GRAND FPD NO. 1

Community Wildfire Protection Plan

Prepared for:
Grand FPD No. 1
Granby, CO

Submitted by:
Anchor Point Group, LLC
Boulder, CO
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ANCHOR POINT
FIRE MANAGEMENT

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PURPOSE

This document has the following primary purposes:

- Provide a detailed, comprehensive and scientifically-based analysis of wildfire-related hazards and risks in the Wildland Urban Interface (WUI) areas of the Grand Fire Protection District No. 1 (herein referred to as “Grand FPD No. 1″ or “the study area”).
- Using the results of the analysis, generate recommendations designed to prevent and/or reduce the damage associated with wildfire to values at risk in the study area.
- Create a Community Wildfire Protection Plan (CWPP) document which conforms to the standards for CWPPs established by the Healthy Forest Restoration Act (HFRA) and the Colorado State Forest Service.

INTRODUCTION

The Grand Fire Protection District No. 1 CWPP is the result of a community-wide planning effort that included extensive field data gathering, compilation of existing documents and GIS data, and scientifically-based analysis and recommendations designed to reduce the threat of wildfire-related damages to “values at risk” (see below). This document incorporates new and existing information relating to wildfire which will be valuable to citizens, policy makers, and public agencies in Grand County, Colorado. Participants in this project include homeowners, state and federal land managers, and other stakeholders. This document meets the requirements of the Federal Healthy Forest Restoration Act of 2003 for community fire planning.

This CWPP meets the requirements of HFRA by:

- Identifying and prioritizing fuels reduction opportunities across the landscape (see the *Fuels Modification* section beginning on page 42).
- Addressing structural ignitability (see the *Home Mitigation* section beginning on page 39, and **Appendix B**).
- Assessing community fire suppression capabilities (see the *Local Preparedness and Firefighting Capabilities* section beginning on page 36).
- Collaborating with stakeholders (see **Appendix E**)

The assessment portion of this document estimates the hazards and risks associated with wildland fire in proximity to WUI areas. This information, in conjunction with identification of the values at risk, defines “areas of concern” and allows for prioritization of mitigation efforts. From the analysis of this data, 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 strategies.

Wildfire hazard data is derived both from the Community Wildfire Hazard Rating system (WHR) and from the analysis of Fire Behavior Potential. Because these analyses are technical in nature and relatively lengthy, they are included 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 wildfire hazard and risk assessment.

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 Wildland-Urban Interface (WUI) neighborhood evaluations 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. Hazard equates to the susceptibility of the communities to be damaged by wildfire.

Values at risk are the intrinsic values identified by citizens as being important to the way of life in the study area, and therefore of particular concern from a wildfire perspective. These values include first and foremost life safety, as well as preservation of property, access to recreation, and wildlife habitat.

THE NATIONAL FIRE PLAN AND THE HEALTHY FOREST RESTORATION ACT

In the year 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 report, prepared by a federal interagency group, was titled "Review and Update of the 1995 Federal Wildland Fire Management Policy" (2001). This report concluded, among other points, that the condition of America's forests had continued to deteriorate.

The second report, titled "Managing the Impacts of Wildfire on Communities and the Environment: A Report to the President in Response to the Wildfires of 2000," was issued by the Bureau of Land Management (BLM) and the United States Department of Agriculture Forest Service (USFS). It became known as the National Fire Plan (NFP). This report, and the ensuing congressional appropriations, ultimately required actions to:

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

Congress increased its specific appropriations to accomplish these goals. 2002 was another severe season: more than 1,200 homes were destroyed and over seven million acres burned. In response to public pressure, congress and the Bush administration continued to designate funds specifically for 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.

Goals and Objectives

- Enhance life safety for residents and responders
- Mitigate undesirable fire outcomes to property and infrastructure
- Mitigate undesirable fire outcomes to the environment and quality of life

To accomplish these goals, the following objectives have been identified:

- Establish an approximate level of risk (the likelihood of a significant wildfire event in the study area).
- Provide a scientific analysis of the fire behavior potential of the study area.
- Group values at risk into “communities” that represent relatively similar hazard factors and mitigation needs.
- Identify and quantify factors that limit (mitigate) undesirable fire effects on the values at risk (hazard levels).
- Recommend specific actions that will reduce hazards to the values at risk.

Other Desired Outcomes

- Promote community awareness: Quantifying the community’s hazards and risk from wildfire will facilitate public awareness and assist in creating public action to mitigate the defined hazards.
- Improve wildfire prevention through education: community awareness, combined with education, will help to reduce the risk of unplanned human-caused ignitions.
- Identify and prioritize appropriate hazardous fuel reductions projects.
- Promote improved levels of response: The identification of areas of concern will improve the focus and accuracy of pre-planning, and facilitate the implementation of cross-boundary, multi-jurisdictional projects.

COLLABORATION: COMMUNITY/AGENCIES/COUNCILS

It is essential to the development of a quality Community Wildfire Protection Plan to solicit the input and expertise of people from varied backgrounds. Each study area is unique, and each community within a study area has its own particularities and concerns that cannot adequately be addressed by even the most careful scientific analyses by fire professionals. Anchor Point makes it a top priority to gather as much local information as possible, in order to produce for its clients the most thorough, actionable CWPP possible.

To that end, many people have been involved in the development of this plan. The names of the core team representatives involved in the development of the Grand FPD No. 1 CWPP are included in **Table 1** on the next page, along with their organizations and various roles and responsibilities. For more information on the collaborative process that led to the development of this CWPP, see **Appendix E**, *CWPP Collaborative Effort*.

Table 1. CWPP Core Development Team

Name	Organization	Roles / Responsibilities
David Boyes, Chief Jen Fuqua, Admin Assistant	Grand Fire	Local expertise; community risk and value assessment; Media outreach and coordination
Jynnifer Pierro, Mayor Wally Baird, Town Manager	Town of Granby	Funding and Assistance
Ron Cousineau, District Forester	CSFS	Facilitation of planning process; approval of CWPP minimum standards; expertise on forestry, fire and fuels; FireWise concepts
Paul Mintier, District FMO	USFS	Fire Behavior assistance and fuels planning
Lynn Barclay	BLM	Input and expertise about projects on adjacent federal lands.
Tim Hartman	Legacy Park, HOA	Collaboration and plan review
Tayler French	Ouray Ranch HOA	Collaboration and plan review
Mike Hulley, Alan Findley	Ten Mile Creek HOA	Collaboration and plan review
Bob and Norma Colosimo	Winter Park Highlands HOA	Collaboration and plan review
Tom Hale	Granby Ranch Conservancy	Collaboration and plan review
Julie Watkins, Center Director Neil Willems	YMCA of the Rockies	Collaboration and plan review
Nobel Underbrink	Northern CO Water Conservancy District	Collaboration and plan review
Gina Hallisey, Forest Mgmt.	Legacy Park Ranch	Collaboration and plan review
Chris White, Structure Protection Specialist Rod Moraga, Fire Behavior Analyst Mark McLean, GIS Project Manager	Anchor Point Group	Development of CWPP document. Fire behavior and community hazard/ risk analysis; set hazard mitigation actions and priorities. Establishment of fuels treatment project areas.

STUDY AREA OVERVIEW

Grand FPD No. 1 is located approximately 70 miles west of Denver, Colorado and comprises 94,282 acres (147 square miles), stretching south of Grand Lake, Colorado to just north of Tabernash, Colorado. The study area is accessed via US Highway 40 from the west and via Highways 34 or 125 from the north.

This area is classified under the Montane (8,000-9,500 ft) and Sub-alpine (9,200-11,000 ft.) life zones of the western slope of the Central Rockies of Colorado.[1] The dominant vegetation in the study area is lodgepole pine (*Pinus contorta*), often mixed with other conifers, which vary in coverage from open stands to dense forest. Most of these stands are mature or decadent, and coverage variation is due primarily to insect mortality and human intervention (mechanical thinning). Insect mortality is very high in conifer stands throughout the study area. Along stream corridors and drainages, conifers are intermixed with riparian vegetation, primarily shrubs. The study area also contains significant stringers and patches of quaking aspen (*Populus tremuloides*) and various species of sage (genus *Artemisia*).

For the purposes of this project, 24 distinct communities were identified, representing the most densely populated areas in the study area. Each community exhibits certain dominant hazards from a wildfire perspective. Fuels, topography, structural flammability, availability of water for fire suppression, egress and navigational difficulties, as well as other hazards both natural and manmade, are considered in the overall hazard ranking of these communities.

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 the promotion of extreme fire behavior.

The community-level assessment has identified 5 of the 24 communities in the study area to be at extreme or very high risk. In these communities, a parcel-level analysis should be implemented as soon as possible to ensure the ongoing safety of residents and survivability of structures. Please refer to the graphics on the following pages for a color-coded hazard ranking reference.

The methodology for this assessment uses the WHR community hazard rating system that was developed specifically to evaluate communities within the WUI for their relative wildfire hazard. 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.**

In addition to these 24 communities, 3 “areas of special interest” (ASI) have been identified: Shadow Mountain Guest Ranch, Three Lakes Sanitation, and the C Lazy U Guest Ranch, indicated in gray on the map below- **see figure 1**. Although these areas may not include residences, they contain critical infrastructure, buildings, and/or other structures that necessitate serious attention from a fire mitigation standpoint.

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

Table 2. Grand No.1 Community Hazard Ratings

1. Bussy Hill	13. Granby Ranch / Sol Vista
2. Winter Park Highlands	14. Highway 125
3. Homestead Hills	15. Idle Glenn
4. Carol Linke Tracts	16. Innsbruck
5. Sunny Shore Park	17. Joslin Ranch
6. C Lazy U Homestead	18. Legacy Park
7. Mount Chauncey	19. Ridge Estates
8. Scan Loch	20. Val Moritz / 10 Mile
9. Shadow Mountain Ranch	21. Walden Hollow / Ouray Ranch
10. Still Water	22. Granby Mesa
11. Trail Creek	23. Lake Shore
12. Alpine Acres	24. Sunset Point

Figure 1. Hazard Ranking of Communities in the Study Area

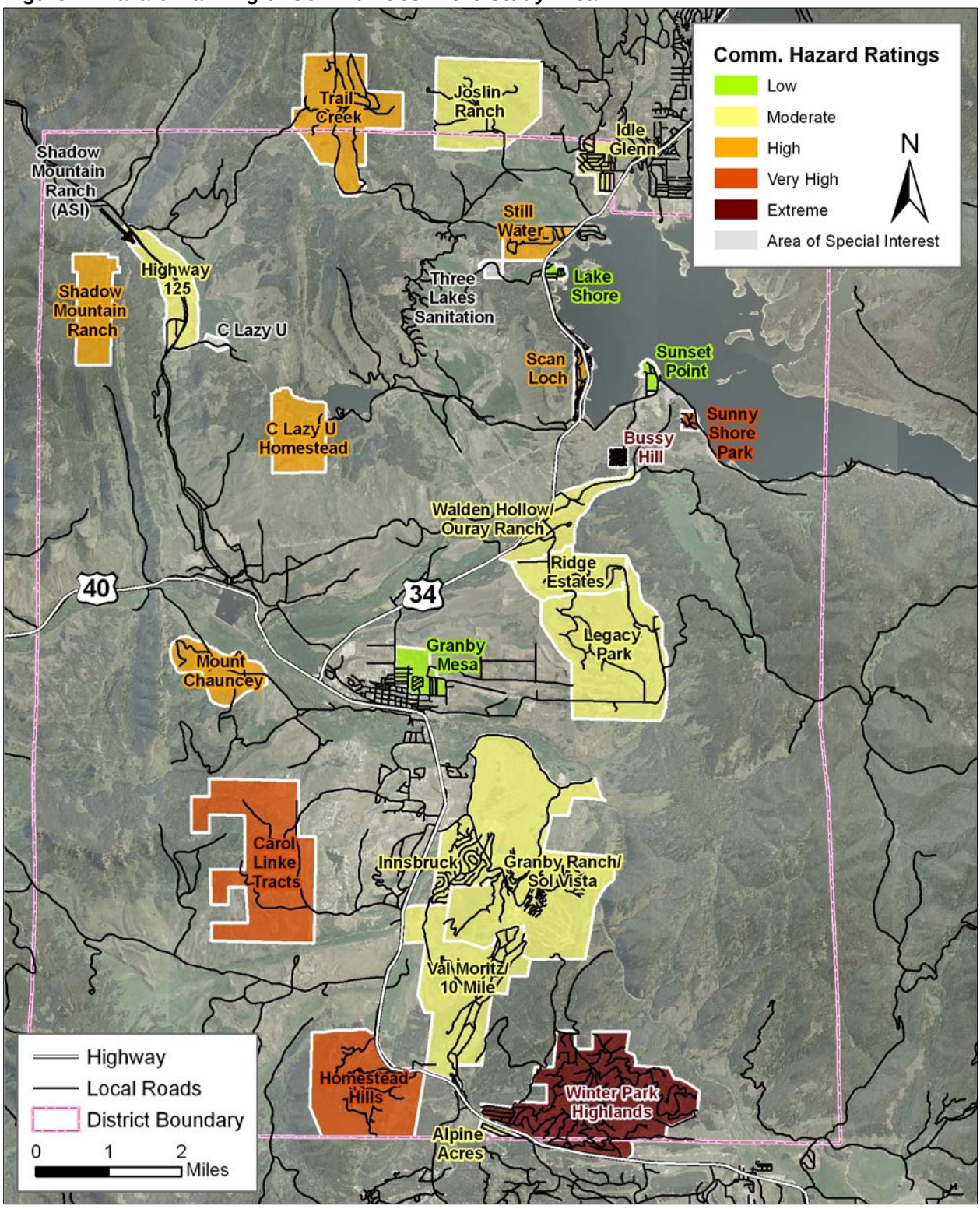
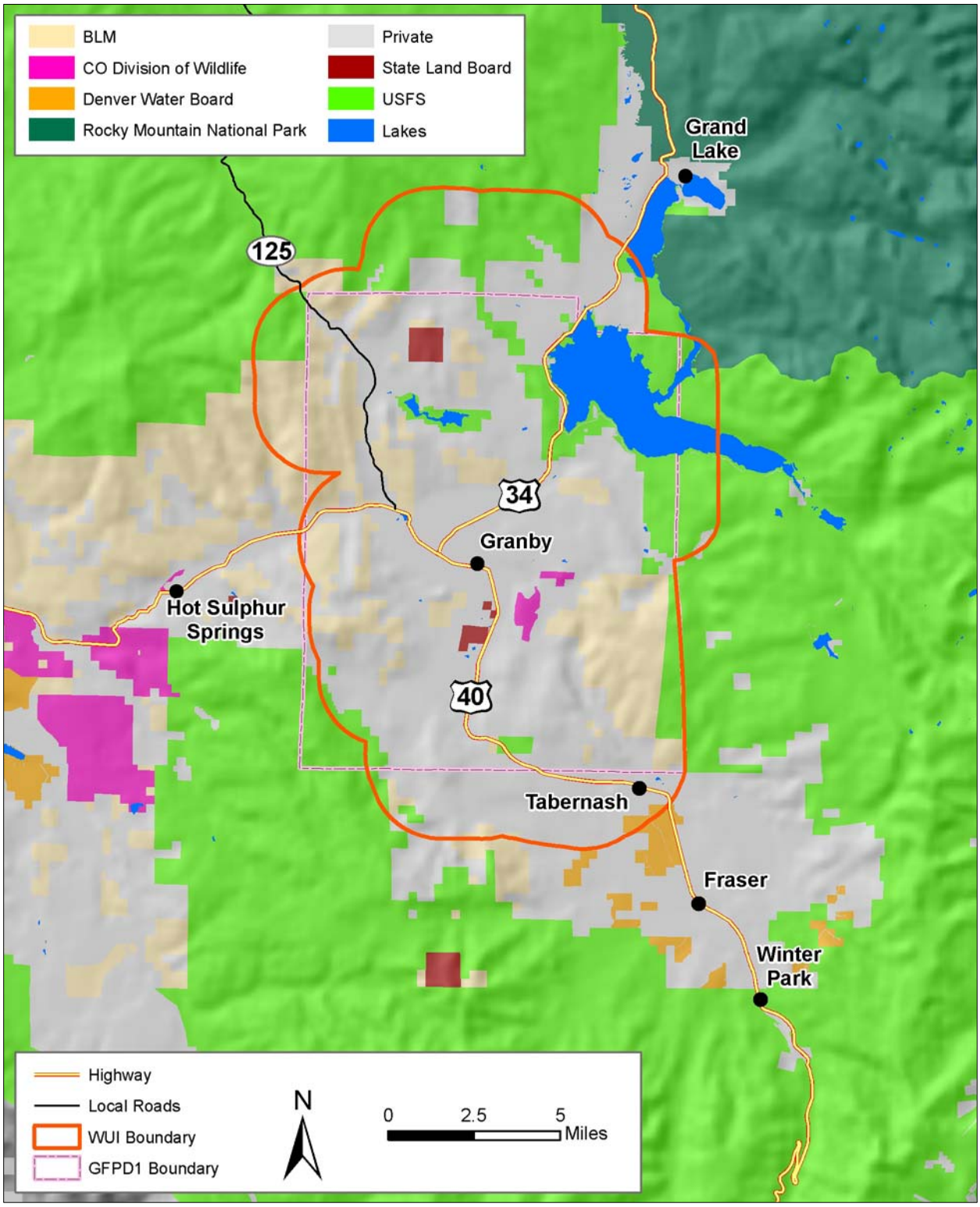


