Foothills Fire Protection District Community Wildfire Protection Plan

May 19, 2008
Walsh Project Number: 7404-050

Walsh

Jefferson County Sheriff Emergency Management

Colorado State Forest Service

Foothills Fire & Rescue

Walsh
Environmental Scientists and Engineers, LLC

FOOTHILLS
FIRE PROTECTION DISTRICT
COMMUNITY WILDFIRE PROTECTION PLAN

May 19, 2008

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Community Wildfire Protection Plan

Foothills Fire Protection District
Jefferson County, Colorado

May 19, 2008

Introduction

This Community Wildfire Protection Plan (CWPP) was developed for the Foothills Fire Protection District with guidance and support from the Jefferson County Division of Emergency Management, Colorado State Forest Service, and U.S. Forest Service. The CWPP was developed according to the guidelines set forth by the Healthy Forests Restoration Act (2003) and the Colorado State Forest Service's Minimum Standards for Community Wildfire Protection Plans (2004). This CWPP supplements the Jefferson County Annual Operating Plan and the Jefferson County Fire Plan.

Wildfire Prevention and Fire Loss Mitigation

The Jefferson County Division of Emergency Management, the Jefferson County Fire Council, and the Foothills Fire Protection District support and promote Firewise activities as outlined in the Jefferson County Fire Plan.

Protection Capability

Initial response to all fire, medical, and associated emergencies within the Foothills Fire Protection District is the responsibility of Foothills Fire & Rescue. Wildland fire responsibilities of local fire departments, Jefferson County, the Colorado State Forest Service, U.S. Forest Service, Bureau of Land Management, and the U.S. Fish and Wildlife Service are described in the current Jefferson County Annual Operating Plan. All mutual aid agreements, training, equipment, and response are the responsibility of the local fire department and the agencies listed above.

The following agencies have reviewed and agree to this Community Wildfire Protection Plan.

_____
Golden District, Colorado State Forest Service

_____
Jefferson County Division of Emergency Management

_____
Foothills Fire Protection District

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List of Acronyms and Abbreviations

AOP	Annual Operating Plan
BTU	British Thermal Unit
CAPCD	Colorado Air Pollution Control Division
CDPHE	Colorado Department of Public Health and Environment
CSFS	Colorado State Forest Service
CWPP	Community Wildfire Protection Plan
DMP	Denver Mountain Parks
DOI	Department of the Interior
EFPD	Evergreen Fire Protection District
ENGB	Engine Boss
ERC	Energy Release Component
F	Fahrenheit
FBFM	Fire Behavior Fuel Model
ft	feet
FEMA	Federal Emergency Management Agency
FFR	Foothills Fire Rescue
FFPD	Foothills Fire Protection District
FPD	Fire Protection District
GFPD	Genesee Fire Protection District
GIS	Geographic Information System
HFRA	Healthy Forests Restoration Act
HOA	Homeowners' Association
ICT	Incident Command Team
IMT	Incident Management Team
JEFFCO	Jefferson County
JFDRS	Jefferson County Fire Danger Rating System
mph	miles per hour
NEPA	National Environmental Policy Act
NFDRS	National Fire Danger Rating System
NFPA	National Fire Protection Association
NWCG	National Wildfire Coordinating Group
PPE	personal protective equipment
RAWS	remote automated weather stations
USFS	U.S. Forest Service
WALSH	Walsh Environmental Scientists and Engineers, LLC
WFU	wildland fire use
WUI	wildland-urban interface

List of Fire Behavior Terms

Aerial Fuels	All live and dead vegetation in the forest canopy or above surface fuels, including tree branches, twigs and cones, snags, moss, and high brush.
Aspect	Direction a slope faces.
Chain	A unit of linear measurement equal to 66 feet.
Crown Fire	The movement of fire through the crowns of trees or shrubs more or less independently of the surface fire.
Dead Fuels	Fuels with no living tissue in which moisture content is governed almost entirely by atmospheric moisture (relative humidity and precipitation), dry-bulb temperature, and solar radiation.
Defensible Space	An area either natural or manmade where material capable of causing a fire to spread has been treated, cleared, reduced, or changed to act as a barrier between an advancing wildland fire and values at-risk, including human welfare. In practice, "defensible space" is defined as an area a minimum of 30 feet around a structure that is cleared of flammable brush or vegetation.
Direct Attack	A method of fire suppression where actions are taken directly along the fire's edge. In a direct attack, burning fuel is treated directly, such as by wetting, smothering, or chemically quenching the fire or by physically separating burning from unburned fuel.
Fire Behavior	The manner in which a fire reacts to the influences of fuel, weather, and topography.
Fire Danger	The broad-scale condition of fuels as influenced by environmental factors.
Fire Front	The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified the fire front is assumed to be the leading edge of the fire perimeter. In ground fires, the fire front may be mainly smoldering combustion.
Fire Hazard	The presence of ignitable fuel coupled with the influences of terrain and weather.
Fire Intensity	A general term relating to the heat energy released by a fire.

Fire Return Interval	The historic frequency that fire burns in a particular area or fuel type, without human intervention.
Fire Regime	The characterization of fire's role in a particular ecosystem, usually characteristic of particular vegetation and climatic regime, and typically a combination of fire return interval and fire intensity (i.e., high frequency low intensity/low frequency high intensity).
Fire Weather	Weather conditions that influence fire ignition, behavior, and suppression.
Flame Length	The distance from the base to the tip of the flaming front. Flame length is directly correlated with fire intensity.
Flaming Front	The zone of a moving fire where combustion is primarily flaming. Behind this flaming zone combustion is primarily glowing. Light fuels typically have a shallow flaming front, whereas heavy fuels have a deeper front.
Fuel Loading	The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area.
Fuel Model	Simulated fuel complex (or combination of vegetation types) for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.
Fuel Type	An identifiable association of fuel elements of a distinctive plant species, form, size, arrangement, or other characteristics that will cause a predictable rate of fire spread or difficulty of control under specified weather conditions.
Fuel	Combustible material; includes vegetation such as grass, leaves, ground litter, plants, shrubs, and trees that feed a fire. Not all vegetation is necessarily considered fuel; deciduous vegetation such as aspen actually serve more as a barrier to fire spread and many shrubs are only available as fuels when they are drought-stressed.
Ground Fuel	All combustible materials below the surface litter, including duff, tree or shrub roots, punchy wood, peat, and sawdust that normally support a glowing combustion without flame.
Indirect Attack	A method of fire suppression where actions are taken some distance from the active edge of the fire due to intensity, terrain, or other factors that make direct attack difficult or undesirable.

Intensity	The level of heat radiated from the active flaming front of a fire, measured in British thermal units (BTUs) per foot.
Ladder Fuels	Fuels that provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. Ladder fuels help initiate and ensure the continuation of crowning.
Live Fuels	Living plants, such as trees, grasses, and shrubs, in which the seasonal moisture content cycle is controlled largely by internal physiological mechanisms, rather than by external weather influences.
National Fire Danger Rating System (NFDRS)	A uniform fire danger rating system that focuses on the environmental factors that control the moisture content of fuels.
Prescribed Fire	Any fire ignited by management actions under certain predetermined conditions to meet specific objectives related to hazardous fuels or habitat improvement. A written, approved prescribed fire plan must exist, and National Environmental Policy Act (NEPA) requirements must be met prior to ignition.
Rate of Spread	The relative activity of a fire in extending its horizontal dimensions. It is expressed as a rate of increase of the total perimeter of the fire, rate of forward spread of the fire front, or rate of increase in area, depending on the intended use of the information. Usually it is expressed in chains or acres per hour for a specific period in the fire's history. Sometimes it is expressed as feet per minute; one chain per hour is equal to 1.1 feet per minute.
Risk	The probability that a fire will start from natural or human-caused ignition.
Surface Fuels	Loose surface litter on the soil surface, normally consisting of fallen leaves or needles, twigs, bark, cones, and small branches that have not yet decayed enough to lose their identity; also grasses, forbs, low and medium shrubs, tree seedlings, heavier branchwood, downed logs, and stumps interspersed with or partially replacing the litter.
Topography	Referred to as "terrain." The term also refers to parameters of the "lay of the land" that influence fire behavior and spread. Key elements are slope (in percent), aspect (the direction a slope faces), elevation, and specific terrain features such as canyons, saddles, "chimneys," and chutes.
Wildfire	A wildland fire that is unwanted and unplanned.

Wildland Fire	Any fire burning in wildland fuels, including prescribed fire, fire use, and wildfire.
Wildland Fire Use	The management of naturally ignited wildland fires to accomplish specific prestated resource management objectives in predefined geographic areas outlined in Fire Management plans.

EXECUTIVE SUMMARY

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. Once the CWPP is finalized and adopted, it is the responsibility of the community or neighborhood to move forward and implement the action items. This may require further planning at the project level, acquisition of funds, or simply motivating individual homeowners.

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

The HFRA of 2003 provides the impetus for local communities to engage in comprehensive forest and wildfire management planning as well as incentive for public land management agencies to consider these recommendations as they develop their own strategic management plans. The HFRA provides communities with a flexible set of assessment procedures and guidelines that facilitate a collaborative standardized approach to identify wildfire risks and prioritize mitigation actions. The CWPP addresses such factors as:

- Stakeholder collaboration;
- Public agency and local interested party engagement;
- Mapping;
- Risk assessment – fuels, historical ignitions, infrastructure, structural ignitability, local resources, and firefighting capability;
- Hazard reduction recommendations; and
- Strategic action plan.

This CWPP provides wildfire hazard and risk assessments and mitigation recommendations for select neighborhoods and subdivisions within the Foothills Fire Protection District (FFPD), situated approximately 20 miles west of Denver. The fire district was formed in 1997 through a consolidation of three existing districts and includes several small communities and neighborhoods ranging in elevation from approximately 6,000 to 8,000 feet (ft). The 25.2 square miles encompassed by the fire district include the foothills immediately to the west of the greater Denver metropolitan area, 8 miles along I-70, north to Clear Creek Canyon and south to Bear Creek County. While the Foothills district is home to approximately 5,000 residents, it also includes significant portions of undeveloped public lands. The district has little commercial

development, but is home to several historic sites and numerous television and radio transmission towers.

The wildland-urban interface (WUI) is defined as the area where development encroaches on undeveloped natural areas and represents the zone of greatest potential for loss due to wildfire. Fourteen discrete WUI areas were identified within the FFPD based on geography and neighborhood characteristics. A hazard/risk assessment was performed for each area to help establish mitigation priorities.

Natural resource management policies, changing ecological conditions and community expansion into wildlands have converged to exacerbate hazardous fuel situations throughout the assessment area. Decades of aggressive fire suppression practices have resulted in very dense and weakened timber stands. Years of drought have further stressed the forests, setting the stage for the devastating insect and disease infestations the region is experiencing today. Shrubs have expanded into traditional grasslands, resulting in accumulating hazardous amounts of woody ground fuel. The diversity of native grasses has succumbed to aggressive non-native species and noxious weeds. In many areas these fire-dependent ecosystems have grown unchecked by fire for more than a century. The collective result is a pronounced increase in the potential for catastrophic wildfire.

Field assessments, public surveys, interviews with public lands managers, and close collaboration with the FFPD and other stakeholders were utilized for data collection, hazard assessments, and treatment recommendations. All information was gathered, analyzed, and prepared in the CWPP format by Walsh Environmental Scientists and Engineers, LLC (WALSH) and Alpenfire, LLC. A project website (http://jeffco.us/sheriff/sheriff_T62_R191.htm) is maintained by Jefferson County Department of Emergency Management and provides access to the draft CWPP report for public review, project updates, meeting notices, and related project information.

The success of any CWPP hinges on community involvement. Although important during the drafting of the report, this type of involvement is critical when it comes to implementing recommended actions. Two public meetings were convened to educate the public about the CWPP process, project goals and objectives, assessment methodology, and wildfire mitigation techniques. These meetings also provided an opportunity for the public to share concerns and ideas regarding wildfire with the Core Team and consultants, which were incorporated into the CWPP process.

Questionnaires were distributed to district residents in order to ascertain public opinion concerning the level of wildfire risk in the FFPD, evaluate values at risk, and assess mitigation practices needed to reduce risk. Safety pamphlets and brochures explaining proper home construction and landscaping practices designed to reduce the risk of wildfire are also made available. CWPP documentation is posted on Jefferson County's emergency management website to encourage public review and comment.

The National Fire Protection Association (NFPA) Form 1144, Standards for Protection of Life and Property from Wildfire, 2002 Edition, was utilized to assess the level of risk and

hazard to individual neighborhoods. Form 1144 provides a means to assess predominant characteristics within individual neighborhood communities as they relate to structural ignitability, fuels, topography, expected fire behavior, emergency response, and ultimately human safety and welfare. Scores are assigned to each element and totaled to determine the overall level of risk. Low, moderate, high, and extreme hazard categories are determined based on the total score. This methodology provides a standardized basis for wildfire hazard assessment and a baseline for future comparative surveys. Fourteen subdivisions and neighborhoods were identified by the FFPD as areas of concern and were surveyed according to NFPA Form 1144 protocols during February and March 2008. A summary of the community hazard ratings is provided in Table ES-1.

Table ES-1. Community Hazard Rating Summary in Order of Hazard Rating

Neighborhood	Hazard Rating
Ski Hill	HIGH
Rainbow Hill, Moss Rock	
Mount Vernon Club Place	
Cody Park	
Hess, Zephyr, Krestview	
Lininger	
Idledale	
Mount Vernon	
Lookout Mountain: Columbine, Cedar Lake	
Grandview	
Buffalo Bill Historic Site	
Grapevine	
Gateway	MODERATE
Spring Ranch	
Paradise Hills	

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

Continued coordination with the Jefferson County Annual Operating Plan (AOP) is also recommended. This provides important information concerning county and regional fire operations, policies, and procedure definitions. Information is available through the Jefferson County Department of Emergency Management website.

The FFPD CWPP is a strategic planning document, developed with and approved by the Core Team. An important component of the development process includes building a stakeholder group that will move the plan forward, implement prioritized recommendations, and maintain the CWPP as the characteristics of the WUI change over time. Organizing and maintaining this team is often the most challenging component of the CWPP process. It is, however, essential in the process of converting the CWPP from a strategic plan into action. This team will oversee the implementation and maintenance of the CWPP by working with fire authorities, community organizations, private landowners, and public agencies to coordinate and implement hazardous fuels treatment projects management and other mitigation projects. Building partnerships among neighborhood-based organizations, fire protection authorities, local governments, public land management agencies, and private landowners is necessary in identifying and prioritizing measures to reduce wildfire risk. Maintaining this cooperation is a long-term effort that requires the commitment of all partners involved. The CWPP encourages citizens to take an active role in identifying needs, developing strategies, and implementing solutions to address wildfire risk by assisting with the development of local community wildfire plans and participating in countywide fire prevention activities.

FOOTHILLS FIRE PROTECTION DISTRICT 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 hazards and risks facing communities and neighborhoods and provides prioritized mitigation recommendations that are designed to reduce those hazards and risks. 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, enhanced cooperation with other agencies, acquisition of funds, or simply motivating individual homeowners.

