Indian Hills Fire Protection District Community Wildfire Protection Plan

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Indian Hills Fire Protection District
Community Wildfire Protection Plan

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LIST OF ACROYNMS AND ABBREVIATIONS

AOP	Annual Operating Plan
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
BLM	Bureau of Land Management
CAPCD	Colorado Air Pollution Control Division
CSFS	Colorado State Forest Service
CWPP	Community Wildfire Protection Plan
ERC	Energy Release Component
EV	Existing Vegetation
FBFM	Fire Behavior Fuel Model
FEMA	Federal Emergency Management Agency
FPD	Fire Protection District
FRCC	Fire Regime Condition Class
HFRA	Healthy Forests Restoration Act
HOA	Home Owners Association
IC	Incident Commanders
IHFPD	Indian Hills Fire Protection District
IHIA	Indian Hills Improvement Association
IMT	Incident Management Team
JFDRS	Jefferson County Fire Danger Rating System
JEFFCO	Jefferson County
NEPA	National Environmental Protection Act
NFDRS	National Fire Danger Rating System
NFPA	National Fire Protection Association
NWCG	National Wildfire Coordinating Group
OEM	Office of Environmental Management
PNV	Potential Natural Vegetation
psi	pounds per square inch
RAWS	Remote Automated Weather Stations
USFS	US Forest Service
WALSH	Walsh Environmental Scientists and Engineers, LLC
WFU	Wildland Fire Use
WUI	Wildland Urban Interface

EXECUTIVE SUMMARY

Steep terrain, large areas of continuous fuels, and frequent high fire danger weather conditions make wildfire a significant concern in Jefferson County, as substantiated by recent large fires. The Community Wildfire Protection Plan (CWPP) is a strategic plan that identifies wildland fire issues facing the community and outlines prioritized mitigation actions. Once the CWPP is adopted, it is the community's responsibility to move forward and implement the action items. This may require further planning at the project level, acquisition of funds, or simply motivating community members.

The Healthy Forests Restoration Act (HFRA) of 2003 provides the impetus for wildfire risk assessment and planning at the county and community level. HFRA refers to this level of planning as Community Wildfire Protection Plans. The CWPP allows a community to evaluate its current situation with regards to wildfire risk and devise ways to reduce risk for protection of human welfare and other important economic or ecological values. The CWPP may address issues such as community wildfire risk, structure flammability, hazardous fuels and non-fuels mitigation, community preparedness, and emergency procedures. A Core Team provides oversight to the development of the CWPP and its implementation in the assessment area.

The focus of this CWPP is on the Jefferson County community of Indian Hills and the Indian Hills Fire Protection District (IHFPD). Human life and welfare are values at risk to wildfire because of the buildup of hazardous fuels around communities and structures and the rural nature of emergency vehicle ingress and egress. Other economic values at risk include businesses, recreational land, wildlife habitat, historic and cultural sites, and critical infrastructure.

Wildfires are common in Jefferson County. In the absence of comprehensive fire data for Indian Hills, the two nearby US Forest Service (USFS) district histories were evaluated showing an average of 45 fires per annum. Significant fires in the area include the 1978 Murphy Gulch fire that scorched 3,300 acres just a couple of miles to the southeast of Indian Hills, and the 1989 Mount Falcon fire that burned over 50 acres on the eastern edge of Indian Hills. The last decade has seen hundreds of thousands of acres burned in the forests near this community, including the Buffalo Creek fire (1996), the Hi Meadow fire (2000), the Snaking fire (2002), the Schoonover fire (2002) and the Hayman fire (2002). While the majority of local forest fires were lighting-caused (65 percent), four out of the five largest fires during the last three decades were human caused.

Natural resource management policy and changing ecological conditions have interacted to produce hazardous fuel situations throughout the assessment area. These forces include historic fire suppression policy, ponderosa pine invasion into shrublands and grasslands, overstocked forests and open spaces, invasive weeds, and changing climatic patterns. The accumulation of hazardous fuels may set the stage for catastrophic wildfire occurrence, resulting in the loss of important economic and ecological values. A variety of hazardous fuel conditions exist in the IHFPD and need to be addressed through the coordinated efforts of fire authorities and private residents.

The IHFPD maintains eight emergency vehicles out of a single fire station. Of the 25 volunteer firefighters, eight are currently trained in wildland firefighting. With these limited resources, the IHFPD faces an expansive wildfire issues, including lack of defensible space, ingress/egress restrictions, and large areas of fuels on public and private lands.

The data used to perform the community risk assessment was obtained through field surveys, interviews with IHFPD and County officials, and public meetings. All information was gathered, analyzed, and prepared in the CWPP format by Walsh Environmental Scientists and Engineers, LLC (WALSH). A project website was maintained by the Jefferson County Division of Emergency Management and project updates and information to promote public awareness and outreach were provided.

Public meetings were convened on October 26 and December 7, 2006 at 7:00 p.m. in the fire station. The meetings were announced by direct mailings, county and community websites, and postings at the fire station and post office. The purpose of the first meeting was to explain the wildfire risk assessment, present the findings of the risk assessment, and provide an opportunity for the public to participate in the process, review the findings, and comment on proposed mitigation possibilities such as hazardous fuels management and non-fuel projects. The purpose of the second meeting was to present the findings of the CWPP to the public. Questionnaires were distributed at meetings and by direct mailings to obtain information on public opinion towards wildfire risk and mitigation (Appendix D). Firewise and defensible space pamphlets and brochures were also handed out at the meetings (Appendix F). A draft report of the CWPP was posted on the County's emergency website to encourage public review and comment.

The National Fire Protection Association (NFPA) Form 1144, Standard for Protection of Life and Property from Wildfire 2002 Edition, was used to assess the level of risk and hazard to communities during the community assessment conducted in October 2006. The evaluation rated attributes such as access, surrounding vegetation (fuels), presence of defensible space, topography, roofing and other construction materials, available fire protection, and placement of utilities. Scores were assigned to each element and then totaled to determine the level of risk. Low, moderate, and high hazard categories were determined based on the total score.

The community of Indian Hills was divided into three assessment areas with the surrounding public lands considered separately (Map 2). Each of the assessment areas was rated as high hazard though this represents a wider range of conditions than the descriptor indicates (Table ES-1).

Table ES-1. Community Hazard Rating and Contributing Factors

Area	Hazard Rating	Contributing Factors
Upper Indian Hills	High	• These neighborhoods are generally at the low end of high. • Many homes are proximate to light or medium fuel loads. Those homes near heavy fuels are at the base of the slope. • Roads are typically narrow and unpaved but with multiple ingress/egress options. • Generally combustible building materials, but very few wood shake roofs. • Most homes would benefit from improved defensible space.
Lower Indian Hills	High (approaching extreme)	• Several neighborhoods approach an extreme rating. • Narrow, unpaved roads with ingress/egress issues. • Heavy fuels proximate to most homes. • Need to improve defensible space around most homes. • Generally combustible building materials, but very few wood shake roofs. • Slopes in excess of 20% proximate to many homes.
285 Area	High / Extreme	• Fuels are generally dense. • Terrain is very steep, often in excess of 40%. • Many homes need improvement to defensible space, though some have already begun this effort. • Access roads are steep, narrow, and dead-end.
Public Lands	NA	• Effects of fire exclusion are becoming pronounced in some areas. • Build-up of fuels and thick reproduction in forest understory. • Brush stands becoming decadent and possibly expanding into grasslands. • Emergency access difficult. • Formerly established mitigation projects are becoming overgrown.

Priority hazardous fuels projects include defensible space, community fuel breaks, and larger scale fuel reduction projects. These projects are designed to reduce the likelihood of extreme fire behavior in close proximity to communities, and in many cases will help return vegetation to more natural conditions. Mechanical treatments and the use of saw crews are generally appropriate for creating defensible space and shaded fuel breaks. Prescribed fire is an additional tool available for large-scale treatments.

Table ES-2. Master Schedule of Proposed Projects

Year	Project	Actions
2007	Annual spring outreach	• Community meeting with presenter • Educational materials distribution
	Annual spring mitigation (Defensible Space)	• Basic yard clean-up and disposal
	Begin shaded fuel break coordination	• Engage landowners • Secure funding • Line-up contractors
2008	Annual spring outreach	• Community meeting with presenter • Educational materials distribution
	Annual spring mitigation (Defensible Space)	• Understory thinning near structures
	Initiate Shaded fuel break treatments	• Santa Clara Rd. • Shawnee Rd. / Salugi Rd. • Osage Rd. / Taos Rd. • Raven Crest area
	Plan priority 2 shaded fuel breaks	• Engage landowners • Secure funding • Line-up contractors
	Initial ingress/egress evaluation	• Determine if emergency ingress/egress routes can be developed using existing two tracks • Implement as practicable
2009	Annual spring outreach	• Community meeting with presenter • Educational materials distribution
	Annual spring mitigation (Defensible Space)	• Understory thinning on private property near roads and in drainages
	Initiate priority 2 shaded fuel breaks	• Parmalee Gulch Rd. • Inca Rd. • Mt. Falcon Rd. / Mt. Falcon service road
	Plan priority 3 shaded fuel breaks	• Engage landowners • Secure funding • Line-up contractors
	Begin area treatment planning	• Develop plan for implementation of area treatments commencing in 2011
	Comprehensive ingress/egress plan	• Evaluate need and practicability for creating turnarounds and emergency access routes
2010	Annual spring outreach	• Community meeting with presenter • Educational materials distribution
	Annual spring mitigation (Defensible Space)	• Overstory treatments on private property
	Initiate priority 3 shaded fuel breaks	• Cherokee Rd. • Namba Rd. /Picutis Rd. • Cameyo Rd. • Mount Lindo Rd. • US 285
	Ingress/egress improvements	• Initiate implementation as planned
2011	Annual spring outreach	• Community meeting with presenter • Educational materials distribution
	Annual spring mitigation (Defensible Space)	• Restart defensible space treatment cycle
	Initiate first area treatment	• Implement as practicable
	Continue ingress/egress improvements	• Implement as planned

Recommended action items are divided into a number of fuels mitigation and non-fuels related categories. Hazardous fuels reductions categories include: defensible space, shaded fuel break construction, and area treatments. Non-fuels related actions include: education and outreach, Firewise building upgrades, fire department preparedness, and

ingress/egress improvements. Some of these projects require the support and coordination of the fire department and other governmental entities as well as substantial planning and funds. However, those actions most essential to the preservation of homes during a wildfire rest in the hands of the landowners.

Implementing, sustaining, and monitoring the CWPP is key to success. Building partnerships among community-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.

INDIAN HILLS FIRE PROTECTION DISTRICT COMMUNITY WILDFIRE PROTECTION PLAN

1 INTRODUCTION

1.1 CWPP Purpose

Steep terrain, large areas of continuous fuels, and frequent high fire danger weather conditions make wildfire a significant concern in Jefferson County. Both general and specific actions are needed to mitigate wildfire risk and improve ecosystem health. Mitigation of hazardous conditions, prevention of unwanted fires, and effective response to fires once ignited must all be addressed to ensure safety of the community.

The Community Wildfire Protection Plan (CWPP) is a strategic plan that identifies wildland fire issues facing the community and outlines prioritized mitigation actions. Once the CWPP is adopted, it is the community's responsibility to move forward and implement the action items. This may require further planning at the project level, acquisition of funds, or simply motivating individual community members.

Precipitated by years of increasing wildfire activity and the devastating 2002 fire season, the Healthy Forests Restoration Act (HFRA) of 2003 provides the impetus for wildfire risk assessment and planning at the community level. This level of planning is referred to as the Community Wildfire Protection Plan (CWPPs) and empowers the community to take advantage of wildland fire and hazardous fuel management opportunities offered under HFRA legislation. The CWPP also provides a local perspective for federal and state agencies to consider when they prioritize fire mitigation projects.

The CWPP offers a framework for evaluating wildfire hazard and risk and identifying mitigation strategies. This plan addresses issues such as community wildfire risk, structure flammability, hazardous fuels and non-fuels mitigation, community preparedness, and emergency procedures.

1.2 Indian Hills Fire Protection District's need for a CWPP

The community of Indian Hills and the Indian Hills Fire Protection District (IHFPD) lie in the forested foothills to the west of Denver (Map 1). This district of approximately 11 square miles is bounded on the west, north, and west by City of Denver and Jefferson County public lands and is within 10 miles of two national forests. Several businesses, churches, an elementary school, and over 600 residences share this picturesque valley, a valley where wildland fire is a historic process. While the surrounding public lands are a major asset for this community, they also provide expanses of uninterrupted potential fuel for future fires.

Wildland fire has historically been a relatively frequent process in and around the Indian Hills area and was a major ecological influence in shaping the natural vegetation. Lightning continues to be the predominant cause of wildland fires in this area, though several recent conflagrations were ignited at the hands of humans. The impact of human caused ignitions will likely grow with the local population and visitation.

The wildland fuels around the structures that may create fire protection problems include any potentially combustible material in the wildland environment that can burn in a wildfire, such as live and dead plant materials in forests, shrublands, and grasslands. The exclusion of fire and other land management practices have exacerbated the buildup of wildland fuels. When combustible homes and associated sources of ignition are placed in proximity to these conditions, the results can be catastrophic for the communities and wildlands alike. A coordinated effort between the IHFPD and private landowners in the assessment area is needed to manage hazardous fuels and reduce the risk of wildfire.

1.3 CWPP Process

The HRFA designed the CWPP to be 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 Minimum Standards for Community Wildfire Protection Plans (CSFS, 11/18/04), and outlined in Table 1.

Table 1. Eight Steps to Developing a CWPP for the IHFPD

Step	Task	Explanation
One	Convene Decision Makers	Form a Core Team made up of representatives from local governments, fire authorities, and CSFS.
Two	Involve Federal Agencies	Engage local representatives of the 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 base map that defines communities at risk, critical infrastructure, and forest/open space at risk.
Five	Develop a Community Risk Assessment	Develop a risk assessment that considers fuel hazards, risk of wildfire occurrence, homes, business, and at risk infrastructure and other values, 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.

Step	Task	Explanation
Eight	Finalize the CWPP	Finalize the District CWPP and communicate the results to interested parties and stakeholders.

The initial step in developing the IHFPD 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 land management agencies and active community stakeholders. Collaboration between agencies and with communities is an important CWPP component as it drives sharing of perspectives, plans, priorities, and other information that would be 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. IHFPD CWPP Core Team Members

Team Member	Organization	Phone Number
D. J. Himstedt, Chief	IHFPD	303-697-4568
Loren Gilbert	IHFPD	303-697-4568
Allen Gallamore	Colorado State Forest Service	303-278-9757 ex.302
Rocco Snart	Jefferson County	303.271.4902

As a strategic plan, the success of any CWPP hinges on effective and long-term implementation of identified objectives. The CWPP planning and development process must include efforts to build 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. These stakeholders may include representatives from affected homeowners associations, water districts, local public land management agencies, forest product interests, and city or community council members, to name a few. Original CWPP core team representatives may, but are not required to help implement the action plan. Public meetings are recommended as a means to generate this needed support.

The successful CWPP utilizes all available geographical information (GIS) to develop a community base map. Comprehensive risk assessment is conducted at the neighborhood or community level in order to determine relative levels of wildfire risk to better address hazard treatment prioritization. A standardized survey methodology is utilized in order to create an addressable rating benchmark for comparative future assessments.

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 these 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 that provides prioritized wildfire hazard reduction treatment projects, preferred treatment methods, base map of the WUI, defensible space recommendations, and other information relevant to the scope of the project.

1.4 Policy and Regulatory Framework

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

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

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

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

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

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

The Jefferson County AFOP provides an intergovernmental Mutual Aid agreement between all fire districts in the county, including the CSFS and USFS. This pre-plan provides emergency response infrastructure for any large incident support.

1.5 Indian Hills Fire Protection District Wildfire Management Goals and Objectives

There are several goals and objectives for the CWPP process, as summarized on Table 3.

Table 3. IHFPD Goals and Objectives for Wildfire Management Planning

Goals	Objectives
Facilitate a CWPP in the Indian Hills Fire Protection District of Jefferson County	• Provide oversight to 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 community-wide wildfire risk assessment. • Identify areas at risk and contributing factors. • Determine the level of risk that wildfires and contributing factors pose to structures.
Develop a mitigation plan	• Identify and prioritize hazardous fuel treatment projects. • Identify and prioritize non-fuels mitigation needs.
Manage hazardous fuels	• Stimulate homeowner initiatives in fuels reduction. • Identify priority fuel treatments based on risk, secure funding, help implement projects. • Focus strategic hazardous reduction projects near values-at-risk.
Facilitate emergency planning	• Develop strategies to strengthen emergency management, response, and evacuation capabilities for wildfire. • Build relationships between county government, fire authorities, and communities.
Facilitate public outreach	• Develop strategies to increase citizen awareness and action for Firewise practices. • Promote public outreach and cooperation for all fuels reduction projects to solicit community involvement and private landowner cooperation.

2 WILDLAND FIRE MANAGEMENT PRIMER

Wildland fire is defined as any fire burning wildland fuels and includes prescribed fire, wildland fire use, and wildfire. Prescribed fires are planned fires ignited by land managers to accomplish resource management objectives. Wildland fire use (WFU) is when naturally occurring fires are allowed to burn under carefully prescribed conditions in order to accomplishment resource management objectives. Wildfires are unwanted and unplanned fires that result from natural or human-caused ignitions. IHFPD actively suppresses all wildfires, and WFU is not authorized in the IHFPD.

2.1 Wildland Fire Behavior

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 terrain and weather. The nature of fuels, terrain, and weather conditions combine to dictate fire behavior, often described in terms of rate of spread and intensity. Wildland fuel attributes refer to both dead and live vegetation and include such factors as density, fuel bed depth, continuity, loading, vertical arrangement, and moisture content.

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. But, 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 (FBFM) 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, but wind tends to be the driving force in fire behavior in the most destructive WUI fires. The “chinook” winds common along the Front Range may rapidly drive wildfire down slope.

2.2 History of Fire

Lightning and human-caused fire has long been an integral part of vegetation communities in the assessment area. Lightning-ignited 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, land clearing, and in warfare. As such, many of the plant species and communities are 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 due to 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 non-indigenous 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 are 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 mechanical treatments

2.3 Prescribed Fire

Prescribed fire in Jefferson County is used to accomplish a number of resource management objectives, such as ecosystem maintenance, hazardous fuels reduction, plant species diversity, noxious and invasive weed abatement, and wildlife habitat improvement. Multiple resource management objectives are often achieved concurrently. The use of prescribed fire in the WUI is carefully planned, enacted only under favorable weather conditions, and must meet air quality requirements of the county and the Colorado Department of Public Health and Environment (CODPHE) Air Pollution Control Division.

Prescribed fire may be broadcast over a defined area or concentrated in localized burn piles. Broadcast burns may range from a few to thousands of acres. Pile burns are the use of fire to dispose of concentrations of non-merchantable woody fuel that are collected after a mechanical treatment. Pile burning is utilized when cost or issues of access make other methods of disposal unrealistic (Appendix H).

2.4 Wildland Urban Interface (WUI)

The WUI is the zone where communities and wildland meet, and is the central focus of this CWPP. The past several decades have seen an alarming loss of life and property in the WUI, and the creation of defensible space around homes is of critical importance to avoiding such losses. This defensible space consists of pruning trees, applying low flammability landscaping, and cleaning up surface fuels and other fire hazards near the home. These efforts are typically concentrated within 30 to 75 feet of the home to increase the chance for structure survival or create an area for firefighters to work in the event of a wildfire.

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

2.5 Hazardous Fuels Mitigation

Wildfire behavior and severity are dictated by fuel type, weather conditions, and terrain. 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 contain wildfires and community assets will have an increased probability of survival. In addition to the creation of defensible space, fuel breaks may be utilized to this end. These are strategically located areas where fuels have been reduced in a prescribed manner, often along roads. These fuel breaks may be associated with or tapered into larger area treatments. When defensible space, fuel breaks, 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. Thinning forest stands in wind prone areas too rapidly can result in subsequent wind damage to the stand. Thinning can also increase the amount of sun and wind exposure on the forest floor, which can increase surface fire intensity if post treatment debris disposal and monitoring are not properly conducted. The overall benefits of properly conducted mitigations treatments are, however, well documented.

