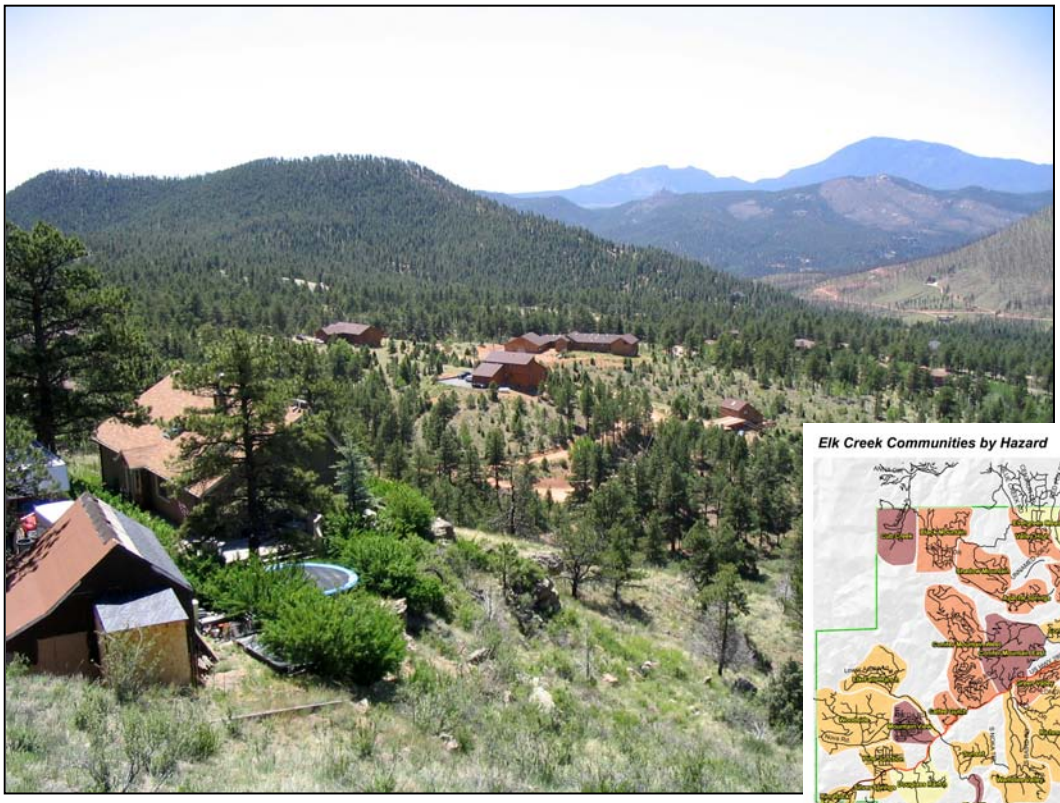
Wildland Urban Interface

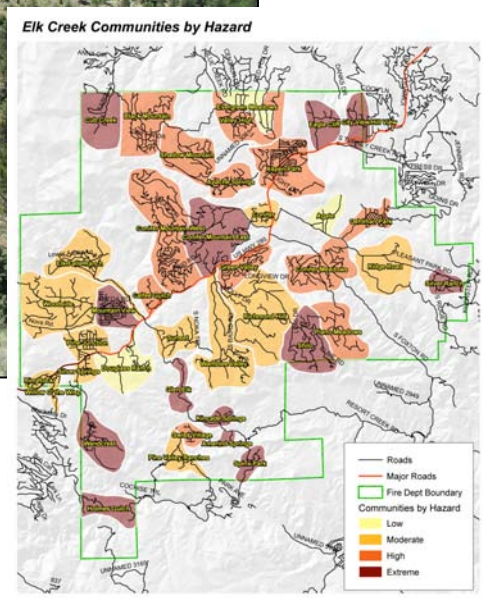
Community Wildfire Protection Plan

Prepared for:

Elk Creek Fire Protection District

Conifer, Colorado





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PURPOSE

The purpose of the fire behavior analysis and community wildfire hazard rating is to provide a comprehensive, scientifically-based assessment of the wildfire hazards and risks within the Elk Creek Fire Protection District. The assessment estimates the risks, likelihood of the occurrence of a significant wildfire event and hazards, potential for deleterious and otherwise undesirable effects resulting from a moderately advancing wildfire, associated with wildland fire in proximity to communities. This information, in conjunction with values-at-risk information, defines "areas of concern" for the community and allows for prioritization of mitigation efforts. From this analysis, solutions and mitigations are offered that will aid land owners, managers and other stakeholders in developing short-term and long-term fuel and fire management plans.

Goals and Objectives

Goals for this project include the following:

1. **Enhance Life Safety for Residents and Responders.**
2. **Mitigate Undesirable Fire Outcomes to Property and Infrastructure.**
3. **Mitigate Undesirable Fire Outcomes to the Environment and Quality of Life.**

In order to accomplish these goals the following objectives have been identified:

1. Establish an approximate level of risk (the likelihood of a significant wildfire event) for the study area.
2. Provide a scientific analysis of the fire behavior potential of the study area.
3. Group values-at-risk into "communities" that represent relatively homogenous hazard factors.
4. Identify and quantify factors that limit (mitigate) undesirable fire effects to the values-at-risk (hazard levels).
5. Recommend specific actions that will reduce hazards to the values-at-risk.

Other Desired Outcomes

1. **Promote community awareness:**

   Quantification of the community's hazards and risk from wildfire will facilitate public awareness and assist in creating public action to mitigate the defined hazards.

2. **Improve wildfire prevention through education:**

   Awareness, combined with education, will help to reduce the risk of unplanned human ignitions.

3. **Facilitate appropriate hazardous fuel reduction:**

   The prioritization of hazardous Fire Management Units (FMU) can assist land managers in focusing future efforts towards the areas of highest concern from both an ecological and fire management perspective.

4. **Promote improved levels of response:**

   The identification of areas of concern will improve the accuracy of pre-planning and facilitate the implementation of cross-boundary, multi-jurisdictional projects.

UNDERSTANDING THIS DOCUMENT

The Elk Creek Fire Protection District Community Wildfire Protection Plan (CWPP) is the result of a community-wide fire protection planning effort including extensive field data gathering, compilation of existing fire suppression documents, a scientific analysis of the fire behavior potential of the study, and input gathered from various stakeholders including homeowners, fire district officials, the Colorado State Forest Service and the United States Department of Agriculture Forest Service (USDA FS). This plan was compiled in 2005 in response to the federal Healthy Forests Restoration Act of 2003 (HFRA).

The CWPP meets the requirements of HFRA by:

1. Proposing actions designed to mitigate undesirable effects of wildland fire on all lands in the study area regardless of ownership;
2. Identifying fuels reduction across the landscape;
3. Addressing structural ignitability; and
4. Collaborating with Colorado State Forest Service, USDA Forest Service, and local fire officials.

The data derived from the community wildfire hazard rating system (WHR) and the analysis of fire behavior potential are extensive and/or technical in nature. Detailed findings and methodologies are included in their entirety in appendices rather than the main report text. This approach makes the actual plan more readable while establishing a reference source for readers interested in the more technical details of wildfire planning.

The National Fire Plan

In 2000, more than 8 million acres burned across the United States, marking one of the most devastating wildfire seasons in American history. One high-profile incident, the Cerro Grande fire at Los Alamos, NM, destroyed more than 235 structures and threatened the Department of Energy's nuclear research facility.

Two reports addressing federal wildland fire management were initiated after the 2000 fire season. The first was a document prepared by a federal interagency group entitled "Review and Update of the 1995 Federal Wildland Fire Management Policy" (2001), which concluded among other points, that the condition of America's forests had continued to deteriorate.

The second report issued by the Bureau of Land Management (BLM) and the USDA Forest Service - "Managing the Impacts of Wildfire on Communities and the Environment: A Report to the President in Response to the Wildfires of 2000" - would become known as the National Fire Plan (NFP). This report and the ensuing congressional appropriations, ultimately required actions to:

- Respond to severe fires.
- Reduce the impacts of fire on rural communities and the environment.
- Ensure sufficient firefighting resources.

Congress increased its specific appropriations to accomplish these goals.

2002 was another severe season, with more than 1,200 homes destroyed and 7 million acres burned. In response to public pressure, Congress and the Bush administration continued to obligate funds for specific actionable items, such as preparedness and suppression. That same year, the Bush administration announced the "Healthy Forests: An Initiative for Wildlife and Stronger Communities," which enhanced measures to restore forest and rangeland health, and reduce the risk of catastrophic wildfires. In 2003, that act was initiated.

Through these watershed pieces of legislation, Congress continues to appropriate specific funding to address five main sub-categories: preparedness, suppression, reduction of hazardous fuels, burned-area rehabilitation, and state and local assistance to firefighters. The general concepts of the NFP blended well with the established need for community wildfire protection in the study area. The spirit of the NFP is keenly reflected in the Elk Creek Fire Protection District CWPP.

STUDY AREA PROFILE

The Elk Creek Fire Protection District (ECFPD) is located in Jefferson and Park Counties, 30 miles southwest of Denver, Colorado. The district is bordered on the east by Inter-Canyon Fire Protection District, on the south by North Fork Fire Protection District, on the west by Platte Canyon Fire Protection District, and on the north by Evergreen Fire Protection District. ECFPD covers an area of 98 square miles and has approximately 4,800 homes. The primary access to the district is via Highway 285.

Figure 1. Typical Area

ECFPD is an area of complex topography. Elevations range from 6,000' to 11,000'. Dangerous topographic features such as steep canyons, natural chimneys, exposed ridges and saddles are common.

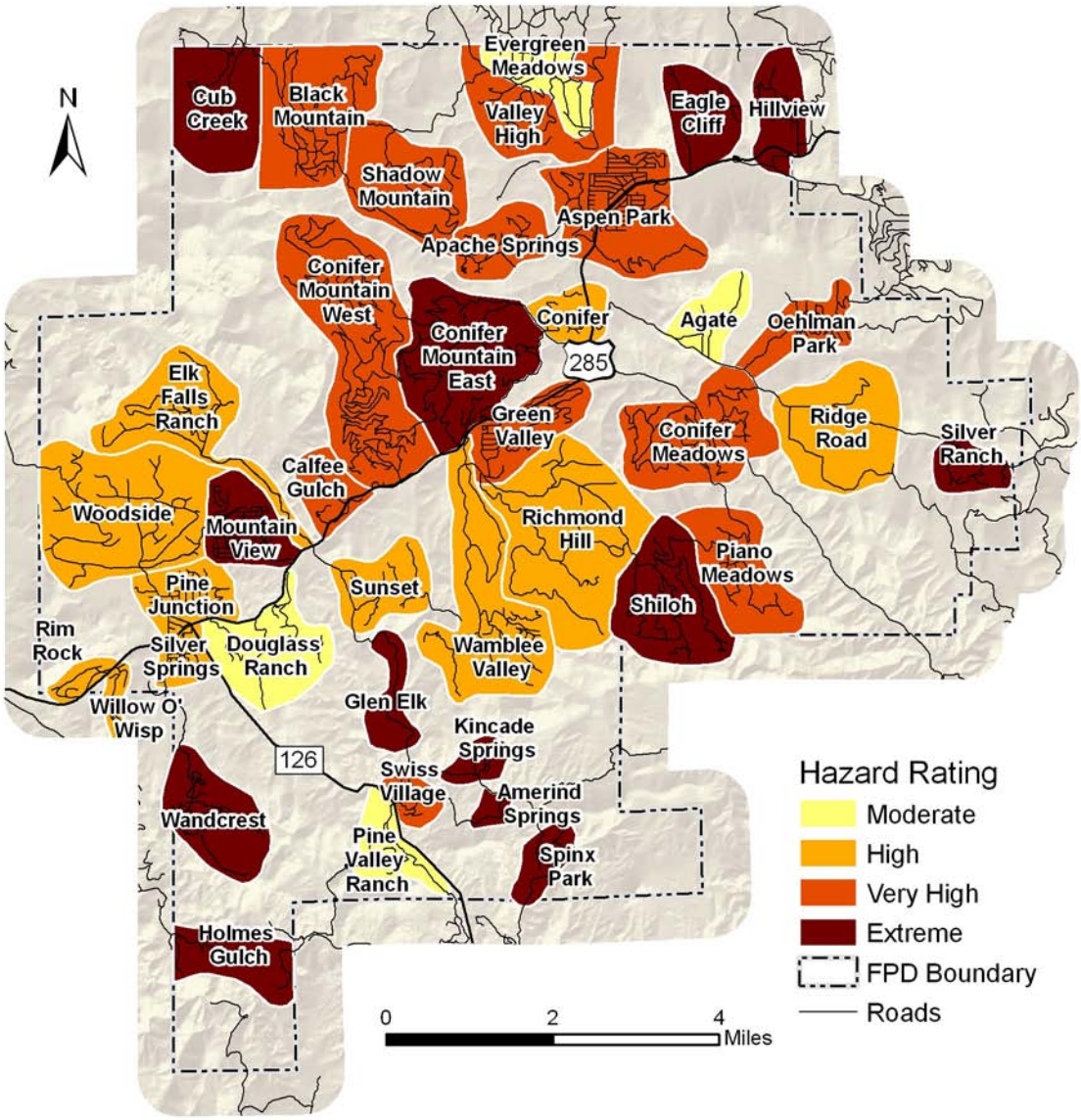
For the purposes of this report, communities have been assessed for the hazards and risks that occur inside the district boundaries. Rankings and descriptions of communities, as well as hazard and risk recommendations, only pertain to the portions of those areas that lie within the boundaries of ECFPD, unless otherwise noted.

The majority of ECFPD is considered to be in the Foothills and Montane zones (5,500'- 9,500') of the eastern slope of the Northern Colorado Front Range.[1] The only significant wildland-urban interface in ECFPD that can be considered to be in the lower Sub-Alpine zone, areas above 9,500', occurs in the Conifer Mountain-West community (see **Figure 4**). The dominant vegetation is composed of conifer forest stands. These consist primarily of over-mature stands of mixed conifer, pure stands of lodgepole pine *(Pinus contorta),* and open-canopy ponderosa pine (*Pinus ponderosa)* with various species of mountain grasses in the understory. These forest stands are broken by primarily short grass meadows and aspen *(Populus tremulodies)* stands in some areas. Canopy coverage within the study area ranges from savanna to dense forest. Various species of riparian shrubs occur in stringers and patches at the lower elevations, particularly along stream corridors and in ravines.

For reference to the rest of this document, **Figure 2** and **Table 1** show the communities that comprise the Wildland/Urban Interface study area and **Figure 3 a**nd **Figure 4** show the general topography of the area.

[1] Elevation limits for life zones were based on life zone ranges from: Jack Carter, "Trees and Shrubs of Colorado" (Boulder, CO: Johnson Books, 1988).