Decades of aggressive fire suppression practices in fire-adapted ecosystems have removed a critical natural cleansing mechanism from the vegetation regeneration cycle. Fire exclusion has altered historic forest and shrubland conditions and contributed to an unprecedented buildup of naturally occurring flammable fuels. Such management tactics have also led to an alteration of prairie habitats, supporting the invasion of aggressive and highly flammable noxious weeds and grasses that, in many areas, have entirely replaced naturally occurring species. 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 have shifted the nation's population growth centers to western and southwestern states where these ecosystems are predominant. The region where human development is pushing into these stressed ecosystems is known as the wildland-urban interface (WUI). This is the area where risk of loss due to wildfire is the greatest. The potential consequences are devastating and costly, and in recent years have drawn the attention of the U.S. Congress in the pursuit of 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 helps implement the core components of the plan and provides the impetus for wildfire risk assessment and planning at the county and community level. The HFRA refers to this level of planning as the CWPP process. This empowers the participating community to take advantage of wildland fire and hazardous fuel management opportunities offered under HFRA legislation. This includes a framework for hazard evaluation and strategic planning, prioritized access to federal grants supporting hazard reduction projects, and a basis for collaboration with local, state, and federal land management agencies.

1.2 Need for a CWPP

The Foothills Fire Protection District (FFPD) lies between approximately 6,000 and 8,200 feet (ft) elevation along the I-70 corridor west of the greater Denver, Colorado metropolitan area. The district is characterized by a decentralized network of neighborhoods and roads running through the mountainous forest and shrublands.

The forest, shrublands, and grasslands in FFPD have adapted to a mixture of low and high severity fires along a broad range of historic frequencies. It is generally acknowledged that a policy of fire suppression along the Front Range has exacerbated the potential for high-intensity wildfire by allowing fuels to build up and facilitating the decline of forest health.

Weather plays a critical role in determining fire frequency and behavior. A dry climate and available fuels in an area prone to strong gusty winds can turn an ignition from a discarded cigarette, vehicle parked over dry grass, or spark from a vehicle into a major wildfire event in a matter of several minutes.

The FFPD is characterized by a combination of a relatively dense population, heavily utilized recreational lands and travel routes, fire-adapted vegetation, and the potential for natural and human ignitions. These factors combine a degree of hazard, ignition risk, and values at risk that require serious evaluation.

The combination of environmental esthetics, recreational opportunities, and proximity to a major metropolitan area make the FFPD a desirable location. However, the district is characterized by several factors that typify a hazardous WUI: development into fire-adapted ecosystems, steep topography, frequent natural and human-caused ignitions, available fuels, periods of prolonged drought, and dry, windy weather conditions. Each identified WUI neighborhood or subdivision represents a distinct response area with a unique combination of wildfire fuels, building construction materials, topography, access, available resources, and opportunities for fuels mitigation.

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

1.3 CWPP Process

The HFRA designed the CWPP to incorporate a flexible process that can accommodate a wide variety of community needs. This CWPP is tailored to meet specific goals as identified by the Core Team, following the standardized steps for developing a CWPP as outlined in “Preparing a Community Wildfire Protection Plan: A Handbook for Wildland-Urban Interface Communities” (Society of American Foresters 2004) and the

Colorado State Forest Service (CSFS) Minimum Standards for Community Wildfire Protection Plans (CSFS 2004). Table 1 presents the CWPP development process.

Table 1. CWPP Development Process

Step	Task	Explanation
One	Convene Decision Makers	Form a Core Team made up of representatives from local governments, fire authorities, and the 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 district 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 district CWPP and communicate the results to interested parties and stakeholders.

The initial step in developing the FFPD CWPP is to organize an operating group that serves as the core decision-making team (Table 2). At a minimum, the Core Team consists of representatives from local government, local fire authorities, and the CSFS. In addition, the Core Team should include relevant affected land management agencies and active community and homeowners' association (HOA) stakeholders. Collaboration between agencies and with communities is an important CWPP component because it promotes sharing of perspectives, plans, priorities, and other information that is useful to the planning process. Together these entities guide the development of the CWPP as described in the HFRA and must mutually agree on the plan's final contents.

Table 2. FFPD CWPP Core Team Members

Team Member	Organization	Phone Number
Brian Zoril	Foothills Fire Rescue	303-526-0707
Rocco Snart	Jefferson County Division of Emergency Management	303-271-4900
Allen Gallamore	CSFS	303-279-9757 x 302
Randy Frank	Jefferson County Open Space	303-271-5925

As a strategic plan, the real success of any CWPP hinges on effective and long-term implementation of the identified objectives. The CWPP planning and development process must include efforts to build a stakeholder group that serves as an implementation team and will oversee the execution of prioritized recommendations and maintain the plan as the characteristics of the WUI change over time. Specific projects may be undertaken by individual HOAs, while larger-scale treatments may require collaboration between multiple HOAs, local government, and public land management agencies. Original CWPP Core Team representatives may, but are not required to, assist in the implementation of the CWPP action plan. Continued public meetings are recommended as a means to generate additional support and maintain momentum.

A successful CWPP utilizes relevant geographic information (e.g., Geographic Information System [GIS] data) to develop a community base map. Comprehensive risk assessment is conducted at the neighborhood or community level to determine relative levels of wildfire risk to better address hazard treatment prioritization. A standardized survey methodology is utilized to create an address-based rating benchmark for comparative future assessments and project evaluations.

CWPP fuel treatment recommendations derived from this analysis are prioritized through an open and collaborative effort with the Core Team and stakeholders. Prioritized treatments target wildfire hazard reduction in the WUI communities and neighborhoods, including structural ignitability and 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 with Core Team consensus. It 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.

1.4 Policy Framework

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

There are several federal legislative acts and policies that provide guidance to the development of the CWPP for the FFPD:

- HFRA (2003) – Federal legislation that promotes 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; and
- Federal Emergency Management Agency (FEMA) Disaster Mitigation Act (2000) – Provides criteria for state and local multiple-hazard and mitigation planning.

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

The Jefferson County Annual Operating Plan (AOP) provides an intergovernmental mutual aid agreement between all fire districts in the county, and includes the CSFS and U.S. Forest Service (USFS). This plan provides emergency response infrastructure for any large incident support.

1.5 FFPD CWPP Goals and Objectives

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

Table 3. FFPD CWPP Goals and Objectives

Goal	Objective
Facilitate and develop a CWPP for the FFPD	▪ Provide oversight for all activities related to the CWPP. ▪ Ensure representation and coordination among agencies and interest groups. ▪ Develop a long-term framework for sustaining CWPP efforts.
Conduct a wildfire risk assessment	▪ Conduct a district-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-fuel mitigation needs.
Manage hazardous fuels	▪ Identify communities at highest risk and prioritize hazard reduction treatments. ▪ Develop sustainable initiatives at the 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 fuel reduction projects to solicit community involvement and private landowner cooperation.

2 WILDLAND FIRE MANAGEMENT PRIMER

Wildland fire is defined as any fire burning in wildland fuels and includes prescribed fire, wildland fire use (WFU), and wildfire. Prescribed fires are planned fires ignited by land managers to accomplish specific natural resource improvement objectives. Fires that occur from natural causes, such as lightning, that are then used to achieve management purposes under carefully controlled conditions with minimal suppression costs are known as WFU. Wildfires are unwanted and unplanned fires that result from natural ignition, unauthorized human-caused fire, escaped WFU, or escaped prescribed fire. The FFPD actively suppresses all wildfires, and WFU is not authorized in the district.

Wildland fires may be further classified as ground, surface, or crown fires. Ground fire refers to burning/smoldering materials beneath the surface including duff, tree or shrub roots, punchy 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 such as leaves, needles, small branches, grasses, forbs, low and medium shrubs, tree seedlings, fallen branches, downed timber, and slash. Crown fire is a wildland fire that moves rapidly through the crowns of trees or shrubs.

2.1 Wildland Fire Behavior

Fire behavior is the manner in which a fire reacts to the influences of fuel, weather, and topography. Fire behavior is typically modeled at the flaming front of the fire and described most simply in terms of fireline intensity (flame length) and in rate of forward spread. The implications of observed or expected fire behavior are important components of suppression strategies and tactics, particularly in terms of the difficulty of control and effectiveness of various suppression resources. The Hauling Chart (Table 4) is an excellent tool for measuring the safety and potential effectiveness of various fireline resources given a visual assessment of active flame length. It is so named because it infers the relative intensity of the fire behavior to trigger points where hauling various resources to or away from an incident should be considered.

Table 4. Hauling Chart Interpretations

Flame Length (Feet)	Fireline Intensity (BTU/Ft/Sec)	Interpretation
0-4	0-100	Persons using handtools can generally attack fires at the head or flanks. Handline should hold the fire.
4-8	100-500	Fires are too intense for direct attack on the head by persons using handtools. Handline can not be relied on to hold fire. Equipment such as dozers, engines, and retardant aircraft can be effective.
8-11	500-1,000	Fires may present serious control problems such as torching, crowning, and spotting. Control efforts at the head of the fire will probably be ineffective.
11+	1,000+	Crowning, spotting, and major runs are common,;control efforts at the head of the fire are ineffective.

Source: Fireline Handbook Appendix B

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.

The characteristics of fuels, topography, and weather conditions combine to dictate fire behavior, rate of spread, and intensity. Wildland fuel attributes refer to both dead and live vegetation and include such factors as density, bed depth, continuity, density, vertical arrangement, and moisture content. Structures with flammable materials are also considered a fuel source.

When fire burns in the forest understory or through grass, it is generally a surface fire. When fire burns through the canopy of vegetation, or overstory, it is considered a crown fire. The vegetation that spans the gap between the forest floor and tree crowns can allow a surface fire to become a crown fire and is referred to as ladder fuel.

For fire to spread, materials such as trees, shrubs, or structures in the flame front must meet the conditions of ignitability. The conditions needed are the presence of oxygen, flammable fuel, and heat. Oxygen and heat are implicitly available in a wildland fire. However, if the potential fuel does not meet the conditions of combustion, it will not ignite. This explains why some trees, patches of vegetation, or structures may survive a wildland fire and others in the near vicinity are completely burned.

Potential surface fire behavior may be estimated by classifying vegetation in terms of fire behavior fuel models (FBFMs) and using established mathematical models to predict potential fire behavior under specific climatic conditions. In this analysis, FBFMs were determined through a combination of field evaluations and interpreting satellite images. Climatic conditions were derived from local weather station records.

Weather conditions such as high ambient temperatures, low relative humidity, and windy conditions favor fire ignition and high-intensity fire behavior. Under no-wind conditions fire burns more rapidly and intensely upslope than on level terrain; however, wind tends to be the driving force in fire behavior in the most destructive WUI fires. The “chinook” winds common along the Front Range can rapidly drive wildfire downslope.

2.2 History of Wildfire

Lightning-induced fire is a natural component of Jefferson County 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. As such, many of the plant species and communities have adapted to recurring fire through phenological, physiological, or anatomical attributes. Some plants, such as lodgepole pine and western wheatgrass, require reoccurring fire to exist.

European settlers, land use policy, and changing ecosystems have altered fire behavior and fuels accumulation from their historic setting. Euro-American settlers in Jefferson County changed 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. The removal of the natural vegetation facilitated the invasion of nonindigenous grasses and forbs, some of which create more flammable fuel beds than their native predecessors.

In addition, more than a century of fire-suppression policy has resulted in large accumulations of surface and canopy fuels in western forests and brushlands. Fuel loads also increased as forests and brushlands encroach into grasslands as a result of fire exclusion. This increase in fuel loading and continuity has created hazardous situations for public safety and fire management, especially when found in proximity to communities. These hazardous conditions will require an array of mitigative tools, including prescribed fire and thinning treatments.

2.3 Prescribed Fire

Prescribed fire may be used as a resource management tool under carefully controlled conditions. This includes pre-treatment of the fuel load and close monitoring of weather and other factors. Prescribed fire ultimately improves wildlife habitat, helps abate invasive vegetation, reduces excess fuel loads, and lowers the risk of future wildfires in the treatment area. These and other fuel management techniques are employed to protect human life, economic values, and ecological values. The use of prescribed fire in the WUI is carefully planned and enacted 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). Open burning permits are obtained from Jefferson County Environmental Health Services (www.co.jefferson.co.us/health/health_T111_R38.htm).

Prescribed fire may be conducted either as a broadcast burn within defined boundaries, or in localized burn piles. Broadcast burns are used to mimic naturally occurring wildfire but only under specific weather conditions, fuel loads, and expert supervision. Burn piles are utilized to dispose of excess woody material after thinning if other means of disposal are not available or cost-prohibitive. Acceptable burn days are determined in consultation with Jefferson County.

2.4 Wildland Urban Interface (WUI)

The WUI is the zone where communities and wildland fuel interface and is the central focus of this CWPP. Every fire season catastrophic losses from wildfire plague the WUI. Homes are lost, businesses are destroyed, community infrastructure is damaged, and, most tragically, lives are lost. Precautionary action taken before a wildfire strikes often makes the difference between saving and losing a home. Creating a defensible space around a home is an important component in wildfire hazard reduction. Providing an effective defensible space can be as basic as pruning trees, applying low-flammability landscaping, and cleaning up surface fuels and other fire hazards near a home. These

efforts are typically concentrated within 75 ft of a home to increase the chance for structure survival or create an area for firefighters to work in the event of a wildfire (see Section 5.2).

While reducing hazardous fuels around a structure is very important to prevent fire loss, recent studies indicate that, to a great extent, the attributes of the structure itself determine ignitability. Experiments suggest that even the intense radiant heat of a crown fire is unlikely to ignite a structure that is more than 30 ft away as long as there is no direct flame impingement (Cohen and Saveland 1997). Studies of home survivability indicate that homes with noncombustible roofs and a minimum of 30 ft of defensible space had an 85-percent survival rate. Conversely, homes with wood shake roofs and less than 30 ft of defensible space had a 15-percent survival rate (Foote 1996).

2.5 Hazardous Fuels Mitigation

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

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

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

3 FOOTHILLS FIRE PROTECTION DISTRICT PROFILE

3.1 County and District Setting

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 population is currently estimated at 529,401 people with approximately 184,640 people living in the incorporated areas.

The FFPD lies between approximately 6,000 and 8,200 ft elevation in the foothills to the west of the greater Denver, Colorado metropolitan area. The district was formed in 1997 through the consolidation of the Mount Vernon, Idledale, and Lookout Mountain fire districts. It stretches from Clear Creek Canyon south to Bear Creek Canyon and is bisected by 8 miles of I-70 (Map 1, Appendix A).

Approximately 5,000 residents live within the 25.2 square miles of the FFPD. 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. Structures within the district range from turn-of-the-century cabins to very large contemporary homes. Though many Denver television and radio stations have transmission towers located on Lookout Mountain and Mount Morrison, there is little other commercial development within the district.