3 INDIAN HILLS 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 IHFPD is located between 6,000 and 8,050 feet in central Jefferson County along the Parmalee Gulch road between US 285 and C74 (Map 1). Of the approximately 11 square miles (7040 acres) within the fire district, around 65 percent is private land. The remainder is public land, predominantly Jefferson County open space with some City of Denver Mountain Park land. This assessment area is bounded by over 7,000 acres of public lands and is within 10 miles of both the Pike and Arapaho National Forests. While the surrounding public lands are a major asset for this community, they also provide expanses of uninterrupted potential fuel for future fires.

The population of Indian Hills is approximately 1,500 or just over 600 homes. While most residents of this community commute to jobs in nearby Denver, several businesses, churches, a summer camp, and an elementary school lie within this valley. Recreation is also economically important to the surrounding area with numerous recreational opportunities available on nearby county, state, city, private, and federal lands. Premier hiking, hunting, climbing, cycling, camping, and fishing areas abound locally.

3.2 Assessment Areas

Though the residents of Indian Hills identify themselves as a single community, this project divides the fire district into three wildland fire assessment areas to facilitate more detailed assessments: Upper Indian Hills, Lower Indian Hills, and the 285 area (Map 2, Table 4). These groupings are based on access points and similarity of fuels and terrain. In addition, Denver Mountain Parks and Jefferson County Open Space lands are considered separately as public lands. IHFPD services the Indian Hills assessment area from one station located on Parmalee Gulch Road (Map 3).

Table 4. Assessment Area Summary Information

Community	Location	Surrounding Fuels
Upper Indian Hills	Areas accessed from Parmalee Gulch Rd, from Lane Ranch north	Open timber with shrubs on south and west slopes and grass on flat grades are predominant. Areas of dense timber are found on northern exposures.
Lower Indian Hills	Areas accessed from Parmalee Gulch Rd, south of Lane Ranch	Dense timber on northern exposures and in narrow draws is predominant. Open timber and shrubs are found on open south slopes.
285 Area	Areas accessed from US 285 rather than Parmalee Gulch Rd.	Dense brush and timber are found adjacent to homes and along access routes.
Public Lands	Lair O' the Bear Park (J)[1] Mount Falcon Park (J) Mount Lindo Park (J) Pence Park (D) O'Fallon Park (D) Corwina Park (D) Little Park (D)	These areas are characterized by dense timber on north facing slopes, with a mix of grass, brush, and open woodlands on other aspects.

[1] J = Jefferson County Open Space; D = Denver Mountain Parks

3.3 Climate

The Indian Hills climate is relatively dry with the majority of precipitation occurring with spring rains and late-summer monsoons (Table 5). The area receives over 240 days of sunshine per year and receives an average of 19 inches of annual precipitation. Winter high temperatures are typically in the mid 40s, and summer highs tend to remain in the 80s. The low precipitation months are typically December, January, and February.

Table 5. Average Monthly Climate Summary for Indian Hills, Colorado

Climate Attribute	Month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Maximum Temperature (F^o)	44	46	50	56	65	75	82	81	74	64	51	46	61.6
Average Minimum Temperature (F^o)	10	14	19	26	34	43	48	47	37	28	18	11	27.9
Average Total Precipitation (inches)	0.6	0.7	1.6	2.4	2.4	2.1	2.1	2.3	1.6	1.3	1.1	0.8	19.0

Average and severe case weather and fuel moisture conditions were determined using records from local remote automated weather stations (RAWS). The Corral Creek, Bailey, and Cheesman stations were selected based on proximity, elevation, and available data. Fiftieth percentile conditions represent average case, and 90th percentile conditions represent severe case conditions for June through August based on data from 1970 through 2006 (Table 6). These data will be used for fire behavior modeling.

Table 6. Average and Severe Case Fire Weather and Fuel Moisture Conditions

	Temp	Relative Humidity	1 hr Fuel Moisture	10hr Fuel Moisture	100hr Fuel Moisture	Herbaceous Fuel Moisture	Woody Fuel Moisture	20 ft Wind Speed	Eye Level Wind Speed
50th Percentile	78 F	31%	6%	9%	12%	89%	121%	7 mph	4 mph
90th Percentile	86 F	14%	3%	4%	7%	38%	81%	11 mph	8 mph

3.4 Wildland Vegetation and Fuels of the Assessment Area

The vegetation in the assessment area is diverse and typical for the Colorado Front Range. The existing vegetation is described in detail and is categorized into FBFM for use in modeling potential fire behavior. Historic conditions are discussed in terms of historic fire regimes to describe the fuels and role of fire in this area prior to Euro-American settlement. Potential natural vegetation is described to provide insight into what future vegetation profiles are likely to be most resilient and maintainable. Fire regime condition class (FRCC) is presented to illustrate the departure of current vegetation (i.e., fuels) conditions in comparison with those of potential natural vegetation.

Map 5 illustrates existing vegetation (EV) that was derived from 2006 Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) satellite imagery, field checked at 48 points throughout the assessment area, and documented in a series of 120 photographs. Narrow draws and northern exposures are covered by dense ponderosa pine – Douglas-fir stands. Open ponderosa pine with grass and/or shrub understory is found on southern and western slopes. Grass and shrubs with widely scattered ponderosa pine may also be found on western and southern slopes as well as eastern exposures. Shrublands are largely composed of mountain mahogany, though areas of Gambel oak may be found throughout the district. There are very small areas of aspen and hardwoods in some mesic areas and pockets of juniper on some southeastern exposures at lower elevations. Grasslands may be found on flat terrain of Upper Indian Hills and in patches throughout Mount Falcon's south-facing slopes.

The same methodology used to identify EV was used to determine FBFMs for use in modeling potential fire behavior. There are several systems for classifying fuel models. This CWPP uses the most commonly used fuel model set as developed by Hal E. Anderson (1982). Of the 13 standard models in this set, six are prevalent in the IHFPD (Table 7). The FBFMs are used as input into fire behavior prediction models that are based on weather and fuel conditions. The differences among the 13 models relate to fuel load and the distribution of fuel-size classes. FBFM descriptions provide information on anticipated fuel load and fire behavior under normal conditions. FBFMs are valuable to planning and prioritizing fuel management projects. Map 7 shows the arrangement of FBFMs in the assessment area.

Table 7. Fire Behavior Fuel Models Occurring in the Assessment Area (Anderson 1982)

Fire Behavior Fuel Model	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. Surface fires 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.
2 Open Timber with Grass Understory	**Grass Group** – Fire spreads through curing of dead herbaceous fuels. These are surface fires where downed woody debris from the shrub and tree component adds to fire intensity. Opened shrub lands, pine stands, or oak stands that cover from one-third to two-thirds of the area generally fit this model.
6 Intermediate 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 height less than 6 feet. These stands include Gambel oak and mountain mahogany less than 6 feet tall.
8 Short-Needle Timber Litter	**Timber Group** – These fuels produce slow-burning ground fires with low flame lengths. Occasional "jackpots" may occur. Only under severe weather conditions with high temperatures, low humidity, and high winds do the fuels pose a fire hazard. These are mixed conifer stands with little undergrowth.
9 Long-Needle Litter	**Timber Group** – Fires run through the surface litter faster than in model 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 will contribute to tree touching, spotting, and crowning.
10 Timber with Heavy Understory	**Timber Group** – Surface fires burn with greater intensity than the other timber litter models. Dead and down are heavier than other timber models and the stands are more prone to hard to control fire behavior such as torching, spotting, and crown runs.

For discussion, these fuel models are grouped into grass, shrub, and timber communities. Local descriptions and photographs are used to put these fuel models into context.

Grasslands

Grass fuels are predominant in much of the Upper Indian Hills areas and areas of Mount Falcon Park with southern exposure (Figure 1). 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 as it will remove excessive dried biomass and add nutrients to the soil. When the accumulation of thatch and the encroachment of brush increases fuel loads, high intensity fires may have damaging affects. This may include the reduction of grass cover, increased erosion, or the encroachment of non-native species.

Figure 1. FBFM 1 in Alpine Village

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. The short- and mid-grass prairie is FBFM 1. FBFM 2 occurs where scattered brush or open forest occurs with the grasses (Figure 2). Though brush and timber fires are known for more intense fire behavior than grass fuels, the potential impact of grass fires should not be underestimated. These light, flashy fuels can be very resistant to suppression, producing incredibly rapid rates of spread and flame lengths in excess of 10 feet. They can pose a very real risk to firefighter safety and a serious threat to homes.

Figure 2. FBFM 2 in Upper Indian Hills

Shrublands

The brush fuels throughout the assessment area are typically best represented by FBFM 6 (Figure 3). Mountain mahogany is the dominant species in this area's shrublands, but little literature exists pertaining to fire behavior and fire effects in mountain mahogany. While less notorious for intense fire behavior than some shrubs, years of fire exclusion can result in dense, continuous stands with a high dead fuel component. When combined with drought conditions, this can produce extreme fire behavior.

Figure 3. FBFM 6, Mountain Mahogany Shrublands

Gamble oak is also found in this area, often in narrow draws. This brush fuel is noted for its combustible nature when allowed to grow decadent in the absence of fire. A variety of other shrub species are common to this area such as chokecherry, rabbit brush, and common juniper.

Forest

Forests on northern slopes are dominated by Douglas-fir and ponderosa pine. This forest type is best represented by FBFM 8 or FBFM 10 where large amounts of dead material have built up on the forest floor (Figure 4). Both of these fuel models may be found throughout these mixed conifer stands, and much of the area is in a transitional stage from FBFM 8 to the denser FBFM 10 as forest litter and young trees, known as reproduction, continue to build up in the absence of fire. This CWPP categories these stands as FBFM 10 to reflect the developing conditions and the worst case scenario.

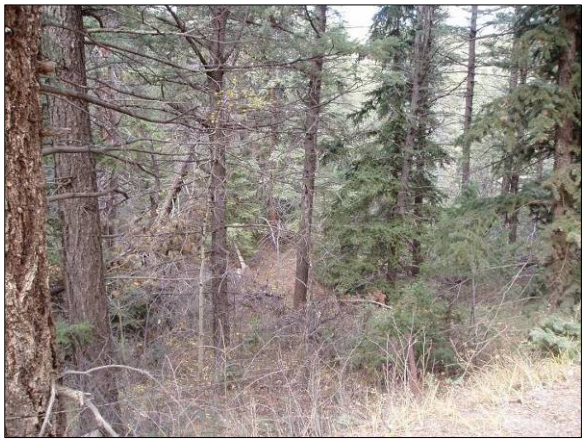


Figure 4. FBFM 10, Timber with Dense Understory

Figure 5. FBFM 8, Long Needle Litter

On drier slopes, ponderosa pine is found in more open stands with needle cast and lighter accumulations of forest litter on the ground. FBFM 9 best represents these areas (Figure 5). Where low density tree stands have allowed abundant grass and brush to grow in the understory because of increased sunlight, FBFMs 2 and 6 are used respectively.

Historic fire regimes describe the frequency and severity of fires prior to Euro-American settlement (Map 6). Fire severity refers to the impact on ecosystem. For example, low severity would mean very little damage to the canopy, while a stand replacement fire would mean loss of the canopy. The shrublands and montane forests of the Colorado Front Range are products of a mixed fire regime. Historic fire return intervals vary from less than 15 to over 200 years with fire intensity being similarly variable from low intensity surface fires to high intensity crown fires. Recent studies concur that fire frequency increased during Euro-American settlement of the area in the late 19th century, and then decreased significantly with the grazing and fire management practices of the 20th century. Fire suppression has had a more significant impact in the lower montane areas (~5,500-7,200 feet) where fires were historically more frequent than the upper montane areas (~7,200-9,000 feet).

3.5 Water Resources

The Indian Hills Water District supplies approximately 60 percent of the residential water supply in the community while wells provide the remainder of the domestic water supply. The water district also supplies and maintains 31 fire hydrants throughout the IHFPD. Water pressure ranges from 10 pounds per square inch (psi) to 197 psi with an average of 106 psi. Over 70 percent of the hydrants provide 80 psi or greater. The estimated gallons per minute delivered by these hydrants ranges from 500 to 1,200 largely depending upon whether they are supplied by a 4-inch (13 hydrants) or 6-inch (18 hydrants) water main.

The power supplies to the pump stations are above ground and susceptible to interruption during a wildfire, but the system's supply tanks have a maximum capacity of 400,000 gallons. This is a relatively robust water system for a rural community and well distributed throughout most of the community in terms of supporting wildland firefighting operations. The distance between hydrants will necessitate a heavy reliance on water shuttle operations if engines are used to any great extent.

There are several static water sources potentially appropriate for drafting or helicopter operations throughout Indian Hills. These include the Geneva Glen pool, stock ponds near Taos and Santa Clara, several ponds between Nampeyo and Acoma, and a pond on the Leprino property. It is recommended that these water sources be examined by qualified engine and helicopter personnel. Access to those sights found suitable for use should be secured through standing agreements with the landowners. Sights approved for use should be inspected annually by qualified personnel.

3.6 Fire Protection Authority

Fire protection for the community of Indian Hills is provided by the IHFPD IHFPD consists of 25 volunteers with eight emergency vehicles out of a single station located on Parmale Gulch Road. An Intergovernmental Agreement for Mutual Aid between fire departments exists between the IHFPD and the other fire departments in Jefferson County in order to provide coverage for very large incidents with many participants (like wildfire or flood). The Inter-Canyon and Foothills Fire Protection Districts are the bordering fire departments that most commonly provide mutual aid to the IHFPD. In the case of large-scale incidents, all of the fire departments in Jefferson County, the CSFS, and USFS participate in the AOP for wildfire.

3.7 Values at Risk

Human life and welfare are at risk to wildfire in the assessment area due to the buildup of hazardous fuels in proximity to the community and roadways, limited emergency vehicle ingress and egress, and lack of defensible space around structures. The entirety of the IHFPD should be considered wildland or WUI. Compared with many rural FPDs, Indian Hills has relatively concentrated areas of structures. This can prove beneficial during a wildfire by allowing resources assigned to structure protection to remain more concentrated and able to support and communicate with one another. These resources will also be generally closer to escape routes and safety zones, compared to areas with

dispersed housing patterns. The density of structures can also be detrimental when multiple structures are simultaneously threatened or when structures present exposure problems to one another.

There are similar benefits and liabilities to this housing pattern when considering mitigation efforts. In areas with small lots, the defensible space efforts of one home can support the efforts of the neighboring structure. Conversely, a lack of Firewise efforts by one resident can pose a hazard to several neighbors.

The general wildland fire issues that face Indian Hills include:

- Build up of wildland fuels within the community and on surrounding public lands
- Limited emergency vehicle access (road width, grade, length of dead-end)
- Structures lacking defensible space or Firewise landscaping and construction
- Failure to maintain defensible space once created
- Distance between fire hydrants
- Potential ignition sources from improper fire use by park users or residents

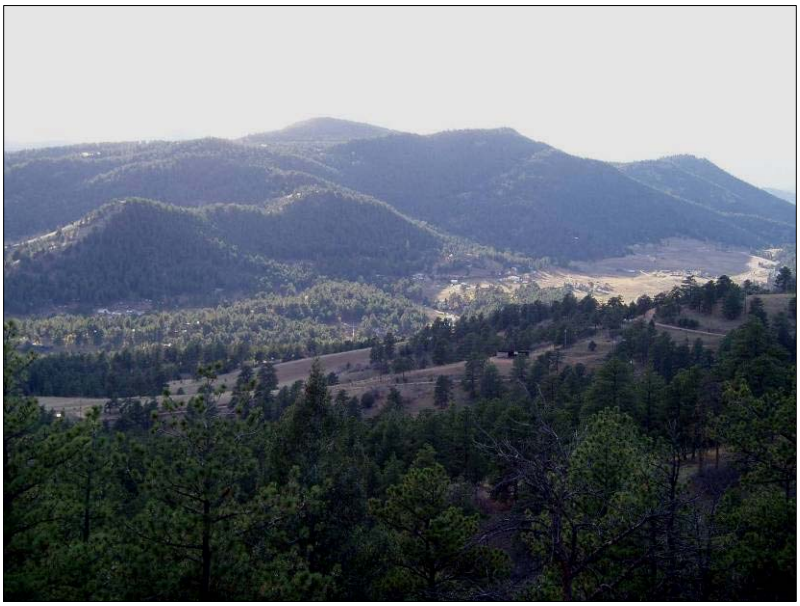


Figure 6. The community of Indian Hills lies in the Parmalee Gulch Valley, which is home to a variety of values at risk to wildfire.

Ecological values within the assessment area are central to the community's interests and esthetics, for residents and visitors alike (Figure 6). Wildfire is a natural part of ecology, and normally occurring fire is necessary to maintain many desirable attributes such as wildlife habitat and livestock forage. Under a normally occurring fire regime, many ecological values will recover within a few years. Air quality should recover within days after a fire but wildlife habitat may take years. However, catastrophic wildfire may change wildlife habitat beyond its capacity to return to its present condition if the

biophysical nature of the soil, vegetation, and watershed are altered. In addition, wildfire may produce conditions conducive to the spread of noxious and invasive weeds. Ecological values at risk to wildfire in this area include:

- Wildlife and aquatic habitat
- Forests
- Viewsheds
- Water quality
- Scenic areas
- Air quality
- Natural vegetation communities
- Cultural and historic sites

4 WILDFIRE RISK ASSESSMENT

4.1 Approach to the Wildfire Risk Assessment

Indian Hills was divided into three assessment areas based on access points and similarity of fuels and terrain (Map 2). In addition, Denver Mountain Parks and Jefferson County Open Space lands are considered as two separate areas. Area assessments were conducted to determine wildfire hazard and risk based on access, adjacent vegetation, defensible space, topography, roof and building characteristics, available fire protection, and placement of utilities. The fuels within a mile of the communities were evaluated based on satellite imagery, field observations, and information from local experts.

For the purposes of this assessment, 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 wildland fuels' probability of ignition. Values-at-risk include infrastructure, buildings, 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 public input in this plan. The meetings were publicized with direct mailings to all residents as well as postings at the post office, fire station, the community store, and on fire department and county websites. Public meetings were held on October 26 and December 7, 2006 at the Indian Hills fire station. The purpose of the first meeting was to explain the wildfire risk assessment; present the findings of the risk assessment; and provide an opportunity for the public to participate in the process, review the findings, and comment on proposed mitigation possibilities. The purpose of the second meeting was to present the findings of the CWPP and to further solicit public input. Questionnaires were distributed and discussion was very productive among the approximately 20 citizens in attendance at each meeting (Appendix B).

Terrain
The IHFPD includes the community of Indian Hills as well as Mount Falcon Park and the northern half of the Mount Lindo Open Space and ranges in elevation from 6,000 feet to 8,050 feet. The steepness of terrain in developed areas of the district ranges from 5 to 20 percent slope, and slopes up to 70 percent may be found in Mount Falcon Park and Mount Lindo Open Space. For fire behavior modeling, a 10 percent slope was used to represent the grass areas while a 30 percent slope was selected as more representative of brush covered and forested terrain.

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 here expressed 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.

BehavePlus software was used to generally illustrate the potential surface fire behavior given the prevailing fuel types, local topography, and local weather conditions. Crown fire and other types of extreme fire behavior are not represented in Table 9. Weather and fuel moisture conditions were derived from data from the Corral Creek, Bailey, and Cheesman weather stations (1970-2006). These stations were selected based on proximity to the assessment area and the data's correspondence to the years of available fire records. The Bailey station is 19 miles to the south of the assessment area at 7,982 feet. It is missing all data from 1993 thru 1999. The Corral Creek station is 11 miles to the west at 7,844 feet and is missing all data from 1987 to 2000. The Cheesman station has complete fire season records for 1987 to 2005 and is 30 miles to the south at 7,473 feet.

Other weather stations in the area did not provide enough data to be of use in this analysis but may prove valuable in determining fire danger. The Waterton North RAWS station is located 11 miles to the south at 8714 feet. Jefferson County has developed a fire danger rating method (Section 4.2) based on alternate weather stations.

Fire behavior simulations were conducted for average (50th percentile) and severe (90th percentile) conditions for the three busiest months of the fire season, June through August (Table 8). Grass fuels were modeled on a 10 percent slope, representative of the terrain where much of the grass fuels are found in this area. Timber and brush fuels were modeled at 30 percent slope, representative of the steeper conditions on which they are locally prevalent.