Figure 2 shows ownership boundaries within the study area. This information is used to identify existing and potential stakeholders and to guide fuels project placement.

Figure 2. Grand FPD No.1 Ownership Map



As a reference for the rest of this document, please see **Figures 3** and **4**, which show the general topography of the area. These graphic representations of the landforms within the study area (slope and elevation) will be helpful in interpreting other maps in this report.

Figure 3. Slope

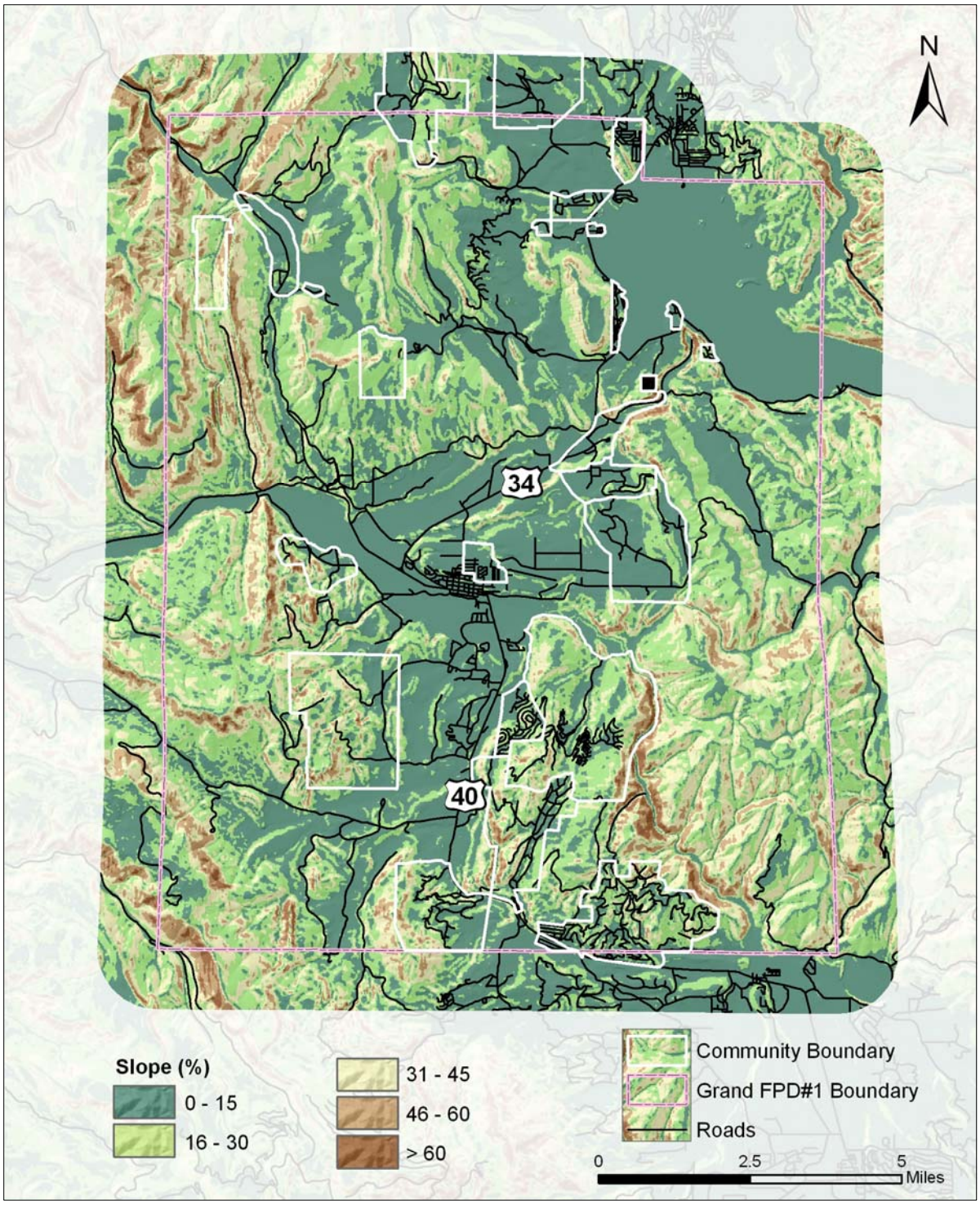
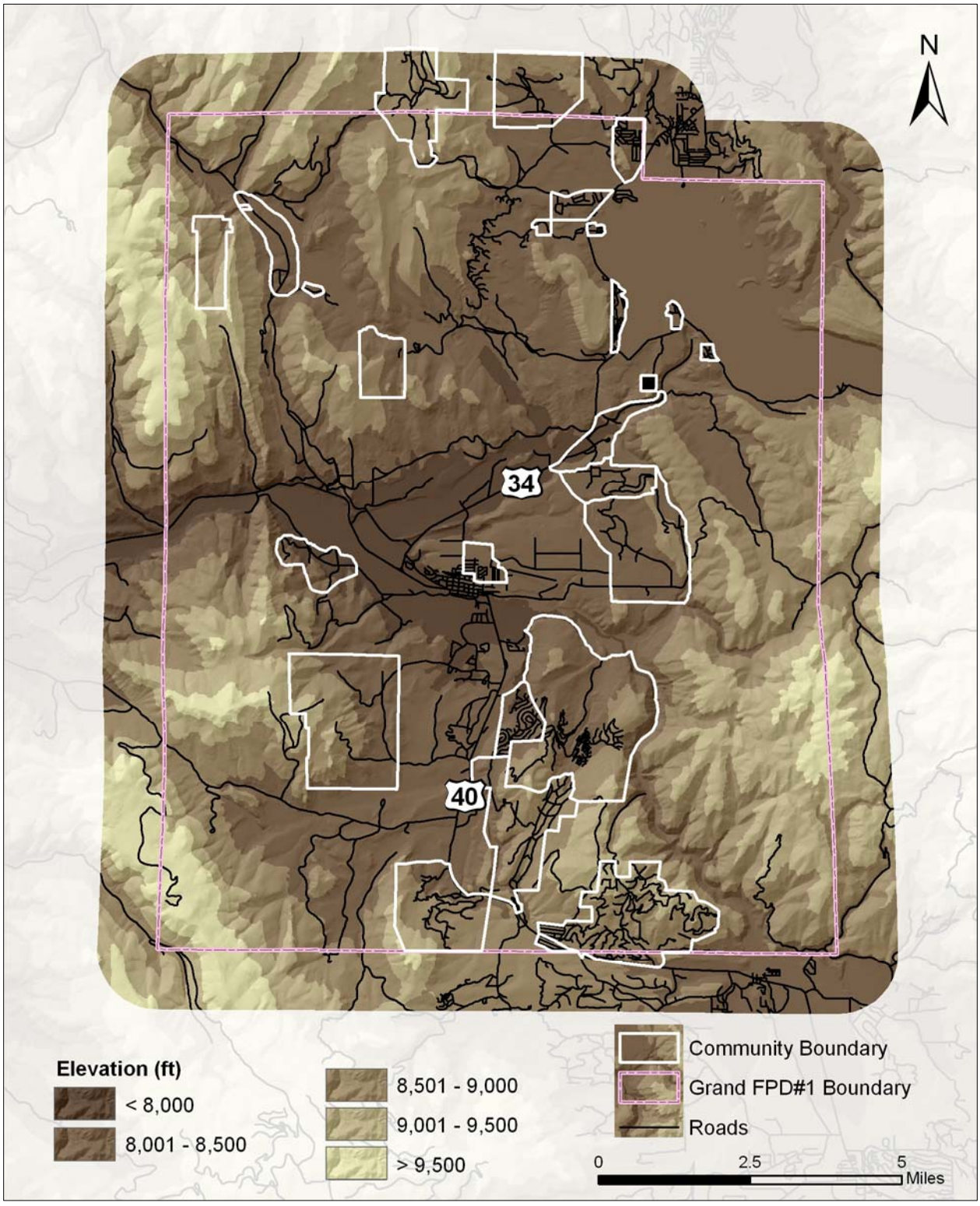


Figure 4. Elevation



VALUES AT RISK

Life Safety and Homes

The Grand FPD No. 1 study area is, for the most part, a rural area, with the exception of the town of Granby. The relatively low ratio of residents to housing units reflects the fact that approximately 80% of the single-family homes in the study area are second homes. Construction of additional housing units is ongoing throughout the study area, and the number of residents and visitors is expected to increase. With a population increase of 5.9% between 2000 and 2003, Grand County, in which the study area is located, is the 19th fastest-growing of Colorado's 63 counties.[2] From January through July of 2007, 341 new building permits for single-family homes were issued in Grand County.[3] As the demand for building sites increases, building in remote mountain areas with difficult access has become a growing concern from a wildfire perspective.

The hazard assessment identified two of the communities in the study area – Winter Park Highlands and Bussy Hill – to be extreme hazard areas. Additionally, a third community – Sunny Shore Park – has been identified as a very high hazard area. Under extreme burning conditions, there is a likelihood of rapid increases in fire intensity and spread in these communities, 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 serious threat to life safety, due to poor egress, and the likelihood of heavy smoke, heat, and/or long response times from suppression resources.

Most of Grand County is vulnerable to some form of natural disturbance, and wildland fire is one of the main concerns. 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.

Cultural Sites

Although no cultural/historic sites were identified in surveys returned by stakeholders for this project, there are historic buildings in the study area that could be threatened by wildfire. It is likely that buildings of historic value are located on some of the larger parcels in the study area. Landowners should be contacted, and where possible, the locations of historic properties should be included in the fire department's Wildland Fire Pre-attack Plan.

Recreation and Lifestyle

Approximately 75% of the land in Grand County is publicly owned. A large portion of the study area is included in the Arapaho National Forest, which ranks among the top National Forests for year-round recreational use. Sol Vista Basin at Granby Ranch, one of the fastest growing ski areas in the region, is located within the study area. Snowmobiling, snowshoeing, and cross-country skiing are an important source of the income in the county during the winter months. There are two commercial Nordic ski areas in the Fraser Valley.

[2] http://www.epodunk.com/top10/countyPop/coPop6.html

[3] http://socds.huduser.org/permits/index.html

Although not in the study area, Winter Park is one of Colorado's main ski destinations in the winter, and is also a major mountain bike destination in the summer. This level of recreational use effects the entire Frasier Valley including the study area.
Other popular summer recreation activities in the study area include hiking, fishing, camping, river rafting, and backpacking. Residents who live here have a keen appreciation for their natural environment. Indeed, recreation and the natural beauty of the area are frequently quoted as key reasons local residents have chosen to live in the study area.

Environmental Resources
The Grand FPD No. 1 study area has a mix of private and public lands. The area has a long history of timber harvesting, railroad, and recreational use. Preserving environmental resources in such a heavy use area will present an ongoing challenge to both public and private land managers. Fire has the potential to cause numerous negative effects to environmental resources. However, fire is also a natural component of the disturbance regime and cannot be excluded from the ecosystem without consequence.

Watershed Concerns
Numerous streams, lakes, and tarns exist in the study area. The major watersheds—the Fraser River watershed and the Upper Fraser River Composite—were both rated as Class III (non-functional) in the Arapaho National Forest watershed-condition assessment. The 1997 revision of the Land and Resource Management Plan for the Arapaho National Forest emphasizes the need to improve conditions in these watersheds. Loss of soil stability and erosion resulting from high-intensity fires, which will in turn lead to increased silting, represents a threat to efforts to improve conditions in these critical watersheds. Heavy fire retardant use during suppression efforts may also result in detrimental effects to watersheds.