The FFPD surrounds the Genesee Fire Protection District (GFPD) on three sides and is in turn largely surrounded by over 20,000 acres of city, state, and county parks and open 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 pens. Foothills Fire Rescue (FFR) responds to fires on 3,456 acres of these lands within its district and an additional 7,552 acres outside of its district.

3.2 Climate

The FFPD climate is relatively dry with the majority of precipitation occurring with spring rains and summer monsoons (Table 5). Observations were taken from the nearest station located at a similar elevation, in similar terrain, and with over ten years of data. This station is located approximately 6 miles to the southwest of the FFPD at an elevation of approximately 7,000 ft. The area receives more than 220 days of sunshine per year and an average of 18.75 inches of annual precipitation. Winter high temperatures are typically in the mid 40s (degree Fahrenheit [F]) and summer highs are in the 70s and low 80s. The low precipitation months are typically December, January, and February.

Table 5. Average Monthly Climate Summary for the FFPD (1961-2007, Evergreen, CO)

Climate Attribute	Month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average maximum temperature (^{o}F)	45	46	50	57	65	75	82	80	72	63	51	45	61
Average total Precipitation (inches)	0.54	0.68	1.66	2.2	2.56	2.19	2.24	2.35	1.49	1.22	0.97	0.66	18.75

Source: Western Regional Climate Center (http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?co2790)

The less populated areas of the district below 7,000 ft have very similar weather, though slightly warmer and drier, as would be expected. Fire weather conditions are discussed in Section 4.2.

3.3 Topography

Topography and elevation play an important role in dictating existing vegetation, fuels, and wildland fire behavior. Topography also dictates community infrastructure design, further influencing overall hazard and risk factors. The elevation of the FFPD ranges from 6,000 to 8,200 ft with most of the homes above 7,000 ft. The entire district is comprised of mountainous terrain with slopes ranging from 10% to over 50%. Most homes are in areas exposed to slopes of 20% or steeper. Defensible space zones need to be expanded to accommodate steep slopes.

3.4 Wildland Vegetation and Fuels

The vegetation found in the district is typical of the Rocky Mountain montane ecosystem. Vegetation type and distribution is controlled primarily by available soil moisture, which is closely related to slope aspect. The east and south-facing slopes in this area support widely spaced ponderosa pine trees, shrubs, and grasses. The spacing of individual ponderosa pine trees is related to available soil moisture and may become dense in protected drainages or more shaded slope aspects.

North aspects of the montane ecosystem retain more soil moisture and support denser stands of conifer that are less drought resistant. In this district Douglas-fir and ponderosa pine are the predominant species on north facing slopes. Willows, mountain alder, water birch, and other water-loving trees may be found in riparian zones along creeks and streams. The district is also characterized by valley meadows that support a variety of high altitude grasses.

Existing vegetation is the fuel source for wildland fire and has a direct effect on fire behavior. Accurately mapping vegetative ground cover is a critical component of fuel modeling and fire behavior modeling. Understanding the fire behavior characteristics of particular fuel types facilitates effective fuels treatment strategies on a local, as well as landscape, level. Map 4 illustrates existing ground cover vegetation, represented as

FBFMs, based on LANDFIRE, the Landscape Fire and Resource Management Planning Tools Project data, derived from Landsat multi-spectral satellite imagery. Satellite classification is also field-surveyed, ground-truthed, and photo-documented to verify results and further classify the characteristics of the understory surface fuels, a critical component in determining the FBFMs that are used in modeling potential fire behavior.

Predictive fire modeling is an important component in a variety of strategic and tactical applications including risk and hazard assessments, pre-attack planning, initial attack, extended suppression, prescribed fire planning, and predictive modeling of active wildfires.

BehavePlus Fire Behavior Prediction and Fuel Modeling software was utilized for this assessment. By inputting several user-defined parameters including FBFM, fuel moisture, weather, and slope, expected rates of spread, associated flame lengths, and fire intensity can be determined. These are important factors in any tactical or strategic fire management decision. Fire behavior analysis is detailed in Section 4.2.

There are several systems for classifying fuel models. This CWPP utilizes the most commonly used fuel modeling methodology as developed by Hal E. Anderson (1982). Thirteen FBFMs are presented in four fuel groups: grasslands, shrublands, timber litter and understory, and logging slash. Each group comprises three or more fuel models. Of these 13 fuel models, FBFMs 1, 2, 4, 8, 9, and 10 are the most prevalent in the FFPD (Table 6).

Table 6. Fuel Models Common (in grey) to the FFPD

Group	FBFM Number	Description
Grasslands	1	Short grass (1 foot)
	2	Grass with timber/brush overstory
	3	Tall grass (2.5 feet)
Shrublands	4	Mature brush (6 feet)
	5	Young brush
	6	Intermediate or dormant brush
Timber Litter and Understory	7	Southern rough
	8	Closed or short-needle timber litter – light fuel load
	9	Hardwood or long-needle or timber litter
	10	Mature/overstory timber and understory
Logging Slash	11	Light slash; closed timber with down woody fuel
	12	Medium slash (35 tons/acre)
	13	Heavy slash (200 tons/acre)

Source: Anderson 1982

Grasslands, FBFMs 1 and 2

Grass fuels are most common on south-facing slopes, and they are mixed with brush fuels on the east-facing slopes. Even in areas where ponderosa pine is prevalent, the surface fuels are often comprised of grasses. The short and mid-grass species common to this area include blue grama, western wheatgrass, needle-and-thread, and prairie Junegrass. These western annual grasses are adapted to the relatively frequent disturbance of fire and benefit from fast moving, "cool" fire because it removes excessive dried biomass and adds nutrients to the soil. In the absence of these periodic fires, the accumulation of thatch and woody material and the encroachment of brush increases surface fuel loads, increasing the probability of high-intensity surface fires.

Historic fire return intervals for these grasslands range from approximately 10 to 35 years, allowing for a rapid departure from the historic fire regime conditions when fire is excluded. Fire exclusion also encourages shrub and noxious grass and weed encroachment. Cheatgrass, also known as downy brome, is an aggressive invasive grass species that is now common throughout the state and region. Cheatgrass provides forage for livestock but matures and dries out earlier than native grasses. It exhibits higher fire intensity than native grasses and often becomes dominate in overgrazed areas.

Although brush and timber fires are known for intense fire behavior, the potential impact of grass fires should not be underestimated. These light, flashy fuels can be resistant to suppression, producing incredibly rapid rates of spread and flame lengths in excess of 10 ft. They can pose a very real risk to firefighter safety and a serious threat to untreated homes.

Open prairie, grassy slopes, and irrigated meadows and lawns are characterized as FBFM 1, though when well irrigated these grasses are unavailable to combustion. A grassy understory of ponderosa pine mixed with other herbaceous fuels that would carry a surface fire is defined as FBFM 2.

Shrublands, FBFMs 5 and 6

Shrubs may be found on all aspects throughout the district. Mountain mahogany is the dominant shrub species and is most dense on northern aspects above 6,800 ft, in drainages, and may be found on all aspects below 6,800 ft. Where less dense, mountain mahogany grows with a grass understory and is best represented by FBFM 2. Riparian zones along creek beds and slope drainages can support other shrub species in this area such as scrub willow, chokecherry, and alder. Areas where conifer is aggressively regenerating are also classified as shrublands based primarily on density and height of the growth. This dense, short conifer stands essentially burn like shrub stands.

Shrub stands in the FFPD are predominantly classified as FBFM 5 (young brush, less than 6 ft tall, clean litter) though limited concentrations of FBFM 6 may be found (intermediate brush, older than FBFM 5, less dense than FBFM 4). It should be noted that shrub vegetation typically constitutes higher-moisture woody plants associated with low to moderate fire behavior. However, prolonged drought (experienced in recent

years) lowers the live fuel moisture content in plant stems, producing extreme fire behavior under favorable weather conditions.

Timber Litter and Understory, FBFMs 8, 9, and 10

Forest composition in the district is strongly influenced by elevation and slope aspect, which are directly related to the available soil moisture. Ponderosa pine favor drier south-facing aspects while Douglas-fir, lodgepole pine, and Engelmann spruce favor moister and cooler north-facing aspects. Lodgepole pine is more common in elevations above 8,000 ft but species will commonly mix on transitional slope aspects. In some areas fire exclusion has allowed Douglas-fir to become disproportionately dominant. Continuous forest canopy, most common at higher elevations and north-facing aspects, often prohibits live surface fuels from taking hold. In some mature and over-mature closed canopy conifer stands the understory is devoid of live surface fuel but thick with woody timber litter from downed trees and ladder fuels.

FBFMs in timber are classified according to the surface fuels that accumulate in the absence of a dominant live understory. FBFM 8 is associated with all short-needle conifer species including Douglas-fir, lodgepole pine, and a variety of spruce; FBFM 9 is characterized by the long needles of ponderosa pine; and FBFM 10 is associated with forest floors that are thick with naturally occurring downed timber in a mature or overmature stand.

This district is characterized by ponderosa pine in timber stands and woodlands with southern exposure and a mix of denser ponderosa pine and Douglas-fir on northern aspects. Ponderosa pine stands are best represented by FBFM 2 or FBFM 9. The mixed stands are best represented by FBFM 8. Though there are areas of dead and down fuel concentrations, very little of the district could be characterized as FBFM 10. A concern in timber stands throughout the district is the encroachment of unchecked conifer regeneration.

3.5 FBFM Classifications of the FFPD

This section details the predominant FBFMs observed in the FFPD, including their unique characteristics and expected fire behavior. Local photos of fuels are displayed with a narrative for each fuel model as described by Anderson (1982). This section can be used independently as a field reference.

FBFM 1 – Short Grass

Figure 1. FBFM 1

Characteristics: Grassland and savanna vegetation are dominant (Figure 1). Very little shrub or timber overstory is present, generally less than 30 percent of the area. Western perennial and annual grasses such as western wheatgrass, buffalograss, blue grama, and little bluestem that characterize short to mid-grass prairie are common. Cheatgrass, medusahead, ryegrasses, and fescues occur at slightly higher elevations. Grass-shrub combinations that meet the above criteria are also represented.

Fire Behavior: Fire spread is governed by the fine, very porous, and continuous herbaceous fuels that have cured or are nearly cured. Fires burn as surface fires that move rapidly through the cured grass and associated material.

Fuel Model Values for Estimating Fire Behavior

Total Fuel Load, less than 3-inch dead and live	0.74 ton/acre
Dead Fuel Load, 0 to ¼ inch	0.74 ton/acre
Live Fuel Load, foliage	0.0 ton/acre
Fuel Bed Depth	1.0 foot

FBFM 2 – Grass with Timber/Shrub Overstory

Figure 2. FBFM 2

Characteristics: FBFM 2 defines surface fuels found in open conifer, shrub, or riparian stands (Figure 2). Ground cover generally consists of grasses, needles, and small woody litter. Conifers are typically mature and widely spaced. Limited shrub or regeneration may be present. This model favors mature conifer in the foothill to montane zones. Open shrubland, pine stands, or Rocky Mountain juniper that cover one-third to two-thirds of the area may generally fit this model. Such stands may include clumps of fuels that generate higher fire intensities that may produce firebrands (embers that stay ignited and aloft for great distances).

Fire Behavior: Fire is spread primarily through the fine herbaceous fuels, either curing or dead. These are surface fires where the herbaceous materials, in addition to litter and dead-down stem wood from the open shrub or timber overstory, contribute to the fire intensity.

Fuel Model Values for Estimating Fire Behavior

Total Fuel Load, less than 3-inch dead and live	4.0 tons/acre
Dead Fuel Load, 0 to ¼ inch	2.0 tons/acre
Live Fuel Load, foliage	0.5 ton/acre
Fuel Bed Depth	1.0 foot

FBFM 5 – Young Brush

Figure 3. FBFM 5

Characteristics: Shrubs in FBFM 5 are younger than in FBFM 6, not as tall as in FBFM 4, and do not contain as much fuel as in FBFMs 4 and 6. Shrub height is less than 6 ft tall and shrubs cover most of area. Young green stands with no dead wood qualify for this FBFM. Fuel situations would include young stands of oak and mountain mahogany (Figure 3).

Fire Behavior: Fire is generally carried on the surface fuels that are made up of litter cast by the shrubs and the grasses and forbs in the understory. The live vegetation produces poor burning qualities.

Fuel Model Values for Estimating Fire Behavior

Total Fuel Load, less than 3-inch dead and live	3.5 tons/acre
Dead Fuel Load, 0 to ¼ inch	1.0 tons/acre
Live Fuel Load, foliage	2.0 tons/acre
Fuel Bed Depth	2.0 feet

FBFM 6 – Intermediate or Dormant Brush

Figure 4. FBFM 6

Characteristics: Shrubs in FBFM 6 are older than in FBFM 5, not as tall as in FBFM 4, and do not contain as much fuel as in FBFM 4. Fuel situations to be considered include intermediate stands of chamise, chaparral, oakbrush, mountain mahogany, and juniper shrublands (Figure 4).

Fire Behavior: Fires carry through the shrub layer where the foliage is more flammable than in FBFM 5; however, this requires moderate winds (greater than 8 miles per hour [mph] at midflame height). Fire will drop to the ground at low wind speeds or break in continuous stands.

Fuel Model Values for Estimating Fire Behavior

Total Fuel Load, less than 3-inch dead and live	6.0 tons/acre
Dead Fuel Load, 0 to ¼ inch	1.5 tons/acre
Live Fuel Load, foliage	0.0 ton/acre
Fuel Bed Depth	2.5 feet

FBFM 8 – Closed or Short-Needle Timber Litter – Light Fuel Load

Figure 5. FBFM 8

Characteristics: Closed canopy stands of short-needle conifers or hardwoods that have leafed out support fire in the compact litter layer (Figure 5). This layer is mainly needles, leaves, and twigs because little undergrowth is present in the stand. Representative conifer types are lodgepole pine, Engelmann spruce, and Douglas-fir. Ponderosa pine can also be included if the understory reflects these characteristics.

Fire Behavior: Fires associated with this model are generally slow-burning, low-intensity ground fires, although a fire may encounter an occasional area of heavy fuels concentration that can flare up (jackpot). Only under severe fire weather conditions does this fuel model pose a significant fire hazard, and this is typically due to fire becoming active in the crowns of trees.

Fuel Model Values for Estimating Fire Behavior

Total Fuel Load, less than 3-inch dead and live	5.0 tons/acre
Dead Fuel Load, 0 to ¼ inch	1.5 tons/acre
Live Fuel Load, foliage	0.0 ton/acre
Fuel Bed Depth	0.2 feet

FBFM 9 – Hardwood or Long-Needle or Timber Litter – Moderate Ground Fuel Load

Figure 6. FBFM 9

Characteristics: Both long-needle conifer and hardwood stands, especially the oak-hickory types, are characterized by FBFM 9 (Figure 6). Closed stands of long-needle pine such as ponderosa pine are grouped in this model.