Figure 2. Study Area Communities



Extreme Very High High Moderate

1. Wandcrest	21. Piano Meadows
2. Sphinx Park	22. Valley-Hi
3. Glen Elk	23. Aspen Park
4. Kincaid Springs	24. Conifer Meadows
5. Holmes Gulch	25. Oehlman Park
6. Shiloh	26. Conifer
7. Cub Creek	27. Elk Falls Ranch
8. Eagle Cliff	28. Silver Springs
9. Conifer Mountain - East	29. Will O Wisp
10. Amerind Springs	30. Pine Junction
11. Mountain View	31. Woodside
12. Silver Ranch Estates	32. Wamblee Valley
13. Hillview	33. Ridge Road
14. Apache Springs	34. Richmond Hill
15. Green Valley	35. Rim Rock
16. Conifer Mountain - West	36. Sunset
17. Black Mountain	37. Pine Valley Ranch
18. Shadow Mountain	38. Agate
19. Swiss Village	39. Douglass Ranch
20. Calfee Gulch	40. Evergreen Meadows

Table 1. Hazard Ranking of Communities in the Study Area

Figure 3. Percent Slope

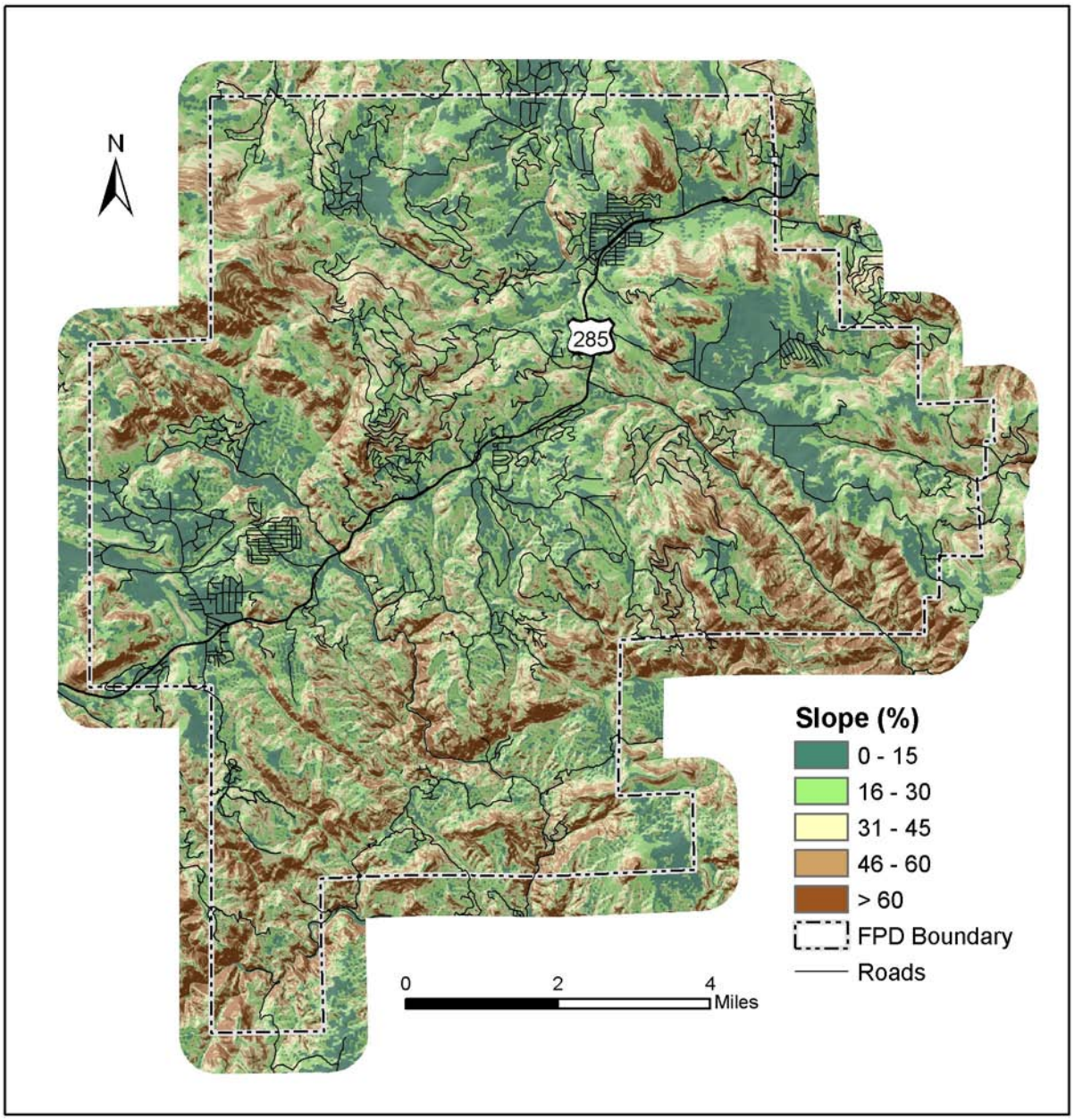
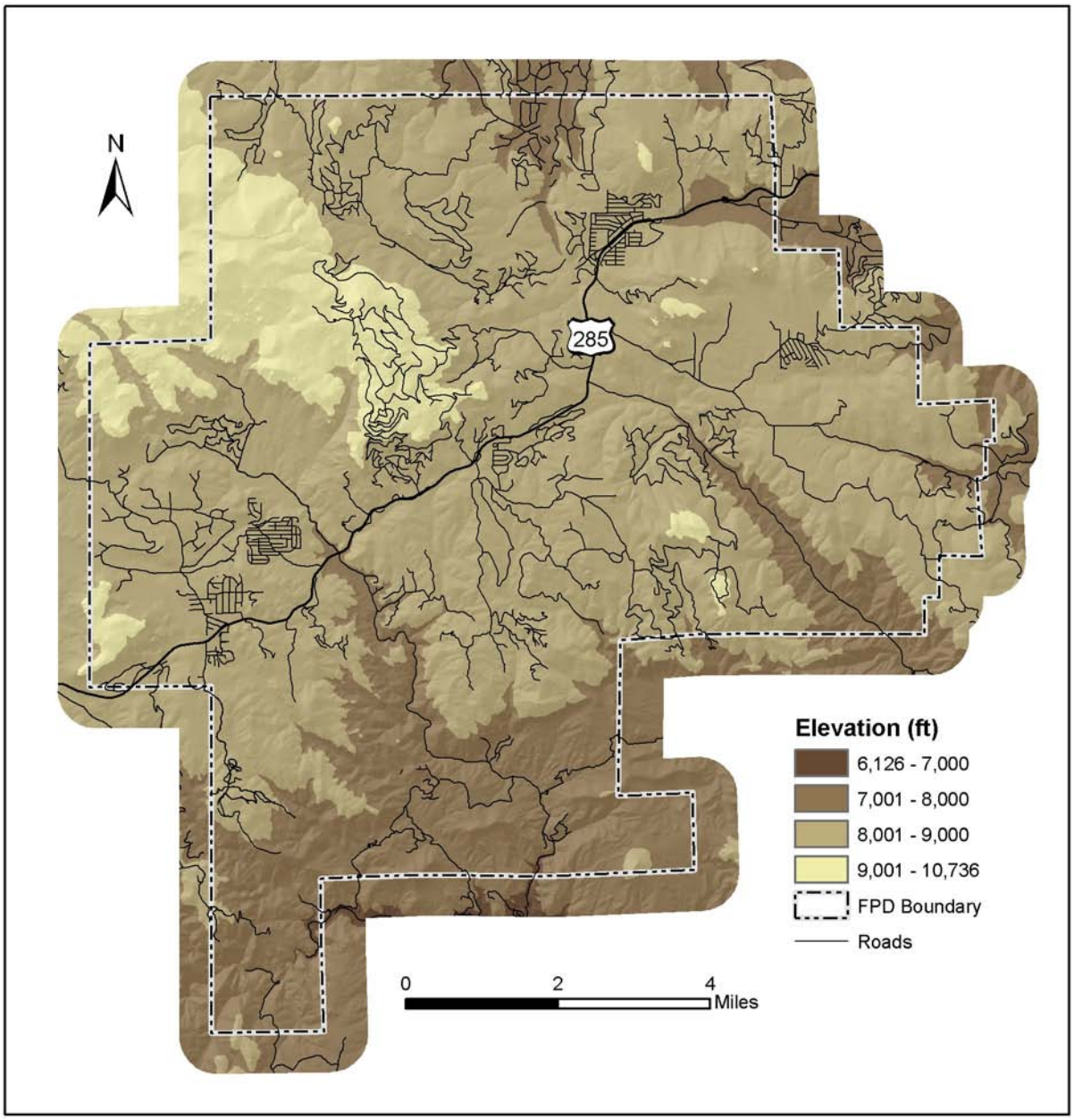


Figure 4. Elevation



VALUES

There are approximately 4,800 homes in ECFPD. The most populated areas were divided into 40 communities. The areas within each community represent certain dominant hazards from a wildfire perspective. Fuels, topography, structural flammability, availability of water for fire suppression, egress and access difficulties as well as other hazards, both natural and manmade, are considered in the overall hazard ranking of these communities. The mid-level assessment identified 25 of the 40 communities in the study area to be at extreme or very high risk. Construction type, condition, age, the fuel loading of the structure/contents and position are contributing factors in making homes more susceptible to ignition under even moderate burning conditions. Under extreme burning conditions, there is a likelihood of rapid fire growth and spread in these areas due to steep topography, fast burning or flashy fuel components and other topographic features that contribute to channeling winds and promotion of extreme fire behavior. These areas may also represent a high threat to life safety due to poor egress, the likelihood of heavy smoke and heat, long response times and/or inadequate response levels.

In addition to residential property, much of the commercial property and infrastructure of the area is at risk from wildland fire. This includes retail and service business, schools, communication infrastructure and other values. The economy of the area is based largely on tourism and the quality of life that attracts city professionals to establish residences in the area. Wildfire, therefore, has the potential to cause devastating damage to the local economy.

The area is host to a diversity of wildlife. There are significant wildlife corridors within ECFPD. A portion of the Pike National Forest as well as Denver Mountain Parks, Jefferson County Open Space Parks and other open space parks and conservation easements are contained within the boundaries of ECFPD. Residents are clear that the preservation of wildlife and the environment is important to the quality of life of the area.

Prioritized Values to be Protected

The Anchor Point team, in concert with the citizens and stakeholder of the ECFPD has identified five priority values to be protected. Any ranking process for values is inherently subjective and should be continuously updated by land managers and stakeholders.

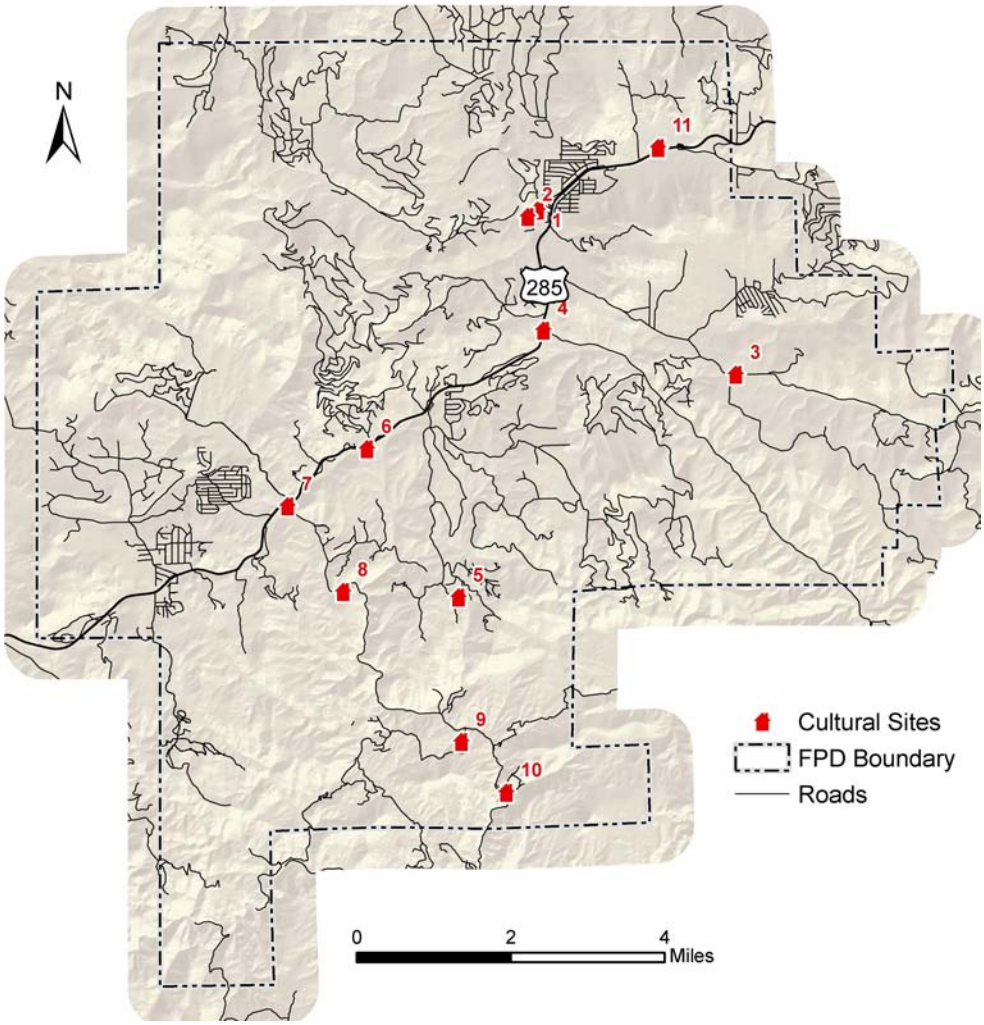
Protection of life and fire fighter safety are always the highest priority in fire mitigation and suppression. Based on the discussion of values above, the following resources should also be prioritized in fire planning:

- Watershed – Water is a precious and finite resource throughout the west. Fires have the potential to cause soil erosion and sedimentation of water resources.
- Tourism – Tourism is a significant economic component of the local economy. Wildland fires that deter tourists from the ECFPD can have a detrimental effect on the area's businesses and residents.

- Private property and infrastructure – Destruction of private property or infrastructure in the District would have a significant economic and social impact on local residents and businesses.
- Aesthetics – Residents and visitors value the ECFPD for its open spaces and views. Wildland fires can affect these views both through denuded landscape and visible smoke.
- Recreation – Both residents and visitors use recreation resources throughout the District. Wildland fires can destroy recreation opportunities and prevent access to recreation areas.[2]

Eleven sites have been designated by local residents as having historical and/or cultural significance. Many to these sites date back to the 19th century. A list of these sites and their locations are shown in **Figure 5/Table 2**.

Figure 5. Cultural Sites



[2] Conifer/285 Corridor Area Community Plan

Elk Creek FPD Cultural Sites		
Number	**Description**	**Coordinates**
1	Conifer Junction School	W 105.3074° N 39.5348°
2	Historic barn and water supply marks the site of Bradford Junction (original name of Conifer)	W 105.3098° N 39.5336°
3	Pleasant Park School	W 105.2593° N 39.5037°
4	Historic church and cemetery	W 105.3061° N 39.5121°
5	Historic cemetery	W 105.3268° N 39.4618°
6	Clifton House - across Highway 285 from King's Valley	W 105.3490° N 39.4898°
7	Shaffer's Crossing - pony express buildings and stage stop	W 105.3683° N 39.4790°
8	Glen Elk - historic district, many historic cabins over 100 years old	W 105.3548° N 39.4629°
9	Amerind Springs - several old railroad cabooses that have been converted to residences	W 105.3262° N 39.4345°
10	Sphinx Park – early 20th century cabins and the location of the historic Bucksnort Saloon	W 105.3153° N 39.4249°
11	Meyer Ranch House - historic homestead located on I-285	W 105.2781° N 39.5466°

Table 2. Cultural Sites

CURRENT RISK SITUATION

For the purposes of this report, risk will be considered to be the likelihood of an ignition occurrence. This is primarily determined by the fire history of the area. Hazard is the combination of the wildfire hazard ratings of the WUI communities and fire behavior potential, as modeled from the fuels, weather and topography of the study area.

The majority of the district is at a high risk for Wildland Urban Interface (WUI) fires. The towns of Conifer, Pine, Pine Junction and Aspen Park as well as Conifer Mountain and Conifer Meadows, are listed in the Federal Register as communities at high risk from wildfire (http://www.fireplan.gov/reports/351-358-en.pdf). The area is shown in the Colorado State Forest Service WUI Hazard Assessment map to be an area of high Hazard Value (an aggregate of Hazard, Risk and Values Layers).

This area has a significant fire history. The Elk Creek Fire Department has responded to approximately 150 confirmed vegetation fires in the last three years. The fire department also responds to approximately 250 to 300 smoke investigations a year. Smoke investigations may have resulted in illegal burns and bon fires that are not included in the statistics for confirmed vegetation fires. Major fires in or near the district since 1998 include the Buffalo Creek, Hi-Meadow, Schoonover, Snaking, Black Mountain and Hayman fires (see **Figure 8**). Fire occurrences for the South Platte, Pikes Peak and South Park Ranger Districts of the Pike-San Isabel National Forests (see **Figure 6**) were calculated from the USDA Forest Service Personal Computer Historical Archive for the ten-year period from 1994-2004. These areas represent federal lands adjacent to the study area, but do not include any data from state, county or private lands. The results have been graphed in the Fire Family Plus software program and are summarized below.

