Rio Arriba County, New Mexico

Wildland-Urban Interface Plan

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Executive Summary

The Rio Arriba County, New Mexico Wildland-Urban Interface Plan (WUIP) has been written by SEC, Inc. to provide the County Fire Marshal's Office with a program-based wildland fire plan for private lands throughout the County. The plan is written for a 10-year time period and is focused on five goals, which include:

- Manage forest fuels to protect life and property.
- Manage forest fuels to promote forest restoration.
- Secure project funding to "jump start" management implementation.
- Market wood products to sustain landscape-scale treatments.
- Adopt an emergency evacuation plan.

The predominant forest types in the study area include pinyon-juniper and ponderosa pine. Historically, low-intensity surface fire was a common occurrence in these forests and created open-grown stands with a clumpy tree distribution and many grassy openings.

The effects of Hispanic and Euro-American settlement have dramatically changed these forests and led to conditions unlike those characteristic of the evolutionary environment in which they evolved. Specifically, fire exclusion and grazing have decreased competition from grasses and led to an increased survival of tree seedlings, an invasion of trees into grasslands, and an accumulation of deadwood and tree litter on the forest floor. These events, and past logging which favored the biggest and best trees, have decreased numbers of large trees, increased numbers of small trees, increased homogeneity across the landscape, increased insect and disease activity, increased tree competition, and increased mortality.

These changes have compromised the long-term health and integrity of the forest resource and significantly increased the threat of damaging, stand-replacing crown fire. Couple this with current region-wide drought conditions, an epidemic bark beetle outbreak, and population growth in forested areas and one has the recipe for disaster, as evidenced by landscape-scale fires such as the Cerro Grande, Viveash, and Rodeo-Chediski of the past few years, which collectively burned over 545,000 acres and destroyed over 630 homes.

In addition to structural loss and life safety, there are numerous other community values at risk in Rio Arriba County, such as:

- Watersheds, soils, and wildlife habitat.
- Economic development.
- Public health.
- Recreational opportunities.
- Scenic values.
- Spiritual and emotional values associated with the land.

- Confidence in government and sense of security

It is now incumbent upon communities faced with catastrophic fire threat to come together to cause ACTION that reduces the risk of devastating fire. Considering the current fire-prone nature of the ecosystem, it is only a question of when, not if, a catastrophic fire will occur. What types of actions need to be taken?

- Forests need to be treated using restoration techniques.
- Collaborative groups and relationships must be formed to create opportunities for project implementation, economic development, etc.
- Innovative structural and policy approaches need to be developed.
- Community outreach and education has to occur.
- Financial resources/funding needs to be sought.
- Restoration by-product utilization strategies have to be developed.

The above recommendations and efforts will need to maintained "for the long haul". Effectiveness will not be achieved overnight. It will take many years (10-20) to produce enough work on the ground to provide a protective ring around fire-risk communities and to begin to restore adjacent forest communities to a more natural and safe condition.

Chapter 1: Introduction

PURPOSE STATEMENT

The Rio Arriba County, New Mexico, Wildland-Urban Interface Plan (WUIP) has been written by SEC, Inc. to provide the County Fire Marshal's Office with a program-based wildland fire plan for private lands throughout the County.

The plan is written for a 10-year time period and adopts an integrated approach to management focused on protecting and enhancing the safety, prosperity, and quality of life for all residents within the County.

PLAN FORMAT

Following the Introduction, *Chapter 2: Resource Description*, provides a description of current resources within the County. Sections on vegetation patterns and disturbances, community fire hazard, wildland fire hazard, threatened and endangered species, water, archaeological resources, utilities, roads, wildland firefighting organizations, and private and national forest management are included. These sections define baseline resource conditions that drive management. *Chapter 3: Values at Risk*, makes the case for landscape-scale fire mitigation treatments. This is done through a discussion of impacts associated with fires, and fires' ability to seriously undermine an area's long-term health and sustainability. Given that certain communities within the County are prone to large-scale, catastrophic fire, a section on emergency evacuation procedures is also included. *Chapter 4: Management Recommendations*, includes both short and long-term management recommendations for the County. These are based on identified needs and the successful components of other projects that have demonstrated effectiveness. The focus is on the formation of community partnerships, public outreach and education, and project implementation.