Fire Behavior: Fires run through the surface litter faster than in FBFM 8 and have longer flame lengths. Fall fires in hardwoods are predictable; however, high winds will actually cause higher rates of spread than predicted because of spotting caused by rolling or blowing embers and fire brands. Concentrations of dead-down woody material will contribute to possible torching, crowning, and spotting.

Fuel Model Values for Estimating Fire Behavior

Total Fuel Load, less than 3-inch dead and live	3.5 tons/acre
Dead Fuel Load, 0 to ¼ inch	2.9 tons/acre
Live Fuel Load, foliage	0.0 ton/acre
Fuel Bed Depth	0.2 feet

FBFM 10 – Mature/Over-Mature Timber and Understory

Figure 7. FBFM 10

Characteristics: Any forest type may be considered FBFM 10 if heavy down woody material is present. Locally this model is represented by dense stands of over-mature ponderosa pine, lodgepole pine, mixed conifer, and continuous stands of Douglas-fir (Figure 7). Examples include insect or disease-ridden stands, wind-thrown stands, over-mature situations with deadfall, and aged light thinning or partial-cut slash. Dead-down fuels include large quantities of 3-inch or larger limbwood resulting from over maturity or natural events that create a large load of dead material on the forest floor.

Fire Behavior: Fire will burn in the surface and ground fuels with greater intensity than the other timber litter models. Crowning out, spotting, and torching of individual trees is more frequent in this fuel situation, leading to potential fire control difficulties.

Fuel Model Values for Estimating Fire Behavior

Total Fuel Load, less than 3-inch dead and live	12.0 tons/acre
Dead Fuel Load, 0 to ¼ inch	3.0 tons/acre
Live Fuel Load, foliage	2.0 tons/acre
Fuel Bed Depth	1.0 foot

FBFMs present in the district are summarized in Table 7.

Table 7. Fire Behavior Fuel Models of FFPD

FBFM	Description
1 Short Grass	**Grass Group** – Fire spread is determined by the fine, very porous, and continuous herbaceous fuels that have cured or are nearly cured. These are surface fires that move rapidly through the cured grass and associated material. Very little shrub or timber is present, generally less than one-third cover of the area. Annual and perennial grasses occur in this model. Fire rate of spread can exceed 300 chains per hour with flame lengths over 8 ft.
2 Grass with Timber/Shrub Overstory	**Grass Group** – Fire spread occurs through curing of dead herbaceous fuels. These are surface fires where downed woody debris from the shrub and tree component adds to fire intensity. Open shrublands, pine stands, or oakbrush stands that cover from one- to two-thirds of the area generally fit this model.
5 Young Brush	**Shrub Group** – Fire is generally carried in the surface fuels that are made up of litter cast by the shrubs and grasses or forbs in the understory. The live vegetation produces poor burning qualities.
6 Intermediate or Dormant Brush	**Shrub Group** – Fire spreads though the shrub layer with flammable foliage but requires moderate winds to maintain the foliage fire. Fire will drop to the ground in low wind situations. Shrubs are mature with heights less than 6 ft. These stands include oakbrush and mountain mahogany less than 6 ft tall. Fire rate of spread can be rapid with flame lengths of 6 to 10 ft.
8 Closed or Short-Needle Timber Litter–Light Fuel Load	**Timber Group** – These fuels produce slow-burning ground fires with low flame lengths. Occasional "jackpots" in heavy fuel concentrations may occur. These fuels pose a fire hazard only under severe weather conditions with high temperatures, low humidity, and high winds. These are mixed conifer stands with little undergrowth. Fire rate of spread is up to 106 ft per hour with flame lengths of 1 foot.
9 Hardwood or Long-Needle or Timber Litter–Moderate Ground Fuel	**Timber Group** – Fires run through the surface litter faster than in FBFM 8 and have longer flame lengths. These are semi-closed to closed canopy stands of long-needle conifers, such as ponderosa pine. The compact litter layer is mainly needles and occasional twigs. Concentrations of dead-down woody material contribute to tree torching, spotting, and crowning. Fire rate of spread is up to 27 chains per hour with flame lengths of 5 ft.
10 Mature/Overmature Timber and Understory	**Timber Group** – Surface fires burn with greater intensity than the other timber litter models. Dead and down surface timber litter is heavier than other timber models and the stands are more prone to hard-to-control fire behavior such as torching, spotting, and crown runs.

Source: Anderson (1982)

3.6 Water Resources

Five public water districts serve the FFPD (Table 8). At least 12 stationary water sources and 154 hydrants are available throughout the district. The water supply is maintained by five separate water districts with a total supply of up to 2.9 million gallons in tanks and reservoirs. Many residences are supplied by well water and are required to maintain a private cistern where the water supply is inadequate for fire service use. Almost all hydrants in the district flow in excess of 500 gallons per minute. The areas most limited in terms of water supply are 1, 3, 14 and parts of 5, 12, and 13. Area 1 has only two cisterns. Area 3 has 11 cisterns but no hydrants, and area 14 has no fire service water

supply. Areas 5, 12, and 13 have hydrants, but have significant portions without ready access to hydrants.

Table 8. Water Districts within FFPD

(FFR Long Range Plan 2003)

Water District	Area Served	Number of Hydrants	Reservoir Capacity in Gallons
Lookout Mountain Water District	North Corridor	75	1,000,000
Mount Vernon Metropolitan District	Mount Vernon Country Club Rd.	26	275,000
Forest Hills Water and Sanitation District	River Chase	27	225,000
Idledale Water District	Idledale	11	200,000
Genesee Water and Sanitation District	Mount Vernon Country Club Rd.	15	1,200,000

3.7 Fire Protection District

The FFPD was created in 1997 when the Mount Vernon, Idledale, and Lookout Mountain fire districts consolidated. FFR responds to approximately 600 fire, medical, and service calls per annum. FFR responds to medical calls with the Highland Rescue Team, which operates the ambulance service covering the Foothills and Genesee Fire Districts. Medical calls comprise approximately half of the department's call volume while wildland fire calls are approximately 1 percent of the total calls. The number of wildland fires does not, however, illustrate the potential for loss posed by wildfire in the district.

The Wildfire Committee is a citizen group that operates under the District Board of Directors to coordinate community information regarding wildfire hazards, planning, and prevention. Mutual aid agreements for the FFPD are governed by the Denver-wide mutual aid agreement as well as the Jefferson County AOP, which provides an intergovernmental mutual aid agreement between all fire districts in the county, and include the CSFS and USFS. Jefferson County maintains a certified Type 3 Incident Management Team (IMT) for additional overhead support in the event of a large-scale incident. FFR also maintains individual mutual agreements and frequently trains with the GFPD, the Highland Rescue Team, and the Alpine Rescue Team. The district is also affiliated with the Jefferson County Fire Council, the North Jeffco Wildland Team, the 285 Wildland Team, and the I-70 Corridor Wildland Engine Taskforce.

FFR has a staff of three paid responders and 55 volunteers who respond out of five fire stations. All firefighters receive basic wildland firefighter training (S-130/190). The department maintains a fleet of 12 pieces of emergency response apparatus of various types. The FFPD drafted a Long Range Plan (2003) that serves as a guiding document for operational capabilities. The specific fire department capabilities are covered in more detail in Section 6, Emergency Operations.

3.8 Values at Risk

In any hazard and risk assessment, human life and welfare are the most important resources to protect. Homes, businesses, aesthetics, and cultural and ecological resources are all important factors and certainly influence any recommendation; however, the safety and welfare of residents and emergency responders remains the top priority. The WUI has inherent risks including residential and commercial development in areas historically prone to fire, hazardous fuels, and limited access. The FFPD is characterized by mixed density residential development mixed with large tracts of preserved forest and grasslands.

General values at risk for this area include:

- Homes
- Businesses
- Local economy
- Municipal water supply
- Community infrastructure
- Wildlife and aquatic habitat
- Watersheds
- Water quality
- Air quality
- Natural vegetation communities
- Viewshed
- Historic structures

Values at risk specific to the FFPD include:

- I-70 corridor
- Jefferson County Open Space lands
- DMP lands
- Lookout Mountain Antennae array
- Mount Morrison Antennae array
- Summer camp sites
- Mother Cabrini Shrine
- Bison and elk pens
- Lookout Mountain Nature Center
- Buffalo Bill historic site

Catastrophic wildfire can have a severe and long-term impact on all natural resource and ecological values that people take for granted. The actions recommended in this CWPP are geared toward lowering the wildfire risk to neighborhoods, as well as economic and ecological resources.

4 WILDFIRE RISK ASSESSMENT

4.1 Approach to the Wildfire Risk Assessment

A comprehensive wildfire risk assessment takes into account a variety of factors that ultimately result in an accurate hazard ranking of the neighborhoods and subdivisions that have been collaboratively identified and determined to be the primary areas of concern within the assessment area. Hazard rankings provide quantifiable guidance in the determination of mitigation treatment project prioritization.

To better understand the nature and scope of the wildfire threat that faces the FFPD, a full spectrum of factors that influence fire behavior are evaluated including vegetation and fuels, topography, weather, potential fire behavior, and historical fire frequency. Community infrastructure is evaluated in terms of emergency response, defensibility, and structural flammability. Analyzing the relationship between expected fire behavior in the wildlands and the placement and design of neighborhoods and subdivisions proximate to those areas is at the core of an effective community wildfire risk assessment. From this process, targeted mitigation recommendations are developed that directly address the identified hazards and, if implemented, will greatly reduce the risk of loss from a wildfire for each homeowner as well as the community as a whole.

The primary assessment area for this CWPP is defined by the boundaries of the FFPD. Sixteen neighborhoods within the district were identified as areas of critical concern and surveyed in detail using a standardized methodology. Several neighborhoods are shared with the GFPD. Vegetation and FBFMs were mapped 1 mile into surrounding regions utilizing LANDFIRE data, which was ground verified and photo documented.

LANDFIRE is an interagency vegetation, fire, and fuel characteristics mapping project. It is a shared project between the Department of the Interior (DOI) and Forest Service wildland fire management programs and is sponsored by the Wildland Fire Leadership Council. LANDFIRE is producing a comprehensive, consistent, scientifically credible suite of spatial data layers for the entire United States and has recently completed areas in central Colorado, including Jefferson County.

In the wildland fire vernacular, fire hazard refers to vegetation or wildland fuel in terms of its contribution to problem fire behavior and its resistance to control. Risk is the probability of ignition of wildland fuels. Values-at-risk include infrastructure, structures, improvements, and natural resources that are likely to suffer long-term damage from the direct impacts of a wildfire.

As part of the assessment, a concerted effort was made to solicit and include input from the public and local experts in fire and natural resource issues. Community meetings were held to explain the CWPP process and intent, present the findings and recommendations of the CWPP investigations to the public, and solicit input for the final CWPP.

Questionnaires were distributed at the meetings and through direct mailings in a further effort to measure public perception of risk and values-at-risk and to assess public tolerance for various mitigation practices. Appendix E provides a summary of the questionnaire responses.

Draft and final district CWPPs are posted and available on the Jefferson County Division of Emergency Management web site; http://www.jeffco.us/sheriff/sheriff_T62_R193.htm.

4.2 Fire Behavior Analysis

Fire behavior 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 the intensity. Rate of spread is often expressed in chains per hour. A chain is 66 ft, and one chain per hour closely approximates a spread rate of 1.1 ft per minute. Fireline intensity is reflected by flame length at the flaming front; it does not account for continued burning of fuels once the main fire front has passed.

BehavePlus is software that was used to assess potential fire behavior given the identified FBFMs, local topography, and local weather conditions. The predicted fire behavior represents surface fire behavior only. Fire moving through the forest canopy (crowning) and other types of extreme fire behavior are not represented in this analysis.

Topography

Topography and elevation indirectly affect fire behavior through influencing sunlight, the local vegetation, and the movement of wind. Because heat, and therefore fire, rises, topography also has a very direct influence on fire behavior.

The elevation of the FFPD ranges from 6,000 to 8,200 ft with most of the homes above 7,000 ft. The entire district is comprised of mountainous terrain with slopes ranging from 10 percent to over 50 percent slope. Most homes are in areas exposed to slopes of 20 percent or steeper.

Fire Weather

Average and severe case weather and fuel moisture conditions were determined using records from local remote access weather stations (RAWS) during the summer wildfire season of June through August. The Corral Creek RAWS is located in the western part of the Evergreen Fire Protection District (EFPD), approximately 12 miles west of the town of Evergreen. Data from the current Corral Creek RAWS only goes back through 2001 (Table 9). The Cheesman RAWS is 35 miles to the south and is the closest station at an appropriate elevation that has uninterrupted data through the 1990s. Closer weather stations have been identified but were not used because of their lack of appropriate data. Average and severe fire climate conditions were identified using 50th and 90th percentile conditions from the Corral Creek RAWS (2001 to 2006). These were compared to the more extensive data of the Cheesman RAWS (1987 to 2006) and found to be very

similar. The same similarities were found when compared to the nearby Bailey RAWS (2000 to 2006).

Table 9. Remote Access Weather Stations

Station	Elevation (feet)	Location Relative to Foothills	Years of Data
Corral Creek	7,844	12 miles west	2001-2006
Cheesman	7,546	35 miles south	1987-2006

Percentile refers to historic occurrences of specified conditions. For example, 90th percentile conditions means that within the weather data examined from the RAWS stations, only 10 percent of the days had more extreme conditions. Fiftieth percentile is approximately average with half the records exceeding recorded conditions and half the records below recorded conditions. Weather was calculated for the typical summer fire season of June through August based on data from 1970 through 2006 (Table 10). Mid-flame wind speeds of 8 and 4 mph were used for the modeling of 90th and 50th percentile conditions respectively.

Table 10. Average and Severe Case Fire Weather and Fuel Moisture Conditions for June - August 2001- 2006

	Max Temp	Relative Humidity	1-Hour Fuel Moisture	10-Hour Fuel Moisture	100-Hour Fuel Moisture	Herbaceous Fuel Moisture	Woody Fuel Moisture
50th Percentile	77ºF	34%	5%	6%	10%	55%	105%
90th Percentile	85ºF	15%	3%	3%	6%	30%	75%

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/cgi-bin/roman/raws_ca_monitor.cgi?state=RMCC&rawsflag=2
- National Fire Weather Page – http://fire.boi.noaa.gov/

Potential Fire Behavior

Fire behavior 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 the intensity. Rate of spread is expressed here in feet per minute, rather than chains per hour as commonly used in the wildland fire profession. Fireline intensity is reflected by flame length at the flaming front.

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 11). 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:

- The differences in surface fire behavior under 50th and 90th percentile conditions (drier fuels, windier conditions) are most pronounced in brush and grass fuels.
- This 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.
- If FBFM 9 converts into the denser FBFM 10, the increase in fire behavior is pronounced and conducive to the initiation of crown fire.

