

Recommendations for Improving Wildfire Safety in Larimer County

Prepared for Larimer County



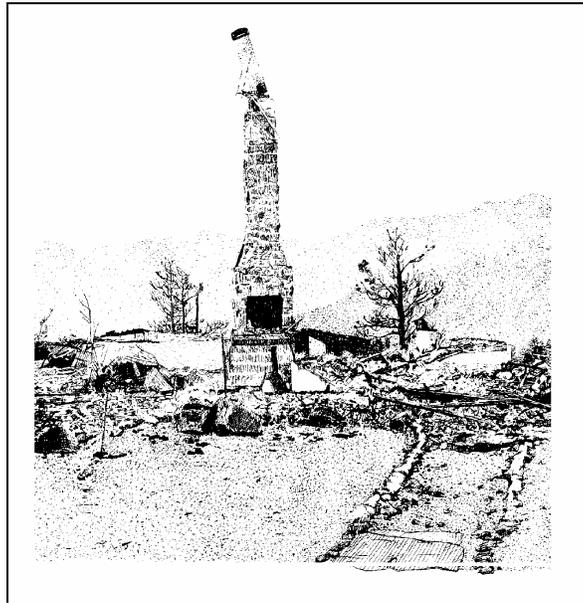
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☞ Our foothills and canyons are a beautiful and often perilous place to live. Many people who chose to do so take prudent steps to protect their property. Others, as officials working the Sugarloaf fire pointed out, have not done so, making efforts to save their homes virtually futile. ☞

-- *Daily Camera*, a Boulder newspaper, shortly after the Black Tiger Fire destroyed 44 homes in 1989.



☞ Please do not wait to act...until after the inevitable calamity ☞

-- Homeowner in letter to the editor, *The Trail-Gazette*,
December 15, 1995.

Acknowledgments

A special thanks must first go to the members of the Larimer County Wildfire Safety Task Force. Their commitment to developing alternatives to improving wildfire safety in Larimer County kept the final recommendations within reasonable bounds. The members are:

Mark DeGregorio - Larimer County Environmental Advisory Board
Jim Disney - Board of County Commissioners
Mike Foley - Arapaho-Roosevelt National Forest
Bob Gann - Larimer Fire Council
Don Griffith - Larimer County Emergency Services
Al Kadera - Larimer County Planning Department
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Gene Michaud - Larimer Fire Council
Marybeth Snyder - Citizen
Don Weixelman - Board of Realtors
Rick Whitworth - State Farm Insurance Companies
Ed Zdenek - Larimer County 35-Acre Task Force

I thank the Emergency Services staff for putting up with my invasion of their facilities during this project. Their willingness to listen to ideas and concepts revolving around improving wildfire safety in Larimer County kept me sane.

I also wish to thank the Colorado State Forest Service Fort Collins District staff for their support during my absence from district operations.

Thank you Lisa, Tessa, Jenna, and Nate for putting up with those evening meetings and weekend presentations!

Mitigation or not, the firefighters of Larimer County accept the dangers and challenges of wildland fire suppression. I hope these recommendations result in reducing those dangers.

Executive Summary

Using historical wildfire occurrence data as a reference, Larimer County can expect approximately 20 fires greater than 100 acres in size during the next ten years. The number of homes, if any, which may be threatened, damaged or destroyed by these wildfires is only speculation. Suppression costs, which are ultimately borne by the taxpayer, are also difficult to predict.

The wildland/urban interface is defined as an area or zone where structures and other human development meets or intermingles with undeveloped wildland or vegetative fuels (McPherson 1990). Larimer County has an estimated 148,000 acres of wildland/urban interface (Jones 1992). Fifty-seven percent of the over 200 subdivisions in this area have a high fire loss potential (Farmer 1995). A subdivision's potential to burn (hazard) is combined with the potential for ignition and average fire size (risk) to estimate a fire loss potential.

The purpose of this report is to inform the Board of County Commissioners and the Planning Division of the wildfire hazards in Larimer County and provide possible solutions to mitigate those hazards. Ultimately, the recommendations provided are intended to minimize the loss of property from wildfire burning in vegetation and spreading to buildings.

Reviewing past wildland/urban interface fires shows the following factors are common among structures destroyed or damaged by wildfire:

- * Combustible roofing material
- * Wood construction
- * Structures not separated from flammable vegetation
- * Fire department had poor access to structures
- * Development located in heavy natural fuel types
- * Structures located on steep slopes covered with flammable vegetation
- * Limited water supply
- * Resources and personnel arrived too late
- * Critical fire behavior with winds over 30 miles per hour

All of these factors, with the exception of high winds, are addressed in this report in one of six categories (general, land use planning, building construction, education, implementation, and miscellaneous). The recommendations provided attempt to establish a minimum set of standards and guidelines to minimize the loss of life and property from wildfire. Implementation of these recommendations will improve the firefighter's ability to protect structures, improve the structure's ability to survive a low intensity wildfire in the absence of suppression forces, and to reduce the likelihood of a structure fire spreading to the forest.

The following briefly highlights the major recommendations given in this report:

Land Use Planning Recommendations

1. Create a Wildfire Hazard Area. All recommended standards and guidelines apply to new development and construction within this zone.
2. Encourage the development of rural fire departments.
3. All future proposed development in the Wildfire Hazard Area shall be reviewed for wildfire safety considerations. An approved Wildfire Mitigation Plan shall be adopted and become part of a development agreement.

Building Code Recommendations

1. Defensible space in compliance with the guidelines developed by Larimer County shall be required on all new construction in the Wildfire Hazard Area.
2. Modify the current propane tank standard to require propane tanks be located on the contour or downhill from the structure.
3. Eliminate the current water supply requirement for single-family residences.
4. Require an option of Class III siding materials or 1-hour exterior wall construction.

Staffing Recommendations

1. Create the position of Wildfire Safety Coordinator to assist with land use planning, defensible space implementation, staff training and public education. Partial funding can provided by a defensible space fee and a land use review fee. The land use review fee is not new; currently the Colorado State Forest Service charges for land use review. This review authority and associated fees would be transferred to the Wildfire Safety Coordinator.

Primary job duties of the Wildfire Safety Coordinator include review of wildfire mitigation plans; providing technical assistance to land developers, homeowners, homebuilders, county staff, homeowner associations, and others; implementation of defensible space program; building inspector training; and assisting the Rural Land Use Center with wildfire mitigation issues. A suggested job description is found in Appendix G.

Public Awareness/Education Recommendations

1. Continuation of a public awareness program is paramount to successful wildfire mitigation in Larimer County. A public awareness/education plan is provided in Appendix F.

Program Review

1. A review of Larimer County's Wildfire Safety program and processes as implemented should be reviewed for effectiveness approximately 18 to 24 months following program initiation.

Wildfire in the wildland/urban interface is not a new problem, nor are the recommended solutions new ideas. Numerous reports and recommendations developed as early as 1960 all contain similar goals, primarily to create a uniform wildfire hazard rating system or to manage wildland fuels near structures. Our challenge is not one of finding new solutions, but of implementing known solutions. Now is the time to act.

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Introduction

The wildland/urban interface is defined as an area or zone where structures and other human development meets or intermingles with undeveloped wildland or vegetative fuels (McPherson 1990). Ranging from isolated cabins to large subdivisions, an estimated 148,000 acres of wildland/urban interface exist in Larimer County (Jones 1992).

The goal of wildfire mitigation is to identify and reduce the long-term risk to human life and property from wildfire. This report uses a four-step process to address the complex issues concerning fire in the wildland/urban interface:

1. Establishment (identification and assessment) of wildfire hazards
 - a. Wildfire Hazard Zone
 - b. Wildfire Hazard Maps
2. Review of development design
 - a. Emergency access (roads)
 - b. Vegetation (fuels)
 - c. Water supply
 - d. Fire station location
 - e. Appropriate mitigative actions
3. Review of building construction
 - a. Building site location
 - b. Emergency access (driveways)
 - c. Vegetation (defensible space)
 - d. Water supply
 - e. Appropriate mitigative actions
4. Education/information
 - a. Homeowners
 - b. Developers
 - c. Building contractors
 - d. Realtors
 - e. Elected officials
 - f. Fire departments

A Basis for Mitigation

Wildfire mitigation, though full of relatively simple individual solutions, becomes a very complex issue when one attempts to put these solution together into an easily accepted and workable package. The following Wildfire Mitigation Matrix was compiled by the author to be used as a tool when defining wildfire mitigation.

The Wildfire Mitigation Matrix A Basis for Wildfire Mitigation

	Building Construction	Land Use Planning	Public Education, Public Information
Structural Integrity	<ul style="list-style-type: none"> *Roofing material *Exterior construction *Decks *Propane tanks 	<ul style="list-style-type: none"> *Community covenants 	<ul style="list-style-type: none"> *Firewise home construction
Infrastructure Reliability	<ul style="list-style-type: none"> *Driveways *Available water supply *Response time 	<ul style="list-style-type: none"> *Collectors & local access roads *Community water supply *Response capabilities 	<ul style="list-style-type: none"> *Firewise community planning & development
Fuels Management	<ul style="list-style-type: none"> *Defensible space 	<ul style="list-style-type: none"> *Hazard identification *Hazard classification *Fuelbreaks *Fuels reduction 	<ul style="list-style-type: none"> *Fire ecology management *Fuels management *Forest health management
Pre- and post-fire hazard planning	<ul style="list-style-type: none"> *Pre-attack planning *Evacuation plans *Post-fire hazards planning 		<ul style="list-style-type: none"> *Public evacuation *Post-fire hazards

Assignment

Under the general direction of an interagency steering committee, the temporary position of Larimer County Wildfire Mitigation Coordinator was established to assist county staff, local wildfire agencies, and local fire departments in the following areas:

- 1) Coordination and implementation of wildland fire public education programs.
- 2) Coordination and implementation of wildfire mitigation projects.
- 3) Review of building codes and land use regulations with respect to wildfire considerations.
- 4) Provide information and assistance to county staff on wildfire mitigation matters as needed.
- 5) Coordination of wildfire mitigation activities for the Fort Collins District, Colorado State Forest Service.

The recommendations provided within this document fulfill the requirements of item 3.

Purpose

The primary purpose of this report is to inform the Board of County Commissioners and the Planning Division of wildfire hazards in Larimer County and provide possible solutions to mitigate those hazards. Ultimately, the recommendations provided are intended to minimize the loss of property from wildfire burning in vegetation spreading to buildings. Implementation of these recommendations will 1) improve firefighter's ability to protect structures, 2) improve a structure's ability to survive a low intensity wildfire in the absence of suppression forces, and 3) reduce the likelihood of a structure fire spreading to the forest.

Scope

The provisions of these recommendations shall apply to new building construction and new proposed Wildfire

of these apply to new building development in the Hazard Area.

Why Worry About Wildfire?

Fire Ecology

Wildfire, along with climate and topography, has been a dominant disturbance factor in determining the structure and compositions of Rocky Mountain forests (Crane 1982). Fire frequency and severity are critical in determining which plant species grow on a particular site. For this reason, species such as aspen may be favored by shorter fire frequencies, but lost from sites during unusually long fire-free periods. Very short fire frequencies may result in the loss of conifer species unable to establish a seed pool. Without question, fire will continue to play a major role in the plant succession of our western forests.

Wildfire has returned to our forested ecosystems at fairly frequent and somewhat predictable intervals, with estimates of the historical fire frequency varying with forest type. Fire frequency of ponderosa pine in Rocky Mountain National Park has been estimated at 30 years (RMNP 1992), while studies by Laven and others indicate fire frequency of about 46 years in ponderosa pine along Colorado's Front Range. Others have estimated the fire frequency of ponderosa pine forests from 12 to 25 years (Crane 1982).

Skinner and Laven (1982) have estimated fires occur in Rocky Mountain National Park lodgepole forests every 50 years. Romme found a 300-400 year period between large fires in Yellowstone National Park. Evidence indicates the Pingree Park area burned about 120 years ago.

Historically, the occurrence of lodgepole pine is largely controlled by fire frequency and severity. Lodgepole seeds in recent burns to form dense, "dog-hair" stands that often remain until destroyed by another wildfire. When homes are built in lodgepole pine forests, the results can be disastrous.

How much wildfire changes forest structure and species composition depends on current forest conditions, weather, topography and fire intensity. Many decades of fire suppression have significantly altered the historical fire regimes in Larimer County. Years of fuel accumulation caused by successful fire suppression, lack of forest management, a general public misunderstanding of forestry and fire ecology, and the increasing number of homes and communities in our forests, have created a significant wildfire problem. Each year that passes without addressing wildland fuels simply increases the potential for disaster.

The Fire Environment

Wildfire is defined as any fire occurring on wildlands that requires suppression response. If left unchecked, it is likely these fires will threaten lives and property.

Wildfire behavior and spread are affected by fuels, topography and weather. Fuels, typically thought of as grass, brush, trees, and dead vegetation, now include homes and other structures. Ironically, improved fire protection combined with decreased forest management has contributed to increased fuels.

Topography helps determine fire spread. Because heat rises, fire spread increases as slopes become steeper. Homes built in canyons or on ridge tops frequently have less chance of surviving wildfire. Steeper slopes also hamper suppression efforts. Historically, fire occurrence is greater on south and southwest facing slopes due to lower amounts of fuel, higher temperatures, lower humidity, and lower fuel moisture.

Weather, the most critical and the most unpredictable element of fire behavior, is constantly changing and often determines fire size. Hot, windy days with low humidities create favorable conditions for wildfire. In Colorado these conditions can occur anytime throughout the year. Most large fires are wind driven events.

Where hazardous fuels, difficult terrain, and extreme weather exist, all that is needed for a wildfire to occur is an ignition source.

Fire Ignition Sources

Lightning strikes the earth an average of 100 times each second totaling over 3 billion strikes each year (Ainsworth & Doss 1995). Though lightning is typically responsible for 30-45% of all fires on federal lands in Larimer County, only 11% of all wildfires on state and private lands are lightning caused. The remaining 89% are human caused or are of unknown origin.

Fire Statistics

On average, over the past twenty years or so, 161 wildfires burn over 2000 acres each year in Larimer County. An average of approximately 98 of these fires occur annually on state and private lands in Larimer County. Records kept by the Arapaho-Roosevelt National Forest show that, historically, 2% of all wildfires reach 100 acres or more in size. Extrapolating this data to state and private lands, Larimer County can expect 19-20 wildfires 100 acres or greater in size during every ten year period. How many of these wildfires will threaten, damage or destroy homes is only speculation; however, must we wait until disaster strikes before something is done?

Past Wildfires

Disastrous wildfires are not uncommon along Colorado's Front Range. A wildfire in 1950 near the Broadmoor in El Paso County killed nine firefighters and destroyed 33 structures (Williams 1992). The Murphy Gulch Fire threatened six homes in Jefferson County in 1978. In 1989, the Black Tiger Fire demolished 44 structures and threatened at least 100 more homes in the Sugarloaf area of Boulder County. Tragedy again struck Boulder County in 1990 when 10 homes were destroyed just north of the city of Boulder. Numerous wildfires threatened structures up and down the Front Range during 1994. The 1996 Buffalo Creek Fire southwest of Denver destroyed 12 homes and disrupted the lives of an entire community.

Fortunately, major residential home loss from wildfire has not occurred in Larimer County. It should be noted, however, that wildfires threaten structures nearly every year in Larimer County. In addition to destroying 13 buildings at Pingree Park, the Hourglass Fire (1994) also threatened about twelve summer homes in the Poudre Springs subdivision. Homes in the Glacier View area were threatened by the Eggers Fire (1994). The Snowtop Fire, in July 1993, threatened at least 5 homes in the Cedar Park area. In 1995, a relatively wet year, the Bonner Peaks Fire threatened eight homes west of Highway 287. In March 1996, two small fires (45 and 15 acres respectively) threatened 10 homes in Glacier View and Rustic. The Crystal Fire threatened 40-50 homes in Buckhorn Canyon in May 1996. As so many fire ecologists, firefighters and others have said, the question is no longer **if** a major wildfire is likely to occur, but **when** and **where** the fire will burn.

How Hazardous is Larimer County?

Larimer County is one of the most hazardous counties in Colorado with respect to wildfire (Summerfelt 1993; Jones 1992). An estimated 57% of subdivisions and other development in Larimer County's foothills and mountains have a high fire loss potential (Farmer 1995). Fire loss potential combines a subdivision's potential to burn (hazard) with the potential for ignition and average fire size (risk) to estimate the likelihood of a devastating wildfire occurring in a subdivision.

What Can Be Done to Minimize Home Loss?

Reviewing past wildland/urban interface fires shows that structures are destroyed or damaged by wildfire for the following reasons (Foote 1994, Perry 1990, NFPA 1991b, NFPA 1990, NFPA 1989, and others):

- A. Combustible roofing material
- B. Wood construction
- C. Structures not separated from flammable vegetation
- D. Fire department had poor access to structures
- E. Subdivisions located in heavy natural fuel types
- F. Structures located on steep slopes covered with flammable vegetation
- G. Limited water supply
- H. Resources and personnel arrived too late
- I. Critical fire behavior with winds over 30 miles per hour

All of these issues are addressed in this report with the exception of item I. The recommendations provided attempt to establish a minimum set of standards and guidelines to minimize the loss of life and property from wildfire.

Procedure

Recommendations

A list of wildfire safety issues, initially developed by the Wildfire Mitigation Coordinator, was reviewed and commented on by fire departments, Larimer County Emergency Services, Larimer County Building Department, Larimer County Planning Department, and Arapaho-Roosevelt National Forest. Additional issues were identified and added to the list for review. The DRAFT Recommendations for Improving Wildfire Safety in Larimer County was developed after review of the following issues:

1. Combustible vegetation (i.e. defensible space)
2. Exterior wall construction
3. Decks and porches
4. Combustible roofing materials
5. Building envelope (home location)
6. Access
7. Water supply
8. Homeowners not fully aware of wildfire issues
9. Lack of financial incentives
10. Land use planning
11. Propane tanks
12. Fire station location

Other issues identified, reviewed and not included in these recommendations are automatic sprinklers, fire shutters, ignition threats of the structure itself, and window screens.