Figure 6. South Platte, Pikes Peak and South Park Ranger Districts

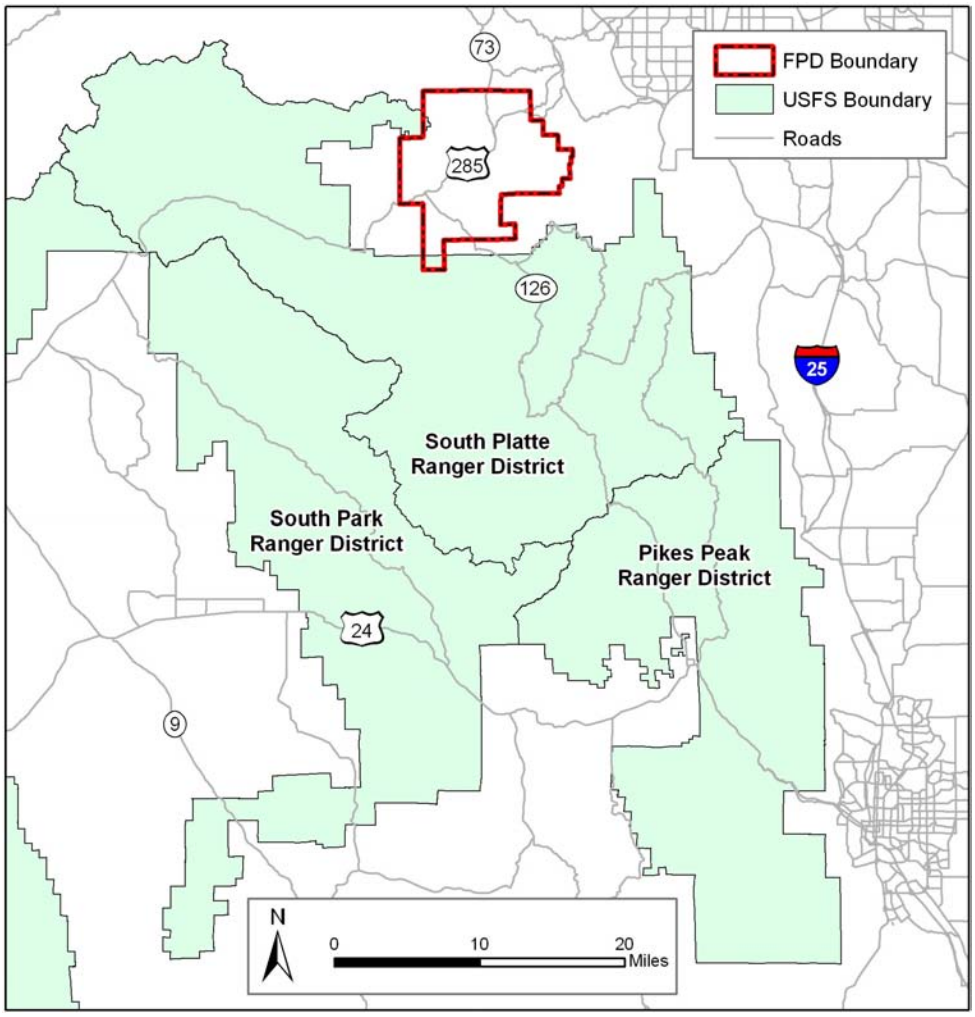
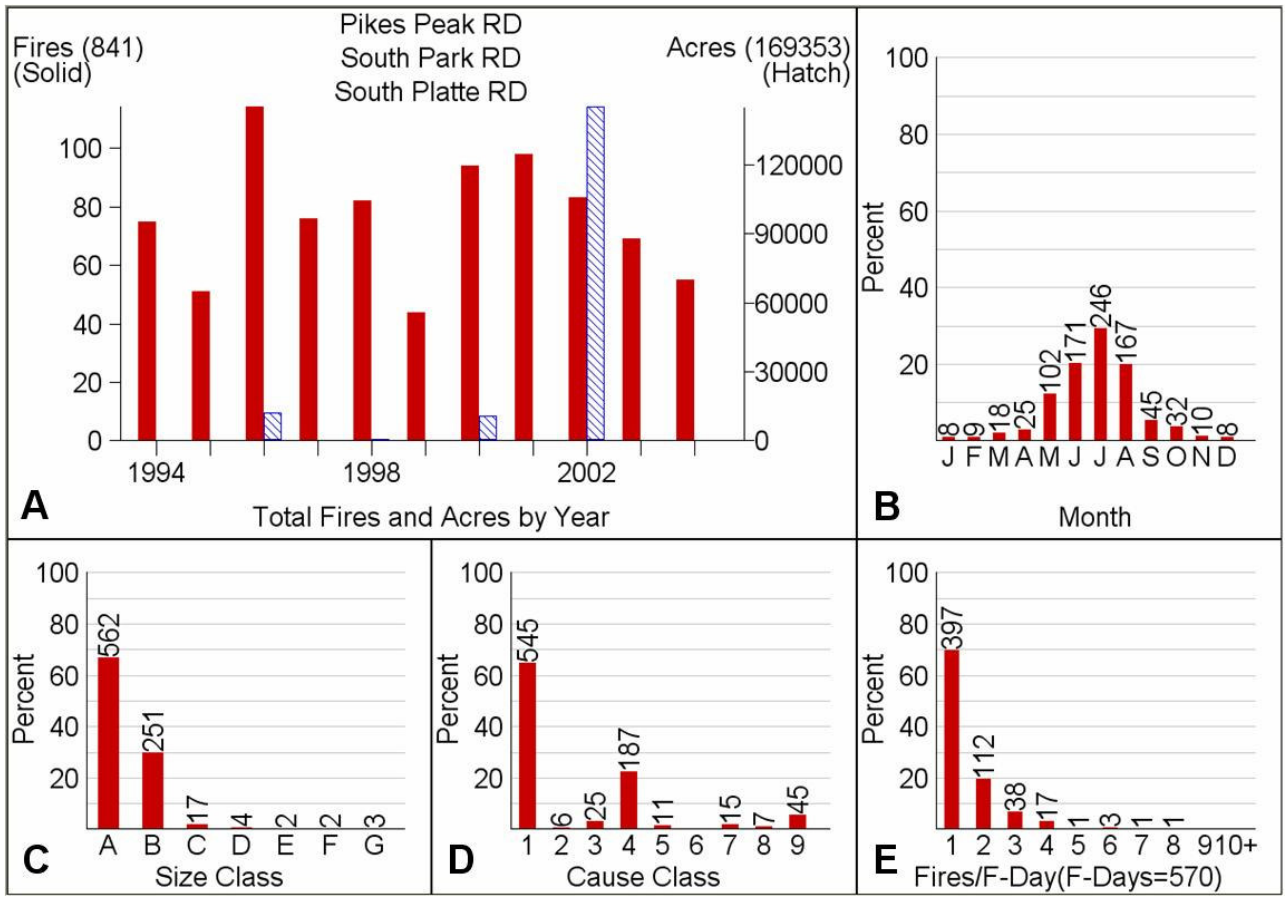


Figure 7A shows the number of fires (red bars) and the total acres burned (blue hatched bars) in the three ranger districts each year. While the number of annual fires ranges from approximately 45 to over 100 fires per year, there is little year-to-year pattern to the variation. Acres burned are by far the greatest in 2002, the year of the Hayman Fire. Other notable years for total acres burned were 1996 and 2000. **Figure 7B** shows the percentage and number of fires between 1994 and 2004 occurring in each month of the year. July had the greatest number of fires followed by June and August. The fewest fires occurred between the months of September and April which reflects the climate conditions for the area. The size class distribution of fires is shown in **Figure 7C**. Approximately 97% of the reported fires (813 of 841) were less than 10 acres in size. These statistics reflect the widely held opinion that throughout the western US the vast majority of fires are controlled in initial attack. **Figure 7D** shows the number of fires caused by each factor. As shown in the graph the most common cause of ignitions is lightning (65%) however the next most common cause is campfires (22%). Overall, natural causes still represent the majority of ignitions (65% natural and 35% human caused), but it should be noted that these numbers are for national

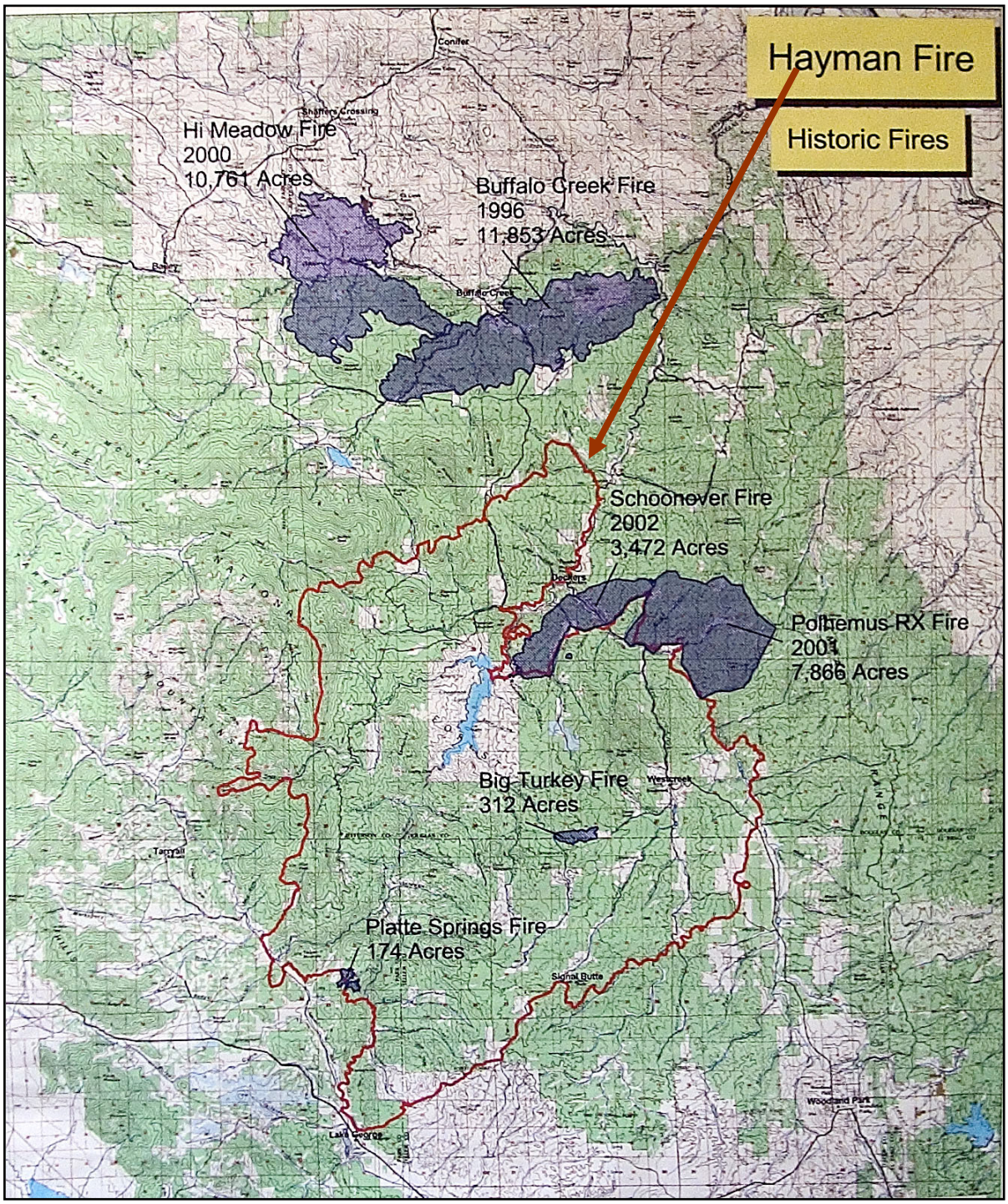
forest areas which lack the concentrated development and many other risk factors present in the portions of the study area where private land is dominant. **Figure 7E** shows the number of fire starts for each day that a fire start was recorded. Most fires (387) occurred on days that only had one fire start. Approximately 15% (86) of fire days had two fire starts recorded and days with three or more fire starts represent approximately 10% of all fire start days. The statistics suggest that multiple start days are a rare occurrence compared to fire days with a single ignition.

Figure 7. Pikes Peak, South Park and South Platte Ranger District Fire Statistics



Size Class (in acres)	A < ¼	B ¼ - 9	C 10 – 99	D 100-299	E 300-999	F 1000 - 4999	G 5000 +		
Causes	1 Lightning	2 Equipment	3 Smoking	4 Campfire	5 Debris Burning	6 Railroad	7 Arson	8 Children	9 Misc.

Figure 8. Recent Large Fires



Development is increasing in the study area at an impressive rate. As the density of structures and the number of residents in the interface increases, potential ignition sources will multiply. Development is moving away from main roads into increasingly remote areas, often those with heavier fuel loads. Unless efforts are made to mitigate the potential for human ignition sources spreading to the surrounding forest, the potential for a large wildfire occurrence will continue to increase.

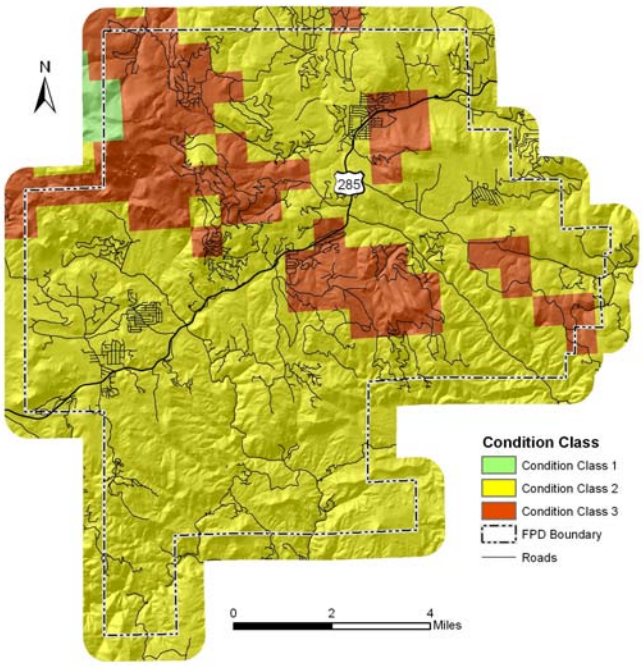
In addition to the risk represented by human activity in the residential and commercial portions of the district that are in close proximity to wildland fuels, Highway 285, a major transportation corridor, also runs through the district. ECFPD is a recreation destination with many campgrounds and open space parks. The study area is home to a portion of the Pike National Forest, Meyer Ranch Open Space Park, Reynolds Ranch Open Space Park, Staunton State Park and other public lands administered by Jefferson County Open Space and Denver Mountain Parks. Due to their close proximity to the Denver metro area, these parks experience heavy visitor use. The Bucksnort Slabs, in the Sphinx Park community, have a long history of heavy use by rock climbers in the summer. On many days during the fire season parked cars on the narrow roads severely restrict access to this portion of ECFPD. The opening of Staunton State Park to the public will significantly increase the amount of human activity, and wildfire ignition potential, in the northwestern portion of the district. The heavy recreational activity the study area receives during the peak months for wildfire potential exacerbates the natural risk factors already existing in this area. While many of the historic fires have resulted from natural causes (Hi Meadow, Schoonover and others), the frequency of major fires caused by human activity, such as Black Mountain, Snaking and Hayman, has experienced a rise in recent years. This disturbing trend of increasing potential for human caused fires is likely to continue in the foreseeable future.

FIRE REGIME AND CONDITION CLASS

The Fire Regime and Condition Class is a landscape evaluation of expected fire behavior as it relates to the departure from historic norms. This is not to be confused with BEHAVE and FLAMMAP fire behavior as detailed in the fire behavior section, which provides functional fire behavior analysis for expected flame length, potential crown fire, how fast the fire would spread, etc.

The fire-regime condition class (FRCC) is an expression of the departure of the current condition from the historical fire regime. It is used as a proxy for the probability of severe fire effects (e.g., the loss of key ecosystem components - soil, vegetation structure, species; or alteration of key ecosystem processes - nutrient cycles, hydrologic regimes). Consequently, FRCC is an index of hazards to the status of many components (e.g., water quality, fish status, wildlife habitats, etc.). **Figure 9** displays graphically the return interval and condition class of the study area.