Threat of Insects and Disease to Forests
The forests in the study area are currently experiencing insect losses of epidemic proportions. In some areas public land managers have chosen to accept insect and disease losses unless they threaten other ownership or cause unacceptable resource damage. In other areas, particularly Wildland Urban Interface (WUI) areas, private landowners are aggressively fighting insect losses through removal of infected trees and chemical control methods. In spite of these efforts, mortality, especially in pine stands, is increasing rapidly. For some years following death, conifers will remain standing with red (dead) needles. It is widely believed in the fire community that red-needle snags (standing dead trees) contribute to increased fire intensity. Regardless of the level of mortality, or whether or not red-needle snags result in increased fire intensity, fires in stands historically tend to be stand replacement fires, in which tree mortality is nearly 100%. This will allow for a new forest to regenerate over time, and for other species, especially aspen, to establish in the newly disturbed areas.

Wildlife
Residents are in agreement that the preservation of wildlife is important to the quality of life of the area. The Arapaho National Forest provides critical habitat to several indicator species and species of concern, including Colorado River Cutthroat Trout, Boreal Toad, Northern Leopard Frog, Townsend's Big-Eared Bat, and others.[4] Habitat effectiveness, an important indicator for wildlife issues, 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 that 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).[5] The USFS has made improving habitat effectiveness and ensuring the viability of these species one of their forest-wide objectives.[6] Wildfire, especially severe wildfire, can have significant adverse effects on habitat effectiveness and species viability.

The Grand FPD No.1 CWPP process is in concert with the guiding principles of environmental stewardship. Through public involvement, local support and a regional perspective, fuels reduction recommendations have been made in this document that will protect and greatly enhance values in the study area.

Commerce and Infrastructure
The Fraser Valley economy is tourism-based and highly seasonal in nature. Jobs in the retail and service sector dominate the workforce, with ski areas and guest ranches being among the largest employers. A large wildfire damaging the natural environment could have a significant impact on the fiscal stability of the study area.

[4] Arapaho and Roosevelt National Forests and Pawnee National Grassland 1997 Revision of the Land and Resource Management Plan, Chapter 1, pages 28-29.

[5] Peak to Peak Community Indicators Project 2003. ©2003, Peak to Peak Healthy Communities Project

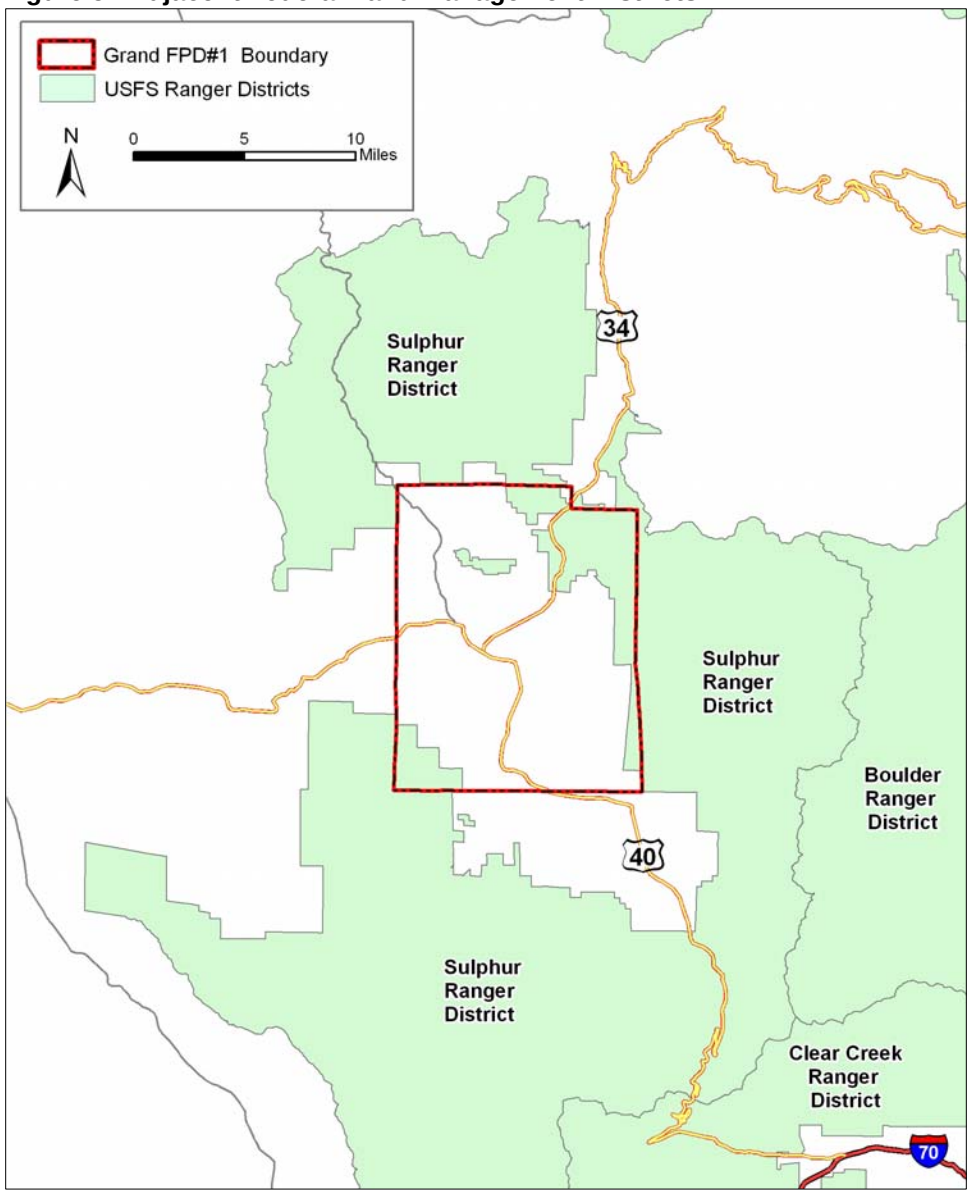
[6] Arapaho and Roosevelt National Forests and Pawnee National Grassland 1997 Revision of the Land and Resource Management Plan, Chapter 1, page 17, Objectives 44-45.

CURRENT RISK SITUATION

The Fraser Valley and the Town of Granby are listed in the Federal Register as areas at risk from wildfire.[7]

The USDA Forest Service fire regime and condition class evaluation of forest stands in the study area shows that historic fire regimes have been altered moderately to substantially- see **Figure 7**.[8]
The nearest USFS lands- see **Figure 5**, in the Sulphur Ranger District, report low to moderate levels of fire activity (128 fires in 29 years, for an average of 4.4 fires per year).

Figure 5. Adjacent Federal Land Management Districts



[7] http://www.forestsandrangelands.gov/resources/documents/351-358-en.pdf
[8] Please see the *Fire Regime and Condition Class* section of this report for details.

Fire occurrences for the Sulphur District were calculated from the USDA Forest Service Personal Computer Historical Archive for the twenty-year period from 1977-2006. This calculation does 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- see **Figure 6**.

Figure 6. USFS Fire History 1977-2006

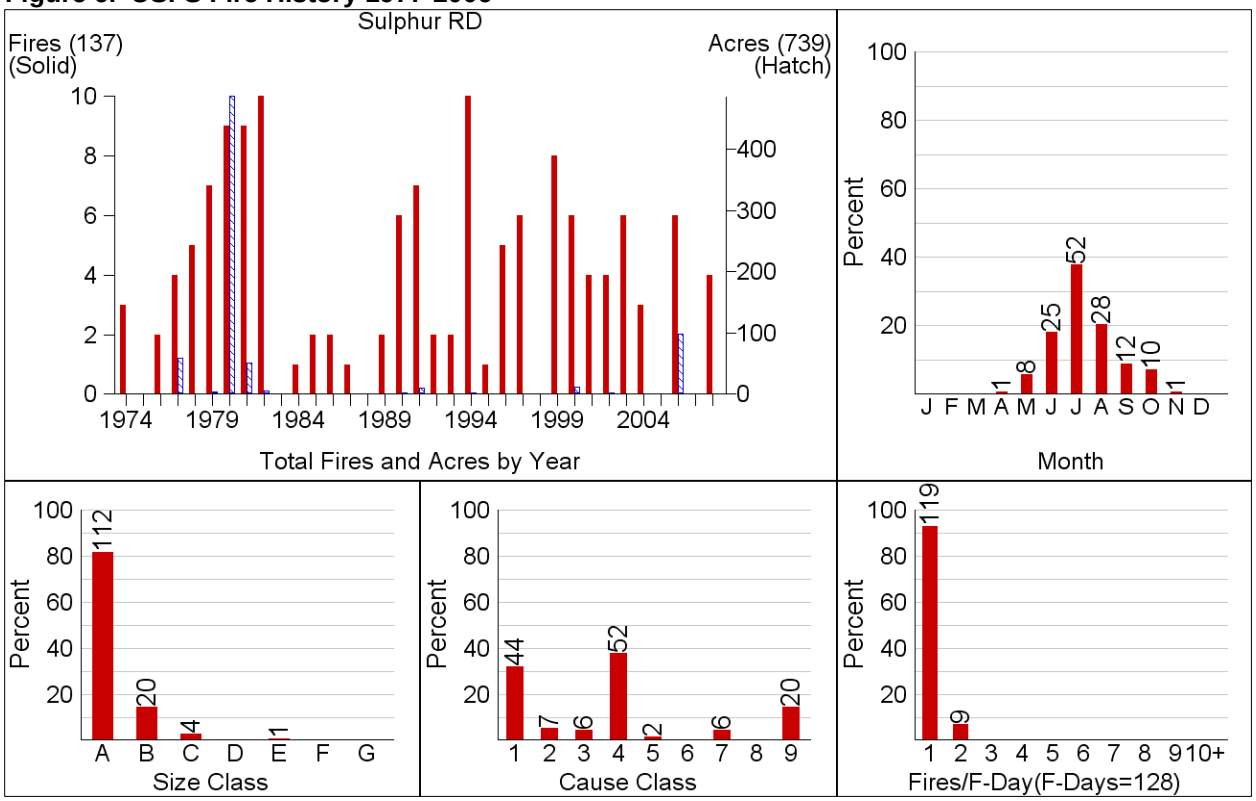


Figure 6a (upper left above) shows the number of fires (red bars) and the total acres burned (blue hatched bars) in the Sulphur Ranger District each year. While the number of annual fires ranges from one to ten, there is little year-to-year pattern to the variation. The number of fires steadily increased between 1977 and 1982, only to be followed by a seven-year period during which less than three fires per season were reported. From 1990 to 2006 fire occurrence per year appears to be random. Acres burned per season were consistently less than ten until 2006, when the Brinker Fire (an arson fire) burned 94 acres in the district. The only other fire in the period to burn more than 10 acres was the Cabin Creek fire in 2000, which burned 12 acres. It is interesting to note that in 2002 (the most severe fire year in this period for the state of Colorado) less than two acres burned and the number of fires was less than half that of the peak years of 1982 and 1994.

Figure 6b (upper right above) shows the percentage and number of fires between 1977 and 2006 occurring in each month of the year. Almost twice as many fires occurred in July than the next most active months, August and June. Fire occurrences were also relatively common in the fall, with September and October both reporting roughly half as many fire starts as June and August. No reported fires occurred between the months of December and March, which reflects the climate conditions and high elevations in this area.

Figure 6c (lower left above) shows the size class distribution of fires. Approximately 98% of the reported fires (126 of 128) were less than ten acres in size. This statistic reflects the fact that throughout the western US, the vast majority of fires are controlled during initial attack.

Figure 6d (lower middle above) shows the number of fires caused by each factor. As shown in this graph, the most common cause for ignitions is campfires (36%); the next most common cause is lightning (33%). If the “miscellaneous cause” category is removed, human causes represent a significant majority of ignitions (61% human-caused and 39% naturally-caused). It should be noted that even these numbers suggesting the predominance of human starts are likely to be conservative, since this data is only for national forest areas lacking the concentrated development and other human-related risk factors present in the portions of the study area where private land is dominant.

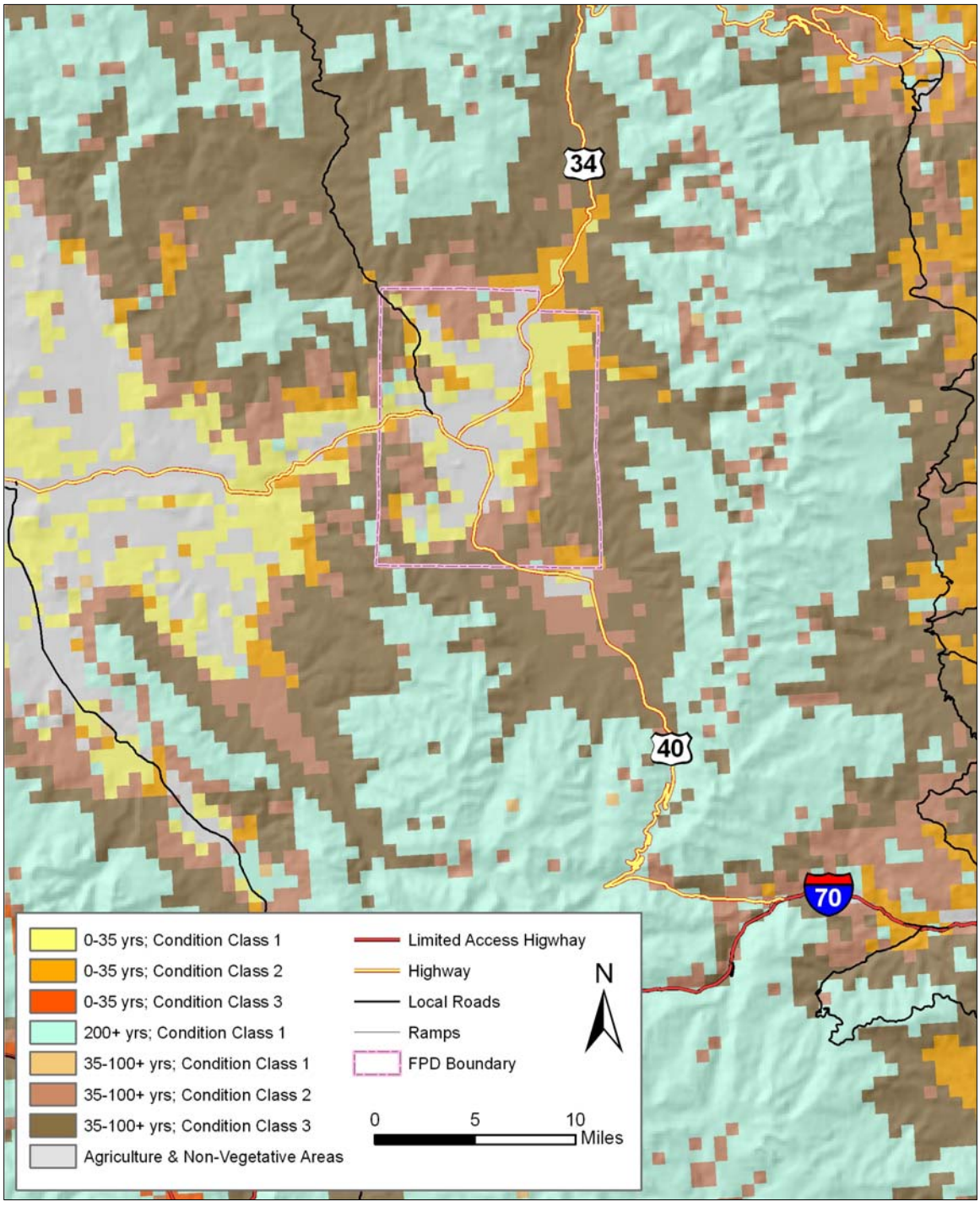
Figure 6e (lower right above) shows the number of fire starts for each day that a fire start was recorded. Most fires (110) occurred on days that only had one fire start. Less than 1% of fire days had two or more fire starts in the twenty nine-year period. These statistics suggest that multiple start days are a rare occurrence, compared to fire days with a single ignition.