COUNTY DESCRIPTION

Rio Arriba County is located in north central New Mexico and occupies a land area of approximately 5,883 square miles (figure 1). Public and Indian-managed lands account for 4,236 square miles, or 72 percent of the County, with the remaining area being predominantly private.

The physical landscape is very diverse ranging from scarp-bounded tablelands in the northwest to high-country mountain and volcanic lands in the east and south. In general, heavily stocked forests, moderately steep slopes, and semi-arid conditions (mean annual precipitation is approximately 9.88 inches in Espanola and 21.96 inches in Chama, WRCC 2002) describe the physical conditions of the mountainous lands.

Figure 1: Location Map

The County is rural in nature with no major metropolitan areas, a year 2000 population of 41,190 people, and approximately 18,016 housing units (2000 U.S. Census for New Mexico). Despite the small population, the County's growth from 1990 to 2000 was 19.9 percent, however, growth over the next 10-year period, as estimated by the University of New Mexico Bureau of Business and Economic Research, is expected to be modest at approximately 4 percent.

Growth in general, and more specifically some of the newer growth, is problematic from a fire management standpoint. This is a function of where the growth occurs and the attitudes and values associated with some of the newcomers. Much of the newer growth is related to residents who come from urban environments and now live in a rural, wildland setting, and many of these wildland settings are prone to fire. Additionally, a percentage of these newer residents have social and cultural values based upon urban expectations and romanticized ideas of living with nature. This background ill prepares them to recognize and accept the risks of living within the wildland-urban interface (WUI) environment (Cortner et al. 1990), and can predispose them to reject ecologically sound solutions to the wildfire problem.

Growth, some of the local attitudes and values, unnatural, heavily stocked forests, and recent bark beetle and drought conditions all combine to make wildfire the number one threat to many communities in the County. Indeed, the New Mexico Forestry Division, utilizing an objective rating system, has identified the Espanola bosque and Brazos Canyon areas as two of the state's most vulnerable communities to catastrophic wildfire (EMNRD 2000).

MANAGEMENT GOALS

The desired future condition for the County is to protect or enhance the safety, prosperity, and quality of life for all residents within the County. Embodied in the desired future condition are five specific goals.

- Manage forest fuels to protect life and property.
- Manage forest fuels to promote forest restoration.
- Secure project funding to "jump start" management implementation.
- Market wood products to sustain landscape-scale treatments.
- Adopt an emergency evacuation plan.

A reduced wildfire threat aimed at protecting life and property, along with other landscape-scale values, is the primary WUIP goal. This is best accomplished by developing appropriate infrastructure, personnel, resources, procedures, and regulations, and then targeting projects in those areas representing the greatest wildfire threat.

The geographic area and time scale involved with community protection and forest restoration is enormous. Therefore, it is critical that projects be economically viable to ensure long-term management across not the only the study area communities, but ultimately the greater landscape. If large-scale fire mitigation and forest restoration are to

succeed, then treatment returns need to be maximized, current wood product markets taken advantage of, and potential wood product markets developed.

When wildfire does come, a coordinated, intelligent wildfire evacuation plan, competently carried out, is essential for public safety. However, while evacuation planning is relatively easy, actual evacuation under duress represents a formidable challenge because of potentially extreme fire behavior, large numbers of people to be accounted for, public panic, and limited road access into and out of certain communities. As a result, the immediate adoption of a specific plan of action and on-the-ground-training is recommended.

Chapter 2: Resource Description

VEGETATION PATTERNS AND DISTURBANCES

Natural communities are dynamic systems that change through time in response to small and large-scale events. In the past 100-plus years, many of the southwest's forests, including those of Rio Arriba County, have been significantly altered through a variety of natural and human influences. The following discussion briefly highlights some of these influences and gives a perspective to current forest health and management needs.