Table 8. BehavePlus Predictions of Fire Behavior

Fire Behavior Fuel Model	Flame Length, (ft) Average Conditions	Rate of Spread (feet/min)[1] Average Conditions	Flame Length, (ft) Severe Conditions	Rate of Spread (feet/min)[1] Severe Conditions
1 Short Grass	4	62	8	309
2 Open Timber with Grass Understory	5	26	12	209
4 Heavy Brush, >6 ft	17	58	33	126
5 Low Brush, <3 ft	3	9	10	67
6 Intermediate Brush, <6 ft	6	30	10	90
8 Short-Needle Timber Litter	1	2	2	6
9 Long-Needle Litter	3	7	5	27
10 Timber with Heavy Understory	5	7	9	23
11 Light Slash	3	9	6	14

[1] Approximated from chains/hr

4.2 Jefferson County Fire Danger Rating System and Local Weather Information

The Jefferson County Fire Danger Rating System (JFDRS) is based on the National Fire Danger Rating System implemented in 1978. The JFDRS uses both Remote Automated Weather Stations (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 model C (Pine-Grass Savanna) and G (Short-Needle (Heavy Dead)). The RAWS stations 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, calculation of 1 hour fuel moisture. After the weather data is 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 Jeffco and an adjective fire danger value (Extreme, Very High, High, Moderate, Low) is assigned. Evergreen Fire Dispatch faxes completed forms for the RAWS and independent weather stations to Jeffco Sheriff's, Colorado State Forest Service and local fire agencies for distribution. The completed form with various components of the NFDRS was used for responders and an adjective fire danger for the public.

Additional weather resources include;

The Waterton North Remote Automated Weather Station (RAWS) went in service July 20, 2002. Station statistics;

ID: WTTC2
NAME: WATERTON NORTH
LATITUDE: 39.4672
LONGITUDE: -105.2097
ELEVATION: 8714 ft
MNET: RAWS

- Current station conditions may be found at; http://raws.wrh.noaa.gov/cgi-bin/roman/meso_base.cgi?stn=WTTC2
- National Fire Weather Page - http://fire.boi.noaa.gov/
- Real-Time Observation Monitor and Analysis Network – ROMAN http://fire.boi.noaa.gov/
- Current Weather Summary for Rocky Mountain Geographic Coordinating Area http://raws.wrh.noaa.gov/cgi-bin/roman/raws_ca_monitor.cgi?state=RMCC&rawsflag=2

4.3 Wildfire Occurrence

In the absence of thorough fire records for the Indian Hills area, records from the nearby South Platte Ranger District (Pike National Forest) and Clear Creek Ranger District (Arapaho National Forest) are included for reference. Each district has borders approximately 10 miles from Indian Hills, South Platte to the southwest and Clear Creek

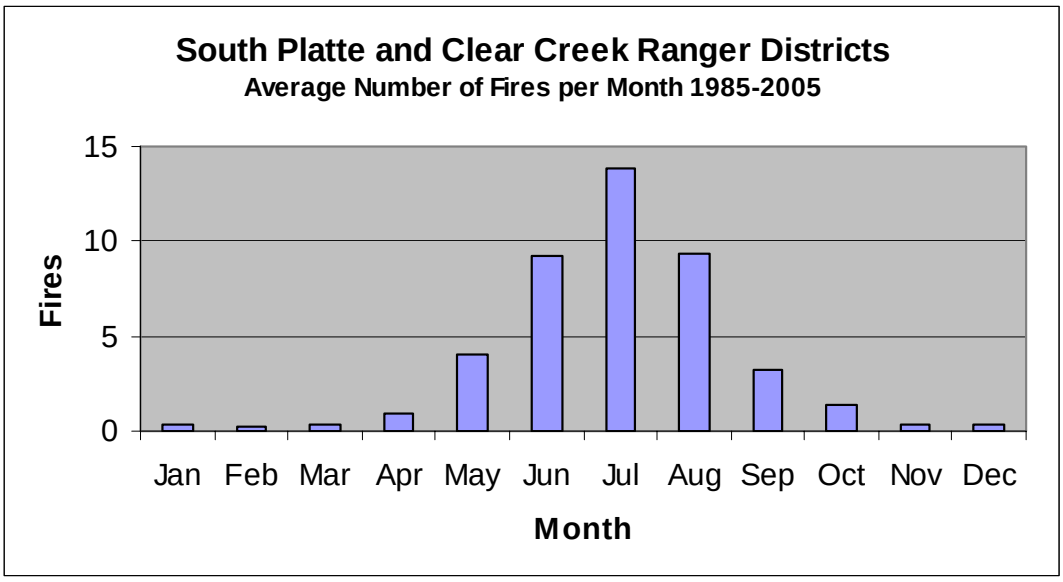
to the west. June, July, and August are the three busiest months for fire occurrence in both districts (Figure 7). From 1985 to 2005, 870 wildfires were started on these two districts (Table 9). This does not include large fires that burned into these districts from adjacent areas. The majority of these fires, 85 percent, occurred on the South Platte district. The majority of wildfires burn less than 0.25 acres. While these records are helpful in illustrating the nature of local fire occurrence, better record keeping by the local fire district will be helpful in developing a more precise fire occurrence profile.

Significant fires in the area include the 1978 Murphy Gulch fire that scorched 3,300 acres just a couple of miles to the southeast of Indian Hills and the 1989 Mount Falcon fire that burned at least 50 acres on the eastern edge of Indian Hills. The last decade has seen hundreds of thousands of acres burned in the forests near this community, including the Buffalo Creek fire (1996), Hi Meadow fire (2000), the Snaking fire (2002), the Schoonover fire (2002) and the Hayman fire (2002). While the majority of local forest fires were lighting-caused (65 percent), four out of the five largest fires were human caused.

Table 9. Wildfire Histories of the USFS South Platte and Clear Creek Ranger Districts

Fire Size Class (Acres)	Number of Fires	
	South Platte RD USFS 1985 - 2005	Clear Creek RD USFS 1985 -2005
A (0 - 0.25)	454	108
B (0.25 - 9.9)	255	21
C (10 - 99.9)	18	1
D (100 - 299.9)	7	0
E (300 - 999.9)	1	1
F (1,000 - 4,999.9)	2	0
G (5,000 - 9,999.9)	2	0

Figure 7. Average Number of Wildfires per Month on the South Platte and Clear Creek Ranger Districts



4.4 Wildfire Risk to Communities

Values at Risk

Community assessments were conducted during October 2006 to determine wildfire hazard and risk. The National Fire Protection Association (NFPA) Wildland Fire Risk and Hazard Severity Assessment Form 1144 (Appendix B) was used to rate communities based on access, adjacent vegetation (fuels), defensible space, topography, roof and building characteristics, available fire protection, and placement of utilities. Since the NFPA 1144 form is designed to be used for individual structures as well as communities, specific adaptations were adopted for its use. Where a range of conditions was found a corresponding range of values was awarded. The final rating was based on the range and median of the final total value and the assessor's observations. Each area was given a rating on the hazard scale of low, moderate, high, and extreme.

Every area within Indian Hills is susceptible to wildfire and will benefit to increased mitigation efforts (Table 10). Upper Indian Hills has generally better access, flatter terrain, and lighter fuels than the other areas. Fuels, terrain, infrastructure, and lack of defensible space pose enough issues to bring this area into the lower end of high hazard.

Lower Indian Hills has substantial areas of heavy fuels and steep terrain. Several roads are narrow and winding with few vehicle turnarounds and a single point of access. Defensible space is largely inadequate. This area is rated in the upper reaches of the high hazard category.

The 285 Area ranges in hazard from high to extreme. Homes are on steep, winding, dead-end roads with few turnarounds suitable for large fire engines. Steep slopes and heavy fuels are present throughout. Many of the homes lack adequate defensible space.

Table 10. Community Hazard Rating and Contributing Factors

Area	Hazard Rating	Contributing Factors
Upper Indian Hills	High	• These neighborhoods are generally at the low end of high. • Many homes are proximate to light or medium fuel loads. Those homes near heavy fuels are at the base of the slope. • Roads are typically narrow and unpaved but with multiple ingress/egress options. • Generally combustible building materials, but very few wood shake roofs. • Most homes would benefit from improved defensible space.
Lower Indian Hills	High (approaching extreme)	• Several neighborhoods approach an extreme rating. • Narrow, unpaved roads with ingress/egress issues. • Heavy fuels proximate to most homes. • Need to improve defensible space around most homes. • Generally combustible building materials, but very few wood shake roofs.

Area	Hazard Rating	Contributing Factors
		• Slopes in excess of 20% proximate to many homes.
285 Area	High / Extreme	• Fuels are generally dense. • Terrain is very steep, often in excess of 40%. • Many homes need improvement to defensible space, though some have already begun this effort. • Access roads are steep, narrow, and dead-end.
Public Lands	NA	• Effects of fire exclusion are becoming pronounced in some areas. • Build-up of fuels and thick reproduction in forest understory. • Brush stands becoming decadent and possibly expanding into grasslands. • Emergency access difficult. • Formerly established mitigation projects are becoming overgrown.

The public lands in this area are integral to the identity of Indian Hills, and high severity fire may compromise the esthetics and ecological health of the area. In the absence of fire or thinning treatments, the local ecosystems will become increasingly susceptible in to insects, disease, and the general lack of vigor associated with decadent vegetation.

5 WILDFIRE MITIGATION PLAN

5.1 Approach to Mitigation Planning

Wildfire mitigation is defined as the reduction of the probability and negative impacts of wildfire. This can be accomplished through wildland fuels management, non-fuels mitigation measures, and public outreach. Results are often most effective when these three approaches are pursued by governmental entities, citizen groups, and individuals working in concert.

Hazardous fuels and non-fuels mitigation projects were identified based on the findings of field surveys, interviews with county and FPD fire suppression experts, and through a community questionnaire, which was mailed to all addresses in the FPD. Fuels mitigation projects were identified and prioritized based on proximity to community, demonstrated efficacy, hazardous fuel load and continuity, terrain, and professional experience.

5.2 Suggested Actions to Achieve Desired Results

Recommended action items are divided into a number of fuels mitigation and non-fuels related categories. Hazardous fuels reductions categories include: defensible space, shaded fuel break construction, and area treatments (Map 9). Non-fuels related actions include: education and outreach, Firewise building upgrades, fire department preparedness and ingress/egress improvements (Table 11, Table 12). Some of these projects require the support and coordination of the fire department and other governmental entities as well as substantial planning and funds. However, those actions most essential to the preservation of homes during a wildfire rest in the hands of the individual owner.

Table 11. Recommended Projects by Category

Project	Actions
Outreach/Public Education	• Spring community meetings • Firewise materials distribution
Defensible Space	• Basic yard clean-up • Understory thinning near structures • Understory thinning near roads • Understory thinning in drainages • Overstory thinning where needed
Firewise Building Improvements	• Replace shake roofs • Enclose exposed decks and gables • Screen vents and chimneys
Shaded Fuel Breaks	• Thin along roadways • Maintain breaks between neighborhoods
Ingress/Egress Improvements	• Create fire apparatus turnarounds • Create secondary ingress/egress routes
Area Treatments	• Thinning projects on large private holdings • Thinning projects on public lands • Prescribed fire as appropriate
Supporting Actions	• Funding and grants

Project	Actions
	• Study of ingress/egress improvements • Revisions to county statutes • Jefferson County Open Space / Denver Mountain Parks Stewardship Planning
Fire Department Preparedness	• Update run books • Firefighter training • Firefighter equipment • Fire apparatus • Tactical pre-suppression planning

Outreach / Public Education: The most effective form of mitigation can be education and outreach. The purpose of a community-wide education program is to: 1) educate the public to the risks of wildfire to property and life; 2) motivate property owners to take responsibility in reducing the risk of wildfire and to create defensible space around their structures; 3) teach the benefits of different types of fire resistant building materials; and 4) educate the public as to the historic role of fire can be mimicked in mitigation actions. Education makes other mitigation programs possible.

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 "clean-up" efforts within the community. Firewise materials and postings should be made available to the public at the fire station, post office, and elementary school every year. A disposal method for yard waste should be coordinated every spring. This may be coordinated with the Indian Hills Improvement Association's annual clean-up day and may include the coordination of a central disposal site, mobile chipping services, or a hauling service. Disposal will be needed every year for the execution of the recommended defensible space project schedule, and coordination at the neighborhood or community level can greatly reduce costs. Grant monies may also be available for these efforts.

Many lots are undeveloped and owned by absentee owners, and a lack of fuels management on these lots can impact the entire community. Attendees at the public meetings have expressed concern over how to best deal with absentee and apathetic land owners. In the absence of enforceable county or IHFPD code to regulate these situations, direct outreach and education may be the only recourse. This issue should be explored further by the Core Team.

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 the creation of defensible space follow the CSFS guidelines as set forth in *Creating Defensible Space Zones, Bulletin No.6.302* (Dennis 2003), which is consistent with Jefferson County regulations.

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 3rd zone that is basically a managed 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 principal 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 8).

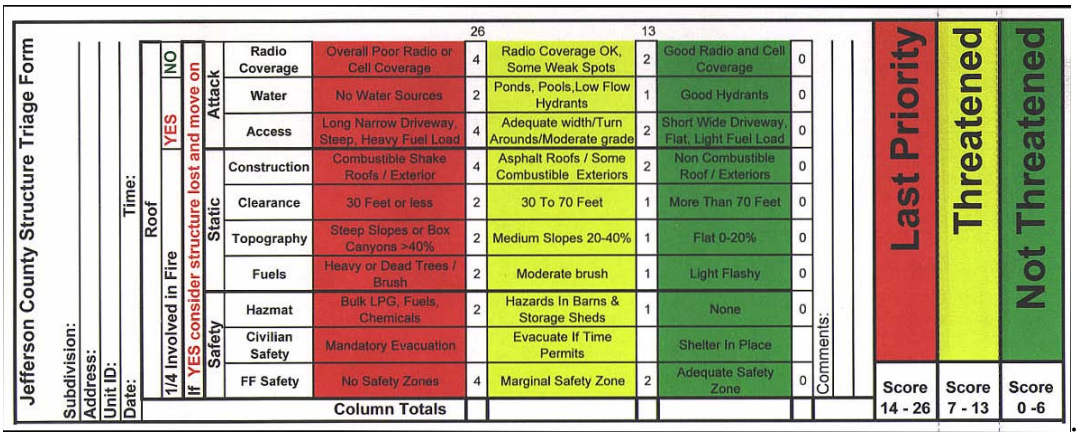


Figure 8. Jefferson County Structure Triage Form illustrates the factors that help establish structure defense priorities during a wildfire.

Zone 1 (0-15 feet from structure): Within 3-5 feet of the structure, decorative rock or mowed, irrigated grass is recommended (Figure 9). Well-spaced and pruned low flammability plants are acceptable if the structure has noncombustible siding. In the remainder of Zone 1, trees' lower braches should be pruned 5-10 feet above the ground (not to exceed ⅓ 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 (15 to at least 75 feet from structure or to the property line): The size of this zone is dependent upon slope. Treatment of ground fuels and ladder fuels is generally the same as Zone 1. Trees (or small groups of trees) and shrubs should be thinned to provide 10 feet of clearance between crowns. Grass should be mowed as it dries 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.

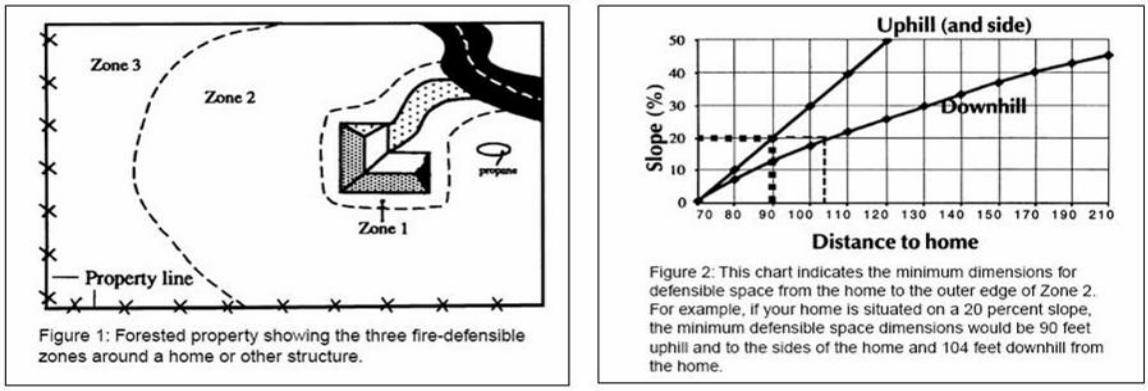


Figure 9. CSFS Defensible Space Standards (Dennis 2003)

Defensible Space efforts can be encouraged and coordinated annually through community meetings, and most of this work can be done by the homeowner with little more than handtools. A phased approach may make this effort less daunting (Table 13). It should be emphasized that defensible space can be created in an esthetically pleasing manner that maintains privacy and the natural character of the community (Figure 10). Defensible space should also be created around out buildings.

Figure 10. Defensible space and privacy can be compatible

Assisting neighbors may be essential in many cases. For example: assisting the elderly, sharing ladders for gutter cleaning, assisting neighbors with large thinning needs such as near roads and in drainages. There are several areas where fuels are especially thick in drainages that run through the neighborhoods. These tend to be on individual lots, but their clean up will benefit the neighborhood as a whole.

Table 12. Recommended Defensible Space Project Schedule

Year	Project	Actions
2007	Basic yard clean-up (annual)	• Dispose of clutter in the yard • Remove dead branches from yard • Mow and rake • Clean off roofs and gutters • Remove combustible vegetation near structures • Coordinate disposal as a neighborhood or community • Post 4" reflective address numbers visible from road
2008	Understory thinning near structures	• Limb trees up to 5-10 feet • Trim branches back 15 feet from chimneys • Trim or cut down brush • Remove young trees that can carry fire into forest canopy • Coordinate disposal as a neighborhood or community
2009	Understory thinning on private property near roads and in drainages	• Limb trees up to 5-10 feet • Trim or cut down brush • Remove young trees that can carry fire into forest canopy • Coordinate disposal as a neighborhood or community
2010	Overstory treatments on private property	• Evaluate the need to thin mature or diseased trees • Prioritize and coordinate tree removal within neighborhoods • to increase cost effectiveness
2011	Restart defensible space treatment cycle	• Continue the annual Basic yard clean-up • Evaluate need to revisit past efforts or catch those that were by-passed

Building Improvements: Improving the Firewise characteristics of structures goes hand-in-hand with the construction of defensible space. Extensive recommendations may 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 replacing wood shake roofs with noncombustible, Class A roofing material, as required for all new roofs in Jefferson County's WUI. All homeowners, and especially those with wood roofs, should keep roofs and gutters clear of leaves and pine needles. Embers can travel surprising distances (over one mile) and ignite receptive pockets of fuel far from the main fire. Screening of gutters and roof vents should be considered.

Though wood shake roofs are an important factor, there are relative few in Indian Hills. More common issues involving building characteristics in Indian Hills include:

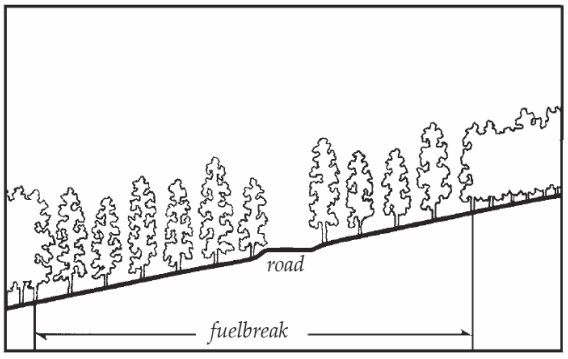
- Combustible decks with exposed undersides
- Lack of clear addressing
- Numerous outbuildings in disrepair
- Improper storage of firewood, surplus constructions materials, ancillary vehicles and machinery
- Combustible fences in disrepair

Enclosing the underside of wood porches can help protect the structure. At minimum, combustible materials such as firewood, vegetations, and pine needles must be removed from under decks. Camping trailers and mobile homes should also have all combustible materials removed from beneath and preferably be skirted. Addresses should be reflective and clearly visible from the road. Openings such as attic vents should be screened to prevent embers from entering. Each structure needs to be evaluated on its own merits to determine specific actions needed to reduce its susceptibility to wildfire.