PLEASE NOTE: Residential development in the WUI is increasing in the study area. As the density of structures and the number of residents increases, potential ignition sources will multiply. Additionally, beetle-kill trees with needles still on the branch are abundant in the study area. Unless efforts are made to mitigate the increased likelihood of human ignition spreading to the surrounding wildland fuels, the probability of a large wildfire occurrence will continue to increase.

FIRE REGIME CONDITION CLASS

Fire Regime Condition Class (FRCC) is a landscape evaluation of expected fire behavior based on 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 of this report), which provide the fire behavior potential analysis for expected flame length, rate of spread, and crown fire development.

Figure 7. Condition Class Map



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 such as the loss of key ecosystem components (soil, vegetation structure, species) or alteration of key ecosystem processes (nutrient cycles, hydrologic regimes). Consequently, the FRCC is an index of hazards to the status of many components (e.g., water quality, fish status, wildlife habitats, etc.). **Figure 7** above displays graphically the return interval and condition class of the study area.

Deriving FRCC entails the comparison between current conditions and an 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 an indicator of potential 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 one would expect that fire size, intensity, and burn patterns would also be subsequently altered if a fire occurred.

Furthermore, it is assumed that if these basic fire characteristics have changed, then it is likely that there would be subsequent effects to those ecosystem components that had adapted to the historical fire regimes. As used here, the potential of ecosystem effects reflects the probability that key ecosystem components may be lost if a fire were to occur within the study area. It should be noted that key ecosystem components can be represented by virtually any attribute of an ecosystem (for example, soil productivity, water quality, floral and faunal species, large-diameter trees, snags, etc.).[9]

The categories of condition class used to qualitatively rank the potential of effects to key ecosystem components are listed in the table on the next page.

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

Table 3. Condition Class Descriptions

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

The populated portions of the study area are primarily classified under Condition Classes 2 and 3. By definition, historic fire regimes have undergone moderate to substantial changes. As a result, ***wildfires in this study area are likely to be larger, more severe and have altered burn patterns from those expected under historic fire regimes.***

FIRE BEHAVIOR POTENTIAL

From the fire behavior potential analysis carried out as a part of this study (see **Appendix A** for detailed findings), the fire behavior potential in the study area was mapped. These maps 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.

Figures 8, 10 and **12** show the fire behavior potential maps for moderate burning conditions. They graphically display potential crown fire activity, flame length, and rate of spread generated by the FlamMap 3.0 fire behavior modeling software (see **Glossary**). Weather observations for a 22-year period (1985-2007) from the Porcupine Creek Remote Automated Weather Station (RAWS) site were used to derive relevant wind and fuel moisture variables for inclusion in FlamMap. The moderate conditions class (16^{th} to 89^{th} percentile) was calculated for each variable (1 hour, 10 hour, and 100 hour fuel moisture, woody fuel moisture, herbaceous fuel moisture, and wind speed) using the Fire Family Plus (see **Glossary**) computer software package. This weather condition class most closely represents an average fire season day.

The extreme conditions maps, **Figures 9, 11** and **13**, were calculated using ninety-seventh percentile weather data. This means that the weather conditions of the most severe fire weather days (sorted by Spread Component) in each season for the twenty two-year period were used for this analysis. It is reasonable to assume that similar conditions may exist on at least three to five days of the fire season during an average year. In fact, during extreme years such conditions may exist for significantly longer periods. Even these calculations may be conservative compared to observed fire behavior. For a more complete discussion of the fire behavior potential methodology, please see **Appendix A**.

FIRE BEHAVIOR MODELING LIMITATIONS AND INTERPRETATION

This evaluation is a prediction of likely fire behavior, given a standardized set of conditions and a single point-source ignition in every cell (each 10 x 10 meter area). It does not consider cumulative impacts of increased fire intensity over time and space. The model does not calculate the probability that a wildfire will occur. It assumes an ignition occurrence for every cell. These calculations may be conservative (under-predict) compared to observed fire behavior.

This model can be conceptually overlaid with the Community Wildfire Hazard Ratings (WHR) or other values at risk identification to generate current and future "areas of concern," which are useful for prioritizing mitigation actions. This is sometimes referred to as a "values layer." One possibility is to overlay the fire behavior potential maps with the community hazard map **(Figure 1)** in order to make general evaluations of the effects of the predicted fire behavior in areas of high hazard value (that is, areas where there are concentrations of residences and other man-made values). However, one should remember that the minimum mapping unit used for fire behavior modeling is one acre; therefore, fine-scale fire behavior and effects are not considered in the model. Additionally, weather conditions are extremely variable, and not all combinations are accounted for. The fire behavior prediction maps are best used for pre-planning and not as a stand-alone product for tactical planning. If this information is used for tactical planning, fire behavior calculations should 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. Please see **Appendix B** for a further discussion of the WHR methodology.

FLAME LENGTH

Figures 8 and **9** on the following pages display the flame length predictions for the two weather scenarios. Flame length is a proxy for fire intensity. Note that flame length is considered to be the entire distance from the base of the flame to the tip, irrespective of angle, not simply the flame height above the ground. In high wind conditions, very intense flames (high flame lengths) are entirely possible, even though flames remain relatively close to the fuel bed.

The legend boxes display flame length in ranges which are meaningful to firefighters. Flame lengths of four feet and less are deemed low enough intensity to be suitable for direct attack by hand crews, and therefore represent the best chances of direct extinguishment and control. Flame lengths of less than eight feet are suitable for direct attack by equipment such as bulldozers and tractor plows. Flame lengths of eight to 12 feet are usually attacked by indirect methods and aircraft. In conditions where flame lengths exceed 12 feet, the most effective tactics are fuel consumption ahead of the fire by burnouts or mechanical methods. Although indirect fireline and aerial attack are also used for fires with flame lengths of greater than 12 feet, as flame lengths increase, the effectiveness of these tactics decreases, and their use is generally designed to slow rates of spread and reduce fire intensity, especially in areas where values at risk are concentrated.

In the moderate fire weather scenario, the model predicts that fires in most of the populated portions of the WUI could be attacked directly by either hand crews or equipment. Under the extreme fire weather scenario, high to extreme flame lengths are predicted in most of the areas covered by the WUI communities, with the exception of a few communities located primarily in the lower elevations of the central portion of the study area.

Even in these areas, the predicted flame lengths indicate that fires are likely to be too intense for direct attack by hand crews. Nonetheless, hand crews would be vital for structure preparation, triage, and the construction of indirect fire line. Under extreme weather and fuel moisture conditions, fire intensity in many of the WUI communities could be a serious issue, and fire control would be difficult to establish and maintain.

Figure 8. Flame Length Predictions (Moderate Weather Conditions)

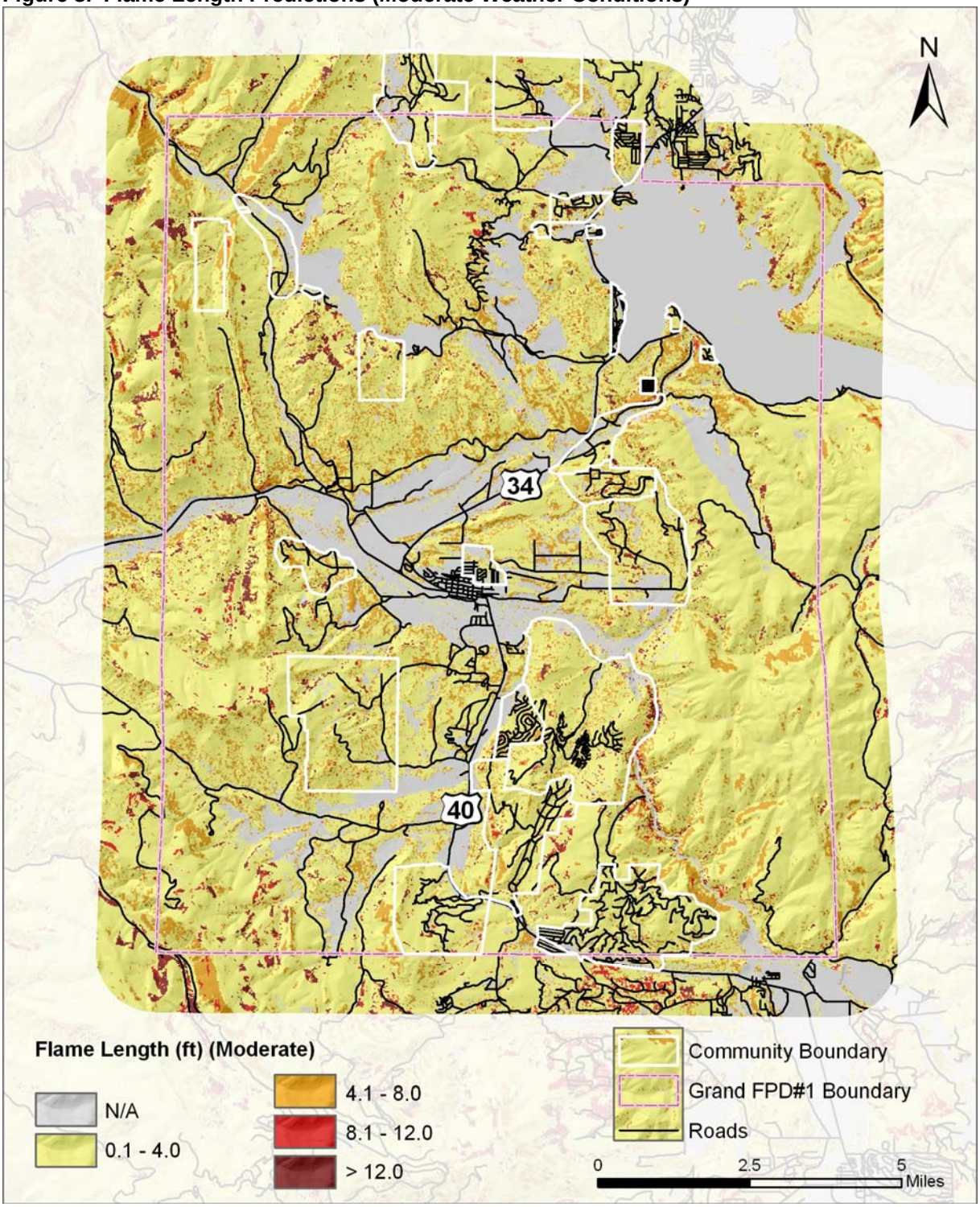
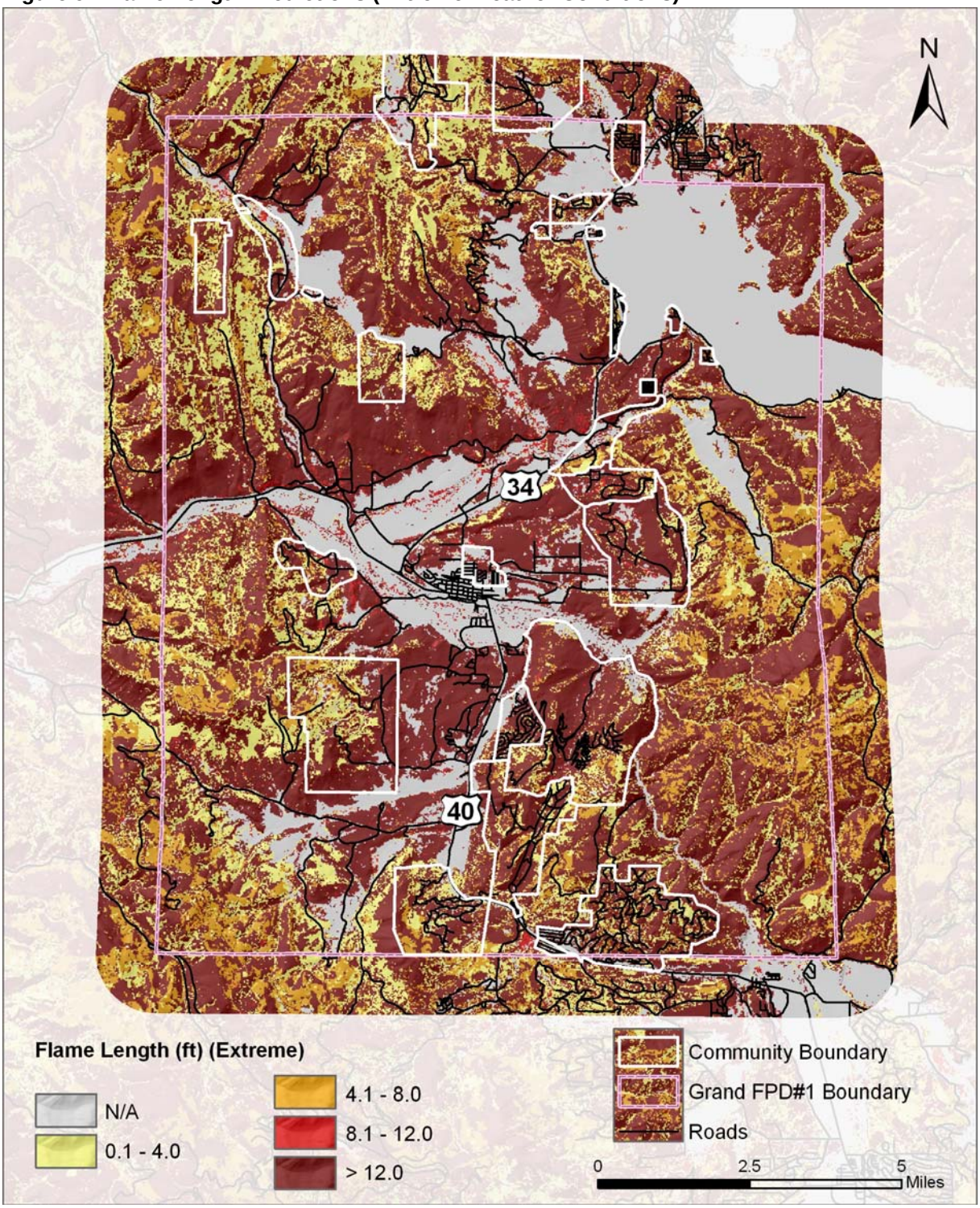


Figure 9. Flame Length Predictions (Extreme Weather Conditions)



RATE OF SPREAD

Figures 10 and **11** show the predicted rates of spread for the moderate fire weather and extreme fire weather scenarios, respectively. Rates of spread are expressed in chains/hour. A chain is a unit of measure commonly used by loggers and firefighters. It is equal to 66 feet. Therefore, one mile equals 80 chains. Rates of fire spread are influenced primarily by wind, slope grade, fuel type/continuity, and fuel sheltering from the wind.

