Wildland Urban Interface

Community Wildfire Protection Plan

Prepared for:

Colorado Sierra Fire Protection District

Golden, Colorado

Submitted By:

Anchor Point

Boulder, Colorado

December 2005

TABLE OF CONTENTS

List of Figures

List of Tables

LIST OF APPENDICES

PURPOSE

The purpose of the Community Wildfire Protection Plan, which includes fire behavior analysis and community wildfire hazard ratings, is to provide a comprehensive, scientifically-based assessment of the wildfire hazards and risks within the Colorado Sierra Fire Protection District.

The assessment estimates the:

RISK: The likelihood of the occurrence of a significant wildfire event, and

HAZARDS: The potential for 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 jurisdiction and allows for prioritization of mitigation efforts. From this analysis, solution and mitigation actions are offered that will aid land owners, land managers, the fire protection district 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.**

Objectives

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 and coordination:**

   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 Colorado Sierra 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 area, 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 Forest Service). 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. Collaboration with Colorado State Forest Service, USDA Forest Service, Colorado State Parks and local fire officials.

The data derived from the community wildfire hazard rating system (WHR) and the analyses of fire behavior potential are extensive and 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 the wildfire hazard and risk assessment.

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 in Los Alamos, New Mexico, 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). That report, and the ensuing congressional appropriations, ultimately required actions to:

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

Congress increased specific appropriations to accomplish these goals.

The following year – 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 "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 Colorado Sierra Fire Protection District CWPP.

Study Area Profile

The Colorado Sierra Fire Protection District (CSFPD) is located in Gilpin County, 35 miles west of Denver, Colorado. The district is bordered on the north, south and west by High Country Fire Protection District and on the east by Golden Gate Canyon State Park. CSFPD covers an area of 2.1 square miles and has approximately 520 homes. The primary access to the district is via Highway 119.

CSFPD is located primarily on a high elevation plateau.

Figure 1. Typical Area

Elevations range from 8,700' to 9,250'. Although the overall topographic variation is not great within the district, steep slopes and ravines exist throughout the larger landscape. 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 response area boundary of CSFPD, unless otherwise noted.

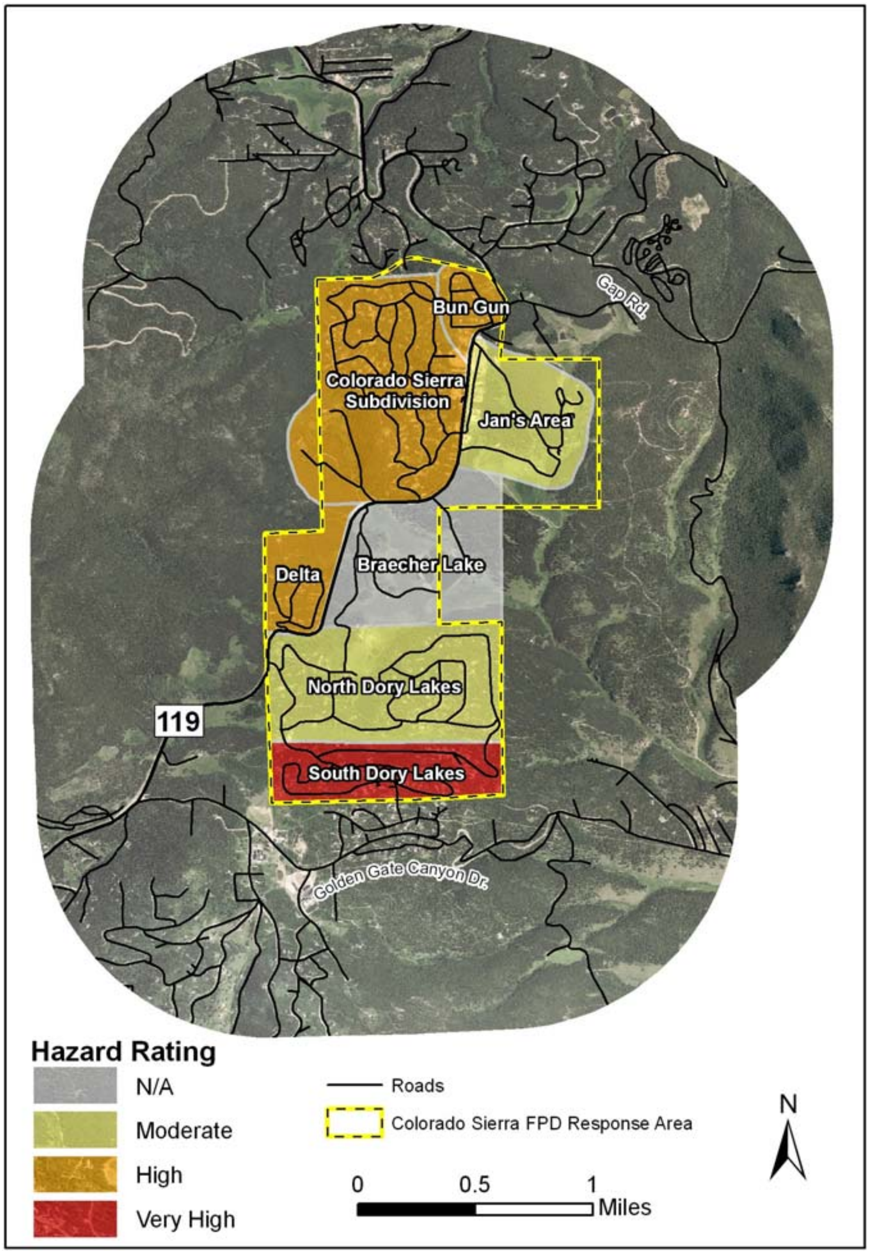
The majority of CSFPD is considered to be in the Montane zone (5,500'- 9,500') of the eastern slope of the Northern Colorado Front Range (see **Figure 4**)[1]. The dominant vegetation is composed of conifer forest and aspen stands. These consist primarily of over-mature stands of mixed conifer, mixed conifer and aspen *(Populus tremulodies)* and pure stands of lodgepole pine *(Pinus contorta),* with timber litter or various species of mountain grasses in the understory. These forest stands are broken by primarily short grass meadows and aspen. Canopy coverage within the study area ranges from savanna to dense forest. Various species of riparian shrubs occur in stringers and patches in low-lying areas, particularly along stream corridors and in drainages.

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** and **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, 1998)

Figure 2. Study Area Communities



Very High High Moderate

1. South Dory Lakes	4. Colorado Sierra Subdivision
2. Bun Gun	5. North Dory Lakes
3. Delta	6. Jan's Area

Table 1. Community Hazard Rating

Figure 3. Percent Slope

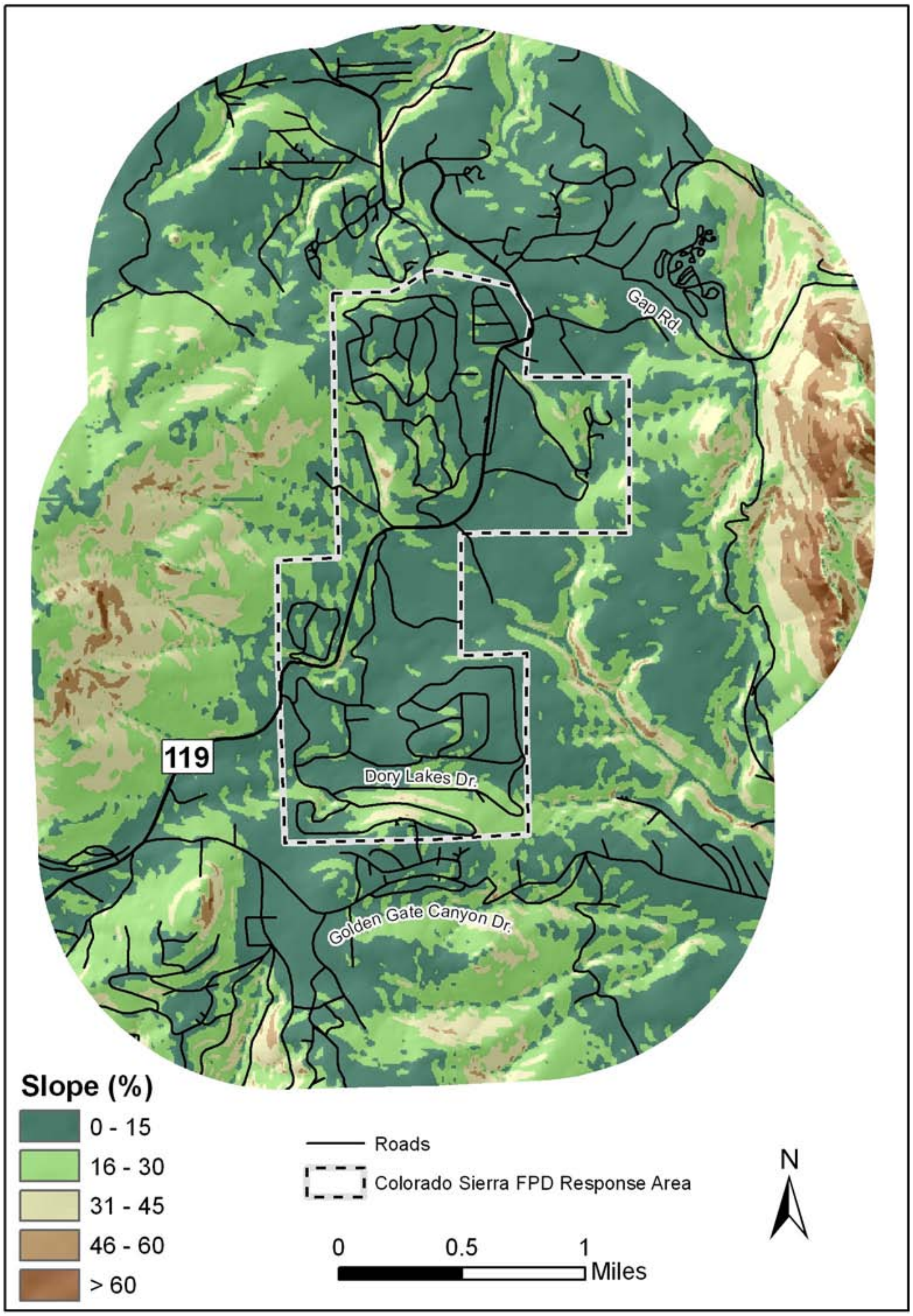
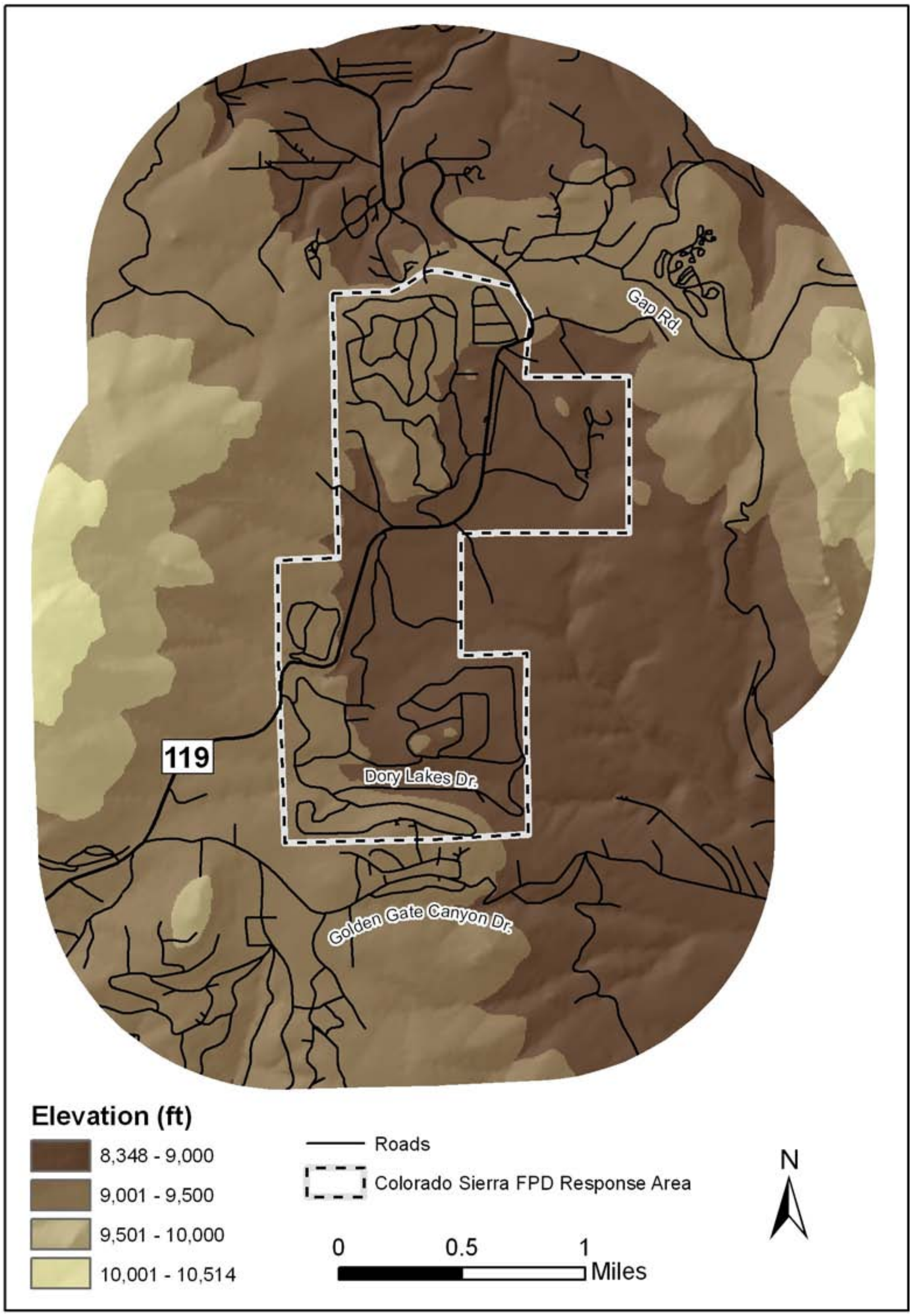