Table 11. BehavePlus Predictions of Fire Behavior on 20 Percent Slope for Average and Severe Climatic Conditions

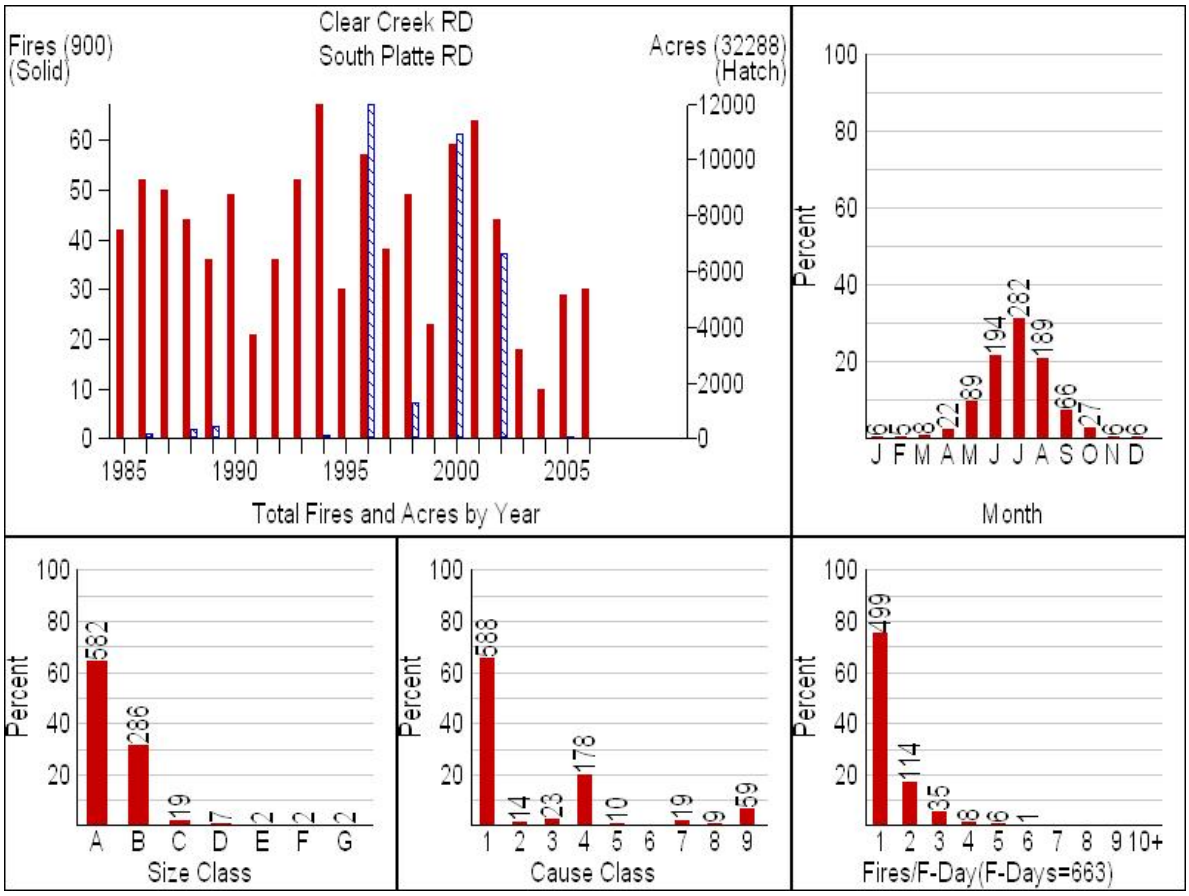
FBFM	Flame Length (feet) Average Conditions[a]	Rate of Spread (chains/hr)[c] Average Conditions	Flame Length, (feet) Severe Conditions[b]	Rate of Spread (chains/hr)[c] Severe Conditions
1 Short Grass	4	72	9	316
2 Grass with Timber/Shrub Overstory	6	33	13	133
5 Young Brush	5	19	11	69
6 Intermediate or Dormant Brush	6	30	10	87
8 Closed or Short-needle Timber Litter – Light Fuel Load	1	2	2	5
9 Hardwood or Long-Needle or Timber Litter – Moderate Ground Fuel	3	7	5	26
10 Mature/Overstory Timber and Understory	5	7	9	23

a. Average conditions based on 50th percentile weather and 4 mph midflame windspeed
b. Severe conditions based on 90th percentile weather and 8 mph midflame windspeed
c. Approximately one foot/minute as 1 chain = 66 feet

4.3 Wildfire Occurrence

The vegetation in the assessment area is diverse and typical for the Colorado Front Range. A mix of grass, brush, and a variety of forest types are found throughout the FFPD. All of these vegetation types represent ecosystems that are fire-adapted. Fire regimes in the area include low, mixed, and high severity with fire return intervals ranging from less than 30 years to over 200 years.

While the majority of fires on the surrounding USFS districts are caused by lightning, humans have started the majority of community-threatening fires in the FFPD, and it is widely acknowledged that fire suppression policies have exacerbated fire intensity along the Colorado Front Range. This is illustrated by historical statistics from the Pike National Forest's South Platte District (15 miles to the south) and the Arapaho National Forest's Clear Creek District (10 miles to the west) as depicted in Figure 8.



Fire size class: A<1/4 ac, B= 1/4 to 9 ac, C= 10 to 99 ac, D= 100 to 299 ac, E= 300 to 999 ac, F= 1,000 to 4999 ac, G> 5,000 ac
Fire cause class: 1=lightning, 2= equipment, 3= smoking, 4= campfire, 5= debris burning, 6= railroad, 7= arson, 8= kids, 9= misc
Source: US Forest Service: http://famweb.nwcg.gov/kcfast.

Figure 8. USFS Fire Data, South Platte and Clear Creek Districts

FFPD call records show that approximately 50 percent of incidents responded to are medical. Approximately 12 percent of responses are fire incidents. The average of five

wildfires per year constitutes approximately 8 percent of fire calls and less than 1 percent of total incidents.

Significant named wildfires in the area are highlighted in Table 12.

Table 12. Significant Wildfires in the Local WUI

Fire	Month/Year	Acres Burned	Fire Protection District
Murphy Gulch	Sep 1978	3,300	Inter-Canyon/Bancroft
Mount Falcon	Apr 1989	125	Indian Hills
O'Fallon	Mar 1991	52	Evergreen
Elk Creek	May 1991	102	Golden Gate
Buffalo Creek	May 1996	10,400	USFS/North Fork
Bear Tracks	Jun 1998	500	USFS/Evergreen
Lininger Mountain	Feb 1999	35	Genesee/Foothills
Hi Meadow	Jun 2000	10,800	Platte Cyn/Elk Cr/North Fork
Black Mountain	May 2002	300	USFS/Elk Cr/Evergreen
Fountain Gulch	Jun 2002	200	Clear Creek
Centennial Cone	Jul 2006	22	Jefferson County Open Space
Upper Bear Creek	Feb 2006	35	Evergreen
Plainview	Jan 2007	2,700	Coal Creek

Source: Gallamore 2007 (See Appendix J for a comprehensive wildfire history of the CSFS, Golden District)

4.4 JFDRS and Local Weather Information

The Jefferson County Fire Danger Rating System (JFDRS) is based on the National Fire Danger Rating System (NFDRS) implemented in 1978. The JFDRS uses both RAWS and independent weather stations that are monitored with the data available from the Internet. Jefferson County limits the fire danger rating to NFDRS fuel models C (Pine-Grass Savanna) and G (Short-Needle [Heavy Dead]). The RAWS supply all necessary data used for fire danger rating; however, the independent stations require manual inputs to calculate fire danger such as state of the weather and calculation of 1-hour fuel moisture. After the weather data are collected the fire danger is calculated with an NFDRS calculator provided in the Fire Family Plus software. The energy release component (ERC) is then compared to the rating chart developed for Jefferson County, and an adjective fire danger value (extreme, very high, high, moderate, or low) is assigned. The Evergreen Fire Dispatch faxes completed forms for the RAWS and independent weather stations to the Jefferson County Sheriff, CSFS, and local fire agencies for distribution. FFPD then receives the weather information from Jefferson County dispatch. The completed form with various components of the NFDRS is used for responders and an adjective fire danger for the public.

4.5 Wildfire Risk to Communities

FFPD assessment and neighborhood hazard and risk surveys were conducted during February and March of 2008. Detailed analysis of the assessment area, conducted with the FFPD, resulted in the identification of 14 individual WUI zones. During the survey phase, one area of concern was subdivided, resulting in two additional survey areas. Each neighborhood represents a specific response area with unique characteristics, resources, and identifiable hazards and risks. The remainder of the district is characterized as rural areas with outlying homes and homesteads or wildlands.

A standardized survey process defined by the National Fire Protection Association (NFPA) was utilized to assess the relative level of wildfire risk and hazard for each neighborhood. Appendix B contains an example of the NFPA Form 1144, *Standard for Protection of Life and Property from Wildfire*. Surveys assess predominant characteristics within individual communities and subdivisions as they relate to structural ignitability, fuels, topography, expected fire behavior, emergency response, and ultimately human safety and welfare. Scores are assigned to each element and then totaled to determine the community's relative level of risk. Low, moderate, high, and extreme hazard ratings may be assigned based on the total community score (Table 13). Detailed observations and survey results are provided in Appendix C.

Table 13. Community Hazard Rating and Contributing Factors

Rating	WUI/Subdivision	Score	Contributing Factors *
HIGH	Ski Hill	104	▪ Single lane access and lack of turn arounds ▪ Poor signage ▪ Topographic locale on ridgeline exposed to slopes in excess of 30% ▪ Limited emergency water access ▪ Distance from fire station and primary roads
	Rainbow Hill, Moss Rock	101	▪ Single ingress/egress ▪ Topographic locale on ridgeline with long chimneys ▪ Limited emergency water access ▪ Majority of homes lack adequate defensible space, are constructed with combustible building material, and are in close proximity to steep, heavily forested slopes
	Mount Vernon Club Place	101	▪ Though largely designed on loops, access/egress bottlenecks to a single point ▪ Majority of homes lack adequate defensible space, are constructed with combustible building material ▪ Relatively steep topography and medium to heavy fuel loads are common ▪ Good access to emergency water supply
	Cody Park	97	▪ Single ingress/egress ▪ Relatively steep slopes and areas of heavy fuels ▪ Limited emergency water access ▪ Limited emergency access/ no turn arounds ▪ Combustible Building materials and inadequate defensible space

Rating	WUI/Subdivision	Score	Contributing Factors *
	Hess, Zephyr, Krestview	93	▪ Single ingress/egress ▪ Some areas have created defensible space, but inadequate defensible space is common ▪ Combustible building materials ▪ Areas with limited water supply ▪ Many homes exposed to very steep, heavily forested slopes
	Lininger	89	▪ Single ingress/egress ▪ Defensible space improvement recommended ▪ Areas with limited water supply ▪ Many homes exposed to very steep, heavily forested slopes
	Idledale	87	▪ Secondary ingress/egress up Grapevine Rd. is narrow, winding, and exposed to fire from below ▪ Access drives are narrow and often over brides with load limits not posted ▪ Inadequate defensible space and dense fuels in drainages ▪ Steep slopes throughout the area ▪ Fuels throughout much of the area are relatively light
	Mount Vernon	86	▪ Light fuels ▪ Long, narrow drives with inadequate turn arounds ▪ Very poorly signed ▪ Fuels are relatively light and defensible space is common
	Lookout Mountain: Columbine, Cedar Lake	80	▪ Two directions of ingress/egress ▪ Some exposure to steep slopes and areas of heavy fuels ▪ Inadequate defensible space in many cases ▪ Combustible building materials
	Grandview	74	▪ Generally light fuels with areas of medium to heavy fuels ▪ Good addressing ▪ Defensible space in need of improvement in some areas ▪ Combustible building materials
	Grapevine	72	▪ Relatively new homes with higher percentage of non-combustible materials ▪ Relatively high percentage of defensible space though some exposure to steep slopes and heavier fuels require defensible space improvement
	Buffalo Bill Historic Site	70	▪ Two directions of ingress/egress ▪ Exposed to very steep, heavily forested slopes ▪ Combustible building materials
MODERATE	Spring Ranch	64	▪ A mix of combustible and non-combustible building materials ▪ Light fuels and relatively low angle slopes ▪ Varying degrees of defensible space ▪ Generally good ingress/egress and turn arounds
	Gateway	66	▪ Generally light fuels and adequate defensible space, moderate slopes ▪ Combustible building materials ▪ Relatively good ingress/egress with some need for improved turn arounds

Rating	WUI/Subdivision	Score	Contributing Factors *
	Paradise Hills	57	▪ Generally light fuels with some heavy concentrations on the northern aspects ▪ Good access with adequate turn arounds ▪ Many homes have adequate defensible space ▪ Slopes in excess of 30% are common

* In addition to the listed factors, rating scores are also influenced by the region's high fire occurrence and potential for severe fire weather.

5 WILDFIRE MITIGATION PLAN

5.1 Approach to Mitigation Planning

Wildfire mitigation can be defined as those actions taken to reduce the likelihood of loss due to wildfire. Effective wildfire mitigation can be accomplished through a variety of methods including reducing hazardous fuels, managing vegetation, creating defensible space around individual homes and subdivisions, 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 will significantly reduce the risk of loss due for wildfire to an individual home, and on a larger implementation scale, for an entire community

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

5.2 Recommended Actions

Action items include specific fuel reduction recommendations such as fuelbreaks along primary and secondary access roads, forest management programs, defensible space around structures, and homeowner assistance to reduce the combustibility of individual homes. Table 14 lists the recommended actions by category. Other recommended projects may address infrastructure characteristics such as community access, signage, evacuation routing, and water resources. Community outreach and educational programs may also be recommended.

Table 14. General Recommendations by Category

Project	Actions
Outreach/Public Education	▪ Develop an annual outreach initiative. ▪ Citizen training in smoke spotting and reporting. ▪ Distribute Firewise materials. ▪ Assess individual homes.
Defensible Space	▪ Initiate efforts with a simple clean-up of yard clutter, dead vegetation, and needles/leaves from roofs, gutters, and the yard. ▪ Establish a fuel-free zone around homes. ▪ Establish a treated second zone that is thinned, pruned, and cleared of excess surface fuels. ▪ Extend treatment to property boundary to improve natural forest conditions and reduce excess hazardous vegetation.

Project	Actions
	▪ Employ defensible space practices around identified resources such as cisterns, dip and draft sites, potential safety zones, or observation areas.
Firewise Building Improvements	▪ Replace shake roofs with fire resistant roofing material. ▪ Implement Firewise construction principals for all remodels. ▪ Enclose exposed decks and gables. ▪ Screen vents and chimneys.
Shaded Fuelbreaks	▪ Thin along primary and secondary evacuation routes. ▪ Improve/expand utility right-of-ways.
Access/Egress Improvements	▪ Improve hazardous primary access routes. ▪ Create/improve dead end turn arounds. ▪ Create/improve secondary evacuation routes where needed. ▪ Improve restricted switchbacks.
Strategic Fuelbreaks	▪ Provide for fuelbreaks in identified treatment zones. ▪ Conduct removal where possible. ▪ Burn piles where needed. ▪ Coordinate with adjacent public land management agencies. ▪ Expand to address infestation where needed.
Supporting Actions	▪ Support actions supporting grant funding acquisition. ▪ Involve Jefferson County in evacuation improvements. ▪ Revise county statutes addressing defensible space requirements for home sales. ▪ Coordinate with agency forest management plans.
Fire Department Preparedness	▪ Own and update district GIS. ▪ Update and distribute run books. ▪ Verify community water resources. ▪ Plan pre-suppression attack. ▪ Conduct ongoing recruitment, training, and certification. ▪ Coordinate mutual aid strategic planning. ▪ Upgrade apparatus, facility, and personal protective equipment (PPE). ▪ Coordinate and publicize evacuation plans.

