and FBFM 40 Groups:

These are 2 different symbolizations of the same data provided by Landfire.gov. This dataset is broken into various types of Fuels: Non-Burnable, Grass, Grass/Shrub, Shrub, Timber Understory, and Timber Litter. For each of these groups there are subsets of each that some of which exist in Jefferson County. For the FBFM 40 map each individual fuel model is shown with an individual color. For the FBFM 40 Groups each individual fuel model is grouped into its corresponding Group to be able to visualize the distribution of these groups throughout the County.

Map 16, TU5 and Slope 20% Analysis:

Fuel models are of particular importance in establishing broad based analysis of catastrophic wildfire potential due to the fact that there are certain fuel models that can propagate ground fire to crown fire. Timber Understory 5 (TU5) is one of these fuel models that can be essential to these fires along the Front Range. Also slope angle or percentage can play a role in fire propagation. Starting with a DEM a slope percentage map was created. Then the TU5 fuel model was queried out selecting all pixels in the FBFM40 raster layer. Those selected features were exported to their own raster. Then the Slope raster layer was queried for all slopes with greater than 20%. Those were exported as well. Then all pixels were selected that had the two features in common, TU5 and slope greater than 20%. These pixels in the raster were then exported to vector points. This layer was then analyzed using the Kernel Density tool in the Spatial Analyst extension in ArcGIS 9.3.1. The results were displayed with address locations from the Jefferson County GIS SDE.

Maps 17-22, Flame length, Rate of Spread, and Crown Fire:

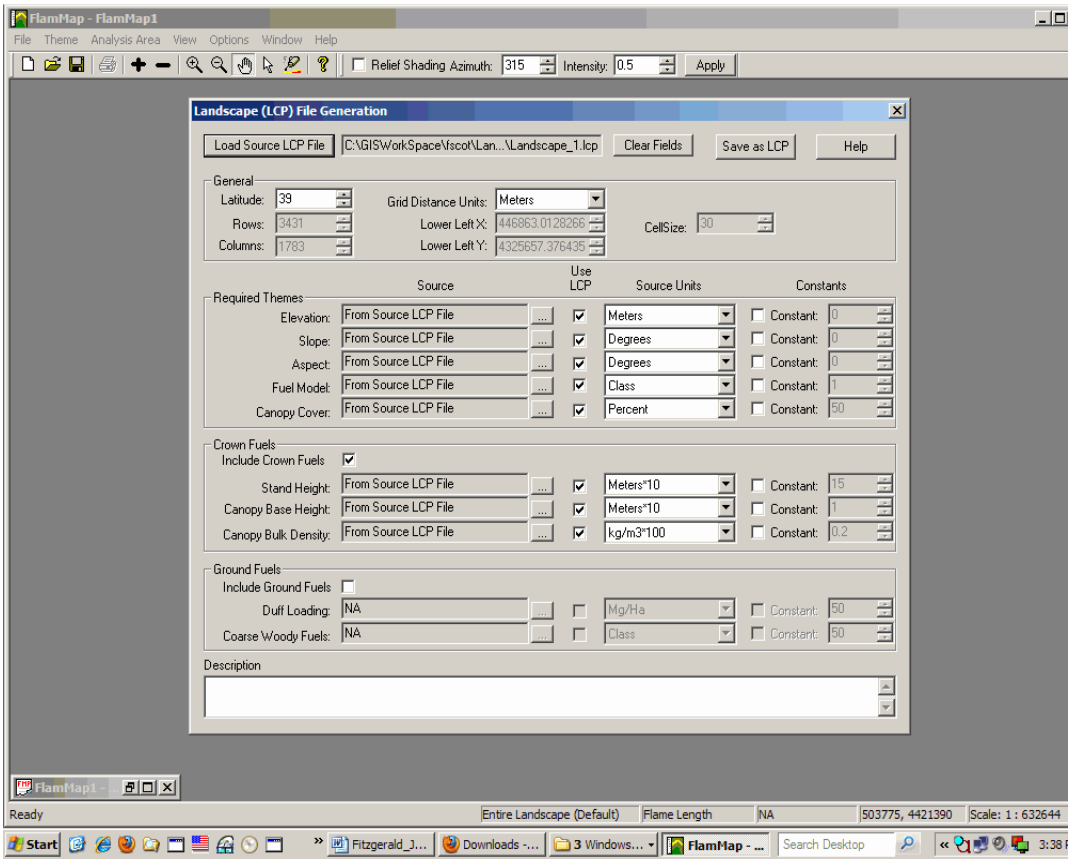
Fire Spread Potential analysis programs will be used to create fire analysis of the county, such as FlamMap3. These programs demonstrate the potential for fire given the fuels data as well as aspect, slope, elevation, fuel model, canopy cover, stand height, crown bulk density, and crown base height. Weather data is then added and can be given a static weather condition or one that varies; file for input. These programs have the ability to analyze fire potential as well as possible rate of spread, but for the purpose of the CWPP, they will be used to create 50^{th} and 90^{th} percentile weather conditions for average and worst case scenarios. These will be compared to known places of inhabitation in the WUI to visualize potential selective cutting recommendations for the neighborhoods in the future, but for now is another factor in determining areas that could be a problem in an active wildfire event.

Step 1: Import each of the needed Zones (27, 28, 33) for each file: DEM, Fuel Model, Canopy Cover, Stand Height, Crown Bulk Density, and Crown Base Height.

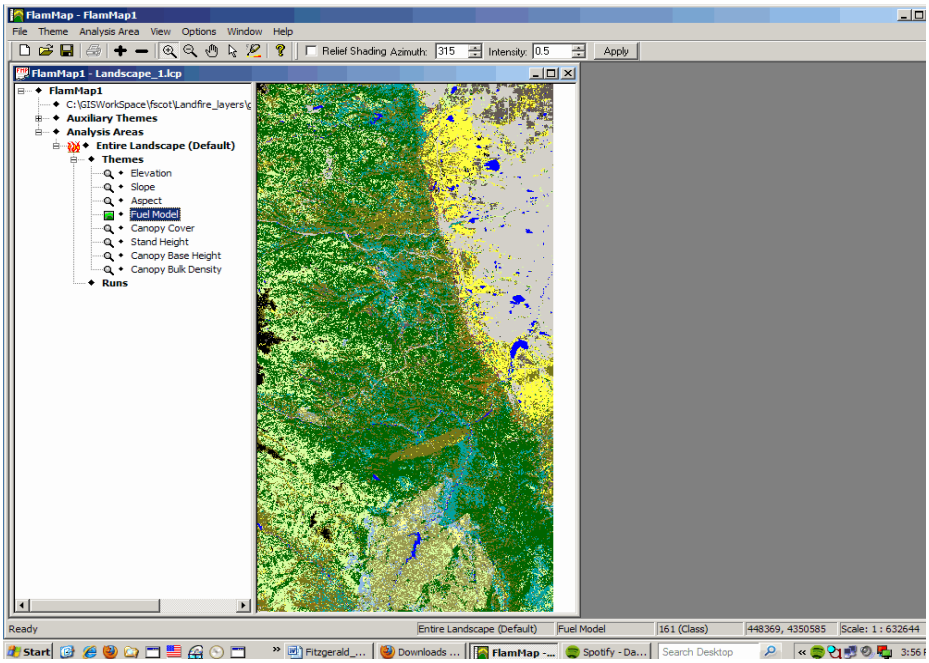
Step 2: Combine each of these Zones for each Raster File type and then export the Raster clipped to the 5 mile buffer of Jefferson County

Step 3: Convert each of the clipped Raster files to ASCII so that it can be used in FlamMap3

Step 4: Open FlamMap3 and create a landscape (.lcp) file importing each of the need layers (see image below)

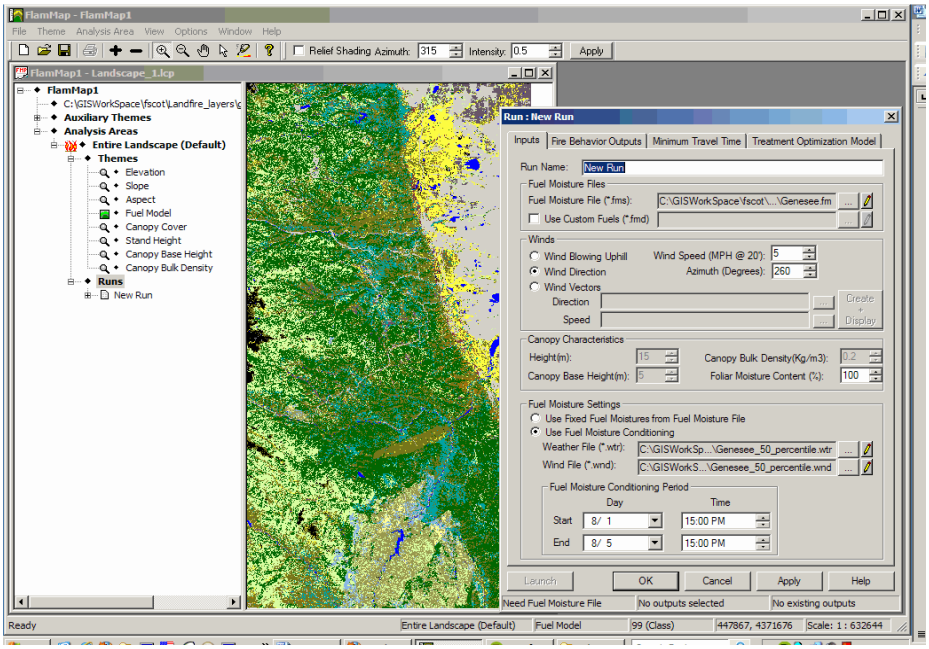


Step 5: Save the landscape file and make sure all the settings are correct for units and options

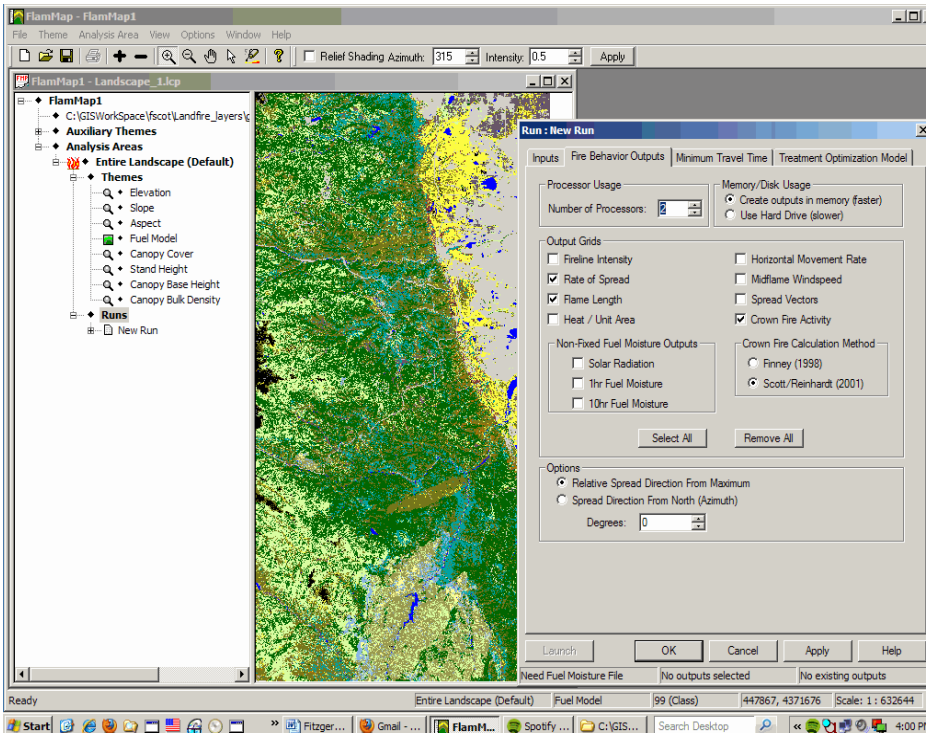


Step 6: Import the Weather (.wtr), Wind (.wnd),, and Fuel Moisture (.fms)

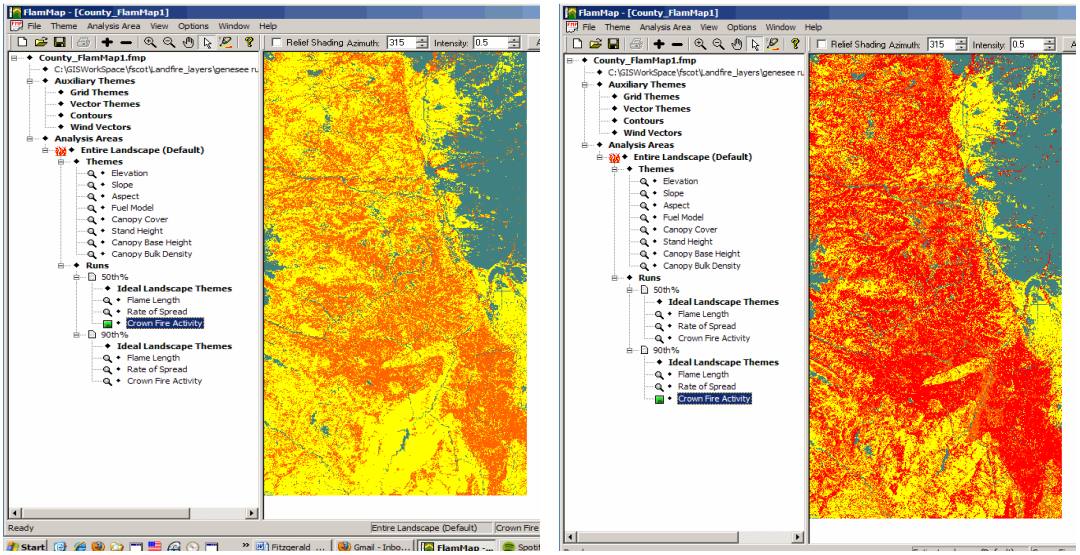
Note: Weather and Wind files are created to represent normal (50%) and extreme conditions (90%). The same fuel moisture file was used for both runs of 50th and 90th percentile weather conditions.



Step 7: Choose your Fire Behavior Outputs (rate of Spread, Flame Length, and Crown Fire Activity) and Crown Fire Calculation Method (Scott/Reinhardt 2001)



Step 8: Result are then completed and the two different runs can be compared for each type of product produced. Each of these is color ramped based upon the default color ramp established in the FlamMap3 parameters for that particular file, this can see below in Figure 5. These layers can then be exported from FlamMap3 in ASCII format to ArcGIS 9.3.1 and re-symbolized.



APPENDIX B

FIRE BEHAVIOR FUEL MODELS

version 1.0 (September 2005)

The following pages detail the FBFMs observed in the ECFPD, their unique characteristics and expected fire behavior (Scott and Burgan 2005). These pages can be used as a pull-out section for field reference.

Adjective class definitions for expected/predicted fire behavior

Adjective class	Rate of Spread (ch/hr)	Flame Length (ft)
Very Low	0 - 2	0 - 1
Low	2 - 5	1 - 4
Moderate	5 - 20	4 - 8
High	20 - 50	8 - 12
Very High	50 - 150	12 - 25
Extreme	> 150	> 25

Non-burnable fuel type models (NB)

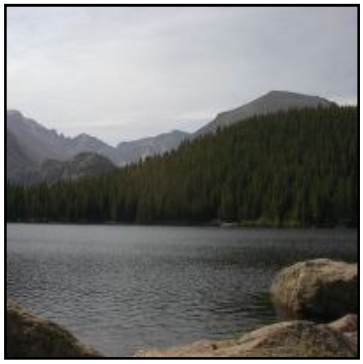
Description:
These non-burnable "fuel models" are included to provide consistency in how the non-burnable portions of the landscape are displayed on a fuel model map. In all NB fuel models there is no fuel load -- wildland fire will not spread. The gap in the NB numbering sequence is to retain fuel model numbers 98 as open water and 99 as "rock", as has been convention in the FARSITE system.

Expected fire behavior:
no fire spread

NB1 (91)
urban/developed

NB2 (92)
snow/ice

NB8 (98)
open water



GR1 (101) Short, sparse dry climate grass (dynamic)


Description:
The primary carrier of fire in GR1 is sparse grass, though small amounts of fine dead fuel may be present. The grass in GR1 is generally short, either naturally or by heavy grazing, and may be sparse or discontinuous. The moisture of extinction of GR1 is indicative of a dry climate fuelbed, but GR1 may also be applied in high-extinction moisture fuelbeds because in both cases predicted spread rate and flame length are very low (compared to other GR fuel models).

Fine fuel load (t/ac): 0.40
Characteristic SAV (1/ft): 2054
Packing ratio (dimensionless): 0.00143
Extinction moisture content (percent): 15

Expected fire behavior:
Very low to low

GR2 (102) Low load, dry climate grass (dynamic)


Description:
The primary carrier of fire in GR2 is grass, though small amounts of fine dead fuel may be present. Load is greater than GR1, and fuelbed may be more continuous. Shrubs, if present, do not affect fire behavior.

Fine fuel load (t/ac): 1.10
Characteristic SAV (1/ft): 1820
Packing ratio (dimensionless): 0.00158
Extinction moisture content (percent): 15

Expected fire behavior:
Low flame length, low to moderate rate of spread

GR4 (104)
Moderate load, dry climate grass (dynamic)


Description:
The primary carrier of fire in GR4 is continuous, dry-climate grass. Load and depth are greater than GR2; fuelbed depth is about 2 feet.