Conditions Prior to Hispanic and Euro-American Settlement

Physical site conditions and climate are the primary determinants of any area's vegetation. Physical site conditions include landscape features of geology, topography, aspect, and elevation. These are relatively permanent features of an area and strongly influence regional climate patterns, local weather, sunlight and water availability, and soil properties in complex relationships that directly influence vegetation patterns.

Climate is an especially strong determinant of vegetation. Tree-ring data used as an indicator of past climate suggests that the Southwest has been predominantly semi-arid for the past few thousand years. However, data also suggest that short-term shifts in moisture can cause significant shifts in plant and animal communities. For example, a regional drought in the mid-1950s led to a bark beetle outbreak that killed millions of trees throughout central and northern New Mexico (Allen and Breshears 2002).

Site conditions and climate also determine vegetation through their influence on natural disturbance processes, which include flooding, grazing, insect and disease activity, and fire, all of which help to shape vegetation patterns across the landscape (Covington et al. 1994).

Physical disturbances such as flooding and downbursts influenced vegetation patterns in the past much as they do today. Generally, only the magnitude, duration, intensity, and frequency of these events change over time.

Grazing by native wildlife also influenced vegetation patterns, and certainly influenced grassland species composition. However, pre-settlement impacts of native wildlife on vegetation were probably negligible as herbivores co-evolved with communities and predators kept population numbers in check.

Bark beetles and other insects attack and kill trees, thereby influencing vegetation patterns. Bark beetles are especially damaging, and lay their eggs in the cambium tissue (inner bark) of physiologically stressed trees where the larvae feed, grow, and emerge at maturity to mate and lay eggs in other trees. Periodic epidemics create patches of mortality that contribute to forest diversity by selectively killing trees of certain sizes and species, and changing tree density, tree species composition, and tree size structure.

Mistletoe, a highly specialized parasitic plant, is probably the most significant tree pathogen in the study. Mistletoes rob water and nutrients from their hosts and have several negative impacts to trees, including loss of tree vigor and growth, reduced quality and quantity of seed, increased susceptibility to drought stress and insect attack, and mortality. Because mistletoe can kill a tree, either directly or indirectly from other agents, it can play a role in vegetation patterns across the landscape.

Among all the various disturbance processes, fire has had the largest influence on Southwest vegetation patterns (Covington and Moore 1994, Covington et al. 1997). Lightning-caused fires, often ignited during the July and August monsoons, have long been a primary agent responsible for species composition, age and size class distribution, and plant health and vigor (figure 2).

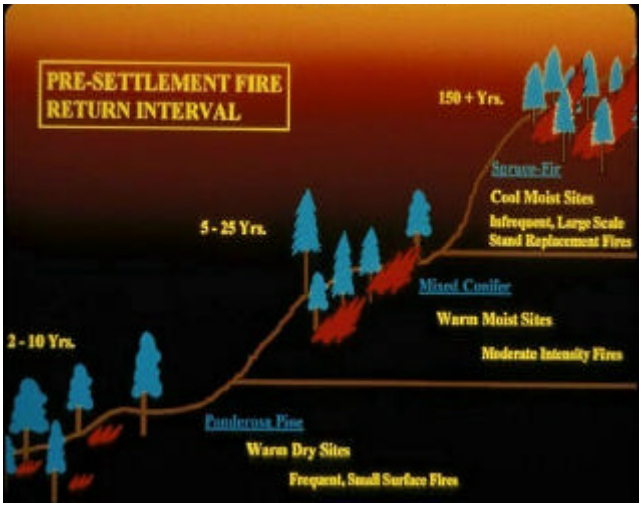

Figure 2. Presettlement fire return interval.