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

- Identify and clarify wildfire hazards and risks. This could include educating the public on how to report a wildfire properly;
- Introduce the benefits of defensible space and Firewise construction principals;
- Urge homeowners to take action on their own property and influence neighbors, friends, and HOAs;
- Initiate creation of oversight group to drive CWPP implementation and grant application;
- Increase awareness of current forest conditions and how hands-on management practices can help restore forest health and reduce wildfire risk; and

- Create awareness of the historical role fire has played in the regional ecosystem and forest and rangeland health.

Some parcels within subdivisions may be undeveloped and/or owned by absentee owners. A lack of fuels management on these lots can impact the entire community. An effort should be made to contact these landowners and determine how to address their concerns and overcome potential obstacles to conducting hazard fuel mitigation on their land.

Action Item: An annual community meeting in the spring can spur action on the part of neighborhoods and individuals. This can be a forum for presentations by experts in the field and allow for coordination of "cleanup" efforts within the community. Firewise materials and postings should be made available to the public at each fire station, post office, HOA, and elementary school on a regular basis. A disposal method for yard waste should be coordinated every spring. This may be coordinated with HOA spring cleanup activities and may include the coordination of a central disposal site, mobile chipping services, or a hauling service. See Section 5.4 for potential funding opportunities.

Action Item: The public has expressed an interest in reducing the number of false smoke reports and improving the way in which they report wildfires. Educational information could be developed to discuss distinguishing fog from smoke, how to describe fire and smoke activity, and how to describe a fire's location. Interested residents who have especially good views could be enlisted and trained as volunteer fire spotters.

All community meetings should include reminder information concerning the benefits of defensible space, recommended methods to reduce structural ignitability, forest health issues, as well as wildfire probability. Yard slash disposal opportunities should be coordinated on an annual basis. This may be coordinated with HOA spring cleanup activities and may include the coordination of a central disposal site, mobile chipping services, or a hauling service.

Defensible Space

An action that can be taken immediately to improve community hazard ratings is the implementation of defensible space around individual homes. It is recommended that defensible space be created following the CSFS guidelines as set forth in *Creating Wildfire Defensible Zones,* Bulletin No. 6.302 (Dennis 2003) (Appendix G), which are consistent with Jefferson County regulations. Effective defensible space in conjunction with non-combustible building materials and clean gutters is the most effective means to protect an individual home from wildfire loss.

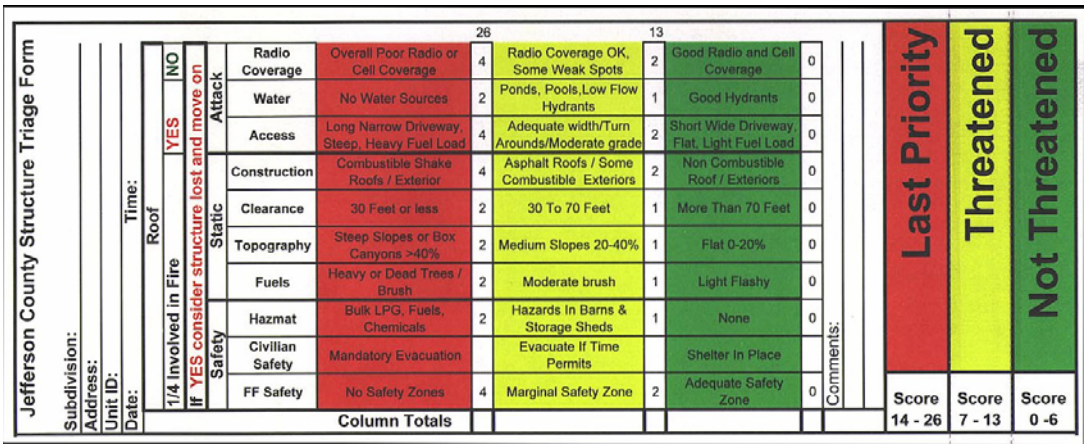


Figure 9. Jefferson County Structure Triage Tag
(for prioritizing structure defense in the event of an advancing wildfire)

Action Item: This is the primary recommendation for hazard fuels mitigation within the FFPD. It is suggested that the above outreach efforts be used to coordinate and spur implementation and slash disposal at the individual homeowner level. Broad participation on an individual basis ultimately leads to effective hazard reduction at the neighborhood or community level. In neighborhoods where lots are smaller and housing density is high, coordinating efforts between multiple adjacent lots may be necessary to achieve recommended zone dimensions. Many homeowners with the highest need for defensible space directly abut public lands. Coordinating fuel reduction activities between public and private lands creates a mutually beneficial environment. Establishing a procedure whereby homeowners who have established defensible space on their property may petition for fuels management on adjacent public lands would facilitate communication and coordination.

Effective defensible space consists of a fuel-free zone adjacent to the home, a treated secondary zone that is thinned and cleaned of surface fuels, and, if the parcel is large enough, a transitional third zone that is basically a managed wildland or forest area. These components all work together in a proven and predictable manner. Zone 1 keeps fire from burning directly to the home; Zone 2 reduces the adjacent fire intensity and the likelihood of torching, crown fire, and ember production; and Zone 3 does the same at a broader scale, keeping the fire intensity lower by maintaining a more natural, historic condition, which in turn reduces the risk of extreme/catastrophic fire behavior.

When this principle of defensible space is combined with fire-resistant construction and some common sense, the risk of structure loss is greatly reduced. When these principals are consistently applied across a neighborhood, everybody benefits. Additionally, 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 (Figure 9).

Zone 1 (0 to 15 feet from structure): Within 3 to 5 ft of the structure, decorative rock or mowed, irrigated grass is recommended. Well-spaced and pruned, low-flammability plants are acceptable if the structure has noncombustible siding. In the remainder of Zone 1, trees' lower branches should be pruned 5 to 10 ft above the ground (not to exceed

one-third of the tree height). Dead wood, tall grass, and ladder fuels (low limbs, small trees, and shrubs that may carry fire into tree crowns) should be removed from this area. Leaves and overhanging branches should be removed from the roof and gutters. The 30-foot area should be irrigated as appropriate. Woodpiles should be removed and stored in Zone 2.

Zone 2 (typically 60 to 110 ft from Zone 1): The size of this zone is dependent upon slope. Treatment of ground fuels and ladder fuels is generally the same as for Zone 1. Trees (or small groups of trees) and shrubs should be thinned to provide 10 ft of clearance among crowns. Grasses should be mowed because they dry in late summer.

Zone 3 (beyond Zone 2 to property line): This area outside of Zone 2 should be managed for the appropriate land use objectives, such as forest health, aesthetics, recreation, and wildlife habitat (Figure 10).

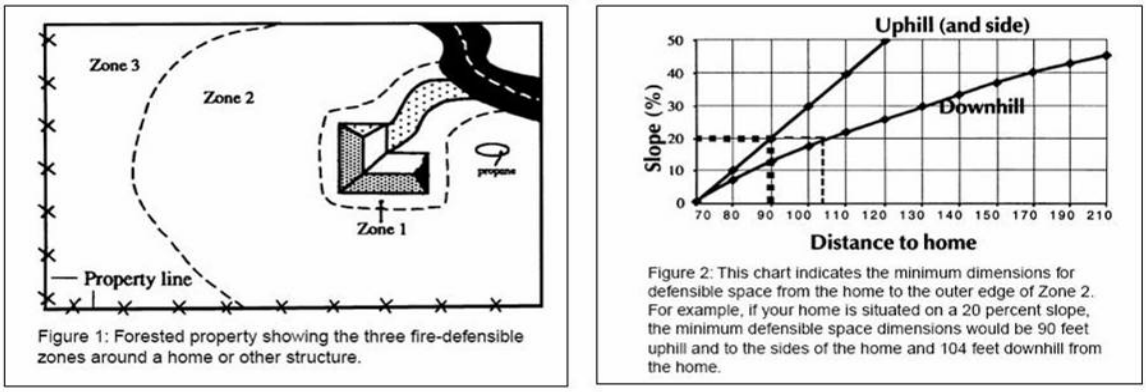


Figure 10. CSFS Defensible Space Guidelines and Standards

Efforts can be encouraged and coordinated annually through community meetings, planned spring cleanups, and organized disposal efforts. Although most of the work can be accomplished by individual homeowners in a phased approach over time, neighborhood cooperation and support is essential to help those who are unable, or to provide access to critical hazardous areas. Table 15 outlines a manageable phased implementation schedule.

Action Item: Defensible space improvements are needed throughout the district but are essential in WUI areas 2, 5, 8, 13, and 14. These are areas with pronounced exposure to steep slopes and hazardous fuels. Defensible space needs to be implemented out into Zone 3 in these areas. In most cases the defensibility of these structures is dependant upon the defensible space of adjacent property owners. Coordination of defensible space for many of these areas may be coordinated with DMP and Jefferson County Open Spaces to ensure continuity of treatments and maximum benefit for all stakeholders.

Table 15. Community-Based Defensible Space Project Schedule

Year	Project	Actions
1	Annual spring outreach	▪ Contact and/or organize homeowners
	Annual spring mitigation (defensible space)	▪ Clean roofs and gutters ▪ Trim limbs/bushes within 3 to 5 ft of home ▪ Rake yard ▪ Help a neighbor ▪ Organize debris disposal
2	Annual spring outreach	▪ Contact and/or organize homeowners
	Annual spring mitigation (defensible space)	▪ Clean up brush along property lines ▪ Repeat basic yard cleanup ▪ Organize debris disposal
3	Annual spring outreach	▪ Contact and/or organize homeowners ▪ Advise individual homeowners on needed improvements to construction features
	Annual spring mitigation (defensible space)	▪ If necessary, coordinate defensible space efforts between homeowner groups who have created defensible space and adjacent open space land managers
4	Annual spring outreach	▪ Contact and/or organize homeowners ▪ Follow-up on construction feature recommendations
	Annual spring mitigation (defensible space)	▪ Complete any outstanding projects from previous years ▪ Begin maintenance phase ▪ Initiate construction feature improvements

Building Improvements: Improving the fire-resistant characteristics of a structure goes hand-in-hand with the development of defensible space. Extensive recommendations can be found in CSFS publications available at http://csfs.colostate.edu/library.htm. The most significant improvement that can be made to many of the homes in the assessment areas is the replacement of wood shake roofing with noncombustible roofing material, as is required for all new and replaced roofs in Jefferson County's WUI. All homeowners should keep roofs and gutters clear of leaves and pine needles. Screening of gutters and roof vents is recommended. Embers from a wildfire can become windborne and travel long distances before settling.

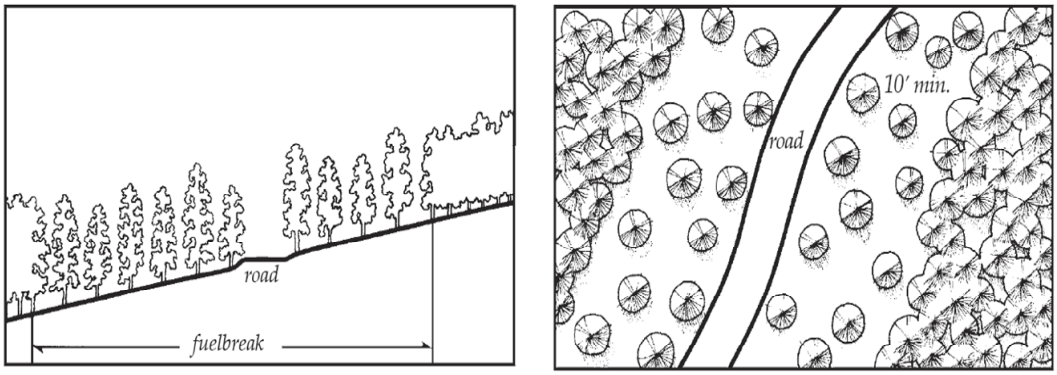
Common structural fuel hazards associated with homes in the WUI include:

- Combustible roofing and siding;
- Combustible decks with exposed undersides;
- Combustible material under decks;
- Open attic vents;
- Propane tanks adjacent or downhill from home;
- Combustible fencing; and
- Woody debris in gutters.

Action Item: Provide for community education, outreach, and information distribution through HOAs and other neighborhood associations. Coordinate public education through existing spring cleanup programs. Grass-roots public awareness can be as simple

and straightforward as coordinating with a local scout troop to distribute applicable CSFS flyers door-to-door.

Shaded Fuelbreaks: All forested access roads should be maintained as shaded fuelbreaks zones where possible. Where this is not possible, areas of heavy regeneration and trees in poor health should be addressed. Reducing the forest canopy along access roads enhances the effectiveness of the physical canopy break the road provides, as well as critical safety factors along likely evacuation and incident access routes. This creates a safer emergency ingress/egress scenario while greatly aiding potential tactical suppression efforts. Fuels treatment along roadways reduces removal costs as well as project complexity (Figure 11). Visit http://csfs.colostate.edu/library for fuelbreak guidelines (Appendix F).



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

Plan view of fuelbreak showing minimum distance between tree crowns.

Source: Dennis, undated

Figure 11. Shaded Fuelbreak

Action Item: All access roads within the FFPD with vegetation or timber encroachment should be targeted for mitigation or seasonal mowing. Treatments may be coordinated with property owners along private roads and coordinated with county and state transportation departments for any public roads. Conifer regeneration along road margins would be addressed. Due to emergency response concerns, monitoring the progress and evaluation of effectiveness by a certified forester is recommended. Appendix F, CSFS Fuelbreak Guidelines for Forested Subdivisions and Communities, has been included as a procedural and methodology reference for all thinning projects.

Strategic Fuelbreaks: Treatment recommendations may target areas that are not directly adjacent to a neighborhood or road, but would provide a critical wildfire buffer in areas where ignitions are likely and topography and fuel loads combine to create a hazardous situation for a subdivision at a higher elevation or downwind prevailing fire weather situations. Strategic fuelbreaks may be designed with shaded fuelbreaks characteristics or as a fuel buffer for more aggressive fuel reduction. Strategic fuelbreaks along neighborhood margins should mutually support adjacent defensible space efforts.

Wildfires frequently burn across jurisdictional boundaries and recommended area treatments may involve agencies outside of the primary assessment area. Fuel treatments of this scale are often subject to a number of hurdles that may include presiding agency staffing levels, current available funding levels, environmental impact concerns, public support, and private ownership. Coordination with managing public agencies may be necessary.