Fine fuel load (t/ac)2.15
Characteristic SAV (1/ft)1826
Packing ratio (dimensionless)0.00154
Extinction moisture content (percent)15

Expected fire behavior:
Low to moderate flame length, low to very high rate of spread

GS1 (121) Low load, dry climate grass-shrub (dynamic)


Description:
The primary carrier of fire in GS1 is grass and shrubs combined. Shrubs are about 1 foot high, grass load is low. Spread rate is high; flame length moderate. Moisture of extinction is low.

Fine fuel load (t/ac): 1.35
Characteristic SAV (1/ft): 1832
Packing ratio (dimensionless): 0.00215
Extinction moisture content (percent): 15

Expected fire behavior:
Moderate to high

GS2 (122) Moderate load, dry climate grass-shrub (dynamic)


Description:
The primary carrier of fire in GS2 is grass and shrubs combined. Shrubs are 1-3 feet high, grass load is moderate. Spread rate is high; flame length moderate. Moisture of extinction is low.

Fine fuel load (t/ac): 2.1
Characteristic SAV (1/ft): 1827
Packing ratio (dimensionless): 0.00249
Extinction moisture content (percent): 15

Expected fire behavior:
Moderate to high

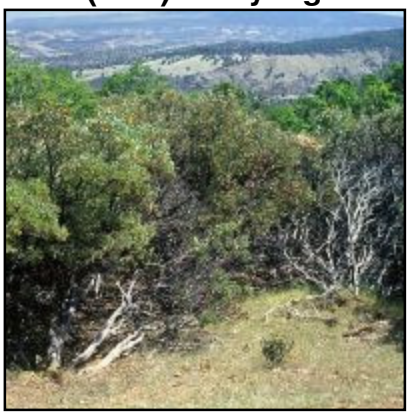
SH1 (141) Low load dry climate shrub (dynamic)


Description:
The primary carrier of fire in SH1 is woody shrubs and shrub litter. Low shrub fuel load, fuelbed depth about 1 foot; some grass may be present. Spread rate is high; flame length moderate.

Fine fuel load (t/ac): 1.7
Characteristic SAV (1/ft): 1674
Packing ratio (dimensionless): 0.00280
Extinction moisture content (percent): 15

Expected fire behavior:
Moderate to high

SH7 (147) Very high load dry climate shrub

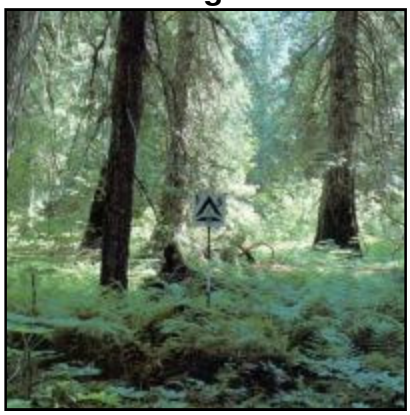



Description:
The primary carrier of fire in SH7 is woody shrubs and shrub litter. Very heavy shrub load, depth 4-6 feet. Spread rate lower than SH5, but flame length similar. Spread rate is very high; flame length very high.

Fine fuel load (t/ac): 6.9
Characteristic SAV (1/ft): 1233
Packing ratio (dimensionless): 0.00344
Extinction moisture content (percent): 15

Expected fire behavior:
Very high

TU1 (161) Low load dry climate timber-grass-shrub

Description:
The primary carrier of fire in TU1 is low load of grass and/or shrub with litter. Spread rate is low; flame length low.

Fine fuel load (t/ac): 1.3
Characteristic SAV (1/ft): 1606
Packing ratio (dimensionless): 0.00885
Extinction moisture content (percent): 20

Expected fire behavior:
Low

TU5 (165) Very high load dry climate timber-shrub


Description:
The primary carrier of fire in TU5 is heavy forest litter with a shrub or small tree understory. Spread rate is moderate; flame length high. In the Front Range, this fuel model is often associated with crown fire inititation.

Fine fuel load (t/ac): 7.0
Characteristic SAV (1/ft): 1224
Packing ratio (dimensionless): 0.02009
Extinction moisture content (percent): 25

Expected fire behavior:
Moderate to high

TL1 (181) Low load compact conifer litter


Description:
The primary carrier of fire in TL1 is compact forest litter. Light to moderate load, fuels 1-2 inches deep. Spread rate is very low; flame length very low. May be used to represent a recently burned forest.

Fine fuel load (t/ac): 1.0
Characteristic SAV (1/ft): 1716
Packing ratio (dimensionless): 0.04878
Extinction moisture content (percent): 30

Expected fire behavior:
Very low

TL3 (183) Moderate load conifer litter


Description:
The primary carrier of fire in TL3 is moderate load conifer litter, light load of coarse fuels. Spread rate is very low; flame length very low.

Fine fuel load (t/ac): 0.50
Characteristic SAV (1/ft): 1532
Packing ratio (dimensionless): 0.02630
Extinction moisture content (percent): 20

Expected fire behavior:
Very low

TL8 (188) Long-needle litter


Description:

The primary carrier of fire in TL8 is moderate load long-needle pine litter, may include small amount of herbaceous load. Spread rate is moderate; flame length low.

Fine fuel load (t/ac): 5.8
Characteristic SAV (1/ft): 1770
Packing ratio (dimensionless): 0.03969
Extinction moisture content (percent): 35

Expected fire behavior:
Low to moderate

APPENDIX C

WILDLAND-URBAN INTERFACE COMMUNITY HAZARD ASSESSMENTS & RECOMMENDED ACTION ITEMS

The purpose of this appendix is to examine, in greater detail, the communities (fire protection districts) in the study area. Most of the hazard assessments are derived from existing fire protection district CWPPs. Remaining WUI areas were delineated and assessed with a GIS weighted regression index.

Arvada

Description: Arvada Fire Protection District maintains 8 active stations throughout 41 square miles in the City of Arvada, the City of Wheat Ridge and unincorporated Jefferson County. The majority of the FPD is urban or developed, with a small portion of the district in the open plains just east of the Front Range foothills. The city of Arvada has a population of approximately 107,700, which comprises the majority of the FPD population. Lots are typically less than one acre, typical of suburban neighborhoods and subdivisions. The outlying areas extend to the west and north, and the district is surrounded by some no-man's lands and is adjacent to Rocky Flats. There are a few neighborhoods that extend into this WUI area, bordering and extending into grass fuels and relatively flat terrain.

Vegetation and fuels: The majority of the area is covered by non-wildland vegetation and fuels. Most properties have irrigated lawns and landscaping. The primary fire carriers in WUI areas are low-load grass fuels. These light, flashy fuels are easily ignited and can cause very fast-moving fires, but are relatively easy to contain with mowed fuelbreaks. A few parks and greenbelts have deciduous trees and grass and shrub understory; many of these areas also have riparian vegetation. These areas could burn under extreme fire weather conditions.

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Reduce percentage of combustible siding and decking on homes.
- Improve or expand defensible space by mowing seasonally around structures
- Enclose open areas below decks and structures to prevent embers from collecting in ignitable areas.
- Add reflective address markers to driveways and homes.
- Homeowners adjacent to open space should incorporate Firewise landscaping that can serve as a fuelbreak.

Coal Creek Canyon

Description: CCCFPD is a rural area whose boundaries contain a number of county, state, and portions of various recreation areas. The District is home to 7,000 residents, which are served by four strategically positioned fire stations. The bulk of the population resides in subdivisions with forested lots consisting of one acre or less, but some residents own large tracts of land. Rapid increase in residential growth has occurred here in recent years. The entire District lies within the WUI. The eastern portion of the District contains a mixture of industry, grazing lands, and undeveloped portions west of the City of Arvada. The upper canyon areas have very rugged topography and thick forests. A significant portion of CCCFPD contains areas of high fire hazard with respect to wildland fire potential. There are dense, continuous fuels, steep terrain, and limited access.

There are 224 miles of roadway; those in the upper canyon are circuitous and slow to navigate, typical of mountain roads. Ten percent of the roads in the District are paved, 85% are unpaved, and 5% are passable only with 4x4 vehicles. Two major state highways cross through the District; Highways 93 and 72. A major railway, now used by several rail lines, was constructed on the heavily forested hillsides in the 1880's and contains 25 tunnels within the District. As many as 28 trains per day use the rail line, some carrying hazardous materials. The presence of this infrastructure raises ignition risk throughout this area.

Vegetation and fuels: The eastern portion of the District is covered primarily by short sparse grasses. Yucca and mountain mahogany are also common. Fire is easily ignited in these fuels, and can spread rapidly. Several recent fires in CCCFPD have burned in this eastern portion of the District. The western portion of the District is covered by a mixture of montane forest cover types, dominated by ponderosa pine, Douglas-fir, and mixed conifer. Steep rocky canyons cross through the entire area, and vegetation is determined largely by slope aspect. At the highest elevations of the District, there are stands of decadent lodgepole pine, which are beginning to be affected by the Mountain Pine Beetle. Communities and homes in these dense forest types require much more extensive fuels mitigation than those at lower elevations.

Coal Creek

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Develop and maintain shaded fuel breaks along primary evacuation routes, main roads, and secondary evacuation routes.
- Strategic forest treatment and thinning zones are recommended for several stands surrounding subdivisions and several stands within subdivisions.
- Survey and note condition of turnarounds switchbacks and improve where needed for apparatus access.
- Develop secondary egress routes where subdivisions have only one way in and out.
- Improve existing power line right-of-ways.
- Implement shaded fuel break along forested zone of Eastridge Drive.
- Seek necessary emergency access permissions through Brumm Road and implement necessary road and shaded fuel break improvements.
- Forest thinning recommended on the north slope north of Burke Road and behind structures along Twin Spruce Road.
- Investigate and formalize secondary emergency evacuation route to the Hilltop subdivision. Improve where necessary.
- Associated strategic forest treatment and thinning zones are recommended for stands upslope from railroad right-of-way along Chute Road and Tunnel 19 Road.
- Develop and maintain shaded fuel breaks along upper Spruce Canyon Drive and forested access in lower portions of the subdivision.
- Develop and maintain shaded fuel breaks along forested portions of Gross Dam Road.
- Strategic forest treatment and thinning zones are recommended for stands adjacent north and east of Spruce Canyon Drive and Butte Drive.
- Install planned cistern near Loomis and Butte Drive
- Develop and maintain shaded fuelbreaks along forested portions of Ranch Elsie Road and Hilltop Drive
- Develop and maintain shaded fuel breaks along upper and lower Miramonte Roads and along forested portions of the local railroad right-of-way to buffer fire spread potential from sparking train brakes.

Edgewater

Description: The City of Edgewater Fire Department is a small all-volunteer department that covers the urban city of Edgewater, on the edge of Wheat Ridge and West Metro FPD's. Denver Fire lies immediately to the east. The area only covers less than one square mile in Jefferson County.

Vegetation and fuels: Vegetation is characterized by irrigated landscaping and other "nonburnable" fuels.

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Clear leaves and other burnable debris from gutters annually

Elk Creek

Description: The ECFPD is located west and south of Denver, and comprises approximately 98 square miles, in western Jefferson County and a small portion of eastern Park County. The District had four fire stations, serving approximately 15,000 residents. The area is generally surrounded by the Pike National Forest (South Platte Ranger District) to the south and west and private land to the north and east. Land ownership within the district is primarily private, but there are also large tracts owned by Colorado State Parks and Wildlife and Jefferson County Open Space. The local economy is dictated by the proximity and ease of access to the business and employment opportunities in the nearby Denver metro area. Most working residents commute daily to Denver, but several local businesses and tourism are economically important to the area. Numerous world-class hunting, climbing, cycling, camping, and fishing areas abound locally. US Highway 285 runs through this district, and is a critical thoroughfare from the Denver-metro area to the southwestern portion of the state. Locally, County Roads 73 and 126 are also major access roads. Many roads are unpaved and/or are only passable with four wheel drive vehicles. Remote, steep, and circuitous roadways are common, and increase response time to many communities. Communities are on or in close proximity to steep slopes and heavy fuels. The southern part of the District burned in the Hi-Meadow fire in 2000, and the area still bears the striking characteristics of the high-severity fire.

Vegetation and fuels: The vegetation in this District is characteristic of the montane and subalpine life zones. The majority of the area is covered by forest dominated by ponderosa pine. On north aspects, Douglas-fir is co-dominant with ponderosa pine. Open meadows and drier sites, as well as previously burned areas, are dominated by short prairie grasses and shrubs. In the upper montane and subalpine zones, dense mixed conifer and lodgepole pine stands are prevalent. Much of the area has gone undisturbed by logging, fire, or insect outbreaks for more than 100 years, which has resulted in a buildup of dense, heavy fuels, particularly in the western half of the District. Much of the area is rated as high fire hazard due to the combination of steep, rugged topography and heavy fuels.

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Develop and maintain shaded fuel breaks along primary evacuation routes, main roads, and secondary evacuation routes.
- Strategic forest treatment and thinning zones are recommended for several stands surrounding subdivisions and several stands within subdivisions.
- Survey and note condition of turnarounds switchbacks and improve where needed for apparatus access.
- Develop secondary egress routes where subdivisions have only one way in and out.
- Improve existing power line right-of-ways.
- Add reflective addressing to all driveways and homes.
- Work with property owners to add apparatus pullouts on narrow access roads.
- Work with private property owner to improve and maintain emergency egress route between Swiss Village and Amerind Springs WUI communitutes.

Elk Creek

Recommendations (continued):

- Install shaded fuelbreak northwest of Buena Vista Drive and south of Sunlight Lane; tie fuelbreak to the meadows on the north and south sides of the Apache Springs WUI.
- Improve Evergreen Drive to create egress route into Conifer High School
- Complete shaded fuelbreak south of Snyder; tie to private roads and light fuels in the subdivision near the highway.
- Complete additional patch cuts in lodgepole west of Black Mountain Road and south of the end of Greening.
- Create small patch cut openings where Aspen saplings are growing, to encourage reestablishment of Aspen groves.
- Work with property owners to connect the end of Elk Haven Road to Calfee Gulch for a secondary emergency egress.
- Complete shaded fuelbreak north of Roman Nose to Pleasant Park Road.
- Complete shaded fuelbreak between Edward's Drive and Christopher Drive
- Complete shaded fuelbreak from Douglas Ranch Road east to the meadow that borders the Sunset WUI.
- Complete shaded fuelbreak to the west of Eagle Cliff Road, connecting the large meadows.
- Build emergency access/egress route between Eagle Cliff and Hillview WUI communities from the end of Wild Heart to Fairall Road.
- Complete emergency access/egress between Elk Falls Ranch and Woodside WUI communities through meadow off of Elk Creek Road.
- Complete shaded fuelbreak from the end of Elk and Deer Trails east to Conifer Ridge, in the Richmond Hill WUI.
- Complete shaded fuelbreak on the south end of Jubilee to Pine Valley Road.
- Extend shaded fuelbreak treatments to the adjacent Butterfield Ranch property.
- Complete shaded fuelbreak between Pine Junction and Mountain View WUI communities northwest of Iroquois Trail, from Parker Road to the meadows.
- Complete shaded fuelbreak from Pine Junction commercial area at Mount Evans Boulevard and US Highway 285, west across Wandcrest Avenue to the meadow in the Lion's Head subdivision.
- Complete shaded fuelbreak from Conifer Ridge Road west to Deer Trail in the Green Valley WUI.
- Build emergency egress road from Gold Spur to Upper Ridge Road in the Upper Ridge Road WUI.
- Connect private driveway off Sunset Drive (off Wamblee Valley Road in Wamblee Valley WUI) to the end of Sunset Drive to create an emergency egress for both communities.
- Initiate community effort to reach seasonal residents for fuels mitigation

Evergreen

Description: Evergreen is an unincorporated community of approximately 40,000 people, and is located in the Front Range of west-central Jefferson County. The EFPD serves 126 square miles of suburban and rural WUI. The majority of the WUI is within the Jefferson County portion of EFPD. Fifty-two square miles of the EFPD lie within east Clear Creek County. The EFPD is mountainous and heavily forested, and also relatively densely populated. Elevation is approximately 6,720 to 10,500 feet. The three major highways in the District are I-70, CR73, and CR 74 (Evergreen Parkway). Evergreen attractions include Evergreen Lake, downtown Evergreen with historic buildings, miles of hiking trails, the Evergreen and Hiwan Golf courses, and the close proximity to Mount Evans and Echo Mountain Park. Evergreen is surrounded by thousands of acres of forested land in the Denver Mountain Parks, Jefferson County Open Space, and Arapahoe-Roosevelt National Forest. WUI delineations focus on neighborhoods, and detailed hazard ratings are located in the EFPD CWPP that was completed in 2007.

Vegetation and fuels: The vegetation in this District is characteristic of the montane and subalpine life zones. The majority of the area is covered by forest dominated by ponderosa pine. On north aspects, Douglas-fir is co-dominant with ponderosa pine. The area is also interspersed with open meadows and drier sites that are dominated by short prairie grasses and shrubs. In the upper montane and subalpine zones, dense mixed conifer and lodgepole pine stands are prevalent. Much of the area has gone undisturbed by logging, fire, or insect outbreaks for more than 100 years, which has resulted in a buildup of dense, heavy fuels, particularly in the western half of the District. Much of the area is rated as high fire hazard due to the combination of steep, rugged topography and heavy fuels.