Figure 9. Condition Class Map



Deriving fire-regime condition class entails comparing current conditions to some estimate of the historical range that existed prior to substantial settlement by Euro-Americans. The departure of the current condition from the historical baseline serves as a proxy to likely ecosystem effects. In applying the condition class concept, it is assumed that historical fire regimes represent the conditions under which the ecosystem components within fire-adapted ecosystems evolved and have been maintained over time. Thus, if it is projected that fire intervals and/or fire severity has

changed from the historical conditions, then it would be expected that fire size, intensity, and burn patterns would also be subsequently altered if a fire occurred. Furthermore, it is assumed that if these basic fire characteristics have changed, then it is likely that there would be subsequent effects to those ecosystem components that had adapted to the historical fire regimes. As used here, the potential of ecosystem effects reflect the probability that key ecosystem components may be lost should a fire occur. Furthermore, a key ecosystem component can represent virtually any attribute of an ecosystem (for example, soil productivity, water quality, floral and faunal species, large-diameter trees, snags, etc.).

The following categories of condition class are used to qualitatively rank the potential of effects to key ecosystem components:

Condition Class	Condition Class Description
1	Fire regimes are within their historical range and the risk of losing key ecosystem components as a result of wildfire is low. Vegetation attributes (species composition and structure) are intact and functioning within an historical range. Fire effects would be similar to those expected under historic fire regimes.
2	Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components as a result of wildfire is moderate. Fire frequencies have changed by one or more fire-return intervals (either increased or decreased). Vegetation attributes have been moderately altered from their historical range. Consequently, wildfires would likely be larger, more intense, more severe, and have altered burn patterns than that expected under historic fire regimes.
3	Fire regimes have changed substantially from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have changed by two or more fire-return intervals. Vegetation attributes have been significantly altered from their historical range. Consequently, wildfires would likely be larger, more intense, and have altered burn patterns from those expected under historic fire regimes.

Table 3. Condition Class Descriptions[3]

[3] Fire Regime Condition Class, website, http://www.frcc.gov/, July 2005.

The study area is dominantly classified under condition class 2 and 3. By definition, historic fire regimes have been moderately to substantially changed; consequently, wildfires are likely to be larger, more severe and have altered burn patterns from those expected under historic fire regimes.

Fire Behavior Potential

From the Wildfire Hazard Analysis carried out as a part of this study (see Appendix A), the fire behavior potential of ECFPD was modeled. This model can be combined with structure density and values-at-risk information to generate current and future "areas of concern", which are useful in the prioritizing of mitigation actions (see "Solutions and Mitigation" section of this report). This is sometimes referred to as a "values layer".

Fire behavior potential maps, **Figures 10-12**, are shown for the outputs of the FLAMMAP model (crown fire activity, flame length, and rate of spread) for the analysis area given the average weather conditions existing between May and October. Weather observations from the Bailey Remote Automated Weather Station (RAWS) were averaged for a thirty-four-year period (1970-2004) to calculate these conditions. The moderate condition class (16th to 89th percentile) was calculated for each variable (1 hr, 10 hr, and 100 hr fuel moisture, woody fuel moisture, herbaceous fuel moisture, and wind speed) using Fire Family Plus. This weather condition class most closely represents an average fire season day.

The "extreme conditions" maps, **Figures 13-15**, were calculated using ninety-seventh percentile weather data. That is to say, the weather conditions existing on the four most severe fire weather days (sorted by Spread Component) in each season for the thirty four-year period were averaged together. It is reasonable to assume that similar conditions may exist for at least four days of the fire season during an average year. In fact, during extreme years such as 2000 and 2002, such conditions may exist for significantly longer periods. Even these calculations may be conservative compared to observed fire behavior. Drought conditions the last few years have significantly changed the fire behavior in dense forest types such as mixed conifer. The current values underestimate fire behavior especially in the higher elevation fuels, because the extremely low fuel moistures are not represented in the averages.

Weather conditions are extremely variable and not all combinations are accounted for. These outputs are best used for pre-planning and not as a stand-alone product for tactical planning. It is recommended that whenever possible, fire behavior calculations be done with actual weather observations during the fire. It is also recommended that the most current Energy Release Component (ERC) values be calculated and distributed during the fire season to be used as a guideline for fire behavior potential. For a more complete discussion of the fire behavior potential methodology, please see Appendix A.

Figure 10. Flame Length Predictions (Average Weather Conditions)

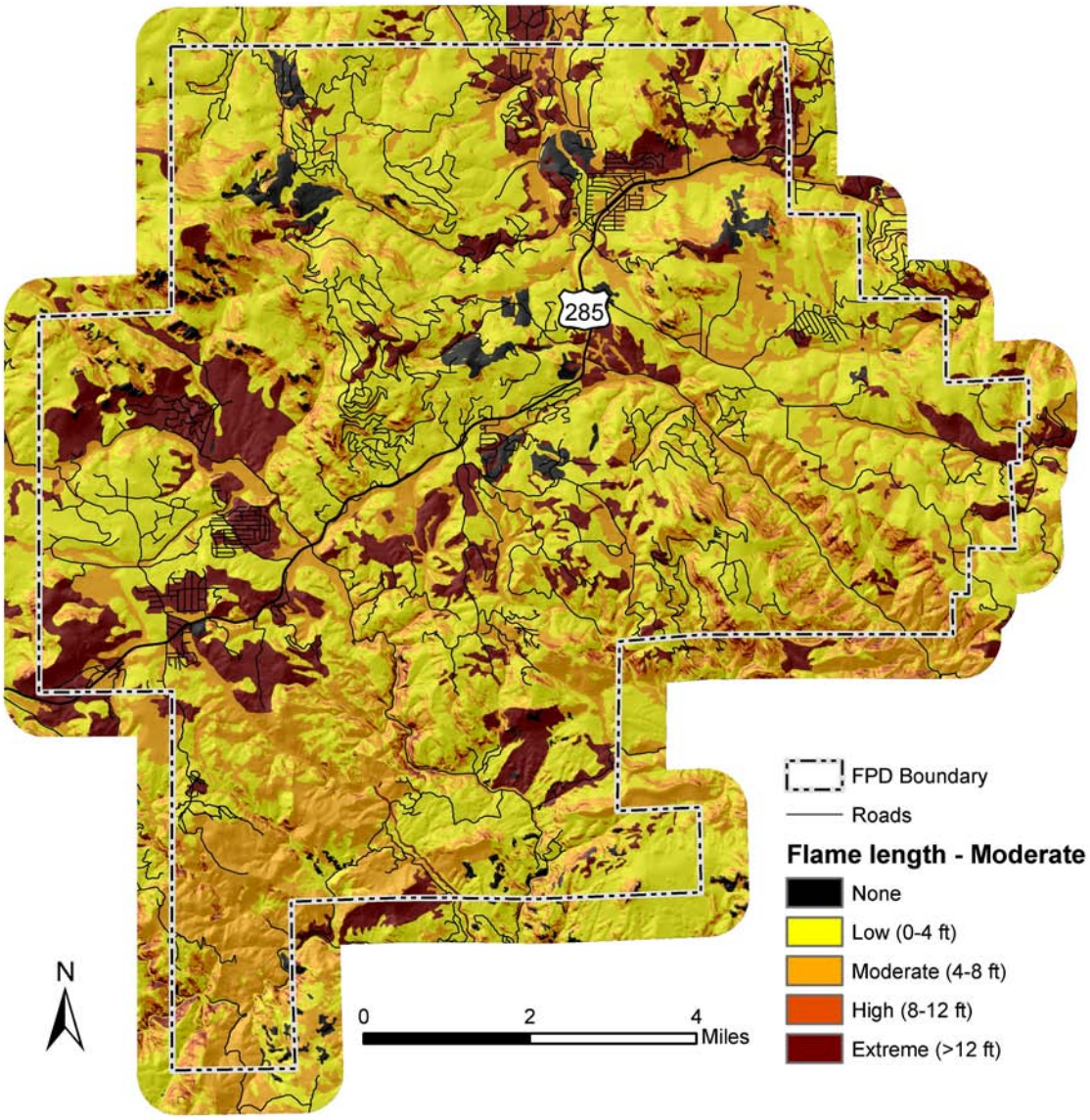


Figure 11. Spread Rate Predictions (Average Weather Conditions)

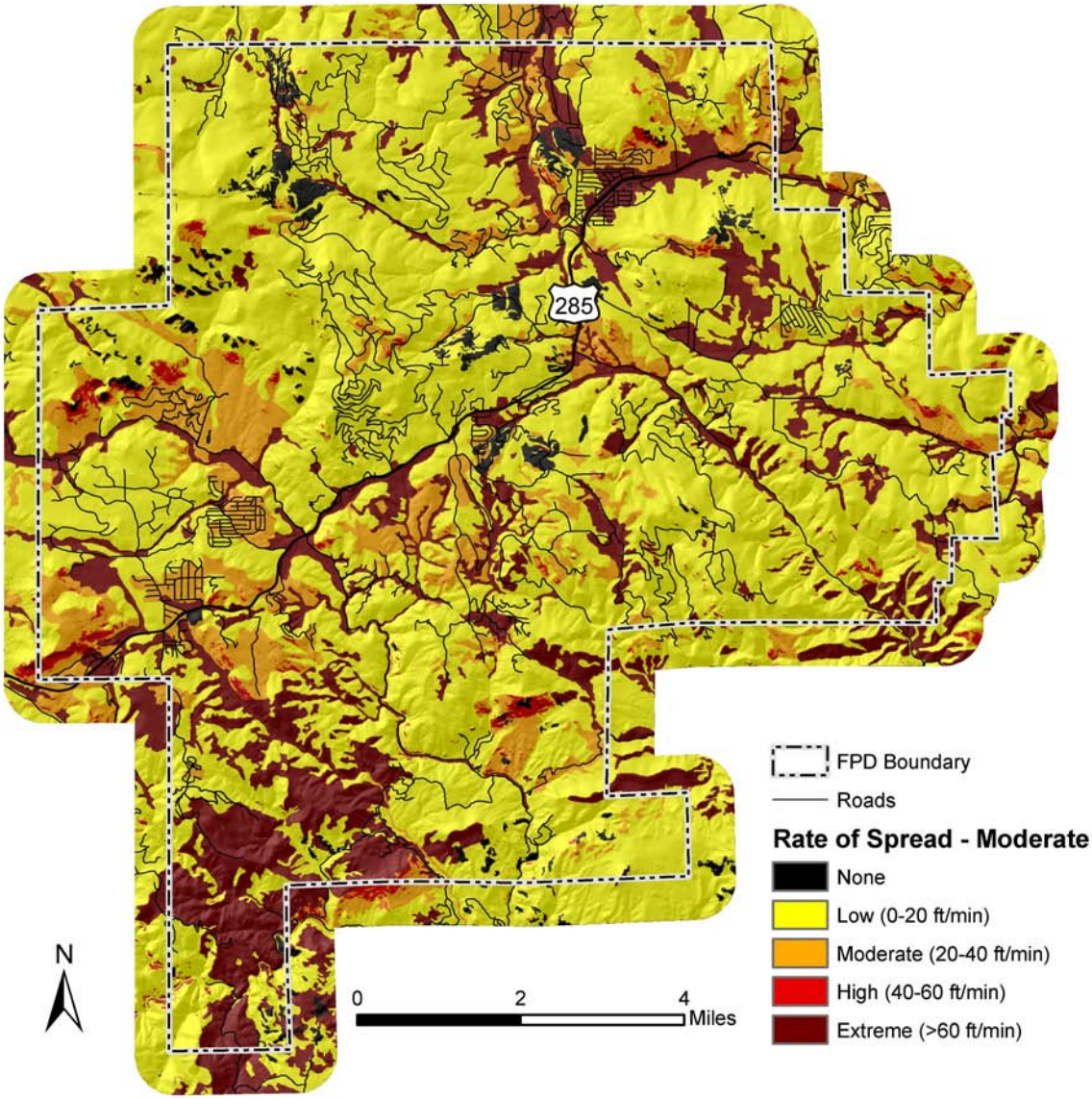


Figure 12. Crown Fire Potential (Average Weather Conditions)

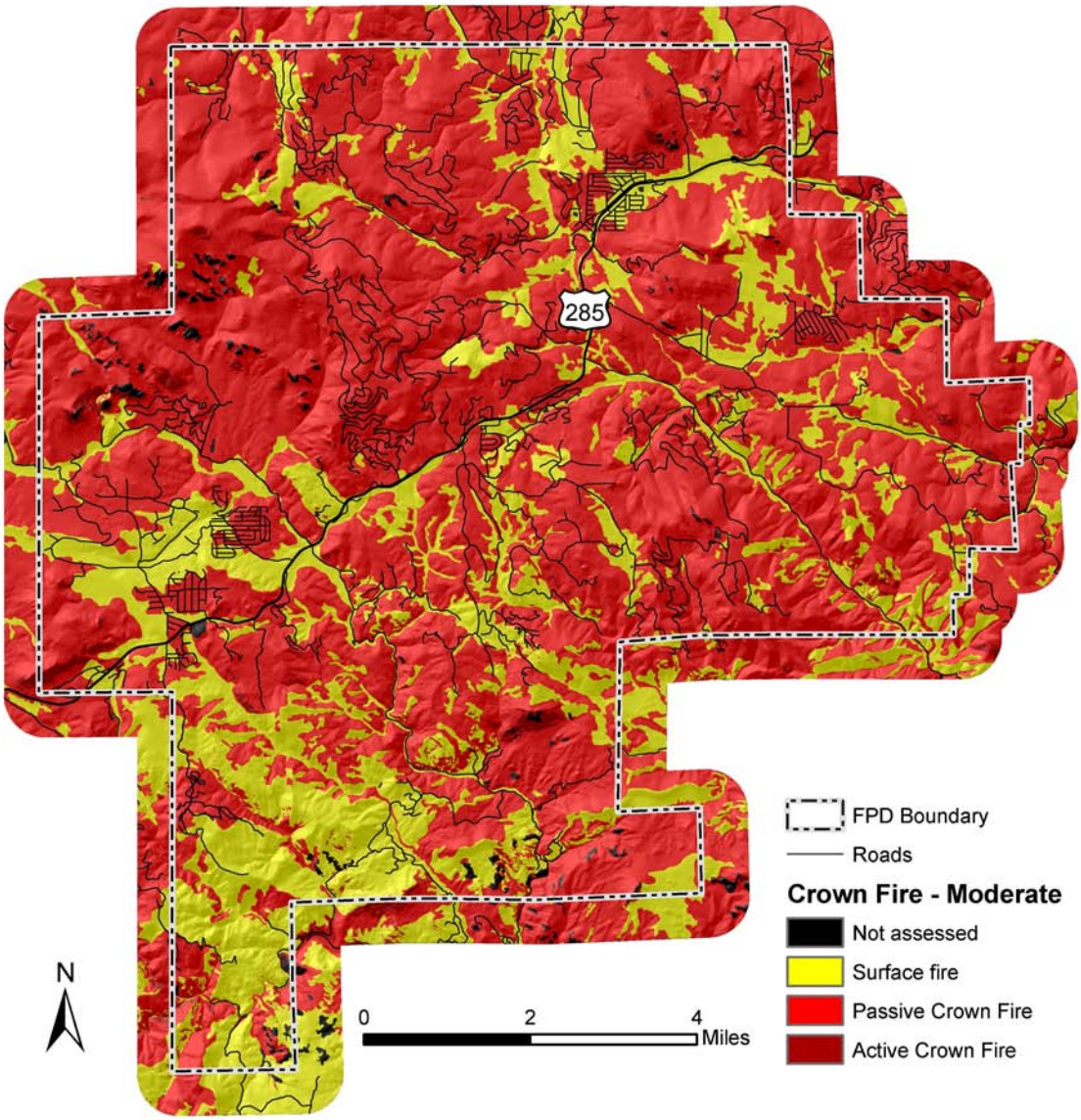


Figure 13. Flame Length Predictions (Extreme Weather Conditions)