Fire and people also have a long history. During the past 10,000 years or so, people began to take an active role in the fire ecology of their landscape by igniting fires and using it as a tool to drive game animals, to create foraging areas for game, and to enhance the growth of certain useful plant species. Although this use of fire may have modified the naturally occurring vegetation pattern, the overall effect was that of perpetuating or enhancing the general pattern of frequent fire.

Changes Associated with Hispanic and Euro-American Settlement

In the mid to late 1800's, greater numbers of Hispanic and Euro-Americans began to populate the area. These newcomers viewed fire as threat to human lives, property, and resources, and they, along with personnel from the newly created Pecos River Forest Reserve, began to vigorously suppress all fire, thereby dramatically changing the fire ecology of the area.

In addition to fire suppression, the rather abrupt occupation of the area brought with it other disturbance pattern changes from timber harvest and the grazing of domestic livestock (figures 3 and 4). Again, the general effect was an immediate disruption in the area's natural fire ecology.

Figure 3. Early settlers generally cut the biggest and best trees.

Figure 4. Grazing by domestic livestock was extremely heavy.

Heavy livestock grazing, in particular, enhanced the success of fire suppression efforts by removing the fine grass fuels that had carried natural, beneficial, low-intensity fires. In many areas, tree seedlings, which had formerly been regularly thinned by fire, and out-competed by dense grass cover, had the chance to become widely established in dense stands. Live and dead vegetation, no longer being regularly removed, began to accumulate heavily. This change in the local fire ecology was quite the opposite of the naturally occurring patterns, but the results of this change were not immediately apparent.

Current Vegetation Patterns and Conditions

A disruption of the historic fire pattern coupled with the wettest 200-year period in the last millennium (RMRS 2002a) and a recent (approximately last 10 to 15 years) inability of federal land managers' to implement logging programs has resulted in a steady accumulation of fuel and some correspondingly significant ecological changes.

Some of these changes have been quantified by Regis Cassidy (2003) of the Santa Fe National Forest. He analyzed ponderosa pine and Douglas-fir survey data from the Jemez Mountains to determine general trends relating to past and present tree stocking levels. The data show that ponderosa pine (4-inch plus diameter) and Douglas-fir have increased by a factor of 5 to 8 times and 6 to 10 times from 1911 to present, respectively. While this data is not from Rio Arriba County, it is useful because of its proximity and similar management history.

In addition to the generally greater number of trees present today, we also see greater forest homogeneity and greater fuel continuities than in the past (figures 5 and 6) (Covington and Moore 1994). The result is decreased diversity, altered energy flow and nutrient cycling processes, and a much greater potential for resource-damaging disturbance events such as insect and disease epidemics and large-scale fire.

Figure 5. Flagstaff, Arizona - 1910.

Figure 6. Same site as in figure 5 - 1989.

As an example, in the summer of 2002, bark beetles multiplied exponentially in an outbreak of unprecedented proportions in Arizona, killing millions of ponderosa pine on approximately 500,000 acres of national forest and Indian reservation land (RMRS 2002b). At the same time, the region experienced record-breaking, landscape-scale fires such as the Ponil Complex in New Mexico, the Hayman Fire in Colorado, and the Rodeo-Chediski Fire in Arizona.

WILDFIRE HAZARD AND RISK

Wildfire hazard and risk are often used interchangeably, but in fact have very different meanings. Wildfire hazard is the potential for a fire, once started, to burn and move across the landscape. Fuels, weather, and topography combine to create hazard conditions. Wildfire risk, on the other hand, represents the potential for a fire to start because of an ignition source. High-risk areas include high frequency lightning strike sites, or anywhere that people typically congregate or use, such as subdivisions, campsites, or roads.

COMMUNITY FIRE HAZARD

The potential for a home to ignite and burn during a wildfire depends primarily on a home's fuel characteristics (building construction) and the heat sources within a couple hundred feet of the home (Cohen 2000). This relatively limited area - often referred to as the home ignition zone - was the focus of the community wildfire hazard assessment.

