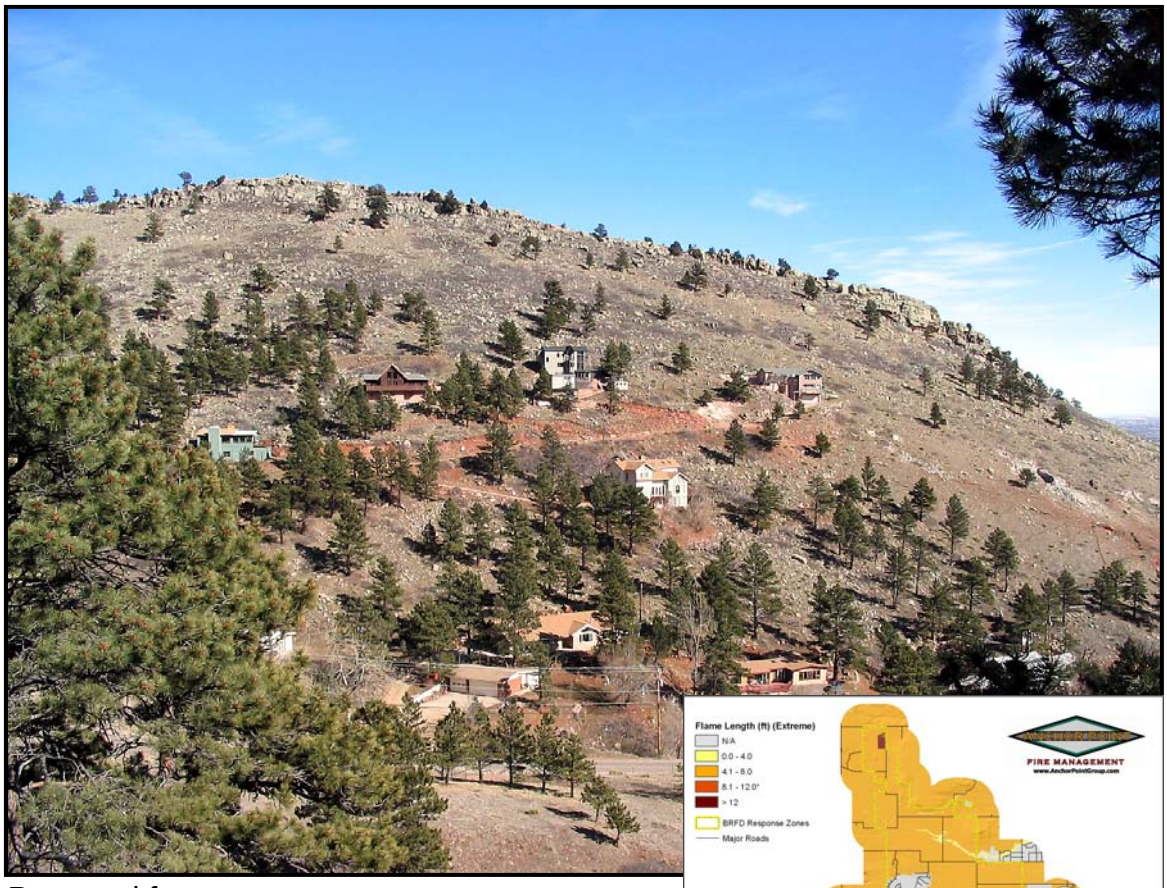
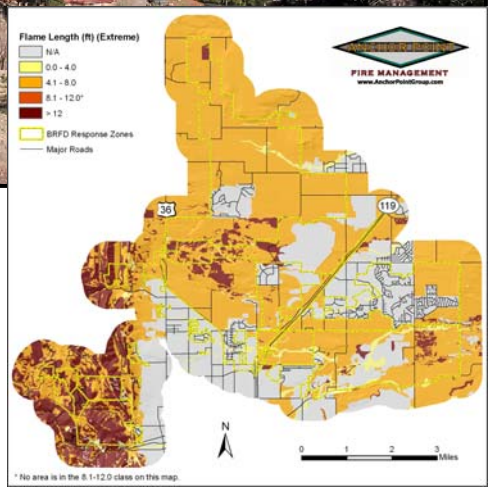
BOULDER RURAL FIRE PROTECTION DISTRICT

WILDLAND URBAN INTERFACE

COMMUNITY WILDFIRE PROTECTION PLAN





Prepared for:
Boulder Rural Fire Protection District
Boulder, Colorado
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July 2007

ANCHOR POINT
FIRE MANAGEMENT

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SUMMARY OF THIS DOCUMENT

This document incorporates new and existing information relating to wildfire for citizens, policy makers, and public agencies in the Boulder Rural Fire Protection District (BRFPD), Boulder, CO. Wildfire hazard data is derived from the community wildfire hazard rating analysis (WHR) and the analysis of fire behavior potential, which are extensive and/or technical in nature. As a result, detailed findings and methodologies are included in their entirety in appendices rather than the main report text. This approach is designed to make the plan more readable while establishing a reference source for those interested in the technical elements of the BRFPD wildfire hazard and risk assessment.

The BRFPD Community Wildfire Protection Plan (CWPP) is the result of a community-wide fire protection planning effort that includes extensive field data gathering, compilation of existing fire suppression documents, a scientific analysis of the fire behavior potential of the study area, and collaboration with various participants: homeowners, BRFPD officials, and the Colorado State Forest Service (CSFS). This project meets the requirements of the federal Healthy Forests Restoration Act (HFRA) of 2003 for community fire planning.

The CWPP meets the requirements of HFRA by:

1. **Identifying and prioritizing fuels reduction opportunities across the landscape**
   See section Fuels Modification FMU on pages 40-49 of this document.

2. **Addressing structural ignitability**
   See pages 35-38 and Appendix B

3. **Collaborating with stakeholders**
   See Appendix E

THE NATIONAL FIRE PLAN

In 2000, more than eight 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 United States Department of Agriculture Forest Service (USFS) - "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 impact of fire on rural communities and the environment
3. Ensure sufficient firefighting resources

Congress increased its specific appropriations to accomplish these goals. But 2002 was another severe season, with more than 1,200 homes destroyed and seven 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 HFRA initiative, which enhanced measures to restore forest and rangeland health and reduce the risk of catastrophic wildfires. In 2003, that act was signed into law.

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 reflected in the BRFPD CWPP.

PURPOSE

The purpose of the risk analysis, fire behavior analysis, community wildfire hazard rating (WHR) and the resulting CWPP is to provide a comprehensive, scientifically-based assessment of the wildfire hazards and risks within the BRFPD.

The assessment estimates the risks and hazards associated with wildland fire in proximity to communities. This information, in conjunction with Values at Risk, defines “areas of concern” for the community and allows for prioritization of mitigation efforts. From these analyses, solutions and mitigation recommendations are offered that will aid homeowners, land managers and other interested parties in developing short-term and long-term fuels and fire management plans. 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 WHR ratings of the WUI communities and the analysis of fire behavior potential, as modeled from the fuels, weather and topography of the study area. Hazard attempts to quantify the severity of undesirable fire outcomes to the Values at Risk.

Values at Risk are the human and intrinsic values identified as important to the way of life of the study area by its inhabitants, such as life safety, property conservation, access to recreation and wildlife habitat. (See pages 9-11 for a comprehensive overview.)

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 similar 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 and prioritize appropriate hazardous fuel reduction:

   Organizing and prioritizing hazard mitigation actions into Fire Management Units (FMU) can assist stakeholders in focusing future efforts from both a social 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.

COLLABORATION: COMMUNITY/AGENCY/STAKEHOLDERS

Representatives involved in the development of the BRFPD CWPP are included in the following table. Their names, organization, and roles and responsibilities are indicated in Table 1. For more information on the collaborative process that led to the development of this CWPP, see **Appendix E, BRFPD CWPP Collaborative Effort**.

TABLE 1. CWPP Development Team

Name	Organization	Roles / Responsibilities
Bruce Mygatt, Chief Jeff Webb, Fire Marshal Robert O'Donnell, Captain	Boulder Rural Fire Department	Local information and expertise, including community risk and value assessment, development of community protection priorities, and establishment of fuels treatment project areas and methods.
Alan Owen, District Forester	Colorado State Forest Service	Facilitation of planning process and approval of CWPP minimum standards.
Chris White, Managing Partner Marc McDonald, Project Manager Mark McLean, GIS Project Manager Quinn MacLeod, WUI Project Specialist	Anchor Point Group LLC Consultants	Development of the CWPP, decision-making, community risk and value assessment, development of community protection priorities, establishment of fuels treatment project areas and methods.

STUDY AREA OVERVIEW

The Boulder Rural Fire Protection District (BRFPD) is located in Boulder County, Colorado. BRFPD covers an area of 25 square miles, and has approximately 17,000 residents. The district consists of several islands of responsibility bordered by various other suppression agencies including the Rocky Mountain Fire Protection District, City of Boulder Fire Department, Four Mile Fire Protection District, Mountain View Fire Protection District, Left Hand Fire Protection District, Sunshine Fire Protection District, and Boulder Mountain Fire Protection District.

FIGURE 1: Typical Area

For the purposes of this report, communities have been assessed for the hazards and risks that occur inside the district boundaries. GIS work for this project has been extended to a project boundary beyond the district boundaries. Unless noted otherwise, rankings and descriptions of communities, as well as hazard and risk recommendations, pertain only to the portions of those areas that lie within the boundaries of the Boulder Rural Fire Protection District.

The district has two distinct areas, the plains and the foothills. The Plains life zone, 3,500 to 5,500 feet, is where the majority of study area population resides. It is dominated by grasslands, tall grass prairie remnants and riparian vegetation (including cattails, cottonwoods and other riparian hardwoods and shrubs) growing along water courses and in drainages. The foothill area is considered to be in the Foothill / Montane life zone (6,000'-10,000') of the eastern slope of the Northern Colorado Front Range.[1] The dominant vegetation is ponderosa pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*). The foothill area also contains dense stands of mixed conifers primarily on north facing slopes. Dense riparian shrub corridors and open canopy woodlands broken by large grass meadows also exist in this area.

Figure 2 and **Table 2** show the communities that define the WUI study area. For the purposes of this project, the most populated areas were divided into 10 communities. Each community represents certain dominant hazards from a wildfire perspective. The overall hazard ranking of these communities is determined by considering the following variables: fuels, topography, structural flammability, availability of water for fire suppression, egress and navigational difficulties, as well as other hazards, both natural and manmade. The methodology for this assessment uses the WHR community hazard rating system developed specifically to evaluate communities within the WUI for their relative wildfire hazard.[2] The WHR model combines physical infrastructure such as structure density and roads, and fire behavior components like fuels and topography, with the field experience and knowledge of wildland fire experts. For more information on the WHR methodology please see **Appendix B**.

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).

2 C. White, "Community Wildfire Hazard Rating Form" *Wildfire Hazard Mitigation and Response Plan*, Colorado State Forest Service, Ft. Collins, CO, 1986.

FIGURE 2. Boulder Rural Community Hazard Rating Map

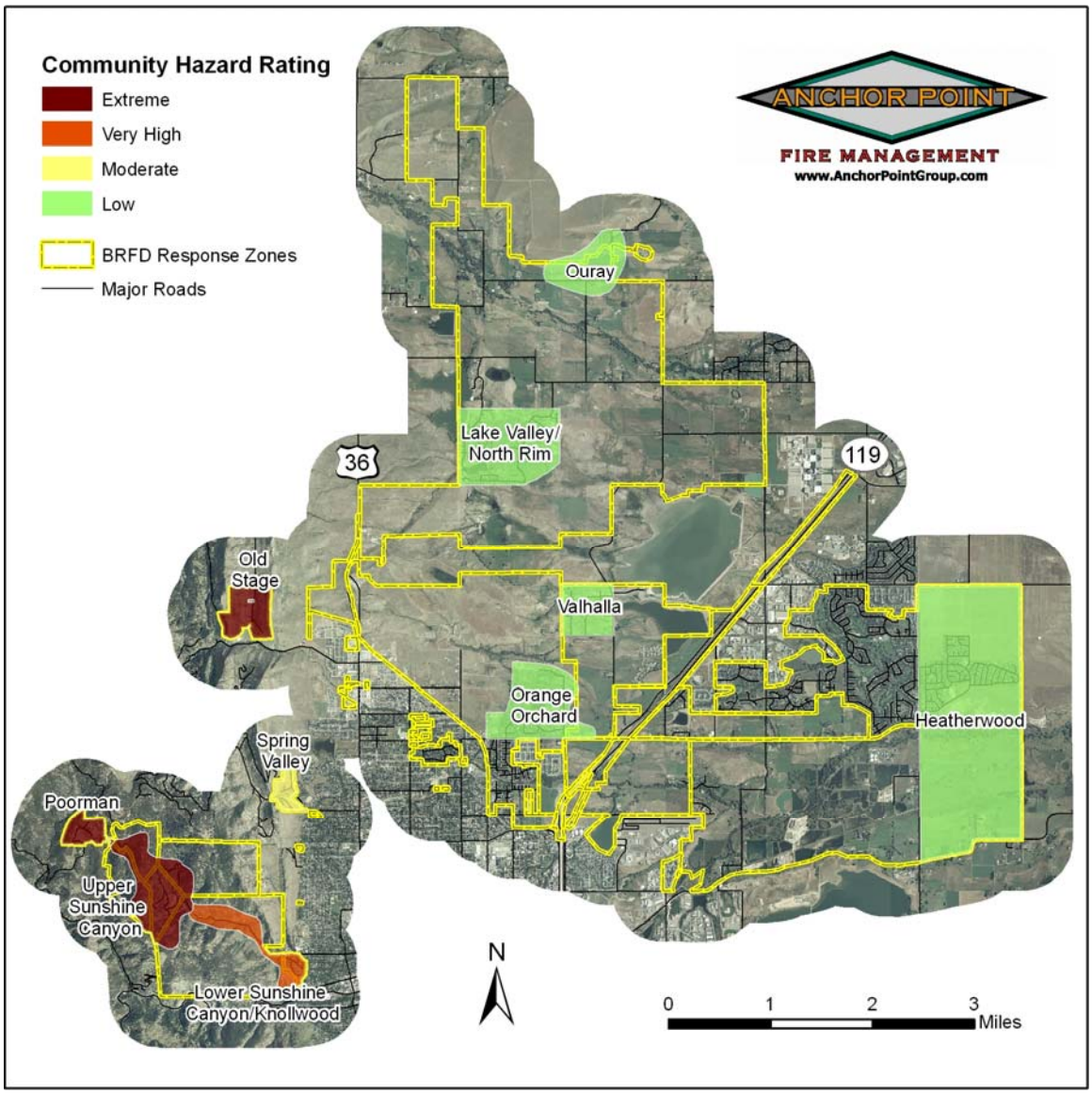


TABLE 2. Study Area Communities

• Poorman	6. Orange Orchard
• Upper Sunshine Canyon	7. Lake Valley/North Rim
• Old Stage	8. Valhalla
• Lower Sunshine Canyon	9. Heatherwood
• Spring Valley	10. Ouray

For reference to the rest of this document, **Figure 3** and **Figure 4** show the general topography of the area. These graphic representations of the landforms of the study area (elevation and slope) will be helpful in interpreting other map products in this report.