Evergreen

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Develop and maintain shaded fuel breaks along primary evacuation routes, main roads, and secondary evacuation routes.
- Strategic forest treatment and thinning zones are recommended for several stands surrounding subdivisions and several stands within subdivisions.
- Survey and note condition of turnarounds switchbacks and improve where needed for apparatus access.
- Develop secondary egress routes where subdivisions have only one way in and out.
- Improve existing power line right-of-ways.
- Complete shaded fuelbreaks west of Beaver Brook on saddles between Saddleback Mountain and Santa Fe Mountain
- Emergency access W. Beaver Brook Road to Santa Fe Mt. Road; E. Beaver Brook Road to Elm Green Road; High School to Elm Green Road; out-of-district with Clear Creek County-Sawmill Creek Rd to I-70 corridor
- Develop and maintain emergency access from Meadow to Old Squaw Pass
- Develop and maintain emergency access between Ruby Ranch and Humphrey
- Develop and maintain emergency access to Old Squaw Pass Road through Castlewood Gulch
- Develop and maintain emergency access routes between Troutdale Scenic Drive and Wildflower and Upper Bear Creek; and between Upper Bear Creek and Stagecoach
- Develop and maintain emergency access routes from Fern Gulch to Independence and Hilltop to Independence
- Develop and maintain emergency access options for Brook Forest to Bluebell (Buffalo Park) and/or Fawn Path/Weasel to Stransky Ranch
- Develop and maintain a emergency access between Gray Hawk, Lynx Lair and Frog Hollow
- Fuel reduction in identified Frog Hollow treatment area (see EFPD CWPP)
- Develop and maintain a emergency access between South Keystone and Kittredge Park

Fairmount

Description: The FFPD serves approximately 24 square miles of primarily suburban and rural interface at the westernmost edge of the greater Denver metro area. The district is bounded by the City of Arvada to the northeast, Wheat Ridge to the east, and the City of Golden to the south. Open foothills extend past the western district boundary. Elevation ranges from 5,500 to 7,000 feet. North Table Mountain, managed by Jefferson County Open Space, dominates the central portion of the district, covering over 2,100 acres at its base and over 1,000 acres of summit plateau. The Dakota Hogback, which runs along the District's western margin, is another significant topographic feature of the area. Major industrial infrastructure includes Coors Brewing facilities, Coors Technical Center, aggregate mining operations, and a variety of commercial manufacturing and warehousing facilities with supporting transportation infrastructure of highways and railroads. The district is characterized by suburban expansion into rural agriculture and open prairie. Several neighborhood margins are directly adjacent to open prairie where potential fire behavior is characterized by rapid rates of spread. As is typical of Colorado Front Range WUI zones, neighborhoods often extend into foothill valleys, canyons, and mountain slopes with restricted access and limited emergency water supplies. In the FFPD, these neighborhoods are located on the district's western margins where topography, access, fuels, and available resources may impact suppression efforts in the event of a wind-driven wildfire ignition.

Vegetation and fuels: The predominant wildfire fuels in the FFPD are grass and shrubs. Short grass prairie species comprise the predominant vegetation. Native shrubs, such as Yucca and mountain mahogany, are intermixed with grasses on higher slopes in the western part of the District. Fire is easily ignited in these fuels, and can spread rapidly. Several recent fires in FFPD have burned in these fuel types in the District. Deciduous species, such as aspen and cottonwood, are found in riparian drainages and ponderosa pine stands are found only along the district's higher western boundary.

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Reduce percentage of combustible siding and decking on homes.
- Improve or expand defensible space by mowing seasonally around structures
- Enclose open areas below decks and structures to prevent embers from collecting in ignitable areas.
- Homeowners adjacent to open space should incorporate Firewise landscaping that can serve as a fuelbreak.
- Complete shaded fuelbreak along upper portion of Indian Head Road.
- Complete fuel reduction in prairie areas where shrubs are encroaching on access routes and structures. Mowing and Grazing are both effective methods of mitigation in these areas.

Foothills

Description: Foothills FPD stretches from Clear Creek Canyon south to Bear Creek Canyon and is bisected by 8 miles of I-70. Approximately 5,000 residents live within the 25.2 square miles of the District. It lies in the foothills to the west of the Denver metropolitan area, with elevations between 6,000 and 8,200 feet. The district is characterized by a decentralized network of neighborhoods and roads running through the mountainous forest and shrublands. Communities within the district include Mount Vernon, Paradise Hills, Cody Park, and Idledale. Many Denver television and radio stations have transmission towers located on Lookout Mountain and Mount Morrison, but there is little other commercial or industrial development within the district. The FFPD is largely surrounded by over 20,000 acres of city and county parks and open space lands. These parks are important local assets as well as a draw for visitors. The Denver Mountain Parks (DMP) located within or adjacent to the FFPD include Genesee, Corwina, O'Fallon, Little, and Red Rocks Parks. The Jefferson County Open Space Parks include Lair O' the Bear, Mount Falcon, Matthews/Winters, Apex, Windy Saddle, and Clear Creek. Other local attractions include the Mother Cabrini Shrine, Buffalo Bill's Gravesite, and bison and elk herd pens. FFPD also responds to an additional 7,552 acres outside of its district in the surrounding "no-man's lands".

Vegetation and fuels: The easternmost portion of the District is covered primarily by short sparse grasses with little tree cover. The majority of the District is primarily covered by ponderosa pine woodlands. On north aspects, Douglas-fir is co-dominant with ponderosa pine, and forests are denser. Overall, forest vegetation is broken by open meadows and shortgrass prairies. Although fuels are lighter and less continuous than in districts at higher elevations farther west, fire can ignite and spread rapidly in the dominant fuel types in this District.

Foothills

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Reduce percentage of combustible siding and decking on homes.
- Improve or expand defensible space by mowing seasonally around structures and clearing woody vegetation.
- Enclose open areas below decks and structures to prevent embers from collecting in ignitable areas.
- Widen turnarounds and pullouts for emergency vehicles on access roads where needed.
- Develop and maintain shaded fuel breaks along primary evacuation routes, main roads, and secondary evacuation routes.
- Strategic forest treatment and thinning zones are recommended for several stands surrounding subdivisions and several stands within subdivisions.
- Improve access and egress for Cody Park
- Develop secondary egress routes where subdivisions have only one way in and out.
- Complete shaded fuelbreak between Lower Moss Rock and Summit Ranch
- Develop emergency egress route linking Cold Springs Road to Holy Court.
- Complete shaded fuelbreak from Spruce Road east to Silver Willow.
- Create small patch cut openings where Aspen saplings are growing, to encourage reestablishment of Aspen groves.

Genesee

Description: The GFPD is relatively small, covering 10 square miles, but densely populated by county standards. Population is approximately 3,700 with a per square mile density of 555.5 and 234.6 housing units per square mile. The district is covered by a lattice of paved roads that connect the neighborhoods to I-70 along the area's northern perimeter. Genesee is known for its predominance of upscale homes and the majestic conifers that surround them. Denver Mountain Parks and Jefferson County Open Space manage adjacent public lands on the northwest and south district margins. The town of Evergreen lies just to the west of this community.

Vegetation and fuels: The majority of the District is primarily covered by ponderosa pine woodlands with grassy understory. Some areas have old-growth ponderosa pine trees that exceed three feet in diameter. On north aspects, Douglas-fir is co-dominant with ponderosa pine, and forests are denser. Overall, forest vegetation is broken by open meadows and shortgrass prairies.

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Improve or expand defensible space by mowing seasonally around structures and clearing woody vegetation.
- Develop and maintain shaded fuel breaks along primary evacuation routes, main roads, and secondary evacuation routes.
- Strategic forest treatment and thinning zones are recommended for several stands surrounding subdivisions and several stands within subdivisions.
- Survey and note condition of turnarounds switchbacks and improve where needed for apparatus access.
- Install reflective, fire-resistant address numbers and road signs.
- Clearly mark all fire hydrants
- Develop secondary egress routes where subdivisions have only one way in and out.
- Improve existing power line right-of-ways.
- Thinning in existing and potential treatment zones identified in the Streamside Open Space and Genesee Vista, Trail and Ridge intersections.
- Maintain and improved existing shaded fuel breaks to include extending treatment zones (see Genessee FPD CWPP), surface fuel reduction, and reducing conifer reproduction.
- Complete shaded fuelbreak in stands south of Montane Drive, and east on the slopes leading to Sawmill Gulch.

Golden

Description: Although not a fire protection district**,** the City of Golden and the surrounding FPD encompasses 9 square miles west of the Denver metropolitan area. Golden Fire is a municipal combination of fire departments. Golden is a rapidly growing city of over 17,160 people, with numerous businesses large and small, as well as numerous schools including the Colorado School of Mines. As the county seat, it is also home to county offices and facilities including the jail. The landscape rises steeply from the rolling open grasslands to mesas and peaks ranging from 6,200 to 7,500 feet. The District is surrounded by more than 7,500 acres of city and county open space, including North Table Mountain, South Table Mountain, Mount Galbraith, Windy Saddle, Apex, Matthews/ Winters Park, and Lookout Mountain Nature Center. Lakewood's 2,500 acre Green Mountain Park is adjacent to the southern end of the area. Outdoor recreation is an important draw for residents and visitors, in addition to the historic downtown area.

Vegetation and fuels: Large portions of the area is covered by non-wildland vegetation and fuels. Most residential properties have irrigated lawns and landscaping. The primary fire carriers in WUI areas are low-load grass fuels. These light, flashy fuels are easily ignited and can cause very fast-moving fires, but are relatively easy to contain with mowed fuelbreaks. A few parks and greenbelts have deciduous trees and grass and shrub understory; many of these areas also have riparian vegetation. These areas could burn under extreme fire weather conditions. The open space areas are mostly characterized by open shortgrass prairie mixed with shrubs. Fire is easily ignited in these fuels, and can spread rapidly. Several recent fires in Golden Fire District have burned in these fuels.

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Clear leaves and other burnable debris from gutters annually.
- Reduce percentage of combustible siding and decking on homes.
- Improve or expand defensible space by mowing seasonally and removing woody debris from around structures.
- Mow along public walking paths to maintain fuel breaks.
- Enclose open areas below decks and structures to prevent embers from collecting in ignitable areas.
- Homeowners adjacent to open space should incorporate Firewise landscaping that can serve as a fuelbreak.

Golden Gate

Description: The GGFPD is located 5 miles west of Golden, CO, and comprises approximately 49 square miles, in northern Jefferson County. Approximately 500 homes and about 1200 residents are served by two fire stations. The district is bordered on the east by the City of Golden and rural Gilpin County to the west. Elevation ranges from 6500 to 9000 feet. Land ownership within the district is primarily private, but there are also large tracts owned by Colorado Parks and Wildlife and Jefferson County Open Space. The primary access to the district is via Golden Gate Canyon Road. Outdoor recreation is an important draw for residents and visitors, particularly in Golden Gate State Park. The area is home to several historic ranch and mining sites, in addition to modern upscale subdivisions and ranchettes. The local economy is dictated by the proximity and ease of access to the business and employment opportunities in the nearby Denver metro area. Most working residents commute daily to Denver, as there is little commercial development in this district.

Vegetation and fuels: Vegetation in this district is highly variable, and typical of the montane zone of the Front Range of the Rocky Mountains. The majority of the District is primarily covered by ponderosa pine woodlands. On north aspects, Douglas-fir is codominant with ponderosa pine, and forests are denser. Overall, forest vegetation is broken by open meadows and shortgrass prairies. Although fuels are less continuous than in neighboring districts at higher elevations and farther west, fire can ignite and spread rapidly in the dominant fuel types in this District. In the highest elevations of GGFPD, very dense mixed conifer and lodgepole pine stands are prevalent. Many of these stands have gone undisturbed by logging, fire, or insect outbreaks for more than 100 years, resulting in a buildup of dense, heavy fuels.

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Develop and maintain shaded fuel breaks along primary evacuation routes, main roads, and secondary evacuation routes.
- Strategic forest treatment and thinning zones are recommended for several stands surrounding subdivisions and several stands within subdivisions.
- Survey and note condition of turnarounds switchbacks and improve where needed for apparatus access.
- Develop secondary egress routes where subdivisions have only one way in and out.
- Improve existing power line right-of-ways.
- Install reflective, fire-resistant road signs and address numbers where they are lacking; improved, consistent signage is needed throughout most of GGFPD
- Assign road names to private roads that provide access to more than three private properties, as is dictated by County Planning and Zoning.

Golden Gate

Recommendations (continued):

- On smaller parcels, create small patch cut openings where Aspen saplings are growing, to encourage the reestablishment of Aspen groves.
- Complete patch cuts on the west side of Bear Paw Road.
- Complete shaded fuelbreak on the west side of Douglas Mountain Drive.
- Thin in gullies below Douglas Mountain Drive to protect access.
- Complete shaded fuelbreaks on the ridge south of Drew Hill Road.
- Complete shaded fuelbreak north of Spirit Ranch Road, parallel to the large meadow, and tie to private access road off of Drew Hill Road.
- Thin vegetation along Spirit Horse Trail; extend thinning into open meadows where possible.
- Complete shaded fuelbreak from Golden Gate Canyon Road north along Horseradish Gulch Road, on the north side of the draw.
- Complete secondary access/egress from private drive at the northern end of the WUI to the end of Summer Star Lane in the Window Rock WUI.
- Complete shaded fuelbreak on the north side of Misty Road; tie thinned areas to meadows and previously completed mitigation work areas.
- Complete access road improvement on private road that connects Misty Road with Homestead Road, to create a passable loop.
- Thin slopes below homes on Calle Louisa and along the steep driveways off the eastern portion of Robinson Hill Road.
- Complete shaded fuelbreak in the northeast corner of the WUI, on the north aspect of the drainage, south of Golden Gate Canyon Road.
- Improve the secondary access to Guy Hill Road.
- Complete shaded fuelbreak at the intersection of Golden Gate Canyon Road and Rye Gulch Road; tie into open meadows.
- Clear and maintain private road loop at the end of The Gulch Road to provide additional emergency egress route to spur of Crawford Gulch Road.

Indian Hills

Description: The IHFPD encompasses approximately 11 square miles (7040 acres) in central Jefferson County. The population of Indian Hills is approximately 1,500 or just over 600 homes. Elevation ranges from 6,000 and 8,050 feet along the Parmalee Gulch road between US 285 and CR 74. Sixty five percent of the district is private land. The remainder is public land, predominantly Jefferson County open space and Denver Mountain Parks land. This district is bounded by over 7,000 acres of public lands and is within 10 miles of both the Pike and Arapaho National Forests. While most residents of this community commute to jobs in nearby Denver, several businesses, churches, a summer camp, and an elementary school lie within this valley. Recreation is also economically important to the surrounding area.

Vegetation and fuels: Vegetation in this district is highly variable, and typical of the montane zone of the Front Range of the Rocky Mountains. The majority of the District is primarily covered by ponderosa pine woodlands. On north aspects, Douglas-fir is codominant with ponderosa pine, and forests are denser. Overall, forest vegetation is broken by open meadows and shortgrass prairies. Although fuels are less continuous than in neighboring districts at higher elevations and farther west, fire can ignite and spread rapidly in the dominant fuel types in this District. In the highest elevations of IHFPD, very dense mixed conifer stands are present, many of which have gone undisturbed by logging, fire, or insect outbreaks for more than 100 years, resulting in a buildup of dense, heavy fuels in some areas.

Indian Hills

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Develop and maintain shaded fuel breaks along primary evacuation routes, main roads, and secondary evacuation routes.
- Strategic forest treatment and thinning zones are recommended for several stands surrounding subdivisions and several stands within subdivisions.
- Survey and note condition of turnarounds switchbacks and improve where needed for apparatus access.
- Develop secondary egress routes where subdivisions have only one way in and out.
- Improve existing power line right-of-ways.
- Install reflective, fire-resistant road signs and address numbers where they are lacking.
- Visibly mark hydrants where obscured.
- Work with property owners to add apparatus pullouts on narrow access roads.
- Create small patch cut openings where Aspen saplings are growing, to encourage reestablishment of Aspen groves.

Inter-Canyon

Description: The Inter-Canyon FPD is located in central Jefferson County covering approximately 55 square miles. The district is bounded on the east near the Dakota Hogback, and extends west of US Highway 285. The northern boundary is just south of Marshdale. The district extends south to within a few miles of Waterton Canyon and the South Platte River. Elevation ranges from 5,600 to 8,900 feet. A few small businesses, churches, and camps are located within the district but most working residents commute to the Denver area. Recreation is also economically important to the area with numerous outdoor recreation getaways on nearby county, federal, and private lands.

Vegetation and fuels: The vegetation in this District is characteristic of the montane and subalpine life zones. Vegetation varies from shortgrass prairie and oakbrush shrublands in the easternmost portion of the District to montane forest. The majority of the area is covered by forest dominated by ponderosa pine. On north aspects, Douglas-fir is codominant with ponderosa pine. Open meadows and drier sites, as well as previously burned areas, are dominated by short prairie grasses and shrubs such as Gambel oak. In the upper montane and subalpine zones, dense mixed conifer and lodgepole pine stands are prevalent. Much of the area has gone undisturbed by logging, fire, or insect outbreaks for more than 100 years, which has resulted in a buildup of dense, heavy fuels, particularly in the western half of the District. Much of the area is rated as high fire hazard due to the combination of steep, rugged topography and heavy fuels.