Figure 4. Elevation



VALUES

Life Safety and Homes

There are approximately 520 homes in CSFPD. The most populated areas were divided into 6 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 1 of the 6 communities in the study area to be at very high risk. Under extreme burning conditions, there is a likelihood of rapid fire growth and spread in this area 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. This area may also represent a high threat to life safety due to poor egress, the likelihood of heavy smoke, heat, and /or long response times.

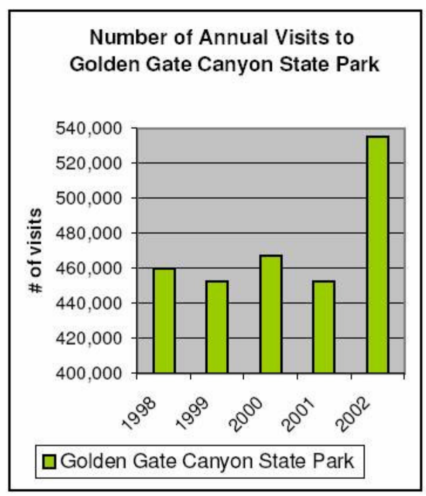
Commerce and Infrastructure

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

Recreation and Life Style

Residents of the study area have a keen appreciation for their natural environment. They like to be in the mountains—it's the context of their quality of life. Recreation and the natural beauty of the area are frequently quoted as reasons local residents have chosen to live in the study area. In the process of meeting with residents, phrases like "This community has a family legacy with a core of outdoors values" and "like living in a park" were heard. As the population in the Front Range continues to grow, so has the number of people accessing and utilizing the natural environment. Golden Gate Canyon State Park, which is adjacent to the boundaries of CSFPD, is no exception. Annual visits to Golden Gate Canyon State Park, which were reasonably flat from 1998 to 2001, started to experience an upward trend in 2002. The park saw 83,000 more visits in 2002 (535,000) than 2001 (452,000).[2]

Figure 5. Golden Gate Canyon State Park Visits 1998-2002



[2] Peak to Peak Community Indicators Project 2003 Presented by Peak to Peak Healthy Communities Project

Habitat Effectiveness

Residents are clear that the preservation of wildlife and the environment is important to the quality of life of the area. Habitat effectiveness is defined as the degree to which habitat is free of human disturbance and available for wildlife to use. Effective habitat is mostly undisturbed land area, which is buffered (at least 300 feet in essentially all situations), from regular motorized and non-motorized use of roads and trails (11 or more people or vehicle trips per week). It is felt that habitat effectiveness should not fall below 50%, and the best wildlife habitats have a much higher percentage. Listed below is the percentage of habitat effectiveness for USDA Forest Service Geographic Areas within Boulder and Gilpin Counties. The desire is to not see these percentages decrease, and to increase habitat effectiveness in those areas currently below 50% (highlighted in red below).[3] Wildfire, especially catastrophic wildfire, can have significant adverse effects on habitat effectiveness.

Geographic Area Name	LOCATION	Habitat EffECTIVENESS
Thorodin	Gilpin	59%
James Creek	Gilpin	57%
James Peak	Gilpin	82%
Lump Gulch	Gilpin	49%
Mammoth	Gilpin	39%
Boulder Creeks	Gilpin/Nederland	52%
Indian Peaks	Nederland Area	77%
Caribou	Nederland Area	53%
Sugarloaf	Nederland Area	41%
Niwot Ridge	Nederland Area	74%
Brainard Lake	Nederland Area	48%

Table 2. Habitat Effectiveness in Gilpin and Boulder Counties Along the Hwy 119 Corridor

[3] Peak to Peak Community Indicators Project 2003 Presented by Peak to Peak Healthy Communities Project ©Copyright 2003 Peak to Peak Healthy Communities Project

CURRENT RISK SITUATION

For the purposes of this report the following definitions apply:

Risk is 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 Wildland Urban Interface (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 moderate risk for WUI fires. This assessment is based on the analysis of the following factors.

1. The nearby towns of Rollinsville, Blackhawk and Central City, as well as the Dory Lakes subdivision, 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 moderate to high Hazard Value (an aggregate of Hazard, Risk and Values Layers).
2. No major fires (fires greater than 100 acres) have been reported in the district since 1994.
3. The USDA Forest Service fire regime and condition class evaluation of forest stands in the study area shows that historic fire regimes have been moderately to substantially altered. Please see the *Fire Regime and Condition Class* section of this report (on page 14) for details.
4. The surrounding federal lands report an active, but far from extreme, fire history. Fire occurrences for the Boulder and Clear Creek Ranger Districts of the Arapahoe-Roosevelt National Forest (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 6a shows the number of fires (red bars) and the total acres burned (blue hatched bars) in the two ranger districts each year. While the number of annual fires range from approximately 9 to over 30 fires per year, there is little year-to-year pattern to the variation. Acres burned are by far the greatest in 2003 primarily due to the Overland fire in the Boulder Ranger District. Of the 4,571 acres reported burned in these two ranger districts between 1994 and 2004, 3,869 were burned by the Overland fire. Between 1994 and 2004 the only other fire to burn more than 100 acres in the two ranger districts was the Bear Tracks fire in 1998.

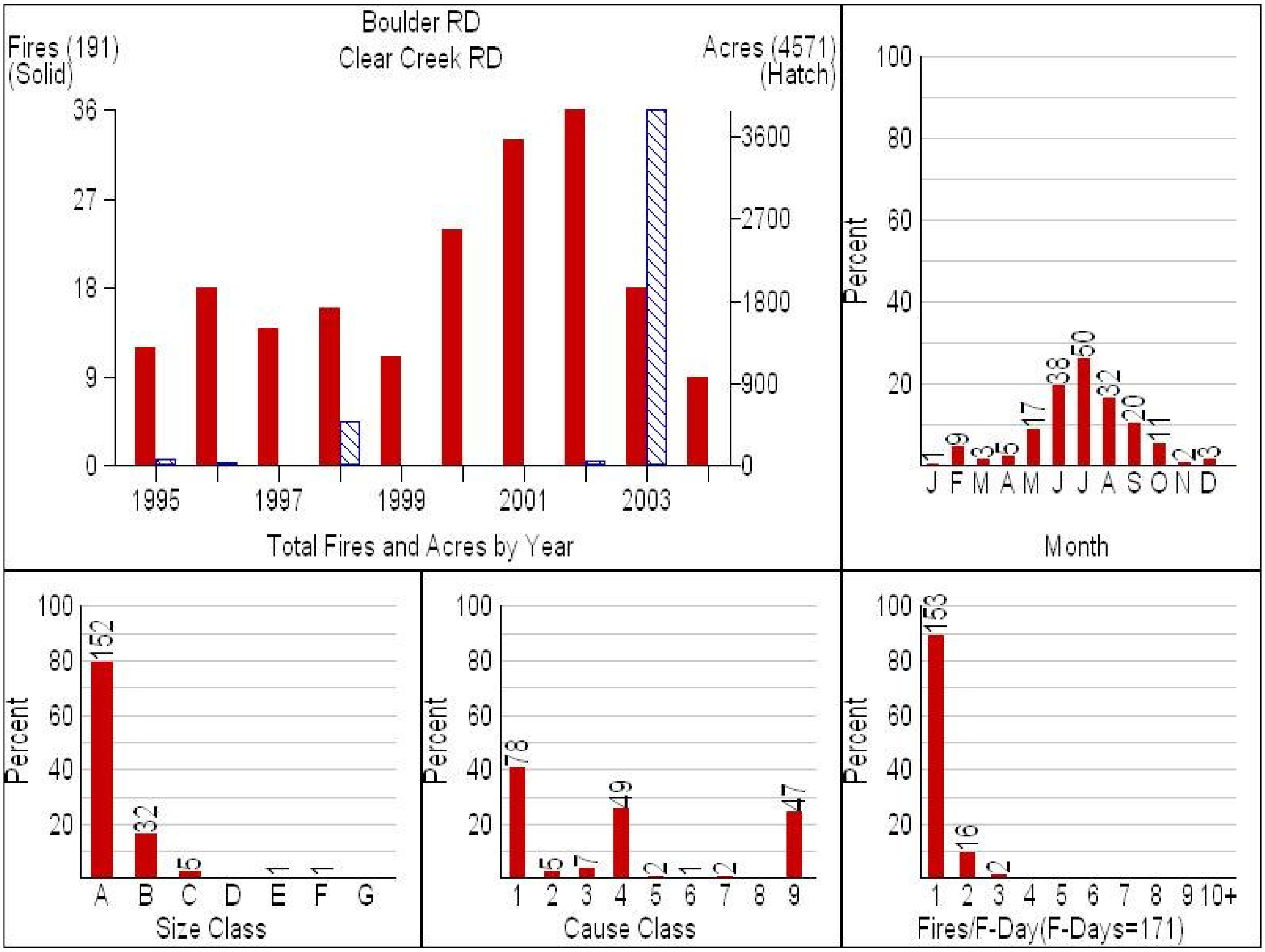
Figure 6b shows the percentage and number of fires between 1994 and 2004 occurring in each month of the year. July had the greatest number of fires followed by June and August. The fewest fires occurred between the months of November and April which reflects the climate conditions for the area.