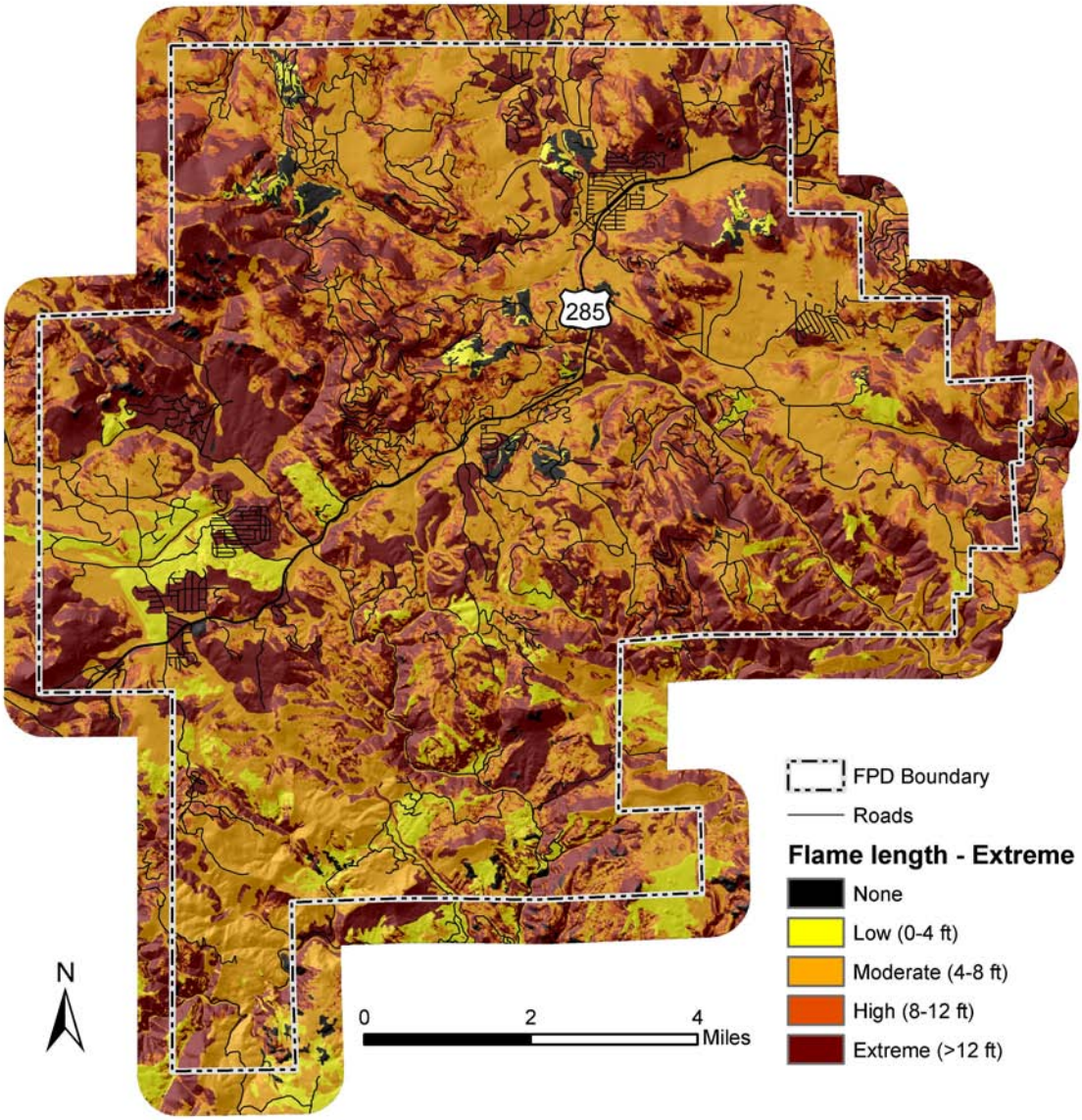


Figure 14. Spread Rate Predictions (Extreme Weather Conditions)

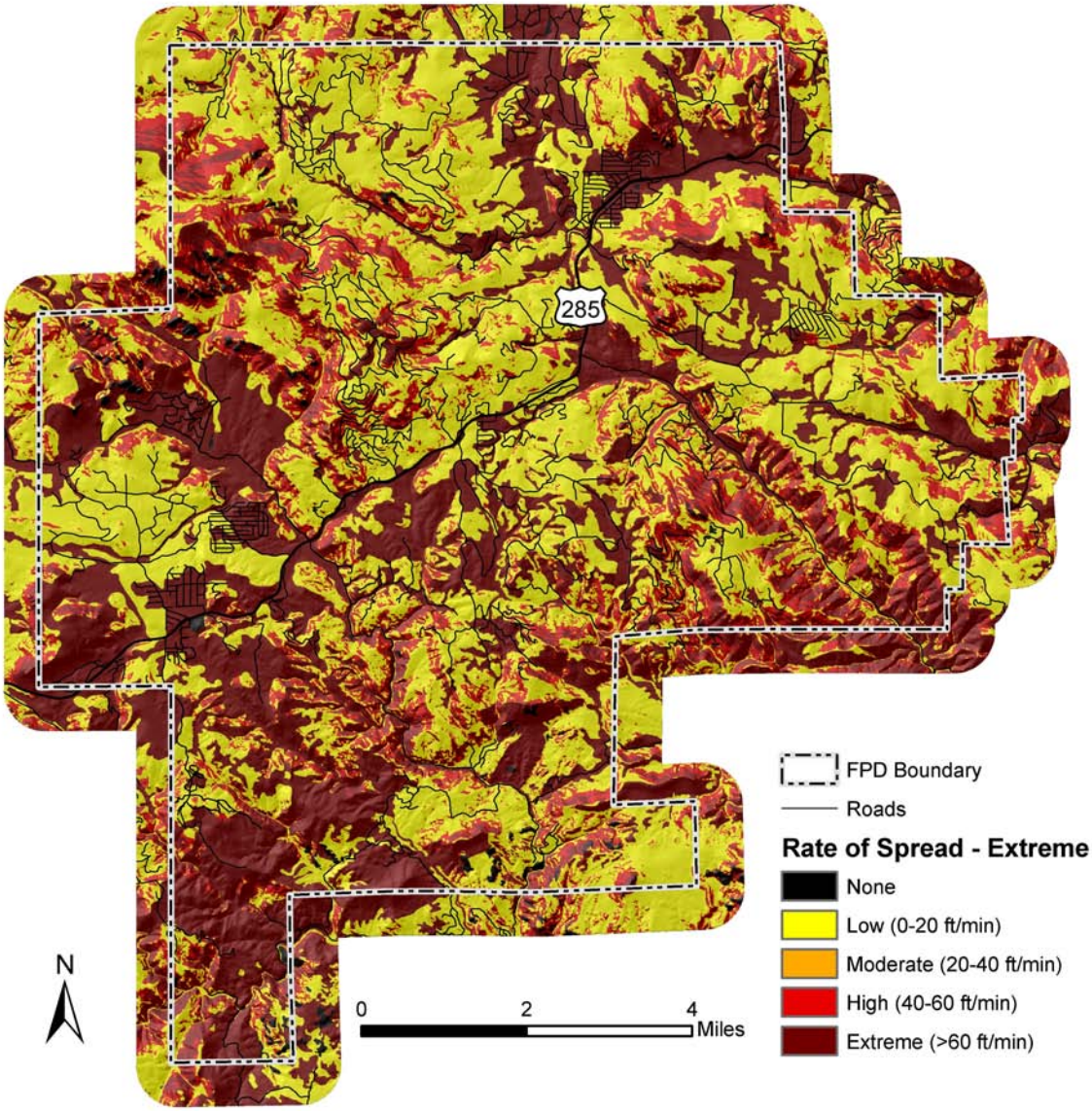
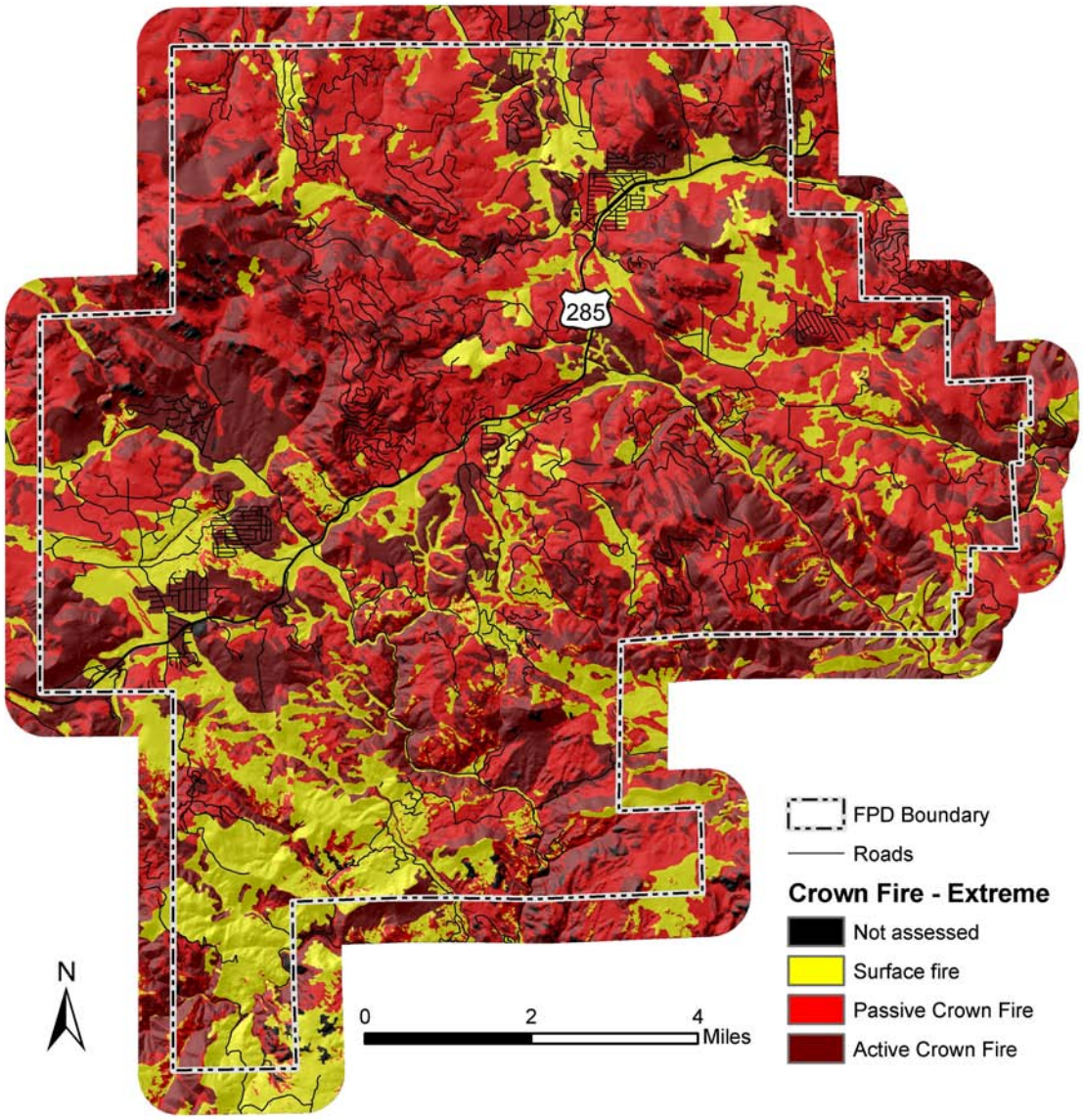


Figure 15. Crown Fire Potential (Extreme Weather Conditions)



SOLUTIONS AND MITIGATION

Establishing and Prioritizing Fire Management Units (FMUs)

An efficient method of prioritizing work efforts is to create Fire Management Units. FMU's should be created prior to planning or initiating fuels management projects and other mitigation. There are unique vegetation and/or mitigation management activities recommended for each unit. Units may be functional or geographic. The local land management and fire management agencies, ideally with the input of the citizen's advisory council, must determine priority actions. Recommendations are presented for the following items. Recommendations are not ordered in priority ranking.

- Access, Evacuation and Sheltering-in-Place
- Public Education
- Fire Department Involvement
- Home Mitigation
- Landscape Scale Fuels Modifications
- Water Supply

Access, Evacuation and Sheltering-In-Place FMU

Addressing

In every community in ECFPD missing or inadequate street signage and addressing is a problem. This problem is also noted in the individual community description in Appendix B. Markers of all types, many homemade, are used throughout ECFPD with no particular order or system. There are many community driveways with flagged addresses that are impossible to decipher (see **Figure 16**) and many homes are missing address markers entirely. Some attempt has been made in some communities to add reflective markers, however the effort has been spotty and in many cases even these are broken or unreadable (see **Figure 17**). Some communities have an additional problem of missing or unreadable street signs and in some areas there are intersecting roads that have names similar enough to cause confusion (see **Figure 18**). While residents may consider homemade address signage to be decorative, it is an impediment to quick and effective response. We consider proper reflective signage to be a critical operational need. The time saved, especially at night and in difficult conditions, is not to be underestimated. Knowing at a glance the difference between a road and a driveway (and which houses are on the driveway) cuts down on errors and time wasted interpreting maps. This is especially true for volunteer operators who do not have the opportunity to train on access issues as often as career firefighters. Recommendations for address markers can be found in Appendix D.

Figure 16. Multiple, Confusing Address Markers

Figure 17. Broken Address Markers

Figure 18. Confusing, Similar Road Names

Figure 19. Unsafe Bridges

RECOMMENDATIONS

- In areas where road names are similar, street signs should be revised to more clearly indicate the differences. For example where Shiloh Road and Shiloh Drive intersect the signs should have Drive and Road printed as prominently as the rest of the street name rather than indicated as an abbreviation in a smaller font.
- A program of replacing worn or difficult to read street signs should be undertaken starting with the extreme and high hazard communities first.
- Flagged addressing on community driveways should be replaced with reflective markers that indicate the proper road fork, where applicable, for each address. This system should be repeated at every place where the driveway divides and an individual driveway leaves the community driveway.
- Reflective markers should be placed for each home where the driveway leaves an access road and on the house itself. These may be in addition to, or in place of, existing decorative address markers. Consistency in height and placement should be stressed.
- Lot markers should be replaced with address markers as soon as a home has a certificate of occupancy.
- Where dead end and private road markers occur, the addresses of homes beyond the marker should be clearly posted. This can be done with a group address marker. For example "10235-10673 Pine Country Lane."
- As a part of the recommended parcel level survey, where properties are accessed by private bridges, notes should be taken to indicate if these bridges are known to be unsafe for apparatus, may be safe for apparatus, or are known to be safe for apparatus. Most private access bridges will be in the middle category since load ratings are usually not available; however there are a number of bridges that will be obviously unsafe (see **Figure 19**). This information can be gathered using the existing RedZone survey software already owned by the district. Once this information is compiled, warning markers for fire apparatus should be posted for all unsafe bridges on the access road.

Evacuation Routes

Eleven road segments have been identified that could serve as alternative evacuation routes to the primary access roads. Most of these evacuation routes are old ranch or forest service roads and as such travel across private land. Agreements would need to be pre-planned with landowners to make use of these as emergency escape routes. Three of these routes are passable for most vehicles, three may require a high-clearance vehicle or 4WD in wet conditions, four would probably be passable only with 4WD high-clearance vehicles and one would be difficult even with modified 4WD. These routes are highlighted in the overview of the district shown in **Figures 20 and 21** (pages 33 & 34).

1. **Grandzella to Highway 285**: Although Grandzella Road ends before it reaches Highway 285, it is possible for high clearance vehicles to drive to the highway. This could be an important escape route for homes along Grandzella if the access to S. Turkey Creek

Road was cut off by fire. Contacting the property owner about improving the short stretch from the end of Grandzella to the highway and adding emergency only access gates is recommended.