FIGURE 3. Boulder Rural Slopes

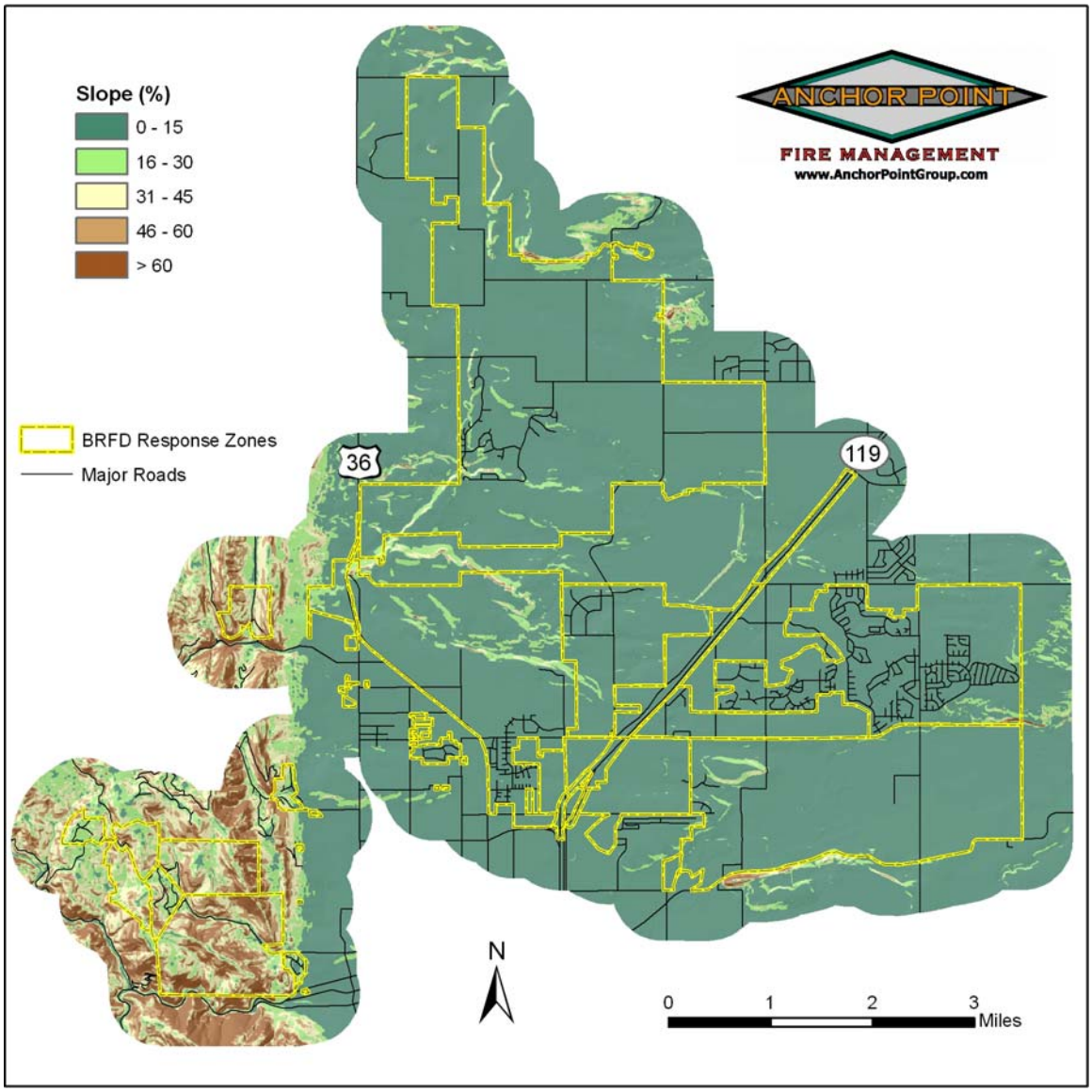
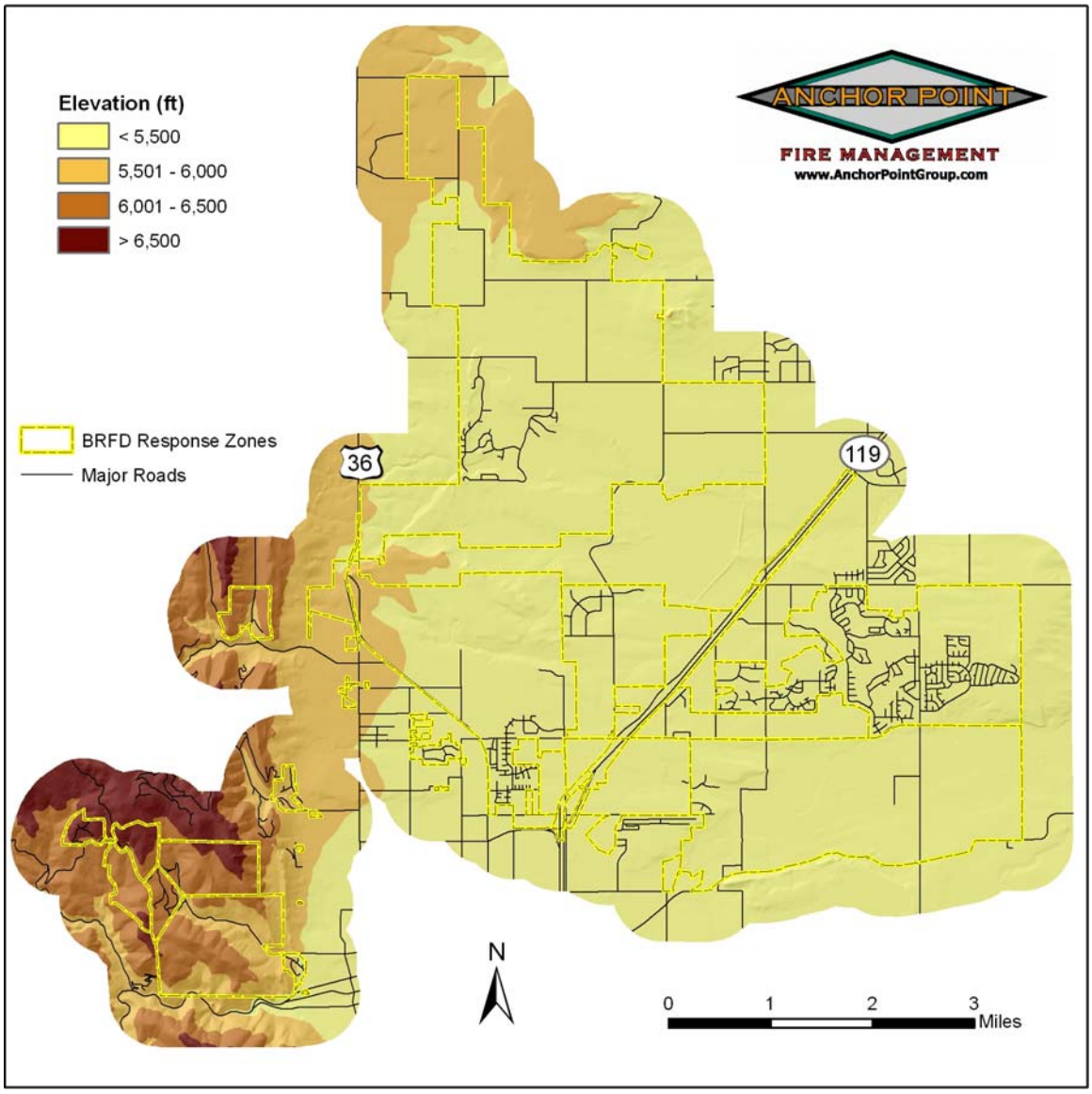


FIGURE 4. Boulder Rural Elevations



VALUES AT RISK

Life Safety and Homes

There are approximately 17,000 citizens residing in 7,000 residences within the BRFPD. The wildland/urban interface areas were divided into 10 communities. Five of the 10 communities are located within the foothills. 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 hazard assessment identified four of the 10 communities in the study area to be extreme or very high hazard areas. Under extreme burning conditions, there is a likelihood of rapid increases in fire intensity 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, heat, and /or long response times.

With tens of thousands of people moving to Colorado each year, building in the once inaccessible mountain areas has become a growing concern. Most of Boulder County is vulnerable to some form of natural disturbance. Recent national disaster events have focused increased attention at both local and state government levels on the need to mitigate such events where possible and to prepare to cope with them when unavoidable.

Boulder County recognizes the wildland urban interface as an area particularly at risk to wildland fires. Fire should be recognized as a natural and/or human-caused occurrence with certain benefits to the ecosystem. The county should strive towards balancing the natural processes of the ecosystem with development concerns so that residents may co-exist in a fire-dependent ecosystem.[3]

The population of Boulder County is growing at an average rate of 3% per year, and has increased 29% between 1990 and 2000, with increased mountain development and recreational pressures following this increase in population. Over 154,000 people in the county live in wildfire hazard areas.

Boulder County experiences an average of 100 fire starts per year. Over the past 20 years the county has seen a number of major wildland fires, and until 2001, held the Colorado record for structural losses from wildland fires. This was due largely to the 1989 Black Tiger fire, which claimed 44 homes. The 1990 Old Stage fire, which destroyed 10 homes, burned within portions of the BRFPD.

3 Boulder County Comprehensive Plan - Boulder County Land Use Department (http://www.co.boulder.co.us/lu/bccp/introduction.htm).

Commerce and Infrastructure

Commercial property and retail business are limited within the wildland/urban interface portions of the BRFPD. However, some residents maintain a variety of home-based businesses. Agricultural properties and livestock-related businesses also exist in some portions of the study area.

In 1978, the *Boulder County Comprehensive Plan* was adopted. This and most other local municipal plans and programs emphasize the fact that environmental factors, natural and cultural amenities, and "quality of life" issues are all crucial to the health of the economy. Indeed, the economy of the area is based largely on the quality of life that attracts professionals to establish residences there. Quality of life in Boulder County, and by extension its economy, have benefited enormously from a legacy of careful land-use decisions and the county's commitment to creating and maintaining open space properties, which include national and state parks, national and state forests, and city and county open space and parks.[4] Because the quality of life is tied so closely to the land, wildfire has the potential to cause significant damage to the local economy.

Recreation and Lifestyle

The culture of Boulder County emphasizes environmental values and outdoor recreation. Boulder County has intermixed land ownership: approximately 60% of the land is owned publicly with 40% owned privately. Public land is divided among a variety of local, state, and federal managers, including the United States Forest Service, Boulder County Open Space, the City of Boulder and Colorado State Parks.[5]

The idea of a county open space program was initiated in the mid-1960s by Boulder County citizens who were interested in parks and recreation needs of the unincorporated area and in "preserving open space land in the face of rapid county development." This was at a time when Boulder County's 750 square miles were home to a population of fewer than 130,000 people. The 2005 population was approximately 280,440.[6]

The *Boulder County Comprehensive Plan* included goals and policies for preserving open space, protecting environmental resources (including both natural and cultural resources) and developing a county-wide trail system. The implementation of the open space plan has been based on both private cooperation and on the county's financial ability to acquire an interest in these lands.

By early 1998, the county open space program comprised more than 52,000 acres of preserved land scattered throughout the county, along with 70 miles of trails. The majority of this land is open for public use. The remainder is under agricultural lease or conservation easements, which do not include public access. Most of the properties are well-suited to passive recreation.[7]

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4 Boulder County Comprehensive Plan – Boulder County Land Use Department (http://www.co.boulder.co.us/lu/bccp/introduction.htm)

5 "Community Responses to Wildland Fire Threats in Colorado" – T. Steelman, D. Bell, Dept. of Forestry, NCSU (http://www.ncsu.edu/project/wildfire/Colorado/boulder/boulder.html)

6 Boulder County Comprehensive Plan – Boulder County Land Use Department (http://www.co.boulder.co.us/lu/bccp/openspace.htm)

7 Ibid

Residents who live in the study area have a keen appreciation for their natural environment. Recreation and the natural beauty of the area, values which can be seriously damaged by wildfire, are frequently quoted as reasons local residents have chosen to live in the study area.

Habitat Effectiveness & Environmental Resources

Residents are clear that the preservation of wildlife and the environment is important to the quality of life in 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.[8] Wildfire, specifically severe wildfire, can have significant adverse effects on habitat effectiveness.

The environmental character of Boulder County is due in large measure to the abrupt altitudinal variation within a 20-mile east-west gradient. The dramatic landform changes sharply define the native ecosystems and their associations of plant and animal species.[9]

The county's environmental heritage includes non-renewable resources such as natural areas, historic/archaeological sites, and natural landmarks. As irreplaceable resources, they warrant preservation from destruction or harmful alteration. Wetlands are critical environmental resources that function variously as wildlife habitat, aquifer recharge areas, linkages in the overall county wildlife system, and aids for smog control.[10]

The goal of the Boulder County Parks and Open Space Department is to maintain and monitor the forests on open space in accordance with the *Boulder County Comprehensive Plan* in ways that benefit the ecosystem and the public. The following are all crucial components of this goal:

- Assessing overall forest conditions through forest inventories and surveys
- Implementing prescriptions based on the results of these inventories and surveys
- Taking action to change or increase the individual tree's health and vigor
- Reducing fire danger
- Improving or maintaining wildlife habitat
- Maintaining and preserving the aesthetic and ecological value of the forest[11]

The BRFPD CWPP process is in concert with these guiding principles. Through public involvement, local support, and a regional perspective, the fuels reduction elements described in this document can and should enhance and protect the values of the study area.

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8 Peak to Peak Community Indicators Project 2003 Presented by Peak to Peak Healthy Communities Project ©Copyright 2003 Peak to Peak Healthy Communities Project

9 Boulder County Comprehensive Plan – Boulder County Land Use Department (http://www.co.boulder.co.us/lu/bccp/envres1.htm)

10 Ibid

11 Boulder County Government website, 2006 (http://www.co.boulder.co.us/openspace/resources/forestry/forest_div.htm)

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 high risk for WUI fires. This assessment is based on the analysis of the following factors:

1. The city of Boulder is listed in the Federal Register as a community at high risk from wildfire (http://www.fireplan.gov/reports/351-358-en.pdf).
2. 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).
3. The Boulder Rural Fire Protection District responded to a total of 177 wildland incidents in the years from 2002 through 2006. Of this total, 90 were confirmed wildland fires while 87 were categorized as smoke reports with no fire found. It is important to note that in 2006 none of these fires exceeded five acres in size.
4. No major fires (fires greater than 100 acres) have burned in the district since 1990 (the Old Stage Fire), however, major fires have occurred near the district recently including the Walker Ranch Fire (2000), the Overland Fire (2003) and a number of large (100 acres +) grass fires in the winter of 2006. It is important to note there are over 20 fire departments in Boulder County, and many mutual aid agreements are in place. The Boulder area has a large number of well-trained resources. Ignitions in this area attract a rapid, professional response and are generally extinguished quickly.
5. Fire history statistics from the Colorado State Forest Service (CSFS) and their cooperator fire departments reflect an active fire history for the years available. CSFS reports 100 fires in 1990, 104 in 1991, 126 in 1992, and 98 in 1993, for a total of 428 in Boulder County for the four-year period.
6. 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 altered. Please see the *Fire Regime and Condition Class* section of this report for details.
7. The surrounding federal lands report an active, but far from extreme, fire history. Fire occurrences for the Boulder Ranger District of the Arapahoe-Roosevelt National Forest (see **Figure 5**) were calculated from the USDA Forest Service Personal Computer Historical Archive for the thirty-year period from 1977-2006. These areas represent federal lands adjacent to the study area, but do not include any data from state, county, or private lands. The data have been processed and graphed using the Fire Family Plus software program and are summarized below.

Figure 5a shows the number of fires (red bars) and the total acres burned (blue hatched bars) in the Boulder Ranger District for each year. While the number of annual fires ranges from approximately 5 to over 30 fires per year, there is little year-to-year pattern to the variation. The single largest fire for acreage burned was the Overland Fire (2003). Of the 9,854 acres reported

burned in the ranger district between 1977 and 2006, 3,869 were burned by the Overland fire. Between 1977 and 2006 there were three other fires burning more than 100 acres in the ranger district. The total number of acres burned was the greatest in 1988, when two large fires accounted for 3,922 acres burned. 1988 also had the highest number of fires on the Boulder Ranger District during the study period. A portion of the Black Tiger Fire also burned 1,804 acres in the Boulder Ranger District in 1989.