Figure 6c shows the size class distribution of fires. Approximately 96% of the reported fires (184 of 191) 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 6d shows the number of fires caused by each factor. As shown in this graph, the most common cause of ignitions is lightning (41%); however, the next most common cause is campfires (26%). If we remove the miscellaneous cause category, natural causes still represent the majority of ignitions (54% natural and 46% 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.

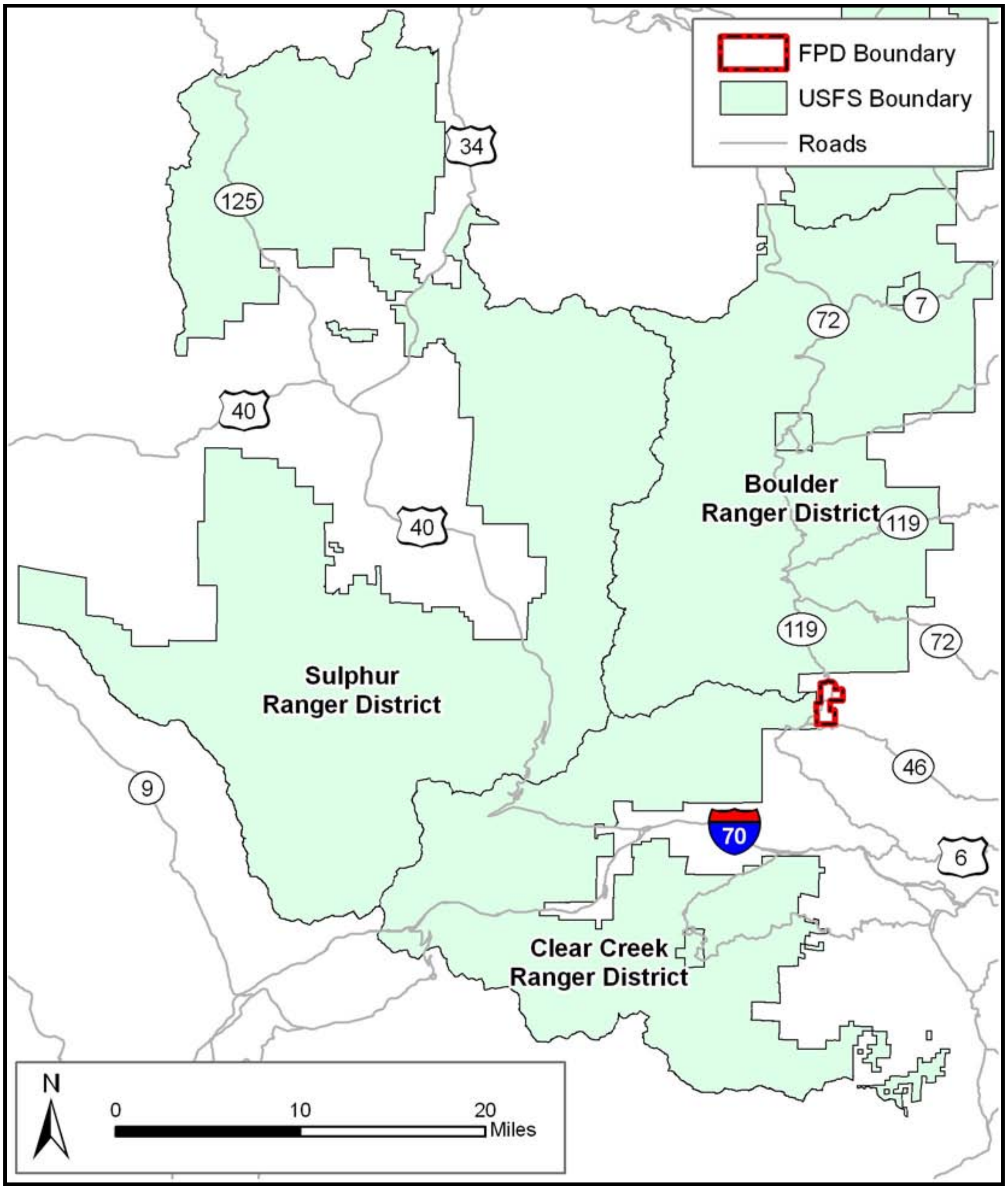
Figure 6e shows the number of fire starts for each day that a fire start was recorded. Most fires (153) occurred on days that only had one fire start. Approximately 8% (16) of fire days had two fire starts recorded and days with three or more fire starts represent approximately 1% of all fire start days. The statistics suggest that multiple start days are a rare occurrence compared to fire days with a single ignition.

Figure 6. Local 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 7. ARNF Ranger Districts



The Sulphur district has been included for reference only.

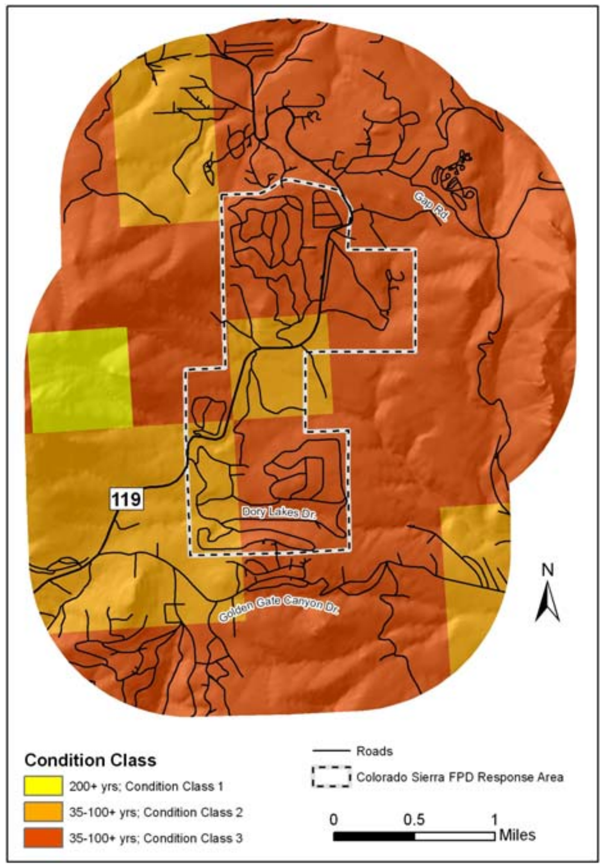
Development is increasing in the study area. As the density of structures and the number of residents in the interface increases, potential ignition sources will multiply. Unless efforts are made to mitigate the potential for human ignition sources spreading to the surrounding forest, the potential for a large wildfire occurrence, although historically low, will undoubtedly increase.

FIRE REGIME CONDITION CLASS

The Fire Regime Condition Class (FRCC) is a landscape evaluation of expected fire behavior as it relates to the departure from historic norms. The data used for this study is from a national level map. The minimum mapping unit for this data is 1 square kilometer. FRCC is not to be confused with BEHAVE and FlamMap fire behavior models, detailed in the fire behavior section, which provide the fire behavior potential analysis for expected flame length, rate of spread and crown fire development.

The 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 8** displays graphically the return interval and condition class of the study area.

Figure 8. 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 within the CSFPD. 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[4]

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***.

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

FIRE BEHAVIOR POTENTIAL

Fire behavior potential maps, **Figures 9-11**, display graphically 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 Pickle Gulch Remote Automated Weather Station (RAWS) were averaged for a ten-year period (1994-2004) to calculate these conditions. The average conditions class (16^{th} to 89^{th} percentile) was calculated for each variable (1 hour, 10 hour, and 100 hour 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 12-14,** 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 ten-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, for example 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. This model can be combined with the community wildfire hazard rating and values-at-risk information to generate current and future "areas of concern", which are useful in the prioritizing of mitigation actions (please see the *Solutions and Mitigation* section of this report). This is sometimes referred to as a "values layer". It is recommended that whenever possible, fire behavior calculations be done with actual weather observations during fire events. 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 9. Flame Length Predictions (Average Weather Conditions)