2. **Evergreen Springs Road to West Jefferson Middle School**: This escape route runs from Evergreen Springs Road in the Evergreen Meadows community to West Jefferson Middle School in Aspen Park. It is paved and should be suitable for all vehicles. The road is chained at the Aspen Park end.
3. **Flemming Road to S. Warhawk**: Although Flemming Road dead ends at a meadow, it would be possible to drive to S. Warhawk if road blocks placed by private property owners were removed. Negotiations should be conducted with property owners to establish an emergency only escape route. This is a potentially important route for evacuating the Black Mountain community to Blue Creek Road (State Highway 75) and should be considered a high priority for development.
4. **Piano Meadows to Red Cloud**: This improved and marked escape route connects Piano Meadows Drive with Foxton Road via Red Cloud Road and a gated extension of White Cloud Road. This is an important escape route for homes in Piano Meadows as the primary access to Highway 285 through Shilo and Richmond Hill is long and could be easily cut off by a fire in any of several ravines below the road. This route is well marked and passable by any vehicle. It is an excellent example the way emergency access routes should be constructed.
5. **Stevens Way to Shadow Mountain Road**: A seasonal 4WD trail approximately 1.5 miles long connects Stevens Way (at 32201 Stevens Way) in the Conifer Mountain West community with Shadow Mountain Road. This trail may be unusable due to a previous landowner's efforts to destroy it. Negotiations with current landowners should be undertaken to determine the possibility of creating a permanent escape route. This route could be critical for many homes in the Conifer Mountain West community and should be considered a high priority for development.
6. **Upper Ranch Road to Ridge Road:** It is possible to escape the Elk Falls Ranch community by driving through Staunton State Park from Upper Ranch Road to Ridge Road in the Hidden Valley Ranches community in Platte Canyon FPD. This land is managed by Colorado State Parks and its use and emergency escape route should be pre-planned with CSP officials. The route is gated at both ends but the dirt road should be passable to most vehicles, except in wet conditions. Recent fuels reduction in Staunton State Park make this even more desirable as an escape route.
7. **Amerind Springs to Swiss Village:** This route utilizes a dirt road that connects Amerind Springs Trail with Pine Valley Road (Highway 126) via Swiss Road. This road is shown as a county road (CR4076) on some maps, but has been gated by a private property owner. The connection on the Swiss Road side is difficult to locate and may also be blocked by private property. The road up to the gate from Amerind Springs is a good dirt road, however the area between the gate and Swiss Village should be field checked for condition. Negotiations should be conducted with property owners to allow the use of this road for emergency access. This route is potentially useful for the residents of Swiss Village as well as Amerind Springs.

8. **Meadow Lane to S. Elk Creek Road:** It is possible to escape the northern portion of the Woodside community by driving across a relatively flat meadow located at 850 Meadow Lane to connect with S. Elk Creek Road via P-1184. This route should be usable by most high-clearance vehicles, but there may be some soft spots in low-lying areas that should be avoided. Fences would need to be cut to access the meadow. Use of this route should be preplanned with the landowner, but may become important if escape from Woodside via Mount Evans Boulevard becomes compromised.
9. **Wisp Creek Drive to North Hill Drive:** The south end of the Will O Wisp community can be easily accessed by a short drive through a grassy area from Brookside Drive in the Roland Valley community of PCFPD. This route should be accessible for almost any vehicle. There is a gate at the Will O Wisp side, but it is not locked. This short route could be especially important for firefighters accessing Will O Wisp from PCFPD stations.
10. **Holmes Gulch Way to Pine Valley Road:** There is a rough track connecting Holmes Gulch Way to Pine Valley Road via Cochise Trail. There is a private land owner that has erected a gate on both ends of his property across this access. These gates do not have fire department locks. This route passes through a low area that may require 4WD in wet conditions. Although there are few homes along Cochise Trail and the River Shelf Road, this route may be the only method of evacuation for these residents as well as an important access route for firefighters. Use of this route should be preplanned with the landowner who has gated the road. This route may become more important as it is obvious that more development is planned for this area.
11. **Toboggan Road to Pine Valley Road:** There is a difficult 4WD road that connects Toboggan Road in the Wandcrest community to Pine Valley Road. In its current state this route is only passable by modified 4WD vehicles and will require extensive work to be a viable escape route. Considering that there is only one way in and of Wandcrest, which is an extremely hazardous community, it would be worth investigating the possibility of improving this route.

Figure 20. East Side Evacuation Routes

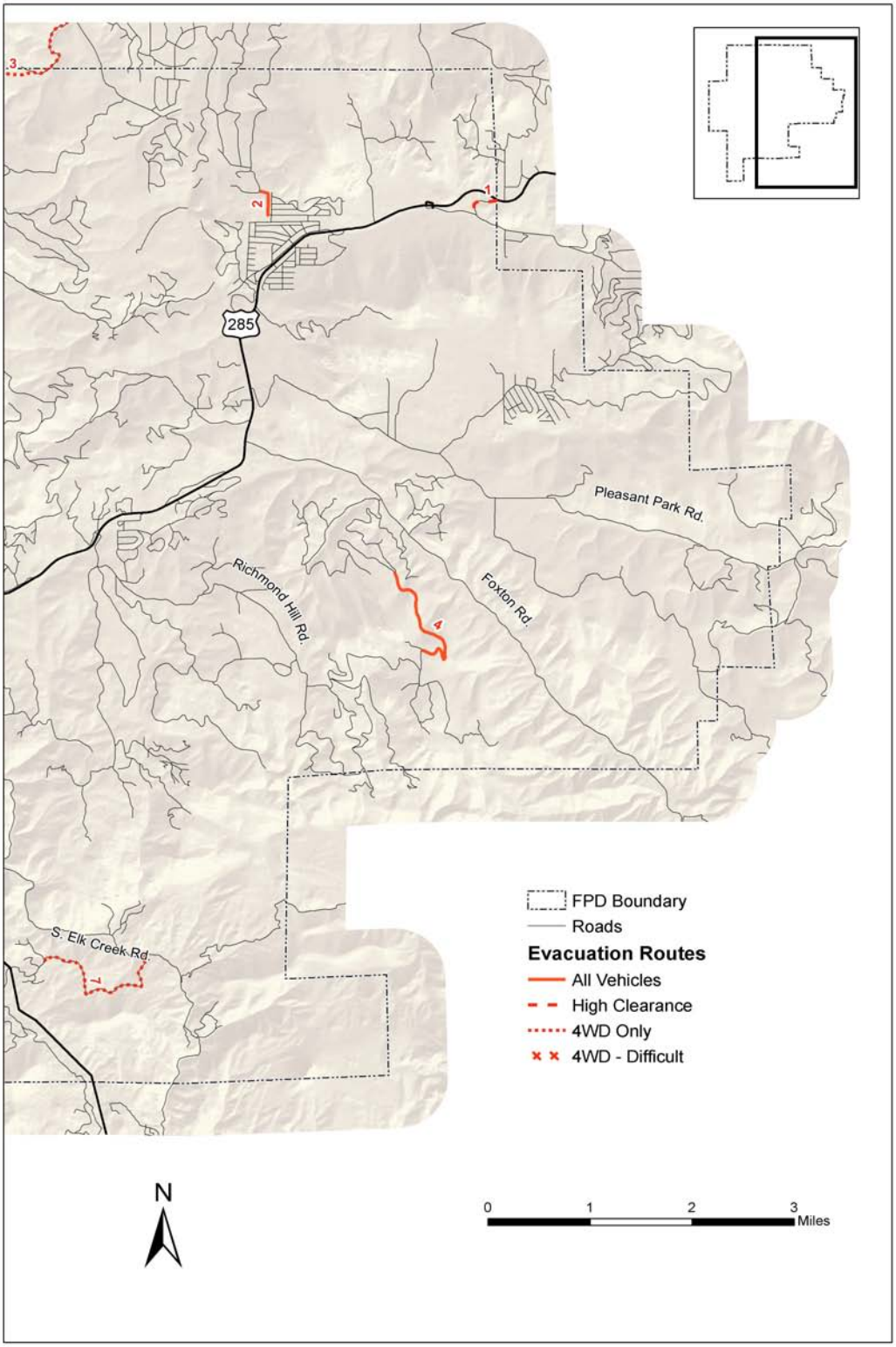
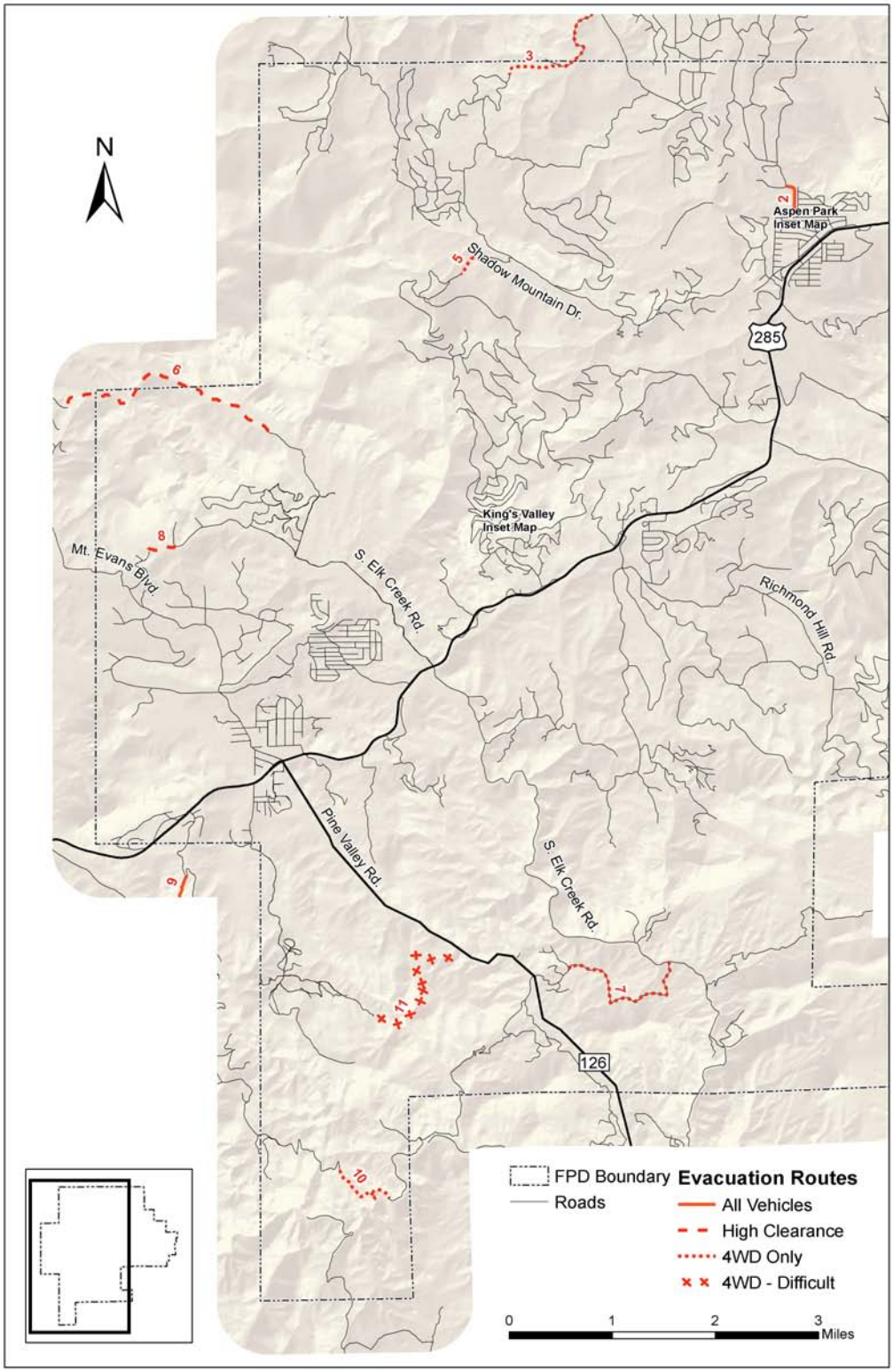


Figure 21. West Side Evacuation Routes



Access Route Fuels Modification Recommendations

In addition to developing additional escape routes, a fuel modification project for primary access corridors should be implemented. Although many of the communities in the study area would benefit from fuels reduction along their principal access routes, priority should be given to access roads in extreme to high hazard communities and communities with single access, which could become impassable due to heat and smoke.

Thinning along primary access roads into communities should include an area of at least 100' on either side of the centerline of the access routes where practical. This distance should be modified to account for increased slope and other topographic features that increase fire intensity (see **Table 4**). This is especially important in communities with steep narrow roads and few turnouts. In these areas, safer access for firefighters would make an impact in the number of structures that could be defended in a wildfire. Existing and natural barriers to fire should be incorporated into the project dimensions.

% Slope	Distance Above Road	Distance Below Road
30	70 feet	145 feet
35	65 feet	153 feet
40	60 feet	160 feet
45	55 feet	168 feet
50	50 feet	175 feet

Table 4. Recommended Treatment Distances for Mid-Slope Roads

The communities that should be considered highest priority for fuels reduction along access corridors include:

- Wandcrest
- Sphinx Park
- Glen Elk
- Kincaid Springs
- Shiloh
- Cub Creek
- Eagle Cliff
- Amerind Springs
- Mountain View
- Hillview
- Apache Springs
- Black Mountain
- Shadow Mountain
- Valley-Hi
- Oehlman Park
- Wamblee Valley
- Ridge Road
- Richmond Hill
- Sunset

In addition to the escape routes suggested on page 31-32, other possibilities should be defined and similar fuels reduction projects employed. In areas where multiple routes exist, consider separating access routes for responders and escape routes for citizens in your preplanning.

The cooperation of adjacent, contiguous landowners should be secured. If this is not possible, more intensive thinning may need to occur within the road easement. Landowner participation allows the project to be more flexible in selecting trees and shrubs for removal. It allows greater consideration for the elements of visual screening and aesthetics. Enlarging the project dimensions, allows more options for vegetative selection while still protecting the access/egress corridor.

- Elements of the fuels modification space for access and egress routes should include:
  - Tree crown separation of at least 10' with groups of trees and shrubs interspersed as desired.
  - Crown separation greater than 10' may be required to isolate adjacent groups or clumps of trees.
  - Limb all remaining trees to a height of 8' or 1/3 of the tree height (whichever is greater).
  - Clean up ground fuel within the project area.
  - Post placards clearly marking "fire escape route". This will provide functional assistance during an evacuation and communicate a constant reminder of wildfire to the community. Be sure to mount signage on non-combustible poles.

OTHER ACCESS ROUTE RECOMMENDATIONS

- In order to reduce conflicts between evacuating citizens and incoming responders, it is desirable to have nearby evacuation centers for citizens and staging areas for fire resources. Evacuation centers should include heated buildings with facilities large enough to handle the population. Schools and churches are usually ideal for this purpose. Fire staging areas should contain large safety zones, a good view in the direction of the fire, easy access and turnarounds for large apparatus, a significant fuel break between the fire and the escape route, topography conducive to radio communications and access to water. Golf courses and large irrigated greenbelts may make good safety zones for firefighting forces. Local responders are encouraged to preplan the use of potential staging areas with property owners.
- Identify and pre-plan alternate escape routes and staging areas.
- Perform response drills to determine the timing and effectiveness of fire resource staging areas.
- Educate citizens on the proper escape routes, and evacuation centers to use in the event of an evacuation.
- Utilize a reverse 911 system or call lists to warn residents when an evacuation may be necessary. Notification should also be carried out by local television and radio stations. Any existing disaster notification systems, such as tornado warnings, should be expanded to include wildfire notifications.

- Emergency management personnel should be included in the development of preplans for citizen evacuation.

Shelter-In-Place

There are numerous communities in ECFPD which could be easily cut off by ignitions in drainages below homes and critical access roads. In addition to improved access/egress, consideration should be given to developing “shelter-in-place” areas that are designed as alternatives to evacuation through hazardous areas. Shelter-in-place recommendations are noted in the Appendix B community sheet for each community where field evaluators deemed this tactic to be appropriate.

There are several ways of protecting the public from an advancing wildfire. One of these methods is evacuation and involves relocation of the threatened population to a safer area. Another is to instruct people to remain inside their homes or public buildings until the danger passes. This concept is new to wildfire in the United States, but not to hazardous materials incident response where time, hazards, and sheer logistics often make evacuation impossible. This concept is the dominant modality for public protection from wildfires in Australia where fast moving, non-persistent fires in light fuels make evacuation impractical. The success of this tactic depends on a detailed preplan that takes into account the construction type and materials of the building used, topography, depth and type of the fuel profile, as well as current and expected weather and fire behavior.