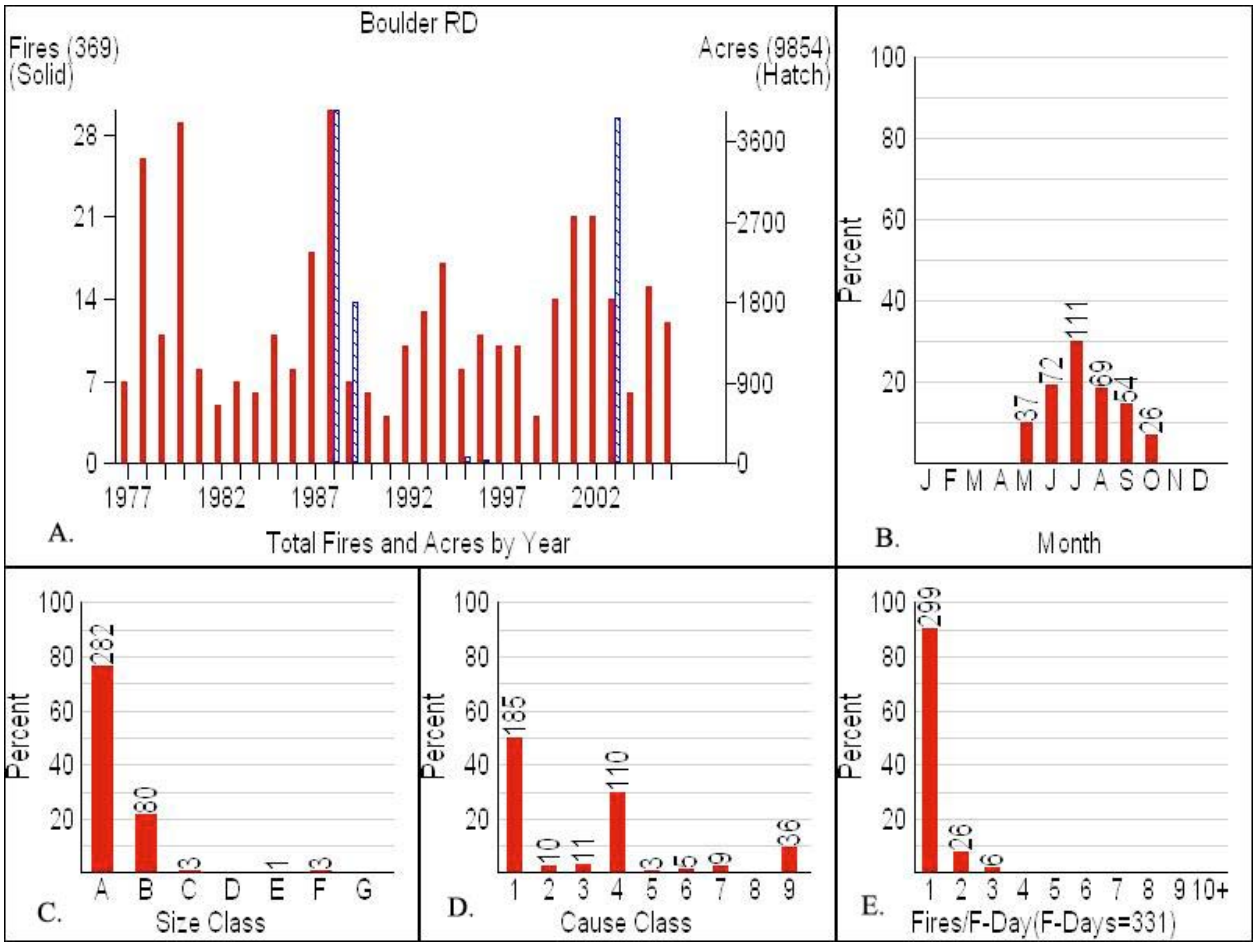
Figure 5b shows the percentage and number of fires between 1977 and 2006 occurring in each month of the year. July had the greatest number of fires, followed by June and August. The fewest fires occurred between the months of November and April, a fact which reflects the climate conditions for the area.

Figure 5c shows the size class distribution of fires. Approximately 98% of the reported fires (362 of 369) 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 during initial attack.

Figure 5d shows the number of fires caused by each factor. As shown in this graph, the most common cause of ignitions is lightning (50%). However, the next most common cause is campfires (30%). If we remove the miscellaneous cause category, natural causes still represent the majority of ignitions (56% natural and 44% 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.

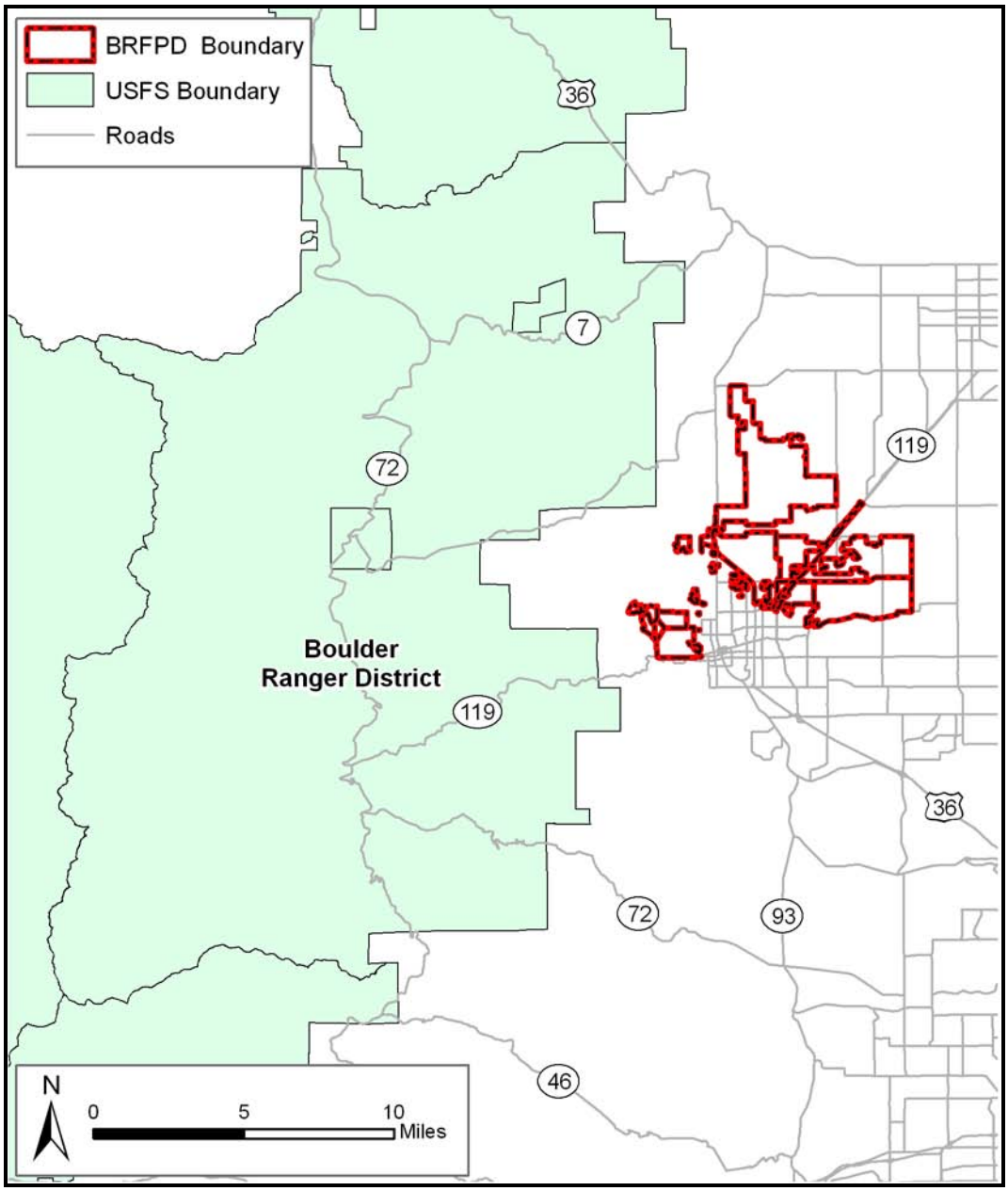
Figure 5e shows the number of fire starts for each day that a fire start was recorded. Most fires (299) occurred on days that only had one fire start. Approximately 8% (26) of fire days had two fire starts recorded and days with three or more fire starts represent less than 2% of all fire start days. The statistics suggest that multiple start days are a rare occurrence compared to fire days with a single ignition.

FIGURE 5. USFS Fire Statistics (Boulder Ranger District)



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 6. USFS Fire History Data Extent



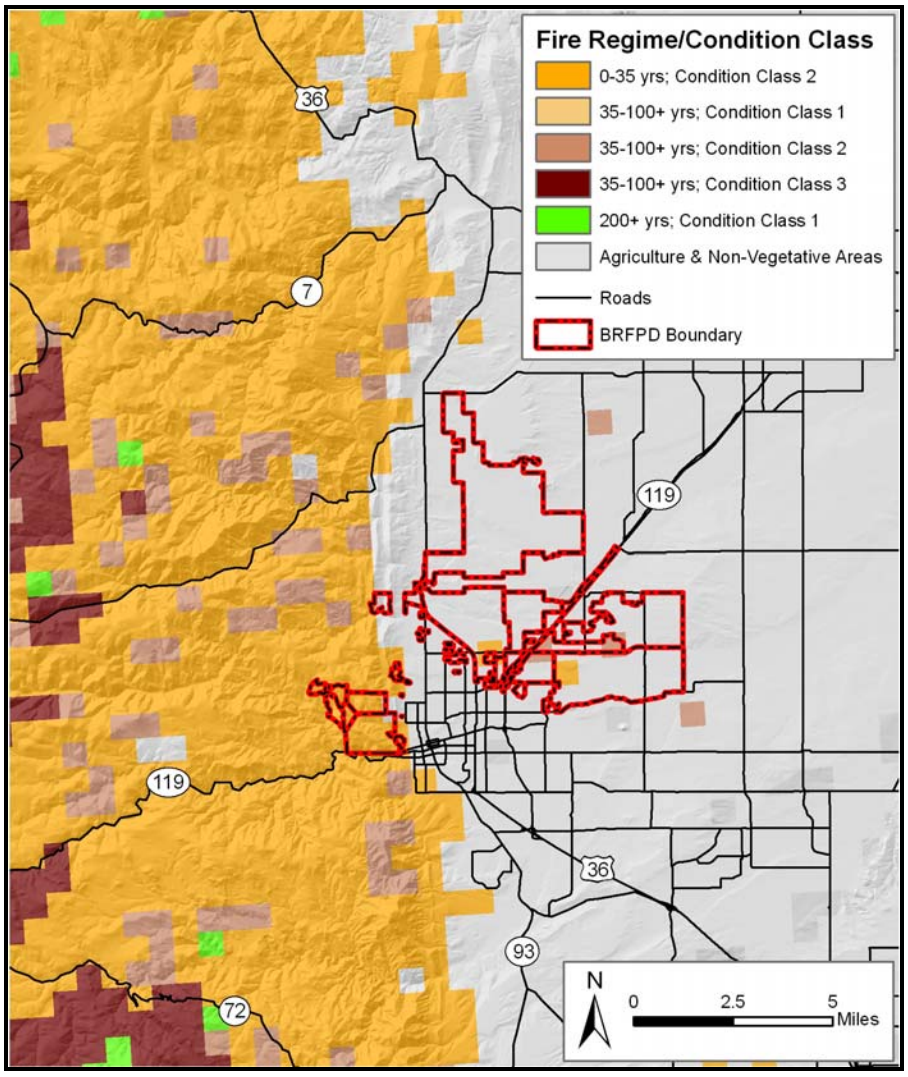
Development is increasing in the study area. As the density of structures and the number of residents in the interface increases, possible ignition sources will multiply. Unless efforts are made to mitigate the potential for human ignition sources spreading to the surrounding forest, the probability of a large wildfire occurrence 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 7** displays graphically the return interval and condition class of the study area.

FIGURE 7. Fire Regime/Condition Class



Deriving FRCC 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 have 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, if it is assumed that 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 would be lost if a fire were to occur within the BRFPD. It should be noted that 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:

TABLE 3. Condition Class Descriptions[12]

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, as compared with those 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, as compared with those expected under historic fire regimes.

The foothill communities of the study area are dominantly classified under Condition Class 2. By definition, historic fire regimes have been moderately altered. Consequently, wildfires are likely to be larger, more severe, and have altered burn patterns, as compared with those expected under historic fire regimes.

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

Fire Behavior Potential

As a part of the wildfire hazard analysis carried out for this study, the fire behavior potential of the study area was modeled (see **Appendix A**). This model can be combined with the community wildfire hazard ratings (WHR), structure density and Values at Risk information to generate current and future "areas of concern". **Figures 8-10** shows the fire behavior potential for the analysis area, given the average weather conditions existing between May 1 and October 31. Weather observations from the Sugarloaf Remote Automated Weather Station (RAWS) were averaged for a thirty-year period (1977-2006) to calculate these conditions.

Figures 11-13 show the fire behavior potential for the analysis area, given ninety-seventh percentile weather data. In other words, the weather conditions existing on the five most severe fire weather days in each season for the thirty-year period were averaged together to provide the weather data for this calculation. It is a reasonable assumption that similar conditions may exist for at least five 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.

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 operations. This model can be combined with the WHR and Values at Risk information to generate current and future "areas of concern," which are useful for prioritizing mitigation actions. It is recommended that when this information is used for tactical operations, fire behavior calculations be done with actual weather observations during the fire event. For greatest accuracy, the most current Energy Release Component (ERC) values should 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 8. Flame Length, Moderate Weather Conditions