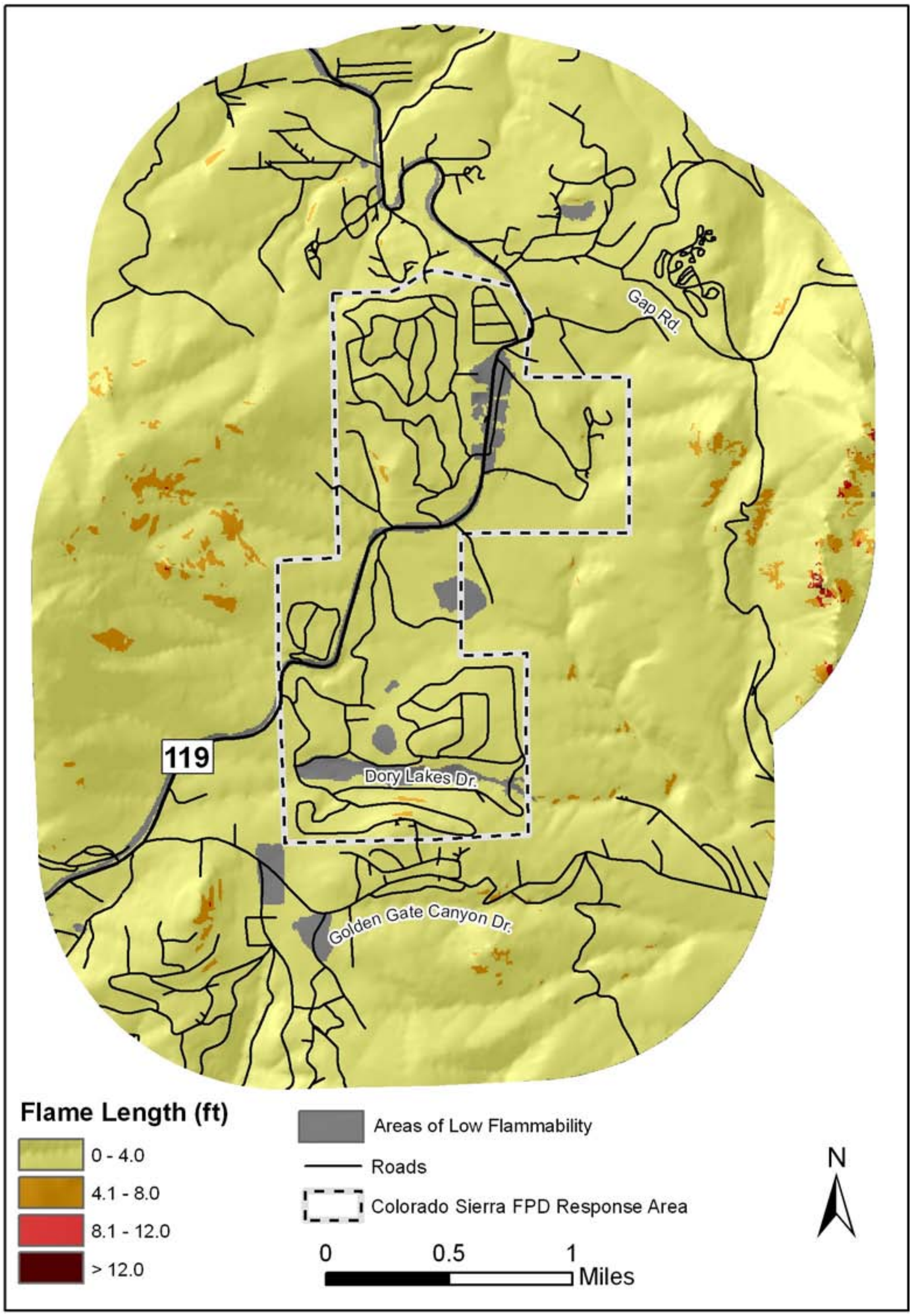
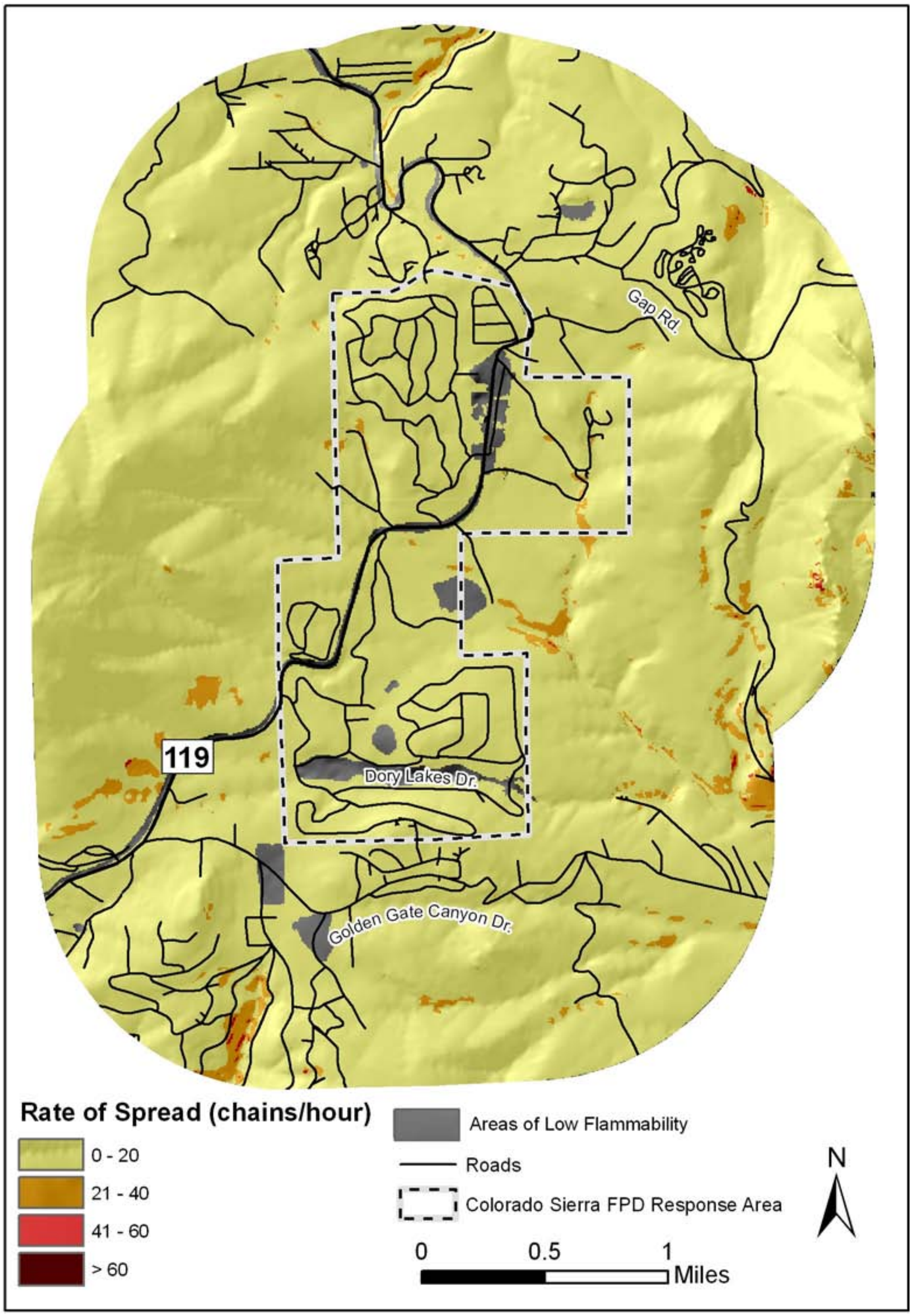


Figure 10. Rate of Spread Predictions (Average Weather Conditions)



(80 chains per hour = 1 mile per hour)

Figure 11. Crown Fire Potential (Average Weather Conditions)

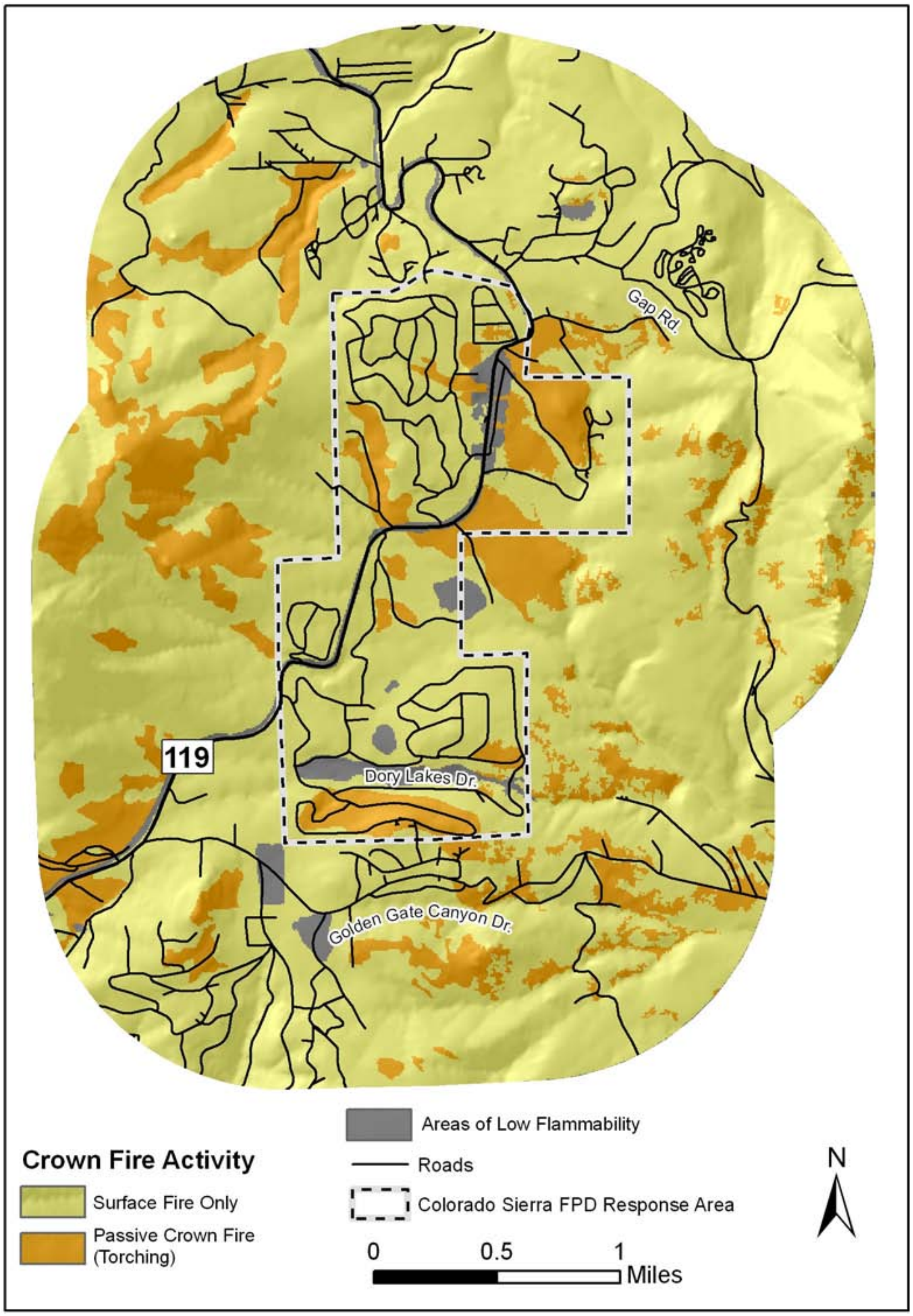


Figure 12. Flame Length Predictions (Extreme Weather Conditions)