After the initial review and comment by county staff and others, the recommendations were presented at five public meetings during the fall of 1996. Meetings were held at the Larimer County Courthouse, Crystal Lakes Community Building, Estes Park Library, Glacier View Community Center, and the Stove Prairie School. Citizen participation was critical at this point to gather ideas, concerns, and comments on possible changes in building codes and land use regulations. All comments made during these public meetings are listed in Appendix C. The recommendations were also reviewed by the Larimer Fire Council. These comments are also in Appendix C.

Information and comments received at these public meetings was taken into consideration by a Wildfire Safety Task Force and the Wildfire Mitigation Coordinator in formulating the final recommendations. This task force, chaired by the Wildfire Mitigation Coordinator, was formed by the Board of County Commissioners to serve as an advisory committee and sounding board for possible changes in building codes and land use regulations as they relate to wildfire safety. These recommendations are the result of countless hours of debate and discussion. Though the task force reached consensus on all recommendations, the Wildfire Mitigation Coordinator takes full responsibility for the content of this report.

Summary of Recommendations

Land Use Planning Recommendations

The Wildfire Mitigation Coordinator, with consensus from the Wildfire Safety Task Force, recommends the items listed below be included in the future Land Use Code.

The Wildfire Safety Task Force also recognizes the Rural Land Use Center (RLUC) as a valuable and beneficial alternative to the traditional 35-acre parcel development. A great deal of thought was given to the effect any wildfire safety recommendation may have on the RLUC; they are not in any way intended as a hindrance to that process. It is believed, however, that the RLUC has the responsibility to address wildfire and other public safety concerns. These recommendations provide guidelines and standards when addressing wildfire issues. The Wildfire Safety Task Force strongly desires to meet and discuss wildfire safety issues with the soon-to-be selected RLUC Director and RLUC board.

1. Larimer County should designate a *Wildfire Hazard Area* (Figure 1) using the same boundary as the current roofing ordinance. Any wildfire safety regulations, codes, standards, guidelines, or incentives would apply only to new development (i.e. MRDs, PUDs, Subdivisions and development other than 35-acre parcels) located west of the designated boundary line.
2. Larimer County should encourage the development of fire departments and fire protection districts by expediting any land use review process for proposed fire stations, waiving or reduction of fees associated with the review process and building permits for constructing fire stations, deferring property taxes for land set aside for future fire stations, and, during the land use review process, looking for opportunities to designate land for future fire stations, and other appropriate assistance.
3. All new development in the Wildfire Hazard Area shall be reviewed for fire safety considerations.
 - A. Wildfire Mitigation Plans should be required for all new development in the Wildfire Hazard Area and should be submitted with the application as outlined in the *1993 Larimer County Hazard Regulations* with one exception. Currently, the hazard regulations require

Figure 1

that wildfire hazard analysis shall be performed by a professional forester with at least two years experience with wildfire hazards in the Rocky Mountain Region. The Task Force recommends that the final Wildfire Mitigation Plan should be approved by a professional forester with at least two years experience addressing wildfire hazards through use of Rocky Mountain Region silviculture, forest ecology, fire behavior, and fuels management. The document *Wildfire Mitigation Plan Standards and Guidelines for Developers and Foresters* has been prepared to assist developers and foresters in plan preparation. A draft copy is included in Appendix D.

- B. The approved Wildfire Mitigation Plan should be adopted and become part of a development agreement. A designee of the Board of County Commissioners will approve all mitigation plans.
 - C. Building envelopes should be considered during the development review process and results should become part of the Wildfire Mitigation Plan.
4. The following should be included in the proposed *Larimer County Land Use Code*:
- A. Wildfire Hazards and the associated Wildfire Hazard Maps should be included in the Land Suitability Factors section.
 - B. Add the following guideline to the Mountain Development Guidelines: Permitted development in high and/or moderate wildfire hazard classes should be designed to reduce wildfire hazards.
 - C. Add the following guideline to the Open Space Guidelines: Where a high probability of wildfire exists, Wildfire Mitigation Plans should be developed for all public and private open space lands. [Note: private open space lands would be addressed during the land use planning process. Education is the only way to address currently designated private open space lands.]
5. An approved year-round, water supply plan shall become part of the development agreement.
- A. The water supply plan should be based upon Sections 2 and 3 of the *Larimer County Water, Sewer and Fire Safety Standards and Procedures Manual*.
 - B. Water supply can be supplied from natural water bodies and/or constructed water sources. Constructed sources include, but are not limited to, aboveground tanks, cisterns, hydrants, or dry hydrants.
6. Road standards are currently being reviewed and updated by the Larimer County Engineering Department. Wildfire and other emergency access are being included as criteria. To avoid duplication of effort and possible confusion, the Wildfire Safety Task Force has deferred any access recommendations the Engineering Department.

Building Code Recommendations

1. Defensible space in compliance with guidelines developed by Larimer County shall be required on all new construction in the Wildfire Hazard Area. Any additions exceeding 50% of the total square footage of the original structure during any one year period must comply with this requirement. A draft defensible space guideline is found in Appendix E. Each homesite is unique. It is intended that each defensible space be evaluated on this uniqueness based upon fuels, topography and desires of the homeowner. Compromises between the homeowner or builder and the approving inspector are expected as long as the basic guidelines are not violated.

Recommended Procedure - When a building permit is issued for a new structure, weekend cabin, or addition located in the Wildfire Hazard Area the homeowner or builder would have three options:

1. Complete the defensible space themselves using the Larimer County Guidelines. County building inspector approves defensible space during routine inspections.
2. Hire a consulting forester to develop a defensible space plan using the Larimer County Guidelines. County building inspector approves defensible space during routine inspections.
3. Hire the County Wildfire Safety Coordinator to develop a site-specific defensible space plan, including marking of trees to be removed. Defensible space plan implementation is the responsibility of the permittee. County building inspector to follow up with review and approval during routine inspections.

The building inspector refers unusual fuel, topographic, or other situations to the Wildfire Safety Coordinator.

Defensible Space Fee - an additional defensible space fee would be required when the building permit is issued. It is recommended this fee be approximately \$60.00. Funds generated from this fee would partially support the Wildfire Safety Coordinator position.

Defensible Space Completion - the defensible space must be completed prior to the applicant receiving a certificate of occupancy.

Defensible Space Maintenance - maintenance of the defensible space area is the responsibility of the homeowner.

2. The current propane tank requirement should be modified to require tanks to be located on the contour or downhill from the structure.
3. Eliminate the current water supply requirement for single-family residences.
4. Require Class III siding materials or 1-hour exterior wall construction. Log or heavy timber construction is considered 1-hour construction.

Public Awareness/Education Recommendations

1. A coordinated, long-term public awareness and education program is the key to successful wildfire mitigation in Larimer County. The Public Awareness & Education Plan located in Appendix F can be implemented regardless of the status of all other recommendations in this report. However, the position of Wildfire Safety Coordinator becomes critical as a leader in this effort.

Implementation and Staffing Recommendations

1. Establish the position of Wildfire Safety Coordinator to assist with land use planning, defensible space implementation, staff training, public education. A suggested position description is found in Appendix G.

Funding - The Wildfire Safety Coordinator position would be partially funded through land use review fees, defensible space fees, and occasionally assisting landowners with defensible space plans and tree marking. (Currently, the Colorado State Forest Service reviews subdivision plats for wildfire safety and charges a fee to the developer. This authority and associated fees would be transferred to the Wildfire Safety Coordinator). Additional funding elsewhere within the County will be needed to support the educational role of the Wildfire Safety Coordinator.

Program Review

1. A review of Larimer County's Wildfire Safety program and processes as implemented should be reviewed for effectiveness approximately 18 to 24 months following program initiation. The Wildfire Safety Coordinator should chair a task force with a membership similar to the Wildfire Safety Task Force.

Appendix A: Definitions

Combustible - a material that fails to meet the acceptance criteria of Standard Method of test for determination of noncombustibility in building materials.

Combustible construction - a type of construction that does not meet the requirement for noncombustible construction.

Defensible space - a natural or man-made area, where woody vegetation capable of allowing a fire to spread unchecked has been treated or modified to slow the spread and reduce the intensity of an advancing wildfire, and to create an area for fire suppression operations to occur.

Fire loss potential - the relative likelihood of a devastating wildfire occurring within a specific area.

Fire-resistive construction - construction designed to resist the spread of fire.

Fire-resistive rating - is the time that the material or construction will withstand the standard fire exposure as determined by a fire test made in conformity with the standard methods of fire tests of buildings, construction and materials.

Fire-retardant-treated wood - any wood product impregnated with chemicals by a pressure process or other means during manufacture, and which...shall have a flame-spread index of not over 25.

Fire separation - a construction assembly that acts as a barrier against the spread of fire.

Firewall - a type of fire separation of noncombustible construction which subdivides a building or separates adjoining buildings to resist the spread of fire and which has a fire-resistance rating and structural ability to remain intact under conditions for the required fire-rated time.

Flame-resistant material - material that has been modified in its chemical composition by impregnation, coating or has inherent composition that makes the material resistant to ignition and combustion when exposed to a small ignition source.

Flame retardant - is an approved chemical, chemical compound or mixture which, when applied in an approved manner to any fabric or other material, will render such fabric or material incapable of supporting combustion.

Flame-spread index (FSI) - a relative index describing the surface-burning characteristics of building materials. The test used to establish FSI evaluates the flame spread over the building material surface when exposed to a test fire. The best known test for this is the tunnel test, American Society for Testing and Materials (ASTM) Test Method E-84. In this test, a sample of the material, 20 inches wide and 25 feet long, is installed as ceiling of a test chamber, and exposed to a gas flame at one end. The rate at which flame spreads across the specimen is compared on a scale of 0 for inorganic reinforced cement board, 100 for red oak. This is a relative index; there are no units associated with the numerical rating. The following table identifies the flame-spread index or classification:

Flame-Spread Classification	Flame-Spread Index (or Rating)
Class I (or A)	0 to 25
Class II (or B)	26 to 75
Class III (or C)	76 to 200

Fuel - combustible material.

Noncombustible - materials that meet the acceptance criteria of Standard Method of test for determination of non-combustibility in building materials.

Noncombustible Construction - a type of construction in which a degree of fire safety is attained by the use of noncombustible materials for structural members and other building assemblies.

One-hour Fire-resistive Construction - will withstand the standard fire exposure for one hour as determined by a fire test made in conformity with the standard methods of fire tests of buildings, construction and materials.

Slash - unusual concentrations of downed fuel resulting from such natural events as wind, fire, or snow breakage or such human activities as timber harvesting, road construction, or building construction.

Wildfire Hazard - the relative likelihood that a fire, once started, will become disastrous. Disastrous means the destruction of life and improved property.

Wildfire Hazard Area - that area in western Larimer County prone to wildfires as identified on the county's Wildfire Hazard Area map.

Wildfire mitigation - any action taken to eliminate or reduce the long-term risk to human life and property from wildfire.

Appendix B. Issue Background Information

Issue 1: Combustible Vegetation

Objective: Minimize ignitions of homes from burning vegetation.

Problem: Combustible vegetation adjacent to structures significantly increases the likelihood of structures burning during a wildfire. Recent studies indicate the most consistent factor associated with structure loss is combustible vegetation surrounding homes. In fact, homes with woody vegetation within 20 feet of the structure were often destroyed during wildfires (NFPA 1991, NFPA 1989).

Current County Requirement/Standard: No county requirements currently exist. Defensible space, fuelbreaks and other fuels reduction activities can be addressed during the subdivision review process; however, there is no guarantee that defensible space is actually completed.

Advantages: A recent study indicates the probability of structure survival to be about 90% if the home has nonflammable roofing material and a defensible space, compared to only 15% without defensible space. A nonflammable roof without defensible space is a Colorado State Forest Service attempt to inform homeowners of the dangers of wildfire and through the educational process has, for the most part, failed. If elected officials and the general public desire to minimize wildfire hazards, an ordinance encouraging mitigation process appears to be the best way to address new construction.

Recommendation: Defensible space in compliance with the guidelines developed by Larimer County shall be required on all new construction in the Wildfire Hazard Area. Defensible space in compliance with guidelines developed by Larimer County shall be required on all new construction in the Wildfire Hazard Area. Any additions exceeding 50% of the total square footage of the original structure during any one year period must comply with this requirement. A draft defensible space guideline is found in Appendix E.

study (Foote 1994) of structure survival to be about 90% if the home has nonflammable roofing material and a defensible space, compared to only 15% without defensible space. A nonflammable roof without defensible space is a Colorado State Forest Service attempt to inform homeowners of the dangers of wildfire and through the educational process has, for the most part, failed. If elected officials and the general public desire to minimize wildfire hazards, an ordinance encouraging mitigation process appears to be the best way to address new construction.

Forest health issues can also be addressed during development of defensible space. Trees with insect and disease problems should be among the first trees removed.

Disadvantages: Slash (limbs, branches, etc) left after thinning must be removed. The two best methods of slash disposal in the defensible space area are burning or chipping. Chipping, though expensive, is a very efficient way to eliminate slash problems. Chips can be used for landscaping purposes. Piling and burning slash is very cost effective. Burning requires a permit and can be done safely under Larimer County's current slash burning guidelines.

Probably the biggest disadvantage is the additional government regulation of private lands.

Background and Discussion: There is a reason this issue is listed first. Fire intensity is the most important determinant of house survival, and this result leads to the conclusion that fuel reduction is a major priority for the protection of houses against wildfire (Wilson 1986). Wildfires have historically served to thin the forest and reduce woody fuels. Fire suppression and lack of forest management have led to increased amounts of fuel and longer intervals between high intensity wildfires. Suppression of wildfires has actually increased the area of vegetation able to sustain fire (Whelan 1995). When wildfires do occur and escape initial attack, they typically

burn larger areas than in the historic past. In essence, long fire intervals permit sufficient fuel build-up to support catastrophic fires.

Woody vegetation around structures in the wildland/urban interface can be managed using the concept of *defensible space*. Defensible space is an area around a structure where vegetation is managed and maintained in such a way as to, in the event of a wildfire, minimize fire intensity. This is **not** an area cleared of woody vegetation! Dead trees and shrubs are removed, trees thinned to separate crowns, and ladder fuels (shrubs, small trees, etc, that may carry a fire from the surface into tree crowns) are eliminated.

The size of the defensible space is site specific, varying with forest type and steepness of the ground on which the home is built. The ultimate goals of defensible space are to 1) improve firefighter's ability to protect the structure, 2) improve the structure's ability to survive a low intensity wildfire on its own, and 3) reduce the likelihood of a structure fire spreading to the forest.

It must be noted that though defensible space does not guarantee home survival, the chance of survival is significantly increased by completion of defensible space.

The primary question in implementing defensible space boils down to education versus regulation. The debate centers around how much risk homeowners are willing to accept versus the responsibility of the fire service to mitigate hazards.

Several regulations exist along the Front Range that address defensible space. These include Colorado Springs (*The Hillside Ordinance*), Boulder County (*Site Plan Review*), Clear Creek County (Amendment to the 1991 UBC), and Summit County (New Construction Requirements). Defensible space is also addressed in codes or standards developed by national organizations including the National Fire Protection Association (NFPA 299) and the International Fire Code Institute (*Uniform Fire Code* and current draft of the *Urban-Wildland Interface Code*). These regulations, with respect to defensible space or vegetative management, are summarized below.

Colorado Springs - On April 13, 1993, the Colorado Springs City Council passed an ordinance amending the Fire Prevention Code and the City Code relative to measures in the hillside areas of Colorado Springs. The ordinance addresses fuels management, fire protection systems and roofing. The majority of the ordinance applies to new construction, except where re-roofing is concerned. In reference to defensible space, the ordinance provides guidelines for fuels management measures...within the safety zone of all new home construction... All new subdivision plats will include a statement of the requirement for fuels management.

Boulder County - Defensible space is addressed during Boulder County's *Site Plan Review*. A Wildfire Mitigation Plan is a condition for Site Plan Review and must address five conditions: 1) site location, 2) construction materials and design, **3) defensible space**, 4) emergency access, and 5) water supply. The defensible space plan follows the guidelines described in the Service-in-Action no. 6.302 Creating Fire Safe Zones developed by the Colorado State Forest Service. A non-refundable fee of \$440 (\$220 for structures less than 1800 square feet) must be included with the Site Plan Review application. In addition, a building permit is required with a plan review deposit of \$100 for new construction (remodels, additions, etc. have a fee of \$18.00).

Clear Creek County - Clear Creek County recently (October 1995) adopted an amendment to the 1991 Uniform Building Code to address wildfire hazard mitigation. A Fire Mitigation Plan is required, and includes sections on 1) defensible space, 2) roofing materials, 3) chimney and flue outlets, 4) overhangs (i.e. eaves), 5) structure size, and 6) driveway and road access requirements. The plan must be submitted as part of the building permit. Defensible space in compliance with the Colorado State Forest Service specifications shall be required...

When a landowner or builder initiates the building permit process, the Building Department collects a \$65 service fee which is passed on to the Colorado State Forest Service. A mitigation forester with the state forest service completes a site visit, designates trees for removal or pruning, and completes a defensible space assessment form. Final inspection is performed by county building inspectors. Clear Creek uses the Colorado State University Service-in-Action Sheet *Creating Fire Safe Zones* as the defensible space standard.

In 1996, the number of defensible space permits ranged from 2 to 16 per month. Completion of defensible space is required prior to obtaining a certificate of occupancy.

Jefferson County - Wildfire mitigation regulations adopted by the Jefferson County Board of Commissioners in 1995 became effective on January 1, 1996. Defensible space is required for all new structures and additions to existing structures of 400 square feet or more. The County has developed an overlay zone that follows the 6000 foot contour. All building permit applications that occur west of this contour are required to meet wildfire mitigation criteria.

At the time of application, the Planning and Zoning Department completes a wildfire mitigation report and collects a \$100 service fee which is eventually passed on to the Colorado State Forest Service. A mitigation forester from the state forest service visits each site, designates any trees for removal or pruning, and completes a wildfire mitigation report. The state forester is also responsible for final inspection and approval. Jefferson County uses the Colorado State University Service-in-Action Sheet *Creating Fire Safe Zones* as the defensible space standard.

In 1996, the number of defensible space permits ranged from 21 to 65 per month. The primary complaint from homebuilders in Jefferson County is the timing; defensible space must be completed prior to the building permit being issued.

Summit County - Summit County has developed a point system that has three sections: 1) water supply, 2) access, and 3) wildfire hazard. Sections must be satisfied prior to issuance of a building permit. The wildfire hazard section must be satisfied prior to issuance of a certificate of occupancy. Points are given for creation of defensible space in the wildfire hazard section.