Inter-Canyon

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Develop and maintain shaded fuel breaks along primary evacuation routes, main roads, and secondary evacuation routes.
- Strategic forest treatment and thinning zones are recommended for several stands surrounding subdivisions and several stands within subdivisions.
- Survey and note condition of turnarounds switchbacks and improve where needed for apparatus access.
- Develop secondary egress routes where subdivisions have only one way in and out.
- Improve existing power line right-of-ways.
- Install reflective, fire-resistant road signs and address numbers where they are lacking.
- Complete shaded fuelbreak between Andrea Lane and North Turkey Creek Road.
- Complete shaded fuelbreak on slope west of US 285, behind ICFPD Station 3.
- Complete shaded fuelbreak mid-slope along City View Drive Complete shaded fuelbreak along east side of Denver Mountain Parks property just west of Hilldale Pines subdivision.
- Improve secondary evacuation access from Trappers Mountain to Sunburst Road/Sampson Road
- Improve secondary evacuation access from Lockheed Martin via primary drainage and 4WD trail to the east.
- Establish and improve secondary evacuation routes to Hilldale Pines (Goins Rd) and South Jennings Road
- Establish and improve secondary evacuation route north from Oak View Trail to West Ranch Trail.
- Implement forest stand thinning downhill and northeast of upper Starlight Drive and Ridgeview Drive.
- Secondary evacuation route development/ improvement from Sunburst to Trapper's Mountain and Sunburst to water tank above Lockheed Martin.
- Complete shaded fuelbreak along the lower portion of Sampson Road and east of Hunter's Ridge.

Lakeside

Description: Lakeside Fire District covers 0.2 square miles in the suburban west Denver-metro area. There are only 20 residents in this district, on small developed lots less than one acre. The area also contains historic Lakeside Amusement Park, which has been in operation since 1908.

Vegetation and fuels: Vegetation is characterized by irrigated landscaping and other "nonburnable" fuels.

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Clear leaves and other burnable debris from gutters annually.

Littleton

Description: Littleton Fire Rescue serves a 92 square-mile area including the City of Littleton, the Littleton Fire Protection District, and Highlands Ranch Metro District. This suburban area comprises much of the southwest Denver-metro area. The population is approximately 220,000 people. In 2010, LFR responded to more than 12,000 calls for service from eight fire stations located throughout the service area; seventy percent of those calls were medical emergencies. Major roadways in the District are C-470, US 85, and CR 121. The densely populated suburban neighborhoods here are bordered to the south by Deer Creek Canyon Open Space Park, Roxborough State Park, and Chatfield State Park. These popular recreation sites near Denver draw thousands of visitors to the area.

Vegetation and fuels: The predominant wildland vegetation in the LFPD is shortgrass prairie and shrubland. Short native grasses and Gambel oak (scrub oak) cover large areas in the westernmost portion of the district. These light, flashy fuels are easily ignited and can cause very fast-moving fires. Parks and greenbelts have deciduous trees and grass and shrub understory; many of these areas also have riparian vegetation. These areas could burn under extreme fire weather conditions. A large portion of the area is covered by non-wildland vegetation and fuels. Most properties have irrigated lawns and landscaping.

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Reduce percentage of combustible siding and decking on homes.
- Improve or expand defensible space by mowing seasonally around structures.
- Mow along public walking paths to maintain fuel breaks.
- Clear leaves and other burnable debris from gutters annually.
- Enclose open areas below decks and structures to prevent embers from collecting in ignitable areas.
- Homeowners adjacent to open space should incorporate Firewise landscaping that can serve as a fuelbreak.
- Complete fuelbreaks on hillsides where Gambel oak is encroaching onto access roads and structures.

North Fork

Description: North Fork Fire Protection District covers 306 square miles in Southern Jefferson and Northwest Douglas Counties. It is the largest FPD in the County, and Pike National Forest composes 80% of the District. It is mostly rural, with small isolated communities scattered throughout. It contains the historic town of Pine Grove, as well as the communities of Buffalo Creek, Spring Creek, Deckers, and North Rainbow Falls. The population is approximately 1700, but it is estimated that Pike National Forest has over one million visitors to the South Platte National Forest District, which is located here, every year. North Fork Volunteer Fire Department maintains three stations, and the majority of homes in the district are located less than five miles from a fire station. Numerous homes are also located along the South Platte River, and scattered private inholdings are interspersed throughout the National Forest. The burn areas of the Hayman and Buffalo Creek Fires are major features of this area.

Vegetation and fuels: The vegetation in this District is characteristic of the montane and subalpine life zones. The majority of the area is covered by forest dominated by ponderosa pine. On north aspects, Douglas-fir is co-dominant with ponderosa pine. Open meadows and drier sites, as well as the large previously burned areas, are dominated by short prairie grasses and shrubs. In the upper montane and subalpine zones, dense mixed conifer and lodgepole pine stands are prevalent. Much of the area has gone undisturbed by logging, fire, or insect outbreaks for more than 100 years, which has resulted in a buildup of dense, heavy fuels. Much of the area is rated as high fire hazard due to the combination of steep, rugged topography and heavy fuels.

North Fork

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Develop and maintain shaded fuel breaks along primary evacuation routes, main roads, and secondary evacuation routes.
- Strategic forest treatment and thinning zones are recommended for several stands surrounding subdivisions and several stands within subdivisions.
- Survey and note condition of turnarounds switchbacks and improve where needed for apparatus access.
- Develop secondary egress routes where subdivisions have only one way in and out.
- Improve existing power line right-of-ways.
- Initiate community effort to reach seasonal residents for fuels mitigation
- Complete ½-mile long shaded fuelbreak along Crystal Ridge Road
- Thin trees along Park Ave.from S. Elk Creek Road to Pine Valley Road
- Complete shaded fuelbreak/roadside thinning between the east side of Pine Valley Road (CR 126) and the private access roads within the rural intermix boundary south of Eagle's Gate Road to Crystal Lake Road
- Install reflective, fire-resistant street signs and house numbers where they are lacking.
- Complete shaded fuelbreaks west of Buffalo Creek Road and south of Logan Ave.; connect these fuelbreaks with those completed by USFS.
- Thin trees and remove hazard trees from along Hilltop Road, tie-in to USFS treatments where possible
- Complete shaded fuelbreaks north of Platte River Road, tie into planned USFS treatment areas and private roads.
- Complete shaded fuelbreak along the Spring Creek Trail, on the southern portion of the loop, where fuels are denser. Where possible, tie treatments on private property to completed USFS mastication treatments.
- Complete planned USFS fuel break on west side of CR 126, parallel to completed fuelbreak on other side of road.
- Complete shaded fuelbreak planned by USFS on south side of Platte River Road at Riverview
- Remove large slash pile from downhill side of Rainbow Falls Road by scattering, chipping, or burning in piles.
- Complete additional thinning along Rainbow Falls Rd, at the edge of the prescribed burn area, to the eastern boundary of the WUI zone.
- Complete shaded fuelbreak between Skyline Drive and Canon Drive.

North Metro

Description: North Metro FPD covers an area of 115 square miles with a population of approximately 90,000 people. The District maintains seven operating fire stations. Major highways in the area are E-470, US 36, and I-25. These roadways are major thoroughfares for the Denver-metro area. The District consists of the towns of Broomfield and Northglenn, and extends to the north into the City and County of Broomfield. This District also covers Rocky Mountain Airport, which covers 633 acres. Housing is mostly in new planned subdivisions that extend into the open prairies to the west.

Vegetation and fuels: The predominant wildland vegetation in the NMFPD is shortgrass prairie and shrubland. Short native grasses are the most common species. The primary fire carriers in WUI areas are low-load grass fuels. These light, flashy fuels are easily ignited and can cause very fast-moving fires, but are relatively easy to contain with mowed fuelbreaks. Much of the area is covered by non-wildland vegetation and fuels. Most properties have irrigated lawns and landscaping. A few parks and greenbelts have deciduous trees with grass and shrub understory.

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Reduce percentage of combustible siding and decking on homes.
- Improve or expand defensible space by mowing seasonally around structures
- Mow along public walking paths to maintain fuel breaks.
- Enclose open areas below decks and structures to prevent embers from collecting in ignitable areas.
- Homeowners adjacent to open space should incorporate Firewise landscaping that can serve as a fuelbreak.
- Clear leaves and other burnable debris from gutters annually

Rocky Mountain

Description: The majority of this FPD lies within Boulder County, at the northernmost edge of Jefferson County. There are no homes in the Jefferson County portion of the FPD, although there is a large subdivision just to the north of 120th and east of McCaslin Boulevard. Rock Creek South Trail is located here, which runs through Rocky Flats National Wildlife Refuge, near Great Western Reservoir. At this time, RMFPD has a contract for the management of a portion of Rocky Flats NWR.

Vegetation and fuels: The primary fire carriers in WUI areas are low-load grass fuels. These light, flashy fuels are easily ignited and can cause very fast-moving fires, but are relatively easy to contain with mowed fuelbreaks.

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Reduce percentage of combustible siding and decking on homes.
- Improve or expand defensible space by mowing seasonally around structures.
- Mow along public walking paths to maintain fuel breaks.
- Enclose open areas below decks and structures to prevent embers from collecting in ignitable areas.
- Homeowners adjacent to open space should incorporate Firewise landscaping that can serve as a fuelbreak.

West Metro

Description: West Metro Fire Protection District lies west of Denver, and covers over 110 square miles from the city of Lakewood, parts of Wheat Ridge and Morrison, and six rural, unincorporated communities: Ken-Caryl North Ranch, Ken-Caryl Ranch, Willow Brook, Willow Springs South, Willow Springs North, and Red Rocks. There are 15 stations that serve 247,648 residents, approximately half of the population of Jefferson County. The major roadways of C-470, US 285, and State Highways 8 and 93 run through this district. The Dakota Hogback formation runs roughly along the western edge of the District, and is a conspicuous feature of the area.

Vegetation and fuels: The predominant wildland vegetation in the WMFPD is shortgrass prairie and shrubland. Short native grasses, yucca, and Mountain Mahogany cover large areas in the westernmost portion of the district, particularly in the areas around Green Mountain Open Space Park. These light, flashy fuels are easily ignited and can cause very fast-moving fires. Several recent fires in WMFPD have burned in this eastern portion of the District. A few parks and greenbelts have deciduous trees and grass and shrub understory; many of these areas also have riparian vegetation. These areas could burn under extreme fire weather conditions. A large portion of the area is covered by non-wildland vegetation and fuels. Most properties have irrigated lawns and landscaping.

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Reduce percentage of combustible siding and decking on homes.
- Improve or expand defensible space by mowing seasonally around structures
- Mow along public walking paths to maintain fuel breaks.
- Enclose open areas below decks and structures to prevent embers from collecting in ignitable areas.
- Homeowners adjacent to open space should incorporate Firewise landscaping that can serve as a fuelbreak.
- Clear leaves and other burnable debris from gutters annually.

Wheat Ridge

Description: Wheat Ridge is a suburban municipality on the west side of Denver. The FPD covers approximately 9 square miles, served by two staffed fire stations. The population is approximately 31,000. Interstate 70 runs through this district, and therefore has heavy continuous traffic through the area. Property lots are typically less than one acre, typical of suburban neighborhoods and subdivisions.

Vegetation and fuels: The majority of the area is covered by non-wildland vegetation and fuels. Most properties have irrigated lawns and landscaping. A few parks and greenbelts have deciduous trees with grass and shrub understory. There are also patches and stringers of riparian vegetation throughout the district, near creeks, ponds, and lakes. The more heavily vegetated areas could burn under extreme fire weather conditions, but are generally low fire hazard under most conditions.

Recommendations:

- For all homes, make improvements within the home ignition zone to reduce structure ignitability.
- Clear leaves and other burnable debris from gutters annually.
- Remove wildland fuels where greenbelt vegetation encroaches on homes and other structures.

APPENDIX D

Jefferson County Community Wildfire Protection Plan Survey

2011

In accordance with Colorado Senate Bill 09-001, Jefferson County Division of Emergency Management, in partnership with Jefferson Conservation District, is preparing a **County-Wide Community Wildfire Protection Plan**. This includes assessing the risk of wildfire in your community and identifying actions to reduce the risk. Your input on this very important topic is needed to create an effective plan. You can help by providing the following information by **June 30, 2011**:

1. What community/town do you live in or closest to? _____

2. Is your community currently part of an existing CWPP
   - ❑ No
   - ❑ I don't know
   - ❑ Yes _____

3. How great of a risk do you think wildfire poses to your community?
   ❑Extreme Risk ❑High Risk ❑Moderate Risk ❑Low Risk ❑No Risk

4. Do you think any areas in Jefferson County are an extreme fire hazard?
   ❑ No. ❑ Yes, this (these) area(s): _____

5. How likely are you to leave your home if it is imminently threatened by fire?
   ❑Will not leave ❑More likely to stay ❑More likely to evacuate ❑Will evacuate

6. Do you think your community is currently prepared for a wildfire?
   ❑ No ❑ Yes ❑ I don't know

7. What types of areas in your community do you think pose a fire risk to homes or property?
   ❑Forests ❑Meadows and Grasses ❑Shrubs and Bushes

8. What do you think are the best ways to mitigate or reduce wildfire risks? (Choose all that apply.)
   - ❑ Reduce vegetation (grasses, trees, etc.) on public land by controlled burns.
   - ❑ Reduce vegetation (grasses, trees, etc.) on public land by mechanical treatments
   - ❑ Develop shaded fuel breaks along roads and strategic locations.
   - ❑ Increase firefighting equipment (more trucks, water tenders, etc.)
   - ❑ Increase number of fire department volunteers.
   - ❑ Increase water availability.
   - ❑ Encourage private landowners to develop defensible spaces around structures.
   - ❑ Conduct community outreach and education programs.
   - ❑ Other_____

9. Have actions been taken to reduce the risk of wildfire in your community? (Choose all that apply)
   - ❑ Not that I am aware of.
   - ❑ Individual homeowners working on defensible space
   - ❑ Community work days to reduce hazardous fuels
   - ❑ Community slash collection days
   - ❑ Shaded fuelbreaks created on private property in the community
   - ❑ Shaded fuelbreaks created on public lands adjacent to the community
   - ❑ Other_____

10. Have fire education programs occurred in your community? (Choose all that apply)
   - ❑ Not that I am aware of.
   - ❑ Firewise Community outreach
   - ❑ Colorado State Forest Service programs
   - ❑ Local Fire Department programs
   - ❑ Other_____

11. How supportive are you of fuel mitigation projects taking place in your community?
   - ❑ Strongly supportive
   - ❑ Somewhat supportive
   - ❑ Neither supportive nor opposed
   - ❑ Somewhat opposed
   - ❑ Strongly opposed

12. Use this space to provide any additional comments or feedback (optional):

_____

_____

_____

_____

Please contact the Jefferson County Emergency Management Community Wildfire Protection Forester if you wish to receive more information about this CWPP and/or fuels mitigation projects:

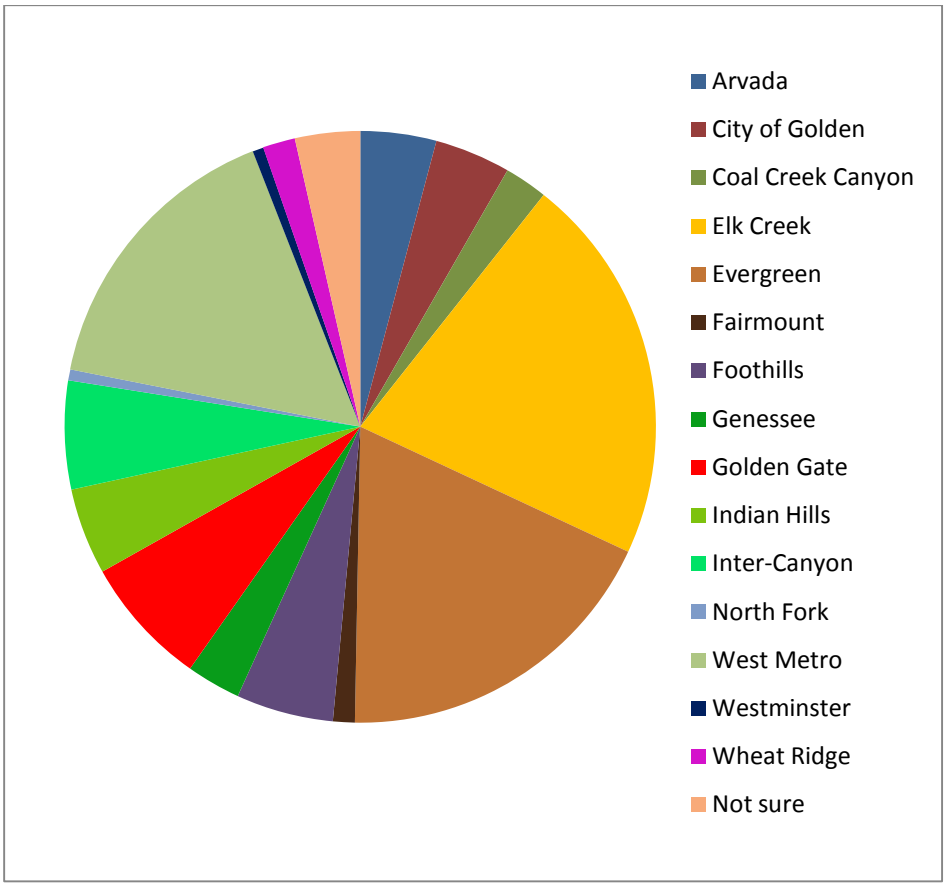
Robin Keith, Community Wildfire Protection Forester