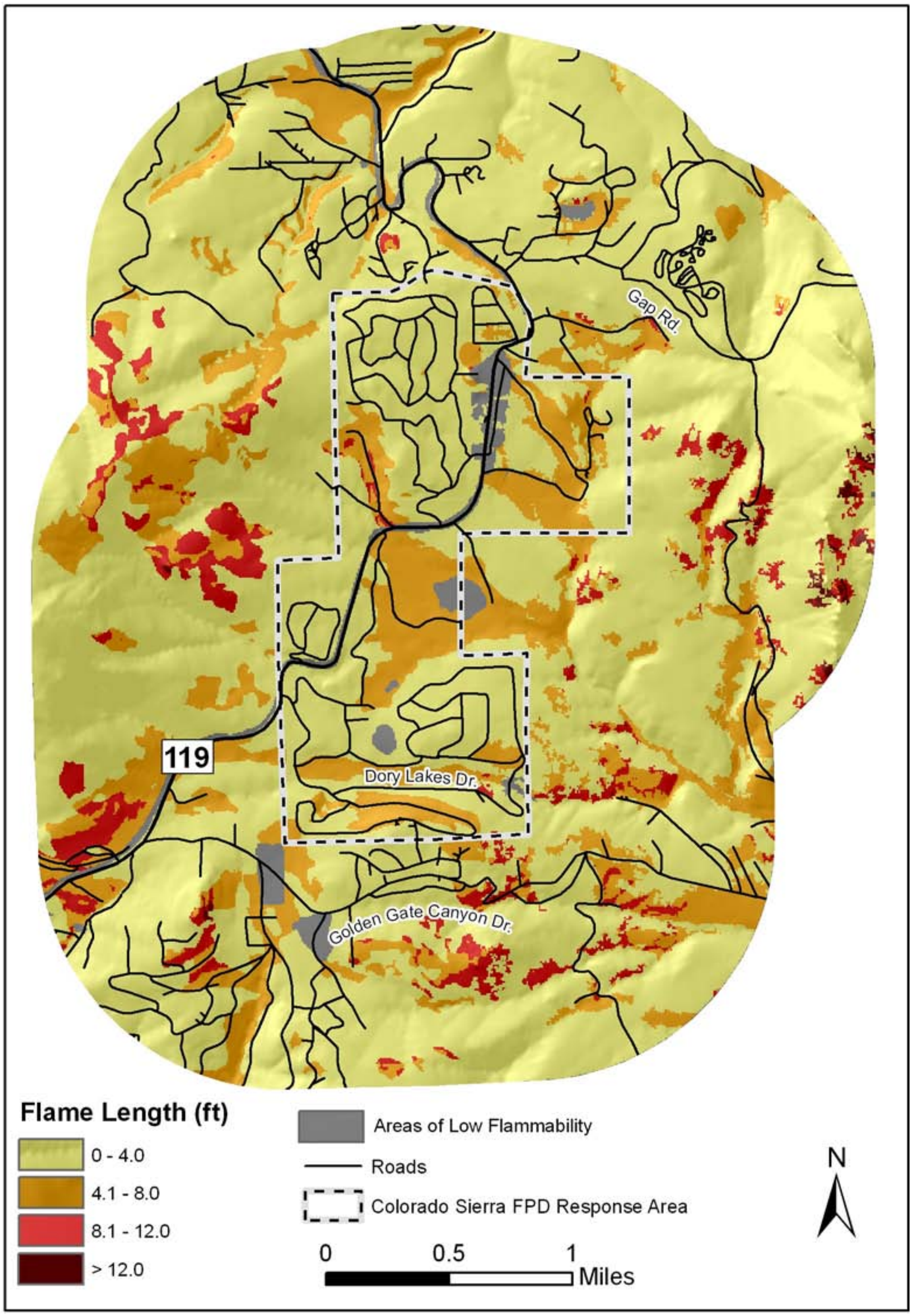
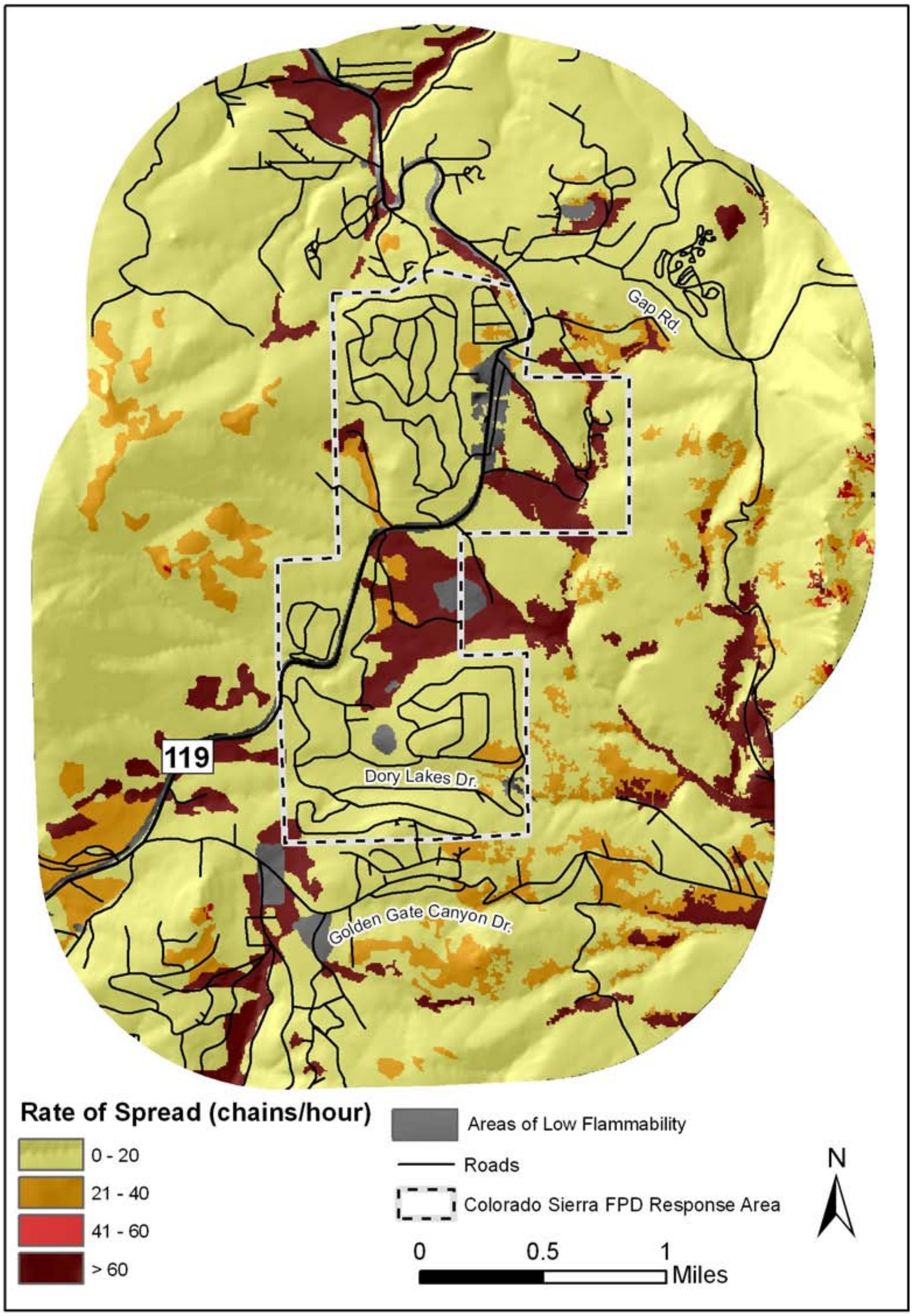
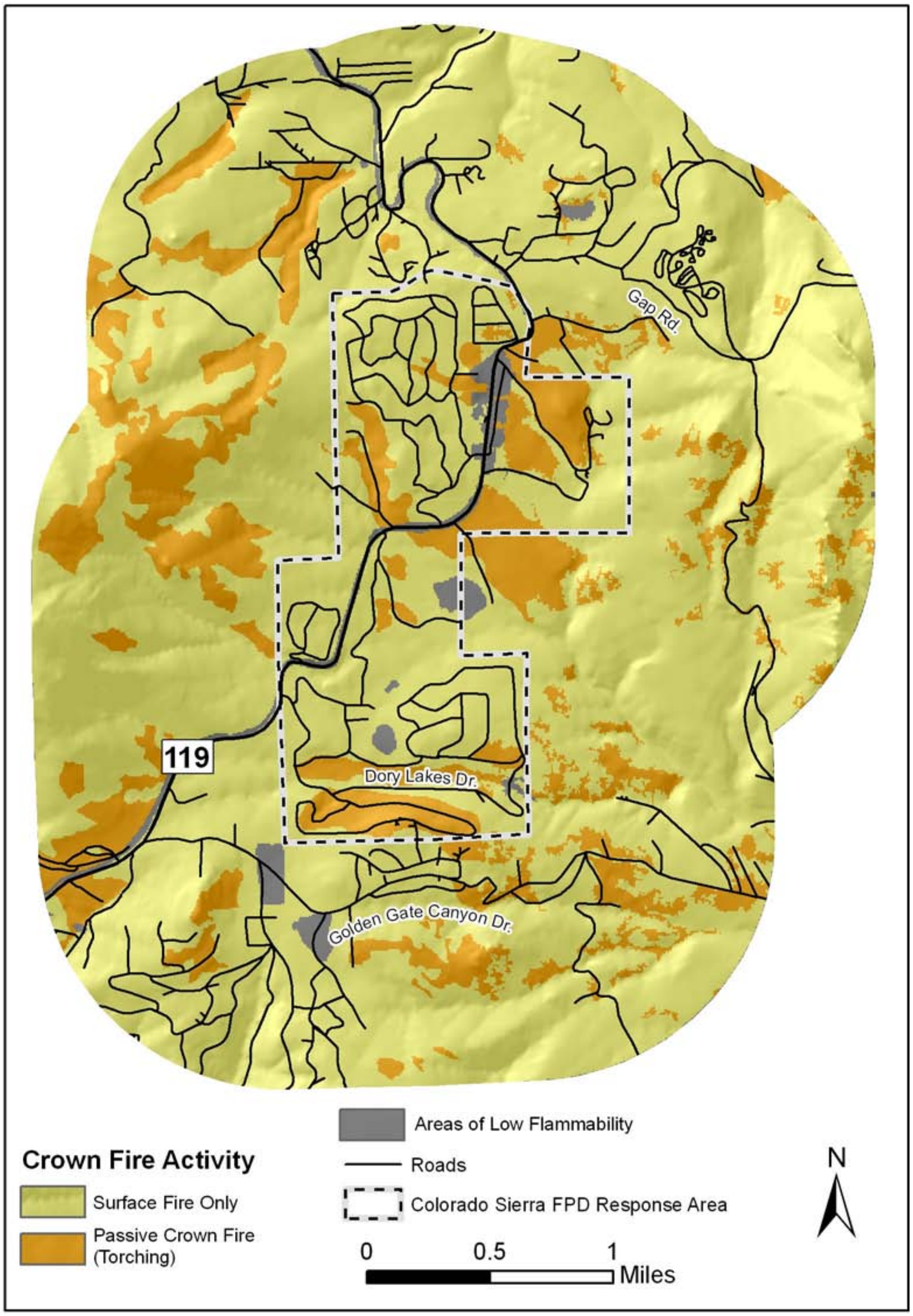


Figure 13. Rate of Spread Predictions (Extreme Weather Conditions)



(80 chains per hour = 1 mile per hour)

Figure 14. 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.

These units reflect a particular function, like developing an effective public outreach program, or a geographic treatment area, like specific fuel reduction projects, FMU's are created prior to initiating management projects and other mitigation activities.

There are unique management activities recommended for each unit. The local land and fire management agencies, with the input of the citizen's advisory council or fire safe council, must determine priority actions. The following FMUs have been identified for the CSFPD; recommendations are provided for each and are ***not*** ranked by priority.

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

Access, Evacuation and Shelter-In-Place FMU

Addressing

In every community throughout the CSFPD, missing or inadequate street signage and addressing is a problem. This problem is also noted in the individual community descriptions in **Appendix B**. In the Dory Lakes community, addressing and street names are very confusing. The majority of the access roads have names similar enough to cause confusion (e.g., Dory Lakes Drive, South Dory Lakes Drive, East Dory Lakes Drive, East Dory Way, West Dory Way and Dory Circle). In both Dory Lakes and Colorado Sierra Subdivision, it is difficult to determine where some streets change names. Markers of all types, some homemade, are used throughout the CSFPD, with no particular order or system. There are road intersections that are difficult to decipher (see **Figure 15**) and many homes are missing address markers entirely (see **Figure 16**). An attempt has been made in some areas to add reflective markers; however, the effort has been spotty, marker placement is inconsistent, and in some cases confusing (see **Figure 17**). While some residents may consider reflective address signage to be unattractive, it is essential to quick and effective response. The time saved, especially at night and in difficult visual 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 outside resources, who do not have the opportunity to train on access issues within the district nor have the local knowledge base of CSFPD personnel. Recommendations for address markers can be found in **Appendix D**.

Figure 15. Confusing Address Markers

Figure 16. Missing Address Markers

Figure 17. Ambiguous Address Marker

Recommendations

- In areas where road names are similar, street signs should be revised to more clearly indicate the differences. For example a symbol could be used in addition to the street name and prominently posted wherever name transitions occur.
- A program of replacing worn or difficult to read street signs should be undertaken. Every intersection and street name change should have large, reflective signage.
- Flagged addressing on common or shared 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 common 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 "14391-14393 Highway 119."

(The 2000 Urban Wildland Interface Code is a good resource for recommended signage specifications)

Evacuation Routes

Seven road segments have been identified that could serve as alternative evacuation routes to the primary access roads. All of these evacuation routes travel across private land. Agreements would need to be pre-planned with landowners to make use of these as emergency escape routes. Most of these routes would require some improvements to be passable for passenger cars. These routes are highlighted in the map of the district shown in **Figure 15** (above).

Iris to Forest Star: This route is an old road cut that is now overgrown, but would only require some chain saw work to be passable to most vehicles. This short route would allow the residents of the northwest portion of Bun Gun to evacuate into the Colorado Sierra Subdivision. Contacting the property owners about improving the road and adding emergency only access gates is recommended.

Roosevelt Ridge to Karlann Drive: This escape route runs from Roosevelt Ridge subdivision, which is now under construction, to Karlann Drive in Colorado Sierra Subdivision via a long driveway through private property at 1452 Karlann Drive. The Roosevelt Ridge end is only passable by ATV currently, but with property owner approval this escape route could be constructed before homes are built in Roosevelt Ridge. This could become an important access route for firefighters since Roosevelt Ridge will be part of the CSFPD and the only existing access is through High Country FPD, via Hwy 119.