Defensible space is defined as a designated area around a home or other structure the size of which is dependent on the vegetation, proximity of tree crowns, slope and distance to adjacent buildings. Within this area all weeds, dry grass, flammable debris and flammable fuel (firewood) are removed. Also, all trees and shrubs are separated so that the crowns are at least 10 feet apart, 10 feet from the building and semi-mature and mature trees are pruned of branches to at least 10 feet above the ground. Branches that touch or overhang the building shall be pruned. Specific design criteria and additional information can be obtained from the Colorado State Forest Service. Pamphlets available include the *Wildfire Safety Guidelines for Rural Homeowners* published by the CSFS or *Protecting Your Home from Wildfire* also available from the CSFS.

National Fire Protection Association's NFPA 299: Protection of Life and Property from Wildfire (1991 Edition) - The purpose of NFPA 299 is "...to provide criteria for fire agencies, land use planners, architects, developers, and local government for firesafe development in areas that may be threatened by wildfire. An all-encompassing standard covering wildland/urban interface analysis, fuel modification planning, access, water supplies, structural design and construction, and fire prevention. Fuel Modification Planning (Chapter 3) addresses defensible space and provides general standards. NFPA 299 Appendix A provides examples of hazard rating and fuel modification.

Uses a 30' minimum as a guideline for defensible space size on level ground. Structures at the top of slopes will require [an additional] 100' or more fuel modification to mitigate increased exposure due to convective and radiant heat transfers.

International Fire Code Institute's Urban-Wildland Interface Code (First Draft) - Chapter 6 - Fire-Protection Requirements: This chapter is divided into six sections (general, defensible space, maintenance of defensible space, spark arresters, LP gas installations, and firewood/combustible materials storage).

SECTION 601 GENERAL - The provisions of [chapter 6] establish requirements for new and existing buildings, structures and premises located within urban-wildland interface areas. The objective of [chapter 6] is to establish minimum requirements to mitigate the risk to life and property from wildland fire exposures, exposures from adjacent structures and to mitigate structure fires from spreading to wildland fuels.

Section 602 DEFENSIBLE SPACE - Provisions of this section are intended to modify the fuel load in areas adjacent to structures to create a defensible space. Defensible space is defined as an area either natural or man-made, where material capable of allowing a fire to spread unchecked has been treated, cleared or modified to slow the rate and intensity of an advancing wildfire and to create an area for fire suppression operations to occur.

Ornamental vegetative fuels or cultivated ground cover, such as green grass, ivy, succulents or similar plants used as ground cover, are allowed to be within the designated defensible space provided they do not form a means of readily transmitting fire from the native growth to any structure.

Trees are allowed within the defensible space provided that the distances between crowns and crowns from adjacent trees, structures or unmodified fuel is not less than 15 feet. Trees shall be maintained free of dead wood and litter.

Fuel modification shall be provided within a distance from buildings or structures as specified in Table 602.

Table 602. Required Defensible Space

Urban-Wildland Interface Area	Fuel Modification Distance (feet)
Moderate hazard	30
High hazard	100
Extreme	200

SECTION 603 MAINTENANCE OF DEFENSIBLE SPACE - ¶ Nonfire-resistive vegetation or growth shall be kept clear of buildings... Persons owning, leasing, controlling, operating or maintaining buildings or structures requiring defensible space are responsible for modifying or removing nonfire-resistive vegetation. The roof of a structure shall be maintained free of leaves, needles or other dead vegetative material. ⌘

¶ Trees extending to within 15 feet of any structure shall be pruned to maintain a minimum clearance of 15 feet. Additionally, trees within the defensible space shall be pruned to remove lower limbs. Trees shall be pruned to minimize ladder fuels. Portions of trees which extend within 15 feet of the outlet of a chimney shall be removed. Trees adjacent to or overhanging a building shall be maintained free of deadwood. ⌘

SECTION 604 SPARK ARRESTERS - ¶ Chimneys ... shall be provided with a spark arrester. ⌘

SECTION 605 LIQUEFIED PETROLEUM GAS INSTALLATIONS - ¶ LP-gas containers shall be located within the defensible space in according with the Fire Code. ⌘

SECTION 606 STORAGE OF FIREWOOD AND COMBUSTIBLE MATERIALS - ¶ Firewood and combustible material ... shall not be stored in unenclosed spaces beneath buildings or structures, or on decks or under eaves, canopies or other projections or overhangs. Storage of firewood and combustible material stored in the defensible space must be located a minimum of 20 feet from structures and separated from the crown of trees by a minimum of 15 feet. ⌘

Uniform Fire Code (1991 Edition) - Appendix II-A addresses clearance of vegetative growth from structures. ¶ Persons owning, leasing, controlling...buildings or structures in, upon or adjoining hazardous fire areas...shall at all times: ⌘

- 1) maintain an effective firebreak by removing and clearing away flammable vegetation and combustible growth from areas within 30 feet of such buildings or structures (makes exceptions for single specimens of trees, ornamental shrubbery, etc. provided they do not form a means of rapidly transmitting fire from the native growth to any structure),
- 2) maintain additional fire protection by removing flammable vegetation located from 30 to 100 feet from such buildings or structures, when required by the chief because of extrahazardous conditions,
- 3) Remove portions of trees which extend within 10 feet of the outlet of a chimney,
- 4) Maintain trees adjacent to or overhanging a building free of deadwood, and
- 5) Maintain the roof of a structure free of leaves, needles or other dead vegetative growth.

Issue 2: Exterior Siding and Wall Construction

Objective: To minimize the ignition potential of homes from an approaching wildfire.

Problem: Radiant heat from a nearby fire can ignite combustible exterior siding.

Current County Requirement/Standard: Typical residential homes in Larimer County have Type V-N exterior wall construction (Chapter 17, 1991 Uniform Building Code). This is the least restrictive method of wall construction allowed by the Uniform Building Code. No exterior siding requirement exists at this time in Larimer County.

Advantages: The hour fire-resistive rated is minimal and, in is realized. Currently, use in western Larimer III or greater

Recommendation: Require an option of either Class III (or greater) siding materials or 1-hour exterior wall construction. Log and heavy timber construction is considered 1-hour construction.

actual cost of Type V 1- compared to Type V non- some cases a cost savings most siding materials in County meets the Class requirement.

Disadvantages: Type construction could add

V 1-hour fire-resistive an additional cost.

Background and Discussion: Most urban home fires have internal sources of ignition. Therefore, exterior construction materials are of relatively minor importance from a fire protection standpoint. In the wildland/urban interface, however, the opposite is true - home fire ignitions during a wildfire are almost entirely external! Thus fire-resistant exterior walls become extremely important.

Flame-Spread Ratings

When evaluating building materials for fire safety many factors including ignition temperature, smoke toxicity and flame-spread are considered. Flame-spread, used to describe the surface burning characteristics of building materials, is one of the most tested fire performance properties of a material. The best know test for developing this rating is the American Society for Testing and Materials Test Method E-84, commonly known as the tunnel test.

This test measures how far and how fast flames spread across the surface of the test sample. The resulting flame spread rating (FSR) is expressed as a number on a continuous scale where inorganic reinforced cement board is 0 and red oak is 100. The scale is divided into three classes. The most commonly used flame-spread classifications are: Class I or A (some codes use Roman numerals, others use letters), with a 0-25 FSR; Class II or B with a 26-75 FSR; and Class III or C with a 76-200 FSR.

In general, inorganic materials such as brick or tile are Class I materials. Whole wood materials are usually Class II, while reconstituted wood materials such as plywood, particle board or hardboard are Class III. Whole wood is defined as wood used in the same form as sawn from the tree.

Flame-spread is expressed in terms of index numbers representing the flame-spread rate over a surface. In this test, a sample of the material, 20 inches wide and 25 feet long, is installed as ceiling of a test chamber, and exposed to a gas flame at one end. The rate at which flame spread across the specimen is compared on a scale of 0 for inorganic reinforced cement board, 100 for red oak. This is a relative index; there are no units associated with the numerical rating. By measuring these rates, a standard can be established to compare different species of wood with regard to fire safety. Roof coverings have a different set of criteria to meet.

Though different species of wood differ in their surface burning (flame-spread) rates, most wood products have a flame-spread rating less than 200 and are considered Class C or III material. A few species have a flame-spread index slightly less than 75 and qualify as Class B or II materials. The chart below compiles information from various sources and shows flame-spread index values and classification for some common building materials:

Flame-Spread Classification	Flame-Spread Rating or Index	
Class I (or A)	0 - 25	
Class II (or B)	26 - 75	
Class III (or C)	76 - 200	
Material/species	Flame-Spread Rating	Flame-Spread Class
hardboard siding panels	<200	III
APA Wood Structural Panels (includes APA 303 Sidings such as T1-11)	76-200	III
Birch, Yellow	80	III
Brick	0	I
Cedar, Western Red	69	II
Douglas-fir	90	III
Fiberboard, Medium Density	167	III
Gypsum Wallboard	10-15	I
Gypsum Sheathing	15-20	I
fiber-cement exterior materials	0	I
Hemlock, West Coast	73	II
Idaho white pine	82	III
Inorganic reinforced cement board	0	I
Maple	104	III
Masonite	<200	III
Oak, Red or White	100	III
Oriented Strand Board (OSB)	150	III
Particle Board	116-178	III
Pine, Lodgepole	98	III

Pine, Ponderosa	115	III
Plywood, Fire-retardant-coated construction	0-45	I or II
Plywood, Fire-retardant-treated construction	0-25	I
Plywood, Oak	125-185	III
Plywood, Pine	120-140	III
Spruce, Engelmann	55	II
T1-11	76-200	III

The most widely accepted flame-spread classification system appears in the National Fire Protection Association Life Safety Code, NFPA No. 101. This Code groups the following classes in accordance with their flame-spread and smoke development:

- Class A - Flame-spread 0-25, smoke developed 0-450.
- Class B - Flame-spread 26-75, smoke developed 0-450.
- Class C - Flame-spread 76-200, smoke developed 0-450.

NFPA 101 primarily applies this classification to interior wall and ceiling finish materials.

Exterior Wall Construction

Exterior wall construction can be classified by fire-resistance. A fire-resistive rating is the time that exterior wall construction can withstand fire exposure as determined by a standard fire test. Wall construction can be classified as 4-hour, 3-hour, 2-hour, 1-hour or non-rated construction. For example, 1-hour fire-resistant construction will withstand the standard fire exposure for one hour before the structural integrity of the wall fails. Most home construction is currently non-rated. This is not to say that non-rated homes have no fire-resistance, it's just less than one hour. Typical home construction provide protection of about 40 to 50 minutes.

The following is Table No. 43-9-W-A from the 1991 U.B.C. Standards:

Description of Finish	Time (minutes)
3/8-inch Exterior-glue plywood	5
1/2-inch Exterior-glue plywood	10
5/8-inch Exterior-glue plywood	15
3/8-inch gypsum wallboard	10
1/2-inch gypsum wallboard	15
5/8-inch gypsum wallboard	30

Description of Finish	Time (minutes)
1/2-inch Type X gypsum wallboard	25
5/8-inch Type X gypsum wallboard	40
Double 3/8-inch gypsum wallboard	25
1/2-inch + 3/8-inch gypsum wallboard	35
Double 1/2-inch gypsum wallboard	40

Wood studs used in exterior wall assembly are given a rating of 20 minutes (1991 U.B.C. Standards). If the space between the wood studs is filled with rock-wool batts or glass-wool batts an additional 15 minutes is allowed.

One-hour fire resistant construction can be accomplished in many ways, in fact, the *Fire Resistance Directory*, published by the Underwriters Laboratory, lists a multitude of examples of fire-resistant exterior wall construction. Log and heavy timber construction is also considered 1-hour construction. Brick, real stucco, block, and stone meet or exceed the 1-hour requirements.

Summary

Realistically, no home is fire proof! However, fire-resistant home construction, coupled with proper defensible space, provides firefighters an excellent opportunity to protect your home. In the absence of defensible space and firewise construction, firefighters may likely choose to locate resources elsewhere. Firewise construction need not be more costly than non-rated construction; in many cases it's less expensive!

The following table give examples costs for various sheathing and siding materials:

Material	Flame-Spread Class	Typical Use	Cost	Cost (\$ per sq ft)
T1-11	III	siding	\$31.17 per 4'x8' panel	0.97
masonite panel	III	siding	\$24.03 per 4'x8' panel	0.64
masonite plank	III	siding	\$6.49 per 8"x16' plank	0.62
cement fiber panel	I	siding	\$24.03 per 4'x8' panel	0.75
cement fiber plank	I	siding	\$5.32 per 8"x12'plank	0.73
1" log veneer (pine)	III	siding	\$0.76 per lineal foot	1.52
1/2" OSB	III	sheathing	\$10.94 per 4'x8' panel	0.34
1/2" gypsum sheetrock	I	sheathing	\$4.80 per 4'x8' panel	0.15
5/8" Type X exterior gypsum wallboard	I	sheathing	\$8.32 per 4'x8' panel	0.26

5/8" Type X interior gypsum wallboard	I	sheathing	\$5.44 per 4'x8' panel	0.17
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Other standards reviewed include the following:

National Fire Protection Association's NFPA 299: Protection of Life and Property from Wildfire (1991 Edition) - The purpose of NFPA 299 is "...to provide criteria for fire agencies, land use planners, architects, developers, and local government for firesafe development in areas that may be threatened by wildfire. Chapter 7 addresses structural design and construction including exterior vertical walls. Section 7-4 (Exterior Vertical Walls) states "Exterior vertical walls shall be constructed of at least 1/2-in. (12.7-mm) nominal sheathing or equivalent material and shall extend from the ground level to roof line."

International Fire Code Institute's Urban-Wildland Interface Code, First Draft (1995) - Section 504.5 Exterior Walls states: "Exterior walls of buildings or structures shall be constructed with materials approved for one-hour-rated fire-resistive construction on the exterior side or with noncombustible materials. Such material shall extend from the top of the foundation to the underside of the roof sheathing. This code makes an exception for heavy timber (log) construction. Exterior windows are required to be tempered glass or multilayered glazed panels. Exterior doors, other than vehicular access doors to garages, shall be noncombustible or solid core not less than 1 1/2 inch thick."

Issue 3: Decks and Porches

Objective: To minimize the ignition probability of wooden decks.

Problem: Wooden decks and porches are vulnerable to ignition by wildfire. Decks often overlook steep slopes, which increase wildfire rate of spread. Outdoor wood decking can become a significant hazard if fuels are allowed to accumulate beneath them.

Current County Requirement/Standard: Permits are required for desks whenever they are 30" or more above the ground. Decks must be self supporting when installed adjacent to a mobile or manufactured home. Unless the deck is self-supporting or bearing on a wall or foundation, a ledger board must be used.

Issue 4: Combustible Roofs

Objective:
potential from wind-embers.

Problem: Wood combustible roofing

factor increasing the likelihood of homes burning during wildfires. Wind-carried burning embers can ignite combustible roofs far ahead of the main fire. Investigators at the Stephan Bridge Road Fire (NFPA 1990) felt that the lack of combustible roofs played an important role in home survival.

Recommendation: No change in the current requirement is recommended. Homeowners should continue to be informed of the hazards of accumulating combustible material beneath wooden decks. Firewise deck materials should be promoted through the Public Awareness and Education Plan.

Minimize ignition carried burning

and other material is a major

Current County Requirement/Standard: Larimer County requires a class C roof covering along the front range east of the foothills. Roofing materials meeting the class C roofing requirement include asphalt composition shingles and wood shakes or shingles pressure impregnated with fire retardants (labeled by an approved agency as a class C roof covering and manufacturers installation requirements are followed).

A class B roof covering is required in the foothills and mountains; metal roofs, fiberglass shingles, and wood shakes or shingles pressure impregnated with fire retardancy (labeled by an approved agency as a class B roof covering and manufacturers installation requirements are followed) are acceptable.

If wood shingles or shakes are being installed, a roofing inspection is required after the shingles are dropped and before roofing is completed. It is the owners and contractors responsibility to get the proper classification of roof covering from the supplier and to be able to show the inspectors. Any repairs, additions, and reroofs exceeding 50% of the total roof during any one year period must comply with this requirement.

Advantages:
adequate.

Disadvantages:
continue to have when asked to wood roofs.

Background and
they are easily

Recommendation: Significant effort was put into developing the current roofing material requirement. A reasonable compromise was reached and the issue should not be reopened. However, efforts to inform homebuilders, architects and homeowners of the alternatives to combustible roofs should be addressed through the Public Awareness and Education Plan.

Current regulation is

Firefighters will second thoughts protect homes with

Discussion: Because ignited burning

embers, combustible wood roofs are a serious fire danger. A study of the 1990 Santa Barbara Paint Fire by the University of California found that 80% of the structures with wood roofing were destroyed. In contrast, 60% of the structures with fire retardant roofing survived the fire undamaged.

Larimer County has taken a major step to eliminate flammable roofing material by passing the roof covering ordinance described below. Though Larimer County requires Class B roofing materials in the wildland/urban interface, wood roofs (rated as Class B) are still allowed. During interface fires, the type of roofing material is a major factor assessed by firefighters to determine the defendability. Wood roofs, whether they are treated or not, are assumed to reduce the defendability of structures. There simply is not enough time to determine if wood roofs are treated with fire retardants.

Objective: To
to minimize wildfire

Issue 5: Building Location

locate building sites
hazards.

Problem: Homes are frequently built on slopes providing scenic views. However, slopes create natural wind flows that increase the spread of wildfire. Slopes with gulleys create a chimney effects that further increases fire spread. Compared to level ground, a 30 percent slope will double fire spread rates while, at the same time, cutting fire control effort in half. Homes built in dense forests also create problems as described in Issue 1.

Current County Requirement/Standard: No subdivision shall be approved where the design or related facilities clearly constitute the creation of a hazardous circumstance or lack of provision for the public safety (Larimer County 1994). Though the exact hazardous circumstance is not specifically defined, the county does require all subdivision applications where 10% of the subdivision has a slope of 30% or greater be submitted to the Colorado State Forest Service for review.

Advantages: No
would fall through
regarding wildfire

Recommendation: All new development within the Wildfire Hazard Area should be reviewed for wildfire hazards. A Wildfire Mitigation Plan should be required to address those hazards. Critical mitigation activities should become part of a development agreement to insure implementation.

new development
the cracks
review.