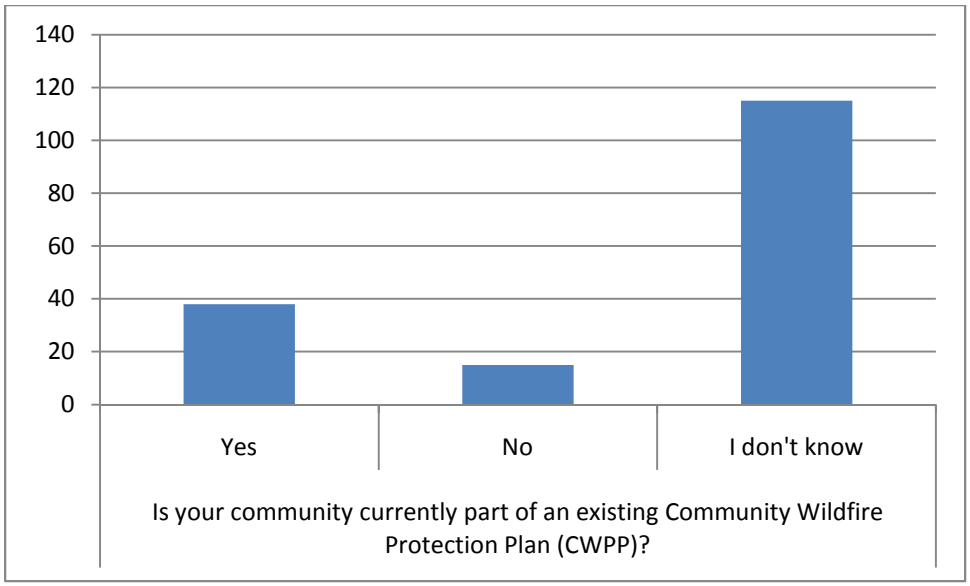
303-271-4926

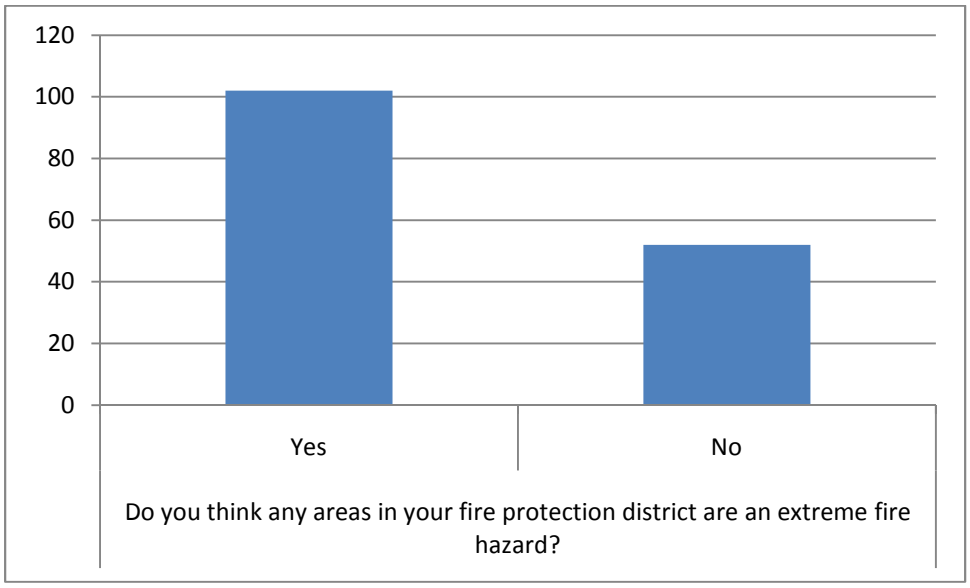
robinpk@jeffco.us

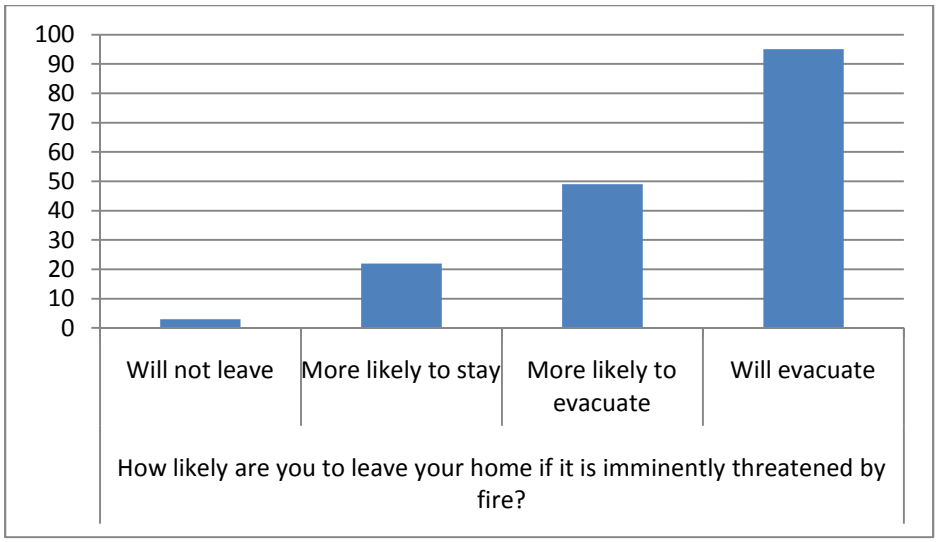
Responses to the Jefferson County CWPP Survey

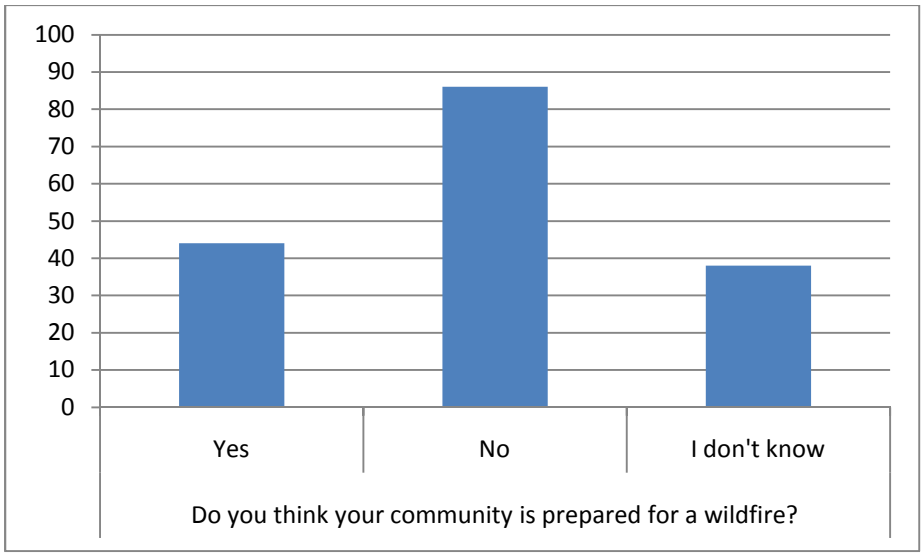
What community/town do you live in or closest to?



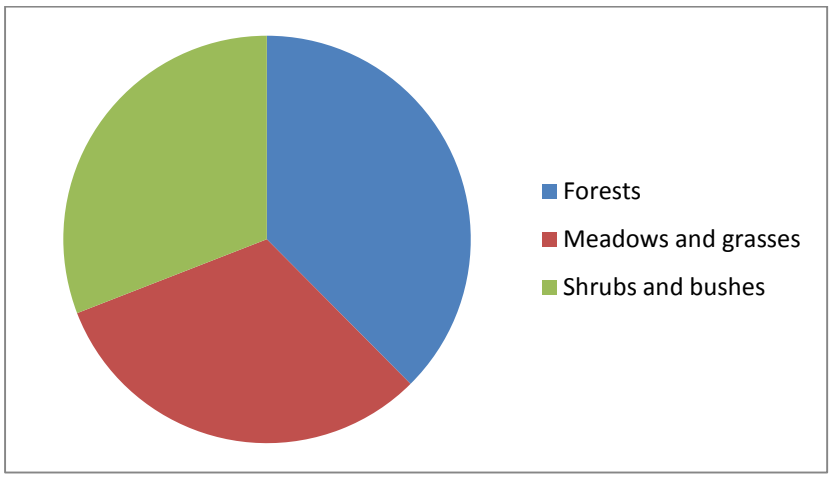

140
120
100
80
60
40
20
0
Yes
No
I don't know
Is your community currently part of an existing Community Wildfire Protection Plan (CWPP)?


120
100
80
60
40
20
0
Yes
No
Do you think any areas in your fire protection district are an extreme fire hazard?

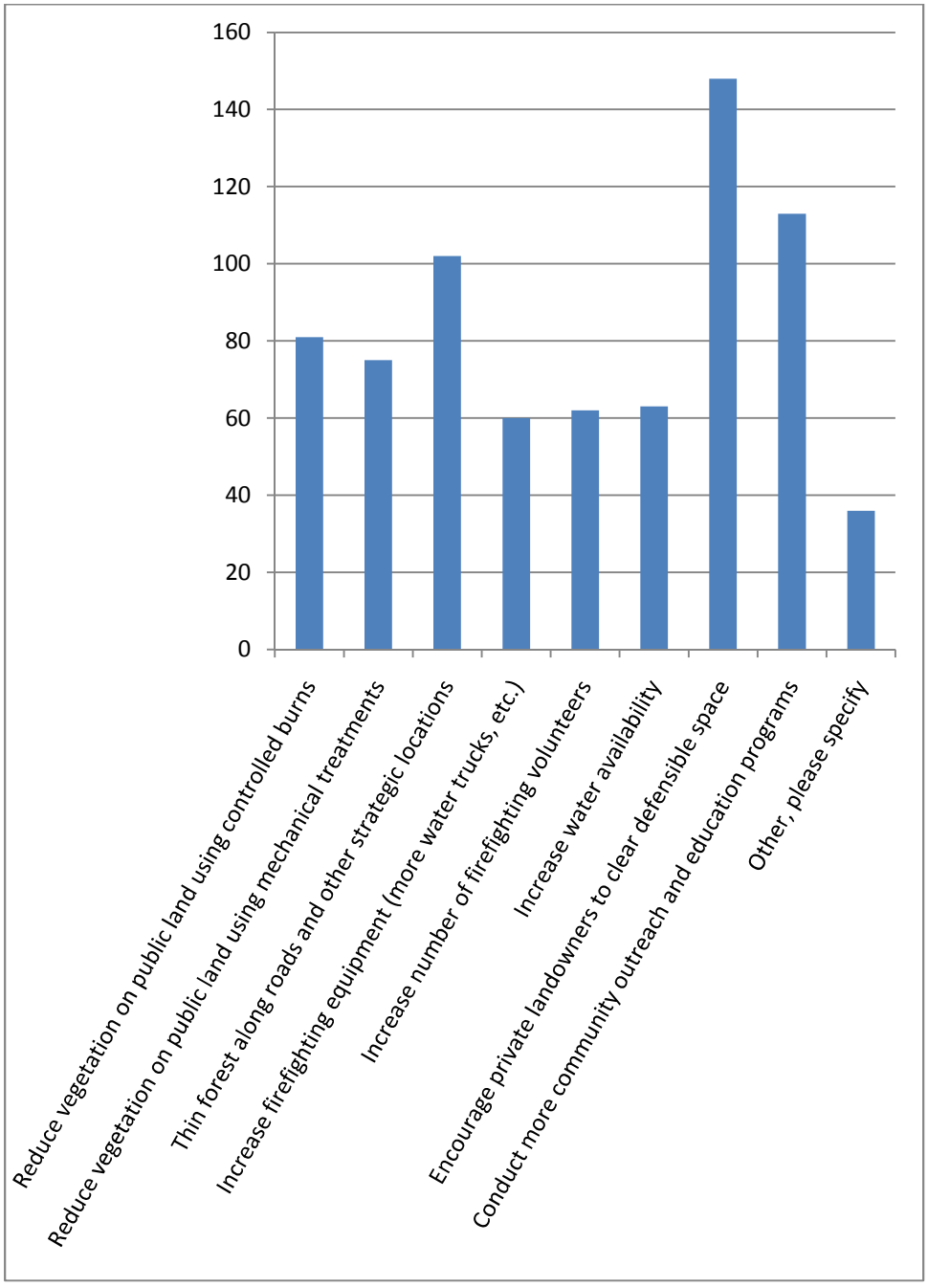




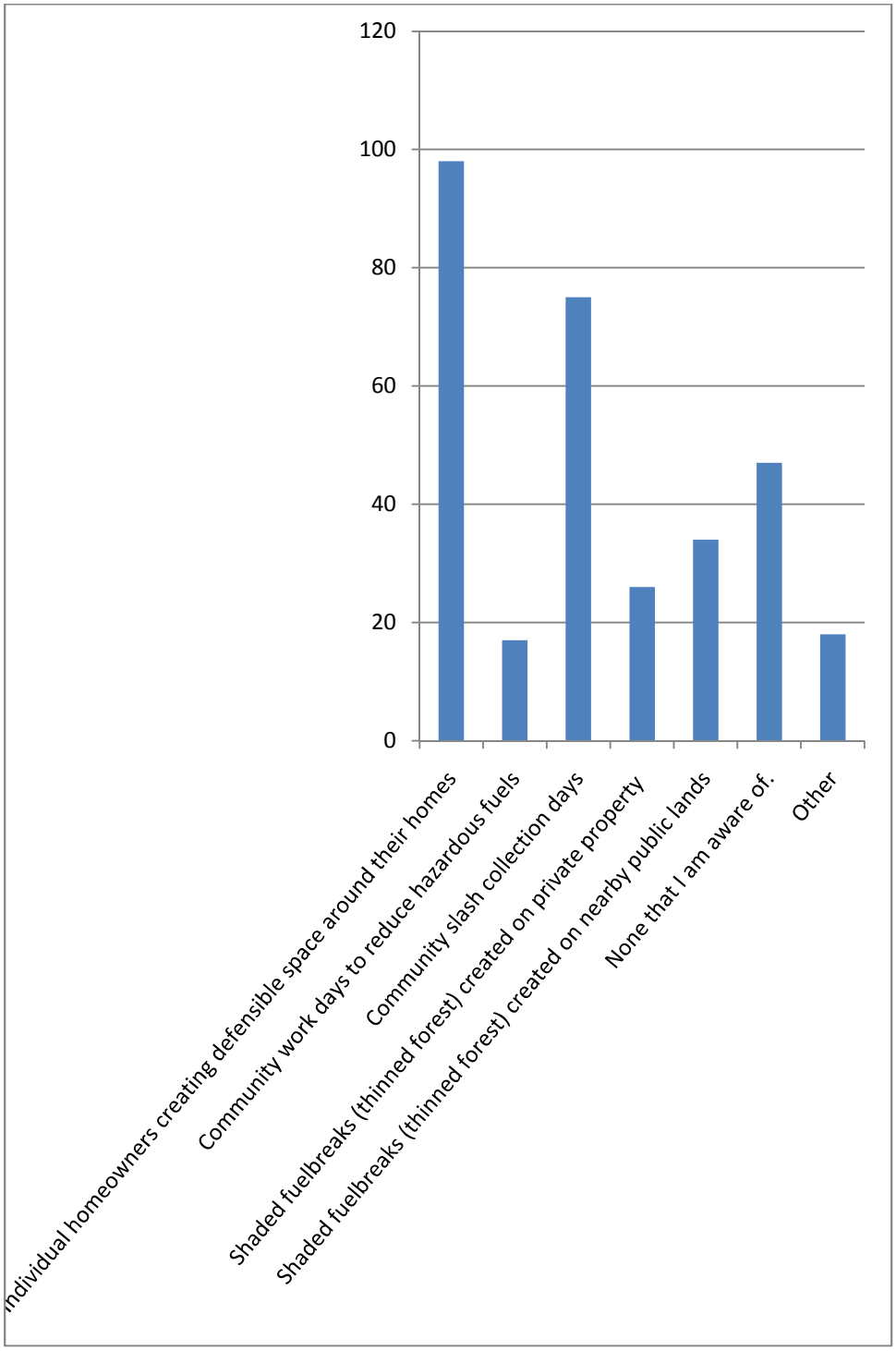
What types of landscapes in your community do you think pose a fire risk to homes or property?



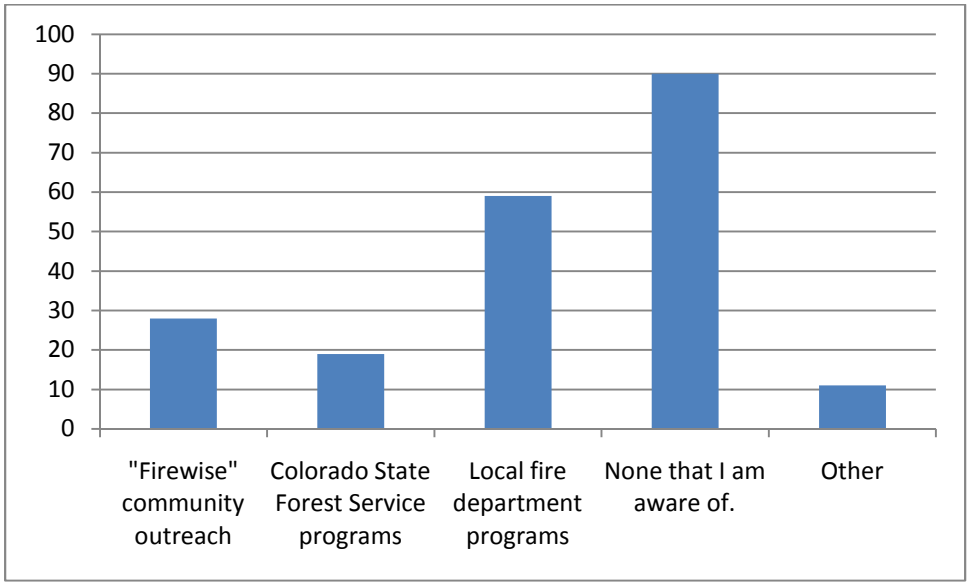
What do you think are the best ways to mitigate or reduce wildfire risks? Choose all that apply.