Of particular importance to wildfire mitigation and suppression in the complicated, often steep topography of the study area is the fact that fire – unique among forces of nature – moves faster uphill than downhill. When all other factors are equal, fire moves disproportionally faster uphill on a slope of 30% than it does on flat terrain. In areas where high to extreme rates of spread (ROS of >40 chains/hour or ½ mile per hour) are predicted, it is possible that fires will spread faster than residents can escape, creating extremely dangerous conditions for firefighters and evacuating residents. High rates of spread also make suppression efforts less effective and increase the tactical complexity of the incident.

In the moderate fire weather scenario, low to moderate rates of spread are predicted in the WUI communities where dense stands of conifers are the dominant fuel. This effect is due primarily to sheltering of surface fuels from the wind. In areas where grasses are dominant with little or no sheltering overstory, rates of spread are predicted to be very high, even under moderate burning conditions.

In the extreme fire weather scenario, higher rates of spread are predicted in most of the WUI communities in the study area, because the sheltering effects of the canopy are overridden by more extreme fuel moisture conditions. The model shows rates of surface spread can be expected to increase even in the dense canopy, making fire control efforts more difficult and requiring control and suppression tactics to be implemented further ahead of the fire.

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

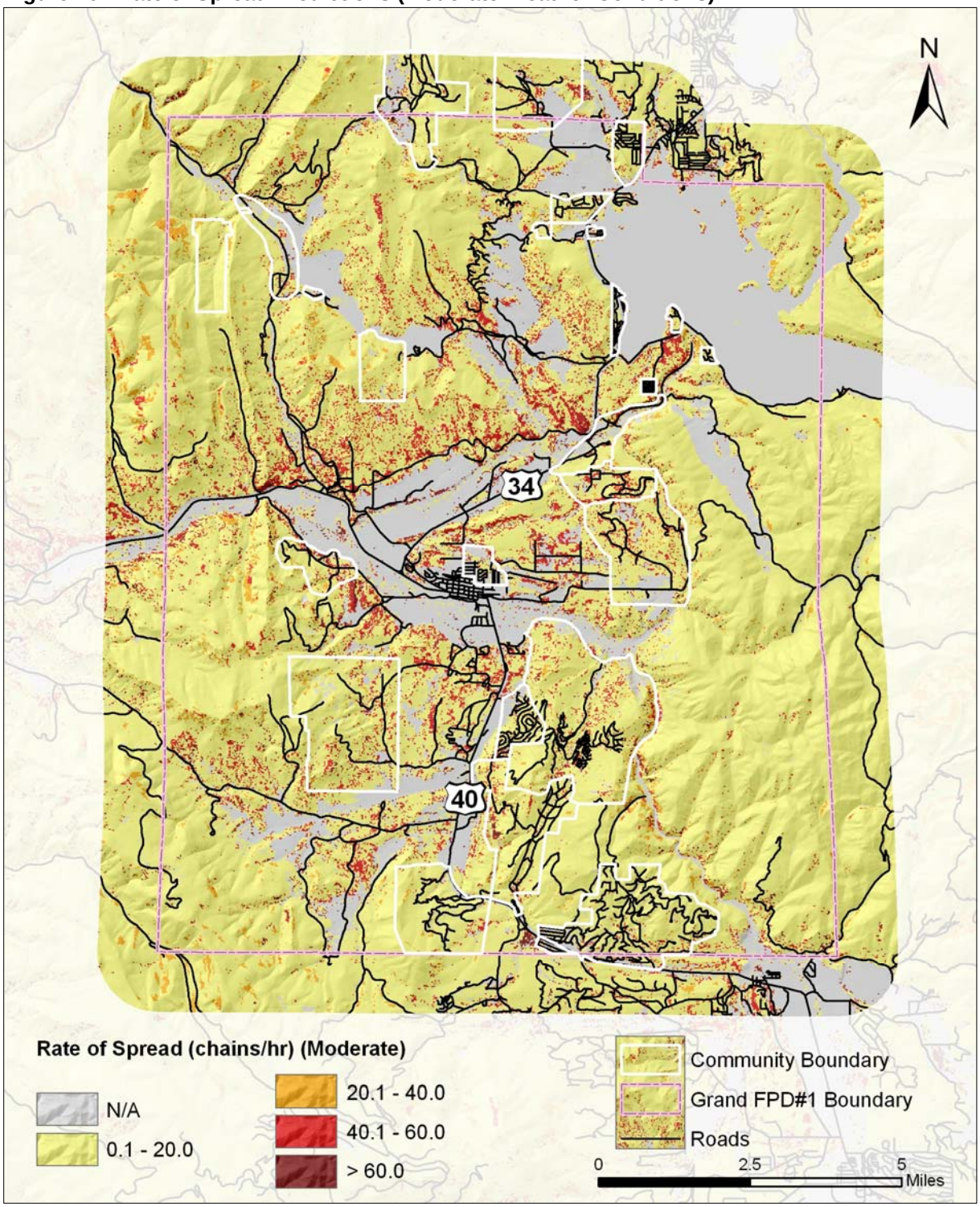
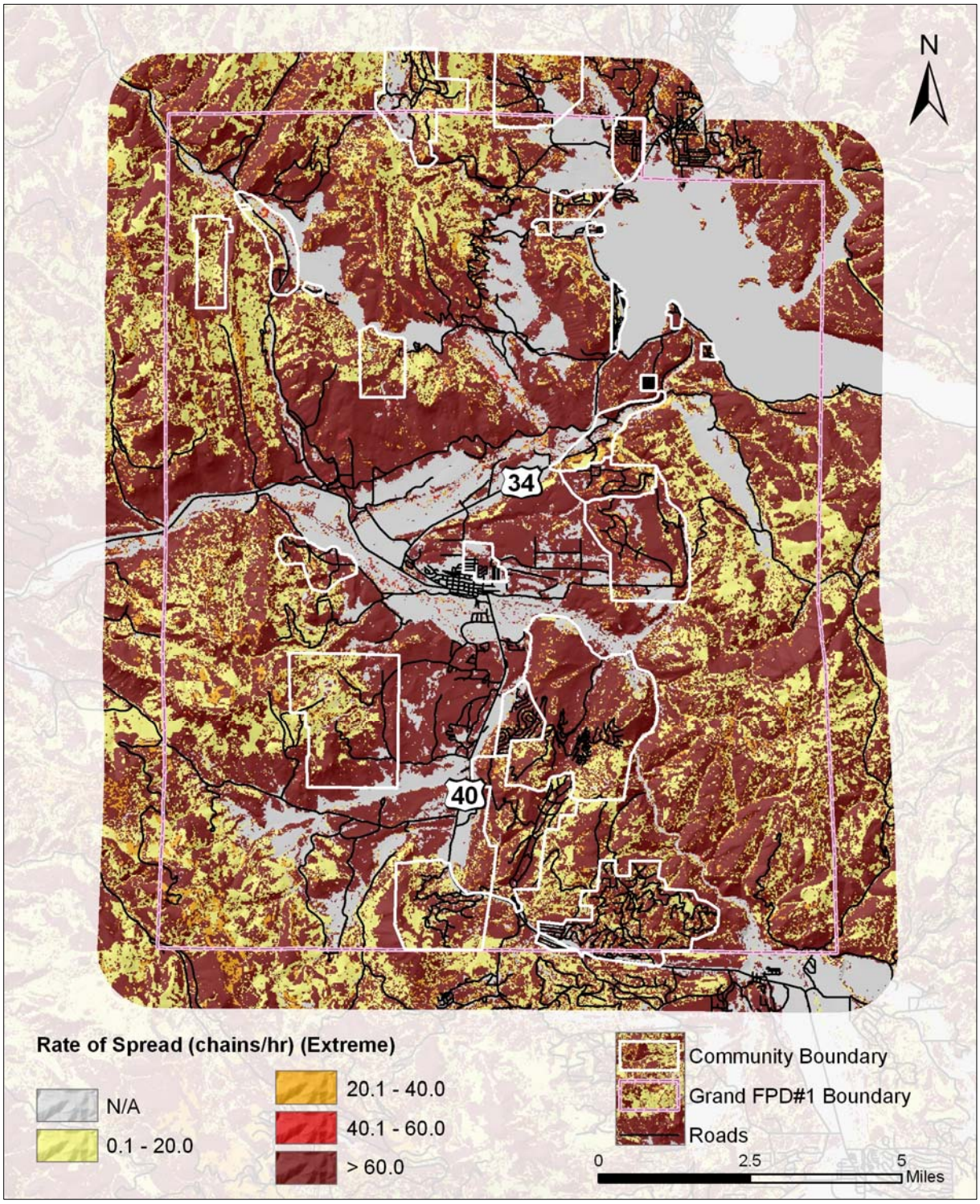


Figure 11. Rate of Spread Predictions (Extreme Weather Conditions)



CROWN FIRE ACTIVITY

The Crown Fire Activity maps (**Figures 12** and **13**) display the potential for fires to move from the surface into the canopy of trees and shrubs. The likelihood of progression from the surface into the aerial fuels is displayed in four categories:

- **N/A** refers to areas where surface fires are unlikely to develop due to the lack of combustible fuels. These would include any area such as rock, ice, snow fields, water, sand, or some urban landscapes.
- The **surface fire** category covers areas where fires are expected to be limited to the surface fuels and lack the energy to initiate and sustain vertical development into the aerial fuels. Areas in which grass fuels without overstory plants are dominant fall into this category, regardless of the energy produced by the fire due to the lack of an aerial fuel bed. Areas covered by the **torching** category are expected to experience isolated combustion of the tree crowns in individual trees and groups of trees. In other words, individual or relatively small clusters of trees will be completely involved, but these fires lack the energy to initiate sustained horizontal movements (referred to as “runs” by fire fighters) through the crowns.
- The **active crown fire** category includes areas where sustained horizontal movements through tree crowns are expected. This category can be further subdivided into *dependent* or *independent* crown fire.
    - **Dependent crown fires** rely on the presence of surface fires to support aerial burning. Independent crown fires develop when aerial burning is sustained, without the need for associated surface fire.
    - **Independent crown fires** are rare and are associated with the most extreme fire behavior conditions. Current fire behavior models do not have the ability to predict independent crown fire development.

> ***All crown fires**, regardless of whether they are dependent or independent, represent extreme fire behavior conditions and are notoriously resistant to typical methods of suppression and control.*

Figure 12. Crown Fire Activity Predictions (Moderate Weather Conditions)