Old Stage Road to Hwy 119: The north end of Old Stage Road is currently blocked from Hwy 119 by a gate and private property. Working with the property owner to reestablish this entrance for emergency use only would allow future residents a method of escape that does not involve driving through heavy fuels to the existing entrance. Depending on how many homes (and where they are located) are constructed in the planned Braecher Lakes development, this could become an important escape route.

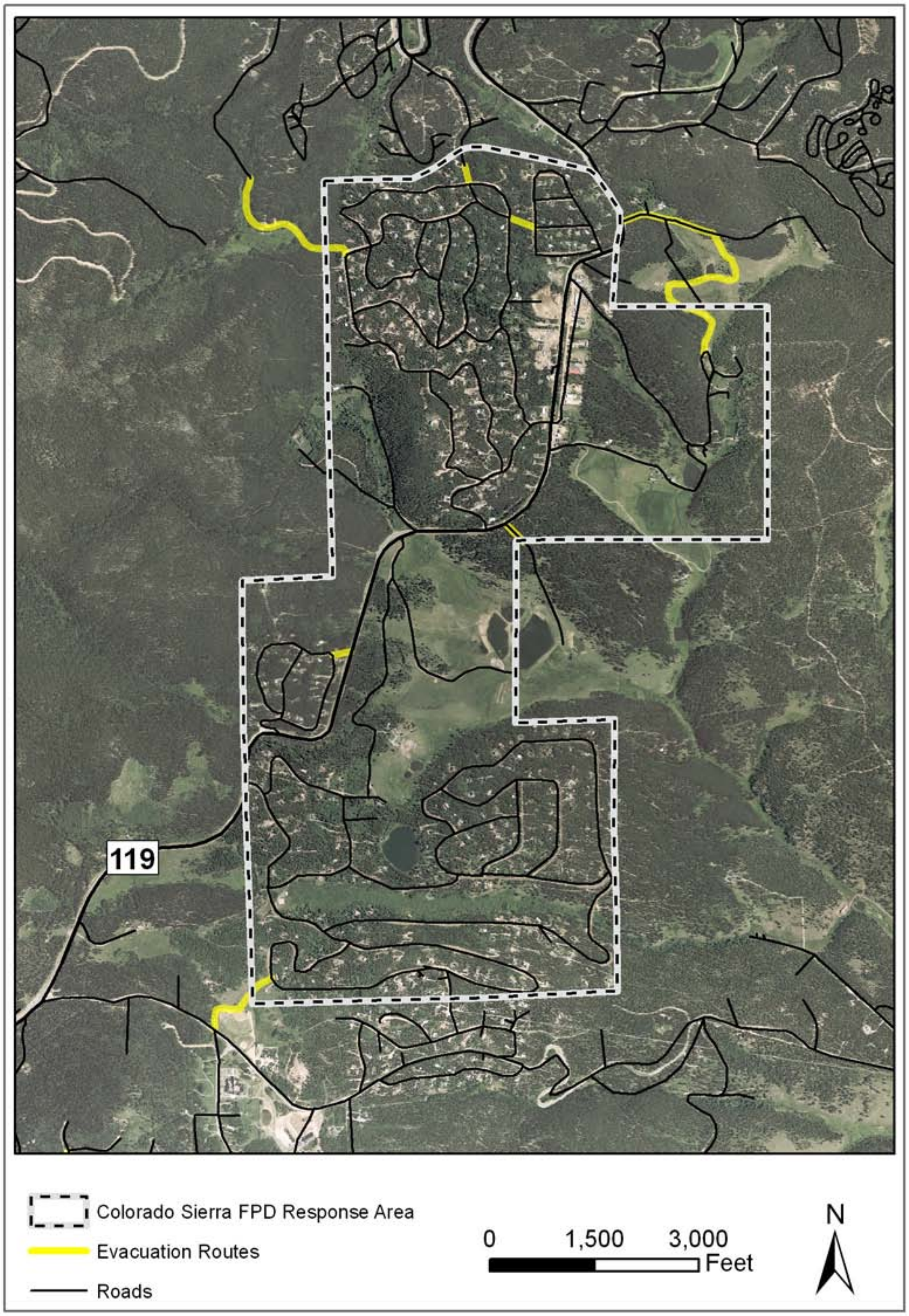
Highpoint to Golden Gate Canyon Road: It may be possible to escape from the western side of the South Dory Lakes community by driving from 1433 Highpoint to Golden Gate Canyon Road by crossing a meadow to the service road for the baseball diamonds located on Golden Gate Canyon Road. If this route could be pre-planned with the property owner it would provide a secondary escape route from the western portion of the South Dory Lakes community and access to a good potential safety zone for firefighters (the baseball diamonds) with little or no improvement.

Jan's Area to Hwy 119: It may be possible to escape from the northern part of Jan's Area by using unnamed roads and two tracks in High Country's district to connect with Hwy 119. Although there are few homes in this area, the primary access requires driving through heavy fuels that could easily be cut off by heat and smoke. This route could also be used by firefighters to access a good potential safety zone in a large meadow near a small lake.

Caesar to Hwy 119: It may be possible to connect Caesar Road to Hwy 119 through private property at 348 Caesar. This short connection may require some improvements and a gate to protect the property owner from unauthorized access, but would provide an alternative access point to the Delta community should the current single access point at Caesar and Hwy 119 become compromised.

Karlann to Hwy 119: It may be possible to escape the north side of the Colorado Sierra Subdivision community by driving through private property at 816 (?) Karlann Drive to Road BH3 (?) which connects to Hwy 119. This short route would need to be pre-planned with the land owner and gates and improvements may be needed.

Figure 15. 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 most of the communities in the study area would benefit from fuels reduction along their principal access routes, priority should be given to the highest high hazard community and communities where the primary access requires relatively long drives through heavy fuels. The road segments could become impassable due to heat and smoke. High traffic areas that could become bottlenecks due to heat and smoke from heavy fuels are also a high priority.

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[5]

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

- Jan's Area
- Braecher Lakes
- South Dory Lakes
- Colorado Sierra Subdivision

In addition to the evacuation routes suggested on pages 25-26, 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

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

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 above ground level (whichever is less).
- 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/cooled 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. In Colorado Sierra meadows near lakes and the baseball diamonds south of the South Dory Lakes community 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 some areas in the CSFPD which could be easily cut off by ignitions below homes and near critical access roads. These communities include Jan's Area, Braecher Lake and some portions of Colorado Sierra Subdivision. 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 may 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, standard operating procedure for public protection from wildfires in Australia where fast moving, non-persistent fires in light fuels make evacuation impractical and shelter-in-place tactics feasible and desirable. 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 a metal, asphalt or other ignition resistant roof and ignition resistant materials such as stucco or concrete, especially close to the ground. Heavy timber construction, such as log homes with a 6" or greater log diameter, 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. 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.[6] 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**.

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 out 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.

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

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/fire/interface.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

Colorado Sierra Fire Protection District (hereafter referred to as CSFPD) provides fire suppression services for the study area. The department has two fire stations.

- Station 1 is located at 14908 Hwy 119 (the intersection of Jankowski Drive & Hwy 119). There are 10 volunteer personnel assigned to Station 1.
- Station 2 is located at 146 N. Dory Lakes Drive in the North Dory Lakes community. There are 8 volunteer personnel assigned to Station 2.

CSFPD maintains one primary response engine (type 6X) and one primary rescue truck (type 6X) at Station 1, and one brush truck (type 6X) and a water tender at Station 2. Mutual aid is available to CSFPD from Black Hawk, High Country, Coal Creek Canyon and Central City Fire Departments.

All of CSFPD's firefighters have NWCG (National Wildfire Coordinating Group) S-130/190 training (basic wildland fire fighter training and fire behavior); six have obtained red cards. 75% of volunteer personnel have had advanced wildland fire training. The average response time from dispatch to first engine rolling is 3 minutes. Average on-scene time for calls in the district is 5 minutes.

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 water tender for the district to be located at Station 1.
  - Ensure that all apparatus are equipped with porta-tanks or pumpkins to assist in water supply.
  - 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 combis.
    - Four smothering tools such as flappers.
    - Four backpack pumps with spare parts.
    - Two complete sawyer's kits including chainsaw, gas, oil, chaps, sawyer's hard hat, ear protection, files, file guides, spare chains and a spare parts kit.
    - MREs and water supplies sufficient for 48 hours.
- Communications:
  - Surveys of Colorado Sierra officers revealed radio communications are good throughout the district.

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.

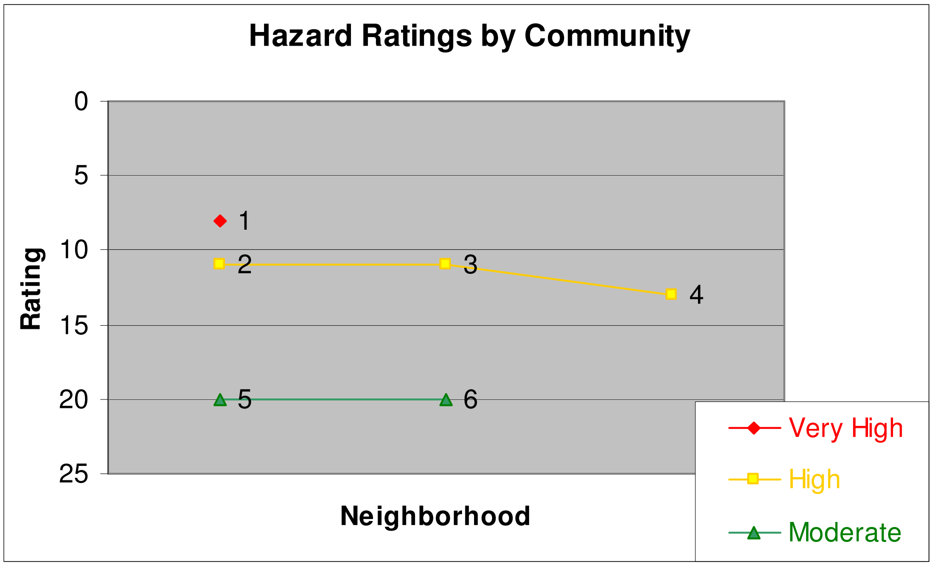
The mid-level assessment has identified 4 of the 6 communities in the study area to be at very high or high risk. Construction type, condition, age, the fuel loading of the structure/contents and position are contributing factors in making homes more susceptible to ignition under even moderate burning conditions. Under extreme burning conditions, there is a likelihood of rapid fire growth and spread in these areas due to steep topography, flammable construction types, natural or manmade hazards, fast burning or flashy fuel components and 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.

Figure 16 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 19 indicates high hazard.
- A rating of 20 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.

Figure 16. Colorado Sierra Communities by Hazard Class



1. South Dory Lakes	4. Colorado Sierra Subdivision
2. Bun Gun	5. North Dory Lakes
3. Delta	6. Jan's Area

Very High High Moderate

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 Colorado Sierra 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.

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.[7] 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, are good candidates for fuel breaks. Crown fire activity values for CSFPD 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 such as a rock outcropping, river, lake, or road. The standard location for fuelbreaks is along the tops of ridges to stop fires from backing down the

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

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 a fuelbreak mid-slope above homes. This would provide some protection from backing fires and rolling materials; however, this location is the least desirable. It would make more 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 mid-slope locations are considered the least desirable from a fire suppression point of view, this maybe the most effective approach in some areas.

Fuelbreaks are often easiest to locate along existing roadbeds (see the description of the fuels modification project for primary access corridors on page 28, 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 28). Fuelbreaks that pass through hazardous topographic features should have these distances increased by 50%.[8]

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.