Shelter–in-place should only be considered when the structure is determined to be “stand alone” in structural triage terms. In order to be "stand alone", homes need to have defensible space and be of ignition resistant construction. Depending on the fuel type and fuel bed depth, it may be necessary to continue treatment beyond the minimum recommended defensible space boundaries in order to make the home stand alone. For a list of defensible space recommendations please see the “General Recommendations” section of Appendix B.

Ignition resistant construction is also necessary for shelter-in-place tactics. Wooden roofs and old structures with untreated wooden sidings are particularly hazardous and should not be considered. It is preferable to have metal or asphalt roofs and ignition resistant materials such as stucco or concrete, especially close to the ground. Heavy timber constructions, such as log homes, are also resistant to surface fires. When combined with an ignition resistant type roof heavy timber may be acceptable. Eves should be enclosed. Any holes in the foundation, siding, or eves should be covered to prevent embers from entering.

Threats to residents remaining in structures include heat, smoke, and ignition of the structure itself. Several steps can be taken by residents to mitigate the effects of heat exposure. The following list highlights some of the important concepts:

- Close all doors and windows and shut down all ventilation systems such as air conditioning, heating, and attic fans.

- If there is adequate time and water, consider plugging downspouts and filling any gutters with water. The sand bags that mountain residents commonly have are good for this purpose.
- If a sprinkler that will reach the roof is available, it should be set up so that it covers as much of the roof as possible paying particular attention to the direction from which the fire is approaching.
- Fill all of the tubs and sinks, and any buckets that are easily handled, with water.
- Remove any lightweight or highly flammable window coverings. Heavy drapes or blinds should be closed in case the windows break.
- Move furniture away from windows. Remove flammables, such as gasoline and propane, to a safe distance away from the structure. Propane and other volatile compressed gas tanks may rocket as far as ½ mile, so they are best removed to an area cleared of fuels, such as a concrete driveway or pad.
- Wear clothes of fire resistant natural fibers such as wool or cotton. Be sure to cover as much exposed skin as possible, and keep water with you for personal protection. Do not wear polyester or other synthetics that may melt to your skin when exposed to high temperatures.
- When the fire arrives retreat to the room in the house farthest away from the flaming front.
- Take drinking water with you and drink often to avoid dehydration.
- Even if it becomes uncomfortably hot and smoky do not run outside while the fire is passing.

Fires consume oxygen and produce toxic gasses and smoke. Much work has been done in the hazardous materials field on the infiltration of toxic gasses into structures. Average homes under average weather conditions may experience indoor concentrations of smoke and contaminants of 45 to 65 percent of the outdoor concentrations in 30 minutes. In two hours the concentrations may reach 60 to 65 percent of the outdoor levels.[4] These numbers are for homes with all doors and windows closed and ventilation systems turned off. Buildings with open windows, doors, or operating ventilation systems will experience contamination levels close to the outdoor levels in minutes. Residents can further slow contamination by blocking gaps around doors and windows with wet towels.

After the fire has passed, the main danger to residents is the home igniting from embers and sparks that entered during the flame front passage. Systematically patrol inside and outside looking for embers and spot fires. Be sure to include attics and other roof spaces. Houses may catch fire several hours after the fire has passed if embers are not found and extinguished. For more information on structural triage and preparation please see Appendix C.

[4] "Handbook of Chemical Hazard Analysis Procedures" (Washington, D.C.: FEMA, 1990).

Public Education Efforts FMU

The study area is experiencing continuing development. Increasing property values have resulted in recently constructed high value residences mixed in with older residences and seasonal cabins, ranch properties and historic buildings in various states of decay. There is likely to be a varied understanding among property owners of the intrinsic hazards associated with building in these areas. An approach to wildfire education that emphasizes safety and hazard mitigation on an individual property level should be undertaken, in addition to community and emergency services efforts at risk reduction. Combining community values such as quality of life, property values, ecosystem protection and wildlife habitat preservation with the hazard reduction message will increase the receptiveness of the public.

Field contacts indicate that some landowners in the district are not interested in wildfire mitigation efforts. Continued attempts at providing educational materials to such individuals through personal contact should be conducted. Property owner education will continue to be a challenge in this area and personal contact will most likely be the best tool for the job.

RECOMMENDATIONS

- Utilize these web sites for a list of public education materials, and for general homeowner education:
  - http://www.nwcg.gov/pms/pubs/pubs.htm
  - http://www.firewise.org
  - http://www.colostate.edu/Depts/CSFS/csfspubs.html
- Provide citizens with the findings of this study including:
  - Levels of risk and hazard.
  - Values of fuels reduction programs.
  - Consequences and results of inaction for planned and unplanned ignitions within the community.
- Create a Wildland Urban Interface (WUI) citizen advisory council to provide peer level communications for the community. Too often, government agency advice can be construed as self-serving. Consequently, there is poor internalization of information by the citizens. The council should be used to:
  - Bring the concerns of the residents to the prioritization of mitigation actions.
  - Select demonstration sites.
  - Assist with grant applications and awards.

Fire Department Involvement

Elk Creek Fire Department (hereafter referred to as ECFPD) provides suppression services for the study area. The department has four fire stations. Station 1 is located at the intersection of Blackfoot Road and Highway 285 in the Conifer Mountain East community. Station 1 is manned by career and volunteer firefighters 24 hours a day. All other Elk Creek fire stations are not manned. Station 2 is located on Mount Evans Boulevard one mile north of the intersection with Highway 285 in Pine Junction. Station 3 is located at 10956 Timothy Road in the Conifer Mountain West community. Station 4 is located at 9737 Rhodus Road, south of Highway 285 in Aspen Park. A fifth station is scheduled for construction south in the Black Mountain community. When this station is completed, it will provide improved service to the communities of Cub Creek, Shadow Mountain, Black Mountain and Apache Springs, all of which were rated as "extreme" or "very high" hazard by their community wildfire hazard rating score. The District should continue to review opportunities to locate other stations where appropriate to enhance response times, customer service and ISO ratings.

ECFPD maintains 4 primary response engines (one at each station), one reserve engine at station 1, one primary rescue truck, 4 water tenders, 3 type I ambulances, a CSFS type 6X wildland engine, the 285 wildland response trailer (seasonally), a Colorado state hazmat response trailer and 10 command and utility vehicles. Mutual aid is available to ECFPD through existing Inter-Governmental Agreements from Evergreen, Inter-canyon, Platte Canyon, Indian Hills and North Fork Fire Departments.

ECFPD employs 65 career and volunteer firefighters. All of ECFPD's firefighters have NWCG (National Wildfire Coordinating Group) S-130/190 training (basic wildland fire fighter training and fire behavior). Twelve firefighters have advanced wildland training (NWCG qualified as Squad Boss or higher). Average response time records from dispatch to first engine rolling were not available.

RECOMMENDATIONS

- Training: Provide continuing education for all firefighters including:
  - NWCG S-130/190 for all department members.
  - Annual wildland fire refresher and "pack testing" (physical standards test).
  - S-215 Fire Operations in the Urban Interface.
  - S-212 Wildfire Power Saws.
  - S-290 Intermediate Fire Behavior.
  - I-200 and I-300 – Basic and Intermediate ICS.
- Equipment:
  - Consider the purchase of an additional type 6x (4WD) engine to be positioned at Station 2 during the wildland fire season in order to provide additional small engine support to extreme and high hazard communities in the southwest portion of the study area. This type of engine is recommended due to rough, narrow and steep access roads throughout this area.

- Consider the purchase of an additional type 3x (4WD) Wildland Urban Interface Engine to be positioned at Station 5 (when construction is completed) during the wildland fire season in order to provide additional small engine support to extreme and high hazard communities in the northwest portion of the study area. This type of engine is recommended due to rough, narrow and steep access roads throughout this area.
- Provide minimum wildland Personal Protective Equipment (PPE) for all firefighters.
  - (See NFPA Standard 1977 for requirements).
- Provide gear bags for both wildland and bunker gear to be placed on engines responding to fire calls. This will help ensure that firefighters have both bunker gear and wildland PPE available when the fire situation changes.
- Provide and maintain a ten-person wildland fire cache at each fire station in addition to the tools on the apparatus. The contents of the cache should be sufficient to outfit two squads for handline construction and direct fire attack. Recommended equipment would include:
  - Four cutting tools such as pulaskis or super pulaskis.
  - Six scraping tools such as shovels or combi tool.
  - Four smothering tools such as flappers.
  - Four backpack pumps with spare parts.
  - Two complete sawyer's kits including chainsaw, gas, oil, sigs, chaps, sawyer's hard hat, ear protection, files, file guides, spare chains and a spare parts kit.
  - MREs and water cubies sufficient for 48 hours.

- Communications:
  - Surveys of ECFPD officers revealed radio communications are poor or nonexistent in the following areas:
    - The southern portion of S. Elk Creek Road including all of Sphinx Park and the area west of Shaffer's Crossing
    - Black Mountain and Cub Creek
    - The east end of Foxton Road, including portions of Ridge Road and Silver Ranch
    - Staunton State Park.

Other front-range fire departments have reported that 800 MHz radio systems work "reasonably well" in similar topography, however, we do not recommend the exclusive use of 800 MHz radios for WUI operations in ECFPD. Many local responders will be limited to VHF radios and VHF radios are still the dominant mode of communications for large (federal) fire incidents. The overall issue of communications difficulties has gained national attention. On August 30th 2005, an Area Command Team (Rounsaville) was tasked by the National Multi-Agency Coordination Group to evaluate radio communications on incidents with consideration to training and education, maintenance and replacement of equipment, narrow banding and communication and coordination with cooperators. This team will provide recommendations and solutions for these issues. Technology has and will continue to provide interoperability solutions.

Home Mitigation FMU

Community responsibility for self-protection from wildfire is essential. Educating homeowners is the first step in promoting a shared responsibility. Part of the educational process is defining the hazard and risks both at the community and parcel level.

The mid-level assessment has identified 25 of the 40 communities in the study area to be at extreme or very high risk. Construction type, condition, age, the fuel loading of the structure/contents and position are contributing factors in making homes more susceptible to ignition under even moderate burning conditions. Under extreme burning conditions, there is a likelihood of rapid fire growth and spread in these areas due to steep topography, fast burning or flashy fuel components and other topographic features that contribute to channeling winds and promotion of extreme fire behavior. These areas may also represent a high threat to life safety due to poor egress, the likelihood of heavy smoke and heat, long response times and/or inadequate response levels.

Table 5, on page 44, illustrates the relative hazard rankings for communities in the study area.

- A rating of 5 or less indicates an area of extreme hazard.
- A rating of 6 to 10 indicates a very high hazard.
- A rating of 11 to 20 indicates high hazard.
- A rating of 21 to 30 indicates moderate hazard.
- A rating of 31 or greater indicates a low hazard.

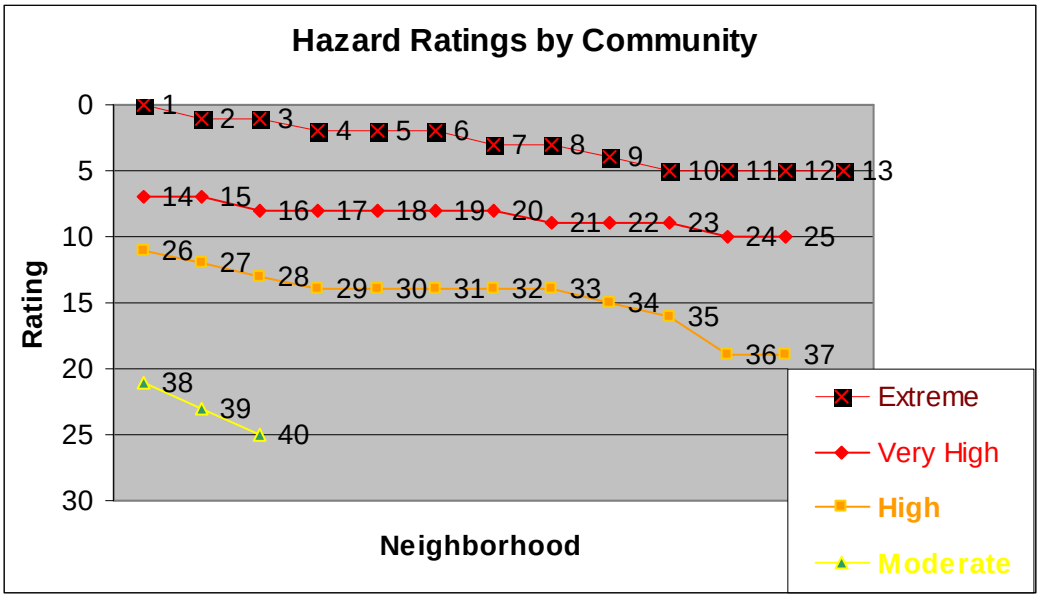
The communities with extreme to high hazard ratings should be considered an FMU where a parcel level analysis should be implemented as soon as possible. Please see Appendix B for more detailed information.

RECOMMENDATIONS

- **The most important goal for the improvement of life safety and property preservation is for every home in the study area to have conforming defensible space.** This is especially important for residences in high hazard communities that have wood or other flammable roofing types. **An aggressive program of evaluating and implementing defensible space for homes will do more to limit fire related property damage than any other single recommendation in this report.**
- Conduct a parcel level wildfire hazard analysis for the homes in the study area. Completing this process will facilitate the following important fire management practices.
  - Establish a baseline hazard assessment for homes in these communities.
  - Education of the community through the presentation of the parcel level Hazard-Risk Analysis at neighborhood public meetings.
  - Identification of defensible space needs and other effective mitigation techniques.
  - Identification and facilitation of "cross-boundary" projects.
  - Community achievement of national FIREWISE status.

- Development of a Pre-Attack/Operational Plan for the FMU and eventually the entire study area. A pre-attack plan assists fire agencies in developing strategies and tactics that will mitigate incidents that occur.

- Improve access roads and turnarounds to create safe access for firefighting resources. See Elk Creek Hazard Assessment Emergency Access and Water Supply (Appendix D).
- Discourage the use of cedar shakes or other flammable materials for roofs and sidings.
- Add reflective address signs at each driveway entrance to all homes (See Appendix D for recommendations).
- Utilize the structure triage methodology provided in Appendix C to identify homes not likely to be defendable.



1. Wandcrest	21. Piano Meadows
2. Sphinx Park	22. Valley-Hi
3. Glen Elk	23. Aspen Park
4. Kincaid Springs	24. Conifer Meadows
5. Holmes Gulch	25. Oehlman Park
6. Shiloh	26. Conifer
7. Cub Creek	27. Elk Falls Ranch
8. Eagle Cliff	28. Silver Springs
9. Conifer Mountain - East	29. Will 'O Wisp
10. Amerind Springs	30. Pine Junction
11. Mountain View	31. Woodside
12. Silver Ranch Estates	32. Wamblee Valley
13. Hillview	33. Ridge Road
14. Apache Springs	34. Richmond Hill
15. Green Valley	35. Rim Rock
16. Conifer Mountain - West	36. Sunset
17. Black Mountain	37. Pine Valley Ranches
18. Shadow Mountain	38. Agate
19. Swiss Village	39. Douglass Mountain
20. Calfee Gulch	40. Evergreen Meadows

Table 5. Hazard Ratings by Community

Landscape Scale Fuels Modifications FMU

One of the most effective forms of landscape scale fuels modification is the fuelbreak (sometimes referred to as "shaded fuelbreak"). A 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. Vegetation is thinned removing diseased, fire-weakened and most standing dead trees. Thinning should select for the more fire resistant species. Ladder fuels, such as low limbs and heavy regeneration are removed from the remaining stand. Brush, dead and down materials, logging slash and other heavy ground fuels, are removed and disposed of to create an open park-like appearance. The use of fuelbreaks under normal burning conditions can limit uncontrolled spread of fires and aid firefighters in slowing the spread rate. Under extreme burning conditions where spotting occurs for miles ahead of the main fire and probability of ignition is high, even the best fuelbreaks are not effective. That being said, however, fuelbreaks have proven to be effective in limiting the spread of crown fires in Colorado. Factors to be considered when determining the need for fuelbreaks in mountain subdivisions include:

- The presence and density of hazardous fuels
- Slope
- Other hazardous topographic features
- Crowning potential
- Ignition sources

With the exception of aspen, all of Colorado's major timber types represent a significant risk of wildfire. Increasing slope causes fires to move from the surface fuels to crowns more easily due to preheating. A slope of 30% causes the fire spread rate to double compared with the same fuels and conditions on flat ground. Chimneys, saddles and deep ravines are all known to accelerate fire spread and influence intensity. Communities with homes located on or above such features as well as homes located on summits and ridge tops would be good candidates for fuel breaks. Crown fire activity values for ECFPD were generated by the FlamMap model and classified into four standard ranges. In areas where independent and dependent crown fire activity is likely to exist, fuelbreaks should be considered. If there are known likely ignition sources (such as railroads and recreation areas that allow campfires) that are present in areas where there is a threat of fire being channeled into communities, fuelbreaks should be considered.