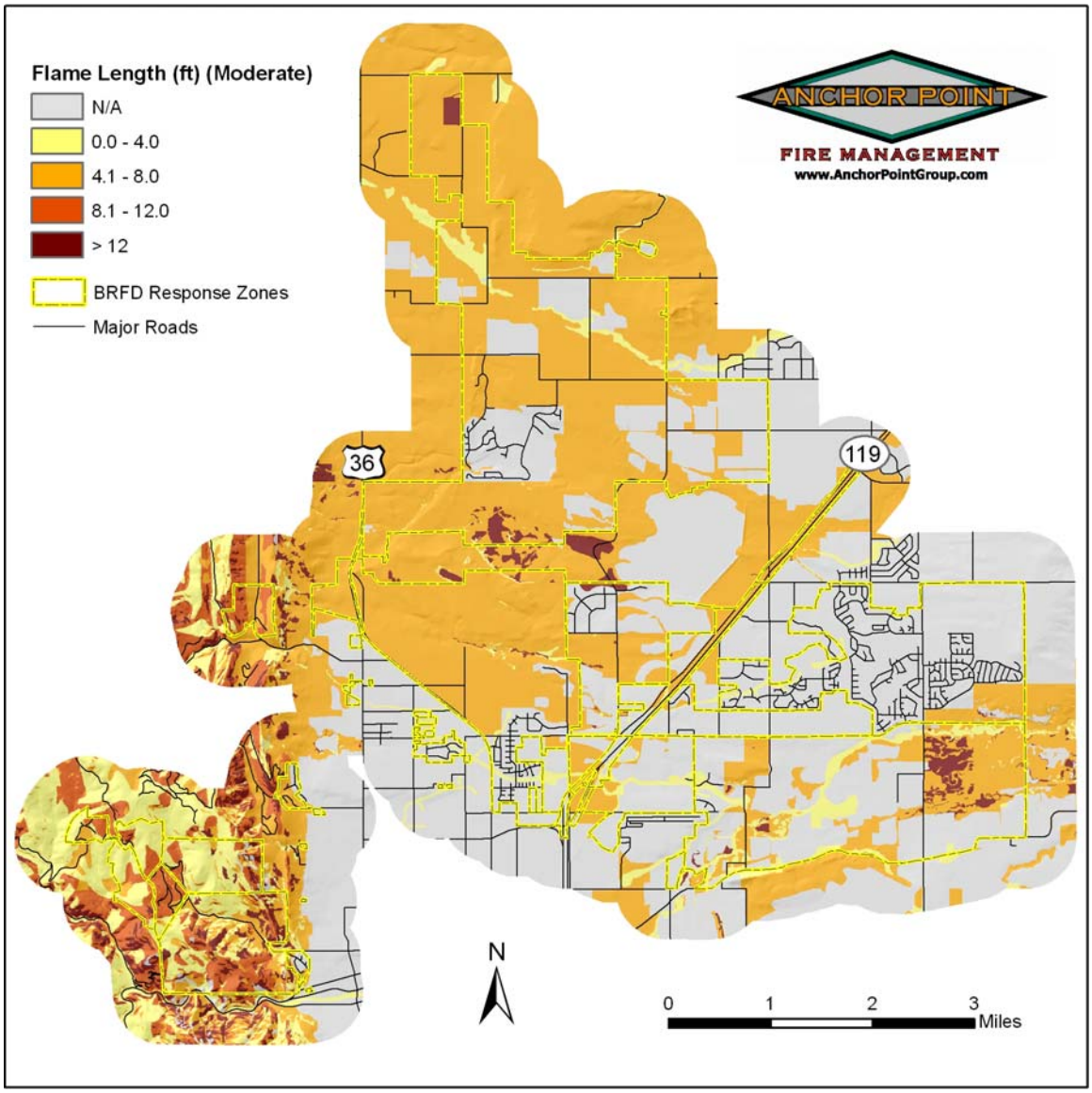


FIGURE 9. Rate of Spread, Moderate Weather Conditions

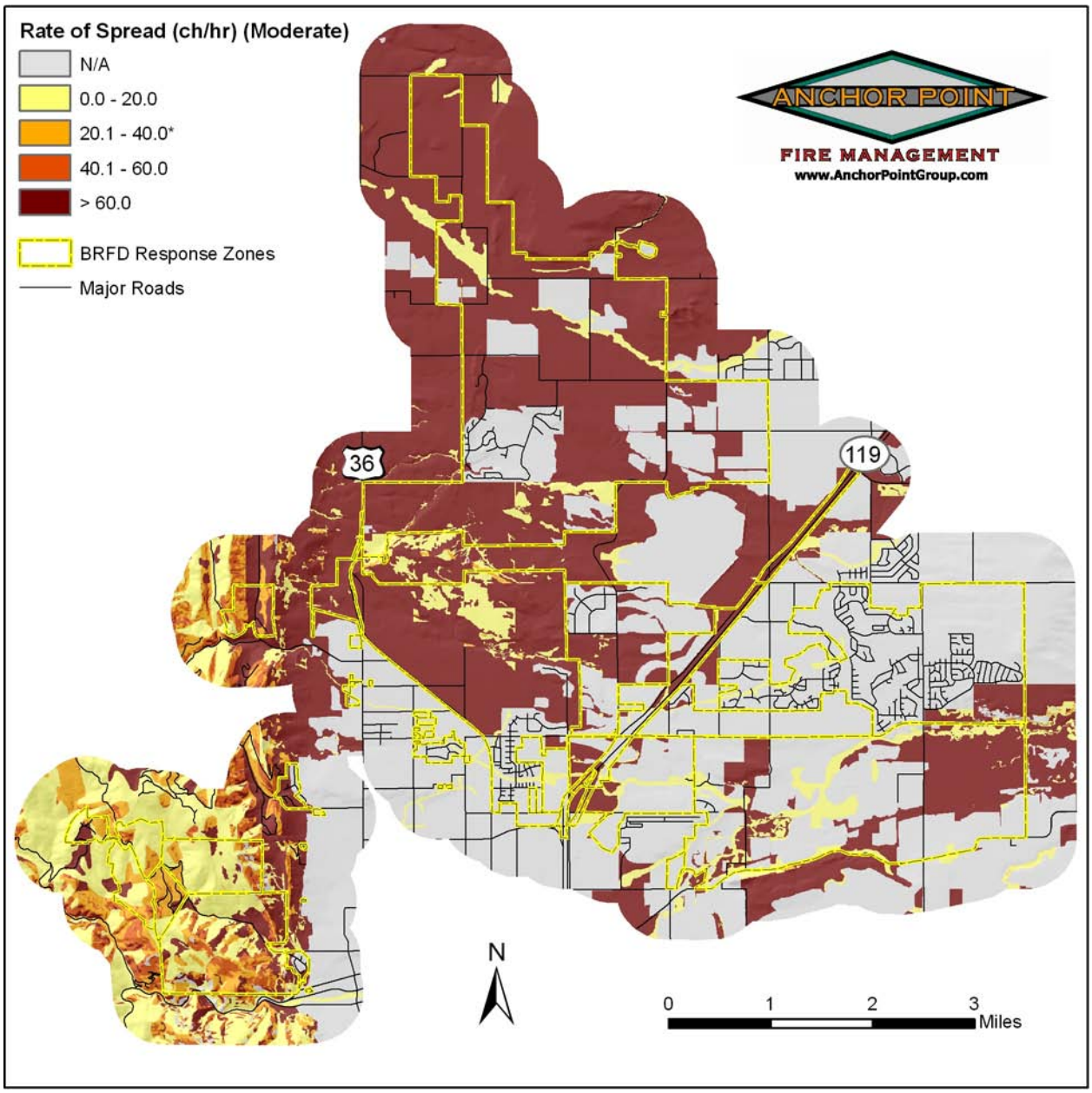


FIGURE 10. Crown Fire Potential, Moderate Weather Conditions

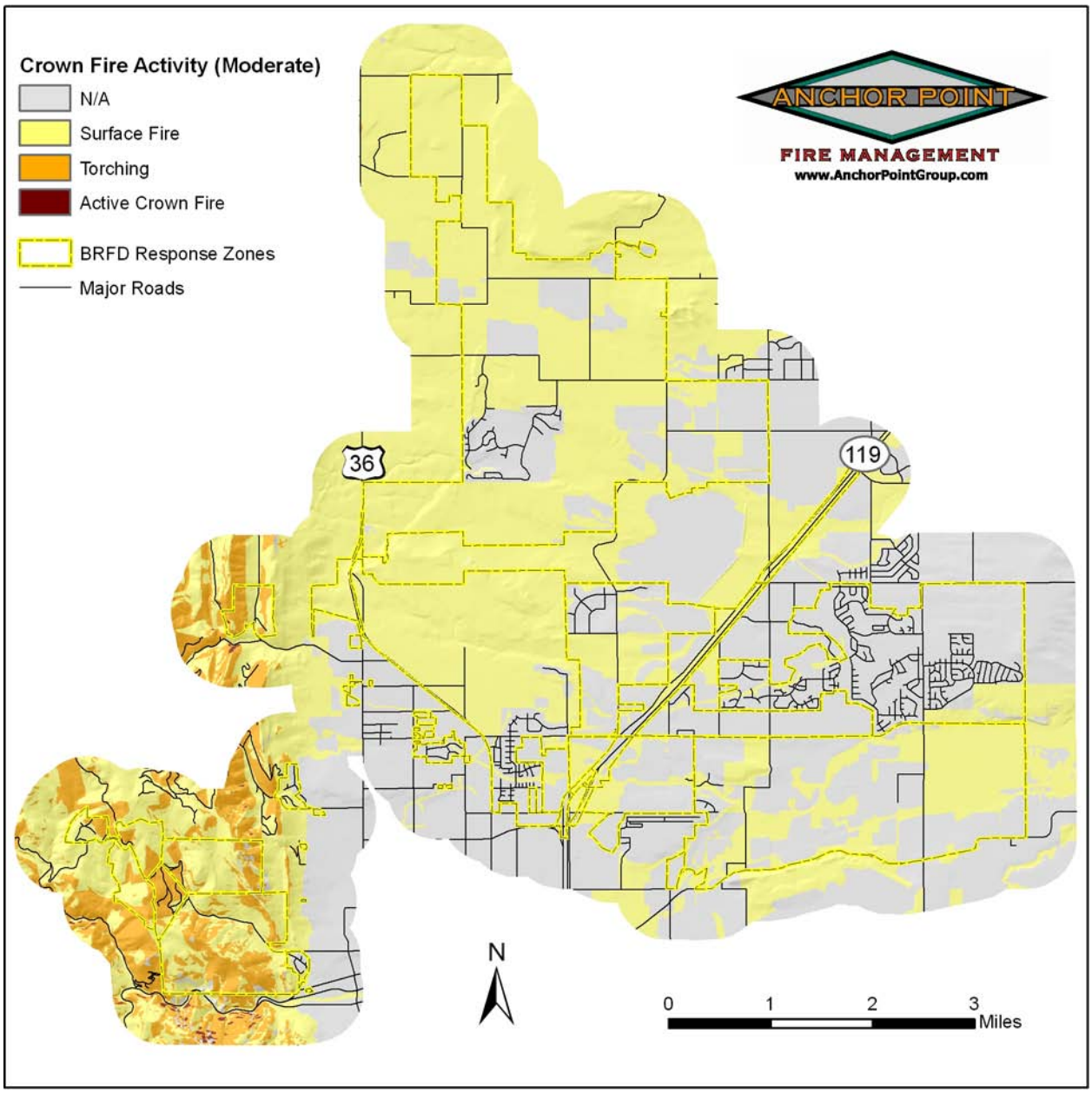


FIGURE 11. Flame Length, Extreme Weather Conditions

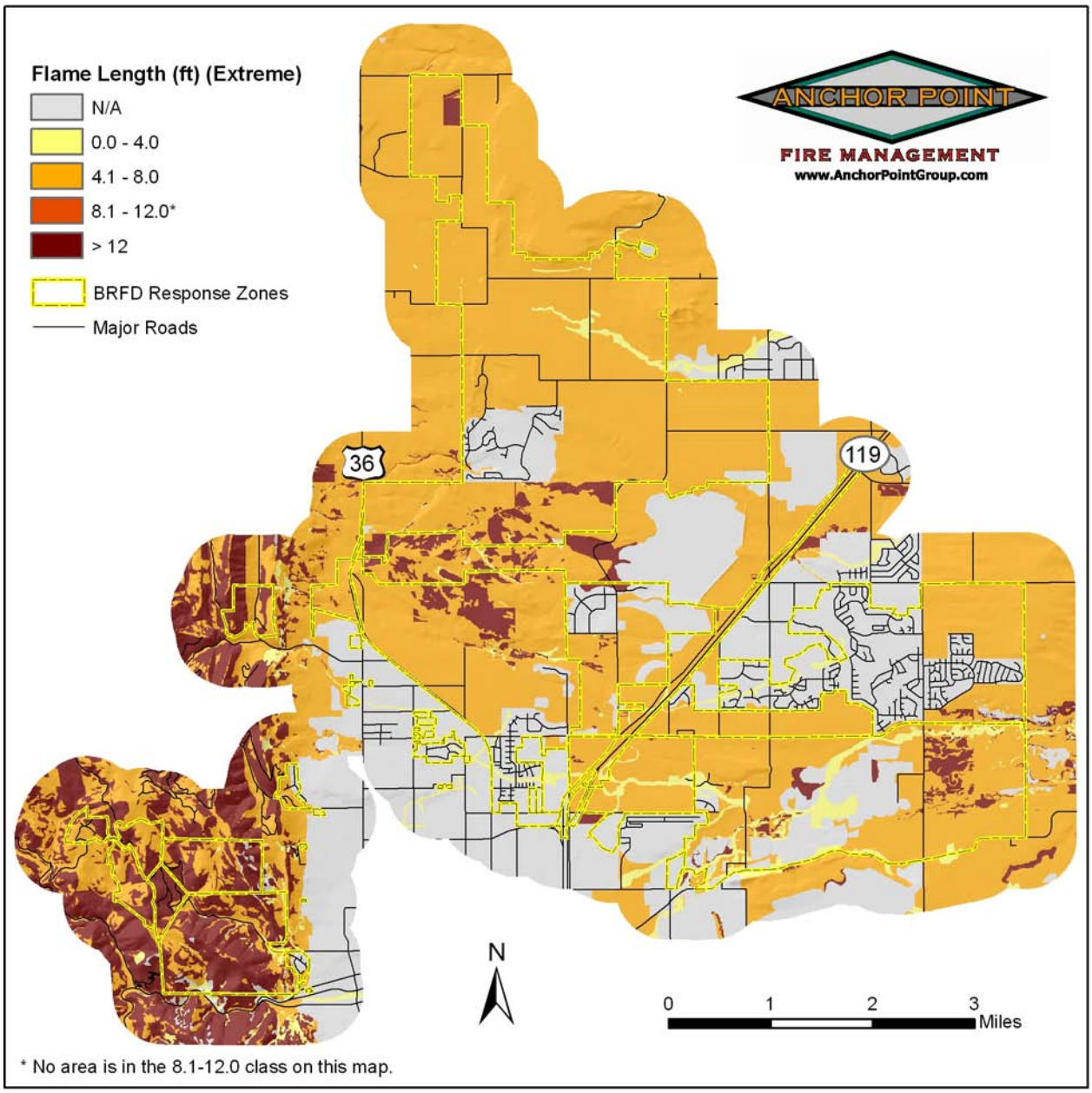


FIGURE 12. Rate of Spread, Extreme Conditions

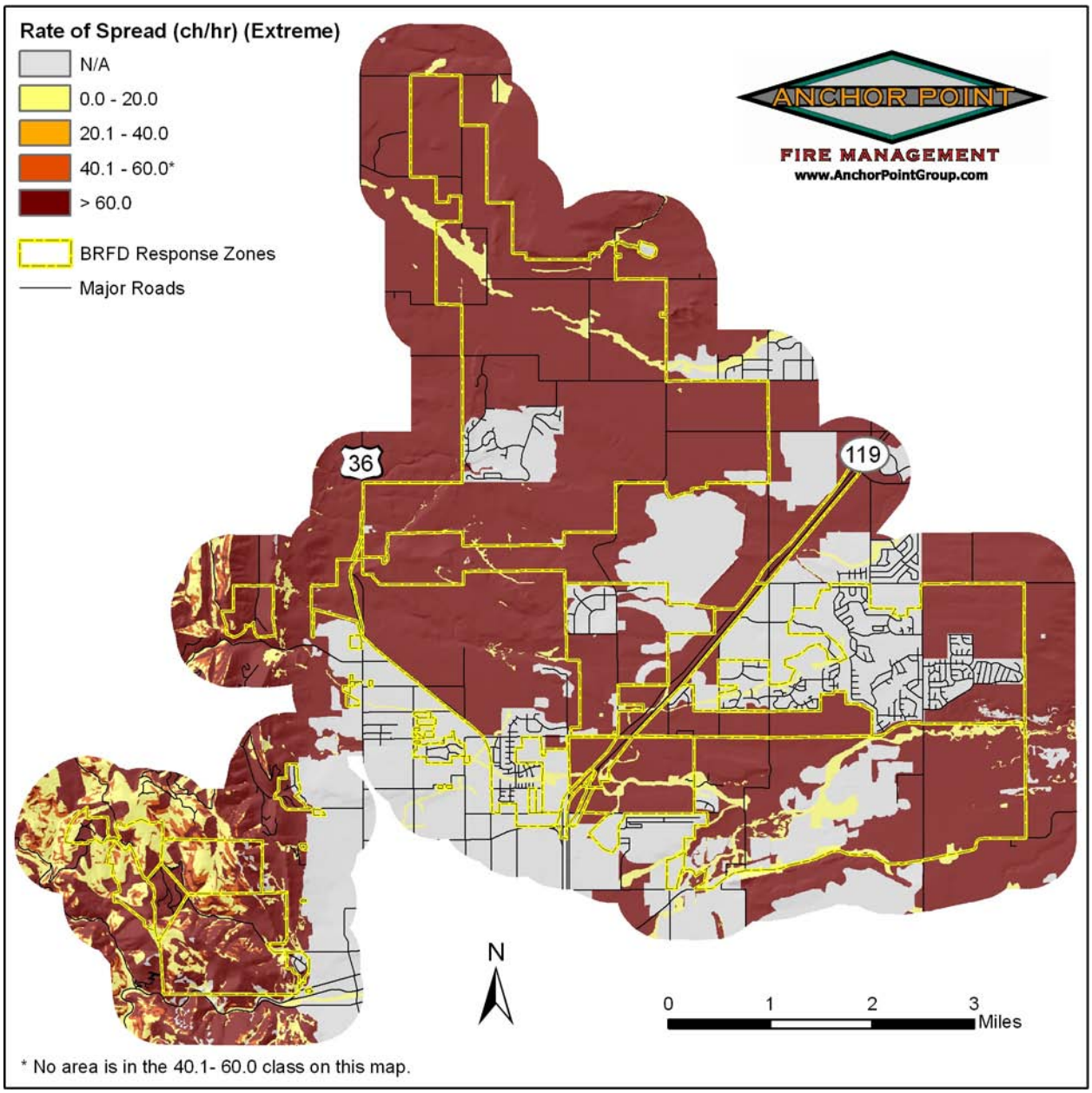
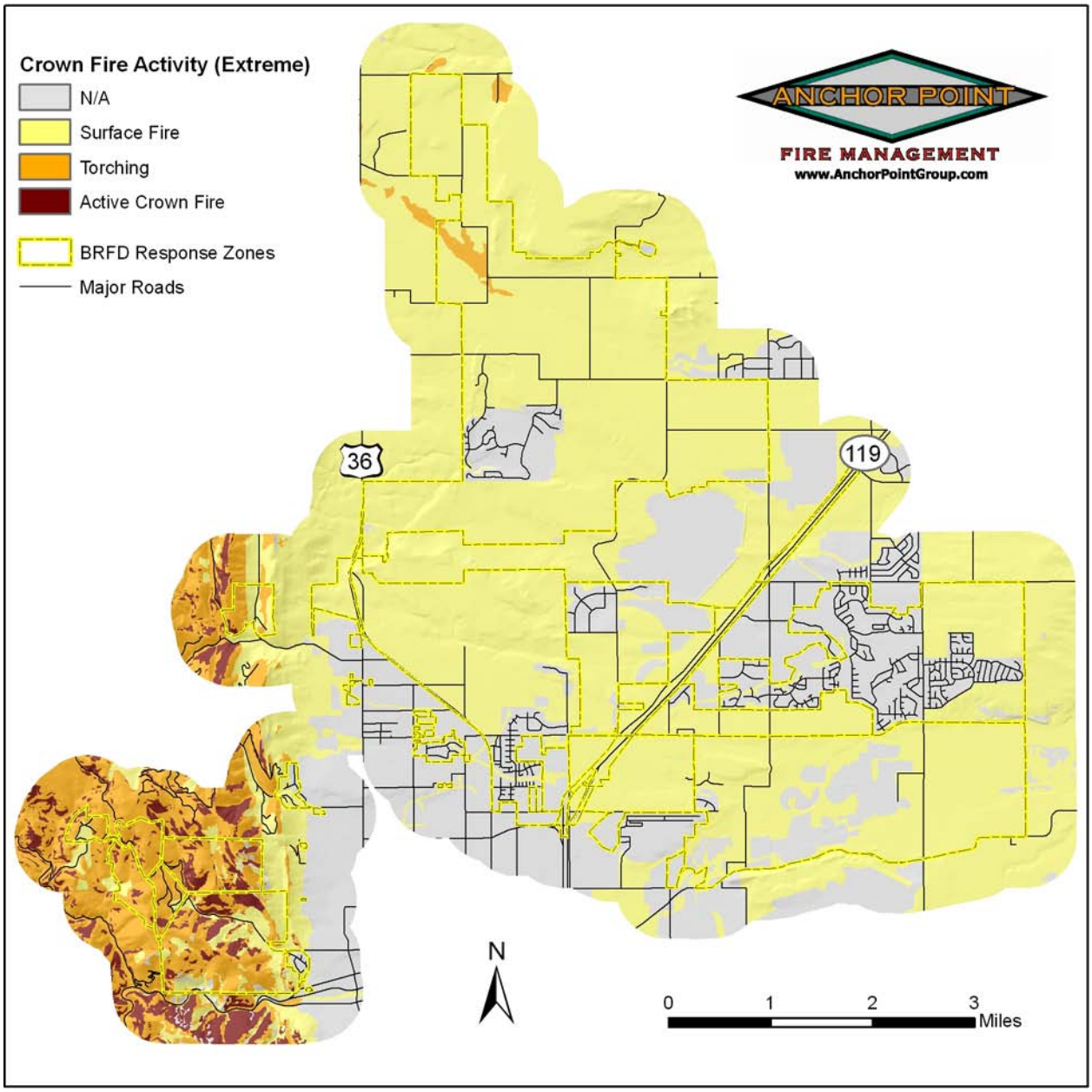


FIGURE 13. Crown Fire Potential, Extreme Conditions



SOLUTIONS AND MITIGATIONS

Establishing and Prioritizing Fire Management Units (FMUs)

An efficient method for prioritizing work efforts is to create FMUs. These units reflect a particular function, like developing an effective public outreach program, or a geographic treatment area, such as an area with related fuel reduction projects. FMUs are created prior to initiating management projects and mitigation activities. Unique activities and objectives are recommended for each unit. These solutions are designed to serve as proposed outlines for projects. They are presented as a starting point for communities to determine the priority and scope of the final project implementation. Local land and fire management agencies, with the input of the citizen's advisory council or fire safe council, must determine the final solutions.

The following FMUs have been identified for the BRFPD; recommendations are provided for each. FMUs are **not** ranked by priority, but priority recommendations have been provided for specific tactical mitigation actions where appropriate within FMUs.

- Safety Zones, Addressing, Evacuation Routes, and Shelter-in-Place FMU
- Public Education FMU
- Local Preparedness and Firefighting Capabilities FMU
- Home Mitigation FMU
- Plains Communities FMU
- Fuels Modifications FMU
- Water Supply FMU

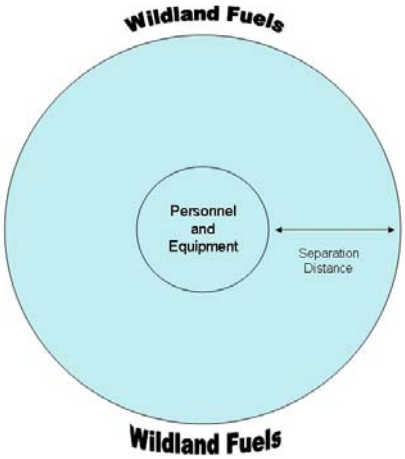
SAFETY ZONES, ADDRESSING, EVACUATION ROUTES, AND SHELTER-IN-PLACE FMU

Safety Zones

When pre-planning for a wildfire incident, designating safety zones for use by the responding firefighters should be a top priority. More than one safety zone is advised, because fire operations can be spread out over a large geographical area. When evaluating areas to be used, they must be easily accessible and adhere to current guidelines recommended by NWCG. (See **Figure 14)**

FIGURE 14. Safety Zone Guidelines

Flame Height	Distance Separation (firefighter to flame)	Area in Acres
10 feet	40 feet	1/10 acre
20 feet	80 feet	1/2 acre
50 feet	200 feet	3 acres
75 feet	300 feet	7 acres
100 feet	400 feet	12 acres
200 feet	800 feet	50 acres
(1 acre = 208 feet x 208 feet, or the approximate size of a football field)		



Distance separation is the radius from the center of the safety zone to the nearest fuels.[13]

RECOMMENDATIONS:

There appear to be a few safety zone options located in the Sunshine Canyon / Poorman Road area. These areas should be evaluated by BRFPD personnel, and if viable inserted in the district's run books.

- North of the intersection of West Leonards Road and Poorman Road.
- Sunshine Canyon Drive and Timber Lane.
- Mapleton Medical Center.

13 http://www.nwcg.gov/pms/pubs/410-1/chapter01.pdf referenced March 20, 2007

Addressing

A number of areas within the BRFPD were found to have poor and/or inconsistent street signage and addressing of properties. In the worse cases, addressing was found to be missing altogether or attached to combustible objects. (See **Figure 15**.) In the foothill areas of Boulder Rural with its intricate mountain roads and driveways, proper standardized reflective signage is critical to effective response. 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 responders. Standardized reflective signage mounted on a non-combustible pole is highly recommended. These signs can be in addition to the current markers.

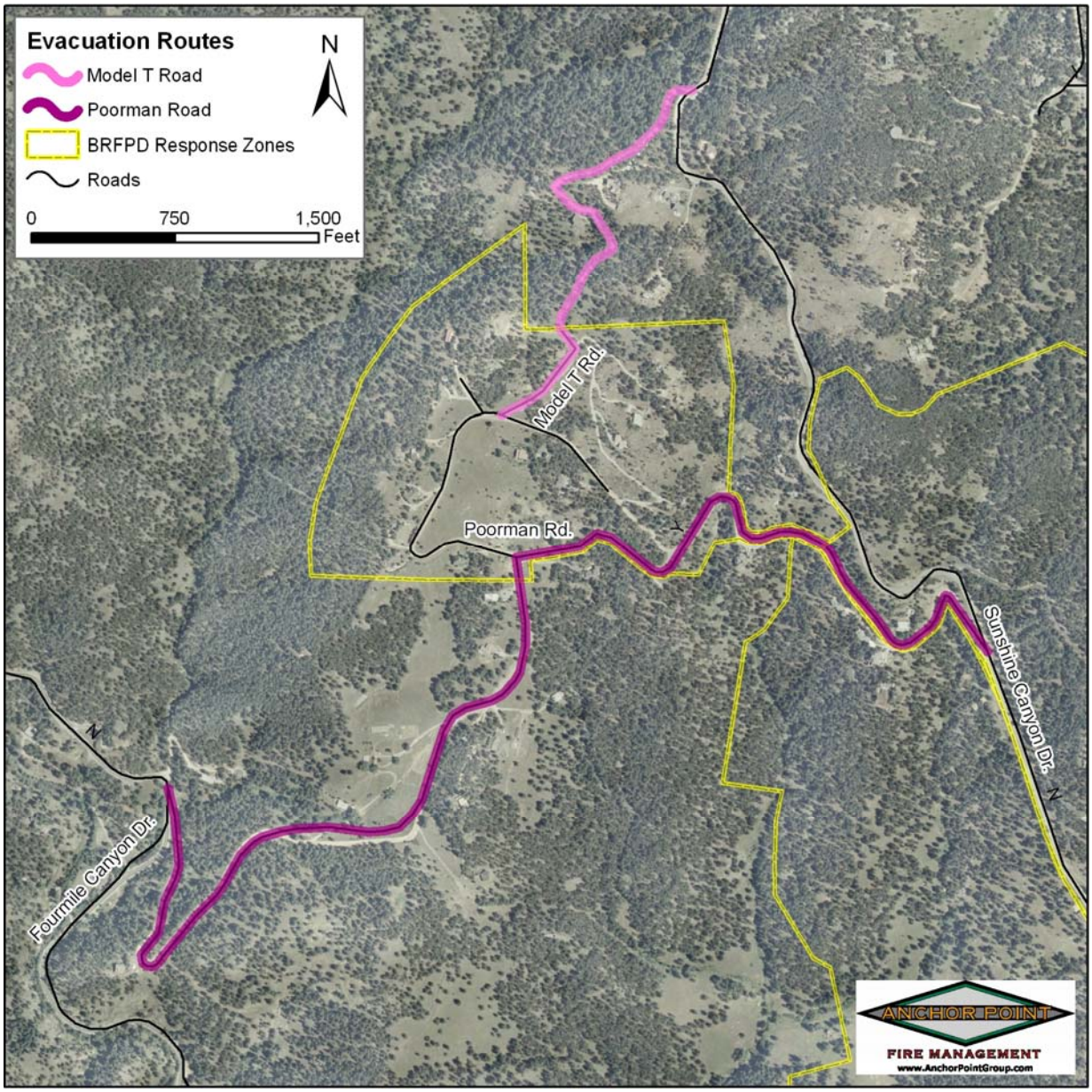
Recommendations for address markers can be found in **Appendix D**.

FIGURE 15.

Evacuation Routes

Two roads have been identified as evacuation route alternatives to the primary access. Of these, only one is potentially important and it may be compromised by land ownership. These routes are highlighted in **Figure 16**.

FIGURE 16.



EVACUATION ROUTE RECOMMENDATIONS:

The routes are represented graphically by **Figure 16**.

1. **Model T Road to Sunshine Canyon Drive. Priority Level High.** This project focuses on opening up Model T Road for emergency usage northward all the way to Sunshine Canyon Drive. This emergency usage would be for both citizens and emergency responders. The road surface should be evaluated to determine the feasibility of allowing larger fire apparatus in and out of the area. Fuels mitigation consisting of limbing and thinning to create a safe, effective escape route is also recommended (see the "Access Route Fuels Modification Projects" section of this report). This project will require a cooperative effort between BRFPD and the Sunshine FPD. It is recommended that the route be well marked.

2. **Poorman Road from Leonards Road (west) connecting to Sunshine Canyon Drive. Priority Level High**. This route has also been identified in the CWPP for the Four Mile FPD. This project focuses on reducing fuels along Poorman Road (see the "Access Route Fuels Modification Projects" section of this report).