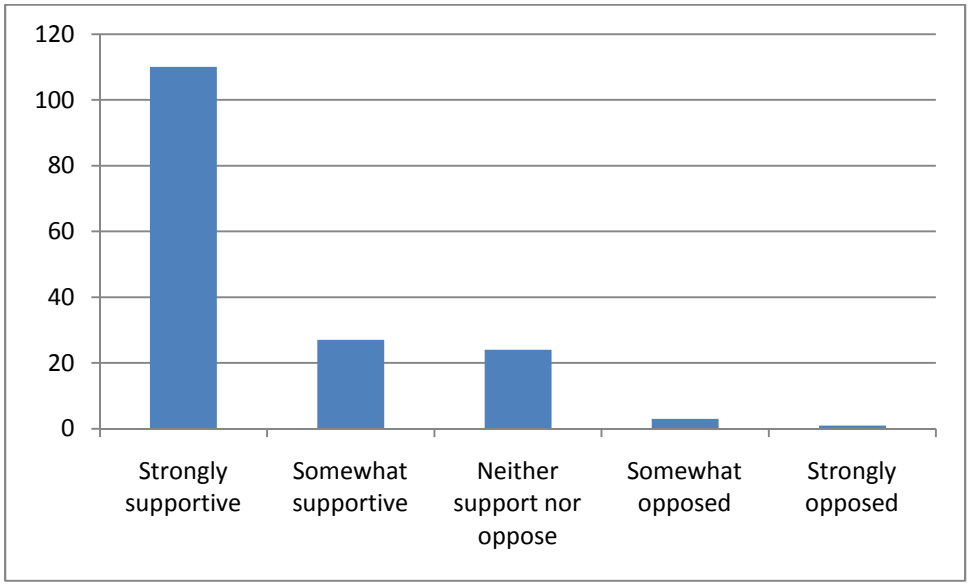
What actions have been taken to reduce the risk of wildfire in your community? Choose all that apply.



What fire education programs have occurred in your community? Choose all that apply.



How supportive are you of fuel mitigation projects taking place in your community?



Fuelbreak Guidelines for Forested Subdivisions & Communities

By

Frank C. Dennis

Colorado State Forest Service

Knowledge to Go Places

This publication was developed for use by foresters, planners, developers, homeowners' associations and others. Implementation of these measures cannot *guarantee* safety from all wildfires, but will greatly increase the probability of containing them at more manageable levels.

Inadequate fire planning can result in loss of life or property and costly suppression activities.

Colorado's forested lands are experiencing severe impacts from continuing population increases and peoples' desire to escape urban pressures. Subdivisions and developments are opening new areas for homesite construction at an alarming rate, especially along the Front Range and around recreational areas such as Dillon, Vail, and Steamboat Springs.

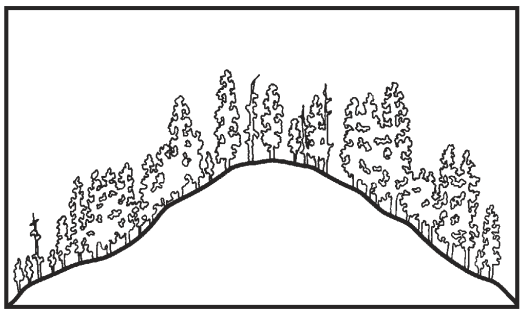
But with development inevitably comes a higher risk of wildfire as well as an ever-increasing potential for loss of life and property. Methods of fire suppression, pre-suppression needs, and homeowner and fire crew safety must all be considered in the planning and review of new developments as well as for the "retrofitting" of existing, older subdivisions.

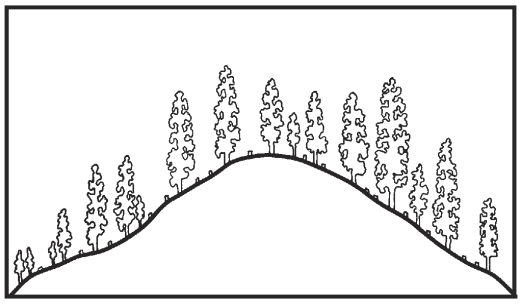
Fuelbreaks should be considered in fire management planning for subdivisions and developments; however, the following are guidelines **only**. They should be customized to local areas by professional foresters experienced in Rocky Mountain wildfire behavior and suppression tactics.

Fuelbreak vs Firebreak

Although the term fuelbreak is widely used in Colorado, it is often confused with firebreak. The two are entirely separate, and aesthetically different, forms of forest fuel modification and treatment.

• A firebreak is strip of land, 20 to 30 feet wide (or more), in which all vegetation is removed down to bare, mineral soil each year prior to fire season.





Above, cross section of mixed conifer stand before fuelbreak modification. Below, after modification.

• A fuelbreak (or shaded fuelbreak) is 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. The stand is thinned, and remaining trees are pruned to remove ladder fuels. Brush, heavy ground fuels, snags, and dead trees are disposed of and an open, park-like appearance is established.

The following is a discussion of the uses, limitations, and specifications of fuelbreaks in wildfire control and fuels management.

Fuelbreak Limitations

Fuelbreaks provide quick access for wildfire suppression. Control activities can be conducted more safely due to low fuel volumes. Strategically located, they break up large, continuous tracts of dense timber, thus limiting uncontrolled spread of wildfire.

Fuelbreaks can aid firefighters greatly by slowing fire spread under normal burning conditions. However, under extreme conditions, even the best fuelbreaks stand little chance of arresting a large

Before and after photos of a forest stand thinned to reduce fuel loads.

fire, regardless of firefighting efforts. Such fires, in a phenomenon called "spotting," can drop firebrands 1/8-mile or more ahead of the main fire, causing very rapid fire spread. These types of large fires may continue until there is a major change in weather conditions, topography, or fuel type.

It is critical to understand: A fuelbreak is the line of defense. The area (including any homes and developments) between it and the fire may remain vulnerable.

In spite of these somewhat gloomy limitations, fuelbreaks have proven themselves effective in Colorado. During the 1980 Crystal Lakes Subdivision Fire near Fort Collins, crown fires were stopped in areas with fuelbreak thinnings, while other areas of dense lodgepole pine burned completely. A fire at O'Fallon Park in Jefferson County was successfully stopped and controlled at a fuelbreak. The Buffalo Creek Fire in Jefferson County (1996) and the High Meadow Fire in Park and Jefferson Counties (2000) slowed dramatically wherever intense forest thinnings had been completed. During the 2002 Hayman Fire, Denver Water's entire complex of offices, shops and caretakers' homes at Cheesman Reservoir were saved by a fuelbreak with no firefighting intervention by a fuelbreak.

Burned area near Cheesman Reservoir as a result of the Hayman Fire. Note the unburned green trees in the middle right of the photo, a treated fuelbreak.

The Need For A Fuelbreak

Several factors determine the need for fuelbreaks in forested subdivisions, including: (1) potential problem indicators; (2) wildfire hazard areas; (3) slope; (4) topography; (5) crowning potential; and (6) ignition sources.

Potential Problem Indicator

The table below explains potential problem indicators for various hazards and characteristics common to Colorado's forest types. All major forest types, except aspen, indicate a high potential for wildfire hazard.

Fuel Type	Characteristics			Hazards			
	Aesthetics	Wildlife	Soil	**Wildfire**	Avalanche	Flood	Climate
Aspen	2	3	3	**2**	4	3	2
Douglas-fir	2	2	3	**5**	2	2	3
Greasewood-Saltbrush	4	2	2	**2**	1	3	3
Limber-Bristlecone Pine	3	2	4	**3**	4	2	5
Lodgepole Pine	2	2	3	**5**	4	2	4
Meadow	5	4	4	**2**	3	4	3
Mixed Conifer	2	1	1	**5**	3	1	3
Mountain Grassland	5	3	4	**3**	3	2	4
Mountain Shrub	3	5	4	**4**	2	2	3
Piñon-Juniper	2	3	4	**4**	2	3	2
Ponderosa Pine	2	3	1	**5**	2	2	3
Sagebrush	4	4	3	**3**	3	2	3
Spruce-Fir	2	3	3	**4**	5	**3**	4

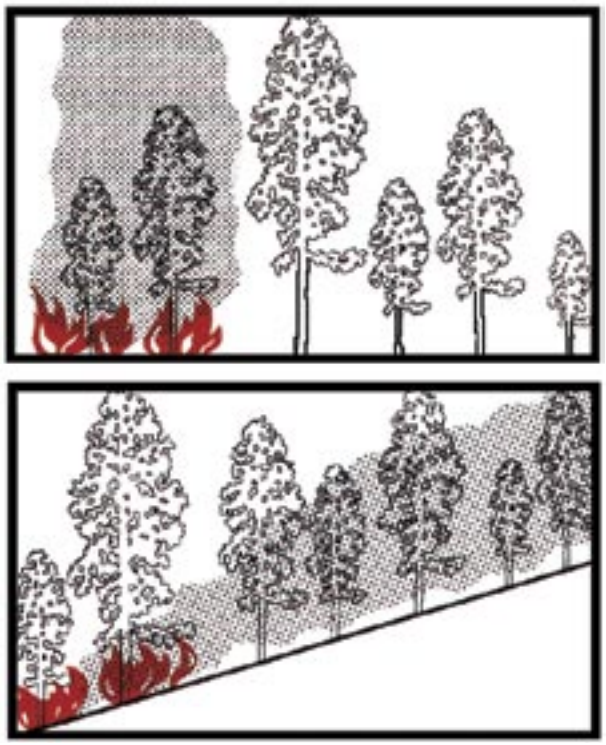
Legend: 5 – Problem may be crucial; 4 – Problem very likely;
3 – Exercise caution; 2 – Problem usually limited;
1 – No rating possible

Wildfire Hazard Maps

The Colorado State Forest Service (CSFS), numerous counties and some National Forests have completed wildfire hazard mapping for many areas within Colorado, particularly along the Front Range. These maps typically consider areas with 30 percent or greater slope; hazardous fuel types; and hazardous topographic features such as fire chimneys. Wildfire Hazard Ratings may be depicted in several ways. Whatever system is used, areas rated moderate or higher should be considered for fuel modification work.

Slope

Rate of fire spread increases as the slope of the land increases. Fuels are preheated by the rising smoke column or they may even come into contact with the flames themselves.



Fire effects, flat vs steep terrain. Note preheating of fuels on steep ground from passage of smoke column.

At 30 percent slope, rate of fire spread doubles compared to rates at level ground, drastically reducing firefighting effectiveness. **Areas near 30 percent or greater slopes are critical and must be reviewed carefully.**

Topography

Certain topographic features influence fire spread and should be evaluated. Included are fire chimneys, saddles, and V-shaped canyons. They are usually recognized by reviewing standard U.S.G.S. quad maps.

• Chimneys are densely vegetated drainages on slopes greater than 30 percent. Wind, as well as air pre-heated by a fire, tends to funnel up these drainages, rapidly spreading fire upslope.

• Saddles are low points along a main ridge or between two high points. Like chimneys, they also funnel winds to create a natural fire path during a fire's uphill run. Saddles act as corridors to spread fire into adjacent valleys or drainages.

Chimney.

Saddle.

• Narrow, V-shaped valleys or canyons can ignite easily due to heat radiating from one side to the other. For example, a fire burning on one side of a narrow valley dries and preheats fuels on the opposite side until the fire "flashes over." The natural effect of slope on fire then takes over and fire spreads rapidly up drainage and uphill along both sides of the valley.

Flashover in V-shaped valley.

Crowning Potential

An on-site visit is required to accurately assess crowning potential. A key, below, helps determine this rating. Fuel modification is usually unnecessary if an area has a rating of 3 or less.

Crowning Potential Key

	Rating
A. Foliage present, trees living or dead — B	
B. Foliage living — C	
C. Leaves deciduous or, if evergreen, usually soft, pliant, and moist; never oily, waxy, or resinous.	0
CC. Leaves evergreen, not as above — D	
D. Foliage resinous, waxy, or oily — E	
E. Foliage dense — F	
F. Ladder fuels plentiful — G	
G. Crown closure > 75 percent	9
GG. Crown closure < 75 percent	7
FF. Ladder fuels sparse or absent — H	
H. Crown closure > 75 percent	7
HH. Crown closure < 75 percent	5
EE. Foliage open — I	
I. Ladder fuel plentiful	4
II. Ladder fuel sparse or absent	2
DD. Foliage not resinous, waxy, or oily — J	
J. Foliage dense — K	
K. Ladder fuels plentiful — L	
L. Crown closure > 75 percent	7
LL. Crown closure < 75 percent	4
KK. Ladder fuels sparse or absent — M	
M. Crown closure > 75 percent	5
MM. Crown closure < 75 percent	3
JJ. Foliage open — N	
N. Ladder fuels plentiful	3
NN. Ladder fuels sparse or absent	1
BB. Foliage dead	0

The majority of dead trees within the fuelbreak should be removed. Occasionally, large, dead trees (14 inches or larger in diameter at 4 1/2 feet above ground level) may be retained as wildlife trees. If retained, all ladder fuels must be cleared from around the tree's trunk.

Ignition Sources

Possible ignition sources, which may threaten planned or existing developments, must be investigated thoroughly. Included are other developments and homes, major roads, recreation sites, railroads, and other possible sources. These might be distant from the proposed development, yet still able to channel fire into the area due to slope, continuous fuels, or other topographic features.

Fuelbreak Locations

In fire suppression, an effective fire line is connected, or "anchored," to natural or artificial fire barriers. Such anchor points might be rivers, creeks, large rock outcrops, wet meadows, or a less flammable timber type such as aspen. Similarly, properly designed and constructed fuelbreaks take advantage of these same barriers to eliminate "fuel bridges." (Fire often escapes control because of fuel bridges that carry the fire across control lines.)

Since fuelbreaks should normally provide quick, safer access to defensive positions, they are necessarily linked with road systems. Connected with county-specified roads within subdivisions, they provide good access and defensive positions for firefighting equipment and support vehicles. Cut-and fill slopes of roads are an integral part of a fuelbreak as they add to the effective width of modified fuels.

Fuelbreaks without an associated road system, such as those located along strategic ridge lines, are still useful in fire suppression. Here, they are often strengthened and held using aerial retardant drops until fire crews can walk in or be ferried in by helicopter.

Preferably, fuelbreaks are located along ridge tops to help arrest fires at the end of their runs. However, due to homesite locations and resource values, they can also be effective when established at the base of slopes. Mid-slope fuelbreaks are least desirable, but under certain circumstances and with modifications, these too, may be valuable.

Fuelbreaks are located so that the area under management is broken into small, manageable units. Thus, when a wildfire reaches modified fuels, defensive action is more easily taken, helping to keep the fire small. For example, a plan for a subdivision might recommend that fuelbreaks break up continuous forest fuels into units of 10 acres or less. This is an excellent plan, especially if defensible space thinnings are completed around homes and structures, and thinning for forest management and forest health are combined with the fuelbreak.

When located along ridge tops, continuous length as well as width are critical elements. Extensive long-range planning is essential in positioning these types of fuelbreaks.

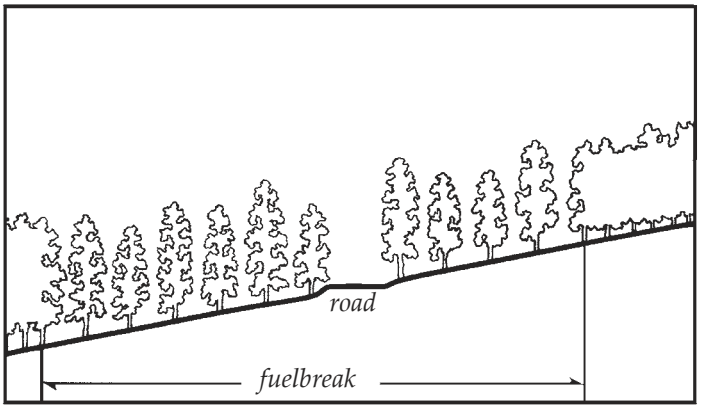
Aesthetics

Improperly planned fuelbreaks can adversely impact an area's aesthetic qualities. Careful construction is necessary when combining mid-slope fuelbreaks with roads involving excessive cut-and-fill.

These photos, far- and near- views of the same site, illustrate that forest can be thinned without impacting aesthetics.

Care must also be taken in areas that are not thinned throughout for fuel hazard reduction. In such cases the fuelbreak visually sticks out like a "sore thumb" due to contrasting thinned and unthinned portions of the forest. (Especially noticeable are those portions of the fuelbreak above road cuts).

These guidelines are designed to minimize aesthetic impacts. However, some situations may require extensive thinning and, thus, result in a major visual change to an area. Additional thinning beyond the fuelbreak may be necessary to create an irregular edge and to "feather," or blend, the fuelbreak thinning into the unthinned portions of the forest. Any thinning beyond the fuelbreak improves its effectiveness and is highly recommended.