---

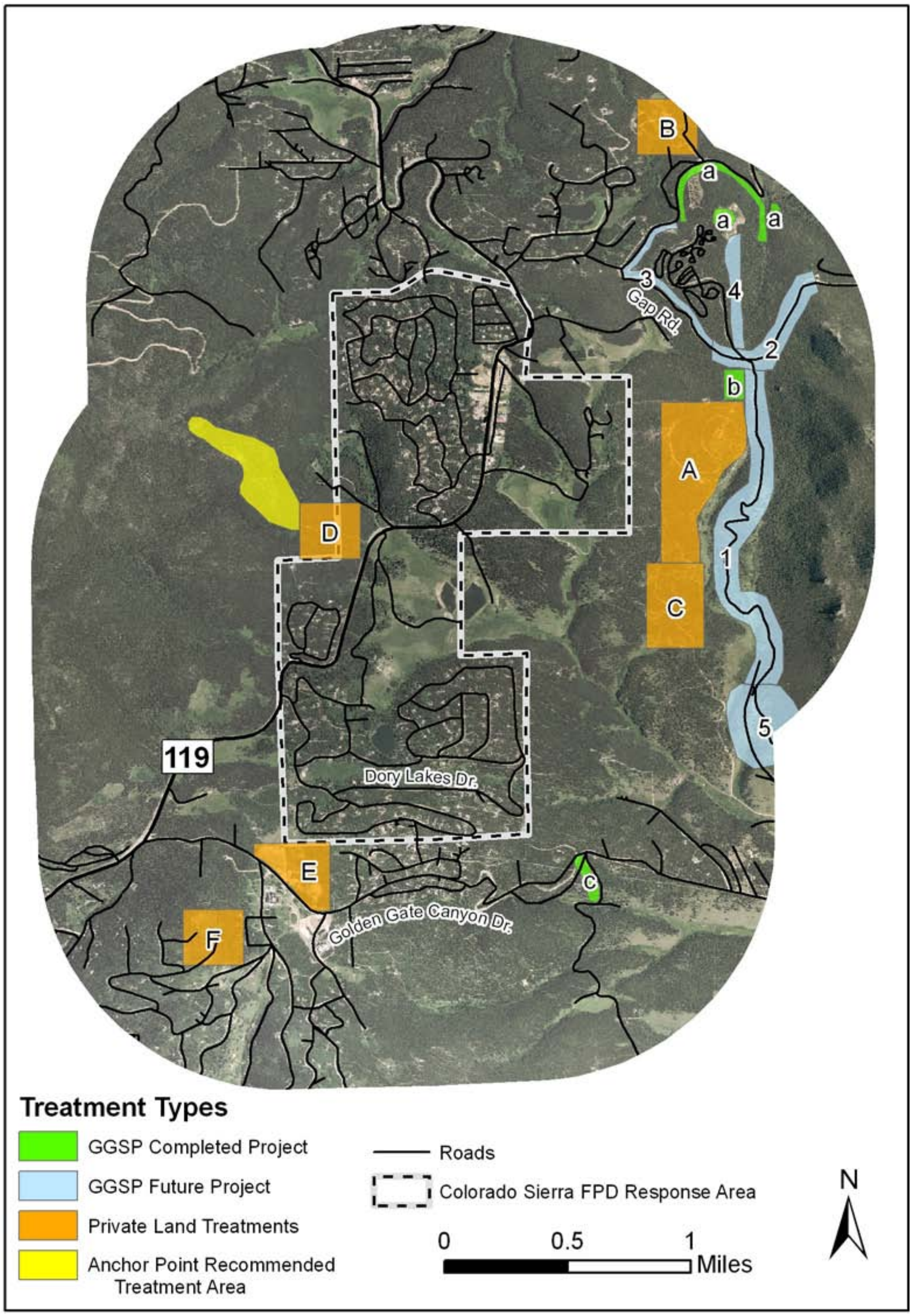
[8] Frank C. Dennis, "Fuelbreak Guidelines for Forested Subdivisions" Colorado State Forest Service, Colorado State University [CSFS #102-1083], 1983.

Current Projects

Public land managers and private property owners in areas adjacent to the study have undertaken a number of fuels reduction projects to make their properties safer and forest stands healthier. These projects, both recently completed and ongoing, are shown in Figure 17 on page 39 and described below.

- **Colorado State Parks Fuels Treatment Areas**
  a. Gap Hole Project: Mechanical fuelbreak 100-200 feet from the road. This treatment was completed in 2004.
  b. North Mountain Base Road Thinning: This area was mechanically thinned in the 1970s and is planned for a follow-up thinning sometime in the next few years (2006-2009). This project ties the work along Mountain Base and Gap Road into the Clinton Property treatment area.
  c. West Green Ranch Project: Three acres of light thinning were completed as a "Good Neighbor Policy" project.
- **Colorado State Parks Planned Future Fuels Treatment Areas**
  1. Mountain Base Road: A fuelbreak along this road is in planning now for implementation in mid-2006.
  2. East Gap Road: A fuelbreak along this road is in planning now for implementation in mid-2006.
  3. Reverend's Ridge Project. Light mechanical thinning is planned along the access road to Reverend's Ridge campground. This project ties into the access thinning projects along Mountain Base Road and Gap Road. This treatment is planned for implementation in 2007.
  4. West Gap Road: Light mechanical thinning along this road is in planning now for implementation in 2007.
  5. Prescribed Fire Area: This area is in planning for prescribed fire treatment in the spring of 2006.
- **Colorado State Forest Service Ag Tax Treatment Areas**
  - Clinton Property: Mechanical treatments are on-going on 300 acres. Looped roads inside the project area make good segment breaks.
  - Eliopulos Property: (62 acres) Defensible space cutting has been completed on this property and light mechanical thinning in lodgepole is ongoing on the remaining 40 acres. This project borders the Gap Hole fuelbreak on Colorado State Park lands.
  - Heuman Property: (80 acres) There is an existing cabin but it is unknown if a defensible space cutting has been done. 40 to 60 acres of mechanical thinning bordering the Clinton property are ongoing on this property.
  - Thidedeau Property: 44 acres on this property are under a 10-year thinning plan with approximately 4 acres being completed per year.
  - Kambic Property: 40 acres on this property being researched with approximately 4 acres being completed per year.
  - Hearn Property: 40 acres on this property are under a 10-year thinning plan with approximately 4 acres being completed per year. Since the landowner is not a resident of the area the assumption has been made that the prescribed treatments are being carried out by a contractor.
- **Miscellaneous Treatment Areas (not shown on the map)**
  - Thorn Lake (Mountain Meadows): Over the last three years extensive defensible space trimming has occurred throughout Thorn Lake. A 15 acre fuelbreak has also been completed running from the northwest corner of the subdivision to the east and tie in with fuels reductions projects in Golden Gate State Park. Anchor Point conducted a parcel level assessment of the homes in Thorn Lake in 2002.

Figure 17. Large Scale Fuels Treatments in CSFPD



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. The landscape scale fuel break recommendation made in this report has been designed to take advantage of prevailing wind patterns in this area (southwest to northeast) and cannot account for all weather conditions and circumstances.

These recommendations will require the cooperation of private landowners and USFS land mangers. Negotiations and public education efforts should begin as soon as possible to secure a consensus for future fuels reduction projects on the landscape scale.

In addition to the defensible space treatments and access route fuels reduction projects previously mentioned in this document the following landscape scale fuels treatments are recommended:

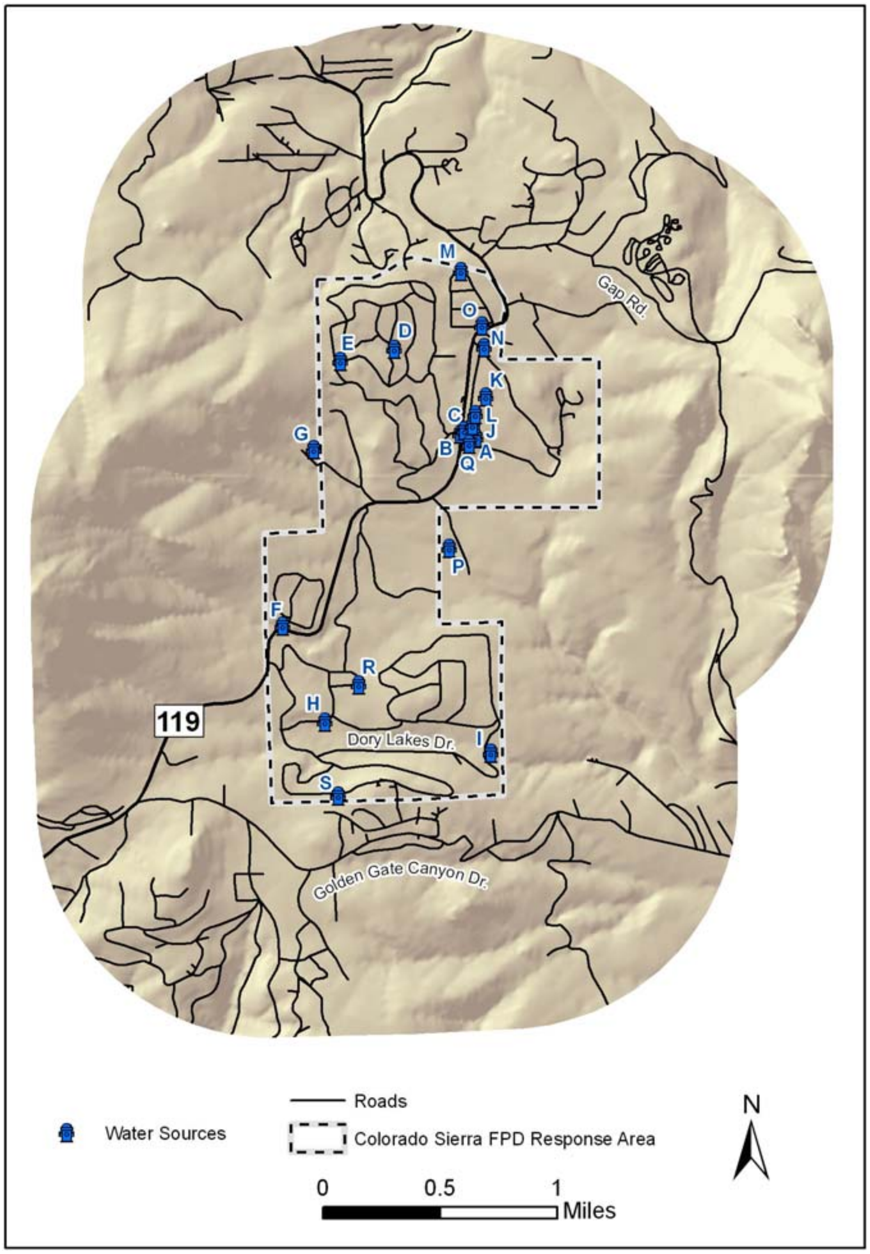
- Fairburn Mountain Fuels Reduction Project: There is a heavy surface load of large diameter downed materials on private and forest service lands west of the study area left from logging activity (see **Figure 18**). This fuel load represents the greatest threat for the development of an intense large scale fire in the study area. Prevailing winds could potentially drive an ignition in this area into populated areas and the heavy fuels would be difficult to extinguish. A collaborative effort between the USFS, CSFPD and private landowners is highly recommended to reduce the heavy surface fuel loads and thin stands in this area. The most critical area for this treatment is indicated by the yellow recommended treatment polygon in **Figure 17**.
- Most of the communities in the study area 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 infestation. 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.