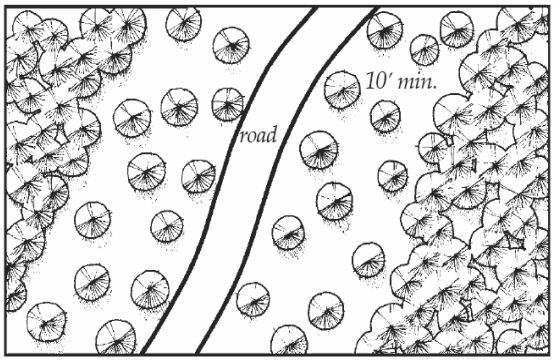
Shaded Fuel Breaks: Shaded fuel breaks can help enhance the effectiveness of defensible space, protect ingress/egress routes, reduce fire intensity near values at risk, and provide tenable areas for fire suppression efforts. Roads provide a good start for a fuel break as well as ready access for machinery and removal of thinned vegetation (Figures 11 and 12). Depending on the width of road easements, much of the work along roads must be initiated by the private land owner, which is why it was included as a phase of the defensible space schedule. Thinning within the easement and along roads on public land will require coordination with the associated public entity.

Great benefit can be realized by merely removing dense reproduction, dead and down forest litter, and low branches along roadways. Thinning of the overstory will break the continuity of the forest canopy and interrupt the spread of crown fires. Recommendation for these fuel breaks may be found in the CSFS publication Fuel Break Guidelines for Forested Subdivisions (Dennis undated). The general principle is to reduce fuels on both sides of a road in a manner similar to defensible space Zone 2:

- Total width of fuel break should be 300 to 340 feet.
- Reduce surface fuel load to approximately 5 tons per acre.
- Reduce surface fuel bed height to 2 feet or lower.
- Employ mechanically based thinning to reduce basal area to 60 to 90 square feet per acre.
- On remaining trees, raise canopy base height to 5 to 12 feet high from ground level.
- Create a minimum of 10 feet of clearance between crowns of trees or tree groups.



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



Plan view of fuelbreak showing minimum distance between tree crowns.

Figure 11. Example of Shaded Fuel Break (Dennis undated)

Due to the fragmented nature of land ownership along the roads, individual prescriptions and cooperation must be closely coordinated. The priority of treatment areas is outlined in the following table based on density of fuels, existing hazards to ingress/egress routes, ease of coordination, and protection to the community as a whole. Many of these projects may be largely addressed by efforts undertaken on private lots.

Figure 12. Thick reproduction is common near roads throughout Indian Hills

Table 13. Recommended Shaded Fuel Break Project Schedule (Map 9)

Year	Project	Priority Area
2007	Coordinate 2008 implementation	Each year's efforts should include planning and coordination for the following year's implementation
2008	Priority 1 implementation	• Santa Clara Rd. • Shawnee Rd. / Salugi Rd. • Osage Rd. / Taos Rd. • Raven Crest area
2009	Priority 2 implementation	• Parmalee Gulch Rd. • Inca Rd. • Mt. Falcon Rd. / Mt. Falcon service road
2010	Priority 3 implementation	• Cherokee Rd. • Namba Rd. / Picutis Rd. • Cameyo Rd. • Mount Lindo Rd. • US 285
2011	Coordinate maintenance cycle	• Treatment areas should be assessed and reevaluated for maintenance needs

The proposed prioritization of fuel breaks (Table 13, Map 9) is based on access/egress concern, density of fuels, steepness of slopes, and structure density. Another fuel break project that should be considered is simply mowing 20-foot swaths around some to the grassy areas between neighborhoods, including:

- Along each side of Lane Ranch
- Between Isoleta Rd. and Nampeyo Rd

Area Treatments of Hazardous Fuel: Wildfires frequently burn across jurisdictional boundaries. As such, hazardous fuels management must be coordinated across jurisdictions and ownership boundaries. The objectives of these vegetative treatments are to reduce buildup of hazardous fuels to reduce fire intensity, rates of spread, and crown fire initiation and propagation. These efforts can increase the efficacy of fire suppression efforts as well as return ecosystems to a healthier and less combustible status.

Hazardous fuels, such as those classified as FRCC 2 or 3 (Map 8), should be managed and restored to less volatile conditions. This may occur by breaking up fuel continuity and reducing fuel load thereby facilitating fire suppression and prescribed fire. Invasive and noxious weedy vegetation also contribute to fuel hazards. Integrated weed management programs will reduce this fuel hazard around and within communities and improve the health of plant communities. The seeding of native grasses and forbs on highly disturbed sites could be beneficial.

Large-scale fuel treatments are subject to a number of hurdles, including: funding, lack of public understanding, environmental impact, and ownership issues. Due to these issues, it can be unrealistic to schedule these projects prematurely. Rather, these projects are prioritized without specific dates. Much of the undeveloped land on which these area treatments are recommended occur on public lands or lands held by a few owners, potentially easing some of the ownership complications. Treatments on Jefferson County Open Space and Denver Mountain Parks lands will have to be planned in the context of larger strategic needs throughout the county. Likewise, efforts on private lands will need to be coordinated with owners' stewardship plans. The Geneva Glen Camp is located on approximately 480 acres and is currently treating 10 acres a year. The Leprino property is several hundred acres and has a forest stewardship plan that is being implemented.

Ten forest thinning projects are prioritized into three categories based on hazard to the Indian Hills Community (Table 14). Priority one projects are those that have already been planned or initiated. Priority 2 projects build upon high priority shaded fuel breaks. Priority 3 projects involve county open space projects that have been considered for future implementation. Additional projects should be considered by public land managers in the area, including grasslands maintenance and restoration, management of shrublands, additional forest stewardship treatments, and prescribed fire in support of the aforementioned.

Table 14. Recommended Area Treatment Project Priorities

Priority	Project	Description
1	Geneva Glen Camp (underway)	South of Santa Clara Rd. and along Camp Service Rd. Project currently underway at 10 acres/ yr. Seek funding support to accelerate project.
	Point 7601	The north side of point 7601at the end of Wiesshorn Rd. This lies on the Leprinos' land is planned for implementation in the near future.
2	Osage Rd.	Expand shaded fuel break into an area treatment south of the road.
	South Shawnee	Fuels on steep slope between Shawnee Rd. and Salugi Rd.
	North Shawnee	Fuels surrounding Adahi Rd.
	Inca Rd.	Expand shaded fuel break into an area treatment south of Inca Rd.
3	Salugi Rd.	Treatment of fuels south of Salugi Rd.
	Falcon Wing	Thin the stand between Falcon Wing Rd. and Mt. Falcon Rd.
	Mount Falcon	Expand shaded fuel break along the service road into a area treatment in the stand downslope to the the north. Combine with prescribed fire in the meadow to the south of the service road.

There are a variety of tools available for hazardous fuel treatments including prescribed fire, mechanical treatments, hand crews, herbicides, livestock grazing, or a combination of the above. Specific planning is needed for each treatment area to determine the best ecological and economical approach. Treatments will depend on fuel location, terrain, spatial extent, proximity to values at risk, and fuel attributes. Hazardous fuels management will potentially result in large amounts of woody plant materials that will need to be disposed. Appropriate disposal practices will depend on the amount of woody material generated and they may include spreading the debris over a large area, burning, chipping and spreading, or burying in a landfill facility. Economical use of the woody debris such as small-diameter wood products or biomass energy production should be explored. Post-treatment management, such as mulching and seeding native grasses, may be necessary to ensure that a productive plant community will establish and not weeds. Post treatment monitoring will determine the need for additional management.

Access: Indian Hills is fortunate to have a large number of roads built in loop systems. This provides multiple ingress/egress options and can negate the need for fire apparatus to turn around on narrow roads. Most of the homes in Indian Hills have relatively rapid access to Parmalee Gulch Road or US Highway 285, each of which affords two directions of evacuation.

The creation of shaded fuel breaks along roadways will enhance the tenability of theses routes. There is also a need to improve turnarounds on several of the longer dead-end roads. These turnarounds should be present at least every 1,000 feet. They should be adequate to accommodate fire apparatus and should conform to a recognized standard such as the International Fire Code or NFPA standards. Private landowners need to assess their own driveways and private roads to determine the need for action.

There are several dead-end roads that should be evaluated for possible extension to secondary access points (Table 15). In the event of a large incident, multiple pieces of heavy fire apparatus will be responding at the same time that residents are attempting to evacuate. Even a well maintained two-track road available only for emergency use will prove a significant safety enhancement to these areas for residents and firefighters alike. As with area fuels treatment, issues of ownership, costs, potential environmental impacts, and engineering needs will necessitate a more thorough study on a project level. Several of these suggested routes will mutually benefit adjacent communities and will require inter-community cooperation. As such, scheduling a specific timeline for these projects is premature at this point.

Table 15. Recommended Ingress/Egress Projects

Project	Location
Fire Apparatus Turnarounds	• Shawnee Rd. / Salugi Rd. / Adahi Rd. • Cameyo Rd. • Raven Crest • Brookmont Rd. • Algonquin Rd. • Ute Rd. / Sioux Rd.
Emergency ingress/Egress Routes	• Wyandotte to Brookmont • Geneva Glen service road to Brookmont or Lone Pine area • Shawnee Rd. to Lone Peak area • Cameyo Rd. to Sioux Rd or 5200 Parmalee Gulch Rd.

Table 16. Master Schedule of Proposed Projects

Year	Project	Actions
2007	Annual spring outreach	• Community meeting with presenter • Educational materials distribution
	Annual spring mitigation (Defensible Space)	• Basic yard clean-up and disposal
	Begin shaded fuel break coordination	• Engage landowners • Secure funding • Line-up contractors
2008	Annual spring outreach	• Community meeting with presenter • Educational materials distribution
	Annual spring mitigation (Defensible Space)	• Understory thinning near structures
	Initiate Shaded fuel break treatments	• Santa Clara Rd. • Shawnee Rd. / Salugi Rd. • Osage Rd. / Taos Rd. • Raven Crest area
	Plan priority 2 shaded fuel breaks	• Engage landowners • Secure funding • Line-up contractors
	Initial ingress/egress evaluation	• Determine if emergency ingress/egress routes can be developed using existing two tracks • Implement as practicable
2009	Annual spring outreach	• Community meeting with presenter • Educational materials distribution
	Annual spring mitigation (Defensible Space)	• Understory thinning on private property near roads and in drainages
	Implement priority 2 shaded fuel breaks	• Parmalee Gulch Rd. • Inca Rd. • Mt. Falcon Rd. / Mt. Falcon service road
	Plan priority 3 shaded fuel breaks	• Engage landowners • Secure funding • Line-up contractors
	Begin area treatment planning	• Develop plan for implementation of area treatments commencing in 2011
	Comprehensive ingress/egress plan	• Evaluate need and practicability for creating turnarounds and emergency access routes
2010	Annual spring outreach	• Community meeting with presenter • Educational materials distribution
	Annual spring mitigation (Defensible Space)	• Overstory treatments on private property

Year	Project	Actions
	Implement priority 3 shaded fuel breaks	• Cherokee Rd. • Namba Rd. /Picutis Rd. • Cameyo Rd. • Mount Lindo Rd. • US 285
	Ingress/egress implementation	• Initiate implementation as planned
2011	Annual spring outreach	• Community meeting with presenter • Educational materials distribution
	Annual spring mitigation (Defensible Space)	• Restart defensible space treatment cycle
	Implement first area treatment	• Implement as practicable
	Continue ingress/egress implementation	• Implement as planned

5.3 Treatment Options

Each of the recommended fuel mitigation projects can be achieved by a variety of methods (Table 17). 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. Costs can vary tremendously, but generally run $300 to $1,200 per acre depending upon:

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

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 Options

Treatment	Estimated Cost	Comments
Machine Mowing	$90 - $200 / acre	• Appropriate for large, flat grassy areas on relatively flat terrain
Prescribed Fire	$100 - $125 / acre	• Can be very cost effective • Ecologically beneficial • Can be used as training opportunities for firefighters • May require manual or mechanical pre-treatment • Carries risk of escape which may be unacceptable in some WUI areas ▪ Must comply with CAPCD smoke management policy • Unreliable scheduling due to weather and smoke management constraints
Brush Mastication	$300 - $500 / acre	• Brush species (Gamble oak in particular) tend to resprout vigorously after mechanical treatment • Follow-treatment with herbicides, fire, grazing, or further mechanical treatments are typically necessary • Mastication tends to be less expensive than manual (chain saw) treatment and eliminates disposal issues
Timber Mastication	$300 - $1200 / acre	• Materials up to 10” in diameter and slopes up to 30% can be treated • Eliminates disposal issues

Treatment	Estimated Cost	Comments
		• Environmental impact of residue being left on-site are still under study
Manual Treatment with Chipping or Pile Burning	$300 - $1200 / acre	• Allows for removal of merchantable materials or firewood in timber • Requires chipping, hauling, pile burning of slash • Must comply with CAPCD smoke management policy
Feller Buncher	$750 and up / acre	• Mechanical treatment on slopes over 30% or of materials over 10" in diameter may require a feller buncher rather than a masticator • Costs tend to be considerably higher than masticator • May allow for removal of merchantable material

5.4 Supporting Projects

Several of the recommended actions will require more extensive study and the cooperation of entities outside of the Indian Hills Community. These are important issues that are integral to the CWPP. They should not be foregone merely because of their complexity.

Funding and Grants: Grant support may be able to accelerate treatment on larger private holdings and along roads as well as disposal. In addition to close coordination with the Jefferson County Office of Emergency Management, an excellent resource for finding grants is www.rockymountainwildlandfire.info.

Ingress/Egress Improvements: The proposed work on roadways will require further study with regards to engineering and environmental issues. These efforts may also be subject to the consent of adjacent land owners. Tenable escape routes are elemental to community wildfire safety. This issue must be examined further.

Public Land Planning: The United States Forest Service, Denver Water Board, Jefferson County Open Space, and Denver Mountain Parks all manage forested wildlands in and around Jefferson County and the IHFPD. The CWPP development process is designed to facilitate dialog with these agencies and coordinate public and private wildfire and forest management strategies. As the CWPP strategic plan is implemented, dialog and collaboration should be maintained with these agencies in order to coordinate strategies and treatments, and make adjustments if necessary.

Regulatory Actions: One of the major issues confronting defensible space and hazardous fuels mitigation is the need for maintenance. While county statutes require defensible space for new construction, there is no requirement for maintenance and no retroactive regulation for existing structures. For defensible space to be consistently successful some regulatory impetus may be necessary. Jefferson County should examine the options for requiring the maintenance of defensible space. This could be associated with the sale of a home or based on time since initial treatment. Those communities with local statutes or covenants should consider similar regulation as an interim step and to help drive the initiative from the bottom up. This is a public safety issue where failure to

maintain one's property can create a hazard for firefighters, adjacent properties, and the community.

5.5 Need for Action

Wildfire occurrence in Jefferson County is common. Ignition usually results from natural causes, although human-caused fire potential is high. Steep terrain, large areas of continuous fuels, and frequent high fire danger weather conditions make wildfire a significant concern in this area, as substantiated by recent large fires.

Both general and specific actions are needed to mitigate wildfire risk, improve forest and open space health, and enhance vegetative diversity. Mitigation of hazardous conditions, prevention of unwanted fires, and effective response to fires once ignited must all be addressed to ensure safety of the community.

6 EMERGENCY OPERATIONS

6.1 Wildfire Response Capability and Recommendations

Response
IHFPD maintains eight emergency vehicles out of a single station in the Upper Indian Hills area. Of the 25 volunteer firefighters in the department, eight are trained as wildland firefighters. The IHFPD fleet includes:

- 1 AWD Engine
- 1 Single Axle Drive Engine
- 1 AWD Type-6 Engine
- 1 1000 gal AWD Tender
- 1 Command Vehicle
- 2 4x4 Ambulances
- 1 All Terrain Vehicle

Even if all eight trained wildland firefighters area available to respond to an incident, their suppression capabilities will be stretched thin on any but the smaller wildfires. Mutual aid is an essential element to the effectiveness of rural fire departments.

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 (National Wildfire Coordinating Group Fireline Handbook 2004) with predicted fire spread under 50th percentile weather conditions. These are much generalized figures provided to illustrate the potential gap between potential fire behavior and available suppression resources.

Table 18. Wildland Fire Production Rates

Wildland Fire Production Rates Per Hour Using Type-6 Engine (3 firefighters)		
Anderson Fire Behavior Fuel Model	**Fireline Production Rate Chains / hr**	**Predicted Fire Spread Under Average Conditions in Chains / hr**
1 Short Grass	24	62
2 Short grass with scattered shrubs or open timber	15	26
6 Shrubs under 6 ft. tall – Brush	12	30
8 Closed timber litter	15	2
10 Closed timber with heavy dead and down woody debris	12	7
Wildland Fire Production Rates Per Hour Using Type-6 Engine (5+ firefighters)		
1 Short Grass	40	62
2 Short grass with scattered shrubs or open timber	25	26
6 Shrubs under 6 ft. tall – Brush	20	30
8 Closed timber litter	24	2
10 Closed timber with heavy dead and down woody debris	20	7

The structure protection 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 Engines		
Firefighters	**Rates**	**Total per hour**
3	30 minutes/structure	2
4	20 minutes/structure	3

Mutual Aid

The district participates in the Jefferson County Resource Groups. These groups are pre-organized task forces used for structure protection or a squad for a hand crew. There is also a county wide mutual aid agreement between the FPDs. All Incident Commanders (IC) and District Chiefs are authorized to request Mutual Aid from participating agencies. Inter-Canyon FPD and Evergreen FPD provide the most proximate mutual aid, and IHFPD reciprocates when resources are not committed to in-district incidents. Additional support for wildfires may be provided by the local CSFS or USFS districts. Major incidents will receive assistance from the entire Front Range Area or across the nation in extreme situations such as the Hayman Fire.

Recommendations:

Wildland Fire Attack

Correlating predicted fire behavior with Wildland Fire Production Rates, IHFPD will have difficulty suppressing fires other than surface fire in timber. It should be remembered that line production capability must be at least twice as great as predicted rate of spread to affect suppression on two flanks of the fire. These numbers are merely predictions made by models, but they illustrate the importance of mutual aid and pre-existing fuel breaks.

- Staffing – Volunteer firefighters should be commended for their devotion to such a difficult job. That said, staffing is a real issue for most volunteer fire departments. Recommendations include:
  - Ensure volunteers are notified and their availability tracked on high fire danger days.
  - Increase the number of wildland trained firefighters. Use the CWPP process and spring defensible space drives as a recruiting opportunity.
  - Explore alternatives for additional resources during extend periods of severity, such as having the county, CSFS, or coalition of FPDs sponsor a staffed severity engine.
- Equipment: Water Tender – Planning should commence for scheduling replacements for the CSFS owned water tender and the type-6 engine.

- Training – Wildland training needs should be assessed and class coordinated with cooperators. A regularly scheduled NWCG class rotation coordinated at the county level should be considered.

Initial Attack
The following are recommended service levels for IHFPD:

- IHFPD will have a minimum of a three-person wildland engine enroute within 30 minutes of the initial smoke report.
- The IHFPD will be able to meet NWCG line production standards.
- IHFPD will use direct fire attack whenever possible to stop the fire prior to the need to perform indirect structural protection.
- IHFPD will have a procedure for assuming a "command only" posture when the initial response is inadequate to address the fire behavior effectively.

Extended Attack
Continued cooperation and coordination amongst cooperators will be essential for effective extended attack in the Indian Hills area. Actions that will improve the effectiveness of extended attack include:

- IHFPD will be able to effectively transfer command to the local type 3 Incident Management Team (IMT).
- IHFPD will have adequate maps and run books to support the local type 3 IMT.
- IHFPD should engage in interagency trainings for the management of extended wildland incidents.

6.2 Emergency Procedures and Evacuation Routes

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

Before residents leave, they should take every precaution to reduce the chance of structure loss as time allows. Human safety is the number one concern in an evacuation. Action could include thoroughly irrigating the defensible space, watering down the roof, and removing all debris from rain gutters. Remove all flammable materials 30 feet or more 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 return. Embers may lodge in small cracks and crevices and smolder for several days before flaming.