Cross-section of a typical fuelbreak built in conjunction with a road.

Constructing the Fuelbreak

Fuelbreak Width and Slope Adjustments

Note: Since road systems are so important to fuelbreak construction, the following measurements are from the toe of the fill for downslope distances, and above the edge of the cut for uphill distances.

The minimum recommended fuelbreak width is approximately 300 feet for level ground. Since fire activity intensifies as slope increases, the overall fuelbreak width must also increase. However, to minimize aesthetic impacts and to maximize fire crew safety, the majority of the increases should be made at the bottom of the fuelbreak, below the road cut.

Widths are also increased when severe topographic conditions are encountered. Guidelines for fuelbreak widths on slopes are given below:

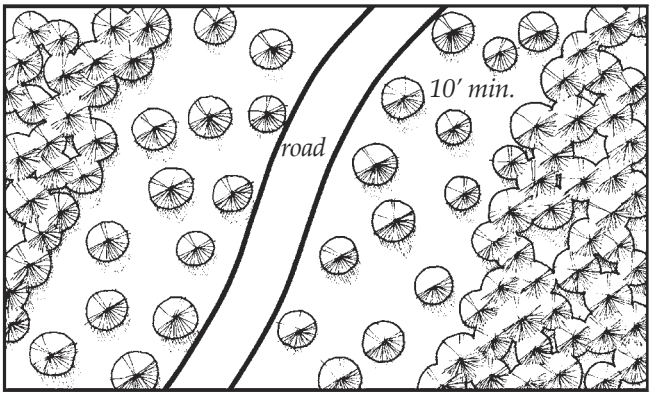
Fuelbreak Width/Slope

Percent Slope (%)	Minimum Uphill Distance (ft)	Minimum Downhill Distance (ft)	Total Width of Modified fuels (ft)*
0	150	150	300
10	140	165	303
20	130	180	310
30	120	195	315
40	110	210	320
50	100	225	325
60	100	240	340

*As slope increases, total distance for cut-and-fill for road construction rapidly increases, improving fuelbreak effective width.

Stand Densities

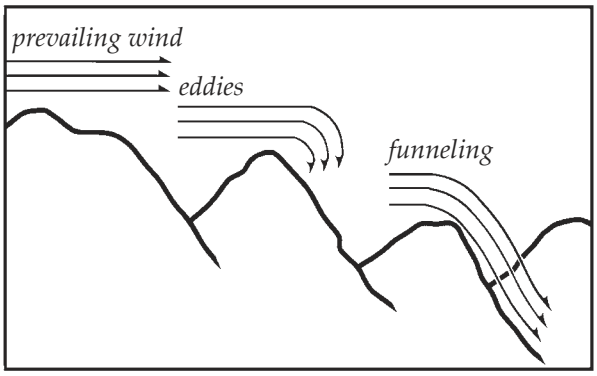
Crown separation is a more critical factor for fuelbreaks than a fixed tree density level. A *minimum* 10-foot spacing between the edges of tree crowns is recommended on level ground. As slope increases, crown spacing should also increase. However, small, isolated groups of trees may be retained for visual diversity. Increase crown spacing around any groups of trees left for aesthetic reasons and to reduce fire intensities and torching potential.



Plan view of fuelbreak showing minimum distance between tree crowns.

In technical terms, a fuelbreak thinning is classified as a heavy "sanitation and improvement cut, from below." Within fuelbreaks, trees that are suppressed, diseased, deformed, damaged, or of low vigor are removed along with all ladder fuels. Remaining trees are the largest, healthiest, most wind-firm trees from the dominant and co-dominant species of the stand.

Because such a thinning is quite heavy for an initial entry into a stand, prevailing winds, eddy effects, and wind funneling must be carefully evaluated to minimize the possibility of windthrow. It may be necessary to develop the fuelbreak over several years to allow the timber stand to "firm-up" — this especially applies to lodgepole pine and Engelmann spruce stands.



Topography affects wind behavior – an important consideration during fuelbreak construction.

Area-wide forest thinnings are recommended for any subdivisions. Such thinning is not as severe as a fuelbreak thinning, but generally should be completed to fuelbreak specifications along the roads (as outlined on page 6.) In addition, "defensible space thinnings" are highly recommended around all structures (see CSU Coop. Extension Fact sheet 6.302, *Creating Wildfire-Defensible Zones*).

Debris Removal

Limbs and branches left from thinning (slash) can add significant volumes of fuel to the forest floor, especially in lodgepole pine, mixed-conifer, or spruce/fir timber types. These materials can accumulate and serve as ladder fuels, or can become "jackpots," increasing the difficulty of defending the fuelbreak during a wildfire. **Slash decomposes very slowly in Colorado and proper disposal is essential.** Proper treatment reduces fire hazard, improves access for humans and livestock, encourages establishment of grasses and other vegetation, and improves aesthetics.

Three treatment methods are commonly used. These are lopping-and-scattering, piling and burning, and chipping. Mulching of small trees and slash using equipment similar to Hydro-axes or Timbcos equipped with mulching heads are becoming a popular method of treatment. Size, amount, and location of slash dictates the method used, in addition to cost and the final desired appearance. The method chosen will also depend on how soon an effective fuelbreak is needed prior to construction in new developments.

Lop and scatter: slash should be no deeper than 12'' above ground surface.

Chipping is the most desirable, but also the most expensive method of slash disposal.

Piled slash can be burned but only during certain conditions, such as after a snowfall.

Fuelbreak Maintenance

Following initial thinning, trees continue to grow (usually at a faster rate). The increased light on the forest floor encourages heavy grass and brush growth where, in many cases, where little grew before. The site disturbance and exposed mineral soil created during fuelbreak development is a perfect seed bed for new trees that, in turn, create new ladder fuels. Thus, in the absence of maintenance, fuelbreak effectiveness will decrease over time.

Fuelbreak maintenance is essential. Ingrowth, shown above, will minimize the effectiveness of this fuelbreak within a few years.

Fuelbreak maintenance problems are most often the result of time and neglect. Misplaced records, lack of follow-up and funding, and apathy caused by a lack of fire events are some of the major obstacles. In addition, the responsibility for fuelbreak maintenance projects is often unclear. For example, control of a fuelbreak completed by a developer passes to a homeowner's association, usually with limited funds and authority to maintain fuelbreaks.

If fuelbreak maintenance is not planned and completed as scheduled, consider carefully whether the fuelbreak should be constructed. An un-maintained fuelbreak may lead to a false sense of security among residents and fire suppression personnel.

Conclusion

An image of well-designed communities for Colorado includes:

• Forested subdivisions where the total forest cover is well-managed through carefully planned, designed, and maintained thinnings. This contributes to reduced wildfire hazards and a much healthier forest — one that is more resistant to insects and disease.

• A system of roads and driveways with their associated fuelbreaks that break up the continuity of the forest cover and fuels. These help keep fires small, while also providing safer locations from which to mount fire suppression activities. In addition to allowing fire personnel in, they will allow residents to evacuate if necessary.

• Individual homes that all have defensible space around them, making them much easier to defend and protect from wildfire, while also protecting the surrounding forest from structure fires.

Creation of such communities is entirely feasible if recognition of the fire risks, a spirit of cooperation, an attitude of shared responsibility, and the political will exists.

Colorado's mountains comprise diverse slopes, fuel types, aspects, and topographic features. This variety makes it impossible to develop general fuelbreak prescriptions for all locations. ***The previous recommendations are guidelines only.*** *A professional forester with fire suppression expertise should be consulted to "customize" fuelbreaks for particular areas.*

FORESTRY

Creating Wildfire-Defensible Zones no. 6.302

by F.C. Dennis [1]

Quick Facts...

Wildfire will find the weakest links in the defense measures you have taken on your property.

The primary determinants of a home's ability to survive wildfire are its roofing material and the quality of the "defensible space" surrounding it.

Even small steps to protect your home and property will make them more able to withstand fire.

Consider these measures for all areas of your property, not just the immediate vicinity of the house.

Fire is capricious. It can find the weak link in your home's fire protection scheme and gain the upper hand because of a small, overlooked or seemingly inconsequential factor. While you may not be able to accomplish all measures below (and there are no guarantees), each will increase your home's, and possibly your family's, safety and survival during a wildfire.

Start with the easiest and least expensive actions. Begin your work closest to your house and move outward. Keep working on the more difficult items until you have completed your entire project.

Defensible Space

Two factors have emerged as the primary determinants of a home's ability to survive wildfire. These are the home's roofing material and the quality of the "defensible space" surrounding it.

Use fire-resistive materials (Class C or better rating), not wood or shake shingles, to roof homes in or near forests and grasslands. When your roof needs significant repairs or replacement, do so with a fire-resistant roofing material. Check with your county building department. Some counties now restrict wood roofs or require specific classifications of roofing material.

Defensible space is an area around a structure where fuels and vegetation are treated, cleared or reduced to slow the spread of wildfire towards the structure. It also reduces the chance of a structure fire moving from the building to the surrounding forest. Defensible space provides *room for firefighters to do their jobs.* Your house is more likely to withstand a wildfire if grasses, brush, trees and other common forest fuels are managed to reduce a fire's intensity.

The measure of fuel hazard refers to its continuity, both horizontal (across the ground) and vertical (from the ground up into the vegetation crown). Fuels with a high degree of both vertical and horizontal continuity are the most hazardous, particularly when they occur on slopes. Heavier fuels (brush and trees) are more hazardous (i.e. produce a more intense fire) than light fuels such as grass.

Mitigation of wildfire hazards focuses on breaking up the continuity of horizontal and vertical fuels. Additional distance between fuels is required on slopes.

Creating an effective defensible space involves developing a series of management zones in which different treatment techniques are used. See Figure 1 for a general view of the relationships among these management zones. Develop defensible space around each building on your property. Include detached garages, storage buildings, barns and other structures in your plan.

The actual design and development of your defensible space depends on several factors: size and shape of buildings, materials used in their construction, the slope of the ground on which the structures are built, surrounding topography,

Colorado State University Cooperative Extension

Putting Knowledge to Work

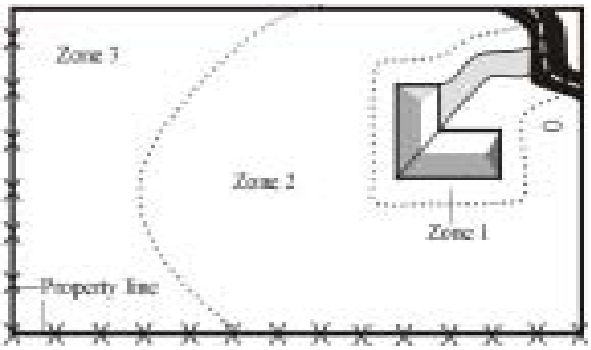


Figure 1: Forested property showing the three fire-defensible zones around a home or other structure.

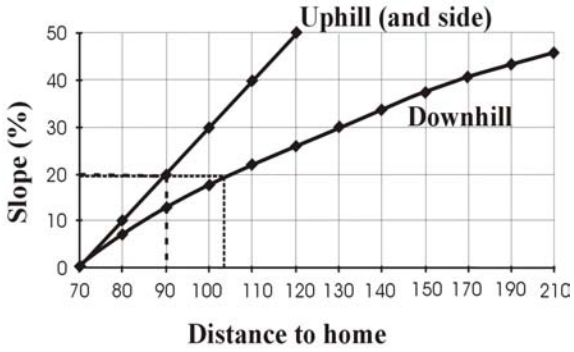


Figure 2: This chart indicates the *minimum recommended* dimensions for defensible space from the home to the outer edge of Zone 2. For example, if your home is situated on a 20 percent slope, the minimum defensible space dimensions would be 90 feet uphill and to the sides of the home and 104 feet downhill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

and sizes and types of vegetation on your property. These factors all affect your design. You may want to request additional guidance from your local Colorado State Forest Service (CSFS) forester or fire department. (See the Special Recommendations section of this fact sheet for shrubs, lodgepole pine, Engelmann spruce, and aspen.)

Defensible Space Management Zones

Zone 1 is the area of maximum modification and treatment. It consists of an area of 15 feet around the structure in which all flammable vegetation is removed. This 15 feet is measured from the outside edge of the home's eaves and any attached structures, such as decks.

Zone 2 is an area of fuel reduction. It is a transitional area between Zones 1 and 3. The size of Zone 2 depends on the slope of the ground where the structure is built. Typically, the defensible space should extend *at least* 75 to 125 feet from the structure. See Figure 2 for the appropriate distance for your home's defensible space. Within this zone, the continuity and arrangement of vegetation is modified. Remove stressed, diseased, dead or dying trees and shrubs. Thin and prune the remaining larger trees and shrubs. Be sure to extend thinning along either side of your driveway all the way to your main access road. These actions help eliminate the continuous fuel surrounding a structure while enhancing homesite safety and the aesthetics of the property.

Zone 3 is an area of traditional forest management and is of no particular size. It extends from the edge of your defensible space to your property boundaries.

Prescriptions

Zone 1

The size of Zone 1 is 15 feet, measured from the edges of the structure. Within this zone, several specific treatments are recommended.

Plant nothing within 3 to 5 feet of the structure, particularly if the building is sided with wood, logs or other flammable materials. Decorative rock, for example, creates an attractive, easily maintained, nonflammable ground cover.

If the house has noncombustible siding, widely spaced foundation plantings of low growing shrubs or other "fire wise" plants are acceptable. Do not plant directly beneath windows or next to foundation vents. Be sure there are no areas of continuous grass adjacent to plantings in this area.

Frequently prune and maintain plants in this zone to ensure vigorous growth and a low growth habit. Remove dead branches, stems and leaves.

Do not store firewood or other combustible materials in this area. Enclose or screen decks with metal screening. Extend the gravel coverage under the decks. Do not use areas under decks for storage.

Ideally, remove all trees from Zone 1 to reduce fire hazards. If you do keep a tree, consider it part of the structure and extend the distance of the entire defensible space accordingly. Isolate the tree from any other surrounding trees. Prune it to at least 10 feet above the ground. Remove any branches that interfere with the roof or are within 10 feet of the chimney. Remove all "ladder fuels" from beneath the tree. Ladder fuels are vegetation with vertical continuity that allows fire to burn from ground level up into the branches and crowns of trees. Ladder fuels are potentially very hazardous but are easy to mitigate. No ladder fuels can be allowed under tree canopies. In all other areas, prune all branches of shrubs or trees up to a height of 10 feet above ground (or 1/2 the height, whichever is the least).

Zone 2

Zone 2 is an area of fuel reduction designed to reduce the intensity of any fire approaching your home. Follow these recommended management steps.

Thin trees and large shrubs so there is at least 10 feet between crowns. Crown separation is measured from the furthest branch of one tree to the nearest branch on the next tree (Figure 3). On steep slopes, allow more space between tree crowns. (See Figure 4 for *minimum recommended* spacing for trees on steep slopes.) Remove all ladder fuels from under these remaining trees. Carefully prune trees to a height of at least 10 feet.

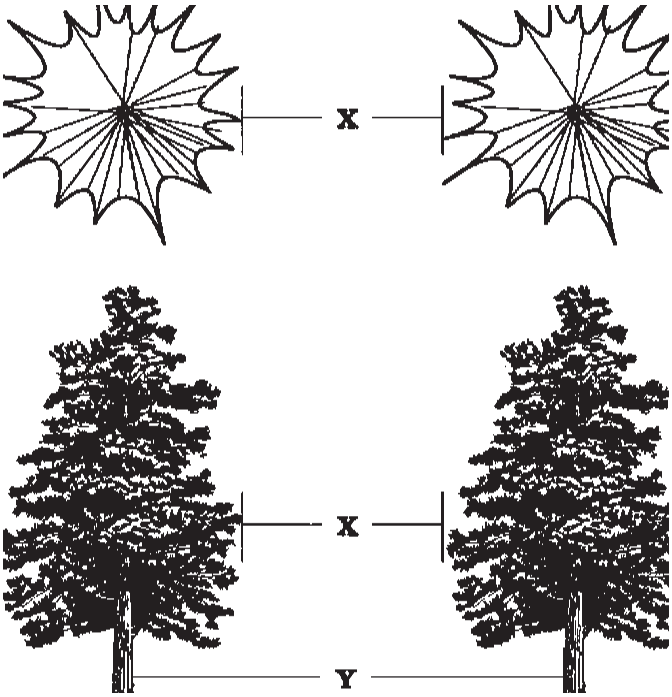


Figure 3: X = crown spacing; Y = stem spacing. Do not measure between stems for crown — measure between the edges of tree crowns.

Small clumps of 2 to 3 trees may be occasionally left in Zone 2. Leave more space between the crowns of these clumps and surrounding trees.

Because Zone 2 forms an aesthetic buffer and provides a transition between zones, it is necessary to blend the requirements for Zones 1 and 3. Thin the portions of Zone 3 adjacent to Zone 2 more heavily than the outer portions.

Isolated shrubs may remain, provided they are not under tree crowns. Prune and maintain these plants periodically to maintain vigorous growth. Remove dead stems from trees and shrubs annually. Where shrubs are the primary fuel in Zone 2, refer to the Special Recommendations section of this fact sheet.

Limit the number of dead trees (snags) retained in this area. Wildlife needs only one or two snags per acre. Be sure any snags left for wildlife cannot fall onto the house or block access roads or driveways.