Assessment Procedures

The first step in the assessment process was to identify all study area communities. This was accomplished through SEC's personal knowledge of the County and through meetings with the County Fire Marshal and New Mexico State Forestry personnel.

After identification of communities, SEC staff took forest service maps and a wildfire hazard rating form into the field and quantitatively assessed and assigned a wildfire hazard rating to each identified community. The fire hazard assessments took place in the summer of 2003.

Eight primary assessment factors were included on the wildfire hazard rating forms to determine the nature and severity of wildfire hazard to a community. These factors include building construction and design, placement of utilities, surface fuel models, topography, defensible space, access, water availability, and available fire protection. The first four factors determine the base hazard for a structure and relate to the characteristics of the fuel or utility on or near a site, and to the likelihood that this material will become involved in an approaching fire. The last four factors contribute to lessening the base hazard by providing a protective zone around the home (defensible space), or by providing protection resources available to fight the fire.

Each of the eight primary factors, and sub-factors within some of the groups, were rated on a scale of 0 to 25 with low scores representing low hazard and high scores representing high hazard. These ratings were summed together at the bottom of each wildfire hazard rating form to arrive at an overall community fire hazard rating, which represents the average hazard rating of all homes within a community.
Each community could fall into one of four hazard rating categories, which were defined as low hazard (less than 40 points), moderate hazard (40 to 69 points), high hazard (70 to 112 points), and extreme hazard (112 plus points).

Communities and Hazard Ratings

A total of 26 communities were identified and assessed. Starting at the southern end of the County and moving generally northward, these include the following: Espanola Bosque, Southern Rio Grande Bosque, Northern Rio Grande Bosque, Rio Embudo Bosque, Southern Rio Chama Bosque, Northern Rio Chama Bosque, Rio Ojo Caliente Bosque, Rio Puerco Area, El Rito, La Madera, Petaca, Vallecitos, Canon Plaza, Placita Garcia, Canjilon, El Vado, Pinon Ridge, Park View Hills, Fort Heron Preserve, Laguna Vista, Lower Brazos Canyon, Brazos Estates, Brazos Meadows Area, Upper Brazos Canyon, Ponderosa Area, and Canones Creek. The wildfire hazard rating for each community can be found in table 1.

Table 1. Rio Arriba Communities and Wildfire Hazard Ratings.

Community	Approximate Number of Residences	*Housing Density	Wildfire Hazard Rating
Espanola Bosque	> 100	High	65 – Moderate
Southern Rio Grande Bosque	> 100	Low	71 – High
Northern Rio Grande Bosque	> 100	Low	59 – Moderate
Rio Embudo Bosque	> 100	Moderate	80 – High
Southern Rio Chama Bosque	> 100	Moderate	73 – High
Northern Rio Chama Bosque	> 100	Moderate	60 – Moderate
Rio Ojo Caliente Bosque	> 100	Low	38 – Low

Table 1. Rio Arriba Communities and Wildfire Hazard Ratings (continued).

Community	Approximate Number of Residences	*Housing Density	Wildfire Hazard Rating
Rio Puerco Area	> 100	Moderate	42 – Moderate
El Rito	> 100	Moderate	46 – Moderate
La Madera	51 – 75	High	51 – Moderate
Petaca	25 – 50	High	68 – Moderate
Vallecitos	51 – 75	Moderate	52 – Moderate
Canon Plaza	25 – 50	High	51 – Moderate
Placita Garcia	< 25	High	53 – Moderate
Canjilon	> 100	Moderate	44 – Moderate
El Vado	25 – 50	Moderate	58 – Moderate
Pinon Ridge	51 – 75	Moderate	65 – Moderate
Park View Hills	25 – 50	Moderate	73 – High
Fort Heron Preserve	< 25	Moderate	51 – Moderate
Laguna Vista	> 100	Moderate	67 – Moderate
Lower Brazos Canyon	25 – 50	Moderate	57 – Moderate
Brazos Estates	< 25	Moderate	52 – Moderate
Brazos Meadows Area	25 – 50	Moderate	74 – High
Upper Brazos Canyon	> 100	High	81 – High
Ponderosa Area	25 – 50	Low	78 – High
Canones Creek	< 25	Low	52 – Moderate