A significant amount of effort should be devoted to educating the homeowners in these areas about the importance of these types of projects. In addition to evacuation, both of these routes are high priority fuels modification projects for the BRFPD.

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. 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.

- Use 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.

- 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, preferably under the street name sign. The placards should start from the furthest point into the subdivision and work outward. These placards greatly assist responding firefighters from other agencies who may not be familiar with the layout of the subdivision.

Shelter-in-Place

The community along Poorman Road and the upper portions of Sunshine Canyon Drive could become inaccessible due to heat and smoke from ignitions in drainages below the primary access road. Consideration should be given to developing shelter-in-place areas designed as alternatives to evacuation through hazardous areas. A shelter-in-place plan could be critical to life safety if both access routes to this area became compromised by fire.

There are several ways to protect the public from an advancing wildfire. One of these methods, evacuation, involves relocation of the threatened population to a safer area. Another method 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 considered suitable as a stand alone structure, homes need to be of ignition-resistant construction and have conforming defensible space. 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 a metal, or some other ignition resistant type roof, heavy timber may be acceptable. Eaves should be enclosed. Any holes in the foundation, siding, or eaves 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:

- If there is adequate time and water, consider plugging downspouts and filling any gutters with water. The sand bags 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 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, and be sure to remove flammables, such as gasoline and propane, to a safe distance away from the structure. Tanks containing propane or other volatile compressed gas may rocket as high 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.
- 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. Many studies have been performed 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.[14] 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

14 FEMA, *Handbook of Chemical Hazard Analysis Procedures, Washington D.C. 1990*

more information on structural triage and preparation please see **Appendix C** and the following articles and websites:

- Wildland Fire Management NFPA Journal Jan/Feb 2005 http://findarticles.com/p/articles/mi_qa3737/is_200501/ai_n9482983
- NFPA Wildland Section News (Wildfire News and Notes-December 2004 http://216.70.126.67/library/?p=165
- Red Cross Shelter-in-Place Fact Sheet http://www.redcross.org/services/disaster/beprepared/shelterinplace.pdf

Public Education FMU

The area around Boulder is experiencing continuing development. Spiraling property values and a limited number of building sites have resulted in recently constructed, high-value residences mixed in with older homes, rental 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 and interviews indicate that some homeowners in the study area are very supportive and proactive with regards to wildfire mitigation efforts. Unfortunately, in the foothill areas there are still homeowners and landowners who refuse to acknowledge the fact that they live in an area at risk of wildfires. Continued attempts to provide educational materials through personal contact should be conducted. Property owner education and the wildfire hazard mitigation message should be an ongoing effort in the foothill portions of the BRFPD and throughout the front-range interface.

RECOMMENDATIONS

- Visit 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://csfs.colostate.edu/protecthomeandforest.htm
  - http://www.brfd.org

- 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 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

Local Preparedness and Firefighting Capabilities FMU

The Boulder Rural Fire Protection District (BRFPD) provides suppression services for the study area. The district has two fire stations: Station 1 (includes the administrative offices) located at Jay Road and 51st Street. Station 2 is located at Fairways Drive and Neva Road in the Lake Valley subdivision. Mutual aid is available from the Rocky Mountain Fire Protection District, City of Boulder Fire Department, Four Mile Fire Protection District, Mountain View Fire Protection District, Left Hand Fire Protection District, Sunshine Fire Protection District, and the Boulder Mountain Fire Protection District.

BRFPD maintains three type-one engines (one CAFS), two type-six brush trucks, and one 1,800 gallon water tender which carries one 2,500 gallon Porta-tank with a spare of equal capacity stored at Station 1.