Disadvantages:
modify the review
MRDs and other

County may need to
procedure of
land divisions.

Background and Discussion: As mentioned above, subdivisions may be reviewed by the Colorado State Forest Service. Other land divisions do not have this requirement. Subdivisions with less than 10% of the area having a slope of 30% or greater may or may not be reviewed, regardless of surrounding terrain. (Most of the buildings in Pingree Park burned by the Hourglass Fire were on slopes significantly less than 30%.) Surrounding terrain and fuel type currently are not always considered during the review process.

Objective: To **Issue 6: Remote Location and Access** provide adequate access for emergency services equipment.

Problem: Response time of emergency personnel and equipment is obviously greater for homes in remote locations. Poor access often limits the ability of firefighters to defend structures. Steep, narrow roads also slow emergency response and evacuation of residents.

Current County Requirement/Standard: Current county requirements for subdivisions are generally acceptable. However, minimum usable surface for local roads should be raised from 16 to 24 feet (NFPA 1991, CSFS 1995). These standards do not apply to all other types of land divisions.

Advantages: standards will lead emergency response.

Disadvantages: with local roads

Background and Minimum usable local roads in

subdivisions is 16 to 24. NFPA 299 - *Protection of Life and Property from Wildfire* requires simultaneous access for emergency vehicles and the evacuation of residents shall be provided for by a traveled way of not less than 24 ft. The Colorado State Forest Service recommends a minimum all-weather gravel or paved roadbed of 34 feet.

Recommendations: 1) Minimum standards for driveways should be included in a defensible space requirement. 2) The Larimer County Engineering Department is currently upgrading road standards. The Wildfire Safety Coordinator should work with the engineering department to insure emergency access is considered as road standards are upgraded.

Improved road to quicker and safer

Road cost associated would increase.

Discussion: surface width for mountain

The Colorado State Forest Service recommendations for driveways are

1. Maximum grade of 12 percent.
2. Entrance to public roads as close to 90 degrees in angle for at least 25 feet from the edge of the public road as terrain will permit.

3. Minimum roadbed width of 16 feet with no curves or turns greater than 90 degrees.

IFC's Urban-Wildland Interface Code and NFPA 299 require a minimum width of 12 feet for driveways.

Objective: To water supply for firefighting

Issue 7: Lack of Water/Low Water Pressure

provide an adequate initial attack resources.

Problem: Piped

sufficient pressure and hydrants for firefighting are usually not available in rural Larimer County. Fire engines seldom are capable of providing enough water during interface fires. Homes served by individual wells often stop functioning during wildfires when utility poles burn and falling wires cut off electricity. Water pressure, especially in periods of drought, may not be sufficient for emergency use.

Current County Requirement/Standard: For one and two family units more than one mile from water lines capable of supplying required fire flow, total water supply on the grounds of the development shall not be less than 2000 gallons. For dwelling units with structural exposure hazard less than 50 feet away and greater than 1000 square feet, the total year round water supply shall not be less than 3000 gallons. Unless other wise specified, the water supply (Q) is computed by the following formula:

$$Q = \frac{\text{Volume of Proposed Structure}}{\text{Occupancy Hazard Classification}}$$

Advantages: eliminates a not supported by personnel, adds homebuilding, and enforced. No

Recommendations: 1) Eliminate the 2000 gallon requirement for single-family residences.
2) Continue to use the current water standards for development other than single-family residences.

Recommendation 1 requirement that is local fire service costs to is not consistently additional

regulation/requirement is needed.

Disadvantages: None noted.

Background and Discussion: The formula currently in use to calculate water supply in Larimer County is based upon National Fire Protection Standards. Total water supply is determined by

the total cubic footage of the structure divided by the occupancy hazard classification number 7 (Light Hazard Occupancies as defined by NFPA 1231 Chapter 3), multiplied by the construction classification number of 1 (as defined by NFPA 1231 Chapter 4). Multiple structures within 50 feet of each other and larger than 100 square feet will be considered a single unit in computing total volume (NFPA 1993). Use of the equation has caused confusion in the past. The proposed table will simplify calculation of water supply.

Objective: To
awareness of
among
realtors, developers,
and others living
the Wildfire Hazard Area.

**Issue 8: Homeowners Are Not Fully
Aware of Wildfire Issues**

improve the
wildfire issues
homeowners,
building contractors
and working within

Problem: Many people moving to the mountains and foothills of Larimer County may not be fully aware of potential wildfire hazards. Homeowners may not be aware of mitigation techniques available to minimize wildfire hazards.

Current County Requirement/Standard: None.

Recommendations: Improving the awareness and understanding of wildfire problems and solutions is critical to any successful mitigation program. A public awareness and education plan should be developed and implemented, with the Wildfire Safety Coordinator as the coordinator and focal point for plan activities.

All local fire suppression agencies, fire departments, homebuilders, county staff, insurance industry, and private citizens have a roll in public awareness and education.

Prescribed fire and forest management should be promoted as valuable tools available to minimize wildland fuels. A number of forested areas treated with thinning and prescribed fire have survived wildfires that severely burned adjacent untreated forest (Arno & Harrington, 1995). Low thinning (the removal of smaller trees) and selective cutting to favor healthy trees is a common practice among Tree Farmers in Larimer County. Many Tree Farmers annually burn slash piles to reduce excessive fuels. Prescribed fire, currently practiced on Arapaho-Roosevelt National Forest lands in Larimer County, can and should be implemented on appropriate state, local government and private lands.

A Public Awareness and Education Plan should be developed using the Wildfire Mitigation Matrix as a guideline.

Objective: To practices through

Issue 9: Lack of Financial Incentives

encourage firewise financial incentives.

Problem: Currently, homeowners in the wildland/urban interface have little, if any, financial incentives (i.e. reduced insurance rates) to create and maintain defensible space, improve access, etc. Incentives such as the Managed Forest Lands Act, which reduces property taxes if lands are managed for wood products, could be considered.

Current County Requirement/Standard: None.

Background and Wildfire

not borne solely by homeowners but by large (Close 1995). large, costly county, state, and our tax dollars) relatively low to little incentive for owners to mitigate For years the fire officials have asked to help with this Services Office, Inc. a program that may help address wildfire mitigation.

Recommendations: Work with insurance companies to inform elected officials, homebuilders, and homeowners on the Building Code Effectiveness Grading Schedule and associated insurance rates. In conjunction with the homebuilder's association and others, develop firewise construction information for distribution to homebuilders, building material suppliers, architects and homeowners. These tasks should be included in a public awareness and education plan. Continue to support the Managed Forest Lands Act.

Discussion:

suppression costs are the affected the population at In Larimer County wildfires are paid by federal agencies (i.e. which, coupled with insurance rates, leads wildland property their wildfire hazards. services and elected the insurance industry issue. The Insurance (ISO) has developed

Called the Building-Code Effectiveness Grading Schedule (BCEGS), this program assesses building codes of a particular community and how that community enforces those codes. Special emphasis is given to attempts to mitigate losses from natural hazards. The concept is simple: communities with effective codes that are well enforced should result in reduced losses. Insurance rates can reflect this lower risk! The prospect of lessening catastrophe-related damage and ultimately lowering insurance costs provides an incentive for communities to enforce their building codes rigorously (ISO nd). The anticipated results are safer buildings, less property damage and lower insured losses.

The BCEGS program will assign each community a BCEGS grade of 1(best) to 10 (no protection). ISO will develop advisory rating credits that apply to ranges of BCEGS classifications (1-3,4-7,8-9,10). BCEGS classifications, BCEGS advisory credits and related underwriting information will be provided to the insurance industry.

BCEGS's introduction is being phased in across the country over a five-year period through the year 2000. Colorado will be evaluated in 1998. Though hurricane and earthquake damage are the driving forces behind this program, wildfire losses have recently entered the ten most costly natural disasters. Hurricane Andrew, the most costly natural disaster, cost the insurance industry \$15.5 billion. The 1991 Oakland Fire, costing \$1.7 billion, is ranked as the fifth most costly natural disaster. Number 7 on the list is the 1992 Southern California fires. These fires cost the insurance industry over \$1.3 billion.

Though not approaching billions of dollars, local wildfires are also becoming more costly. Loss estimates on Boulder's Black Tiger Fire totaled \$10 million, and suppression costs were another \$1 million (NFPA 1989). Larimer County's 1994 Hourglass Fire cost \$1.5 million to put out. The estimated building loss was over \$2.2 million with an additional \$300,000 of conference revenue lost. Over \$380,000 were spent suppressing the 1996 Crystal Fire in Buckhorn Canyon. That's well over \$2000 per acre!

Objective: To address wildfire hazards during the land use planning process.

Issue 10: Land Use Planning

address wildfire land use planning

Problem: Development of wildland continues with little or no wildfire mitigation activities implemented prior to lot sales. Structures in these areas continue to be threatened by wildfire. Existing developments can only be addressed through codes. Future developments can be addressed during the planning process.

Current County Requirement/Standard: Requirements vary with development type and are summarized in the following table:

Development Type	Wildfire Review Requirements
Subdivision	Where applicable, hazard mitigation reports as required by the Larimer County Natural Hazards Resolution must be submitted to the Planning Department for review. The Planning Department can then distribute a copy of the application to the Colorado State Forest Service for review and recommendations regarding fire hazards for mountain subdivisions. The Subdivision Resolution does not require the Planning Department to distribute subdivision applications to the Larimer County Emergency Services; however, Planning Department does, as a matter of policy, submit application to Emergency Services.
Minor	The location of all potential hazards, including wildfire hazards, must be identified. Following

Residential Development (MRD)	receipt of a complete application, the application will be sent to appropriate county, state, federal and local agencies... Where applicable, hazard mitigation reports as required by the Larimer County Natural Hazard Resolution must be submitted. Plans to mitigate wildfire hazards shall be submitted to the State Forester for review. The applicant is responsible for paying fees required by the State Forester.
Minor Land Divisions	No review of wildfire hazards are currently required. Review only occurs if determined by the Planning Department.
Planned Unit Development (PUD)	No review of wildfire hazards are currently required, though requirements may be imposed to insure that the proposed development will...not create fire hazards.

Background and the boom years of early 1970's legislature to enact regulations. For 35 changed the subdivision and governments control land less than 35. Though Senate Bill rigorous review of indirectly growth of the interface by divisions of 35 acres or more from the subdivision review process.

Recommendations: 1) Designate a Wildfire Hazard Area, 2) all new development in the Wildfire Hazard Area should be reviewed for wildfire safety considerations, 3) require Wildfire Mitigation Plans for all new development as outlined in the *1993 Larimer County Hazard Regulations*, 4) approved Wildfire Mitigation Plans should become part of a development agreement, and 5) an approved year-round water supply should become part of the development agreement based upon the *Water, Sewer, and Fire Safety Standards and Procedures Manual*.

Discussion: During the late 1960's and encouraged the State far-reaching land use example, Senate Bill definition of the term gave local over all divisions of acres in size. 35 allowed for more subdivisions, it also contributed to the wildland/urban exempting land

Lands with no previous development approvals are the easiest to address in mitigation wildfire hazards. County regulations exist, but do not adequately address development in the wildland/urban interface. Colorado laws require regulations for subdivisions with lots under 35 acres in size; however, there are few requirements addressing wildfire issues for lands subdivided into lots over 35 acres. Minor residential developments and other types of land division often are not required to address wildfire issues.

Currently, if a proposed development is determined to be within a hazard area, the *1993 Larimer County Hazard Area Regulations* requires the applicant to submit three copies of the following:

- * An index map showing the general location of the development area
- * A map showing the location, nature and density of the proposed development or land use change.

- * In case of a wildfire hazard, a report and maps portraying the extent and severity of the wildfire hazard at the particular site.
- * A text explaining the above maps and cross-sections with particular emphasis on evaluating and predicting the impact of the hazard or hazards affecting the proposed development. Such reports shall also include mitigating procedures to be employed in meeting the purposes of this regulation.
- * All maps and reports prepared under this regulation shall be prepared by or under the responsible direction of a person having technical expertise in the field. Wildfire hazard analysis shall be performed by a professional forester with at least two years experience with wildfire hazards in the Rocky Mountain Region.

Objective: To minimize the hazards caused by venting

Issue 11: Propane Tanks

minimize the hazards caused by venting propane tanks.

Problem: Liquefied petroleum gas (LPG) presents both combustion explosion and fire hazards when released from confinement (NFPA 1991a). LPG is normally 1 1/2 to 2 times heavier than air, therefore, it will tend to flow like water.

Current County Requirement/Standard: Minimum distance from structure for 125 to 500 gallon tanks is ten feet. For 500 to 1200 gallon tanks, ten feet is required from building and property lines and 25 feet to other gas containers. Minimum distance for 1201 to 2000 gallon tanks is 25 feet, and for over 2000 gallon tanks is 50 feet.

Advantages: Placing propane tanks on the contour or downhill from a structure insures that in the event of a tank leaking, LPG will flow away from the structure. This would be a minor change in the current requirement.

Recommendation: In addition to the current standards, require all propane tanks be located on the contour or downhill from the structure and that all propane tanks be supported by a noncombustible solid surface.

Placing propane tanks on the contour or downhill from a structure insures that in the event of a tank leaking, LPG will flow away from the structure. This would be a minor change in the current requirement.

Disadvantages: Where homes are close together, placing a propane tank downhill from one structure may place the tank uphill from a second structure.

Background and Discussion: IFC's *Urban-Wildland Interface Code* refers to the Fire Code. The following table compares Fire Code requirements with current Larimer County requirements for aboveground containers:

Container Capacity (gallons)	Fire Code (UFC 1991) Minimum Distance from Structure (feet)	Container Capacity (gallons)	Larimer County Minimum Distance from Structure (feet)
< 125	5	125 to 1200	10
125 to 500	10	1201 to 2000	25
501 to 2000	25	> 2000	50
2001 to 30,000	50		
30,001 to 70,000	75		
70,001 to 90,000	100		
90,001 to 120,000	125		

The Fire Code also requires all weeds, grass, brush, trash and other combustible materials shall be kept not less than 10 feet from LP-gas tanks or containers.

Objective: To reduce emergency response times to

Issue 12: Fire Station Location

reduce emergency response times to a reasonable level.

Problem: Several areas within Larimer County are not serviced by a local fire department. Larimer County Emergency Services is responsible for wildfire suppression in these areas. Because Emergency Services responds from Fort Collins, response time in some cases is as much as 1 1/2 hours.

Current County Requirement/Standard: No county standard currently exists.

Background and unreasonable to times in rural similar to those in Poudre Fire standard response or less. A 15 to 20 is reasonable for departments. This accomplished fire department Larimer County.

Recommendation: Larimer County should encourage the development of fire departments and fire protection districts by expediting any land use review process for proposed fire stations, waiving or reducing fees associated with the review process and building permits for constructing fire stations, deferring property taxes for land set aside for future fire stations, and, during the land use review process, looking for opportunities to designate land for future fire stations, and other appropriate assistance.

Discussion: It is expect response Larimer County urban settings. Authority has a time of six minutes minute response time most rural can only be through support of development in rural

Objective: To save

Issue 13: Automatic Sprinklers

lives and property.

Problem: systems are issue and not a wildfire protection system.

Automatic sprinkler primarily a life-safety

Current County Requirement/Standard: If the water storage requirements as stated in the *Larimer County Water, Sewer and Fire Safety Standards and Procedures Manual* cannot be achieved, the alternative method of fire protection of residential sprinklers is usually required.

Background and Fire Protection show that 96 percent sprinklered controlled or sprinkler system, percentage of these more than two or 1993). In the 3 to 4 unsatisfactory following human (NFPA 1993):

Recommendation: No change in current county requirements at this time. Sprinkler systems are intended to save lives and property; any structure protection is secondary. External sprinkler systems, though used in other parts of the country, are not practical in the rural areas of Larimer County. Where water storage requirements cannot be met, residential sprinklers should continue to be required.

Discussion: National Association records of all fires in buildings are extinguished by the with a large fires controlled by no three heads (NFPA percent with performance, the failures were noted

- a) Sprinkler system was shut off and not in service.
- b) Fire Department shut off water to sprinkler heads before fire was completely

- extinguished.
- c) Fire department robbed sprinkler system of water supply.
- d) Fire department did not use fire department connection.
- e) Sprinkler system was not designed to protect existing contents or occupants.

The following discussion regarding water source for sprinkler systems is from NFPA 1231 *Water Supplies for Suburban and Rural Fire Fighting*: Sprinklered buildings are usually provided with a water supply such as an elevated tank, ground-level suction tank, or pond equipped with a fire pump. In a number of cases, a distribution system with hydrants is also provided. Ground level tanks, as well as elevated tanks, can be used by the fire department to supply water-hauling operation. Adequate provisions should be made by the fire department so as not to deplete the tank supply without also making provisions for refilling the tank at the conclusion of water-hauling operations.

Objective: To minimize the amount of heat entering windows.

Issue 14: Fire Shutters

minimize the amount structures through

Problem: Heat from wildfire can ignite flammable material inside structures through windows.

Current County Requirement/Standard: None.

Background and 299 Protection of from Wildfire all glazed openings concentrations of within 30 ft. Of the provided with closable, solid exterior shutters.

Recommendation: Homeowners, building contractors and architects should be informed of the costs and benefits of fire shutters and other firewise construction materials and home design.

Discussion: NFPA Life and Property (1991) requires that that face vegetative fuels openings shall be

Background and

threats of the identified as an

considered. A

reference to several

wood stoves, fireplaces, spark arresters, wind deflectors, hot water heaters, propane tanks, automatic gas shutoff, fire alarms to central dispatch centers, smoke detectors, and automatic fire extinguishing systems) was suggested. A review of most of these items is beyond the scope of this report; however, propane tanks and automatic fire extinguishing systems (i.e. sprinkler systems) are addressed.

Issue 15: Ignition Threats to the Structure Itself

Discussion: Ignition structure itself was issue to be

review of codes in items (furnaces,

Objective: To

embers from

through screened

Issue 16: Window Screens/Vents

prevent burning

entering structures

windows.

Problem: Burning embers can enter structures if no screens are present.

Current County Requirement/Standard: There are no code requirements for window screens. Screens are required for attic and other ventilation systems. All vents are required to be screened with a corrosion-resistant wire mesh with mesh not to exceed 1/4 inch in size.