* Housing density values based on lot size, > 10 acres = low, 1-10 acres = moderate, < 1 acre = high

As table 1 shows, 0 communities rated as an extreme hazard, 7 as a high hazard, 18 as a moderate hazard, and 1 as a low hazard. In general, the high and moderate ratings are a function of poor subdivision roads, lack of nearby water sources, heavy fuels, lack of defensible space, and combustible building materials on homes.

The location of each identified community can be found on the enclosed Forest Service and Bureau of Land Management maps. Further information regarding each community's firefighting hazards and constraints is contained in the wildfire hazard rating forms in Appendix A.

WILDLAND FIRE HAZARD

Vegetation Types

Five major vegetation types occur within or adjacent to communities in Rio Arriba County. These include grasslands, bosques of cottonwood (*Populus* spp.), willow, (*Salix* spp.), elm (*Ulmus* spp.) and Russian olive (*Eleagnus angustifolia*), pinyon-juniper (*Pinus edulis-Juniperus* spp.), ponderosa pine (*Pinus ponderosa*), and mixed conifer dominated by Douglas-fir (*Pseudotsuga menziesii*) and white fir (*Abies concolor*). High-elevation spruce-fir (*Picea englemanii-Abies lasiocarpa*) also occurs within the County, but because of limited access and harsh weather, this zone is largely restricted to only a few summer homes. These different vegetation types, with the exception of the spruce-fir, are discussed in terms of their general fire history and ecology, and their implications for fire management.

Grasslands

In Rio Arriba County, grasslands can occur on almost any non-forested site. They typically burn often because of fine fuels and the semi-arid climate. Fortunately, they are generally easy to suppress because total fuel loads are low and the fuels burn quickly. The clearing of grass from around structures or the establishment of watered lawns can provide a measure of protection as direct flame contact is usually required to ignite a building; however, this clearing must be done every year because grasses are annuals. Also, the vastness of the County's grasslands lengthens response time for firefighters, and the fast-moving nature of these fires makes it difficult to defend numerous scattered homes. Fire hazards and risks in the County's grasslands are highly variable, primarily as a function of presence or absence of development and total surface fuel loads.

Bosque

Bosque communities occur adjacent to the larger rivers and watercourses in the County. They are popular building sites due to screening from vegetation and the proximity to water. Fire in the bosque can be very dangerous as a function of numerous homes, extremely high fuel loads, and the tendency for fire in this forest type to spread through tree canopies (active crown fire). Fuel reduction treatments in the bosque can dramatically reduce fire hazards, but these treatments are costly because of fuel loads and attempts to implement restoration ecology practices. Fire hazards in the County's bosque areas are generally extreme.

Pinyon-Juniper

Pinyon-juniper woodlands are located primarily in the basins and foothills of the mountains. They are popular building sites because of the screening and privacy that the trees provide in otherwise open country. Fire in this stand type is typically confined to slow moving surface fire; however, in hot, dry, windy conditions, many of these stands can support fast-moving crown fires which will destroy homes and anything else in their

path. The current drought and bark beetle outbreak has caused significant mortality on many of the County's pinyon-juniper sites. As a result, and as a function of any particular site's tree density, fire hazards in this vegetation type are generally moderate to high.

Ponderosa Pine

Ponderosa pine occurs in the montane forest above the pinyon-juniper. It is a popular forest type for homesites because of the aesthetics of the forest and a generally moderate climate. However, the ponderosa pine type has been dramatically altered from presettlement times, where it grew as an open-grown forest with a clumpy tree distribution and many grassy openings.