BRFPD adheres to the National Wildfire Coordinating Group (NWCG) curriculum for training. Of BRFPD's, 46 combination members, 43 are firefighters with NWCG S-130/190 training (basic wildland fire fighting and weather). Approximately 7 firefighters are qualified at the Crew Boss/Engine Boss level or higher.

RECOMMENDATIONS:

- Firefighter Training (**Priority Level High)**: Provide education and experience 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-290 Intermediate Fire Behavior
- I-200 and I-300 – Basic and Intermediate ICS
- Encourage personnel to seek higher wildfire qualifications
- Encourage personnel to participate in out of district wildfire assignments
- Encourage prescribed burn participation
- Encourage Type 3 incident management team participation and utilization

Equipment:

- **Priority Level High.** Provide minimum wildland Personal Protective Equipment (PPE) for all firefighters. (See NFPA Standard 1977 for requirements).

- **Priority Level High.** Provide gear bags for both wildland and bunker gear to be placed on apparatus responding to fire calls. This will help ensure that firefighters have both bunker gear and wildland PPE available when the fire situation changes.

- **Priority Level Moderate.** Purchase and equip a type 3 engine for interface firefighting.

- **Priority Level Moderate.** Provide and maintain a ten-person wildland fire cache in addition to the tools on the apparatus. The contents of the cache should be

sufficient to outfit two squads for hand line 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, 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:

- **Priority Level Moderate.** Secure additional VHF portable radios and batteries. These should be programmable. Training with these radios should be provided quarterly.

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-level and parcel level.

The community-level assessment has identified four of the 10 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. There is also 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.

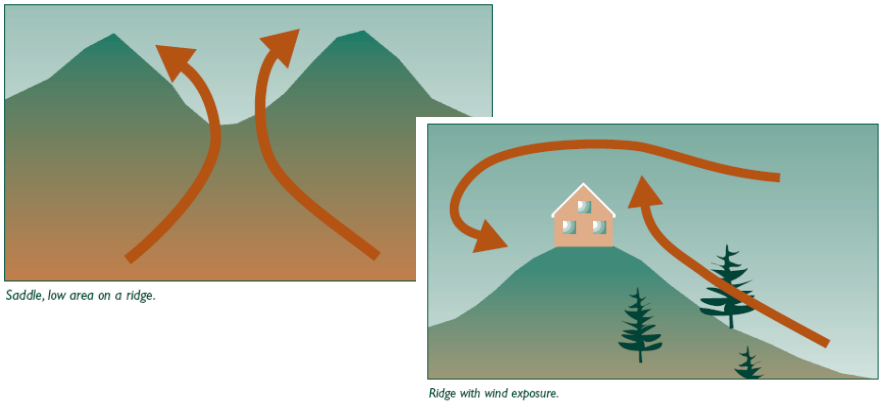
Table 3 illustrates the relative hazard rankings for communities in the study area.

- A rating of nine or less indicates an area of extreme hazard.
- A rating of 10 to 15 indicates a very high hazard.
- A rating of 16 to 20 indicates high hazard.
- A rating of 21 to 30 indicates moderate hazard.
- A rating of 30 or greater indicates a low hazard.

The communities with extreme and very 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.

The most important element for the improvement of life safety and property preservation is for every home in the study area to have compliant, effective defensible space. This is especially important for homes with wood roofs and homes located on steep slopes, in chimneys, saddles, or near any other topographic feature that contributes to fire intensity.

FIGURE 17. Saddle & Ridge Top Development[15]



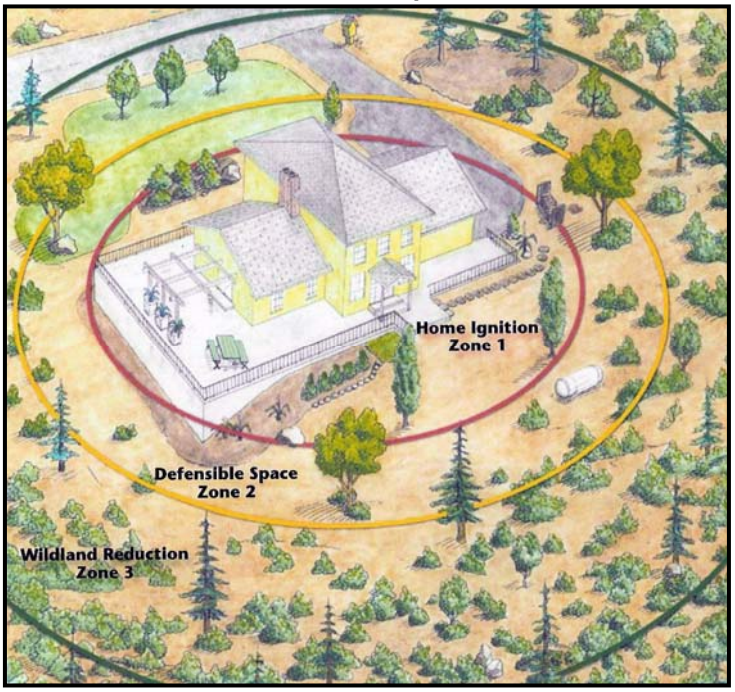
An aggressive program of evaluating and implementing defensible space for homes will do more to limit fire-related property damage than any other single recommendation in this report.

There is no question that any type of dense/flammable vegetation should be removed from around a home in order to reduce the risk of structural ignition during a wildfire. The question is how much should be removed. The basic rule is to eliminate all flammable materials (fire-prone vegetation, wood stacks, wood decking, patio furniture, umbrellas, etc.) from within 30 feet of the home. For structures near wildland open space, an additional 70 feet should be modified in such a way as to remove all dead wood from shrubbery, thin and trim trees and shrubs into "umbrella" like forms (lower limbs removed), and prevent the growth of weedy grasses (see **Figure 18**). Steep slopes and/or the presence of dangerous topographic features as described above may require the defensible space distances to be increased.

The term “clearance” leads some people to believe that all vegetation must be removed down to bare soil. This is not the case. Removing all vegetation unnecessarily compromises large amounts of forested terrain, increases erosion, and will encourage the growth of weeds in the newly disturbed soil. These weeds are considered “flashy fuels,” which actually increase fire risk because they ignite so easily. Defensible space must be ecologically sound, aesthetically pleasing, and relatively easy to maintain. Only then will the non-prescriptive use of fuels reduction around homes become commonplace.

15 *FireWise Construction*, Peter Slack, Boulder Colorado

FIGURE 18. Defensible Space Zones[16]



RECOMMENDATIONS

- **Priority level-High.** A parcel-level wildfire hazard analysis for the homes located in the Poorman, Upper, and Lower Sunshine Canyon communities was conducted in 2003. The Old Stage community will need the same analysis conducted. This data should 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.

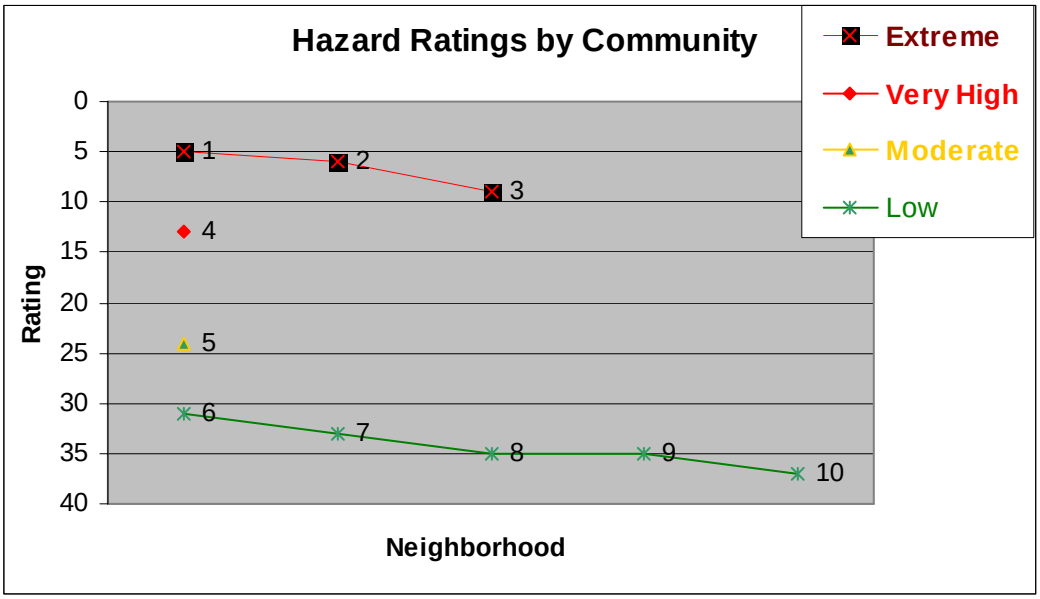
- **Priority level-High.** Add reflective address signs at each driveway entrance to all homes (see **Appendix D** for recommendations).

- **Priority level-High**. Use the structure triage methodology provided in **Appendix C** to identify homes not likely to be defendable.

16 *A Homeowner's Guide to Fire Safe Landscaping*(2005) www.FireSafeCouncil.org

- **Priority level-Moderate**. Improve access roads and turnarounds to create safe access for firefighting resources. See “Boulder Rural FPD Hazard Assessment Emergency Access and Water Supply” (**Appendix D**).

TABLE 4. BRFPD Hazard Ratings by Community



1. Poorman	**6. Orange Orchard**
2. Upper Sunshine Canyon	**7. Lake Valley/North Rim**
3. Old Stage	**8. Valhalla**
4. Lower Sunshine Canyon	**9. Heatherwood**
5. Spring Valley	**10. Ouray**

Plains Communities FMU

Some communities exist in the central and eastern portions of the study area that are not representative of true Wildland-Urban Interface, but are adjacent to, or in close proximity to, significant wildland fuel beds. These fuel beds consist of primarily tall grass prairie remnants and short grasses. Shrubs and hardwoods are also found growing in stringers and patches in drainages and riparian areas. There are some areas with jackpots of heavier fuels, most of which are smaller than the minimum mapping unit of the fire behavior model. Most of these fuels are located on open space parcels, and while some are grazed on a rotating basis, they represent a potential threat to some or most of the homes in these communities, especially those directly adjacent to them. These communities generally have low to flat topography, but ravines exist in some areas. Agricultural properties and larger rural lots are mixed in with suburban style subdivisions throughout this area. Construction type and structure age varies widely with both ignition resistant construction and homes with flammable roofs and sidings often existing in the same neighborhood. Although these communities have been given a low hazard rating, there are general mitigation measures which should be considered to reduce the possibility of loss resulting from fires occurring in the neighboring natural fuels. Homes located on the perimeter of these communities, or otherwise adjacent to continuous areas of natural

fuels, are the highest priority for mitigation. The following recommendations should be considered for the communities of Ouray, Lake Valley/North Rim, Valhalla, Orange Orchard and Heatherwood.

RECOMMENDATIONS

- Defensible space is recommended for all homes. Maintain defensible space throughout the year.

    - ✓ Mow grass and weeds to a low height.
    - ✓ Clean needle litter from roofs and gutters and away from foundations.
    - ✓ Do not dispose of yard waste into open space areas.
    - ✓ Discourage the planting of flammable vegetation such as juniper within 30 feet of homes.
    - ✓ Encourage the use of xeriscaping, and use fire and drought tolerant plants for ornamental plantings, especially within 30 feet of homes (see **Home Mitigation FMU**).
    - ✓ Water ornamental vegetation during times of drought.
    - ✓ When possible, maintain an irrigated green belt around the home.

- Extended defensible space is recommended for all homes located on the perimeter of native fuel beds, especially those located near ravines, steep slopes, or other dangerous topographic features. These areas are also noted in **Appendix B**

- Wooden shake and other flammable roofing types should be replaced with ignition resistant roofing such as asphalt or metal (see the **Home Mitigation FMU** section of this report).

- Encourage the use of low-combustibility materials for decks and projections on new construction and renovations, especially where homes are upslope from heavy fuels.

- Do not store combustibles or firewood under decks. Open areas below decks, outdoor stairways, and homes should be enclosed or screened to prevent the ingress of embers, especially where such openings are located on slopes above natural (non-irrigated, not maintained) vegetation.

- Trees along driveways should be limbed and thinned as necessary to maintain clearance for emergency vehicle access (13’ 6” vertically and 16’ horizontally).

- Propane tanks should be located at least 30’ from all structures. The area around the tank must be free of combustible material such as yard debris, weeds, etc.

FUELS MODIFICATION PROJECTS FMU

Introduction

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 the 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. Nonetheless, fuelbreaks have proven to be effective in limiting the spread of crown fires in Colorado.[17] 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 when compared to the fire-spread rate (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 Boulder Rural 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) 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, in order to stop fires from backing down the other side or spotting into the next drainage. This is not always practical from a WUI standpoint, because 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, but it may be easiest to achieve as an extension of defensible space work or off 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 commonly employed tactic is to position fuelbreaks along the bottom of slopes. It would make

17 Frank C. Dennis, “Fuelbreak Guidelines for Forested Subdivisions” (Colorado State Forest Service, Colorado State University, 1983), p. 3.

sense to locate fuelbreaks mid-slope below homes 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.

Fuelbreaks are often easiest to locate along existing roadbeds (see the description of the fuels modification project for access routes on page 42 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 fuelbreak 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**). Fuelbreaks that pass through hazardous topographic features should have these distances increased by 50%.[18] Since fuelbreaks can have an undesirable effect on the aesthetics of the area, crown separation should be emphasized over stand density levels. In other words, isolating groupings rather than cutting for precise stem spacing will help to mitigate the visual impact of the fuelbreak.

In **Appendix B** we noted that some communities have done mitigation work and not removed the resulting debris. 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, potentially 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 it is also the least effective, since it adds to the surface fuel load.

It is important to consider 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.
One of the most difficult issues in establishing and maintaining fuelbreaks is securing the cooperation and participation of landowners. Ownership maps of the area indicate that implementation of fuels reduction projects recommended here would require the approval of public land management agencies as well as private landowners.

18 Frank C. Dennis, "Fuelbreak Guidelines for Forested Subdivisions" (Colorado State Forest Service, Colorado State University, 1983), p. 11.

ACCESS ROUTE FUELS MODIFICATION RECOMMENDATIONS

A fuel modification project for primary access corridors should be implemented. Sunshine Canyon Drive and Poorman Road constitute the primary transportation corridors through the critical sections of the district. In general, these roads have adequate openings. However, the communities in the study area would benefit from fuels reduction along their principal access routes.

Thinning along primary access roads of the 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 5**). This is especially important in communities with steep, narrow roads and few turnouts. In these areas, safer access for firefighters would make an impact on the number of structures that could be defended in a wildfire. Existing and natural barriers to fire should be incorporated into the project dimensions.

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 for removal. It allows greater consideration for the elements of visual screening and aesthetics. Enlarging the project dimensions allows more options for tree 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.
- Tree 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.

TABLE 5. Recommended Treatment Distances For Mid-Slope Roads

% 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

Current and Proposed Cross-Boundary Projects

One purpose of this CWPP is to make known other agencies' fuel reduction projects adjacent to the BRFPD. The Four Mile FPD CWPP recommends constructing a fuelbreak below Poorman Road. This proposed project covers approximately 18 acres and would utilize existing large grassy areas. Some of these grassy areas could be large enough to be considered safety zones for firefighters. This project will benefit the BRFPD and should be a mutual effort between the two fire districts. Another project focuses on limbing and thinning along Canyonside Drive to link defensible spaces. This particular roadside treatment ties in with the Anemone Hill project proposed by OSMP.