Action Item: A series of strategic fuelbreaks is proposed along the northern periphery of the fire district. These are areas where relatively dense development is located at the top of steep, heavily forested drainages. Improved defensible space is essential in all of these areas, but may be inadequate in some locations, necessitating larger scale treatments. The purpose of these fuelbreaks is to reduce fire intensity to a point that crown fire can not be sustained and the fire contacts residential defensible space as surface fire. The planning and implementation of these treatments will need to include Jefferson County Open Spaces. Cost, access, and terrain will be concerns for all recommended treatments and will need careful consideration on a case-by-case basis.

Action Item: Forest management plans for public lands often focus on fuel reduction activities that address forest health and wildfire risk reduction concerns. Strategy development for these plans should take into account wildfire hazard factors that exist for adjacent WUIs and target forest management activities that are beneficial to both public and private lands.

Refer to Appendix F, CSFS Fuelbreak Guidelines for Forested Subdivisions and Communities, for recommended thinning methods and procedures.

Weeds: Weed abatement programs will reduce fuel hazards around and within communities and improve the health of grasslands. Fire exclusion practices in meadow and shrub lands have allowed the encroachment of non-native and noxious species that have decreased effective foraging and in some cases have increased wildfire fire potential. In the event of a wildfire, rehabilitation treatment management such as the seeding of native grasses and spreading mulch is beneficial and may be necessary to establish a productive plant community.

Action Item: An ecological evaluation of the health and species status is recommended for meadow, prairie, and shrub lands within the assessment area. Historically, these areas supported the foraging needs of large game, and studies to assess the presence of noxious weeds and aggressive non-native species, as well as the condition of shrubs may be useful. Results may indicate the need for small-scale prescribed burning, application of herbicide, or foster modifications to county burned area rehabilitation seeding practices for future wildfire incidents.

Access: Access is an important component of any community's wildfire hazard and risk profile. Availability of ingress/egress, characteristics of road surface, road layout and design, treatment of dead ends, grade, characteristics of switchbacks, and width all factor into access assessment.

Action Item: The FFPD is large and diverse with access characteristics unique to each assessed WUI. Many areas within the district will benefit from road widening or the creation of turn around points. Specific access characteristics and mitigation recommendations are defined for each WUI in the survey summaries located in Appendix C.

Forest Health: Public land managers monitor forest health within public lands, and citizens should be encouraged to do the same on their property. The current mountain pine beetle epidemic has gravely impacted much of Colorado's lodgepole pine, though lodgepole pine is not a significant component of forest lands in the GFPD. Ponderosa pine may also be attacked by the mountain pine beetle, and diligence on the part of the property owner is warranted. Other forest pathogens, such as dwarf mistletoe, are observed at endemic levels in some areas of the GFPD.

Action Item: Residents should monitor the health of trees on their property and contact their local CSFS District Forester or a professional arborist with concerns. Further information is available at http://csfs.colostate.edu/iandd.htm.

Emergency Response Planning: In addition to the recommendations outlined in Section 6, two planning initiatives can greatly improve the safety and effectiveness of wildfire response in FFPD. The creation of tactical pre-incident plans could prove very beneficial. This might include the development of maps for dissemination to incoming cooperators, improved run books, or possibly even individual home assessments. The second recommended planning initiative is the coordination of evacuation plans with Jefferson County Emergency Services. Evacuation exercises which include the county, FFR, cooperating fire districts, the Colorado State Patrol, and other agencies might prove greatly beneficial in the future.

Table 16 provides a summary of the community surveys and outlines a prioritized approach to specific mitigation and related hazard reduction recommendations.

Table 16. Community Mitigation Recommendation Summary

	WUI/Subdivisions	Hazard Reduction Recommendations			
HIGH	Ski Hill	Improve signage, addressing, and vehicle turn arounds.	Improve defensible space, especially on northern aspects.	Water supply should be reassessed.	
	Rainbow Hill, Moss Rock	Improved defensible space is the best overall fuels strategy given the widely dispersed housing pattern. Coordinate with DMP as appropriate.	Thinning along roads will improve tenability of ingress/egress. Regeneration and trees in poor health should be addressed soon.	Construction of apparatus turn arounds is recommended throughout this area.	Water supply should be reassessed.

	WUI/Subdivisions	Hazard Reduction Recommendations			
	Mount Vernon Club Place	Recommend strategic fuelbreaks west of Rangeview, north of Pine Song, north of Centennial, and north of the Country Club.	Defensible space work in zone 3 anchored to adjoining defensible space and roads may be very effective.	Construction of apparatus turn arounds is recommended throughout this area.	
	Cody Park	Recommend strategic fuelbreak on the west end of Spruce Rd.	Defensible space is very inter-dependant in this area and should be a high priority. Thin along roads and maintain powerline easement.	Construction of turn arounds recommended throughout this area. Several possible emergency access routes exist and should be considered for improvement.	Water supply should be reassessed.
	Hess, Zephyr, Krestview	Strategic thinning project along the northern portion of this area should be carefully considered.	Defensible space is inter-dependant in this area and should be a high priority. Thinning along roads will improve tenability of ingress/egress.	Construction of apparatus turn arounds is recommended throughout this area.	Water supply should be reassessed.
	Lininger	Defensible space is the key element in this area, especially on northwest aspects.	Emergency access route from South Lininger Rd to the west could be considered.		
	Idledale	Defensible space is inter-dependant in this area and should be a high priority.	Bridges should be assessed and load limits posted.	The drainage east of Grapevine Rd. requires fuel reduction and clean-up.	
	Mount Vernon	Improved defensible space will bring this area into the moderate category.	Recommend FFR assess apparatus turn arounds in this area.	Signage and addressing are entirely inadequate in this area.	Water supply should be reassessed.
	Lookout Mountain: Columbine, Cedar Lake	Thin and improve defensible space in the Cedar Lake Rd area.	New street signs are needed.		
	Grandview	Defensible space improvement should be the focus in this area. Homes along Parkview and Sky Meadow are especially exposed.	Over 20 wood shake roofs in this area. Recommend replacement as possible.	Recommend FFR assess apparatus turn arounds in this area.	
	Grapevine	Improve and maintain defensible space where needed. Coordinate efforts to compliment forest treatment units	Reduce structural ignitability through phased building improvements, new construction, and seasonal maintenance	Improve or construct turn arounds at dead ends Mow grassy road margins seasonally	Ensure private road gates accessible for emergency evacuation

	WUI/Subdivisions	Hazard Reduction Recommendations			
	Buffalo Bill Historic Site	Thin along Lookout Mountain Rd. in this area.	Maintain defensible space in the Buffalo Bill historic site.		
MODERATE	Gateway	Improve defensible space along Clearview Rd. and at the west end of Columbine Glen Ave.	Improve turn arounds on Clearview Rd. and Columbine Glen Ave.		
	Spring Ranch	Improve defensible space, especially in Upper Cold Springs area.	Recommend FFR assess apparatus turn arounds along the Spring Ranch and Cold Springs Rds.	Recommend FFR asses possibility of secondary access from south end of Cold Springs Gulch.	
	Paradise Hills	Quality of defensible space is highly variable in this area and should be the focus of treatment, especially Paradise Rd, Cabrini Rd, Poco Calle.	Thinning or the creation of a fuelbreak in the "Enchanted Forest" north and west of Poco Calle is recommended.	New street signs needed in some areas.	

5.3 Treatment Options

Fuels treatment recommendations for the FFPD focus primarily on the creation of defensible space around structures and shaded fuelbreaks along roads. Each of the recommended fuel mitigation projects can be achieved by a variety of methods (Table 16). There are also recommendations for strategic fuelbreaks in several places along FFPD's northern boundary. This is where homes and infrastructure are exposed to steep forested slopes rising up from Clear Creek Canyon.

Selecting the most appropriate, cost-effective option is an important planning step. This brief synopsis of treatment options and cost estimates is provided to assist in this process. Cost estimates for treatments should be considered as very general guidelines (Table 17). Timber treatment costs can vary tremendously based on project complexity, but generally run $300 to $1,200 per acre depending upon:

- Type of fuel;
- Diameter of materials;
- Acreage of project;
- Steepness of slope;
- Density of fuels;
- Proximity to structures;
- Access; and
- Transportation costs.

It is imperative that implementers plan for the long-term monitoring and maintenance of all treatments. Post-treatment rehabilitation including, seeding with native plants and erosion control, may be necessary.

Table 17. Treatment Methods

Treatment	Estimated Cost	Comments
Machine Mowing	$90 - $200 per acre	▪ Appropriate for large, flat grassy areas on relatively flat topography.
Prescribed Fire	$75 - $300 per acre	▪ Can be very cost effective. ▪ Ecologically beneficial. ▪ Can be used as training opportunities for firefighters. ▪ Cost varies with complexity. ▪ Carries risk of escape, which may be unacceptable in some WUI areas. ▪ Unreliable scheduling due to weather and smoke management constraints.
Brush Mastication	$300 - $500 per acre	▪ Brush species (Gamble oak in particular) tend to resprout vigorously after mechanical treatment. ▪ Follow-up treatments with herbicides, fire, grazing, or further mechanical treatments are typically necessary. ▪ Mastication tends to be less expensive than manual treatment and eliminates disposal issues.
Timber Mastication	$300 - $1,200 per acre	▪ Materials up to 10 inches in diameter and slopes up to 30 percent can be treated. ▪ Eliminates disposal issues. ▪ Environmental impacts of residue being left onsite are still under study.
Manual Treatment with Chipping or Pile Burning	$300 - $1,200 per acre	▪ Allows for removal of merchantable materials or firewood in timber. ▪ Requires chipping, hauling, and pile burning of slash.
Feller Buncher	$750 and up per acre	▪ Mechanical treatment on slopes over 30 percent or of materials over 10 inches in diameter may require a feller buncher rather than a masticator. ▪ Costs tend to be considerably higher than mastication. ▪ May allow for removal of merchantable material.

5.4 Project Support

This section provides information that will be helpful in planning and preparing for fuels mitigation projects. Residents may wish to follow some basic steps when initiating wildfire mitigation projects:

1. Organize with neighbors or through the HOA.
2. Refer to CWPP recommended actions.
3. Research available funding and landowner assistance.
4. Contact the local FPD to inform the local jurisdiction and determine if coordination with other public entities is warranted.

Funding and Grants: Grant funding support is often a necessary component of a fuels treatment project and can facilitate recommended mitigation on both private and public lands. In addition to opportunities that may be available through Jefferson County Division of Emergency Management, CSFS (Gallamore 2008) has summarized the following available resources:

CSFS Eligible Landowner Assistance Programs and contingencies (5/23/07):

- Landowners apply through CSFS District Offices unless noted below;
- Applications approved when funds are available throughout the year;
- Matching expenses or in-kind activities by landowner are generally required; and
- Grant availability is subject to continued funding from Federal and State Government.

1. **WUI Incentives** – Wildland Urban Interface for fuels reduction.
2. **FLEP** – Forest Land Enhancement Program for multiple conservation practices *(applications are usually handled through local Soil & Water Conservation District).*
3. **I & D Prevention and Suppression** – Bark Beetle – Forest Health.
4. **FRFTP** – Front Range Fuels Treatment Partnership for fuels reduction.
5. **STEVENS'** – Stevens' or "Companion" funds for fuels reduction projects on non-federal lands that may be threatened by burning on US Forest Service lands *(these funds may be "no match" in some cases).*

CSFS Assistance Programs – Communities and Agencies and (3/20/08):

- Cooperators, communities, organizations, agencies – apply through CSFS District Offices;
- Applications received and approved during the identified funding windows;
- Matching expenses or in-kind activities by applicants are generally required
- Grant availability is subject to continued funding from Federal and State Government; and
- Applications for activities listed in current CWPPs are normally ranked highest for funding.

1. **WUI Incentives** – Wildland Urban Interface for fuels reduction – *Application period is August, for grants awarded the following May; grants are usually for a one-year period ending September 30th of year following award.*
2. **CWPP Implementation** (CSFS/SFA) - *Application period is January or May, for grants awarded that year; grants usually must be completed by September 30th of the awarded year.*
3. **Colorado Community Forest Restoration** *(HB 07-1130) – Application period is July-August, for grants awarded that year; grants are usually for a two-year period ending June 30th of 2nd year following award; subject to continued funding through Colorado Legislature.*
4. **FRFTP** – Front Range Fuels Treatment Partnership for fuels reduction - *Application period is January or May, for grants awarded that year; grants usually must be completed within one to two years of the award date.*
5. **STEVENS'** – Stevens' or "Companion" funds for fuels reduction projects on non-federal lands that may be threatened by burning on US Forest Service lands *(these funds may be "no match" in some cases) Application period is*

January or May, for grants awarded that year; grants usually must be completed within one to two years of the award date.

6. **I & D Prevention and Suppression** – Bark Beetle – Forest Health – *Application period is January or May, for grants awarded that year; grants usually must be completed within one to two years of the award date.*

For additional grants and grant application assistance visit:

Rocky Mountain Wildland Fire Information - Grant Database:
http://www.rockymountainwildlandfire.info/grants.htm
Grant Writing Handbook:
http://www.theideabank.com/freeguide.html

Public Land Planning: Public lands within the FFPD include those managed by the Jefferson County Open Space and DMP. 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, dialogue, and collaboration should be maintained with these agencies to coordinate strategies and treatments, and make adjustments if necessary.

Regulatory Support: One of the major issues confronting defensible space and hazardous fuels mitigation is the need for ongoing maintenance. Treatment projects in timber or brush fuels have an effective life span of approximately 10 to 15 years before re-growth fuel loads again become hazardous. On the other hand, defensible buffers and fuelbreaks mowed in grasslands are beneficial only through that growing season. For defensible space to be consistently successful some regulatory impetus is recommended.

Jefferson County addresses the need for regulatory support of wildfire hazard reduction on forested lands through county zoning regulations. Subsection G addresses defensible space specification and maintenance;

Section 50: W-H Wildfire Overlay District (orig. 1-27-76; am. 7-11-06) provides basic landuse and mitigation guidelines; ***Subsection G. Maintenance of Defensible Space and Associated Fuel Break Thinning****; Defensible space and fuelbreak thinning work must be completed and maintained to the standards described in the Colorado State University's Cooperative Extension Fact Sheet 6.302. The responsibility for maintaining defensible space and associated fuelbreak thinning lies with the landowner. Noncompliance with defensible space maintenance standards will be enforced as a Zoning Violation, as specified in the Enforcement and Administrative Exceptions Section of this Zoning Resolution. (orig. 6- 18-02; am. 7-11-06)*

6 EMERGENCY OPERATIONS

6.1 Wildfire Response Capability and Recommendations

FFR has a staff of three paid responders and 55 volunteers who respond out of five fire stations. All firefighters receive basic wildland firefighter training (S-130/190). Approximately 40 to 50 percent of the firefighters maintain the red card credential with the annual pack test. The red card is a national recognized document that tracks a firefighter's wildland fire credentials. The department maintains a fleet of 12 pieces of emergency response apparatus of various types.