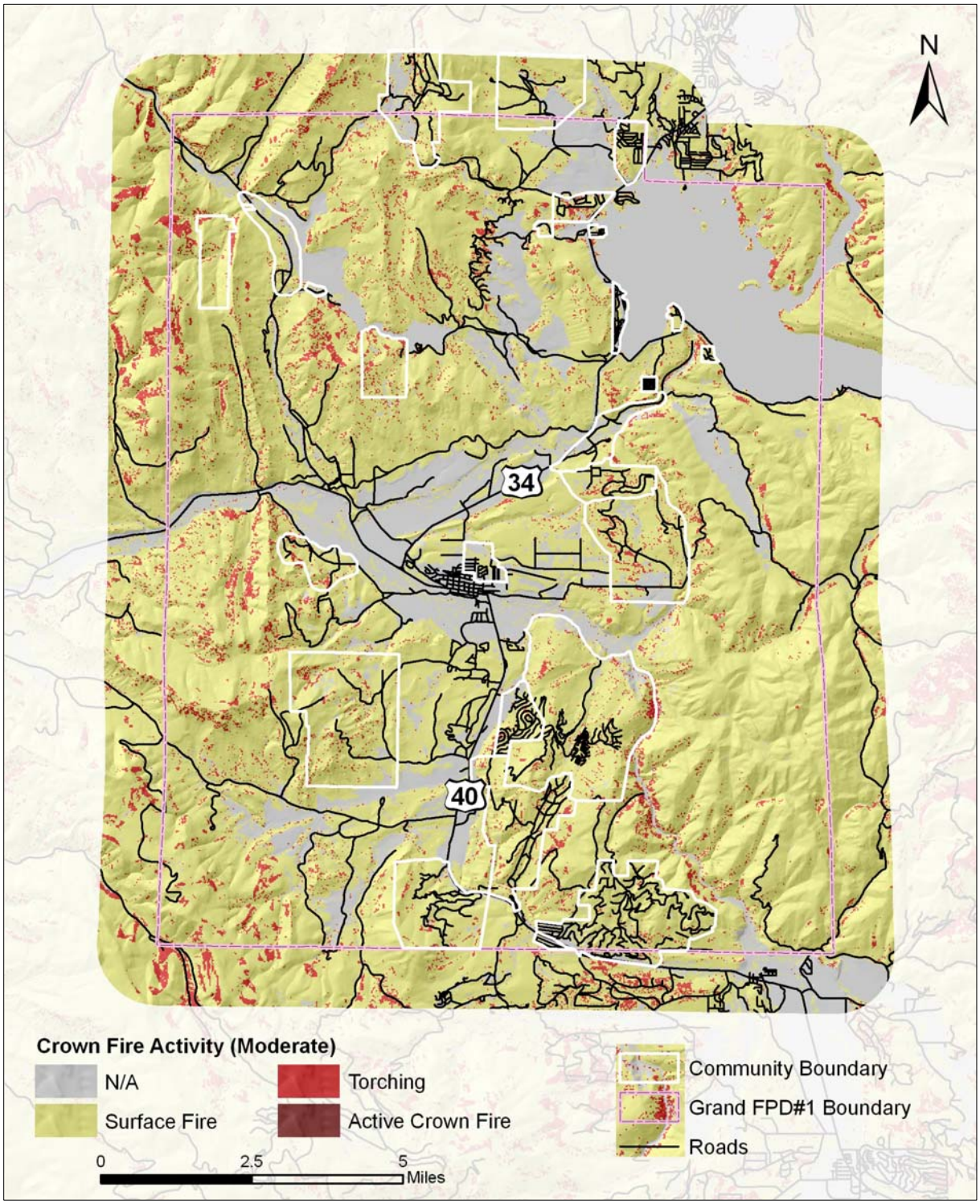
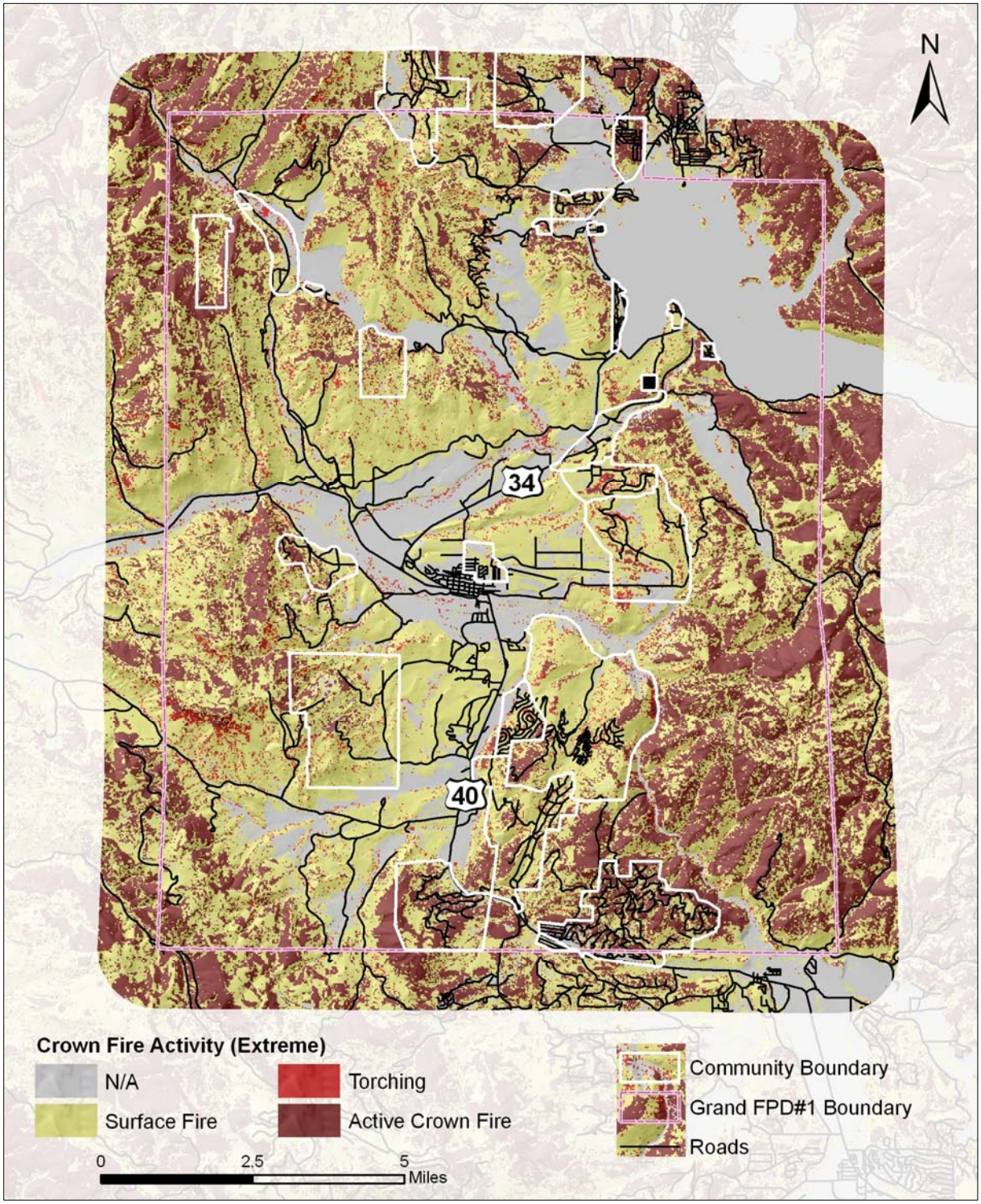


Figure 13. Crown Fire Activity Predictions (Extreme Weather Conditions)



SOLUTIONS AND MITIGATION

The local land management and fire management agencies have agreed upon priority actions. The following categories have been identified for the study area, and recommendations are provided for each. Although these categories are not ranked by priority, priority recommendations have been provided for specific tactical mitigation actions, where appropriate, within each category.

- Addressing and Evacuation
- Public Education
- Local Preparedness and Firefighting Capabilities
- Home Mitigation
- Fuels Modification Projects
- Water Supply
- Areas of Special Interest

ADDRESSING AND EVACUATION

Most of the communities within the Grand FPD No.1 have missing or inadequate street signage and/or addressing. This problem was especially notable in the following communities: Alpine Acres, Bussy Hill, Carol Linke Tracts, Homestead Hills, Idle Glenn, Legacy Park, Ridge Estates, Scan Loch, Sunny Shore Park, Trail Creek, Walden Hollow/Ouray Ranch, and Winter Park Highlands. This problem is also noted, where applicable, in the individual community descriptions in **Appendix B.**

In some parts of the study area, there are intersections with no street signs. The only address marker for many homes is a homemade marker. These vary widely in type and location, and some are difficult to identify as address markers. Most are not reflective and would be difficult to locate in dark or smoky conditions. In most of the communities, address markers are mounted on wooden poles or trees. Some of these are located in the middle of the yard rather that at the driveway or the structure. There are community driveways in the study area where multiple homes are accessed from a single driveway off the public road. Some of these have flagged addressing. Flagged addressing is a term that describes the placement of multiple addresses on a single sign, which services multiple structures located on a common access. Where flagged addressing exists, the marker placements are inconsistent, often difficult to read and in some cases confusing.

While residents may consider non-reflective wooden address signage to be decorative, it is an impediment to quick and effective response. Proper reflective signage is a critical operational need. The value of the time saved, especially at night and in difficult conditions, cannot be overestimated. Knowing at a glance the difference between a road and a driveway (and which houses are on the driveway) cuts down on errors and time wasted interpreting maps. This is especially true for volunteer operators who do not have the opportunity to train on access issues as often as career firefighters. Recommended specifications for address markers can be found in **Appendix D.**

GENERAL ADDRESSING RECOMMENDATIONS

- A program of replacing worn or difficult to read street signs should be developed. Include specifications and input from the county, developers, HOAs, and the Fire District.
- Every intersection and street name change should have adequate, reflective signage.
- Grouped addressing on community driveways should be replaced with reflective markers that indicate the proper road fork, where applicable, for each address. This system should be repeated at every place where the driveway divides and an individual driveway leaves the community driveway.
- For each home, reflective markers should be placed where the driveway leaves an access road and on the house itself. These may be in addition to, or in place of, existing decorative address markers. Consistency in height and placement should be stressed.
- Lot markers should be replaced with address markers as soon as a home has a certificate of occupancy.
- Where dead-end and private road markers occur, the addresses of homes beyond the marker should be clearly posted. This can be done with a group address marker, for example, “14391-14393 Highway 125.”
- Develop a public education campaign to advise property owners of the importance of proper street addressing and how to properly address their property.

RECOMMENDED EVACUATION ROUTE PROJECTS

Three projects have been identified which could serve as alternative evacuation routes and/or firefighter access routes to the primary access.

Priority level High: *Unnamed Dirt Road Connecting Winter Park Highlands to Sol Vista*. An unnamed dirt road running west and north from the intersection of Lions Creek and Callahan Way could be planned and improved as an emergency-only evacuation route from the northern portion of Winter Park Highlands. This road connects with a service road for the Sol Vista ski resort and runs back to the base area of the resort. The road would need to be inspected for suitability for passenger cars and pre-planned for emergency-only use because of gates. If the road proves to be appropriate, it should be maintained and fuels should be thinned to shaded fuelbreak standards. This is a high priority project due to the high density and hazardous conditions in the Winter Park Highlands community.

Priority level Moderate: *Joslin Ranch to Still Water.* The purpose of this project is to create an alternative escape route between the communities of Joslin Ranch and Still Water. Access to Joslin Ranch is off of Highway 34, going west on County Road 42. The recommended alternative escape route would also be along County Road 42, but instead of traveling to Highway. 34, would then go further west, and drop east into the community of Still Water on Grouse Road. This road will need to be maintained, which includes thinning fuels away from the roadside, and removing any dead trees along the side that may cut off access. Grassy areas should be mowed regularly. This additional escape route also benefits residents of Still Water by providing an additional way out if a fire were to block the access to Highway 34 along Grouse Road.

Priority level Moderate: *C Lazy U*. A road that connects C Lazy U homestead to the C Lazy U guest ranch could be a valuable secondary egress. It is recommended that this road be evaluated for its ability to act as an additional access point. If it is found to be acceptable, the road should be maintained. The area along the road should be mowed, trees should be thinned to shaded fuelbreak recommendations, and dead trees should be removed.

PUBLIC EDUCATION

The Grand FPD No. 1 study area is experiencing ongoing development. Increasing property values and the associated rise in the number of non-resident owners has resulted in a varied understanding among property owners of the intrinsic hazards associated with building in WUI areas. In addition to community and emergency services efforts at risk reduction, an approach to wildfire education emphasizing safety and hazard mitigation on an individual property level should be undertaken. 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.

Community responsibility for self-protection from wildfire is essential, and should be actively encouraged in the study area. Homeowners need to be made aware that fire suppression resources cannot be the only line of defense against wildland fires. Landowners and homeowners must take responsibility as key players in mitigation efforts. The Anchor Point analysis has shown that landscape-scale fuels modifications may not be effective in preventing the loss of structures in the fuels and conditions that exist in the study area. Defensible space planning, maintenance, ignition-resistant construction, and preventative landscaping techniques are critical to the mitigation of the loss of life and property during wildfire events.

PUBLIC EDUCATION RECOMMENDATIONS

- Post fire awareness signs (not current fire danger signs) at all high use entrances into the study area. This will raise both residents' and guests' fire awareness. These signs should be placed along the major highways, including Highway 34, Highway 40, and Highway 125 at the district boundaries or other logical locations. It is recommended that signs in need of frequent adjustment (Fire Danger Signs) only be used at Fire Station locations, since upkeep is critical and difficult if sign location is too distant from fire stations.
- Use these web sites for a list of public education materials, and for general homeowner education:
    - http://www.fs.fed.us/fire/links/links_prevention.html
    - http://www.firewise.org
    - http://csfs.colostate.edu/protecthomeandforest.htm
    - http://www.blm.gov/nifc/st/en/prog/fire.1.html
- Provide citizens with the findings of this study including:
    - Levels of risk and hazard
    - Values of fuels reduction programs
    - Consequences of inaction for the entire community
- Create a Fire Safe Council or similar WUI citizen advisory council to promote the message of shared responsibility and the importance of defensible space. Too often, advice from government agencies can be construed as self-serving. Consequently, citizens may resist acting on this information. The Fire-Safe Council should consist of local citizens and stakeholders and its primary functions should be the following:

    - Selecting specific projects for inclusion in an Annual Work Plan
    - Voicing the concerns of the residents as regards the prioritization of mitigation actions
    - Selecting demonstration sites
    - Assisting with grant applications and awards

- Make use of regional and local media to promote wildfire public education messages in the fire district.
- Develop a wildfire educational presentation explaining the concepts of defensible space and wildfire hazard mitigation. The information in this report should be incorporated into that presentation for the education of homeowners district-wide. The presentation could be made at informational gatherings sponsored by the fire department, homeowners associations or neighborhood groups, including local festivals and school events. Consider also making these presentations when there is heightened awareness concerning wildfire, such as times of extreme fire danger, when residents will be most receptive to the information provided. Remember, it is far easier to bring the information to citizens than to bring citizens to the information, making this an especially powerful resource.

LOCAL PREPAREDNESS AND FIREFIGHTING CAPABILITIES

Fire suppression services for the study area are provided by the Grand Fire Protection District No. 1. The East Grand Fire Protection District and Grand FPD No. 1 have jointly built a new fire station, the Red Dirt Station, near the YMCA of the Rockies Snow Mountain Ranch, and have an auto aid agreement. The main station for Grand FPD No. 1 is located at 60500 US Highway 40 in Granby. A third station is planned for the north side of the district on US Highway 34. Mutual aid is available from the Grand Lake Fire Protection District, Hot Sulphur Springs-Parshall Fire Protection District, Kremmling Fire Department, Clear Creek Emergency Services District and the Northwest Colorado I-70 Corridor Mutual Aid Group.

Distances to the nearest fire stations were calculated by a Geographic Information System (GIS) and take into account the road distance to a given area, rather than merely the "flight distance." **Figure 14** shows the road distances from the communities to the nearest fire station. Several communities are greater than five miles from a fire station. However, for the purposes of this report, this is not an Insurance Services Office (ISO) issue, but one of defining response distance to potential fire ignitions. The distance analysis calculates drivable distance, not drive time. However, the distance is an important factor in rating community hazards. Response times will vary greatly over the same distance due to road conditions, steepness, curvature of roads, and evacuation traffic.

Response time is composed of a number of distinct elements: call processing time (the time it takes for dispatchers to ascertain the location and nature of the emergency and initiate the appropriate response); turnout or staffing time (the time it takes for personnel to respond to the dispatch, board apparatus, and begin traveling to the scene); and travel time (the actual time it takes to travel from the station to the scene). Mutual and auto aid stations in other jurisdictions were utilized in this analysis as well as the proposed North station for Grand FPD No. 1.