Evacuations should be a fairly straight forward matter in the Indian Hills; get to Parmalee Gulch and drive away from the fire. Nevertheless the issue as to whether detailed community evacuation plan is needed should be addressed by the Core Team with public input. Evacuation plans for the elementary school and Geneva Glen camp are reviewed annually by the fire chief. An animal evacuation plan or community safety zone for animals should be considered.

7 INDIAN HILLS CWPP MONITORING AND EVALUATION

7.1 CWPP Plan Adoption

A meeting was convened on December 7, 2006 at the IHFPD fire station to present the Indian Hills CWPP to the Core Team, fire authorities, stakeholders, and public. The draft CWPP will be posted on Jefferson County's website to allow public review and response. A three-week public response period occurred before the CWPP was finalized and presented to the Core Team.

The IHFPD 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 authorities for CWPP require adoption of this plan, as does the FEMA Disaster - Mitigation Act of 2000. With formal adoption of this plan by the Core Team, Jefferson County, and CSFS, the IHFPD will be competitive for hazardous fuels and non-fuels mitigation funding that may assist with plan implementation. Furthermore, adoption of this plan highlights the partnerships among fire stations, local government, community-based organizations, and public agencies.

7.2 Sustaining CWPP Efforts

Implementing and sustaining the CWPP is key to success. This ultimately is the responsibility of the CWPP stakeholders. The CWPP process encourages citizens to take an active role as fuel treatment strategies are developed and prioritized. Once the plan is finalized, however, it's stakeholder ownership that really drives the action plan. The magnitude of the wildfire risks and hazards facing the IHFPD is significant and any effective reduction requires on-going commitment and collaboration to implement the treatments recommended in this CWPP.

The IHFPD is committed to supporting fire protection and emergency services within the district and surrounding areas. It is important that the district continue to provide support in maintaining risk assessment information and emergency management coordination. Stakeholders will implement recommended actions by working with fire authorities, community organizations, private landowners, and public agencies to coordinate hazardous fuels management and other mitigation projects.

7.3 CWPP Oversight, Monitoring and Evaluation

Stakeholders will be responsible for CWPP monitoring and evaluation through regular meetings, public involvement and coordination with IHFPD, 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 overtime in a way that will determine if the CWPP goals and objectives are being obtained (Table 20).

Table 20. Monitoring and Evaluation Tasks

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

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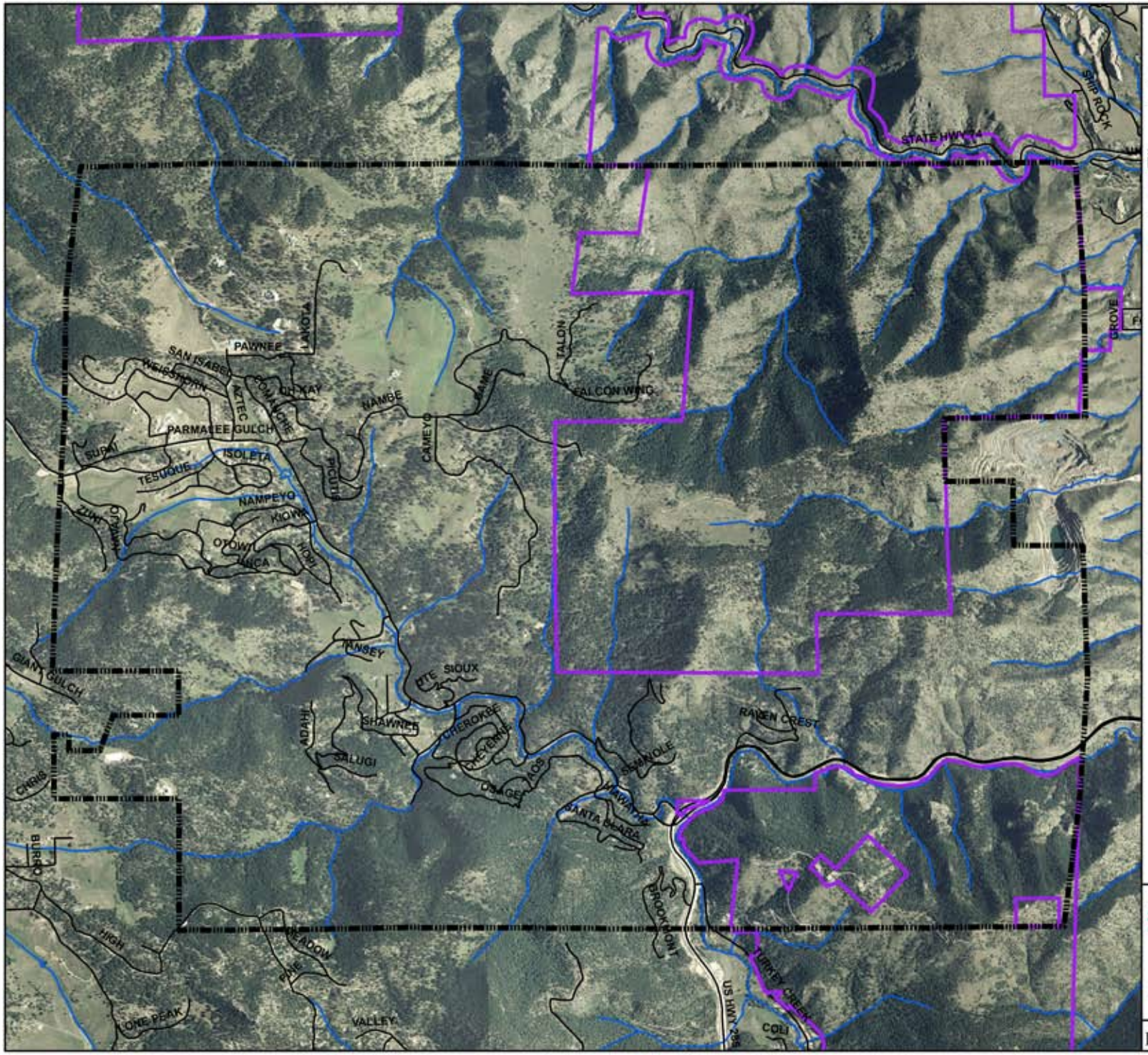
APPENDIX A
MAPS



Indian Hills Fire Protection District Jefferson County, Colorado

CWPP Assessment Area
Open Space
Roads
Streams

Map Source: NAPP 2004

0 0.1 0.2 0.4 0.6
Miles

N W E S

Walsh
an ecology and environment company

Map 1
Assessment Area Overview

Proj # 7404	Date: 1/2007

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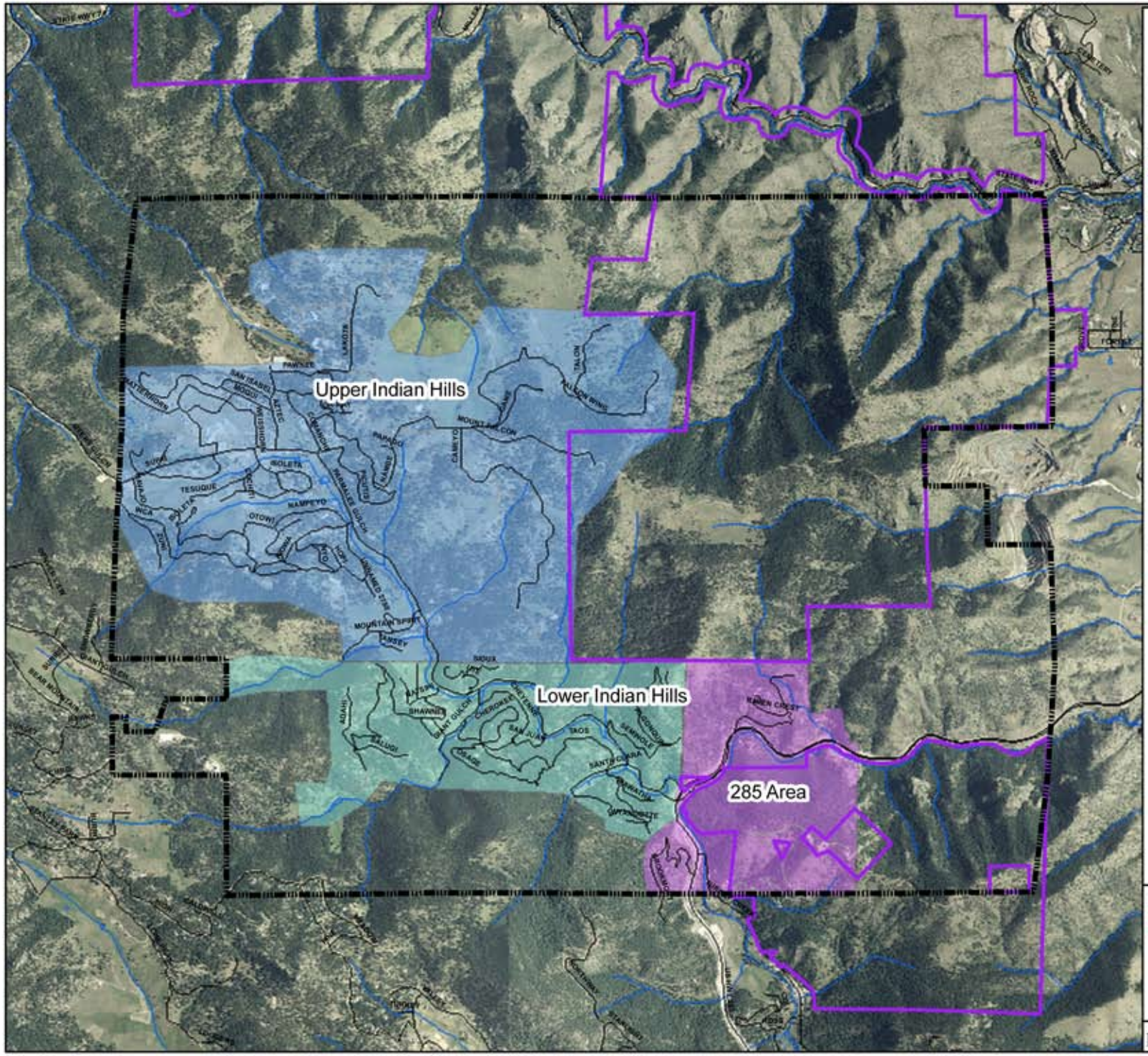

Indian Hills Fire Protection District Jefferson County, Colorado

CWPP Assaessment Area
Open Space
Roads
Streams

0 0.1 0.2 0.4 0.6
Miles

N
W E
S

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Map 2
Communities Map

Proj # 7404	Date: 1/2007

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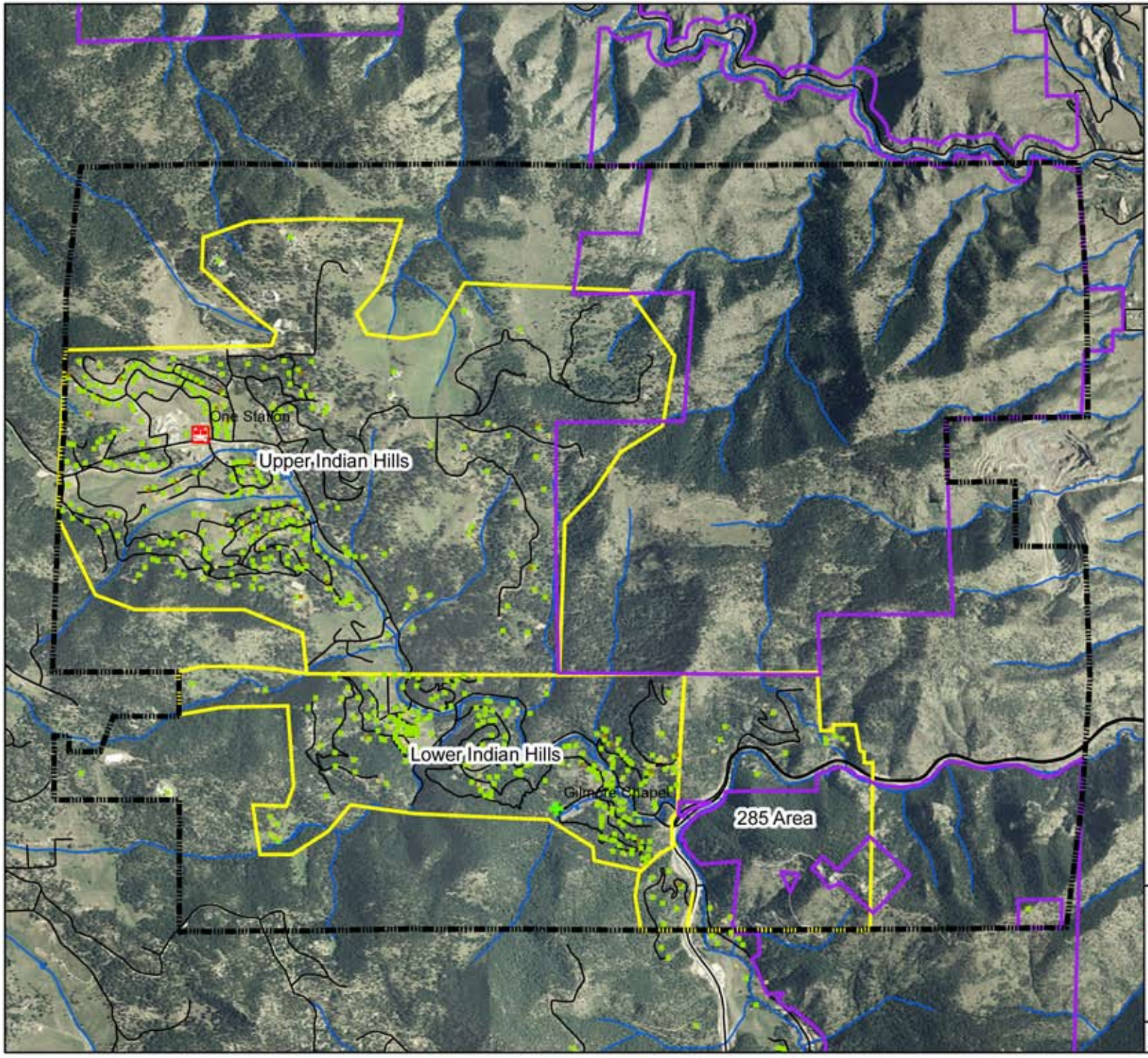

Indian Hills Fire Protection District Jefferson County, Colorado

CWPP Assessment Area
Open Space

Structures
- House
- Garage
- Out Building

Institutions
- School
- Church
- Cementary
- Fire Station

Roads
Streams

0 0.1 0.2 0.4 0.6
Miles

N W E S

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Map 3
Community and Fire Infrastructure

Proj # 7404 | Date: 1/2007

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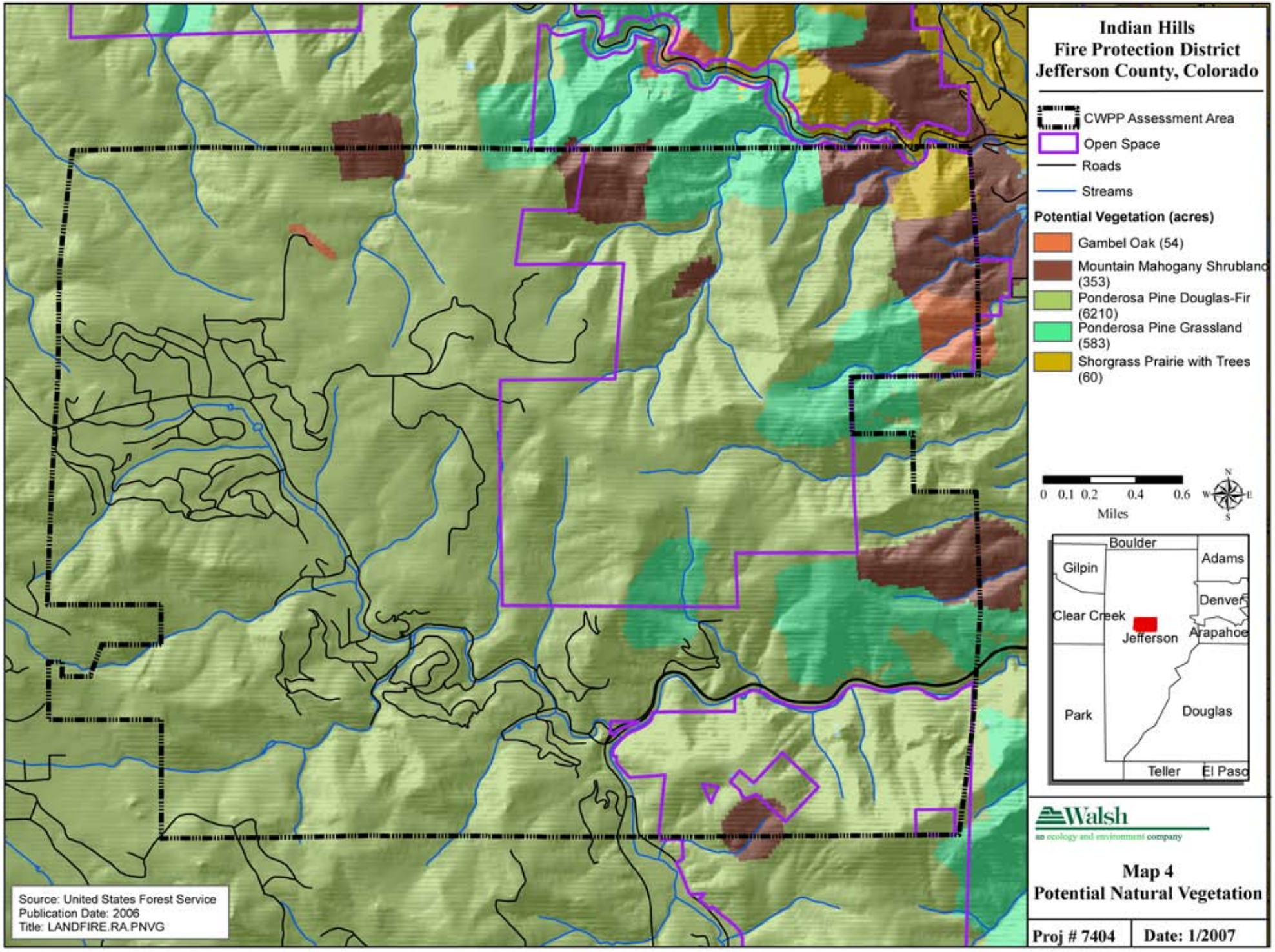
Indian Hills
Fire Protection District
Jefferson County, Colorado
CWPP Assessment Area
Open Space
Roads
Streams
Potential Vegetation (acres)
Gambel Oak (54)
Mountain Mahogany Shrubland (353)
Ponderosa Pine Douglas-Fir (6210)
Ponderosa Pine Grassland (583)
Shorgrass Prairie with Trees (60)
0 0.1 0.2 0.4 0.6
Miles
N
W
E
S
Boulder
Gilpin
Adams
Denver
Clear Creek
Jefferson
Arapahoe
Park
Douglas
Teller
El Paso
Source: United States Forest Service
Publication Date: 2006
Title: LANDFIRE.RA.PNVG
Walsh
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Map 4
Potential Natural Vegetation
Proj # 7404
Date: 1/2007
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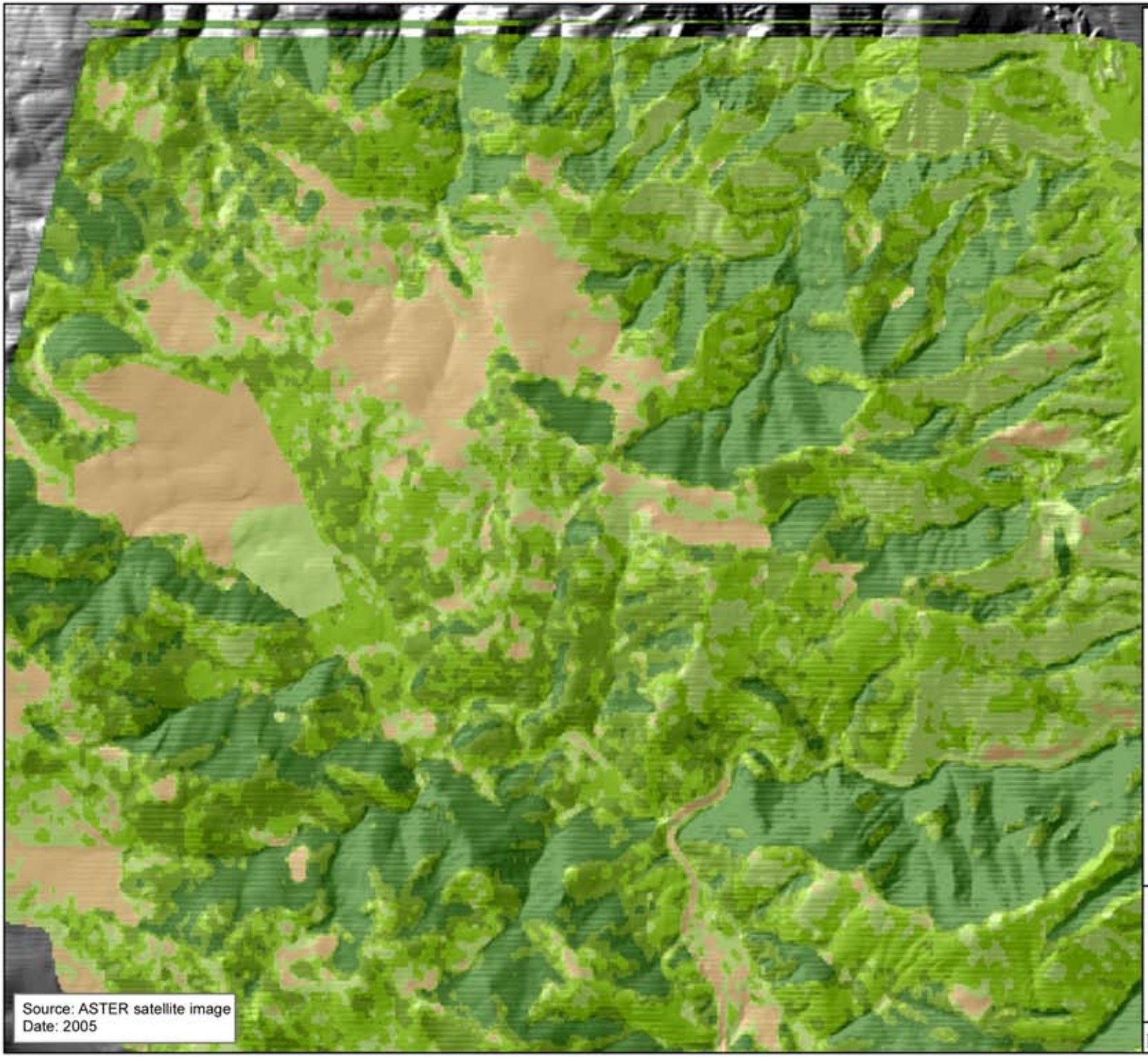