Mow grasses (or remove them with a weed trimmer) as needed through the growing season to keep them low, a maximum of 6 to 8 inches. This is extremely critical in the fall when grasses dry out and cure or in the spring after the snow is gone but before the plants green up.

Stack firewood and woodpiles uphill or on the same elevation as the structure but at least 30 feet away. Clear and keep away flammable vegetation within 10 feet of these woodpiles. Do not stack wood against your house or on or under your deck, even in winter. Many homes have burned from a woodpile that ignited as the fire passed. Wildfires can burn at almost any time in Colorado.

Locate propane tanks at least 30 feet from any structures, preferably on the same elevation as the house. You don't want the LP container below your house — if it ignites, the fire would tend to burn uphill. On the other hand, if the tank is above your house and it develops a leak, LP gas will flow downhill into your home. Clear and keep away flammable vegetation within 10 feet of these tanks. Do not screen propane tanks with shrubs or vegetation.

Dispose of slash (limbs, branches and other woody debris) from your trees and shrubs through chipping or by piling and burning. Contact your local CSFS office or county sheriff's office for information about burning slash piles. If neither of these alternatives is possible, lop and scatter slash by cutting it into very small pieces and distributing it over the ground. Avoid heavy accumulations

% slope	Tree Crown Spacing	Brush and Shrub Clump Spacing
0 -10 %	10´	2 1/2 x shrub height
11 - 20%	15´	3 x shrub height
21 - 40%	20´	4 x shrub height
> 40%	30´	6 x shrub height

Figure 4: Minimum tree crown and shrub clump spacing.

Tree Diameter (in inches)	Average Stem Spacing Between Trees (in feet)
3	10
4	11
5	12
6	13
7	14
8	15
9	16
10	17
11	19
12	21
13	23
14	24
15	26
16	28
17	29
18	31
19	33
20	35
21	36
22	38
23	40
24	42

Figure 5: Minimum tree spacing for Zone 3.

of slash. Lay it close to the ground to speed decomposition. If desired, no more than two or three small, widely spaced brush piles may be left for wildlife purposes. Locate these towards the outer portions of your defensible space.

Zone 3

This zone is of no specified size. It extends from the edge of your defensible space to your property lines. A gradual transition into this zone from defensible space standards to other management objectives you may have is suggested. Typical management objectives for areas surrounding homesites or subdivisions are: provide optimum recreational opportunities; enhance aesthetics; maintain tree health and vigor; provide barriers for wind, noise, dust and visual intrusions; support limited production of firewood, fence posts and other forest commodities; or grow Christmas trees or trees for transplanting.

Specific requirements will be dictated by your objectives for your land and the kinds of trees present. See Figure 5 for the *minimum* suggested spacing between "leave" trees. Forest management in Zone 3 is an opportunity for you to increase the health and growth rate of the forest in this zone. Keep in mind that root competition for available moisture limits tree growth and ultimately the health of the forest.

A high canopy forest reduces the chance of a surface fire climbing into the tops of the trees and might be a priority for you if this zone slopes steeply. The healthiest forest is one that has multiple ages, sizes, and species of trees where adequate growing room is maintained over time. Remember to consider the hazards of ladder fuels. Multiple sizes and ages of trees might increase the fire hazard from Zone 3 into Zone 2, particularly on steep slopes.

A greater number of wildlife trees can remain in Zone 3. Make sure that dead trees pose no threat to power lines or fire access roads.

While pruning generally is not necessary in Zone 3, it may be a good idea from the standpoint of personal safety to prune trees along trails and fire access roads. Or, if you prefer the aesthetics of a well-manicured forest, you might prune the entire area. In any case, pruning helps reduce ladder fuels within the tree stand, thus enhancing wildfire safety.

Mowing is not necessary in Zone 3.

Any approved method of slash treatment is acceptable for this zone, including piling and burning, chipping or lop-and-scatter.

Special Recommendations

Tree spacing guidelines do not apply to *mature* stands of aspen trees where the recommendations for ladder fuels have been complied with. In areas of aspen regeneration and young trees, the spacing guidelines should be followed.

Brush and shrubs

Brush and shrubs are woody plants, smaller than trees, often formed by a number of vertical or semi-upright branches arising close to the ground. Brush is smaller than shrubs and can be either woody or herbaceous vegetation.

On nearly level ground, minimum spacing recommendations between clumps of brush and/or shrubs is 2 1/2 times the height of the vegetation. Maximum diameter of clumps should be 2 times the height of the vegetation. As with tree crown spacing, all measurements are made from the edges of vegetation crowns (Figure 3).

For example: For shrubs 6 feet high, spacing between shrub clumps should be 15 feet or more apart (measured from the edges of the crowns of vegetation clumps). The diameter of shrub clumps should not exceed 12 feet (measured from the edges of the crowns). Branches should be pruned to a height of 3 feet.

Grasses

Keep dead, dry or curing grasses mowed to less than 6 inches. Defensible space size where grass is the predominant fuel can be reduced (Figure 5) when applying this practice.

Windthrow

In Colorado, certain locations and tree species, including lodgepole pine and Engelmann spruce, are especially susceptible to damage and uprooting by high winds (windthrow). If you see evidence of this problem in or near your forest, or have these tree species, consider the following adjustments to the defensible space guidelines. It is highly recommended that you contact a professional forester to help design your defensible space.

Adjustments: If your trees or homesite are susceptible to windthrow and the trees have never been thinned, use a stem spacing of diameter plus five instead of the guides listed in the Zone 3 section. Over time (every 3 to 5 years) *gradually* remove additional trees. The time between cutting cycles allows trees to "firm up" by expanding their root systems. Continue this periodic thinning until the desired spacing is reached.

Also consider leaving small clumps of trees and creating small openings on their lee side (opposite of the predominant wind direction). Again, a professional forester can help you design the best situation for your specific homesite and tree species. Remember, with species such as lodgepole pine and Engelmann spruce, the likelihood of a wildfire running through the tree tops or crowns (crowning) is closely related to the overabundance of fuels on the forest floor. Be sure to remove downed logs, branches and *excess* brush and needle buildup.

Maintaining Your Defensible Space

Your home is located in a forest that is dynamic, always changing. Trees and shrubs continue to grow, plants die or are damaged, new plants begin to grow, and plants drop their leaves and needles. Like other parts of your home, defensible space requires maintenance. Use the following checklist each year to determine if additional work or maintenance is necessary.

% slope	D-space size (uphill, downhill, sidehill)
0 - 20 %	30'
21 - 40%	50'
> 40%	70'

Figure 6: Minimum defensible space size for grass fuels.

Defensible Space and FireWise Annual Checklist

- □ Trees and shrubs are properly thinned and pruned within the defensible space. Slash from the thinning is disposed of.
- □ Roof and gutters are clear of debris.
- □ Branches overhanging the roof and chimney are removed.
- □ Chimney screens are in place and in good condition.
- □ Grass and weeds are mowed to a low height.
- □ An outdoor water supply is available, complete with a hose and nozzle that can reach all parts of the house.
- □ Fire extinguishers are checked and in working condition.
- □ The driveway is wide enough. The clearance of trees and branches is adequate for fire and emergency equipment. (Check with your local fire department.)
- □ Road signs and your name and house number are posted and easily visible.
- □ There is an easily accessible tool storage area with rakes, hoes, axes and shovels for use in case of fire.
- □ You have practiced family fire drills and your fire evacuation plan.
- □ Your escape routes, meeting points and other details are known and understood by all family members.
- □ Attic, roof, eaves and foundation vents are screened and in good condition.

Stilt foundations and decks are enclosed, screened or walled up.

□ Trash and debris accumulations are removed from the defensible space.

□ A checklist for fire safety needs inside the home also has been completed. This is available from your local fire department.

References

Colorado State Forest Service, Colorado State University, Fort Collins, CO 80523-5060; (970) 491-6303:

- *FireWise Construction — Design and Materials*
- Home Fire Protection in the Wildland Urban Interface
- Wildfire Protection in the Wildland Urban Interface
- *Landowner Guide to Thinning*

Colorado State University Cooperative Extension, 115 General Services Bldg., Fort Collins, CO 80523-4061; (970) 491-6198; E-mail: resourcecenter@ucm.colostate.edu:

- 6.303, *Fire-Resistant Landscaping*
- 6.304, *Forest Home Fire Safety*
- 6.305, *FireWise Plant Materials*
- 6.306, *Grass Seed Mixes to Reduce Wildfire Hazard*
- 7.205, *Pruning Evergreens*
- 7.206, *Pruning Shrubs*
- 7.207, *Pruning Deciduous Trees*

FIREWISE Community Fire Prevention Partnership ©1999 CSFS

FIREWISE is a multi-agency program that encourages the development of defensible space and the prevention of catastrophic wildfire.

Colorado State FOREST SERVICE

This fact sheet was produced in cooperation with the Colorado State Forest Service.

[1]*Wildfire Hazard Mitigation Coordinator, Colorado State Forest Service.*

APPENDIX G
PRESCRIBED FIRE PILE BURNING GUIDLINES
GOLDEN DISTRICT

Colorado State FOREST SERVICE

PRESCRIBED FIRE-PILE BURNING GUIDELINES

This handout is designed to be used by forest landowners, land managers, and fire department personnel in planning and conducting safe and effective burning of piled forest debris ("slash") - called "pile burns". These guidelines cannot guarantee safety against accidents, unforeseen circumstances, changing burning conditions, or negligent actions of the individuals conducting the prescribed fire. By following the intent of these guidelines and using common sense, the landowner or forest manager can reduce slash accumulations, improve the appearance of their forest land, and reduce wildfire risk on their property. The reader should contact a local office of the Colorado State Forest Service (CSFS) or their local fire authority for updated versions of this publication and current requirements about the use of open fires.

DEFINITIONS:

Slash: The accumulation of vegetative materials such as tops, limbs, branches, brush, and miscellaneous residue resulting from forest management activities such as thinning, pruning, timber harvesting, and wildfire hazard mitigation.

Pile Burning: The treatment of slash by arranging limbs and tops into manageable piles. Piles are burned during safe burning conditions, generally during the winter following cutting.

Chunking-In: The process of moving unburned materials from the outside perimeter into the center of the still burning piles. This is done after the pile has initially burned down and is safe to approach, but before the hot coals in the center have cooled. Chunking-in allows greater consumption of the piled slash.

Mop-up: The final check of the fire to identify and extinguish any still-burning embers or materials. This is accomplished by mixing snow, water, or soil with the burning materials.

MATERIALS TO BE INCLUDED IN PILES:

All limbs, tops, brush, and miscellaneous materials recently cut in the area, no greater than 3 inches in diameter and from 1 to 8 feet in length. Older branches can be used; as long as they still have needles/foliage attached or have not started decaying. Materials greater than 3 inches in diameter do not significant help a fire spread rapidly, will generally burn longer and require more chunking-in or mopping-up than is cost-effective, produce greater amounts of smoke, and should be used for sawtimber, posts & poles, firewood, or left for wildlife habitat. **Do not place garbage or debris in the piles**.

LOCATION OF PILES:

Piles should be located in forest openings or between remaining trees, in unused logging roads and landings, meadows, and rock outcrops. Piles should be preferably at least 10 feet from the trunk of any overhead trees. In denser stands of trees, piles can be located closer to the trees and even under the overhanging branches, but these piles should be smaller in size and burned when snow or moisture is present in the tree crowns. Piles should NOT be located on active road surfaces, in ditches, near structures or poles, under or around power lines, or on top of logs or stumps that may catch fire and continue smoldering.

CONSTRUCTION OF PILES:

Piles should be constructed by hand whenever possible, but if constructed by machine they should clean of dirt and debris. Piles should be started with a core of kindling-like materials such as needles, small branches, or paper in the bottom of the pile. Pile slash soon after cutting (while still green) and before winter snowfall. Do not include wood products such as firewood and logs. Pile branches and tops with the butt ends towards the outside of the pile, and with the branches overlapping so as to form a series of dense layers piled upon each other. The piles should be compact, packed down during construction, and with no long branches that will not burn from sticking out into the surrounding snow. Piles should be up to 8 feet in diameter, and at least 4 to 6 feet high. These measures prevent snow and moisture from filtering down into the piles and extinguishing the fire before it gets going. If the fuels do not have sufficient needles or fine fuels to carry the fire or kept moisture out (such as oak brush or very old conifer branches), then you should cover the piles with 6 mil plastic to keep them dry until the day of the burn, and then remove it.

PLANNING YOUR BURNING EFFORT:

Individuals should check with the local CSFS office or fire authority for the current requirements on open fires. Generally, you must complete one or more of the following steps before burning slash:

1. Complete and have an approved open burning permit from the local (county) Health Department.
2. Obtain authorization from the legally constituted fire authority for your area. This may be part of the health department's permit process.
3. Land management agencies must complete and have approval of an open burning permit from the Colorado Department of Health - Air Pollution Control Division.

Copies of all permits should be available on-site during the burning operation. Burning activities should also include plans for safety, supplemental water sources, and extra assistance from the local fire authority or the landowner. The individual(s) planning the burning operation should notify the following entities on the day of a burn: the local fire authority; county sheriff's department; and adjacent landowners who may be affected by smoke. Notification should include the date, times, and exact location of the burn. Pile burning must be conducted under suitable weather conditions. Periods of snow or light rain, with steady, light winds (for smoke dispersal), and sufficiently snow cover (6-12 inch depths) are ideal. Do not burn during periods of high winds, low humidity or drying conditions, temperature inversions (especially "Red Air Quality" days in metropolitan areas), with a lack of snow cover or these conditions are expected to develop after starting the burn. Persons burning slash piles should have the following: leather gloves; shovels; suitable footwear; masks for covering the mouth and nose; and proper eye protection.

BURNING SLASH PILES:

Piles may be ignited by several means. If the needles and fine fuels within the pile have dried though the summer, ignition can be easily started with matches and a large ball of newspaper placed within the bottom of the pile. If fuels are still partially green, or the pile is wet from rain or melting snow, then a hotter and longer burning source may be necessary. Drip torches (a specially designed gas can used by foresters for igniting fires) or sawdust soaked with diesel fuel can be used to ignite the pile. Flares used for highway emergencies can also be utilized to ignite the piles. **Do not use gasoline for this purpose.**

One test pile should be ignited to see if it burns and at what rate, prior to igniting other piles. If suitable burning conditions exist, then additional piles may be started. Ignite only those piles that can be controlled by the available manpower and resources until they have burned down. You can slow the rate of burning (and possible scorching of adjacent trees) by shoveling snow or spraying water into the pile and cooling the fire down. Depending upon weather conditions, pile size, and moisture content of the fuels, piles should burn down in 30-60 minutes. As a general rule, one person can manage 3-6 closely situated piles.

After the piles have burned down, chunk-in any unburned slash and wood into the hot coals in the center of the pile. As much as 95% of the original slash can be consumed by aggressive chunking-in. Do not start any new piles on fire after 2:00 pm, as they may continue burning into the evening and will not burn as completely due to lower temperatures and higher relative humidity. Smoke inversions may be a problem for piles still burning after sunset. At all times, piles may need to be actively mopped-up if the weather conditions will not extinguish the fire, or if the fires could escape. If high winds or melting snow increases this risk, then all burning materials must be mopped-up.

ADDITIONAL ASSISTANCE:

If landowners have questions about burning slash, they should contact a local CSFS office (http://csfs.colostate.edu/). CSFS can assist landowners with planning or conducting prescribed fire activities such as pile burning or broadcast (area) burning.

Local, state, and fire department authorities may require a burn plan, smoke management plan, and weather monitoring for complex burning operations.

APPENDIX H

Jefferson County Structure Triage Form. The structure is tagged with the completed form so that emergency personnel know which structures have priority for defense in an advancing wildfire.

Jefferson County Structure Triage Form

Subdivision:

Address:

Unit ID:

Date: **Time:**

	Roof										
	1/4 Involved in Fire							**YES**		**NO**	
	If YES consider structure lost and move on										
	Safety			**Static**				**Attack**			
Column Totals	**FF Safety**	**Civilian Safety**	**Hazmat**	**Fuels**	**Topography**	**Clearance**	**Construction**	**Access**	**Water**	**Radio Coverage**	
	No Safety Zones	Mandatory Evacuation	Bulk LPG, Fuels, Chemicals	Heavy or Dead Trees / Brush	Steep Slopes or Box Canyons >40%	30 Feet or less	Combustible Shake Roofs / Exterior	Long Narrow Driveway, Steep, Heavy Fuel Load	No Water Sources	Overall Poor Radio or Cell Coverage	
	4		2	2	2	2	4	4	2	4	26
	Marginal Safety Zone	Evacuate If Time Permits	Hazards In Barns & Storage Sheds	Moderate brush	Medium Slopes 20-40%	30 To 70 Feet	Some Combustible Asphalt Roofs / Exteriors	Adequate width/Turnarounds/Moderate grade	Ponds, Pools,Low Flow Hydrants	Radio Coverage OK, Some Weak Spots	
	2		1	1	1	1	2	2	1	2	13
	Adequate Safety Zone	Shelter In Place	None	Light Flashy	Flat 0-20%	More Than 70 Feet	Non Combustible Roof / Exteriors	Short Wide Driveway, Flat, Light Fuel Load	Good Hydrants	Good Radio and Cell Coverage	
	0		0	0	0	0	0	0	0	0	
	Comments:										

Score 14 - 26	**Last Priority**
Score 7 - 13	**Threatened**
Score 0 -6	**Not Threatened**