FIGURE 19. Current and Proposed Projects Near BRFPD

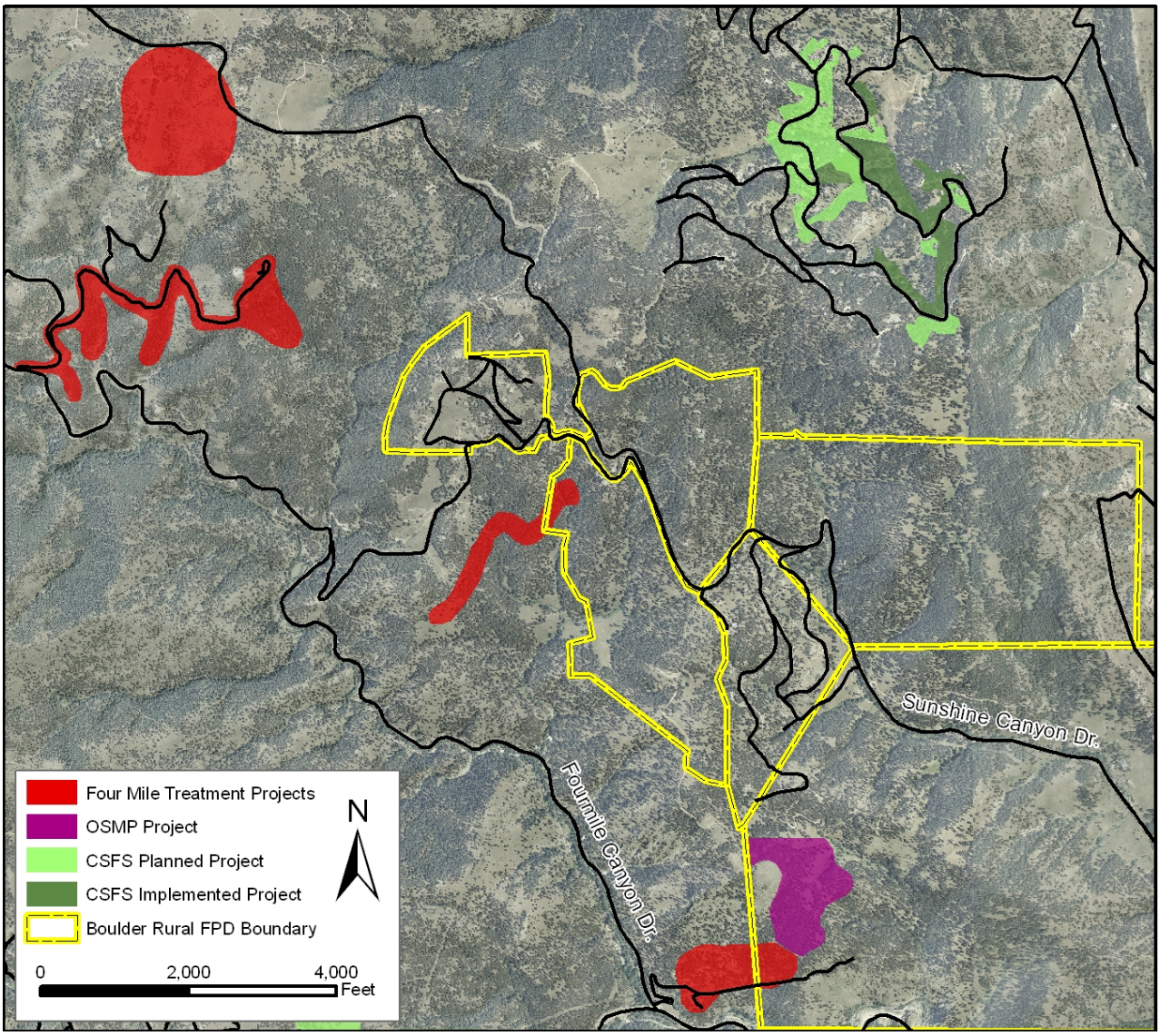
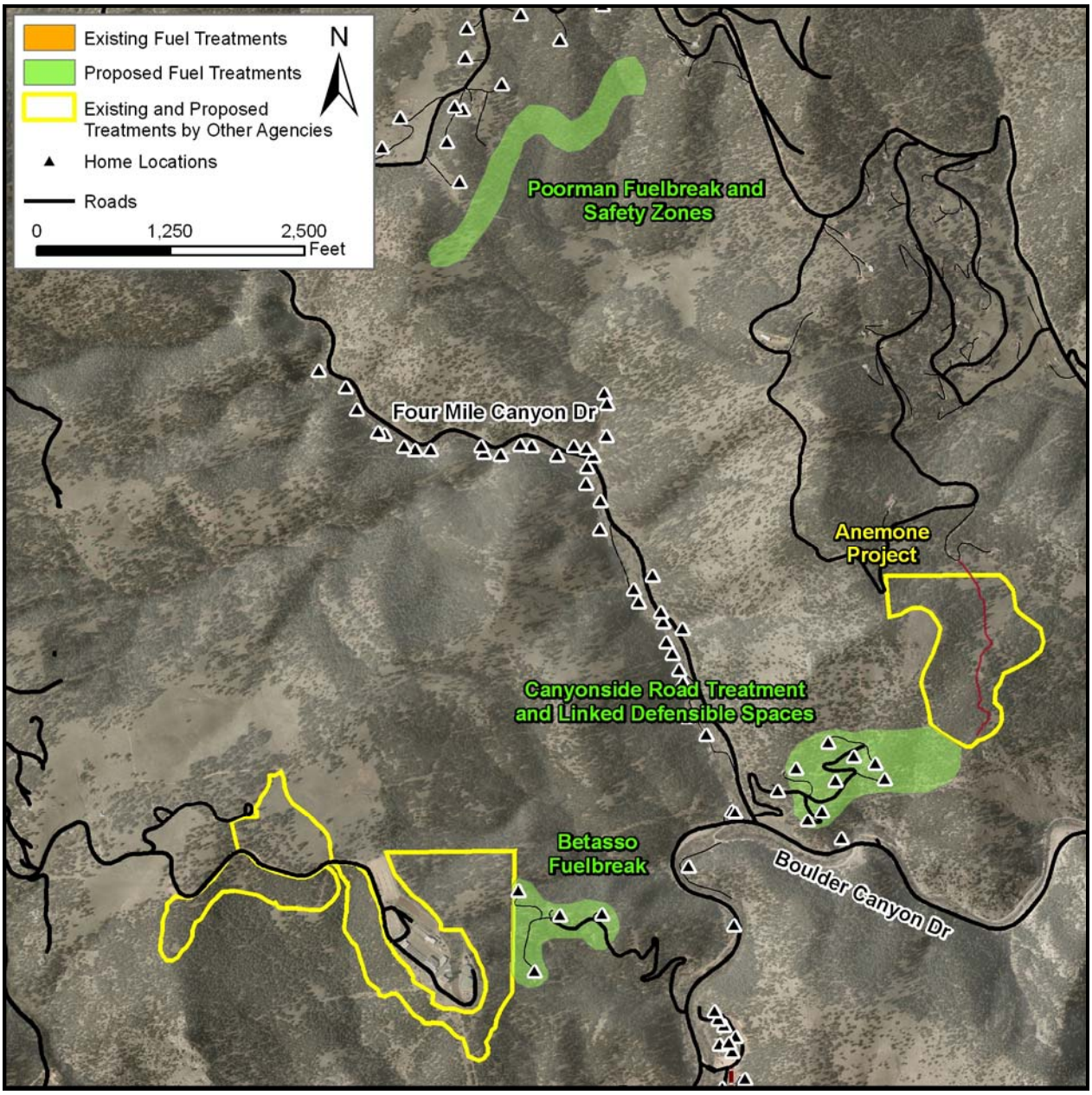


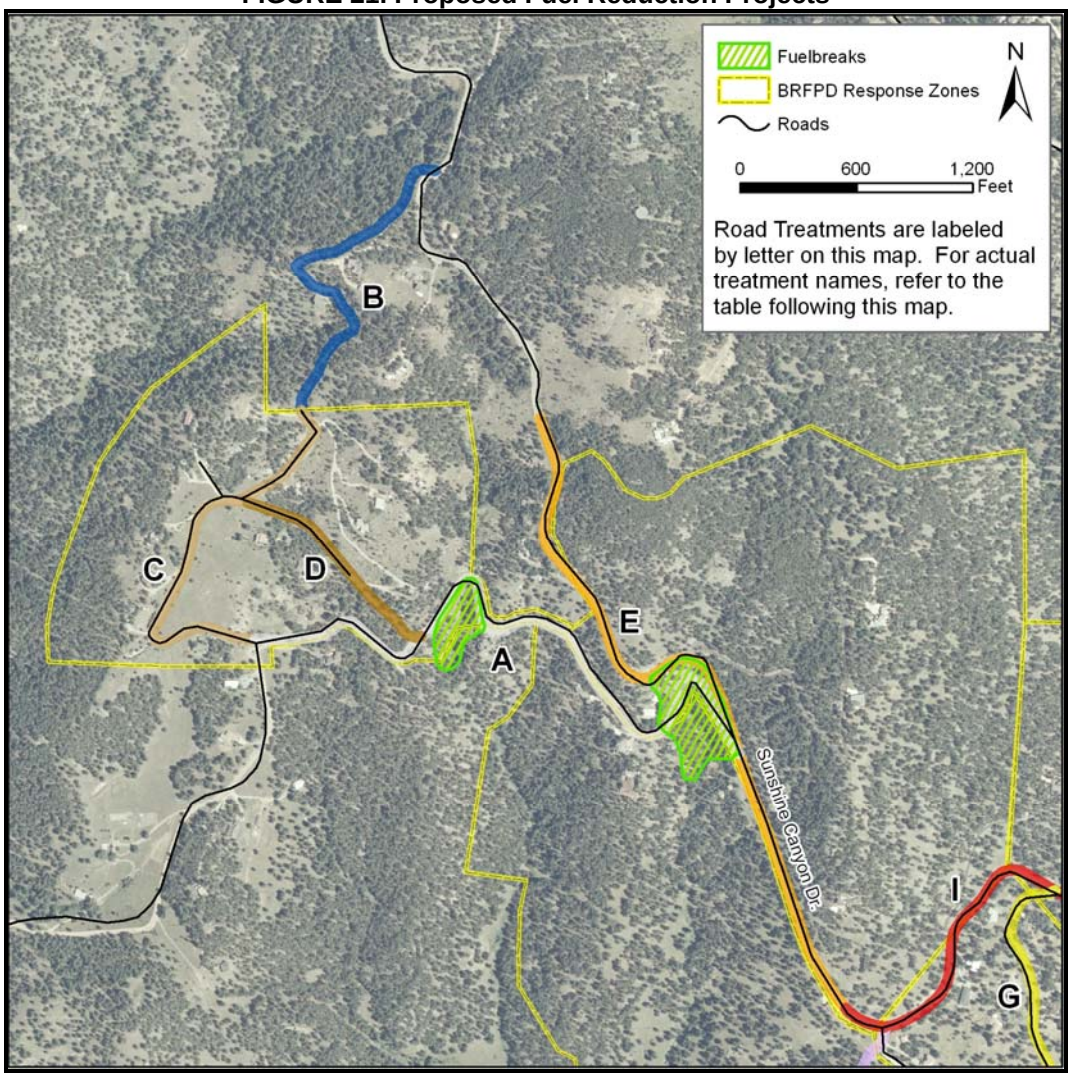
FIGURE 20. Four Mile FPD, East Side Fuels Modification Projects


Existing Fuel Treatments
Proposed Fuel Treatments
Existing and Proposed Treatments by Other Agencies
Home Locations
Roads
0
1,250
2,500
Feet
N
Poorman Fuelbreak and Safety Zones
Four Mile Canyon Dr
Anemone Project
Canyonside Road Treatment and Linked Defensible Spaces
Betasso Fuelbreak
Boulder Canyon Dr

PROPOSED FUELS REDUCTION PROJECTS FOR BRFPD

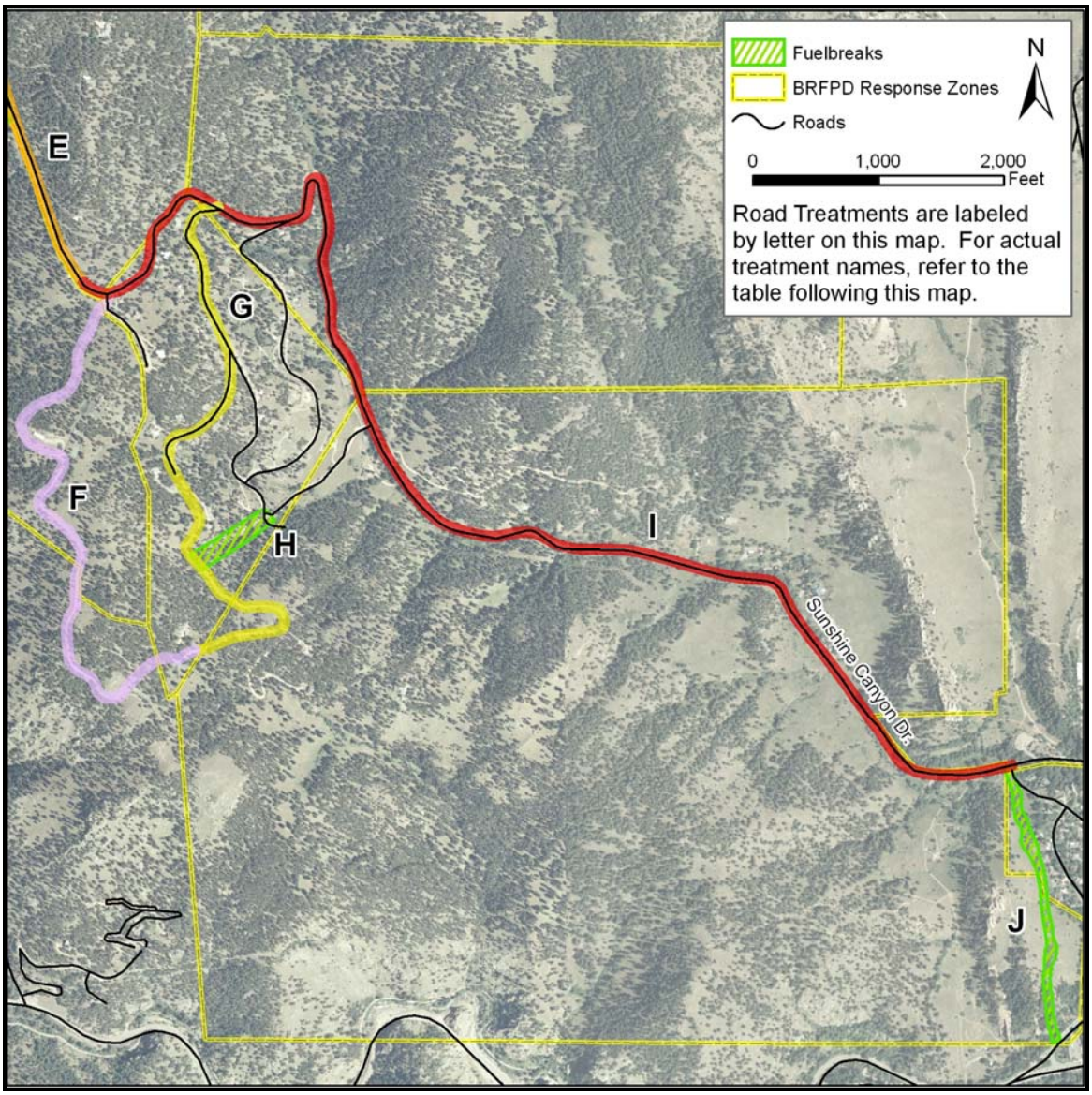
The following recommendations are in addition to, not in place of, the fuels reductions mentioned in the **Safety Zones, Addressing, Evacuation Routes, and Shelter-in-place FMUs**. It is important to note that the boundaries shown on the maps in this document are only approximate. Exact boundaries will be determined when treatment agreements are negotiated with the involved land owners and/or land managers.

FIGURE 21. Proposed Fuel Reduction Projects



A. Poorman Road Treatment
B. Model T Road Evacuation Route Treatment
C. Leonards Road (west side) / Model T Road Treatment
D. Leonards Road (east side) Treatment
E. Upper Sunshine Canyon Drive Treatment

FIGURE 22. Proposed Fuel Reduction Projects



E. Upper Sunshine Canyon Drive Treatment
F. Eagles Drive Treatment
G. Seven Hills Drive / Anemone Drive Treatment
H. Timber Trail Fuelbreak
I. Lower Sunshine Canyon Drive Treatment
J. Knollwood Fuelbreak

RECOMMENDATIONS:

A. **Poorman Road Treatment (Approximately 15.2 Acres). Priority level – High (see Figure 21).** This project focuses on limbing and thinning along Poorman Road from west Leonards Road to Sunshine Canyon Drive. Thinning should be conducted to conform to the shaded fuelbreak guidelines described in the "Access Route Fuels Modification Recommendations" section. Extra depth should be considered below the road in the drainages (200 feet). If combined with defensible space for all homes, this project will help protect a critical access route, as well as interrupting the continuity of fuels below the road.