Fuelbreaks should always be connected to a good anchor point like a rock outcropping, river, lake, or road. The classic location for fuelbreaks is along the tops of ridges to stop fires from backing down the other side or spotting into the next drainage. This is sometimes not practical from a WUI standpoint as the structures firefighters are trying to protect are usually located at the tops of ridges or mid-slope. Mid-slope positioning is considered the least desirable for fuelbreaks; however it may be easiest to achieve as an extension of defensible space work or an extension of existing roads and escape routes. One tactic would be to create fuelbreaks on slopes below homes located mid-slope and on ridge tops so that the area of continuous fuels between the defensible space of homes and the fuelbreak is less than ten acres. Another tactic that is commonly used is to position fuelbreaks along the bottom of slopes. In most of the study area this would require the cooperation of many individual landowners. In some areas the only way to separate residences from fuels is to locate the

fuelbreak mid-slope above homes. This would provide some protection from backing fires and rolling materials. It would make sense to locate fuelbreaks mid-slope below homes, where this is possible, to break the continuity of fuels into the smaller units mentioned above. Even though this position is considered the least desirable from a fire suppression point of view, it would be the most effective approach in some portions of the study area.

Fuelbreaks are often easiest to locate along existing roadbeds (see the description of the fuels modification project for primary access corridors on page 11 of this report). The minimum recommended fuelbreak width is usually 200 feet. As spread rate and intensity increases with slope angle, the size of the fuel break should also be increased with an emphasis on the downhill side of the roadbed or centerline employed. The formulas for slope angles of 30% and greater are as follows: below road distance = 100' + (1.5 x slope %), above road distance = 100' – slope % (see **Table 4** on page 35)[5]. Fuelbreaks that pass through hazardous topographic features should have these distances increased by 50%. Since fuelbreaks can have an undesirable effect on the esthetics of the area, crown separation should be emphasized over stand density levels. That is to say that isolating groupings rather than cutting for precise stem spacing will help to mitigate the visual impact of the fuelbreak. Irregular cutting patterns that reduce canopy and leave behind islands with wide openings are effective in shrub models.

Another issue in mechanical thinning is the removal of cut materials. It is important to note that in Colorado's dry climate slash decomposes very slowly. One consequence of failing to remove slash is to add to the surface fuel loading, perhaps making the area more hazardous than before treatment. It is imperative that all materials be disposed of by piling and burning, chipping, physical removal from the area, or lopping and scattering. Of all of these methods lopping and scattering is the cheapest, but also the least effective since it adds to the surface fuel load.

It is also important to note that fuelbreaks must be maintained to be effective. Thinning usually accelerates the process of regenerative growth. The effectiveness of the fuelbreak may be lost in as little as three to four years if ladder fuels and regeneration are not controlled.

Current Projects

There is a CSFS thinning project currently underway along Wamblee Valley Road. When Station 5 is constructed at the corner of Greening and Black Mountain Road dog-hair stands of lodgepole pine on the property are scheduled to be thinned to defensible space standards on the fire station property. Forest health thinnings have been done on the 80 acre Landcaster family property in Shadow Mountain for many years, however thick dog-hair stands remain in spite of the efforts. Extensive thinning efforts in Staunton State Park have been successful in converting large areas along access roads from closed-canopy mixed conifers (FM 9 and FM 10) to open-canopy conifers with grass understory. Recently a CSFS fuelbreak was cut in the Butterfield Ranch that goes almost all the way to Pine. This fuelbreak is accessed from 15602 South Elk Creek Road.

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[5] Frank C. Dennis, "Fuelbreak Guidelines for Forested Subdivisions" Colorado State Forest Service, Colorado State University [CSFS #102-1083], 1983.

RECOMMENDATIONS

The following recommendations are in addition to, not in place of, the fuels reductions mentioned in the *"Access Route Fuels Modification Recommendations"* section of this report. Historically most fires have moved with the prevailing wind patterns in this area (west to east). The landscape scale fuel break recommendations made in this report have bee designed to take advantage of this general pattern and cannot account for all weather conditions and circumstances.

All of these recommendations will require the cooperation of private landowners and in some cases land managers from multiple public agencies. Negotiations and public education efforts should begin as soon as possible to secure a consensus for future fuels reduction projects on the landscape scale.

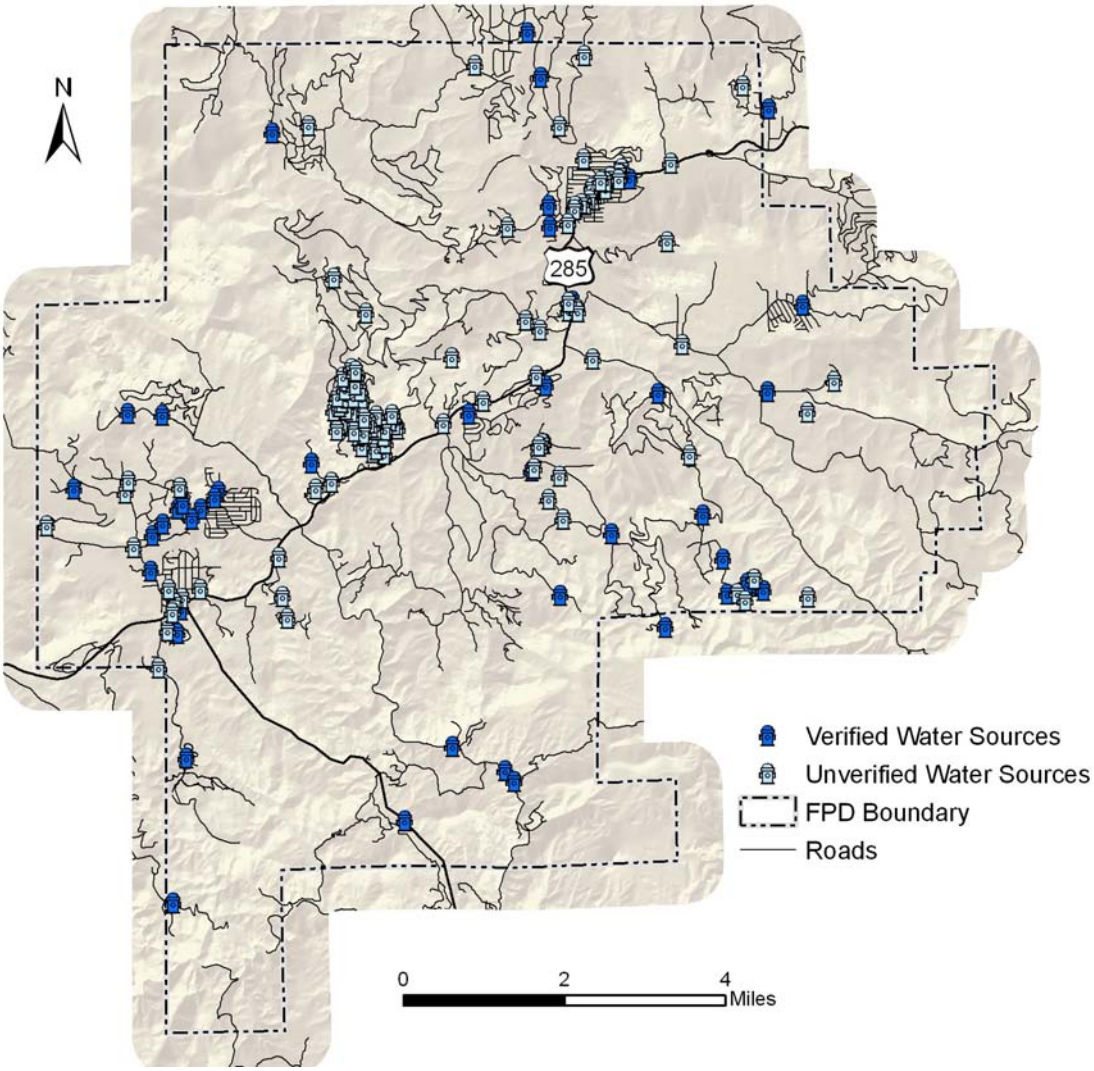
Of the communities assessed in this study the following are recommended for fuel breaks:

- The CSFS thinning project along Wamblee Valley Road should be continued to the southern end of this community to slow the spread of fire and improve access. Thinning standards should be the same as those outlined in the *Access Route Fuels Modification Recommendations* section of this report.
- Investigate the possibility of tying the shaded fuelbreak on the Butterfield Ranch into South Elk Road north of Amerind Springs using an existing jeep track through moderate terrain. This jeep track is shown on most topo maps as running past some water tanks northwest of Amerind Springs. If this work could be done it should slow rates of spread and reduce fire intensity in an area shown by the wildfire behavior potential to have high rates of spread and intensity even under moderate burning conditions.
- Investigate the possibility of extending the thinning project in Staunton State Park to the Hidden Valley Ranches community in Platte Canyon FPD and along Hidden Valley Boulevard to slow rates of spread and reduce fire intensity in the Elk Falls Ranch and Woodside communities.
- Investigate the possibility of partnering with the USFS to use existing forest service roads and trails in the Arapahoe Roosevelt National Forest to provide a fuel break to the north and west of the Cub Creek community to provide a fuel break for the Cub Creek and Black Mountain communities. Ideally this work would eventually be tied into the thinning work in Staunton State Park.
- Investigate the possibility of cutting a shaded fuelbreak along Wandcrest Road, Tobbogan Road and the proposed escape route mentioned in this report to Pine Valley Road. This would provide not only access protection, but slow the spread of fires moving from southwest to northeast through the numerous gullies in the area.
- There are some communities in the study area that have a notable amount of standing dead and diseased trees. We recommend annual insect and disease surveys take place in any area exhibiting signs or symptoms of attacks. Insect surveys should be conducted in between an insect's flight periods to identify newly attacked trees. All newly attacked trees should be removed and treated prior to the beginning of the insect's next flight period. For example, mountain pine beetle (*Dendroctonus ponderosae*) should be surveyed for between the months of October and June. Mountain pine beetle infested trees should be removed and treated prior to July 1 of the following year. Cooperation between public and private landowners will be required to achieve the maximum effectiveness of these recommendations.

Water Supply FMU

In the study area, like many of the mountainous areas of Colorado, water is a critical fire suppression issue. Although there are only two communities (Conifer Mountain West and Will O Wisp) with pressurized fire hydrants, Elk Creek does have a network of tanks, cisterns, dry hydrants and seasonal draft ponds. Approximate locations of water sources within the study area are shown in **Figure 22**.

Figure 22. Water Supply Locations in the Study Area



A list of water supplies in ECFPD was compiled from District records. Several water supplies remain unverified in their location, and capability. As a part of the fieldwork for this report several sample points were taken to verify the existing data. During the fieldwork, sampling of cisterns, dry hydrants and draft pond locations were noted. Water sources were not examined for functionality but merely noted as present at that location. During the course of the fieldwork 18 water sources

were noted that did not exist in the District records. These were added to 147 water sources that were compiled from the District records. Several of the water sources that did exist were corrected for coordinate location. Water sources listed in the Department records but not field verified are indicated in light blue in **Figure 22**.

The mid-level assessment revealed several communities in the study area where easily accessible water sources for fire suppression are not present.

- Wandcrest
- Sphinx Park
- Glen Elk
- Cub Creek
- Amerind Springs
- Shadow Mountain
- Swiss Village
- Wamblee Valley
- Rim Rock
- Sunset

There are also communities in the study area where the water supply is inadequate, either because of size, distance, accessibility factors, or the number of homes being served. These communities include:

- Kincaid Springs
- Eagle Cliff
- Conifer Mountain East
- Silver Ranch Estates
- Black Mountain
- Apache Springs
- Conifer Meadows
- Oehlman Park
- Ridge Road
- Pine Valley Ranch

The communities listed above are, or could be under certain circumstances, a considerable distance from reliable water sources for fire suppression. Improvement of the water supply in these communities constitutes an important FMU.

RECOMMENDATIONS

- All of the water sources that were not visited as part of the field data collection should be checked for proper coordinates, physical location and type. Water sources listed in the District records but not field verified are indicated in the detailed water supply list in the *Elk Creek FPD Pre-Attack Operational Plan* as unverified water supplies. None of the data derived from the District records should be assumed to be accurate until field verified.
- Consult the individual community sheets in Appendix B for specific water source recommendations for each community.
- Dry hydrants have been color coded in the ECFPD District records to indicate the capacity of the water source; however this information has become lost. An effort should be made to recover this information and include in the *Elk Creek FPD Pre-Attack Operational Plan*
- A program of periodic hydrant testing should be instituted to check the function and condition of pressurized and dry hydrants throughout the district. Hydrants should be tested at least once every two to three years.

GLOSSARY

The following definitions apply to terms used in the Elk Creek Fire Protection District Community Wildfire Protection Plan.

Citizen Safety Zone: An area that can be used for protection by residents, and their vehicles, in the event that the main evacuation route is compromised. The area should be maintained, cleared of fuels and large enough for all residents of the area to survive an advancing wildfire without special equipment or training.

Community Assessment: A fifty-point scale analysis designed to identify factors that increase the potential and/or severity of undesirable fire outcomes in WUI communities.

Defensible Space: An area around a structure where fuels and vegetation are modified, cleared or reduced to slow the spread of wildfire toward or from the structure. The design and distance of the defensible space is based on fuels, topography, and the design/materials used in the construction of the structure.

Extended Defensible Space (also known as Zone 3): A defensible space area where treatment is continued beyond the minimum boundary. This zone focuses on forest management with fuels reduction being a secondary consideration.

Fire Behavior Potential: The expected severity of a wildland fire expressed as the rate of spread, the level of crown fire activity, and flame length. Derived from fire behavior modeling programs utilizing the following inputs: fuels, canopy cover, historical weather averages, elevation, slope and aspect.

Fire Danger: Not used as a technical term in this document due to various and nebulous meanings that have been historically applied.

Fire Hazard: The likelihood and severity of Fire Outcomes (Fire Effects) that result in damage to people property and/or the environment. Derived from the Community Assessment and the Fire Behavior Potential.

Fire Mitigation: Any action designed to decrease the likelihood of an ignition, reduce Fire Behavior Potential, or to protect property from the impact of undesirable Fire Outcomes.

Fire Outcomes (aka Fire Effects): A description of the expected effects of a wildfire on people, property and/or the environment based on the Fire Behavior Potential and physical presence of Values-at-Risk. Outcomes can be desirable as well as undesirable.

Fire Risk: The probability that an ignition will occur in an area with potential for damaging effects to people, property and/or the environment. Risk is based primarily on historical ignitions data.

Fuel Break: A natural or constructed discontinuity in a fuel profile utilized to isolate, stop, or reduce the spread of fire. Fuel breaks may also make retardant lines more effective and serve as control lines for fire suppression actions. Fuel breaks in the WUI are designed to limit the spread and intensity of crown fire activity.

Shelter-in-Place Areas: A method of protecting the public from an advancing wildfire involving instructing people to remain inside their homes or public buildings until the danger passes. This concept is new to wildfire in the United States, but not to hazardous materials incident response where time, hazards, and sheer logistics often make evacuation impossible. This concept is the dominant modality for public protection from wildfires in Australia where fast moving, short duration fires in light fuels make evacuation impractical. The success of this tactic depends on a detailed preplan that takes into account the construction type and materials of the building used, topography, depth and type of the fuel profile, as well as current and expected weather and fire behavior. For a more complete discussion of the application and limitations of Shelter-in-Place concepts see the “Access, Evacuation, and Sheltering-In-Place FMU" section in the main report.”

Values-at-Risk: People, property and environmental features within the project area which are susceptible to damage from undesirable fire outcomes.

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