Background and

299 Protection of from Wildfire

be screened with a corrosion-resistant, noncombustible wire mesh with the mesh not to exceed nominal 1/4 inch in size.

Recommendation: No change in the current requirements.

Discussion: NFPA

Life and Property

requires all vents to

Appendix C: Public Comments

Approximately 20 citizens attended this meeting. Brice Miller (Building Official) and Dan Kunis (GIS Specialist, Planning Dept.) attended and helped to answer questions. Eighteen citizens signed the attached attendance sheet. Stars by their names indicate they want to be notified of the final hearing. The meeting began with an introduction by Bob Gann, Chief of Rist Canyon VFD. A brief slide presentation defining the wildfire problem, was followed by a review of all recommendations. After a short break, questions & answers, comments, concerns, etc. were fielded from the citizens. A flip chart was used to capture all comments. These comments are as follows:

Summary of Public Meeting at Stove Prairie School

August 27, 1996

1. Use National Guard crews to maintain/improve existing [private] roads.
2. Tree Farm, Forest Agriculture, and other forest management plans that address wildfire mitigation could be considered Wildfire Mitigation Plans.
3. The current water storage regulation needs to be better defined. Some concern over inconsistency of enforcement of this regulation.
4. Type V 1-hour exterior wall construction is not practical.
5. Propane tanks located downhill from home may be uphill from the neighbors home.
6. There needs to be a way to do prescribed burns on small, private areas.
7. Incentives preferred over regulations.
8. Incentives for forest management on smaller properties [< 40 acres]. What is more costly, incentives or the cost of fire suppression. Some people felt the incentive is a personal responsibility to protect your own property.
9. Education (i.e. Code of the West) rather than new regulations. Attach to building permit or deed.
10. Realtors should be required to educate new home owners about wildland fires and urban interface.
11. Slash disposal is a problem. Needs to be a way for landowner to dispose of the stuff. Glacier View is an example of the local community addressing this problem. An area is designated for slash piling; pile is burned as a training for the fire department. Can state, federal, and county lands be used in this manner?
12. County should support VFD/FPD fire stations (i.e. waiving building permit fees, providing land, excavation, water supply).
13. Subdivision incentive for the developer to provide fire station location.
14. No matter what you do, some fires will burn any house. What gives the county the right

- to dictate how to build the house?
15. Incentive #1, best incentive is personal responsibility to protect your property.
 16. No monetary incentive are needed from any government at any level.
 17. Guidelines and standards for new and existing developments and property too.
 18. The landowner is responsible.
 19. No new ordinances!
 20. Suggested ordinance: If there is a fire on a property, and the property has not been brought up to the guidelines and standards (i.e. defensible space), landowner is liable for loss on the property, and if proven negligent [following county sheriff investigation/county attorney], also liable for losses resulting from that fire caused on other property. Probably only for human ignitions, not lightning.
 21. Who pays for road improvements on existing roads when new homes are built that use the existing road as access?
 22. Any regulations, guidelines or standards should apply to all types of development and ~~non-developed~~ (unimproved lands).
 23. All building codes, land use regulations, standards and guidelines for the wildfire hazard overlay zone should be place in one document.
 24. What is the time frame for implementation of any regulation that passes?
 25. How will existing home be regulated? Same as new construction? Nothing? Additions?
 26. Is education enough? People doing the work are doing it well. Do we focus on education?
 27. The lending industry needs to be involved. Should be represented on task force.
 28. Defensible space is preferred over 1-hour exterior wall construction.
 29. Defensible space makes good sense. But we moved up here to get away from regulation.
 30. Communications is an issue for suppression forces.
 31. Water supply - define how close water needs to be, what are acceptable water sources.
 32. County, state, and federal lands are not being managed to reduce fuels.
 33. Need public awareness signs.

Nineteen meeting. Brice Official), David Enforcement Kunis (GIS Dept.) attended and

Summary of Public Meeting at Glacier View Community Center
September 3, 1996

citizens attended this Miller (Building Korth (Code Officer) and Dan Specialist, Planning helped to answer

questions. Stars by names on the attached sign-in sheet indicate they want to be notified of the final hearing. The meeting began with an introduction by Jim Foster, Chief of Glacier View Fire Protection District. A brief slide presentation defining the wildfire problem, was followed by a review of all recommendations. After a short break, questions & answers, comments, concerns, etc. were fielded from the citizens. A flip chart was used to capture all comments.

These comments are as follows:

1. Using cellular phones purchased outside Larimer County to dial 9-1-1 does not get local 9-1-1 operators.
2. Much confusion on the current 2000 gallon water storage requirement.
3. 100' radius too great for roads. 60' is adequate.
4. Current county standard for road grade is 10%. Maximum of 10% with a variance of 12% is adequate. 15% for driveways is adequate.
5. No objection to 20' road width as a minimum standard.
6. Keep in mind that access is needed for other emergency vehicles (i.e. ambulance), not just fire trucks.
7. Use of a point system for defensible space, water, terrain, access, etc. to get building permit. Provides options.
8. Terrain makes road standards difficult for some landowners to meet.
9. How would these proposals affect 35-acre parcels?
10. In reference to 35-acre parcels, can public safety override state statutes?
11. What about fuels management on vacant property?
12. Define improvements agreement as it applies to fire mitigation.
13. What are the guidelines for a fire mitigation plan?
14. What encouragement (\$) can the county provide for building fire stations?
15. What part of building fees would go back to appropriate fire stations/fire departments?
16. Research needed on use of 2000 gallon water storage requirement. Why lack of enforcement? Needs clarification! Need standards for locations, fittings, etc.
17. Would a fire district rather have \$200 donation or 2000 gallon cistern? Answer from fire chief: \$200.
18. Reason for lack of enforcement on the 2000 gallon storage...it's not feasible!
19. Some lands (parcels) should not be built on because of wildfire hazards and other things.
20. The concept of defensible space is reasonable. Implementation [regulation, incentive, education] is the question.
21. Some people think an ordinance is just more "BIG GOVERNMENT"...more Commissioner interference.
22. Some regulation is necessary for public safety!
23. Some people think 35-acre parcels should be looked at for wildfire hazards, while other don't think so.
24. All forest landowners have a responsibility for managing fuels.
25. Concerns regarding costs of building materials (i.e. the 1-hour exterior construction).
26. There are certain risks some people should be able to take.
27. "Code of the West" needs to get into the hands of potential mountain property owners (especially people within fire hazard areas) early in the process.
28. Lack of grazing and forest management is cause for fuel buildup.
29. Review NFPA standard for dry hydrants for practicality in Larimer County.

Twenty-
attended this
Korth (Code
Officer), Dan Kunis
Planning Dept.),
District Forester),

**Summary of Public Meeting at the Estes
Park Library**

September 19, 1996

three citizens
meeting. David
Enforcement
(GIS Specialist,
Mike Babler (CSFS
Bill Nelson

(Emergency Services), and Don Griffith (Emergency Services) attended and helped to answer questions. Stars by names on the attached sign-in sheet indicate they want to be notified of the final hearing. The meeting began with an introduction by Alice Gray of the Estes Valley Improvement Association. A brief slide presentation defining the wildfire problem, was followed by a review of all recommendations. After a short break, questions & answers, comments, concerns, etc. were fielded from the citizens. A flip chart was used to capture all comments. These comments are as follows:

1. There is confusion as to who is in and who is not in the local [Estes Park] fire district.
2. There is a need to bring existing development towards fire safety.
3. Homeowner restrictive covenants can be more restrictive than county regulations.
4. Provide information to insurance industry on fire hazards.
5. 7% grade on curve should be maximum for road standards.
6. Road intersection of 90 degrees is difficult on steep terrain.
7. Road design should fit contour of land. Keep flexibility in road standards.
8. Type of emergency response vehicles should control road standards.
9. Circulation roads should be designed for use by emergency vehicles (fire trucks).
10. All of Larimer County [i.e. county and cities] should have one [combined] building department (code).
11. Subdivisions should be rated by hazards and [insurance] premiums should be appropriate. Should include response time.
12. For existing subdivisions insurance incentives may be the way to encourage responsible fuel management.
13. Slash treatment in older subdivisions is a concern.
14. [Definition of] new development should include ~~new development~~ in old subdivisions.
15. If mitigation standards are not met by developer, then no building permits should be approved.
16. It ~~is~~ important where fire stations are located.
17. Tie existing and potential housing density to response time and location of [future] fire stations.
18. Dedication of land for fire station is not enough! There ~~is~~ a need for fire protection.
19. Need to standardize adequate connection to water storage, for fire-fighting.
20. 2000 gallons of water isn't ~~it~~ enough.

21. Scattered water supply not efficient.
22. [Recommendation] B-10 - take out [the word] proposed.
23. Hazards for wildfire areas should be treated by insurance companies similar to flood hazards.
24. Need more input from experts in planning, building, engineering, foresters, etc. [during the planning process].
25. You can enforce defensible space on new construction...but what about existing homes?
26. Need better communication between government agencies and the citizens. People building large campfires/bonfires that concern neighboring property owners.
27. An ordinance is reasonable for new construction re: defensible space.
28. [Wildfire] is a community issue (public safety).
29. Everyone should be able to take their own risks.

Only three meeting. Brice Official), Dan Kunis Planning Dept.), and District Forester) to answer questions.

Summary of Public Meeting at Crystal Lakes Community Building
September 24, 1996

citizens attended this Miller (Building GIS Specialist, Mike Babler (CSFS attended and helped Stars by names on

the attached sign-in sheet indicate they want to be notified of the final hearing. A brief slide presentation defining the wildfire problem, was followed by a review of all recommendations. Questions & answers, comments, concerns, etc. were fielded from the citizens during the review. A flip chart was used to capture all comments. These comments are as follows:

1. Slash disposal? Where? How? Need to look at developing slash disposal drop off areas.
2. Encourage USFS, CSFS, and County to manage their open space/forested lands.
3. All dead end roads should be marked appropriately, including public and private roads (driveways?).
4. Minimum size for lettering for address numbers and mailboxes.
5. Continue to hand out defensible space brochures with building permits.
6. People should be able to build a home wherever they want...but they should take responsibility for hazard and loss.
7. Certificate of occupancy should be contingent upon creating adequate defensible space.
8. Who's going to define and inspect defensible space?
9. Type V 1-hour fire resistant construction not feasible to regulate.
10. 16' minimum width roadbed for driveway hard to attain. Length of driveway and curvature problems. Turn-arounds are problem too.
11. Involve media for public safety programs (TV, radio). Put in middle of Bronco's games!
12. Wildfire Safety Inspector could be located in Sheriff's Emergency Services Department.

Thirteen
attended this
Miller (Building
(GIS Specialist,
Mike Babler (CSFS
Bill Nelson

**Summary of Public Meeting - Larimer
County Courthouse**

October 1, 1996

people (six citizens)
meeting. Brice
Official), Dan Kunis
Planning Dept.),
District Forester),
(Emergency

Services), and Roger Tarum (Arapaho-Roosevelt National Forest) attended and helped to answer questions. Rick Whitworth (State Farm) attended and helped answer questions involving the insurance industry. Rick will be on the Wildfire Safety Task Force. Stars by names on the attached sign-in sheet indicate they want to be notified of the final hearing. A brief slide presentation defining the wildfire problem, was followed by a review of all recommendations. After a short break, questions & answers, comments, concerns, etc. were fielded from the citizens. A flip chart was used to capture all comments. These comments are as follows:

1. There are some areas where it is difficult to meet minimum road standards (grades, switchbacks, etc.).
2. If you're going to have access, there should be a minimum standard requirement.
3. Standardize width of cul-de-sacs for turnarounds.
4. Road names and signs on current development needs improvement, standardization & maintenance.
5. Fire mitigation for all development needs to be addressed.
6. Volunteer Fire Departments have no legal obligation for fire mitigation/education/inspection. Is this a problem?
7. Review process [listed in the recommendations] needs to be implemented and enforced; it's only logical!
8. What is current requirement for building [or establishing] fire departments?
9. Should Colorado State Legislature create State Fire Marshall position?
10. Create County Wildfire Safety Inspector position.
11. The Wildfire Safety Inspector position could make fire mitigation consistent.
12. Individuals living in fire-hazard areas need to be responsible for themselves (water supply, defensible space, etc.) This aids in community safety.
13. Development review process needs to address 2000 gallon water storage requirement (planning, building, emergency services) for it to be effective.
14. Some older subdivisions have dangerous building sites (parcels, lots). There needs to be flexibility and compromise to allow new construction (defensible space, fire resistant building material, water storage, access, etc.)
15. [There needs to be more public] fire education regarding fire chimneys, danger, and risk.
16. Defensible space ordinance is absolutely essential for old and new construction.

17. If neighbors don't implement defensible space it defeats the purpose for neighbors who do.
18. Because of increase in population/housing in fire hazard areas, education may not be enough to provide public safety. Regulations may be needed.
19. Education is important!
20. There is a need for an organized effort to educate public regarding dangers associated with living in fire hazard areas.
21. Utilize road associations as vehicles for education.
22. [Use post cards] for homeowners & road associations for response to fire mitigation activities [to find out if educational programs lead to action].
23. Construction design features sometimes defeat the precautions taken by using fire resistant construction materials. Are design guidelines needed?
24. Three critical issues re: home fire prevention (wildfire):
 1. Roofing material
 2. What's around the home ([vegetative] fuels)
 3. Construction material of house
 (Comment from an insurance disaster inspection standpoint)
25. What are options for providing one-hour defensible construction.
26. Would like to see more field-underwriting from the insurance industry.
27. Insurance premiums should reflect risk.
28. [There is] lots of talk about increased population and housing in forested areas, but not enough talk about the conditions for our national/public forests. Lack of management (timber/fuels, standing, down and dead material).

Thirteen representing nine agencies attended slide presentation problem, was of all

Summary of Comments - Larimer Fire Council
October 2, 1996

individuals fire departments or this meeting. A brief defining the wildfire followed by a review recommendations.

After a short break, questions & answers, comments, concerns, etc. were fielded from the citizens. A flip chart was used to capture all comments. These comments are as follows:

1. The real focus is on private lands.
2. Road system standards should apply county-wide.
3. Road surface should be all-weather.
4. Requirements for Wildfire Mitigation Plan - keep them simple but effective.
5. What percentage of new home construction is projected in existing parcels versus new development?
6. [Items] B-6 and B-7 need to go hand-in-hand. [Land Use Review and Improvements

Agreement].

7. Do volunteer fire departments want to review all new development?
8. Wildfire Safety Inspector [must] coordinate with local fire departments.
9. Are any fees transferrable to local fire departments?
10. County could subcontract with fire departments that want to do inspections/review.
11. Look at homeowner associations and covenants to include mitigation requirements.
12. Maintenance of defensible space? Like a weed ordinance? Education? Insurance companies?
13. Exterior wall construction by itself [without defensible space] doesn't accomplish much.
14. [Need to review] LP tank distance from house.
15. Driveway requirements to strict as written.
16. Cisterns are a waste of time and money.

Appendix D: Wildfire Mitigation Plans - Standards and Guidelines for Land Developers and Foresters

Wildfire Mitigation Plans Standards and Guidelines for Land Developers and Foresters

Purpose

The Wildfire Mitigation Plan Standards and Guidelines is provided as a supplement to the *Larimer County Hazard Area Regulations* to assist developers, planners, foresters, and others in development of wildfire mitigation plans.

Mitigation Plan Objectives

The primary objectives of wildfire mitigation plans are 1) to provide adequate infrastructure for reasonably safe ingress/egress for property owners and firefighters during a wildfire, and 2) to improve opportunities for successful fire suppression operations. Wildfire mitigation plans should focus on local access roads, community water supply, and fuels management. This document addresses fuels management.

Definitions

Aspect - the cardinal direction that the land surface faces.

Wildfire Hazard Rating - a word or letter used to describe or designate the wildfire hazard severity of an area.

Fuel - vegetation, debris, or other substances that will support combustion.

Fuelbreak - a strategically located strip of land, variable in width, on which the vegetation has been modified to reduce the rate of fire spread so that fire suppression forces can be utilized in relative safety to control a wildfire.

Fuel modification - manipulation or management of fuels to render them less hazardous when subjected to wildfires. The term usually includes, but is not limited to, standing trees and/or brush.

Slash - vegetative debris left after cutting or thinning operations in forest or brush areas and which requires treatment.

Slope - the gradient of the ground surface measured in percent.

Spot fire - a wildfire starting outside the main wildfire perimeter due to rolling, blowing, or falling firebrands from the main wildfire.

Wildfire - an uncontrolled fire burning in vegetation, structures, or other improvements.

Wildfire behavior - the predictable action of a wildfire under given conditions of fuels, weather, and topography.

Wildfire hazard - a wildfire phenomena which is so adverse to past, current or foreseeable construction or land use as to constitute a significant hazard to public health, safety, or property. The term includes but is not limited to the combined affects of slope, aspect, wildfire behavior, and existing vegetation.

Wildfire hazard area - an area containing or directly affected by a wildfire hazard.

Wildfire Hazard Mitigation Area - that area identified by Larimer County as an area with significant wildfire hazards.

Elements of A Wildfire Hazard Mitigation Plan

Plan date

Development area/name

Current Fire Protection

Property description

Topography - slopes, aspect, topographic features that present significant potential wildfire behavior problems.

Vegetation

Access (see *Larimer County Road Policy & Standards Manual* or the current County standard)

Water supply/sources (see *Larimer County Water, Sewer, and Fire Safety Standards and Procedures Manual* or the current County standard)

Copy of Site Plan outlining proposed access and building envelopes

Wildfire Hazards Present

Copy of Wildfire Hazard Map (copies can be purchased from the Larimer County Planning Department).

Wildfire hazards: Total acres and acres in each Hazard Class as shown on the Wildfire Hazard Map (refer to Appendix I)

Mitigation actions recommended. Appendices II, III, and IV are to be used as guidelines when developing mitigation actions.

Technical Assistance Available

Technical assistance is available from consulting foresters or the Colorado State Forest Service. For further information contact the Colorado State Forest Service at (970) 491-8660.

Appendix I: Guidelines for Identifying Wildfire Hazards

Introduction and Purpose

These guidelines represent the basic procedures for Wildfire Hazard Area Mapping (WHAM) for state and private lands in Larimer County. This system of wildfire hazard mapping is currently being used by Rocky Mountain National Park and the Arapaho-Roosevelt National Forest; therefore all wildlands in Larimer County are now using the same basic format to rate wildfire hazards. The primary purpose of this document is to slightly modify the current wildfire hazard area mapping procedures used in the past by the Colorado State Forest Service to bring all lands under one hazard rating system.