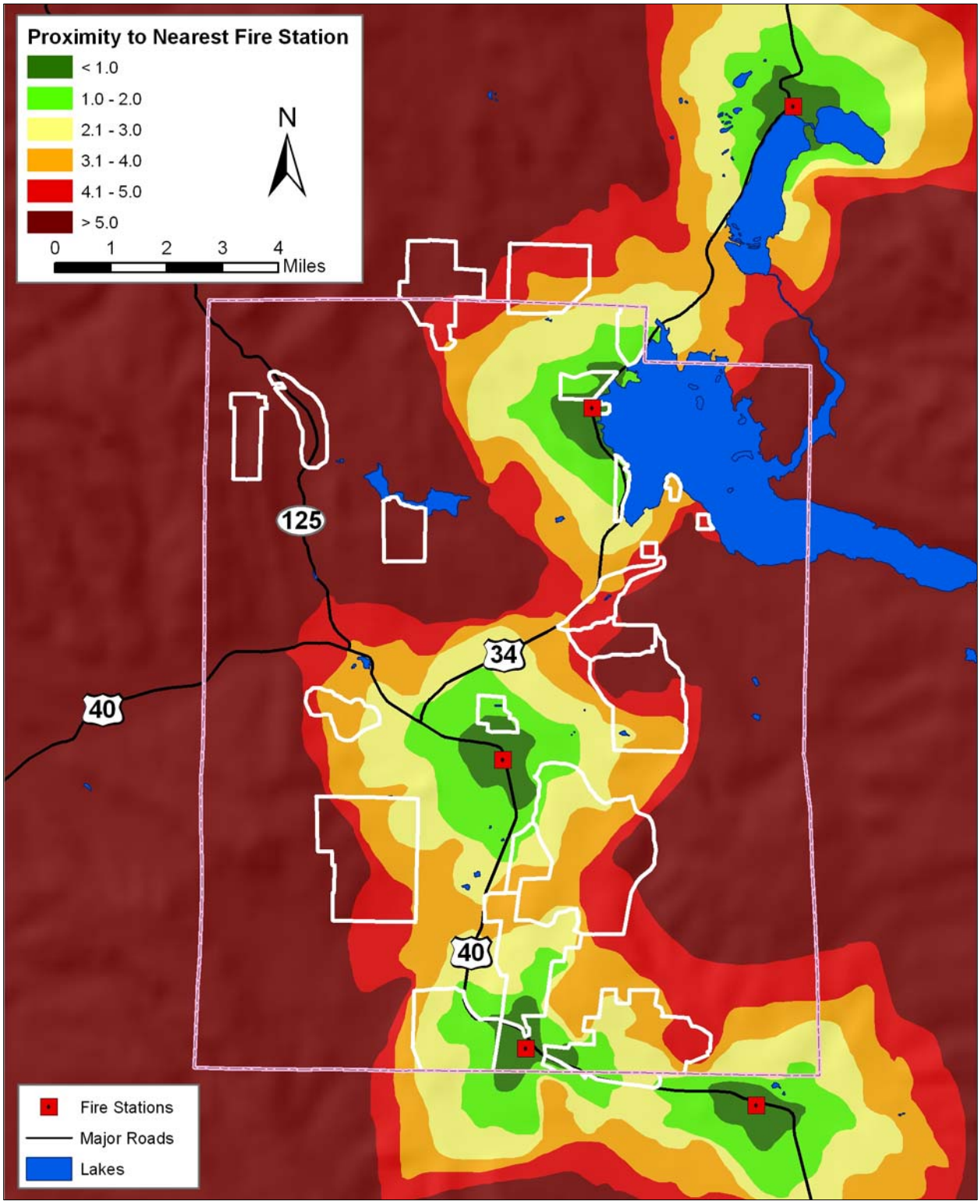
The National Fire Protection Association (NFPA) has established time objectives for volunteer organization fire response. NFPA 1720 requires: Ten minutes or less for the arrival of the first arriving engine company at a fire suppression incident. If a turnout time of two minutes is observed and the average driving speed is 30 MPH, then the engine company will be able to drive four miles in the ten minutes established by NFPA 1720. Therefore, communities with mean distances greater than four miles from a fire station were given a weighted increase in their hazard rating.

Note: Construction of a new fire station is planned for the district. The proposed location of the North Satellite Station (on the northwest side of the lake) is indicated, along with existing fire station locations, in **Figure 14** on the next page. This station will greatly reduce response times to many of the communities within the northern area of the district.

North Satellite Station Recommendations

As part of the new equipment, it is recommended that a large pump be purchased, which could be towed behind a fire vehicle to access the multiple water sources in the area. A large pump would allow for greater volume of water as well as the ability to draft from greater heights, thus improving the opportunity for water supply. It is also recommended that the station install water storage on-site. A 30,000 gallon cistern would allow immediate access to a water supply from the station if needed.

Figure 14. Map - Community Distances to Nearest Fire Stations



FIREFIGHTING RECOMMENDATIONS

Training

Priority level High. Provide continuing education for all firefighters including:

- NWCG S-130/190 for all department members
- Annual wildland fire refresher and "pack testing" (physical standards test) for all department members
- In-house Wildland Urban Interface engine operation training for all department members.
- S-212 Wildland Power Saws for at least one department member per/shift per/apparatus
- S-215 Fire Operations in the Urban Interface for all officers and engine operators
- S-290 Intermediate Fire Behavior for all officers
- I-200 and I-300 (Basic and Intermediate ICS) for all firefighters

Equipment

Priority level High. Ensure that all firefighters have wildland Personal Protective Equipment (PPE). See NFPA Standard 1977 for requirements.

Priority level High. Provide gear bags for both wildland and bunker gear to be placed on engines responding to fire calls. This helps ensure that firefighters have both bunker gear and wildland PPE available when the fire situation changes. It is recommended that auto-aid agencies carry the same equipment on their apparatus.

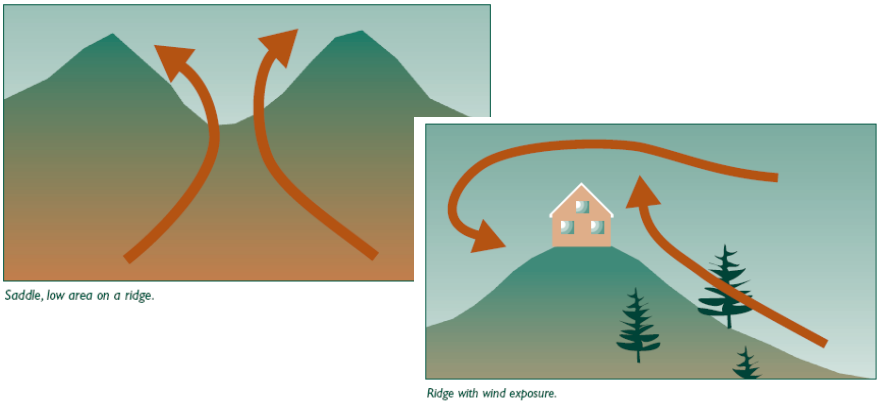
Priority level Moderate. Provide and maintain a ten-person wildland fire cache at all stations, in addition to any tools on the apparatus. The contents of the cache should be sufficient to outfit two squads for handline construction and direct fire attack. Recommended equipment would include:

- Four cutting tools such as pulaskis or super pulaskis
- Six scraping tools such as shovels or combis
- Four smothering tools such as flappers
- Four backpack pumps with spare parts
- Two complete sawyer's kits including chainsaw, gas, oil, 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.
- Consider the purchase of backpack-mounted CAFS units such as the Macaw CAF Backpack offered by Intelagard of Broomfield, CO. This system provides for very rapid structure protection. Visit www.intelagard.com

HOME MITIGATION AND DEFENSIBLE SPACE

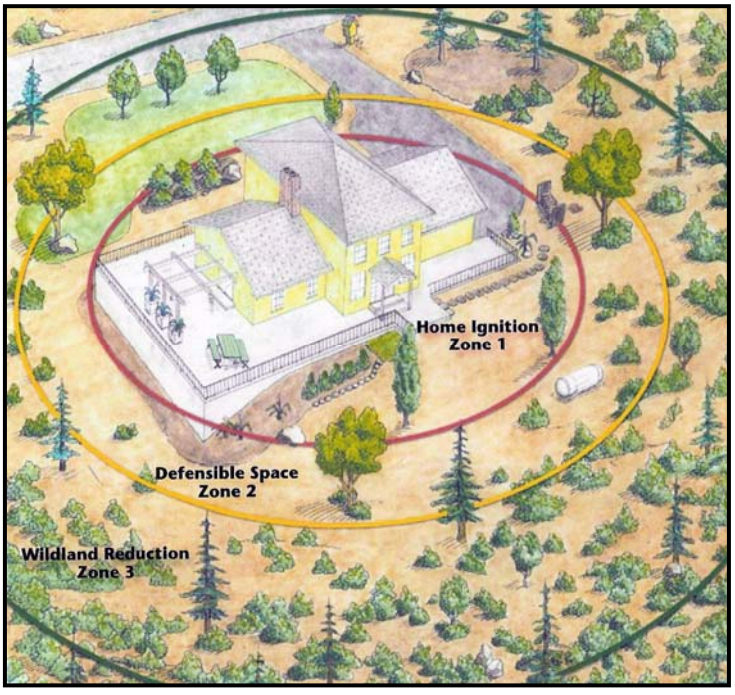
The most important element for the improvement of life safety and property preservation is conforming, effective defensible space for every home in the study area. This is especially important for homes with wood roofs and homes located on steep slopes, in chimneys, saddles, or near any other topographic feature that contributes to fire intensity (**Figure 15**).

Figure 15. Saddle & Ridge Top Development[10]



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*.

Figure 16. Defensible Space Zones[11]



There is no question that dense, flammable vegetation should be removed from around homes to reduce the risk of structural ignition during a wildfire. The challenge is deciding how much to remove. The basic rule is to eliminate all flammable materials (fire-prone vegetation, wood stacks, wood decking, patio furniture, etc.) from within 30 feet of the home. For structures near wildland open space, an additional 70 feet should be modified as follows: remove dead wood from shrubbery; thin and trim trees and shrubs into umbrella-like forms (lower limbs removed); mow or weed to stem the growth of weedy grasses. Note that steep slopes or dangerous topographic features as described above typically necessitate larger defensible space zones.

[10] *FireWise Construction*, Peter Slack, Boulder, Colorado
[11] A Homeowner's Guide to Fire Safe Landscaping(2005) www.FireSafeCouncil.org

Defensible space is an issue that can be contentious among homeowners, because the “natural state” of the land surrounding their homes is often one of the primary reasons they have chosen to live in the WUI in the first place. It is therefore important to understand that defensible space need not result in land that is bare or ugly, and to take whatever steps necessary to educate homeowners about this fact. Homeowners will be pleased to find out that following sound defensible space guidelines not only makes their homes safer; it generally results in wildland perimeters around homes that are far more aesthetically pleasing than land that is simply “let go.”

One term that tends to cause issues is “clearance,” which often leads people to believe that *all* vegetation must be removed down to bare soil. This is absolutely not the case. In fact, 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. Ecologically sound defensible space recommendations, as iterated here, will result in land that is both aesthetically pleasing and relatively easy to maintain.

Finally, the great advantage to homeowners of adequate, sound defensible space – beside increased safety – is that it often eliminates the need for county or state fuels treatment projects to extend onto their property. This is a benefit that most homeowners in the WUI will greatly appreciate.

HOME MITIGATION RECOMMENDATIONS

Priority level High: Conduct a parcel-level wildfire hazard analysis for all the homes in communities rated Extreme, Very High, or High hazard. Completing this process will facilitate the following important fire management practices:

- Establish a baseline hazard assessment for individual 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 study area. A pre-attack plan assists fire agencies in developing strategies and tactics that will mitigate damage when incidents do occur.

Priority level High: Request that homeowner's associations and other neighborhood groups promote the development of defensible space and Firewise plantings. Eliminate any covenants or deed restrictions that require or endorse the use of flammable building materials such as shake roofs.

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

LANDSCAPE SCALE FUELS MODIFICATIONS

One of the most effective forms of landscape scale fuels modification is the fuelbreak (sometimes referred to as a "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 to remove 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 to create an open park-like appearance.

The use of fuelbreaks under normal burning conditions can limit uncontrolled spread of fires and aid firefighters in slowing the spread rate. Under extreme burning conditions where spotting occurs for miles ahead of the main fire, and the 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.[12]

Factors to be considered in determining the need for fuelbreaks in WUI areas 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. Chimneys, saddles, and deep ravines are all known to accelerate fire spread and influence intensity. Communities with homes located on or above such features, or with homes located on summits and ridge-tops, are usually good candidates for fuelbreaks.

Crown fire activity values for the study area (see **Appendix A** for full details) were generated by the FlamMap fire behavior model and classified into three standard ranges (surface fire only, passive crown fire (torching), and active crown fire). In areas where active crown fire activity is likely, fuelbreaks are recommended. If there are known likely ignition sources (such as railroads and recreation areas that allow campfires) in areas where there is a threat of fire being channeled into communities, fuelbreaks should be considered. Fuelbreaks should also be considered, where appropriate, to help protect critical infrastructure and ecosystem values.

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 that firefighters are trying to protect are usually located at the tops of ridges or mid-slope. Mid-slope positioning is considered the least

[12] Footnote: Frank C. Dennis, "Fuelbreak Guidelines for Forested Subdivisions" (Colorado State Forest Service, Colorado State University, 1983), p. 3.

desirable for fuelbreaks, but it may be the easiest to achieve, as an extension of either defensible space work or existing roads and escape routes.

One tactic is to create fuelbreaks on slopes below homes that are located either mid-slope or on ridge tops, so that the area of continuous fuels between the defensible space of homes and the fuelbreak is less than ten acres. Another tactic commonly employed is positioning fuelbreaks along the bottom of slopes. In most of the study area this would require the cooperation of many individual landowners. In some areas, the only way to separate residences from fuels is to locate the fuelbreak mid-slope above homes. This would provide some protection from backing fires and rolling materials. Where possible, it would make 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, it would be the most effective approach in some portions of the study area.

Fuelbreaks are often easiest to locate along existing roadbeds. The minimum recommended fuelbreak width is usually 200 feet. As spread rate and intensity increases with slope angle, the size of the fuel break should 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 ft. + (1.5 x slope %); above road distance = 100 ft. – slope% see table below. Fuelbreaks that pass through hazardous topographic features should have these distances increased by 50%.[13]

Table 4. 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

Since fuelbreaks can potentially have an undesirable effect on the aesthetics of the area, crown separation should be emphasized over stand density levels, because isolating groupings rather than cutting for precise stem spacing will help to mitigate the visual impact of the fuelbreak. Irregular cutting patterns that reduce canopy and leave behind islands with wide openings are effective in shrub models. This is sometimes referred to as a mosaic cut.