Fire Stations

- Lookout Station
- Idledale Station
- Grapevine Station
- Mount Vernon Station
- Rainbow Hills Station

Apparatus

- 530- 4x4 engine, 1000 gpm pump, 600 gal tank
- 531- 4x4, 1000 gpm pump, 500 gal tank
- 543- 4x4, 1250 gpm pump, 750 gal tank
- 544- 4x2, 1250 gpm pump, 1000 gal tank
- 551- 4x4 type 6, 150 gpm pump, 300 gal tank
- 560- 6x4 tender, 500 gpm pump, 2500 gal tank
- 561- 6x4 tender, 250 gpm pump, 2500 gal tank
- 570- 4x4 tender, 250 gpm pump, 3000 gal tank
- 572- 6x6, 1250gpm pump, 1000 gal tank
- 581- 4x4 heavy rescue unit
- 582- 4x4 crew cab pick-up
- 583- 4x4 command post 583- 4x4 command post

The FFPD drafted a Long Range Plan in 2003, valid through 2008. District goals specific to wildland fire include:

1. Prevention
   - Promote the maintenance of defensible space around each structure;
   - Work towards strategic fuel reduction; and
   - Educate the public on safety and fire prevention issues.
2. Preparation
   - Provide frequent opportunities for training in all likely areas of operation; and
   - Strive to ensure all fire fighters are certified in structural firefighting, wildland, HazMat awareness, and emergency medical first response.

3. Response
    - Establish and maintain preplans for all likely incidents.

The threat of a large wildland conflagration is recognized as the greatest threat for which FFR needs to prepare, and specific wildfire suppression priorities were developed:

- Locate and extinguish small fires before they become large;
- In the event of a significant fire (one that escapes initial attack) the FFR priority will be to work with the sheriff's department to evacuate citizens; and
- Work with mutual aid partners to establish lines of defense and protect evacuation routes in the event of a large fire.

To address these priorities, FFR has established service level objectives for each of its two identified wildland fire exposures:

Non-Wildland/Urban Interface Wildland Fires

1. FFR will complete a size-up and have the wildfire scouted by basic wildland qualified personnel within 30 minutes of the arrival of the first unit on scene.
2. FFR will have an initial attack hand crew on the fireline within 1hour of the arrival of the first unit on scene.
3. FFR will be able to supply 30 gallons per minute from at least two 1 ½" lines within 2,000 ft of access of apparatus.
4. FFR will have qualified personnel predict fire behavior using weather information, fuel loading, and fire danger ratings and communicate the prediction to operations/planning within 30 minutes of the arrival of the first unit on scene.
5. When deemed necessary by qualified personnel, FFR will be able to activate air support within 30 of the arrival of the first unit on scene.
6. FFR shall have the capability for sustained operations when the fire moves into extended attack operations. FFR will be able to maintain Incident Management until relieved by the Jefferson County IMT Type III.

Urban/Interface Wildland Fire

1. FFR will complete a size-up and have the wildfire scouted by basic wildland qualified personnel within ten minutes of the arrival of the first unit on scene.
2. FFR will strive to have National Wildland Coordinating Group (NWCG) red card certified personnel, sufficient for initial attack, at staging within 20 minutes of the arrival of the first unit on scene.
3. FFR will be able to prepare a single complex of structures (up to four structures) for structural protection within 20 minutes of assembly on scene. This includes having two 1½ inch lines surrounding the complex, placement of a wet line, strung out for a distance to safely protect the structure without direct intervention by the engine crews, and preparing the structure for the fire front.

4. FFR will use direct fire attack whenever possible to stop the fire prior to the need to perform indirect structural protection.
5. FFR will have qualified personnel predict fire behavior using weather information, fuel loading, and fire danger ratings and communicate the prediction to operations/planning within 20 minutes of the arrival of the first unit on scene.
6. FFR will be able to activate air support within 10 minutes of the arrival of the first unit on scene.
7. FFR shall have the capability for sustained operations when the fire moves into extended attack operations. FFR will be able to maintain an IMT Type IV organization until relieved by the Jefferson County IMT Type III.

Mutual Aid

FFPD is a participant in the Jefferson County AOP, which provides intergovernmental wildland fire response memos of understanding between all fire districts in the county, and includes DMP, Jefferson County Open Space, CSFS, and USFS. The AOP provides agreements that outline all management aspects of the wildland fire within the county that includes reimbursement, operational responsibilities, financial responsibilities, and other general areas of interface between the organizations and agencies responsible for wildland fire response. Jefferson County maintains a certified Type 3 IMT for additional overhead support in the event of a large-scale incident. FFR also maintains individual mutual agreements and frequently trains with the GFPD, the Highland Rescue Team, and the Alpine Rescue Team. The district is also affiliated with the Jefferson County Fire Council, the North Jeffco Wildland Team, the 285 Wildland Team, and the I-70 Corridor Wildland Engine Taskforce.

Training and National Wildfire Coordinating Group (NWCG) Positions

All firefighters receive basic wildland firefighter training (S-130/190). A minimal number of personnel are trained in leadership positions to NWCG standards. Training and maintaining this level of fireline leadership will require an ambitious commitment from the department and its firefighters. Completion of the required handbooks for these positions can be facilitated by participation on prescribed fires but is still subject to the availability of wildfire assignments. FFR may wish to consider setting intermediate targets which come as close to the intent of NWCG standards as possible while remaining obtainable for the department in a timely manner.

Action Item: Training wildland personnel is arguably the most important step in improving firefighter safety and effectiveness in the wildland fire arena. Pursuant to the department's stated goals and objectives, a majority of firefighters should be red carded and officers should be working towards credentials as initial attack incident commanders. Annual wildfire refresher training will be required.

Example of position/training targets:

- Year 1: Put the entire department through S-130/190 basic red card class.

- Year 2: Officers initiate FFT1/Incident Command Team (ICT) 5 task book, classes: S-131, S-133.
- Year 3: Officers complete FFT1/ICT5 task book; Officers initiate Engine Boss (ENGB) task books, classes: S-290, S-230 (for ENGB)
- Interested and qualified personnel should be encouraged to pursue higher leadership positions as opportunities allow.

Suppression Requirements

For illustration purposes, Table 18 compares initial attack capabilities for an average engine crew as determined from the "Line Production Rates for Initial Action by Engine Crews" charts (NWCG 2004) with predicted fire spread under 50th percentile climatic conditions. These are generalized figures provided to illustrate the potential gap between potential fire behavior and available suppression resources and do not account for response time.

Table 18. Wildland Fire Production Rates vs. Fire Growth

Initial Attack Fire Line Production Rates Using 3-Person Engine Crew			
FBFM	**Predicted Fireline Production Rates (chains/hr)**	**Fire Acreage and Perimeter (chains) After First Hour**	**Predicted Fire Spread (chains/hr) Under Average Conditions**
1 – Short grass	24	222 acres/183 chains	72
2 – Grass with Timber/Shrub Overstory	15	47 acres/84 chains	33
4 – Mature Brush	8	16 acres/157 chains	61
5 – Young Brush	12	15 acres/47 chains	19
6 – Intermediate or Dormant Brush	12	39 acres/77 chains	30
8 – Closed or Short-Needle Timber Litter – Light Fuel Load	15	0.1 acres/5 chains	2
9 – Hardwood or Long-Needle or Timber Litter – Moderate Ground Fuel	12	2 acres/18 chains	7
10 – Mature/Overstory Timber and Understory	12	2 acres/18 chains	7

1 chain = 66 feet. Source for fire size and rate of spread: BehavePlus Fire Behavior Modeling System

Table 19 is based on the time a crew can prepare a structure for a wildland fire using a Type-1 engine. The accepted standard is 20 minutes for a four-firefighter crew and 30 minutes for a three-firefighter crew.

Table 19. Structural Protection Rates

Structural Protection Rates Per Hour Using Type-1 Engine		
Firefighters	**Rates**	**Total Structures per Hour**
3	30 minutes/structure	2
4	20 minutes/structure	3

6.2 Emergency Procedures and Evacuation Routes

In the event that the Jefferson 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 safe sites. The need to evacuate may be communicated by telephone, media, and/or direct contact from emergency personnel. However, the need for evacuation can occur without notice when conditions for wildfire are favorable. Homeowners should be prepared to evacuate without formal notice. Human safety is the number one concern in an evacuation.

An evacuation route will depend on a number of factors specific to an incident and will vary according to the subdivision. In general, communities to the south of I-70 will evacuate along I-70. Communities north of I-70 may need to evacuate via I-70 or the Lookout Mountain/Lariat Loop Road. Idledale residents will most likely evacuate via State Highway 74, with South Grapevine Road serving as a secondary route if needed. There may be cases when authorities advise citizens to remain in place. Citizens will need to pay close attention to evacuation instructions during an incident to ensure the proper evacuation route is understood.

The FFPD should work with the Jefferson County Sheriff's Department to ensure the coordination of evacuation pre-incident planning. Evacuation plans should outline available evacuation centers and the procedures to activate them. Large animal evacuation centers also need to be identified. These procedures should be addressed in public or HOA meetings with information eventually being distributed door-to-door.

Before residents leave they should take every precaution to reduce the chance of structure loss as time allows. Actions could include thoroughly irrigating the defensible space, watering down the roof, and removing all debris from rain gutters. Ensure all flammable materials are at least 30 ft from the house, such as woodpiles, leaves, debris, and patio furniture. 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.

Families should have meeting locations in place 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. The exterior of the house should be monitored for smoke for several days after residents return. Embers may lodge in small cracks and crevices and smolder for several hours or days before flaming.

Action Item: The potential for secondary ingress/egress routes should be examined in several areas, including: Area 3 at the south end of Cold Springs Gulch, Area 5 to the east of Cody Park, and Area 12 at the south end of Lininger Rd. Additionally, areas with gated access routes should be reevaluated periodically, including: lower Cold Springs Gulch, Ski Hill, Riva Chase, and the Cody Park-Mistletoe connection.

7 FFPD CWPP MONITORING AND EVALUATION

7.1 CWPP Adoption

The FFPD CWPP is a strategic planning document that is developed and approved by the Core Team. An important component of the development process includes building a stakeholder group that will move the plan forward, implement prioritized recommendations, and maintain the CWPP as the characteristics of the WUI change over time. Organizing and maintaining this team is often the most challenging component of the CWPP process. It is, however, essential in the process of converting the CWPP from a strategic plan into action.

This team will oversee the implementation and maintenance of the CWPP by working with fire authorities, community organizations, private landowners, and public agencies to coordinate and implement hazardous fuels treatment projects management and other mitigation projects. Building partnerships among neighborhood-based organizations, fire protection authorities, local governments, public land management agencies, and private landowners is necessary in identifying and prioritizing measures to reduce wildfire risk. Maintaining this cooperation is a long-term effort that requires the commitment of all partners involved. The CWPP encourages citizens to take an active role in identifying needs, developing strategies, and implementing solutions to address wildfire risk by assisting with the development of local community wildfire plans and participating in county-wide fire prevention activities.

Public meetings are a planned component of the CWPP development process. Community meetings were held to explain the CWPP process and intent, present the findings and recommendations of the CWPP investigations to the public, and solicit input for the final CWPP.

Questionnaires were distributed at the meetings and through direct mailings in a further effort to measure public perception of risk and values-at-risk and to assess public tolerance for various mitigation practices.

CWPP documentation is posted on Jefferson County's Emergency Management website to encourage public review and comment.

The final draft of the FFPD CWPP was reviewed by the Core Team, composed of representatives from the FFPD, Jefferson County Division of Emergency Management, and CSFS.

The FFPD CWPP provides the foundation and resources for understanding wildfire risk and presents opportunities to reduce potential losses from wildfire. Individual communities and private landowners can take action by developing specific fire plans or by participating in district-wide activities for prevention and protection.

The HFRA authority for the CWPP requires adoption of this plan, as does the FEMA Disaster Mitigation Act of 2000. With formal adoption by the Core Team, participating

agencies and WUI neighborhoods will be competitive for available hazardous fuels and non-fuels mitigation funding that may assist with plan implementation. Furthermore, adoption of this plan highlights a collaborative planning and development process between the FFPD, local government, public agencies, and neighborhood organizations.

7.2 Sustaining CWPP Efforts

A CWPP can serve as the foundation for a safer and healthier WUI through hazard assessment and strategic planning focusing on the threat of wildfire. The mitigation strategies outlined in this report will greatly reduce that risk, but only if implemented. Converting strategy into action is the key to achieving this important goal.

Communities can, in fact, be made safer, and this CWPP has outlined realistic measures to achieve that goal. The CWPP process encourages homeowners to take an active role as fuel treatment strategies are developed and prioritized. Ownership of CWPP implementation at that same local level is the most effective means to achieving effective results and sustaining the effort from year to year.

Proactive neighborhoods can seek support and guidance through a variety of local, state, and federal resources identified in this report including the CSFS, Jefferson County Division of Emergency Management, and FFPD.

7.3 CWPP Oversight, Monitoring, and Evaluation

Maintaining the momentum created by this process is critical to successful implementation and ongoing community wildfire hazard reduction. Ownership of this responsibility lies with each community, neighborhood, and HOA identified in the CWPP.

As wildfire hazard reduction efforts are implemented over time and the characteristics of particular WUIs change, neighborhoods may wish to reassess particular areas and update the findings of the original CWPP. Monitoring the progress of project implementation and evaluating the effectiveness of treatments is an important component of CWPP oversight and maintenance. The assessment methodology utilized in this report is a standardized, well-documented hazard and risk survey approach that is designed to provide a benchmark against which future assessments can be compared. Successes, challenges, and new concerns should be noted and subsequently guide any modifications to the CWPP that better accommodate the changing landscape.

Stakeholders will be responsible for CWPP monitoring and evaluation through regular meetings, public involvement and coordination with Foothills FPD, neighborhood communities, and HOAs. Monitoring is the collection and analysis of information acquired over time to assist with decision making and accountability and to provide the basis for change. Evaluation will include analysis of the effectiveness of past fuels reduction and non-fuels mitigation projects, as well as recent wildfire suppression efforts. Monitoring and evaluation measures should progress over time in a way that will determine whether the CWPP goals and objectives are being attained (Table 20).

Table 20. Monitoring and Evaluation Tasks

Objective	Tasks	Timeline
Risk Assessment	▪ Use reliable data that is compatible among partner agencies. ▪ Update the CWPP as new information becomes available. ▪ Continue to asses wildfire risk to communities and private landowners.	Annual Annual Biennial
Fuels Reduction	▪ Identify and prioritize fuels treatment projects on public land through development of a 5-year plan. ▪ Track fuels reduction projects and defensible space projects on private land. ▪ Monitor fuels reduction projects on evacuation routes. ▪ Track grants and other funding sources and make appropriate application.	Annual Biennial Annual Ongoing
Emergency Management	▪ Review suitability and the need for fuels reduction along evacuation routes.	Annual
Public Outreach	▪ Plan and hold Firewise education week. ▪ Provide Firewise pamphlets at public events. ▪ Evaluate techniques used to motivate and educate private landowners.	Annual Annual Annual

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