It is intended that this system of wildfire hazard rating be placed on each agency's geographical information system for use by agency personnel as well as county planners, fire departments, developers, Colorado State Forest Service and others.

Wildfire Hazards

Wildfire hazard is defined as the relative likelihood that a wildfire, once started, will become disastrous (Fahnestock 1971). Though predicting exactly when and where disastrous wildfires will occur can be done with little accuracy, wildfire hazards that are based upon forest cover type and fire regime are valuable indicators of wildfire potential.

Using historical wildfire data, Larimer County can expect approximately 20 fires greater than 100 acres in size every ten years (Farmer 1996). How many homes, if any, which may be threatened, damaged or destroyed is anyone's guess. A recent study (Jones 1992) estimated that Larimer County has 148,000 acres of wildland/urban interface. Fifty-seven percent of the subdivisions within this interface have a high fire loss potential (Farmer 1995).

Information Needed

STEP 1 Vegetative Cover Type - determine if the site is forest land, nonforest land, or water. Then code the appropriate cover type. Cover types are named for the one plant species that is presently (not potentially) dominant, using canopy cover as the measure of dominance. Table 1 summarizes the local cover types.

Table 1. Summary of local cover types.

CODE	R2RIS Field Name
TRJ	Rocky Mountain Juniper
TSF	Engelmann spruce/subalpine fir
TBS	blue spruce
TBC	bristlecone pine
TLP	lodgepole pine
TLI	limber pine
TPP	ponderosa pine
TCW	cottonwood and tree willows
TAA	aspen
TDF	Douglas-fir
GRA	grassland
SHR	shrubland
NFL	non-vegetated sites

STEP 2 Habitat Structural Stage - determine the habitat structural stage as described in *Managing Forested Lands for Wildlife*. This includes determining crown cover percentage. Table 2 summarizes characteristics of each structural stage.

Table 2. Summary of habitat structural stage characteristics.

Structural Stage	Valid Code	Stand Size Class	Diameter Range for Most Trees	Crown Cover %
GRASS-FORB	1	nonstocked	any	0-10
SHRUB-SEEDLING	2	seedling/sapling	< 1.5" diameter	11-100
SAPLING-POLE	3a	seedling/sapling or poletimber	1.5" to 9" diameter	11-40
	3b	☺	☺	41-70
	3c	☺	☺	71-100
MATURE	4a	sawtimber	9" and larger	11-40
	4b	☺	☺	41-70
	4c	☺	☺	71-100
OLD GROWTH (Over mature)	5	poletimber or sawtimber	trees generally 150 years or older	71-100

STEP 3 Slope - determine slopes greater than 30%. Slope steepness simulates wind in its effect on fire spread. Changing from level ground to a 30 percent slope approximately doubles rate of spread of surface fires.

STEP 4 Aspect - determine south and southwest facing aspects.

STEP 5 Wildfire Hazard Class - determine Wildfire Hazard Class. As with Fahnestock's Classification, the five wildfire hazard classes used are based upon expected wildfire behavior as described in Table 3. Information on mitigating wildfire hazards is provided in Appendix B. Based upon fire behavior, five classes appear adequate to distinguish significantly different levels of wildfire hazard. The likelihood of crown fire occurrence is the prime criterion for defining three classes. A fourth class represents non-arboreal fuels that can support high-intensity wildfires under some circumstances. For completeness, a fifth class includes all examples of a ☺zero hazard.

Table 3. Summary of fire behavior and vegetation characterizing Wildfire Hazard Classes.

Hazard Class*	Expected fire behavior	Cover types (and associated habitat structural stages)
O	None	None (open water, bare rock, cultivated field, etc.)
LOW	Low intensity/short duration - flame lengths 0-4 feet, higher flareups rare; duration of highest flames brief; fire spread slow to fast, 1-40 acres/hour; spotting rare, short range.	Aspen Douglas-fir (1,2,3a,3b,4a) Limber pine (1,2,3a,3b,4a) Lodgepole pine (1,2) Mountain Meadow Ponderosa pine (1,2,3a,3b,4a) Riparian Spruce/Fir (1,2)
MODERATE	Moderate intensity/longer duration - flame lengths 4-8 feet, intermittent flareups occurring to many feet above tree tops; short and medium range spotting common; behavior between flareups as in LOW class.	Douglas-fir (3c) Limber pine (3c,4b,4c,5) Lodgepole pine (3a,4a,4b) Ponderosa pine (3c,4b,4c) Spruce/Fir (3a,4a)
HIGH-t	High intensity/long duration - flame lengths greater than 8 feet, flareups higher than trees frequent to continuous; spread up to several hundred acres/hour; fire front impassible; spotting several hundred yards common, possible to a mile or more.	Douglas-fir (4b,4c,5) Lodgepole pine (3b,3c,4c,5) Ponderosa pine (5) Spruce/Fir (3b,3c,4b,4c,5)
HIGH-s	High intensity/medium duration - flame lengths 5-20 feet, of brief duration; fire spread usually fast, at least 40 acres/hour; short range spotting common from blowing leaves.	Mountain Shrub Sagebrush

* If the aspect is south or southwest, and/or if and slope is greater than 30% increase Hazard Class one category. If slash is present in significant quantities, increase Hazard Class one category.

Treatments & Modifications by Hazard Class
(Adapted from *Guidelines and Criteria for Wildfire Hazard Areas, CSFS 1974*)

LOW Wildfire

Hazard Class (Class

L)

Mitigation Procedures - Little or no mitigation is necessary except as noted (2) below. Fire protection is necessary since some LOW hazard fuels ignite very easily and burn very rapidly. Consequently, numerous, large but low-intensity fires may occur in these areas.

- (1) Avoidance: Usually not necessary.
- (2) Nonconflicting uses: Nearly all uses are compatible with this hazard class. Exceptions could be schools, hospitals, nursing homes and other developments for children, invalids or elderly if no other precautions are taken.
- (3) Modifications and treatments: Usually none. Developments for children, invalids or the elderly must be located in areas that are:
 - (a) separated from natural fuels by roads, parking lots, playgrounds, watered landscape, or
 - (b) separated from natural fuels by elimination of the fuels in a 12-foot to 14-foot wide strip around the development through quarterly discing , or
 - (c) use of fire retardant chemicals on the fuels, or
 - (d) prescribed burning the fuels, or
 - (e) a combination of these methods.

MODERATE Wildfire Hazard Class (Class

M)

Mitigation Procedures - mitigation should accompany development in MODERATE hazard fuels. Good wildfire and structural fire protection is needed in these areas.

- (1) Avoidance: Whenever possible, MODERATE hazard fuels should be avoided when LOW hazard fuels are available and can accommodate the same development.
- (2) Nonconflicting uses: Without modification or treatment, nonconflicting uses include agriculture, mineral extraction, forestry, grazing, recreation, roads, energy transmissions, greenbelts, open space; with modification or treatment additional nonconflicting uses include camping, single family dwellings, small retail businesses, schools, nursing homes, hospitals, and planned urban development.
- (3) Modifications and treatments: MODERATE hazard fuels can usually be lowered to a hazard rating of LOW if modified correctly through thinning, pruning, grouping or the use of fuelbreaks. On-the-ground prescriptions for modifications must be made and work approved by a graduate forester with at least two years fire experience in the Rocky Mountain area. Untreated slash will raise the hazard rating one level. Developments for children, invalids or the elderly must be in areas rated as LOW or treated as in section I(3).

HIGH-trees Wildfire Hazard Class (Class

H-t)

Mitigation Procedures - Mitigation must be practiced for all development in the HIGH-t hazard class. Good wildfire and structural fire protection is a must for developments in these areas.

- (1) Avoidance: HIGH-t fuels must be avoided in all but exceptional or absolutely necessary cases. Whenever LOW or MODERATE fuels are available and can safely accommodate the same development, they should be the preferred areas to develop. Goals should be to prevent conflicting development in HIGH-t areas.
- (2) Nonconflicting uses: Without modification or treatment, nonconflicting uses include agriculture, mineral extraction, forestry, grazing, recreation, roads, energy transmission, and open space; with modification or treatment, additional nonconflicting uses include camping, single family dwellings on large lots, small isolated businesses, clustered multiple family dwellings or planned urban development.
- (3) Modifications or treatments: The HIGH-t hazard class may be lowered to a MODERATE hazard (rarely a LOW hazard) if modified correctly through thinning, pruning, grouping or use of fuelbreaks. **It is strongly recommended that on-the-ground prescriptions for modifications must be made and work approved by a graduate forester with at least two years fire experience in the Rocky Mountain area.** Untreated slash will compromise all modification work.

HIGH-shrubs Wildfire Hazard Class (Class H-s)

Mitigation Procedures - Mitigation by fuel modifications and treatments, though often difficult, is necessary. Avoidance and nonconflicting use are the best procedures until better techniques are found. Good fire protection is highly desirable but may not be able to provide the adequate protection in HIGH-s fuels.

- (1) Avoidance: HIGH-s fuels must be avoided for all conflicting uses. Whenever other fuel classes are available and can safely accommodate the same development, they must be the areas developed. The only sure way to reduce or eliminate losses in HIGH-s fuels is to avoid them.
- (2) Nonconflicting uses: With partial treatment, nonconflicting uses include agriculture, grazing, roads, buried pipelines, and open spaces. With complete clearing of brush except for occasional, widely-spaced individual plants, all uses as outlined in Section I(2) will become nonconflicting, provided that the brush can be kept from returning and that water quality for surface run-off will sustain no adverse effects.
- (3) Modifications and treatments: Except for complete removal with heavy equipment, most HIGH-s fuels cannot be easily modified or treated. Some species are resistant to normal herbicide treatments since such treatments may encourage increased fuel density by promoting a species' sprouting abilities. Repeated herbicide applications over several years may kill most of the brush, but environmental standards may not allow such a practice.

Nearly all species respond favorable to burning with vigorous new sprouts and regrowth. Pruning is possible but costly and may result in new sprouting. Reduction of fuels by grazing of domestic livestock is often questionable since at least one species (oakbrush) is toxic to animals at certain times of the year. Complete removal of roots and stems by heavy equipment will reduce wildfire hazard, but in the process soils will be highly disturbed and exposed to erosion. Complete removal of the brush may also destroy aesthetics and the reasons that prompted development to be located there in the first place. Slightly lower wildfire hazards can be obtained if wide, grassy, inter-connected openings (fuelbreaks) exist between clumps of brush and the openings can be kept free of invading brush. **It is strongly recommended that partial modification of HIGH-s fuels must be under the supervision of a graduate forester or range scientist with at least two years fire experience in the Rocky Mountain area.**

Numerical comparison of wildfire hazard classes is not possible because many different considerations are involved. Classes LOW and HIGH-s are most likely to have fires that spread rapidly because of the abundance of fine surface fuels that dry rapidly and are exposed to the wind. In the LOW Hazard Class, the threat to life is negligible, fires can be controlled relatively easily, and property damage occurs only where fuels are tolerated right up to structures. Fires that occur in the HIGH-s Hazard Class when the brush is dry can burn with sufficient intensity to endanger life and ignite structures at some distance. Quite troublesome destructive wildfires have occurred in Class HIGH-s. The usual fire in Classes MODERATE AND HIGH-t is slow-spreading, of low intensity, and easily controlled. However, dry conditions coupled with wind or steep slopes can produce the type of inferno, typified by the Hourglass Fire of 1994, that would could wipe out a residential development in minutes.

Appendix III: Wildfire Crowning Potential

Crown fires are divided into three class:

Passive crown fires - those in which trees torch as individuals, reinforcing the spread rate, but are not basically different from surface fires.

Active crown fires - those in which a solid flame develops in the crowns, but the surface and crown phases advance as a linked unit dependent on each other.

Independent crown fires - those in which the fire advances in the crowns alone.

The conditions under which crown fires are likely to occur are those that produce fireline intensities in surface fires beginning in the 500 to 1000 Btu/foot/second range. This usually requires hot, dry conditions with strong winds or steep slopes. An overstory that is conducive to carrying or sustaining a crown fire is also required. A goal of fuels management is to reduce the likelihood of crown fires.

Fahnestock (1970) developed a crowning potential key that identifies the nature of ladder fuels spacing and general tree crown characteristics that lead to crown fires. Fuel modification is needed if the Crowning Potential Rating is > 3 .

An on-site visit is required to assess the potential of a wildfire to be carried into tree crowns. The following key is provided to determine this rating. Fuel modification is necessary if an area has a rating greater than 3.

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%.....9
GG. Crown closure less.....7
FF. Ladder fuels sparse or absent - H
H. Crown closure > 75%.....7
HH. Crown closure less.....5
EE. Foliage open - I
I. Ladder fuels plentiful.....4
II. Ladder fuels 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%.....7
LL. Crown closure less.....4
KK. Ladder fuels sparse or absent - M
M. Crown closure >75%.....5
MM. Crown closure less.....3
JJ. Foliage open - N
N. Ladder fuels plentiful.....3
NN. Ladder fuels sparse or absent.....1
BB. Foliage dead - O
O. Crowns dense - P
P. Ladder fuels plentiful - Q
Q. Canopy closure >75%.....10
QQ. Canopy closure less.....9
PP. Ladder fuels sparse or absent - R
R. Canopy closure >75%.....8
RR. Canopy closure less.....4
OO. Crowns open - S
S. Ladder fuels plentiful.....6
SS. Ladder fuels sparse or absent.....2
AA. Foliage absent, trees dead - T
T. Average distance between trees 33 feet or less - U
U. Ladder fuels plentiful - V
V. Trees with shaggy bark and/or abundant tinder.....10
VV. Trees not as above.....8
UU. Ladder fuels sparse or absent - W
W. Trees with shaggy bark and/or abundant tinder.....10
WW. Trees not as above.....5
TT. Average distance between trees > 33 feet.....2

(Modified from
for Forested
C. Dennis, 1983)

Appendix IV: Fuelbreak Guidelines

Fuelbreak Guidelines
Subdivisions by Frank

Introduction

This information is designed for use by foresters, planners, developers, and homeowners. It cannot guarantee safety from all wildfires but will greatly increase the probability of preventing or containing them at manageable levels.

Colorado's forested lands are experiencing severe impacts from continuing population increases, energy development, and people's 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 areas such as Dillon, Vail, and Steamboat Springs.

But with development inevitably comes a higher risk of wildfire and an ever-increasing potential for loss. Methods of fire suppression, pre-suppression needs, and homeowner and fire crew safety must all be considered in the planning and review process for new developments.

Fuelbreaks should be considered in fire management planning, but the following are guidelines only. They should be customized to local areas by professional foresters experienced in Rocky Mountain wildfire suppression.

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 fuel modification.

A firebreak is an area, 20 to 30 feet wide (or more), in which **all** vegetation is removed down to mineral soil. It is reworked and maintained each year prior to fire season.

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 management.

Fuelbreak Limitations

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

They can greatly aid firefighters by slowing fire spread under normal burning conditions. However, under extreme conditions, even the best fuelbreaks stand little chance of arresting a large fire, regardless of firefighting efforts. Such fires can drop firebrands 1/8 mile or more ahead of the main fire, and may continue until there is a major change in the weather conditions, topography, or fuel type.

Most important: The fuelbreak is the line of defense. The area (including developments) between it and the fire will be sacrificed.

In spite of these somewhat gloomy limitations, fuelbreaks have proven themselves effective in Colorado. During the 1980 Bear Trap Fire near the Crystal Lakes Subdivision in Larimer County, crown fires were stopped in areas with fuelbreak thinning, while other areas of dense lodgepole pine burned completely.

The Need for a Fuelbreak

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

The publication "An Ecosystem Guide for Mountain Land Planning, Level I", explains potential problem indicators for various hazards and characteristics common to Colorado's ecotypes. All major timber types, except aspen, indicate a high probability of wildfire hazard.

Table 1. Potential problem indicator.

Fuel Type	Wildfire Hazard
Aspen	Problem usually limited
Douglas-fir	Problem may be crucial
Lodgepole pine	Problem may be crucial
Meadow	Problem usually limited

Mixed conifer	Problem may be crucial
Mountain grassland	Exercise caution
Mountain shrub	Problem very likely
Pinyon-juniper	Problem very likely
Ponderosa pine	Problem may be crucial
Spruce-fir	Problem very likely

The rate of fire spread increases as the slope of the land increases. Fuels are preheated by the rising smoke column, and a "ladder" effect may be created in the adjoining timber (spreading fire from the ground to tree crowns).

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 slope 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 tends to funnel up the drainage, rapidly spreading fire upslope.

Saddles are low points along a main ridge or between two hills. Like chimneys, they also funnel winds to create a natural fire path during an uphill run and act as corridors -- spreading fire into adjacent valleys or drainages.

Crowning Potential

An on-site visit is required to assess crowning potential. Appendix C provides a key to help determine this rating. Fuel modification is unnecessary if an area has a rating of 3 or less. Remove all dead trees within the fuelbreak. Occasionally, dead trees 14 inches or larger in diameter may be retained as wildlife trees. If retained, clear all ladder fuels from around the tree trunk.

Ignition Sources

Possible ignition sources which may threaten the development must be investigated thoroughly.

Included are other developments and homes, major roads, recreation sites, and railroads. These might be distant from the development, yet still able to channel fire into the area due to slope or other topographic features.

Equally important is the possibility that the development is an ignition source threat to other homes or subdivisions.

Fuelbreak Locations

An effective fireline is connected or anchored to natural or artificial barriers. Such anchor points might be rivers, creeks, large rock outcrops, wet meadows, or a less flammable timber type. Similarly, proper fuelbreak construction takes advantage of such barriers to eliminate "fuel bridges". (Fires often escape control lines with the aid of fuel bridges.)

Since fuelbreaks provide quick, safe access to defensive positions, they are necessarily linked with 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 reduce the amount of fuel modification needed.

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 be effective when established at the base of slopes. Mid-slope fuelbreaks are the least desirable, but under certain circumstances and with modifications, these too can be valuable.

Fuelbreaks are located so that the area under management is broken into small, controllable units. Thus, a fire remains small, and when it reaches modified fuels, defensive action is more easily taken. It is recommended that fuelbreaks break up continuous forest fuels into units of 10 acres or less. This is an excellent plan, especially if thinning for forest management is accomplished in addition to fuelbreak construction.