Indian Hills Fire Protection District Jefferson County, Colorado

- CWPP Assaessment Area
- Open Space
- Roads
- Streams

Vegetation Type

- High density timber (1961)
- Medium density timber (1604)
- Mixed timber shrubs grass (1889)
- Grass and shrubs (1168)
- Grass \low cover (638)

0 0.1 0.2 0.4 0.6
Miles

N W E S

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Map 5
Existing Vegetation (ASTER)

Proj # 7404	Date: 1/2007

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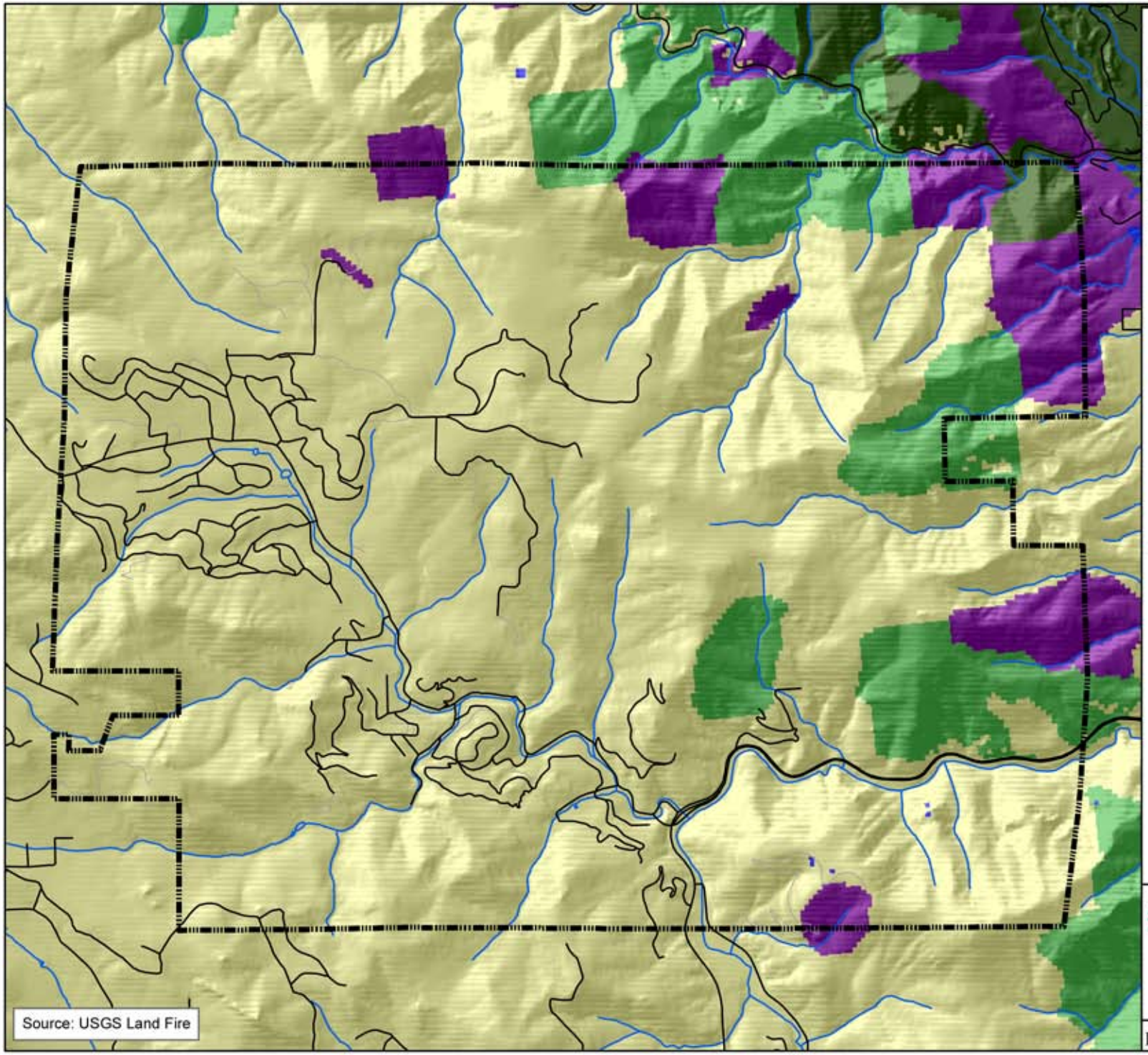

Indian Hills Fire Protection District Jefferson County, Colorado

CWPP Assaessment Area
Roads
Streams

Historic Fire Regimes

- 0-35 year frequency; low and mixed severity
- 0-35 year frequency; replacement severity
- 35-200 year frequency; low and mixed severity
- 35-200 year frequency; replacement severity

0 0.1 0.2 0.4 0.6
Miles

N
W E
S

Walsh
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Map 6
Historical Fire Regimes

Proj # 7404	Date: 1/2007

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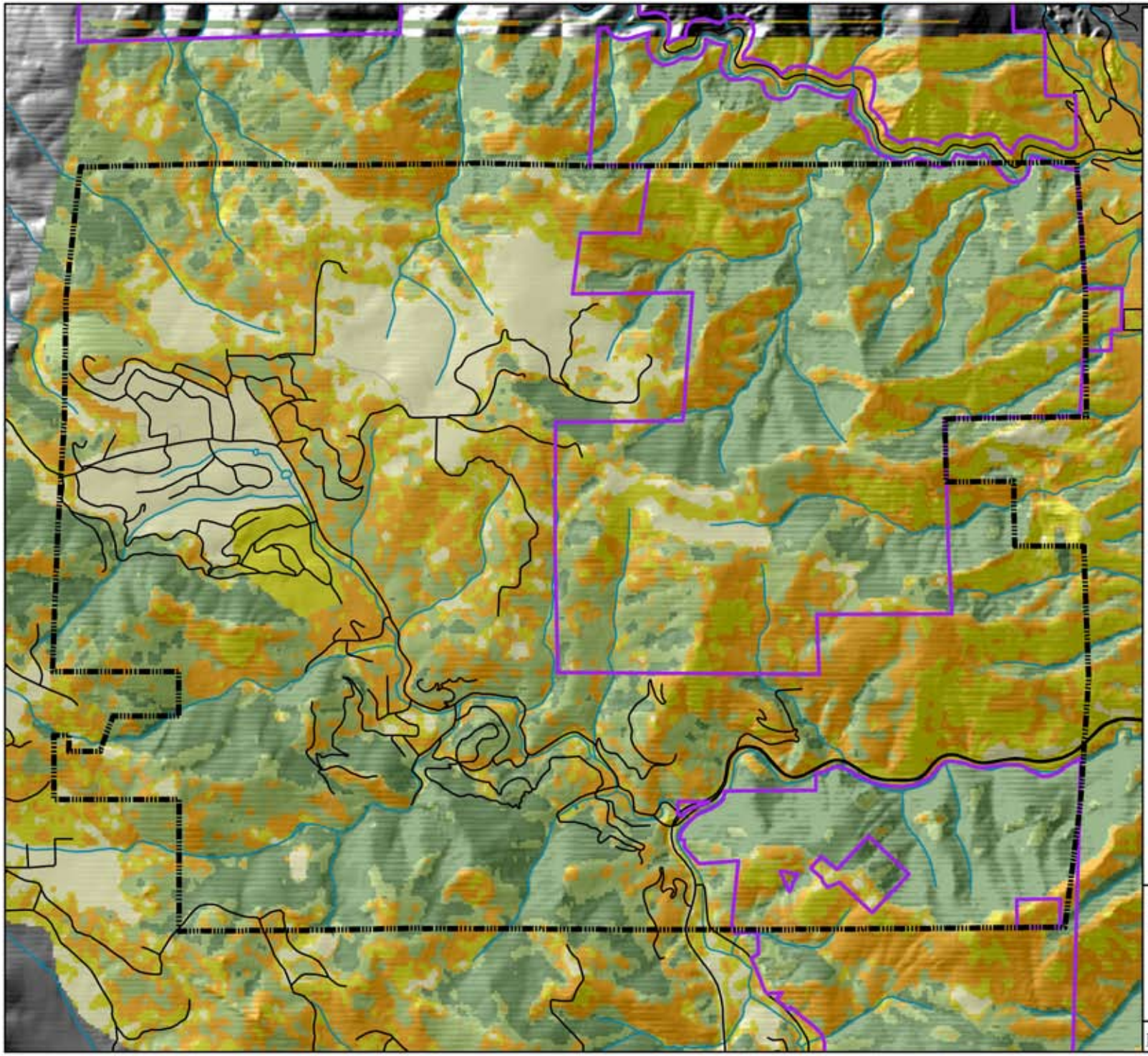

Indian Hills Fire Protection District Jefferson County, Colorado

CWPP Assessment Area
City Boundary
Open Space
Roads
Streams

Fire Behavior Fuel Model (acres)

FBFM 10 Timber with Heavy Understory (1961)
FBFM 9 Long Needle (1604)
FBFM 6 Intermediate Brush (1889)
FBFM 2 Grass with Timber (1168)
FBFM 1 Short Grass (638)

0 0.1 0.2 0.4 0.6
Miles

N
W E
S

Boulder
Gilpin
Adams
Denver
Clear Creek
Jefferson
Arapahoe
Park
Douglas
Teller
El Paso

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Map 7
Fire Behavior Fuel Model

Proj # 7404 | Date: 1/2007

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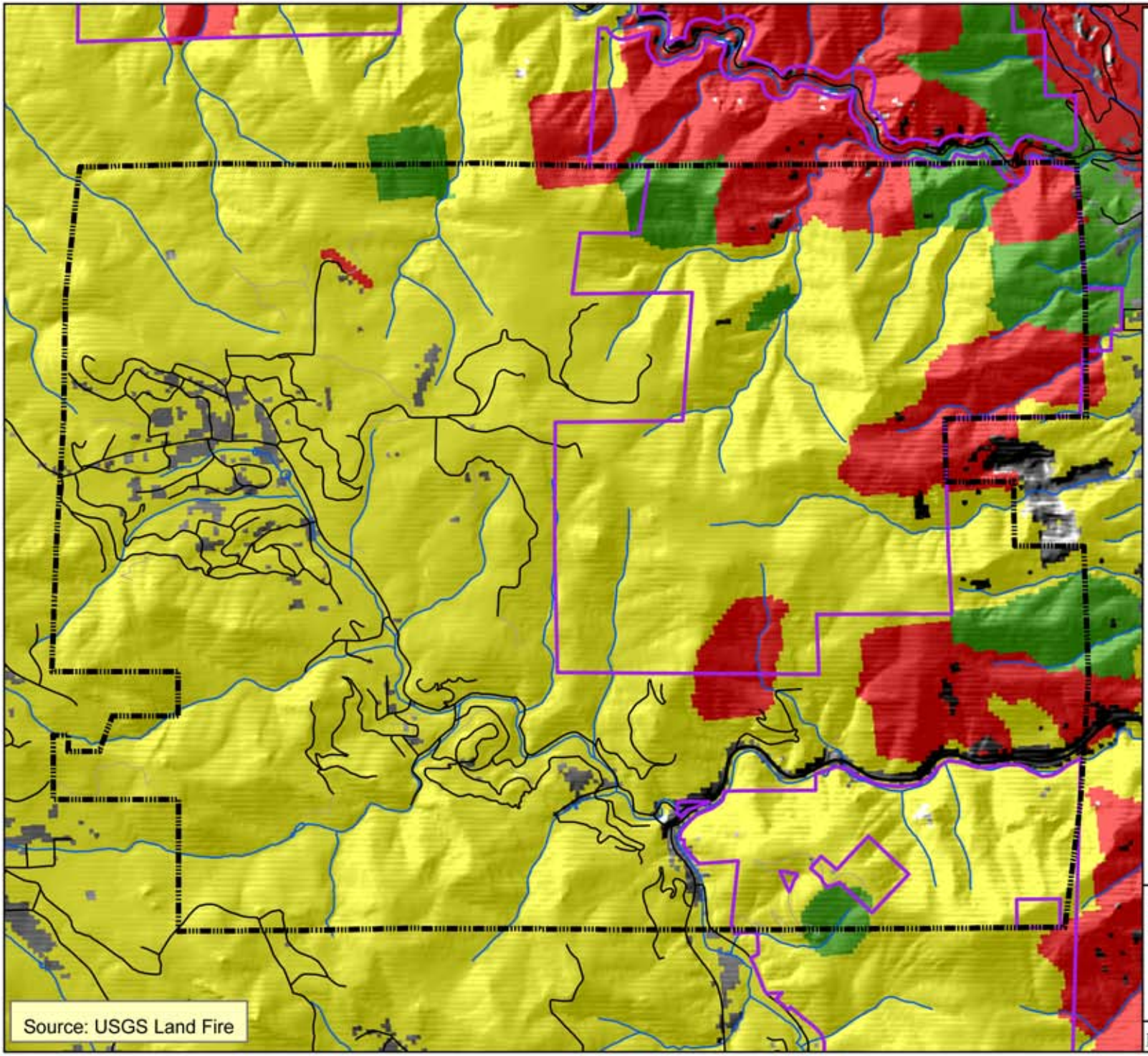

Indian Hills
Fire Protection District
Jefferson County, Colorado

CWPP Assessment Area
Roads
Streams
Open Space

FRCC (acres)
Class 1 (351)
Class 2 (6034)
Class 3 (683)

0 0.1 0.2 0.4 0.6
Miles

N
W E
S

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Map 8
Fire Regime
Condition Class

Proj # 7404	Date: 1/2007

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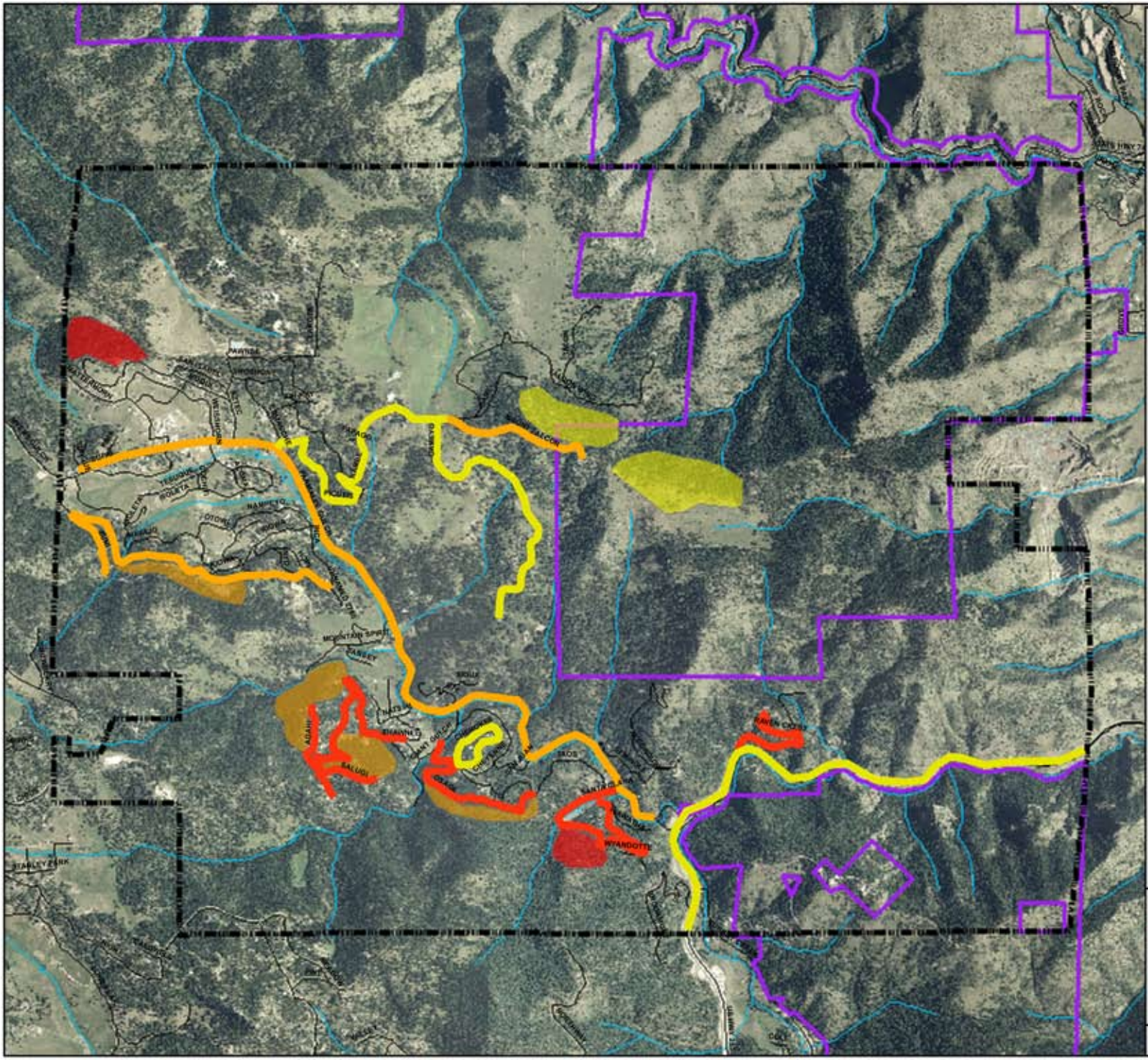

Indian Hills Fire Protection District Jefferson County, Colorado

CWPP Assessment Area
Open Space
Roads
Streams

Proposed Fuel Treatments

Priority

1
2
3

Proposed Fuel Breaks

2008
2009
2010

0 0.1 0.2 0.4 0.6
Miles

N
W E
S

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Map 9
Fuel Treatment Areas

Proj # 7404	Date: 1/2007

7404_cwpplIC_maps.mxd

Map A1

3063000 3066000 3069000 3072000

1663000 1660000 1657000

A2 B1 B2

PAWNEE
LAKOTA
FALCON WING
GAME
TALON
MATTERHORN
WEISSHORN
MONT BLANC
SAN ISABEL
MOGUL
AZTEC
SHOSHONE
CHEYENNE
Upper Indian Hills
NAMBE
MOUNT FALCON
CAMEYO
PARACHO
One Station
PARMALEE GULCH
MYERS GULCH
TONGUE
PIMA
SUPAI
TESUQUE
COCHITI
ACOMA
ISOLETA
PICURIS
NAVAJO
HOPI
ZUNI
OTOWI
MARICOPA
NAMPEYO
KIOWA
INCA

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0 250 500 1,000 1,500 2,000 Feet

APPENDIX B

NFPA WILDLAND FIRE RISK AND HAZARD SEVERITY ASSESSMENT FORM 1144

WILDLAND FIRE RISK AND HAZARD SEVERITY ASSESSMENT FORM

Assign a value to the most appropriate element in each category and place the number of points in the column on the right.