B. **Model T Road Evacuation Route Treatment (Approximately 9.3 Acres). Priority Level – High (see Figure 21).** This project focuses on opening upper Model T Road for emergency usage to Sunshine Canyon Drive by limbing and thinning. This usage would be for both citizens and emergency vehicles. This project will require a cooperative effort between BRFPD and the Sunshine FPD. Thinning should be conducted to conform to the shaded fuelbreak guidelines described in the "Access Route Fuels Modification Recommendations" section. If combined with extended defensible space for all homes, this project will help protect an important escape route, as well as providing a critical fuelbreak.

C. **Leonards Road (west side) / Model T Road Treatment (Approximately 11.1 Acres). Priority Level – High (see Figure 21).** This project focuses on providing a fuelbreak by linking together extended defensible space between all the homes. The project begins at Poorman Road and extends along the western edge of Leonards Road up Model T Road, and also includes Commander Spur. This project builds off of the Model T Road escape route project (recommendation B). Thinning should be conducted to conform to the shaded fuelbreak guidelines described in the "Access Route Fuels Modification Recommendations" section. This treatment will also help to protect the upper areas of the subdivision.

D. **Leonards Road (east side) Treatment (Approximately 5.3 Acres). Priority Level – High (see Figure 21).** Some homes along the east side of Leonards Road currently have defensible spaces. A fuelbreak is recommended linking the existing defensible spaces and extending them to Poorman Road. This project is designed to provide a fuelbreak between Leonards Road and the homes above, while also protecting the egress route from this area. Limbing and thinning should be continued, where necessary, beyond defensible space guidelines for the distance recommended in the "Access Route Fuels Modification Recommendations" section.

E. **Upper Sunshine Canyon Drive Treatment (Approximately 12.5 Acres). Priority Level – High (see Figure 21).** This project begins at the water pump house and extends to the fire district border with Sunshine FPD. Thinning should be conducted along Sunshine Canyon Road to conform to the shaded fuelbreak guidelines described in the "Access Route Fuels Modification Recommendations" section. If combined with defensible space for all homes, this project will help protect a critical access route, as well as breaking the continuity of fuels below the road. This treatment will also help to protect the homes located above the road at 2700 Sunshine Canyon Drive.

F. **Eagles Drive Treatment (Approximately 23.7 Acres). Priority Level – High (see Figure 22).** This project begins at the intersection of Sunshine Canyon Drive and Eagles Drive. It utilizes the west asphalt driveway (14 Eagles Drive) extending south. After approximately 2,000 feet a two-track road further extends this access road treatment. Limbing and thinning to the specifications of an access route are recommended since one of the project goals is to provide safe emergency assess for a proposed homesite. The treatment area continues along and hooks around the south slope to connect with Anemone Drive in Seven Hills. Thinning should be conducted to conform to the shaded fuelbreak guidelines described in the "Access Route Fuels Modification Recommendations" section. When combined with extended defensible space for all homes (current & planned), this project will help protect an access route, as well as breaking the continuity of fuels below the road. This project is designed to take advantage of the proposed OSMP Anemone Hill thinning project to reduce the potential fire intensity throughout this area. This project may require a cooperative effort between BRFPD and the Four Mile FPD.

G. **Seven Hills Drive / Anemone Drive Treatment (Approximately 23.2 Acres). Priority Level – High (see Figure 22).** This project focuses on limbing and thinning to connect the Eagles Drive Treatment project (recommendation F) with Sunshine Canyon Drive within the Seven Hills subdivision. Thinning should be conducted to conform to the shaded fuelbreak guidelines described in the "Access Route Fuels Modification Recommendations" section. If combined with defensible space for all homes, this project will help protect an access route, as well as break up the continuity of the fuels.

H. **Timber Trail Fuelbreak (Approximately 2.4 Acres). Priority Level – Moderate (see Figure 22).** This project focuses on creating a fuelbreak from the west end of Timber Trail uphill to Anemone Drive. Existing defensible space should be incorporated and extended to help create this fuelbreak. Thinning to reduce ladder fuels and interrupt the crown continuity of fuels is recommended for a distance of at least three times the flame lengths predicted by the extreme weather scenario fire behavior model. This project is rated as a moderate priority because it does not protect against the dominant direction of fire movements in this area. Fuels are also lighter, many homes already have defensible space and areas with heavier fuel loads are a higher priority.

I. **Lower Sunshine Canyon Drive Treatment (Approximately 30.2 Acres). Priority Level – Moderate (see Figure 22).** This project will begin at the water pump house and extend down Sunshine Canyon Drive to the border of the fire district with the City of Boulder. Thinning should be conducted to conform to the shaded fuelbreak guidelines described in the "Access Route Fuels Modification Recommendations" section. If combined with defensible space for all homes, this project will help protect a critical access route, as well as breaking the continuity of fuels along the road. This treatment will also help to protect the homes located above the road at 1400 Sunshine Canyon Drive. This treatment is rated as a moderate priority, because of the relatively low density of homes along this portion of Sunshine Canyon Drive and the topographic position of the road.

J. **Knollwood Fuelbreak (Approximately 3.3 Acres). Priority level – Low. (see Figure 22).** This project area runs along the western edge of the Knollwood subdivision from Sunshine Canyon Drive to Pearl Street. Thinning to reduce ladder fuels and interrupt the crown continuity of fuels is recommended for a distance of at least three times the flame lengths predicted by the extreme weather scenario fire behavior model. Riparian vegetation adjacent to the creek bed should be improved to act as the fuelbreak in the appropriate areas. Educating homeowners to not dump yard waste in the treatment area will be necessary. This project is designed to reduce fire intensity and slow the spread of ignitions coming from the west. This project is rated as low priority due to light fuels.

Water Supply FMU

In the study area, as in many of the mountainous areas of Colorado's Front Range, water is a critical fire suppression issue. Although most of the plains communities are serviced by an adequate hydrant network, the following communities are not serviced by a municipal hydrant network:

- Poorman
- Upper Sunshine Canyon
- Old Stage
- Lower Sunshine Canyon (hydrants in Knollwood subdivision only)
- Pleasant Ridge Road (part of the Orange Orchard community)
- Ouray

Additional (not municipal hydrants) water supplies currently used by BRFPD are shown in **Figure 23**. **Table 6** gives a brief description of these water sources.

FIGURE 23. BRFPD Water Sources

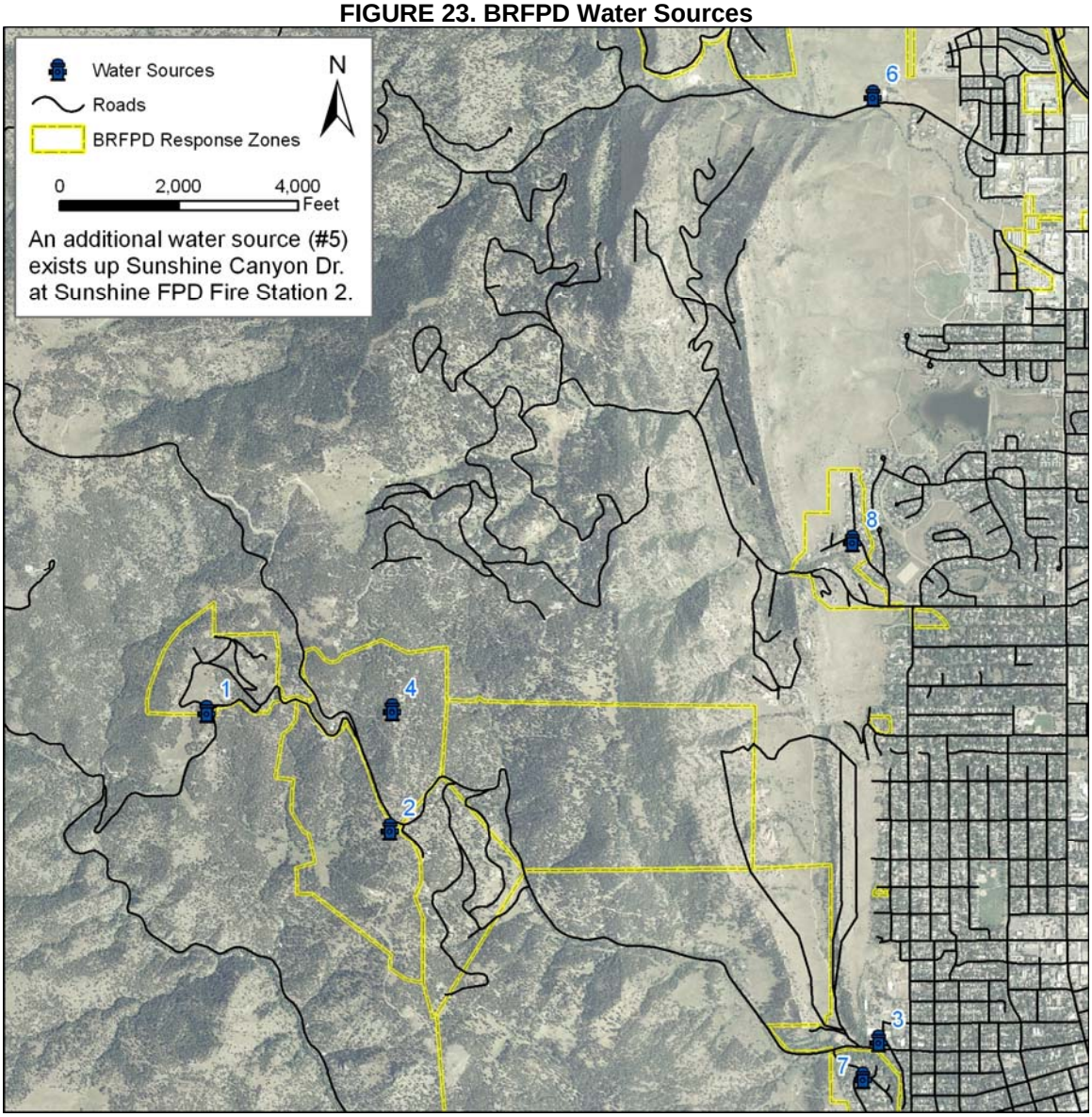


TABLE 6. BRFPD Water Sources

Water Source Name	Address / Location	Capacity (Gallons)	Type	Delivery
1. Poorman Boulder Rural Cistern	Poorman Rd & Leonard Rd (west) (Lock combo 3000)	45,000	Cistern	4" / 6" Draft
2. Pump House (Pinebrook Water Dist.)	NW of Sunshine Cyn Dr. & Eagles Dr. (2.1 mi)	300,000	Well / storage	2 1/2' outlet. 750 GPM
3. Boulder City water hydrant	Mapleton Medical Center	unlimited	City Hydrant	4 ½" / 2 ½"
4. Pinebrook Water District*	Near 2700 Sunshine Canyon Dr.	300,000	Well / Storage	4 ½" / 2 ½"
5. Sunshine Canyon FD Cistern	Sunshine Cyn FD Station #2 (6.1 mi)	50,000	Cistern	4" / 6" Draft
6. City Water Hydrant	City hydrants along Lee Hill Rd.	unlimited	City Hydrant	4 ½" / 2 ½"
7. Knollwood **	Lower Sunshine Canyon Comm.	unlimited	Hydrant	4 ½" / 2 ½"
8. Spring Valley **	Spring Valley Comm.	unlimited	Hydrant	4 ½" / 2 ½"

*** This hydrant may or may not be an available water source. See recommendations.**
**** These private water systems produce lower flow rates and at times require augmentation.**

There are private cisterns scattered throughout the district, but these are not maintained or used by the BRFPD.

- The mid-level assessment revealed a marginally adequate water supply in the study area. In certain areas there is a considerable distance from reliable water sources for fire suppression. Immediately accessible secondary water sources must always be considered.

BRFPD is equipped with only one true water tender. One portable tank is kept on the tender, and an additional tank is kept at station one (See **Firefighting Capabilities**.) Firefighting efforts can be enhanced by improving water supplies in the FMU.

RECOMMENDATIONS:

- **Priority Level High.** The Pump House located 2.1 miles up Sunshine Canyon Drive has a proposal in the planning stages to plumb the "on-site" 30,000 gallon cistern into a 500 GPM pressurized water source. A dry hydrant will also be plumbed into the cistern for use in the event of a power loss. Recommend that this proposal be immediately investigated.
- **Priority Level High.** A medium sized (10,000-20,000 gal.) cistern is recommended for the area of lower Seven Hills. The intersection of Sunshine Canyon Drive and Timber Trail would be a suitable location. This would give an adequate spacing of water sources within the study area. This is the most critical water supply need in the entire study area.
- **Priority Level High.** The Pump House water source fill outlet is not visible at first glance. It is recommended to attach signs to the structure marking "FIRE DEPARTMENT WATER SOURCE" or similar wording. Additional signage should be installed near the outlet and labels positioned near the switches identifying their functions. Additionally, creating defensible space around the structure will help to improve visibility of the water outlet.
- **Priority Level High.** Pinebrook Hills Water District is currently undergoing changes. The water flow with regards to the hydrant near 2700 Sunshine Canyon Dr. and the Pump House is in question. We recommend that BRFPD contact the water district and schedule an on-site meeting to discuss the current situation.
- **Priority Level High.** All water sources should be inspected and preventive maintenance performed on a quarterly schedule at a minimum.
- **Priority Level Moderate.** The hydrant located near 2700 Sunshine Canyon Dr. should be labeled describing its capabilities.
- **Priority Level Moderate.** Research the feasibility of Pinebrook Hills Water District running a water main down to Sunshine Canyon Dr. This hydrant could be used by BRFPD and the Sunshine FPD for fire suppression. Investigate a possible collaborative effort between all water and fire districts.

GLOSSARY

The following definitions apply to terms used in the Boulder Rural 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 called 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 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, which may or may not be independent 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.

Energy Release Component: An index of how hot a fire could burn. ERC is directly related to the 24-hour, potential worst case, total available energy within the flaming front at the head of a fire.

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. Fire Behavior Potential is derived from fire behavior modeling programs using 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: Given an ignition, the likelihood and severity of Fire Outcomes (Fire Effects) that result in damage to people, property, and/or the environment. Fire Hazard is 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.

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

FlamMap: A software package created by the Joint Fire Sciences Program, Rocky Mountain Research Station. The software uses mapped environmental data such as Elevation, Aspect, Slope, and Fuel Model, along with fuel moisture and wind information, to generate predicted fire behavior characteristics such as Flame Length, Crown Fire Activity, and Spread Rate.

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 can be defined by function (e.g., public education efforts) or geography (e.g., fuel reduction projects in a given area).

Fuelbreak: A natural or constructed discontinuity in a fuel profile used to isolate, stop, or reduce the spread of fire. Fuelbreaks 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.

ICP (Incident Command Post): The base camp and command center from which fire suppression operations are directed.

ISO (Insurance Standards Office): A leading source of risk information to insurance companies. ISO provides fire risk information in the form of ratings used by insurance companies to price fire insurance products to property owners.

Jackpot Fuels: a large concentration of discontinuous 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 by 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 which 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** section of this 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 63 percent of the difference between its initial moisture content and its equilibrium moisture content.

Values at Risk: People, property, ecological elements, and other human and intrinsic values within the project area. Values at Risk are identified by inhabitants as important to the way of life of the study area and are specifically susceptible to damage from undesirable fire outcomes.

WHR (Community Wildfire Hazard Rating. AKA Community Assessment): A fifty-point scale analysis designed to identify factors which increase the potential for and/or severity of undesirable fire outcomes in WUI 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. Sometimes referred to as Urban Wildland Interface, or UWI.