When located along ridge tops, continuous length as well as width is a critical feature. Extensive long-range planning is essential in positioning this type of fuelbreak. Much of the work can be accomplished through commercial timber sales at little or no cost.

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

Care must also be taken in areas which are not thinned throughout for fuel hazard reduction. In such cases the fuelbreak sticks out like a "sore thumb" due to contrasting thinned and unthinned

portions of the timber stand (especially noticeable are areas 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.

Constructing a 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 cut for uphill distances.

The **minimum** recommended fuelbreak width is approximately 200 feet. Since fire activity intensifies as slope increases, the overall fuelbreak width must also increase. However, to minimize aesthetic impacts, the majority of the increases should be taken from the bottom of the fuelbreak below the road cut.

Fuelbreak width should also be increased when severe topographic conditions are encountered. Guidelines for fuelbreak width are given below.

Percent Slope	Uphill Distance (feet)	Downhill Distance (feet)	Total Width of Modified Fuels (feet)*
0	100	100	200
10	90	115	205
20	80	130	210
30	70	145	215
40	60	160	220
50	50	175	225
60	40	190	230

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

Additional guidelines used to determine fuelbreak width include:

- 1) Below road distance: Distance (ft.) = 100 + [(150%)(slope%)]
- 2) Above road distance: Distance (ft.) = 100 - slope%

- 3) Fuelbreaks which pass through chimney or saddle areas should have distances increased by at least 50%.
- 4) Ridgetop fuelbreaks should be thinned on both sides of road based on the above table.

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 desirable. Small, isolated groups of trees may be retained for visual diversity.

A fuelbreak thinning is classified as a heavy "sanitation and improvement" cut from below. Trees which are suppressed, diseased, deformed, damaged, and 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 are carefully evaluated. It may be necessary to develop the fuelbreak over several years to allow the stand to "firm-up".

Area-wide forest thinning is recommended for **any** subdivisions. They will not be as severe as fuelbreak thinnings, but should be completed to fuelbreak specifications along roads.

Debris Removal

Limbs and branches left from thinning (called slash) can add significant volumes of fuel (especially in lodgepole pine, mixed-conifer, or spruce/fir timber types)/ These materials can accumulate and serve as ladder fuels, or can become hot spots, increasing the difficulty of defending the fuelbreak. Slash decomposes very slowly in Colorado and proper disposal is essential.

Three treatment methods commonly used are: (1) lopping and scattering, (2) piling and burning, and (3) chipping. Proper treatment reduces fire hazard, improves access for humans and livestock, encourages establishment of grasses and other vegetation, and improves aesthetics.

Size, amount, and location of slash dictates the method used, in addition to final appearance desired and cost. The method will also depend on how soon an effective fuelbreak is needed prior to development.

Lopping and scattering is the easiest and cheapest method of disposal, but also the least desirable and must be used with caution. Large branches are cut into small sections and scattered over an area. In fuelbreaks, pieces are cut small enough so that all slash is within 12 inches of the ground. (Contact with the ground increases decomposition rates.)

Piling and burning is a quick way to eliminate a large amount of slash at moderate cost. The material is piled for burning in open areas when snow cover is sufficient to prevent fire spread. Piles are located far from remaining trees to prevent scorching and should be compact enough to facilitate burning. The sheriff and local fire department must be notified before any burning is done.

Chipping is the most expensive disposal method. Branches are fed through a machine resulting in chips approximately 1/4 inch square by 1/2 inch thick. They decompose rapidly, present little fire hazard, act as mulch to hold soil moisture, stimulate vegetative growth, prevent erosion on cut-and-fill slopes, and facilitate movement within the area. They may, however, retard vegetative growth if spread too heavily. Chipping is highly recommended for fuelbreaks.

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, nothing grew before. Site disturbance and exposed mineral soil is a perfect seed bed for new trees which, in turn, create new ladder fuels. Thus, fuelbreak effectiveness tends to decrease over time.

Fuelbreak maintenance problems are most often the result of time and neglect. Misplaced records, lack of follow-up, and apathy caused by lack of fire activity are some of the major obstacles.

In addition, the responsibility for fuelbreak projects is often unclear. Completed by the developer, control then passes to the homeowner's associations, usually with limited funds and authority to maintain fuelbreaks.

If fuelbreak maintenance is not planned, the fuelbreak should never be constructed.

Conclusion

Colorado mountains are comprised of diverse slopes, fuel types, aspects, and topographic features. This variety makes it impossible to develop general prescriptions for all locations. Recommendations stated previously are guidelines only. A professional forester with fire suppression expertise should be consulted to "customize" fuelbreaks for particular areas.

Appendix E: Defensible Space Guidelines for Larimer County

Creating the Fire-
Resistant Home

Creating Defensible Space: Guidelines for Homeowners and Foresters

Ultimately, the homeowner is responsible for creating a fire-resistant home. Creating fire-resistant homes greatly improves the likelihood of home survival during wildfire. Five critical steps should be taken to create a fire-resistant environment around a home or building site:

1. Choose a firewise location
2. Use fire-resistant home construction material
3. Landscape with fire-resistant plants
4. Create and maintain a defensible space with fire safety in mind
5. Develop driveways with emergency vehicle access and personal evacuation in mind.

Firewise locations include bottoms of slopes, level areas, and places where trees are widely spaced. Avoid saddles, narrow ridges, and narrow or steep canyons. On a ridge top, a home should be set back at least 30 feet from the edge of the ridge. Contact a forestry consultant or the Colorado State Forest Service for more information on choosing a building site.

Roofing materials are most critical for wildfire protection. Proper exterior wall construction and siding materials also improve chances for home survival. For information on fire-resistant construction materials consult your home builder or local building material supplier. Costs of many fire-resistant materials are comparable to non-rated materials.

Fire-resistant plant materials include wildflowers, perennials, and low-growing, non-resinous shrubs. Colorado State University has prepared several Service in Action sheets that provide plant material lists. These can be obtained from your local Cooperative Extension office or the Colorado State Forest Service. Local nurseries are also a good source of plant material information. Caution: all plants will burn during periods of drought.

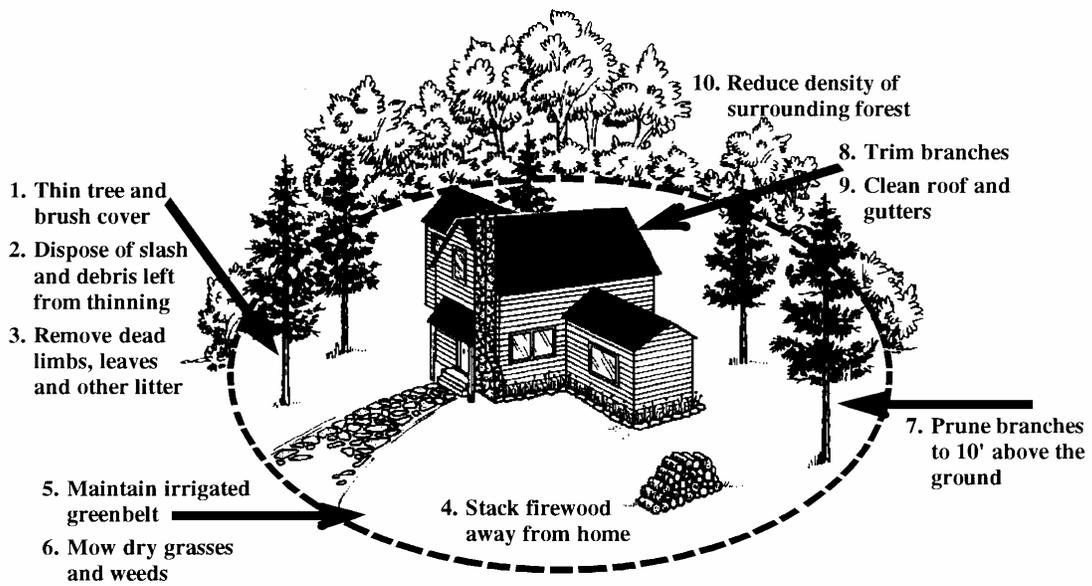
Defensible space is the most important way homeowners can improve home fire protection. For use in these guidelines, defensible space is defined as an area around a home or other structure that is intentionally created and maintained to minimize the potential of wildfire to damage that structure. A defensible space provides an opportunity for firefighters to defend the home, reduces the likelihood of a house fire spreading to the forest, and improves the chances of a structure surviving a wildfire without any intervention by firefighters.

Basic wildfire behavior tells us that fuel is the only factor firefighters or foresters can realistically address in fire suppression or wildfire mitigation efforts. Fuel modification or fuels reduction can significantly reduce wildfire hazards in most areas.

Limited or poor access greatly reduces the ability of firefighters to protect structures. These guidelines are provided to assist homeowners and foresters in creating safe access and developing defensible space in the major forest cover types in Larimer County.

The Defensible Space Concept

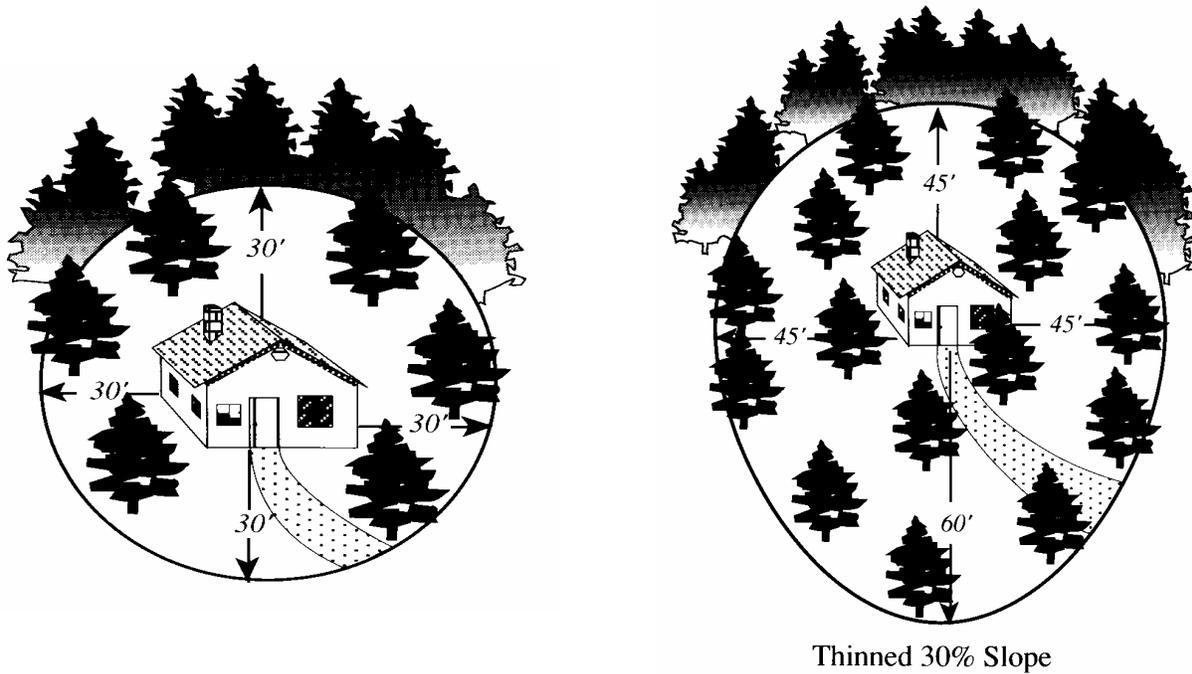
Severe wildfire hazards exist in many areas of Larimer County. These hazards can be reduced by creating a defensible space (Figure 1) around homes, outbuildings and driveways. Defensible space refers to a natural or man-made area surrounding a homesite where vegetation is modified to slow fire spread and reduce fire intensity, thereby creating an area for safe fire suppression operations. Defensible space, combined with fire-resistant construction materials, also improves the chances of a home surviving a wildfire without intervention by firefighters.



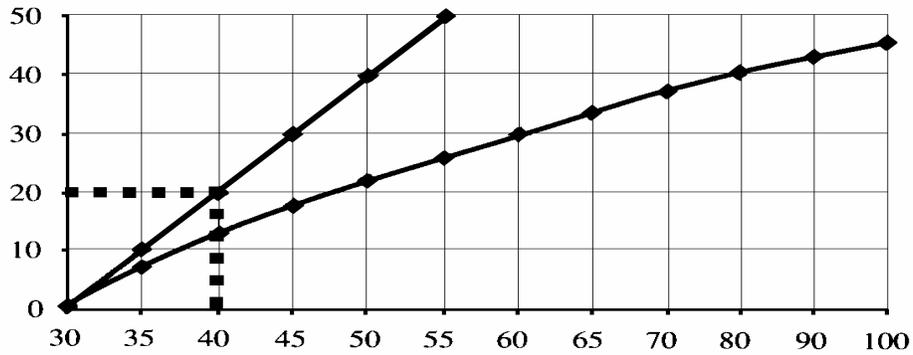
As heat rises, fuels on slopes preheat and ignite quickly, leading to increased fire spread. Therefore, as slope increases, or if critical fuels or topographic features are present, the defensible space area should be increased accordingly.

Creating Your Defensible Space

The minimum defensible space area for homes on level ground should extend outward at least 30 feet on all sides (Figure 2). Figure 3 gives minimum distances for home located on a 30% slope. The increased size is based on increased rate of fire spread.



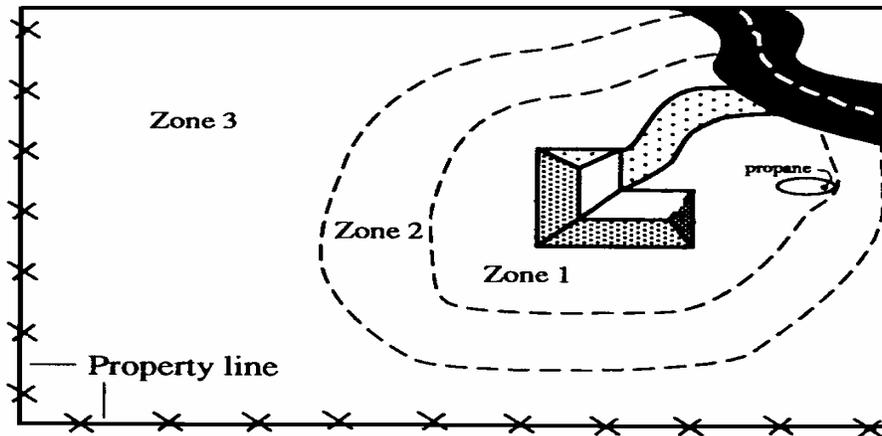
If your building site is located on slopes other than those listed, use the slope chart given in Figure 4 to help determine minimum defensible space dimensions. **However, if the forest surrounding the defensible space has not been thinned, double these sizes.**



General Guidelines

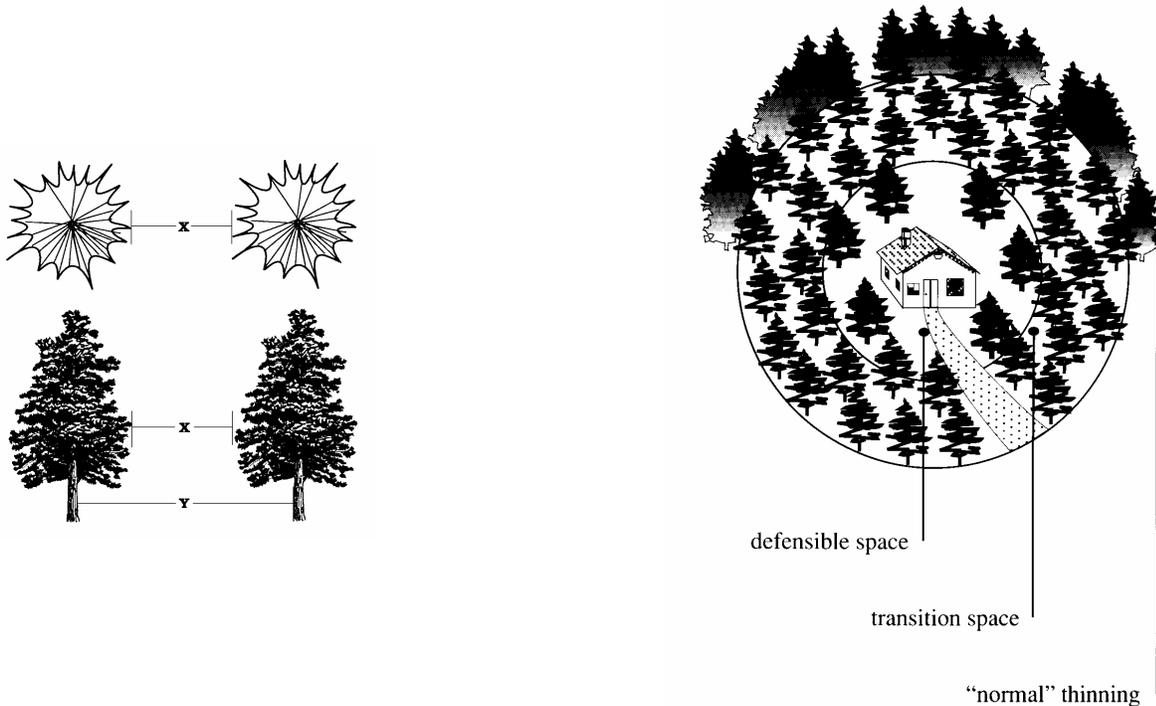
Once you have determined the necessary defensible space size, the three **R₂S**s can be used to modify combustible vegetation in the defensible space area. The three **R₂S**s include removal, reduction, and replacement.

The defensible space of each homesite can be separated into three distinct zones (Figure 5) radiating out from the home. **Zone 1** is the first 5 to 10 feet around the outside of the home. This is the area of potential maximum modification and management. Combustible materials in this area should be removed or replaced with fire-resistant plant material. If any water is available for irrigation, it should be used in Zone 1. Remove branches hanging within 15 feet of chimneys.



Zone 2 begins at the perimeter of Zone 1 and extends outward to the previously determined minimum distance (30 feet on level ground). Trees should be widely spaced to prevent crown fires. Generally it is recommended that tree crowns be separated by at least 10 feet as shown in Figure 6 (additional guidelines are outlined in the Guidelines for Foresters section of this document). Isolated clumps may be left if the 10 foot minimum is increased. Special considerations must be given for thinning forest types that, if thinned to this distance, may result in remaining trees blowing down. A professional forester should be consulting in these situations.