Element	Points	
A. Means of Access		
1. Ingress and egress		
a. Two or more roads in/out	0	_____
b. One road in/out	7	_____
2. Road width		
a. ≥7.3 m (24 ft)	0	_____
b. ≥6.1 m (20 ft) and <7.3 m (24 ft)	2	_____
c. <6.1 m (20 ft)	4	_____
3. All-season road condition		
a. Surfaced road, grade <5%	0	_____
b. Surfaced road, grade >5%	2	_____
c. Non-surfaced road, grade <5%	2	_____
d. Non-surfaced road, grade >5%	5	_____
e. Other than all-season	7	_____
4. Fire Service Access		
a. ≤91.4 m (300 ft) with turnaround	0	_____
b. >91.4 m (300 ft) with turnaround	2	_____
c. <91.4 m (300 ft) with no turnaround	4	_____
d. ≥91.4 m (300 ft) with no turnaround	5	_____
5. Street signs		
a. Present [10.2 cm (4 in.) in size and reflectorized]	0	_____
b. Not present	5	_____
B. Vegetation (Fuel Models)		
1. Characteristics of predominate vegetation within 91.4 m (300 ft)		
a. Light (e.g., grasses, forbs, sawgrasses, and tundra) NFDRS Fuel Models A, C, L, N, S, and T	5	_____
b. Medium (e.g., light brush and small trees) NFDRS Fuel Models D, E, F, H, P, Q, and U	10	_____
c. Heavy (e.g., dense brush, timber, and hardwoods) NFDRS Fuel Models B, G, and O	20	_____
d. Slash (e.g., timber harvesting residue) NFDRS Fuel Models J, K, and L	25	_____
2. Defensible space		
a. More than 30.48 m (100 ft) of vegetation treatment from the structure(s)	1	_____
b. 21.6 m to 30.48 m (71 ft to 100 ft) of vegetation treatment from the structure(s)	3	_____
c. 9.14 m to 21.3 m (30 ft to 70 ft) of vegetation treatment from the structure(s)	10	_____
d. <9.14 m (30 ft) of vegetation treatment from the structure(s)	25	_____
C. Topography Within 91.4 m (300 ft) of Structure(s)		
1. Slope <9%	1	_____
2. Slope 10% to 20%	4	_____
3. Slope 21% to 30%	7	_____
4. Slope 31% to 40%	8	_____
5. Slope >41%	10	_____

(NFPA 1144, 1 of 2)

Element	Points	
D. Additional Rating Factors (rate all that apply)		
1. Topographical features that adversely affect wildland fire behavior	0–5	_____
2. Areas with a history of higher fire occurrence than surrounding areas due to special situations (e.g., heavy lightning, railroads, escaped debris burning, and arson)	0–5	_____
3. Areas that are periodically exposed to unusually severe fire weather and strong dry winds	0–5	_____
4. Separation of adjacent structures that can contribute to fire spread	0–5	_____
E. Roofing Assembly		
1. Class A roof	0	_____
2. Class B roof	3	_____
3. Class C roof	15	_____
4. Nonrated	25	_____
F. Building Construction		
1. Materials (predominate)		
a. Noncombustible/fire-resistive siding, eaves, and deck (*see Chapter 8*)	0	_____
b. Noncombustible/fire-resistive siding and combustible deck	5	_____
c. Combustible siding and deck	10	_____
2. Building setback relative to slopes of 30% or more		
a. ≥9.14 m (30 ft) to slope	1	_____
b. <9.14 m (30 ft) to slope	5	_____
G. Available Fire Protection		
1. Water source availability		
a. Pressurized water source availability		
1892.7 L/min (500 gpm) hydrants ≤304.8 m (1000 ft) apart	0	_____
946.4 L/min (250 gpm) hydrants ≤304.8 m (1000 ft) apart	1	_____
b. Nonpressurized water source availability (off site)		
≥946.4 L/min (250 gpm) continuous for 2 hours	3	_____
<946.4 L/min (250 gpm) continuous for 2 hours	5	_____
c. Water unavailable	10	_____
2. Organized response resources		
a. Station ≤8 km (5 mi.) from structure	1	_____
b. Station >8 km (5 mi.) from structure	3	_____
3. Fixed fire protection		
a. NFPA 13, 13R, 13D sprinkler system	0	_____
b. None	5	_____
H. Placement of Gas and Electric Utilities		
1. Both underground	0	_____
2. One underground, one aboveground	3	_____
3. Both aboveground	5	_____
I. Totals for Home or Subdivision (Total of all points)		

Hazard Assessment	Total Points
Low hazard	<40
Moderate hazard	40–69
High hazard	70–112
Extreme hazard	>112

(NFPA 1144, 2 of 2)

APPENDIX C

COMMUNITY/NEIGHBORHOOD/SUBDIVISION HAZARD AND RISK SURVEY METHODOLOGY

1) The district was divided into assessment areas based on access and similarity of fuel, infrastructure, and construction characteristics.

2) Each assessment area was divided into neighborhoods.

3) Each neighborhood was rated using the NFPA 1144 Wildland Fire Risk and Hazard Severity Assessment Form. The rating assigned represents the average conditions for the neighborhood.

4) Road widths were measured where necessary.

5) Road grades and slopes were determined from GIS maps and field checked.

6) Fuel models were determined by satellite imagery interpretation and field checked. Photographs were used to double check field assessments and provide a baseline record. While the NFPA form refers to NFDRS fuel models the corresponding FBPS fuel models are:

Light	1, 2, 3
Medium	5, 6, 7, 8, 9
Heavy	4, 10
Slash	11, 12, 13

7) When fuel or defensible space conditions in a neighborhood were best represented by two different rating classes, an average was used. For example, when a neighborhood was on the boundary between dense forest (20 points) and light brush (10 points), with approximately half of the homes exposed to each condition, a rating of 15 points was assigned.

8) Ratings for individual neighborhoods were totaled and averaged to arrive at the assessment area rating.

Upper Indian Hills Assessment Area

These neighborhoods are generally at the low end of the high rating. There is a mix of conditions, with homes in the center of the assessment area on flat terrain near light fuels and homes on the periphery closer to timber fuels and slopes. Many homes that are proximate to slopes are at the base of the slopes. Roads are typically narrow and unpaved but with multiple ingress/egress options. Homes are generally constructed of combustible building materials, but very few wood shake roofs are present. The primary recommendation for the homes in this area is to create or improve defensible space..

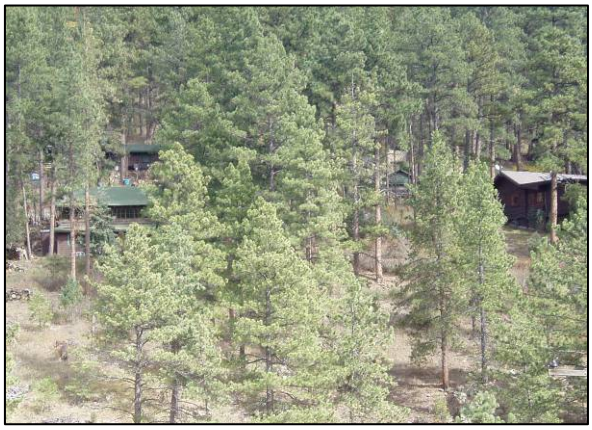
Wildfire Fire Risk and Hazard Severity Form NFPA 1144						
Upper Indian Hills Assessment Area		SW of Parm. Gulch	Alpine Village	NE of Parm. Gulch	Cameyo	Average
Means of Access						
Ingress and Egress	Points					1.75
2 or more roads in & out	0	0	0	0		
One road in & out	7				7	
Road Width						2.50
> 24 ft	0		0			
> 20 ft < 24 ft	2	2				
< 20 ft	4			4	4	
Road Condition						3.00
Surfaced Road, grade <5%	0		0			
Surfaced Road, grade >5%	2					
Non-surfaced Road, grade <5%	2	2				
Non-surfaced Road, grade >5%	5			5	5	
Other than all season	7					
Fire Access						3.00
< 300 ft with turnaround	0		0			
> 300 ft with turnaround	2	2				
< 300 ft with no turnaround	4					
> 300 ft with no turnaround	5			5	5	
Street Signs						2.00
Present - reflective	0					
Present - non-reflective	2	2	2	2	2	
Not present	5					
Vegetation (fuel models)						
Predominant veg						13.75
Light - 1, 2, 3	5		5			
Medium - 5, 6, 7, 8, 9	10	15		15		
Heavy - 4, 10	20				20	
Slash - 11, 12, 13	25					
Defensible Space						12.00
> 100 ft around structure	1					
> 70 ft < 100 ft around structure	3		3			
> 30 ft < 70 ft around structure	10			10	15	
< 30 ft around structure	25	20				

Upper Indian Hills Assessment Area		SW of Parm. Gulch	Alpine Village	NE of Parm. Gulch	Cameyo	Average
Topography Within 300 ft of Structures						
Slope						5.50
< 9%	1					
10% to 20%	4		4	4		
21% to 30%	7	7			7	
31% to 40%	8					
> 41%	10					
Additional Rating Factors (rate all that apply)						
Additional factors						4.00
Topographic features	0-5	1	0	1	2	1.00
History of high fire occurrence	0-5	0				0.00
Severe fire weather potential	0-5	3	3	3	3	3.00
Separation of adjacent structures	0-5	0				0.00
Roofing Assembly						
Roofing						0.00
Class A	0	0	0	0	0	
Class B	3					
Class C	15					
Unrated	25					
Building construction						
Materials (predominant)						10.00
Non-combustible siding, eaves, deck	0					
Non-combustible siding/combustible deck	5					
Combustible siding and deck	10	10	10	10	10	
Building set-back						2.00
> 30 ft to slope	1	1	1	1		
< 30 ft to slope	5				5	
Available Fire Protection						
Water source						3.00
Hydrants 500 gpm < 1000 ft apart	0					
Hydrants 250 gpm < 1000 ft apart	1					
Non-pressurized > 250 gpm/2 hrs	3	3	3	3	3	
Non-pressurized < 250 gpm/2 hrs	5					
Water unavailable	10					
Organized response						1.00
Station < 5 mi from structure	1	1	1	1	1	
Station > 5 mi from structure	3					
Fixed fire protection						5.00
NFPA sprinkler system	0					
None	5	5	5	5	5	
Placement of gas and Electric Utilities						
Utilities						5.00
Both underground	0					
One above, one below	3					
Both above ground	5	5	5	5	5	
						HIGH
Totals for home or subdivision		79	42	74	99	74

Hazard Rating Scale
< 40 LOW
> 40 MODERATE
> 70 HIGH
> 112 EXTREME

Lower Indian Hills Assessment Area

Several of these neighborhoods approach an extreme rating. Ingress/egress is compromixed by narrow, unpaved roads. There are heavy fuels in proximity to most of the homes in this area. Though there are very wood shake roofs, combustible siding and decks are a concern. Slopes in excess of 20% are proximate to many homes. Creation of or improvement of defensible space is the top priority in this area.



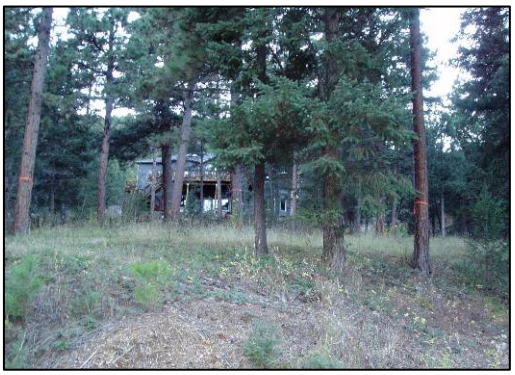
Wildfire Fire Risk and Hazard Severity Form NFPA 1144							
Lower Indian Hills Assessment Area		Santa Clara	Shawnee	Chiquita	Taos	Algonquin	Average
Means of Access							
Ingress and Egress	Points						4.20
2 or more roads in & out	0			0	0		
One road in & out	7	7	7			7	
Road Width							4.00
> 24 ft	0						
> 20 ft < 24 ft	2						
< 20 ft	4	4	4	4	4	4	
Road Condition							2.60
Surfaced Road, grade <5%	0						
Surfaced Road, grade >5%	2						
Non-surfaced Road, grade <5%	2	2		2	2	2	
Non-surfaced Road, grade >5%	5		5				
Other than all season	7						
Fire Access							4.25
< 300 ft with turnaround	0						
> 300 ft with turnaround	2				2		
< 300 ft with no turnaround	4						
> 300 ft with no turnaround	5	5	5			5	
Street Signs							2.00
Present - reflective	0						
Present - non-reflective	2	2	2	2	2	2	
Not present	5						
Vegetation (fuel models)							
Predominant veg							16.00
Light - 1, 2, 3	5						
Medium - 5, 6, 7, 8, 9	10			10		10	
Heavy - 4, 10	20	20	20		20		
Slash - 11, 12, 13	25						
Defensible Space							22.00
> 100 ft around structure	1						
> 70 ft < 100 ft around structure	3						
> 30 ft < 70 ft around structure	10			10			
< 30 ft around structure	25	25	25		25	25	

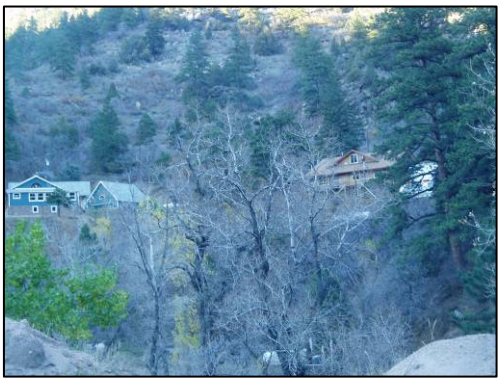
Lower Indian Hills Assessment Area		Santa Clara	Shawnee	Chiquita	Taos	Algonquin	Average
Topography Within 300 ft of Structures							
Slope							6.20
< 9%	1			1			
10% to 20%	4						
21% to 30%	7				7	7	
31% to 40%	8	8	8				
> 41%	10						
Additional Rating Factors (rate all that apply)							
Additional factors							5.40
Topographic features	0-5	4	4	0	1	3	2.40
History of high fire occurrence	0-5	0					0.00
Severe fire weather potential	0-5	3	3	3	3	3	3.00
Separation of adjacent structures	0-5	0					0.00
Roofing Assembly							
Roofing							1.20
Class A	0		0	0	0		
Class B	3	3				3	
Class C	15						
Unrated	25						
Building construction							
Materials (predominant)							10.00
Non-combustible siding, eaves, deck	0						
Non-combustible siding/combustible deck	5						
Combustible siding and deck	10	10	10	10	10	10	
Building set-back							1.80
> 30 ft to slope	1	1		1	1	1	
< 30 ft to slope	5		5				
Available Fire Protection							
Water source							3.00
Hydrants 500 gpm < 1000 ft apart	0						
Hydrants 250 gpm < 1000 ft apart	1						
Non-pressurized > 250 gpm/2 hrs	3	3	3	3	3	3	
Non-pressurized < 250 gpm/2 hrs	5						
Water unavailable	10						
Organized response							1.00
Station < 5 mi from structure	1	1	1	1	1	1	
Station > 5 mi from structure	3						
Fixed fire protection							5.00
NFPA sprinkler system	0						
None	5	5	5	5	5	5	
Placement of gas and Electric Utilities							
Utilities							5.00
Both underground	0						
One above, one below	3						
Both above ground	5	5	5	5	5	5	
							HIGH
Totals for home or subdivision		108	112	57	91	96	93

Hazard Rating Scale
< 40 LOW
> 40 MODERATE
> 70 HIGH
> 112 EXTREME

285 Assessment Area

This area consists of those residents accessed from US highway 285 and includes Brookmont, the El Comar or Raven Crest area, and the Mount Lindo road. Roads are steep and narrow with only a single point of access. The Brookmont road is paved. Fuels are generally dense and terrain is quite steep, often in excess of 40%. Though many homes require improvements to defensible space, there is evidence of an ongoing effort on the Brookmont road.





Wildfire Fire Risk and Hazard Severity Form NFPA 1144					
285 Assessment Area		Brookmont	El Comar	Mt. Lindo	Average
Means of Access					
Ingress and Egress	Points				7.00
2 or more roads in & out	0				
One road in & out	7	7	7	7	
Road Width					4.00
> 24 ft	0				
> 20 ft < 24 ft	2				
< 20 ft	4	4	4	4	
Road Condition					4.67
Surfaced Road, grade <5%	0				
Surfaced Road, grade >5%	2	2			
Non-surfaced Road, grade <5%	2				
Non-surfaced Road, grade >5%	5			5	
Other than all season	7		7		
Fire Access					2.00
< 300 ft with turnaround	0				
> 300 ft with turnaround	2	2	2	2	
< 300 ft with no turnaround	4				
> 300 ft with no turnaround	5				
Street Signs					3.00
Present - reflective	0				
Present - non-reflective	2	2		2	
Not present	5		5		
Vegetation (fuel models)					
Predominant veg					20.00
Light - 1, 2, 3	5				
Medium - 5, 6, 7, 8, 9	10				
Heavy - 4, 10	20	20	20	20	
Slash - 11, 12, 13	25				
Defensible Space					20.00
> 100 ft around structure	1				
> 70 ft < 100 ft around structure	3				
> 30 ft < 70 ft around structure	10	10			
< 30 ft around structure	25		25	25	

285 Assessment Area		Brookmont	El Comar	Mt. Lindo	Average
Topography Within 300 ft of Structures					
Slope					9.33
< 9%	1				
10% to 20%	4				
21% to 30%	7				
31% to 40%	8	8			
> 41%	10		10	10	
Additional Rating Factors (rate all that apply)					
Additional factors					3.00
Topographic features	0-5	3	3	3	3.00
History of high fire occurrence	0-5	0			0.00
Severe fire weather potential	0-5	0			0.00
Separation of adjacent structures	0-5	0			0.00
Roofing Assembly					
Roofing					0.00
Class A	0	0	0	0	
Class B	3				
Class C	15				
Unrated	25				
Building construction					
Materials (predominant)					10.00
Non-combustible siding, eaves, deck	0				
Non-combustible siding/combustible deck	5				
Combustible siding and deck	10	10	10	10	
Building set-back					5.00
> 30 ft to slope	1				
< 30 ft to slope	5	5	5	5	
Available Fire Protection					
Water source					3.67
Hydrants 500 gpm < 1000 ft apart	0				
Hydrants 250 gpm < 1000 ft apart	1	1			
Non-pressurized > 250 gpm/2 hrs	3				
Non-pressurized < 250 gpm/2 hrs	5		5	5	
Water unavailable	10				
Organized response					1.00
Station < 5 mi from structure	1	1	1	1	
Station > 5 mi from structure	3				
Fixed fire protection					5.00
NFPA sprinkler system	0				
None	5	5	5	5	
Placement of gas and Electric Utilities					
Utilities					3.33
Both underground	0	0			
One above, one below	3				
Both above ground	5		5	5	
					High
Totals for home or subdivision		80	114	109	101

Hazard Rating Scale
< 40 LOW
> 40 MODERATE
> 70 HIGH
> 112 EXTREME

APPENDIX D

XXXXXX FIRE PROTECTION DISTRICT QUESTIONNAIRE

Questionnaire
Community Wildfire Protection Plan (CWPP)
Jefferson County

October 2006

Walsh Environmental Scientists and Engineers LLC—under contract with Jefferson County Emergency Management and in collaboration with Colorado State Forest Service and US Forest Service—is developing CWPPs for nine fire protection districts, which have significant wild-land urban interface lands. You can help by providing information and suggestions on your perceptions of wildland fire and potential mitigation projects by responding to the following question:

1. What **community** do you live in or are closest to? (please write in)	
2. How great of **risk** does wildfire pose to your community?	□ Extreme Risk □ Moderate Risk □ Low Risk □ No Risk
3. What areas are at **extreme fire hazard** and pose a risk to homes or property?	□ Forestlands □ Grasslands □ Shrublands □ Juniper Stands □ Other Areas: _____ **Location:**
4. What is the best way to **mitigate or reduce** wildfire hazards?	□ Increase number of fire department personnel □ Reduce vegetation (grasses, trees, etc.) on public lands by controlled burns. □ Reduce vegetation (grasses, trees, etc.) on public lands by mechanical treatments. □ Increase firefighting equipment (more trucks, water tenders, etc.) □ Increase water availability □ Encourage private landowners to reduce fuels and develop defensible spaces around

	structures.
5. What **recent actions** have been taken to reduce the risk of wildfire to your community?	□ None that I am aware of. □ If you know of actions that have been taken, please explain:
6. What **fire education programs** have occurred in your community?	□ None that I am aware of. □ If you know of programs that have occurred, please explain:
7. Is the community **prepared** to combat wildfire?	□ No, if not, why: □ Yes, if so, how come: □ I do not know
8. What **actions** do you think need to be taken to reduce the risk of wildland fire?	
Additional Comments:	

Please provide **contact information** in case we have further questions:

Name	
Address	
Phone	

Please fill out this survey and mail, fax, or email your response to:

Walsh Environmental Jerry Barker 303-443-0367 (fax) 4888 Pearl E. Circle, Suite 108 Boulder, CO 80301-2475 jbarker@walshenv.com	Jeffco Emergency Management Rocco Snart 303-271-4905 (fax) 800 Jefferson County Parkway Golden, CO 80419 rsnart@jeffco.us

APPENDIX E
INDIAN HILLS CWPP QUESTIONNAIRE SUMMARY

Questionnaires were provided at public meetings convened on October 26 and December 7, 2006 at the Indian Hills FPD station. Participants of the meetings were asked to respond to the questionnaire while at the meeting or mail responses at a latter time. Also, in November 2006, the questionnaire was mailed to all Indian Hills residents by the Indian Hills FPD. Twelve questionnaires have been received as of January 3, 2007. The following tables summarize the responses of the 12 questionnaires that were received.