Figure 18. Heavy Surface Fuels Created By Logging Activity West Of the Study Area

Water Supply FMU

In the study area, like most of the mountainous areas of Colorado, water is a critical fire suppression issue. Colorado Sierra has a network of tanks, dry hydrants and seasonal draft ponds. Approximate locations of water sources within the study area are shown in **Figure 19** and they are briefly described in **Table 5**.

Figure 19. Water Supply Locations in the Study Area



Colorado Sierra Water Supplies						
Map ID	**Water Source Name**	**Type**	**Delivery**	**Latitude**	**Longitude**	**Volume (in gals.)**
A	Taggerts	Hydrant	Draft	39 51.902	105 27.887	10,000
B	Premier Realty	Tank	Draft	39 51.915	105 27.963	10,000
C	CO Natural Gas	Tank	Draft	39 51.928	105 27.942	10,000
D	Sierra Pond	Pond/Lake	Draft	39 52.230	105 28.280	.23 acre /8' deep
E	1600 Karlann Dr.	Tank	Draft	39 52.185	105 28.540	10,000
F	Sierra Delta - 9 Caesar Rd.	Tank	Draft	39 51.203	105 28.818	10,000
G	Dory Pond #1	Pond/Lake	Draft	39 51.858	105 28.667	Unknown
H	CSFPD Station #2	Tank	Other	39 50.850	105 28.615	1,000
I	Dory Pond #3	Pond/Lake	Draft	39 50.733	105 27.815	Unknown
J	CDOT Facility (under construction)	Tank	Draft	39 51.947	105 27.902	30,000
K	Mountain Man Auto	Tank	Draft	39 52.053	105 27.840	20,000
L	Black Hawk Storage Sheds	Tank	Draft	39 51.987	105 27.890	10,000
M	Renaissance Solutions	Tank	Draft	39 52.52	105 27.958	10,000
N	Grapes (D & J Excavating)	Tank	Draft	39 52.237	105 27.848	10,000
O	Gilpin County Library	Tank	Draft	39 52.318	105 27.858	10,000
P	Braecher Meadow Lakes (mile marker 14.5 Hwy 119)	Pond/Lake	Draft	39 51.491	105 27.017	Unknown
Q	CSFPD Station #1	Tank	Other	39 51.878	105 27.919	10,000
R	Big Lake in Dory Lakes	Pond/Lake	Draft	39 50.987	105 28.452	Unknown
S	Small Private Pond (Highpoint Circle)	Pond/Lake	Draft	39 50.575	105 28.550	Unknown

Table 5. Water Sources in CSFPD

This list of water supplies was compiled from field surveys done by CSFPD personnel for this study. As the map shows, most of the water for fire suppression is clustered along Hwy 119 near CSFPD Station 1. As mentioned in the *Fire Department Involvement* section of this report, CSFPD currently has only 4 pieces of apparatus, making water source availability a critical limitation in the event of a large wildfire event in the district.

In most of the communities in the study area, the water supply is inadequate, either because of size, distance, accessibility factors, or the number of homes being served relative to the resources available. These communities include:

- South Dory Lakes
- Colorado Sierra Subdivision
- North Dory Lakes
- Delta
- Jan's Area

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

RECOMMENDATIONS

- ❑ At least one large cistern (30,000 gallon minimum) should be added on Highpoint Circle or Dory Circle in the southern end of the S. Dory Lakes community.
- ❑ At least one large cistern (30,000 gallon minimum) should be added on Nero Road or Caesar Road in the northern end of the Delta community.
- ❑ At least two large cisterns (30,000 gallon minimum) should be added in the Colorado Sierra subdivision. One should be located in the north on Karlann and one on the southwest end on Verdi or Tschaikovsky.
- ❑ At least two large cisterns (30,000 gallon minimum) should be added on Lodgepole Drive.
- ❑ Individual cisterns are recommended for all homes in Jan's Area not located near one of the draftable ponds or near the cisterns on Hwy 119. Several counties in Colorado utilize 2,500 gallon cisterns for individual homes.
- ❑ Consider the possibility of requiring individual parcel cisterns for the new homes planned for construction in the Braecher Lakes community.
- ❑ Consider the purchase of an additional water tender for the district to be located at Station 1.
- ❑ Ensure that all apparatus are equipped with porta-tanks and/or pumpkins.
- ❑ A program of periodic inspection should be instituted to check the function and condition of the dry hydrants throughout the district. All water sources should be inspected at least once every year to ensure they are still functional.

GLOSSARY

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

1 hour Timelag fuels: Grasses, litter and duff; <1/4 inch in diameter.

10 hour Timelag fuels: Twigs and small stems; ¼ inch to 1 inch in diameter.

100 hour Timelag fuels: Branches; 1 to 3 inches in diameter.

1000 hour Timelag fuels: Large stems and branches; >3 inches in diameter.

Active Crown Fire: a crown fire in which the entire fuel complex – all fuel strata – become involved, but the crowning phase remains dependent on heat released from the surface fuel strata for continued spread (also, a running crown fire or continuous crown fire).

ArcGIS 9.x: Geographic Information System (GIS) software designed to handle mapping data in a way that it can be analyzed, queried and displayed. ArcGIS is in its ninth major revision and is published by the Environmental Systems Research Institute (ESRI).

Crown Fire (Crowning): The movement of fire through the crowns of trees or shrubs more or less independently of the surface fire.

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.

Fine Fuels: Fuels that are less than ¼ inch in diameter such as grass, leaves, draped pine needles, fern, tree moss, and some kinds of slash which, when dry, ignite readily and are consumed rapidly.

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 a area with potential for damaging effects to people, property and/or the environment. Risk is based primarily on historical ignitions data.

Flagged Addressing: A term describing the placement of multiple addresses on a single sign, servicing multiple structures located on a common access.

Flame Length: The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface); an indicator of fire intensity.

FMU (Fire Management Unit): A method of prioritizing fire mitigation work efforts. Units may be functional or geographic.

Fuelbreak: 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.

Jackpot Fuels: a large concentration of fuels in a given area such as a slash pile.

Passive Crown Fire: a crown fire in which individual or small groups of trees torch out (candle), but solid flaming in the canopy fuels cannot be maintained except for short periods.

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 "Addressing, Evacuation, and Shelter-In-Place FMU" on page 23 in the main report.

Slash: Debris left after logging, pruning, thinning or brush cutting; includes logs, chips, bark, branches, stumps and broken understory trees or brush.

Spotting: Behavior of a fire producing sparks or embers that are carried by the wind and start new fires beyond the zone of direct ignition by the main fire.

Structural triage: the process of identifying, sorting and committing resources to a specific structure.

Surface fire: a fire that burns on the surface litter, debris, and small vegetation on the ground.

Timelag: Time needed under specified conditions for a fuel particle to lose about 63 percent of the difference between its initial moisture content and its equilibrium moisture content.

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

WHR (Community Wildfire Hazard Rating - aka Community Assessment): A fifty-point scale analysis designed to identify factors that increase the potential and/or severity of undesirable fire outcomes in Wildland Urban Interface communities.

WUI (Wildland Urban Interface): The line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

BIBLIOGRAPHY

Anderson, Hal E., *Aids to Determining Fuel Models for Estimating Fire Behavior*, National Wildfire Coordinating Group, NFES 1574, April 1982.

At Home in the Woods – Lessons Learned in the Wildland/Urban Interface, FEMA, 2004.

Bachmann, Andreas and Britta Allgower, *A Consistent Wildland Fire Risk Terminology is Needed!,* Fire Management Today (61,4), USDA Forest Services, Washington, DC, Fall 2001.

Dennis, Frank, C., *Fuelbreak Guidelines for Forested Subdivisions,* Colorado State Forest Service, Colorado State University, 1983.

Developing a Cooperative Approach to Wildfire Protection, National Wildland-Urban Interface Fire Protection Program.

Development Strategies in the Wildland/Urban Interface, International Association of Fire Chiefs and Western Fire Chiefs Association, Billings, Montana, July 1991.

Firefighter Safety in the Wildland/Urban Interface – A Video Series (VHS Video - 60 Mins.), National Wildland/Urban Interface Fire Program, 2003.

Fires that Changed the Fire Service – Wildlands (VHS Video – 84 Mins.), American Heat, March 2000.

FireSmart – Protecting Your Community from Wildfire, Partners in Protection, Edmonton, Alberta, CANADA, May 1999.

Hirsch, K.G., M.M. Pinedo, and J.M. Greelee, *An International Collection of Wildland-Urban Interface Resource Materials*, Information Report NOR-X-344, Canadian Forest Service – Northwest Region – Northern Forestry Centre, 1996.

Home Improvement: A Firewise Approach (VHS Video – 15 Mins.), 2003.

Introducing Firewise Communities Workshops (VHS Video– 6 Mins.), Firewise Communities, Quincy, MA.

Mangan, Richard J., *Improving Firefighter Safety in the Wildland-Urban Intermix*, FE02P16 – USDA Forest Service Technology and Development Program, Missoula, Montana, February 2000.

National Wildland/Urban Interface Fire Protection Program Building a Fire wise Home (VHS Video – 20 Mins.), Hearst-Argyle Television Productions, Needham, MA, November 1997.

Plangowski, *Fire and Fuels Analysis to Support Project Planning*, November 2003.

Preparing a Community Wildfire Protection Plan – a Handbook for Wildland-Urban Interface Communities, Sponsored by: Communities Committee, National Association of Counties, National Association of State Foresters, Society of American Foresters, Western Governors' Association, March 2004.

Queen, Phillip L., *Fighting Fire in the Wildland/Urban Interface*, Fire Publications, Inc., Bellflower, California, 1993.

Slaughter, Rodney (ed.), *California's I-ZONE – Urban/Wildland Fire Prevention & Mitigation*, Sacramento, California, January 1996.

Standard for Protection of Life and Property from Wildfire, NFPA 299, National Fire Protection Association, Quincy, MA, 1997.

Standard for Protection of Life and Property from Wildfire, NFPA 1144(02) (Formerly *NFPA 299*) National Fire Protection Association, Quincy, MA, 2002.

Urban-Wildland Interface Code™, International Fire Code Institute, Whittier, California, January 2000.

White, Christopher, *Dry Hydrant Manual – A Guide for Developing Alternative Water Sources for Rural Fire Protection,* Developed for Summit County, Colorado.

Wildfire! Preventing Home Ignitions! (VHS Video – 19 Mins.), Firewise Communities, Quincy, MA.

Wildland/Urban Interface Fire Hazard Assessment Methodology, Developed by National Wildland/Urban Interface Fire Protection Program.

Wildland/Urban Interface Fire Policy Action Report, Western Governor's Association, February 1996.

WEBSITE RESOURCES

FireWise, website, http://firewise.org/, January 2005.

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

FRAMES -- Fire Research And Management Exchange System, website, **http://www.frames.gov/tools/**, January 2005.

Interagency Wildland Fire Communications Group – Rocky Mountain Area, website, http://www.rockymountainwildlandfire.info/grants.htm, January 2005.

National Database of State and Local Wildfire Hazard Mitigation Programs, website, http://www.wildfireprograms.com, January 2005.

RAMS - (Risk Assessment and Mitigation Strategies), U.S. Department of Interior, Bureau of Land Management, National Interagency Fire Center, Wildland Fire Management Information, website, http://www.nifc.blm.gov/nsdu/fire_planning/rams, January 2005.

Standard for Protection of Life and Property from Wildfire, NFPA 1144, website, http://www.normas.com/NFPA/PAGES/NFPA-1144(02).html, January 2005.

Standard for Protection of Life and Property from Wildfire, NFPA 299, website, http://webstore.ansi.org/ansidocstore/product.asp?sku=29997PDF, January 2005.