Another issue in mechanical thinning is the removal of cut materials. It is important to note that in Colorado's dry climate, slash decomposes very slowly. One consequence of failing to remove slash is that it adds to surface fuel loading, in some cases making the area more hazardous than it was before treatment. Slash materials must be disposed of by piling and burning, chipping, physical removal from the area, or lopping and scattering. 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 also important to note that fuelbreaks must be maintained to be effective. Thinning usually accelerates the process of regenerative growth. The effectiveness of the fuelbreak may be lost

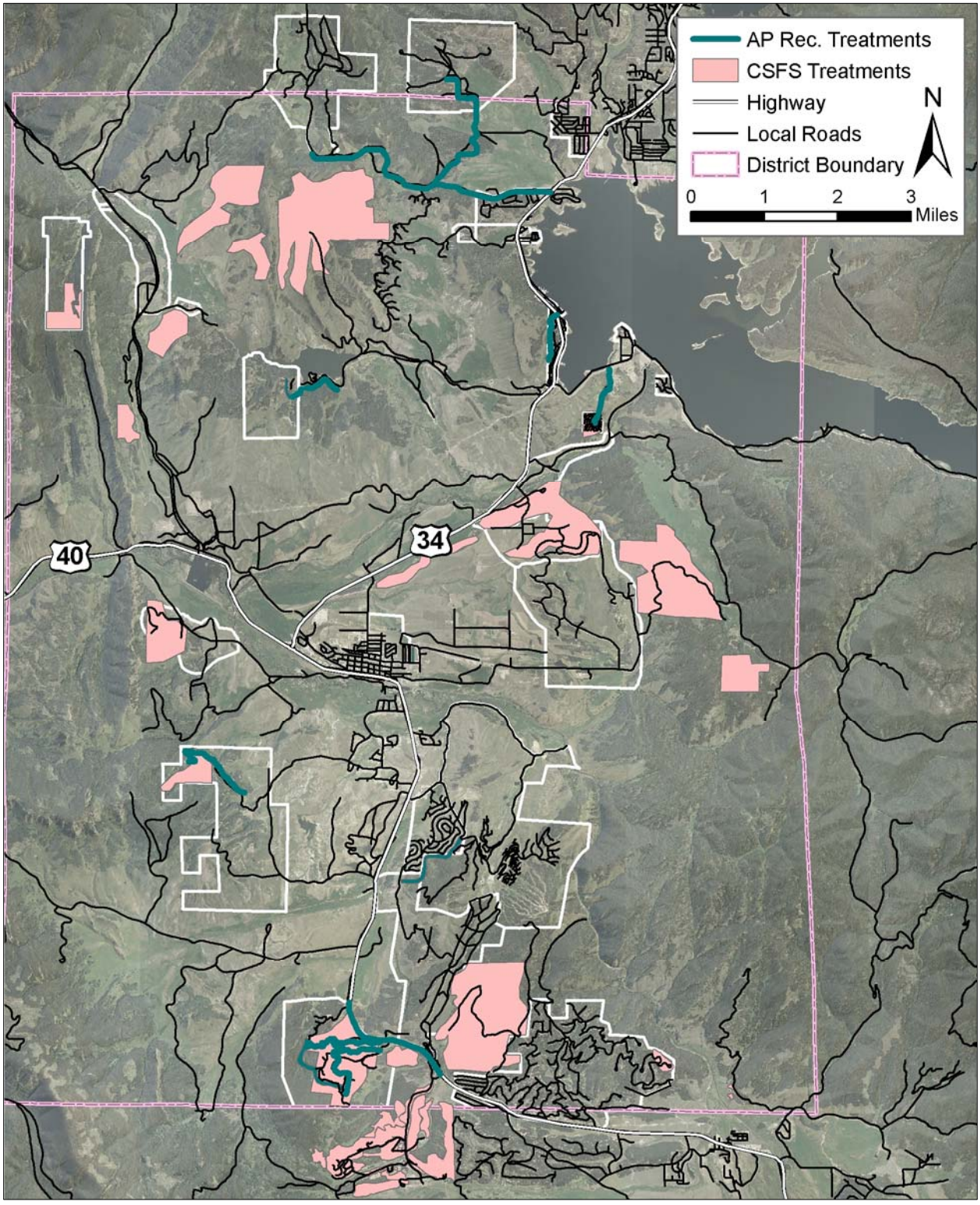
[13] Frank C. Dennis, "Fuelbreak Guidelines for Forested Subdivisions" (Colorado State Forest Service, Colorado State University, 1983), p. 11.

in as little as three to four years if ladder fuels and regeneration are not controlled. Therefore, fuelbreaks should not be constructed without a maintenance plan in place.

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 the reduction projects recommended here may require the approval of public land management agencies as well as private landowners. These entities include the United States Forest Service, the Bureau of Land Management, the Denver Water Board, the Colorado State Forest Service, towns, resorts and others.

Figure 17 on the next page shows past, current and future fuels reduction projects within the study area, including those of the Colorado State Forest Service and the Anchor Point recommended treatments.

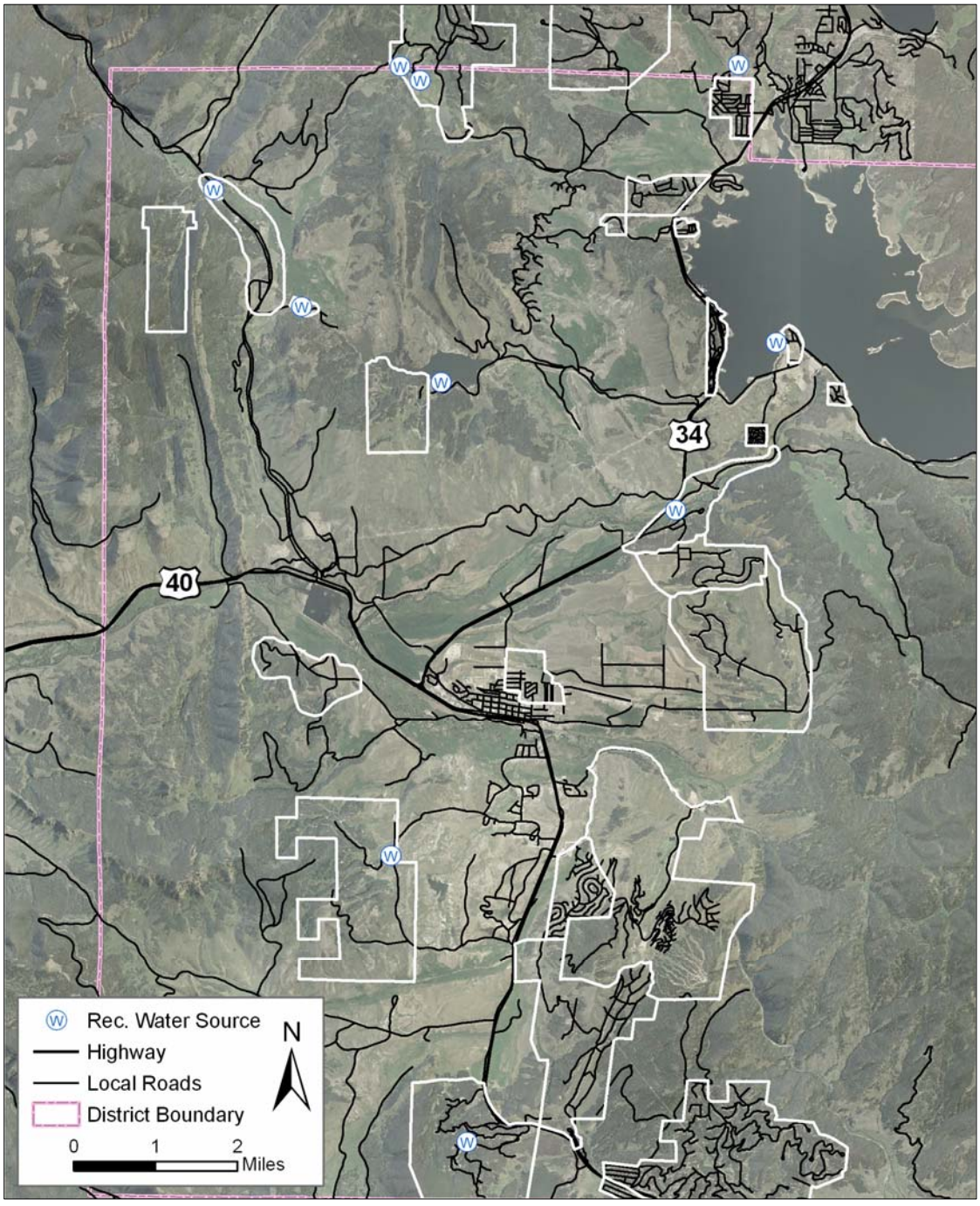
Figure 17. Current and Existing Fuels Treatment Projects



WATER SUPPLY

Water is a critical fire suppression issue in the study area, as it is in most of the mountainous areas of Colorado. There is an adequate network of hydrants in some places within the study area, but city hydrants are not available in many of the most hazardous interface communities. As part of this study, an on-the-ground evaluation of alternative water sources was conducted, and additional (non-pressurized hydrant) water sources were identified and pre-planned. Approximate locations of hydrants and supplemental water sources are shown below (Figure 18).

Figure 18. Recommended New or Improved Water Supply Locations



WATER SUPPLY RECOMMENDATIONS

Priority Level High. Throughout the study area, there are private ranches and landowners with water supplies suitable for fire suppression. Wherever such private water sources exist, agreements should be sought with the property owners for the use of the water as a secondary or supplemental source during emergency suppression operations. When such agreements are reached, the water source should be included in fire department pre-plans with the following information: maps; access information such as gate codes or key locations; the size and type of the water source, whether or not it is accessible to aircraft and equipment; and connections needed for use. This information is crucial to the successful use of the water supply by outside resources unfamiliar with the area.

Priority Level High. Consider adding two or three 30,000 gallon cisterns in the Winter Park Highlands community for fire suppression use. At least one cistern should be located in the isolated northern portion of this community.

Priority Level High. Consider adding a 30,000 gallon cistern to the Carol Linke Tracts community for fire suppression. See the map on the previous page for recommended location.

Priority Level High. It is recommended that a dry hydrant be installed in the pond on the Fox property within the Homestead Hills community. In addition, installing a 30,000 gallon cistern is recommended for fire suppression use. The cistern should be located in an area that is easily accessible for fire apparatus.

Priority Level High. A draft hydrant is recommended in the Highway 125 community. This hydrant should be located in the river, just north of the Shadow Mountain Ranch ASI.

Priority Level High. The community of Sunset Point currently has a boat ramp to access Lake Granby. The road between the boat ramp and community should be improved for fire apparatus access. The addition of a turbo draft fire eductor (www.turbodraft.com) would be a beneficial piece of equipment to be able to pull a draft from the lake. An alternative to an eductor would be a large portable pump, which could be stored on-site or on a trailer, and pulled behind an emergency vehicle. This recommendation is high because it benefits not only the Sunset Point community, but the other surrounding communities as well – Bussy Hill in particular.

Priority Level High. The Trail Creek community is already equipped with a dry hydrant, but the hydrant needs maintenance and possibly needs to be raised to accommodate large diameter suction hose. Access to this hydrant is difficult. It is recommended that access be improved by either extending the connection or other means. This dry hydrant should be tested regularly for flow capacity and ability of apparatus to pull a draft.

Priority Level High. A dry hydrant should be installed at the C Lazy U Ranch ASI. This hydrant should be installed in the pond. The addition of a dry hydrant will be highly beneficial for the C Lazy U Ranch and the surrounding communities.

Priority level Moderate. A dry hydrant should be installed in Willow Creek Reservoir for use by the C Lazy U Homestead community. A temporary extension of the boat access ramp should be installed to allow engine access to the water supply. If this is not feasible or cost effective, a dry hydrant or turbo draft (http://www.turbodraft.com/) should be installed.

Priority level Moderate. The Sol Vista ski area has snow making equipment. This equipment should be adapted so it can be used in the summer for fire suppression activities. This has been successfully accomplished in other ski areas and has proven to be a valuable asset for structure protection.

Priority level Moderate. A sign should be erected to direct emergency responders to the water supply at the Farr Pumping plant.

Priority level Moderate. The Legacy Park community is currently experiencing increased growth and development. Additional large cisterns are recommended as the community continues to expand for use for fire suppression activities.

Priority level Moderate. Since there is currently no water available to the community Scan Loch, on-site water storage, such as a 30,000 gallon cistern, is recommended.

Priority level Moderate. A potential site for a draft hydrant has been identified for the Trail Creek community and may also be a valuable asset. This dry hydrant should be installed in addition to the existing one. These dry hydrants should be tested regularly to ensure that apparatus have the ability to pull a draft from them.

POST-FIRE REHABILITATION PROCEDURES

The most common post-fire rehabilitation plan is called BAER (Burned Area Emergency Rehabilitation) and is implemented by the federal government. After a fire event, assistance can be requested at the Hot Sulphur Springs district office. Common issues are erosion, runoff, siltation, sedimentation and re-vegetation. The bulk of this information can be found on the following website and is therefore not included in this report;

http://www.fs.fed.us/r2/psicc/hayres/baer/

The procedures to activate the system can be summarized as follows:

- A government agency needs to request a BAER team as soon as is reasonable during or after the fire.
- This request will go through the NIFC ordering process and will be dispatched to the location.
- A local contact needs to be established to help with the coordination of the process and to serve as a resource advisor.
- Payment will be determined by the local agencies but is likely paid for by the same agencies that paid for fire suppression.

GLOSSARY

The following definitions apply to terms used in the Grand FPD No.1 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: This is 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: This is Geographic Information System (GIS) software that is 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): This is 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. This is derived from fire behavior modeling programs using the following inputs: fuels, canopy cover, historical weather averages, elevation, slope, and aspect.

Fire Danger: In this document we do not use this as a technical term, 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. The hazard rating 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: This is 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 categorizing and 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 that is 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. Fuelbreaks 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 (as defined by the insurance industry) 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 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 that involves instructing people to remain inside their homes or public buildings until the danger passes. This concept is new to wildfire in the United States, but not to hazardous materials incident response, where time, hazards, and sheer logistics often make evacuation impossible. This concept is the dominant modality for public protection from wildfires in Australia, where fast-moving, short-duration fires in light fuels make evacuation impractical. The success of this tactic depends on a detailed preplan that takes into account the construction type and materials of the building used, topography, depth and type of the fuel profile, as well as current and expected weather and fire behavior. For a more complete discussion of the application and limitations of shelter-in-place concepts, see the *Addressing, Evacuation, and Shelter-In-Place FMU* section in the main report.

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

Spotting: Refers to the 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 in the surface litter, debris, and small vegetation on the ground.

Timelag: Time needed under specified conditions for a fuel particle to lose about 63% 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 in the study area, and are particularly susceptible to damage from undesirable fire outcomes.

WHR (Community Wildfire Hazard Rating, AKA Community Assessment): A sixty-point scale analysis designed to identify factors that 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. This is sometimes referred to as Urban Wildland Interface, or UWI.

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