Table 1 Questionnaire Summary

Question		Number of Response
2. How great of risk do wildfires pose to your property and community?	Extreme	10
	Moderate	2
	Low	
	No	
3. What areas do you think are at extreme fire hazard and pose a risk to homes or property?	Forestlands	10
	Grasslands	2
	Shrublands	1
	Juniper	1
	Other	1
4. What do you think would be the best way to mitigate or reduce these hazardous?	Reduce Vegetation	7
	Increase Equipment	
	Increase Volunteers	1
	Develop Defensible Space	9
	Firewise Education	1
	Evacuation Routes	1
	Increase available water	2
5. Do you know of recent actions taken to reduce the risk of wildfires or to protect residents from wildfire spreading from public lands onto private lands or visa versa?	No	7
	Yes	3
6. Have there been recent fire education programs in your community?	No	7
	Yes	3
7. Do you think that the community in which you live is prepared to combat wildfire? (See Table 2 for responses)	No	8
	Yes	
	I do not know	2
8. What actions do you think need to be taken to reduce wildfire risk?	See Table 3 for responses.	

Table 2 Written Responses to Question 7

Comment Number	Number Received	Comment
1	2	Lack of hydrants
2	1	Lack of evacuation routes
3	2	Too many trees
4	1	Isolated communities

Table 3 Summary of Responses to Question Number 8

Comment	Number Received	Comment
1	6	Develop fuels mitigation mandates
2	1	Help senior citizens develop defensible space
3	1	Proactive fire department
4	1	Reduce hazardous fuels

APPENDIX F

FUELBREAK GUIDELINES FOR FORESTED SUBDIVISIONS AND COMMUNITIES

Fuelbreak Guidelines for Forested Subdivisions & Communities

By

Frank C. Dennis

Colorado State Forest Service

Knowledge to Go Places

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

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

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

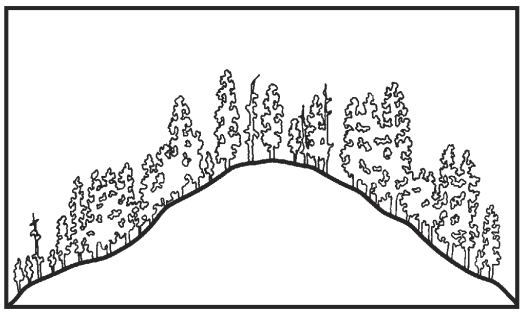
But with development inevitably comes a higher risk of wildfire as well as an ever-increasing potential for loss of life and property. Methods of fire suppression, pre-suppression needs, and homeowner and fire crew safety must all be considered in the planning and review of new developments as well as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

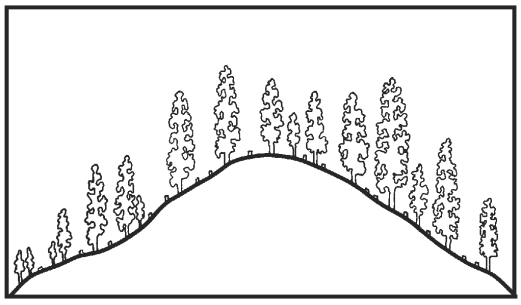
Fuelbreaks should be considered in fire management planning for subdivisions and developments; however, the following are guidelines **only**. They should be customized to local areas by professional foresters experienced in Rocky Mountain wildfire behavior and suppression tactics.

Fuelbreak vs Firebreak

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

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





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

• A fuelbreak (or shaded fuelbreak) is an easily accessible strip of land of varying width (depending on fuel and terrain), in which fuel density is reduced, thus improving fire control opportunities. The stand is thinned, and remaining trees are pruned to remove ladder fuels. Brush, heavy ground fuels, snags, and dead trees are disposed of and an open, park-like appearance is established.

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

Fuelbreak Limitations

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

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

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

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

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

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

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

The Need For A Fuelbreak

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

Potential Problem Indicator

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

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

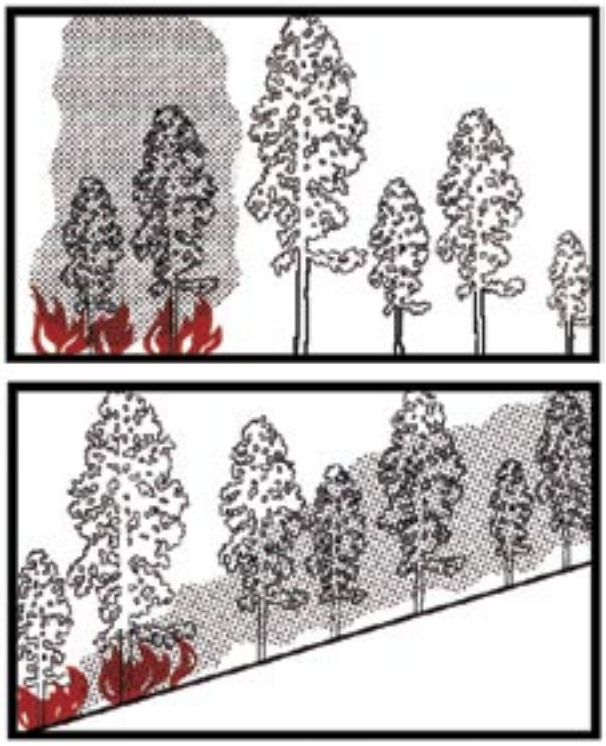
Legend: 5 – Problem may be crucial; 4 – Problem very likely;
3 – Exercise caution; 2 – Problem usually limited;
1 – No rating possible

Wildfire Hazard Maps

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

Slope

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



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

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

Topography

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

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

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

Chimney.

Saddle.

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

Flashover in V-shaped valley.

Crowning Potential

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

Crowning Potential Key

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

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

Ignition Sources

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

Fuelbreak Locations

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

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

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

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

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

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

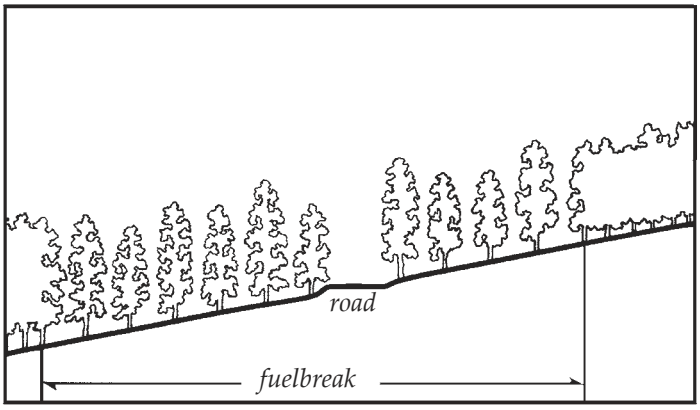
Aesthetics

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

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

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

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



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

Constructing the Fuelbreak

Fuelbreak Width and Slope Adjustments

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

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

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

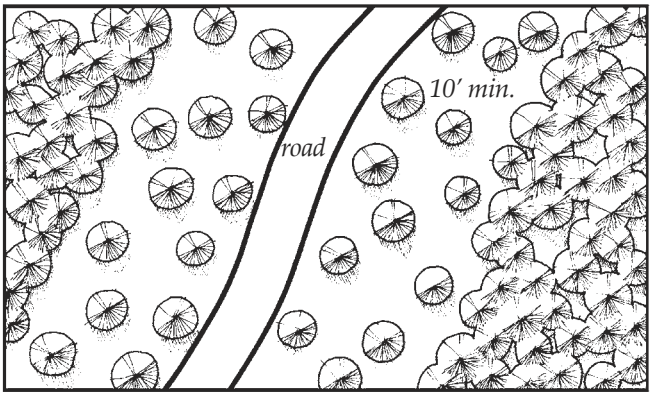
Fuelbreak Width/Slope

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

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

Stand Densities

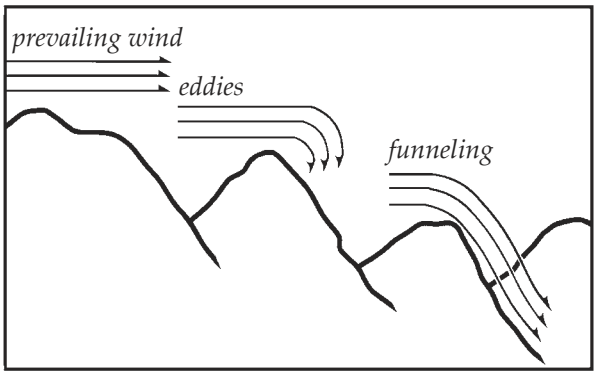
Crown separation is a more critical factor for fuelbreaks than a fixed tree density level. A *minimum* 10-foot spacing between the edges of tree crowns is recommended on level ground. As slope increases, crown spacing should also increase. However, small, isolated groups of trees may be retained for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



Plan view of fuelbreak showing minimum distance between tree crowns.

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

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



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

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

Debris Removal

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

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

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

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

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

Fuelbreak Maintenance

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

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

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

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

Conclusion

An image of well-designed communities for Colorado includes:

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

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

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

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

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

APPENDIX G
CREATING WILDFIRE DEFENSIBLE ZONES

FORESTRY

Creating Wildfire-Defensible Zones no. 6.302

by F.C. Dennis [1]

Quick Facts...

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

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

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

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

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

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

Defensible Space

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

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

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

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

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

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

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

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Putting Knowledge to Work

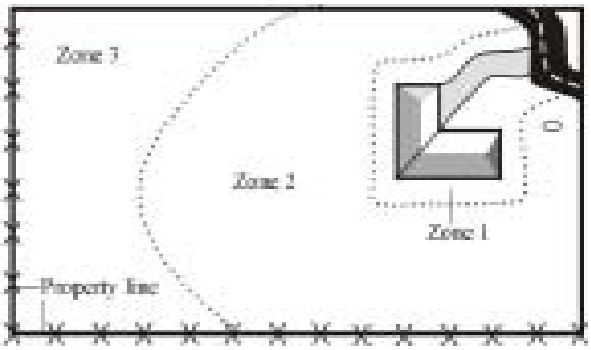

Figure 1: Forested property showing the three fire-defensible zones around a home or other structure.

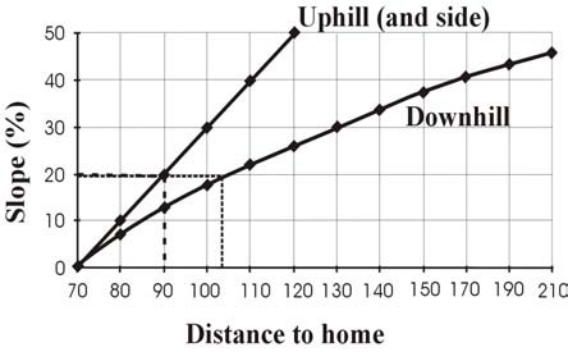

Figure 2: This chart indicates the *minimum recommended* dimensions for defensible space from the home to the outer edge of Zone 2. For example, if your home is situated on a 20 percent slope, the minimum defensible space dimensions would be 90 feet uphill and to the sides of the home and 104 feet downhill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

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

Defensible Space Management Zones

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

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

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

Prescriptions

Zone 1

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

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

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

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

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

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

Zone 2

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

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

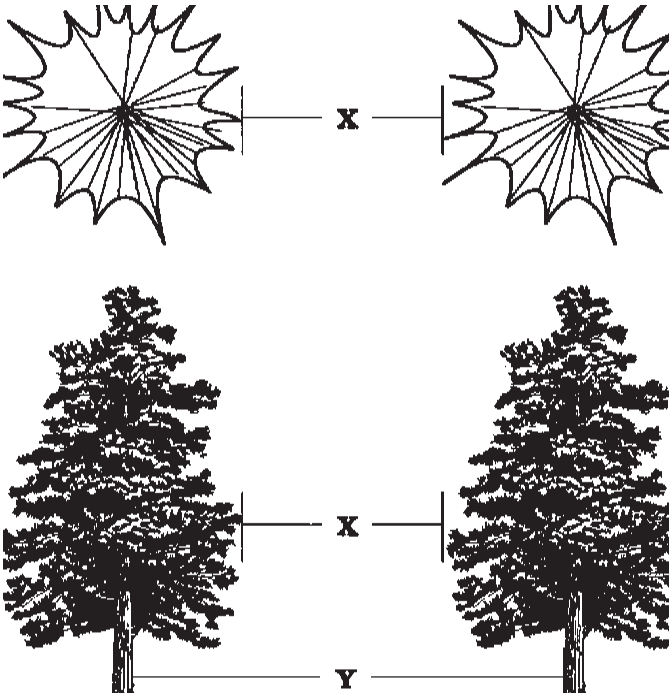

Figure 3: X = crown spacing; Y = stem spacing. Do not measure between stems for crown — measure between the edges of tree crowns.

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

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

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

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

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

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

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

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

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

Figure 4: Minimum tree crown and shrub clump spacing.

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

Figure 5: Minimum tree spacing for Zone 3.

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

Zone 3

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

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

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

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

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

Mowing is not necessary in Zone 3.

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

Special Recommendations

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

Brush and shrubs

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

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

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

Grasses

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

Windthrow

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

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

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

Maintaining Your Defensible Space

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

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

Figure 6: Minimum defensible space size for grass fuels.

Defensible Space and FireWise Annual Checklist

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

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

- □ Trash and debris accumulations are removed from the defensible space.
- □ A checklist for fire safety needs inside the home also has been completed. This is available from your local fire department.

References

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

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

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

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

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

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

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

APPENDIX H

PRESCRIBED FIRE PILE BURNING GUIDLINES

Colorado State FOREST SERVICE

GOLDEN DISTRICT

PRESCRIBED FIRE-PILE BURNING GUIDELINES

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

DEFINITIONS:

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

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

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

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

MATERIALS TO BE INCLUDED IN PILES:

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

LOCATION OF PILES:

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

CONSTRUCTION OF PILES:

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

PLANNING YOUR BURNING EFFORT:

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

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

Copies of all permits should be available on-site during the burning operation. Burning activities should also include plans for safety, supplemental water sources, and extra assistance from the local fire authority or the landowner. The individual(s) planning the burning operation should notify the following entities on the day of a burn: the local fire authority; county sheriff's department; and adjacent landowners who may be affected by smoke. Notification should include the date, times, and exact location of the burn.

Pile burning must be conducted under suitable weather conditions. Periods of snow or light rain, with steady, light winds (for smoke dispersal), and sufficiently snow cover (6-12 inch depths) are ideal. Do not burn during periods of high winds, low humidity or drying conditions, temperature inversions (especially "Red Air Quality" days in metropolitan areas), with a lack of snow cover, or these conditions are expected to develop after starting the burn. Persons burning slash piles should have the following: leather gloves; shovels; suitable footwear; masks for covering the mouth and nose; and proper eye protection.

BURNING SLASH PILES:

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

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

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

ADDITIONAL ASSISTANCE:

If landowners have questions about burning slash, they should contact a local CSFS office (http://csfs.colostate.edu/). CSFS can assist landowners with planning or conducting prescribed fire activities such as pile burning or broadcast (area) burning. Local, state, and fire department authorities may require a burn plan, smoke management plan, and weather monitoring for complex burning operations.

APPENDIX H

PRESCRIBED FIRE PILE BURNING GUIDLINES

Colorado State FOREST SERVICE

GOLDEN DISTRICT

PRESCRIBED FIRE-PILE BURNING GUIDELINES

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

MATERIALS TO BE INCLUDED IN PILES:

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

LOCATION OF PILES:

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PLANNING YOUR BURNING EFFORT:

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5. Obtain authorization from the legally constituted fire authority for your area. This may be part of the health department's permit process.
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BURNING SLASH PILES:

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

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

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

ADDITIONAL ASSISTANCE:

If landowners have questions about burning slash, they should contact a local CSFS office (http://csfs.colostate.edu/). CSFS can assist landowners with planning or conducting prescribed fire activities such as pile burning or broadcast (area) burning. Local, state, and fire department authorities may require a burn plan, smoke management plan, and weather monitoring for complex burning operations.

APPENDIX I
WEB REFERENCE GLOSSARY

Resource	Web Site
Jefferson County Emergency Operating Plan	http://www.co.jefferson.co.us/ca/chap06016.htm#P6_19
Jefferson County Policies and Procedures	http://www.co.jefferson.co.us/ca/ca_T148_R2.htm
Fire Regime Condition Class	http://www.frcc.gov/index.html
Jefferson County CWPP project site	http://www.co.jefferson.co.us/emerg/index.htm
Colorado State Forest Service Library	http://csfs.colostate.edu/library.htm
Rocky Mtn Geographic Science Center – Wildfire Support	http://wildfire.cr.usgs.gov
FireWise	http://www. Firewise.org.
Searchable Grants Database	http://www.rockymountainwildlandfire.info/
Jefferson County Office of Emergency Management	http://www.co.jefferson.co.us/emerg/
Indian Hills Improvement Association	http://indianhillscolorado.com
Landfire Geospatial Data	http://www.landfire.gov/products_overview.php
Colorado State Forest Service	http://csfs.colostate.edu/
Waterton North RAWS	http://raws.wrh.noaa.gov/cgi-bin/roman/meso_base.cgi?stn=WTTC2
National Fire Weather	http://fire.boi.noaa.gov/
Real-Time Observation Monitor and Analysis Network –	http://fire.boi.noaa.gov/
Current Weather Summary for Rocky Mountain Geographic Coordinating Area	http://raws.wrh.noaa.gov/cgi-bin/roman/raws_ca_monitor.cgi?state=RMCC&rawsflag=2

APPENDIX J
LIST OF PREPARERS

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