Ideally, trees should be thinned for fire hazard reduction as shown in Figure 7. Thin heavily in the defensible space, moderately in the transition zone, and continue normal thinning in the surrounding forest.



Ladder fuels (any vegetation that may carry a surface fire into tree crowns) should be removed. Prune live and dead limbs on mature trees to a height of 6 to 10 feet.

In Zones 1 and 2, remove all standing or fallen dead trees and other dead woody vegetation from the forest floor. Any slash (limbs, branches, etc.) resulting from thinning should be removed.

Zone 3 includes the remaining portion of the property. It is no specific size, but would ideally extend from the defensible space perimeter to the property boundaries. Traditional forest management activities, such as tree thinning, that meet the landowners specific objectives may occur in Zone 3. In some cases, the landowner may choose not to schedule forest management activities in this zone; However, it should be noted that forest management can be designed to significantly reduce wildfire hazards and improve chances for home survival.

Maintaining Your Defensible Space

Maintenance of your defensible space is critical! Woody vegetation in the defensible space should be maintained in the condition described above. Grasses and weeds should be mowed in Zones 1 and 2 once the grass has cured or dried out. Roofs and gutters should be kept clear of debris such as pine needles. Firewood should be stacked uphill and at least 25 feet from your home.

Additional Home Safety Tips

- * Use noncombustible or fire resistant building materials, especially on the roof.
- * Install a chimney screen or spark arrestor.
- * Enclose or screen off porch, foundation, roof, and attic openings to keep debris from accumulating underneath or firebrands from entering.
- * Post house or lot number so that it is clearly visible.
- * Do not park motor vehicles in tall dry grass -- hot mufflers can start fires.
- * Stack firewood uphill, or on a contour, and at least 25 feet away from buildings. Remove fine fuels (such as grass) in the vicinity of the firewood.
- * Place one or more 10-pound ABC-class fire extinguisher in the home. A 50-foot garden hose connected to the hot water drain is useful in the event of a fire emergency inside the home.
- * Install power and telephone lines underground. If burying the lines is not possible, keep branches clear of them.

Driveway standards

- * Minimum unobstructed driveway width should be 14 feet.
- * Minimum unobstructed height (i.e. distance to low hanging branches) should be 13 feet 6 inches.
- * Driveways longer than 300 feet should have turnouts of at least 20 feet wide every 150 feet.
- * Turnarounds should be at the end of the driveway and every 1000 feet along driveways.
- * Maximum road grade should be 12%. A variance of up to 15% on a distance no longer than 300 feet may be given provided the driveway has an all-weather surface. It is recommended that all driveways have an all-weather surface.

Additional Guidelines for Foresters

Professional foresters are often called upon to assist homeowners in developing a defensible space plan. The following seven step process can be used to guide the forester when preparing such a plan.

- Step 1. Minimum defensible space dimensions can be identified used the chart in Figure 4.
- Step 2. Determine cover type, stand density, and Potential Problem Indicator (see Appendix I).
- Step 3. Determine available fuel conditions in the homesite area. As a minimum, fuel loading and amount of ladder fuels should be identified.
- Step 4. Determine crowning potential using the key in Appendix II.
- Step 5. Adjust defensible space dimensions as warranted by cover type, Potential Problem Indicator, fuel loading, ladder fuels and crowning potential.
- Step 6. Identify any significant topographical features or other conditions that may effect fire behavior.
- Step 7. Develop a site-specific defensible space plan based upon items 1 through 6.

Recommended spacing between standing trees will vary with forest cover type. Table 1 provides general guideline for tree spacing by forest cover type. **It is highly recommended that a professional forester be contacted prior to actual cutting. To achieve these spacing guidelines in certain cover types (especially lodgepole pine) and prevent windthrow of remaining trees, two or three cuttings may be necessary over a period of 5 to 10 years.**

Table 1. General tree spacing guidelines for defensible space by forest cover type.

Forest Cover Type	Spacing Guidelines*
Aspen	Remove only dead, diseased, and dying trees.
Douglas-fir	Diameter + 11
Engelmann spruce	Diameter + 9
Lodgepole pine	Diameter + 9
Ponderosa pine	Diameter + 11
Subalpine fir	Diameter + 9

* Diameter is measured in inches and converted to feet. For example, if the average tree diameter to be left after thinning is an 8-inch ponderosa pine, $8 + 11 = 19$, for an average spacing of 19 feet between trees as measured between tree stems.

Example Defensible Space Plan

Situation - homesite in lodgepole pine, mid-slope, on a 20% slope.

Minimum defensible space dimensions - 40 feet uphill and on the sides; 47 feet on the downhill side.

Forest cover type - lodgepole pine

Stand density - BA 180

Potential Problem Indicator - Problem may be crucial. Wildfire hazard is high due to high stand density. Lodgepole pine ecosystems typically originate by fire.

Fuel loading - approximately 14 tons per acre. This is moderately high.

Ladder fuels - minimal in vicinity of homesite.

Crowning potential - this stand has a relatively high crowning potential of 7.

Other Considerations - other than slope, no significant topographic features are present. This area is considered to be of moderate risk to windfall. Comandra blister rust and dwarf mistletoe are present.

Defensible space prescription - Due to the high density of the surrounding lodgepole pine stand, it is recommended that the minimum defensible space dimensions be doubled to 80 feet uphill and on the sides, and 94 feet on the downhill side. The initial cut should be limited to thinning from below to remove about 30% of the current basal area. A general guideline for spacing between trees is diameter plus 5 feet. For example, if a tree is 6" in diameter, spacing between it and other trees should be 11 feet (i.e. 6+5). Attempt to obtain a separation between tree crowns of at least 10 feet. The general height canopy should be maintained.

A second entry should occur in about 5 to 7 years or when the stand becomes windfirm. This entry should also remove about 30% of the original basal area. Ultimately, a basal area of 80 or a tree spacing of diameter plus 9 is desired.

Remove as many trees infected with comandra blister rust and/or dwarf mistletoe as possible without removing more than the recommended basal area or creating large openings in the canopy. Remove lodgepole pine in Tree Vigor Classes $\frac{3}{4}C$ and $\frac{3}{4}D$. All dead trees should be removed from the defensible space area.

Remove all ladder fuels and prune limbs on leave trees to a height of 8 to 10 feet. All must be eliminated from the defensible space area.

Appendix I

Potential Problem Indicator

The Potential Problem Indicator is used to alert planners to potential problems related to each forest cover type. Awareness of these problems early in the planning process allows the extent of the problem to be determined before any development occurs. The following indicator descriptions for wildfire have been taken from *An Ecosystem Guide for Mountain Land Planning* (Lynch 1975):

Aspen Ecosystem: **Problem usually limited** - A lush understory of vegetation, usually moist conditions, and low flammability of aspen trees generally make this a fire-safe area. In early spring or very late fall, when vegetation is dead, danger of fire is increased. The threat is still limited, however.

The fire-resistant nature of this ecosystem can be used advantageously in land planning to serve as a natural fuel break. In some cases, this ecosystem can be encouraged to occupy sites in the fire hazard areas to reduce the hazard.

Douglas-fir Ecosystem: **Problem may be crucial** - The hazard may be very high due to arrangement of fuels within the forest canopy. The tree cover is typically quite dense and tree crowns are close together. Slopes may be steep and some understory vegetative types may provide fuel ladders to spread fires vertically. Several forestry practices can usually be adopted in these areas which will reduce wildfire hazard.

Lodgepole Pine Ecosystem: **Problem may be crucial** - Wildfire hazard may be very high due to the close spacing of trees and the presence of tree limbs which extend nearly to the ground. Fires can be intense, fast spreading, and difficult to control in these areas. Forests on slopes above 30 percent should be considered extremely hazardous. This ecosystem typically originates by fire and is generally proof that fire has occurred in that location in the past. Several forestry techniques, such as thinning the stand, pruning trees, and cutting fuel breaks, can reduce fire hazard.

Mixed-Conifer Ecosystem: **Problem may be crucial** - Wildfire hazard should be considered to be very high. Climatic conditions and mixtures of tree species can provide fuel characteristics that are conducive to serious fire situations. Slopes above 30 percent should be considered to have especially hazardous potential. Hazard modification is possible in certain situations and aspen, when present, may provide some natural resistance to fire.

Mountain Shrub Ecosystem: **Problem very likely** - This ecosystem has considerable wildfire potential. The hazard is directly related to shrub density and height. Fires can be fast spreading, hot, and difficult to control on steep slopes. Oakbrush areas can be especially

dangerous. Some studies indicate that fire was probably the most important factor in influencing oakbrush density and location. Facilities located in this area should be planned with wildfire hazard in mind. Several methods can be used to reduce the hazard.

Pinyon/Juniper Ecosystem: **Problem very likely** - Tree species in this ecosystem have limbs extending to the ground in most situations. This creates an excellent "fuel ladder" and allows fire to travel quickly from ground to tree crown. Spacing of trees and density of understory vegetation directly influence wildfire hazard in these areas. In many cases, understory vegetation is so sparse, and bare soil so prevalent, that the spread of fire is significantly limited. Previous use of the area may, therefore, have direct influence on current fire hazard. Future uses may allow the current situation to change. When grasses, forbs, and shrubs are plentiful and mixed with tree cover, fire hazard in this ecosystem can be severe.

Ponderosa Pine Ecosystem: **Problem may be crucial** - Density and structure of understory and forest vegetation are usually such that fire can spread rapidly and develop high intensities in ponderosa pine forests. Since this ecosystem typically occupies dry sites, conditions for fire spread are present for much of the year. Generally, wildfire is a serious threat to life and property in these areas, but a number of fuel modification techniques may be used to reduce this hazard.

Spruce/Fir Ecosystem: **Problem very likely** - Fire occurrence in this ecosystem is somewhat reduced by moist conditions often associated with the ecosystem. When fires do occur and burning conditions are right, very intense and destructive fires may result especially when accompanied by high winds. The presence of dead, persisting lower limbs can spread fire rapidly into tree crowns with spectacular and dangerous results. Often there is a large volume of dead fuel within the area which can increase fire intensity and impede fire control efforts. Fire hazard may be reduced through fuel modification procedures, good forestry practices, and careful land use planning.

Appendix II Crowning Potential

(Rothermel 1983) - Crown fires are grouped into three classes:

Passive crown fires are those in which trees torch as individuals, reinforcing the rate of spread, but are not significantly different from surface fires.

In **active crown fires** a solid flame develops in the crowns, but the surface and crown phases advance as a linked unit dependent on each other.

Fires that advance in the tree crowns alone are classified as **independent crown fires**.

Conditions under which crown fires are likely to occur are those that produce fireline intensities in surface fires beginning in the 500 to 1000 Btu/ft/second range (Rothermel 1983). This usually requires hot and dry conditions with steep slopes and/or strong winds. It also requires an overstory that is conducive to carrying or sustaining a crown fire. Canopy continuity is a key characteristic in sustaining crown fires.

Fahnestock (1970) produced a "Crowning Potential Key" that identifies the nature of ladder fuels spacing and general tree crown characteristics that are conducive to crown fires. The key produces a value between 0 to 10. The output numbers indicate order of likelihood of a sustained crown fire and are not to be construed as a proportionality nor as a probability.

An on-site visit is required to assess the potential of a wildfire to be carried into tree crowns. The following key is provided to determine this rating. Fuel modification is necessary if an area has a rating greater than 3.

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%.....9
GG.Crown closure less.....7
FF.Ladder fuels sparse or absent - H
H. Crown closure > 75%.....7
HH.Crown closure less.....5
EE.Foliage open - I
I. Ladder fuels plentiful.....4
II.Ladder fuels 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%.....7
LL.Crown closure less.....4
KK.Ladder fuels sparse or absent - M
M. Crown closure >75%.....5
MM.Crown closure less.....3
JJ.Foliage open - N
N. Ladder fuels plentiful.....3
NN.Ladder fuels sparse or absent.....1
BB.Foliage dead - O
O. Crowns dense - P
P. Ladder fuels plentiful - Q
Q. Canopy closure >75%.....10
QQ.Canopy closure less.....9
PP.Ladder fuels sparse or absent - R
R. Canopy closure >75%.....8
RR.Canopy closure less.....4
OO.Crowns open - S
S. Ladder fuels plentiful.....6
SS.Ladder fuels sparse or absent.....2
AA.Foliage absent, trees dead - T
T. Average distance between trees 33 feet or less - U
U. Ladder fuels plentiful - V
V. Trees with shaggy bark and/or abundant tinder.....10
VV.Trees not as above.....8
UU.Ladder fuels sparse or absent - W
W. Trees with shaggy bark and/or abundant tinder.....10
WW.Trees not as above.....5
TT.Average distance between trees > 33 feet.....2

**Appendix F: Larimer County
Wildfire
Public Awareness and
Education Plan**

Activity	Key Groups*	Target Dates
Provide defensible space materials at building department.	WSC, BD, CSFS	Ongoing
Develop portable displays/booths for county fair, New West Fest, and other events.	WSC	1998
School Programs	WSC, CSFS, VFD	Ongoing
Press releases at appropriate times of year	WSC	Annually
Develop a Homeowner Packet with videos, brochures and other information and place in public libraries	WSC	1998
Maintain wildfire information on County web page	WSC	Ongoing
Provide inserts for homeowner association newsletters	WSC	As requested
Develop a list of homeowner associations and provide wildfire information	WSC	1998
Demonstration projects	CSFS, ARF, PVT	1998
Develop a model covenant based upon firewise construction and landscaping	WSC	1998
Presentations to Board of Realtors	WSC	1998
Develop/distribute firewise landscaping brochures	WSC, CSFS	1998
Develop/distribute firewise construction brochures	WSC, HBA, ISR	1997

Activity	Key Groups*	Target Dates
Tours of firewise communities, post-fire areas, fire recovery tours, etc.	WSC, ARF, CSFS, ESU	
Tours for insurance industry	WSC, VFD	1998
Homeowner presentations	WSC, VFD, CSFS, ARF, RMNP, ESU	Ongoing
Presentations to homebuilders on firewise construction	WSC, HBA, ISR	1998
Wildfire information & mitigation techniques on local cable TV	WSC	1998

*ARF - Arapaho-Roosevelt National Forest

BD - Building Department

CSFS - Colorado State Forest Service

ESU - Emergency Services Unit

PD - Planning Department

PVT - Private landowners

HBA - Northern Colorado Homebuilders Association

ISR - Insurance industry

RMNP - Rocky Mountain National Park

VFD - fire departments

WSC - Wildfire Safety Coordinator

POSITION TITLE:
Coordinator

**Appendix G: Wildfire Safety
Coordinator Job Description**

Wildfire Safety

DEPARTMENT:
Building Department

Larimer County

SUPERVISION: The Wildfire Safety Coordinator works under the direct supervision of the Larimer County Building Official.

OVERALL JOB OBJECTIVE: Under general direction of the Building Official, to assist County staff, land management agencies, fire departments, homebuilders, developers and rural residents in the coordination and implementation of wildfire safety programs, code enforcement, public awareness and education, land planning issues, and provide information to County staff on wildfire mitigation matters as needed.

COMPENSATION: Grade 150 (\$2462.34 - \$3311.58 per month)

MACHINES AND EQUIPMENT USED IN WORK INCLUDE, BUT ARE NOT LIMITED TO, THE FOLLOWING: Personal computer, 4-wheel drive vehicle, 35-mm camera.

REQUIREMENTS: Bachelor's degree in Forestry, Natural Resources Management, Forest Ecology, Wildland Fire Science or related field. Minimum two years experience addressing wildfire hazards through use of Rocky Mountain Region silviculture, forest ecology, fire behavior, fire suppression, wildfire mitigation techniques and fuels management. A demonstrated understanding of problems associated with the wildland-urban interface. Ability to coordinate and work cooperatively with other staff, agencies, fire departments, developers, homebuilders, homeowners, and rural communities. Willingness and ability to work evenings and weekends as needed. Demonstrated communication, organization and interpersonal skills, including the ability to work with people in difficult situations. Experience in agency planning and conflict resolution. Excellent written and verbal communication skills. Demonstrated ability to work with minimal daily supervision and is self-motivated. Ability to develop, prioritize and implement work plans with specific tasks, deadlines, and budgets. Physical ability to stand, kneel and walk for extended periods of time over rough terrain while performing on-site inspections. Upper body strength to lift and carry equipment and supplies as needed. Capable of driving in mountainous terrain in variable weather conditions. Valid Colorado driver's license.

DESIRED REQUIREMENTS: Previous experience in public relations and processes. Advanced degree in any of the fields listed above. Experience with building construction and building materials. Familiarity with Uniform Building Code, Uniform Fire Code, volunteer fire departments, land use planning, building design, fuels reduction and defensible space concepts, wood waste management, and Geographic Information Systems. Ability to seek and procure

funding or outside resources to carry out projects, programs, and work closely with residents of the Wildfire Hazard Area.

DUTIES AND RESPONSIBILITIES: Works with and coordinates programs and activities with various County Departments and staff, Arapaho-Roosevelt National Forest, Rocky Mountain National Park, fire departments, Colorado State Forest Service, Larimer Fire Council, Rural Land Use Center, Northern Front Range Wildland Fire Cooperators, homebuilders, homeowners, rural road and homeowner associations, and county residents.

Works with Building Department staff, homebuilders, and homeowners to effectively implement defensible space requirements. Training of Building Inspectors on defensible space concepts and inspection. Assists Building Inspectors with defensible space inspection and approval.

Works with Planning Department and Engineering Department staff, developers, and local fire jurisdiction on land use review with respect to wildfire. Reviews and approves Wildfire Mitigation Plans. Negotiates with developer, County staff and fire jurisdiction on critical mitigation activities that will become part of the development agreement. Assists the Rural Land Use Center with wildfire planning and mitigation.

Provides technical assistance to County staff, developers, homebuilders, homeowners, fire departments, forestry consultants and others.

Coordinates the implementation of a Public Awareness and Education Plan. This includes public and industry presentations, publication and brochure development, and media relations. Coordinates interagency public presentations as needed. Meets with rural residents to provide presentations on the wildland fire environment and wildfire mitigation techniques.

Assists County staff with post-fire hazard mitigation, and fire management of parks and open space. Assists Sheriff's Department with media relations during large wildfire events.

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