Fire exclusion and grazing, as discussed in the opening of this chapter, have decreased competition from understory grasses and led to an increased survival of tree seedlings, an invasion of trees into grasslands, and an accumulation of deadwood and tree litter on the forest floor. These events coupled with past logging which favored the biggest and best trees has decreased numbers of large trees, increased numbers of small trees, increased homogeneity across the landscape, increased insect and disease activity, increased intraspecific tree competition, and increased mortality. Collectively, these changes have compromised the long-term health and integrity of this forest type and significantly increased the threat of catastrophic fire.

Add the current drought conditions to all of the above and most ponderosa pine surface fuels will readily burn after a few days of dry weather. This means a dangerous fire situation is possible during much of the year. The good news for homeowners and firefighters is that fuels management is very effective in this forest type. The bad news is that without fuels management the risk of severe fires can threaten homes during seasons when fires are generally uncommon. At present, fire hazards in the County's ponderosa pine type are generally high to extreme.

Mixed Conifer

This forest type occurs above the ponderosa pine zone, and of the study area communities assessed, only the Upper Brazos Canyon area is situated within the mixed conifer (even this area is transitional ponderosa pine-mixed conifer). This forest type typically has high tree density but is reasonably "fire-safe" because of moisture; however, in drought conditions like the region is currently experiencing, this forest type becomes highly hazardous. As with ponderosa pine, fuels management in this forest type is very effective, but slightly more difficult because of the greater fuel quantities generally present. Current fire hazards in the County's mixed conifer are generally high to extreme.

Fuel Models

The five vegetation types discussed above have been associated with standardized fire behavior fuel models as described by Anderson (1982). These models are known as the National Forest Fire Laboratory (NFFL) fuel model classifications, and are classified into

four groups, which include grass (models 1, 2, and 3), shrubs (models 4, 5, 6, and 7), timber (models 8, 9, and 10), and logging slash (models 11, 12, and 13).

Each model represents the surface fuels in which a fire is most likely to burn and the corresponding fire severity associated with the fuels during the severe period of the fire season. Fires burn differently in the different fuel models under the same weather conditions, primarily as a function of different fuel loading on a tons/acre basis and the fuel loading distribution among the fuel particle size classes.

The vegetation type-fuel model associations were determined during the field-based community assessment work and through personal knowledge of the County's forest types. As such, they represent only generalized relationships that might be expected for any given site.

The grassland types throughout the County are typically associated with fuel model (FM) 1 (figures 7 and 8). Fire spread in this model is governed by fine, nearly continuous herbaceous fuels that have cured or are nearly cured. Fires are surface fires that move rapidly across the landscape. When fuel moisture averages 8 percent and the effective wind speed is 5 miles/hour, a fire in model 1 has a predicted flame length of 4 feet and will spread at a rate of approximately 5,148 feet/hour (Anderson 1982).

Figure 7. Grassland - FM 1.

Figure 8. Grassland - FM 1.

The bosque forest type is best associated with FM 4 (figures 9 and 10). Fire intensity and spread rates are high and involve foliage in the understory shrub layer and woody material on the forest floor. When dead fuel moisture averages 8 percent, live fuel moisture is 100 percent, and the effective wind speed is 5 miles/hour, a fire has a predicted flame length of 19 feet and will spread at 4,950 feet/hour (Anderson 1982).

Figure 9. Bosque - FM 4.

Figure 10. Bosque - FM 4.

The pinyon-juniper forest type is associated with FM 2 and 6 (figures 11 and 12). Sparsely stocked stands with an understory dominated by grass fit model 2, and sparsely or heavily stocked stands dominated by sage (*Artemesia* spp.) or oak (*Quercus* spp.) fit model 6. Fire spread in model 2 is primarily through the fine herbaceous fuels, either curing or dead. These are surface fires where the herbaceous material, litter, and dead-down stemwood from the timber overstory contribute to fire intensity. Fire spread in model 6 is through the sage or oak layer. Fire in this model will drop to the ground at low wind speeds or openings in the stand. When fuel moisture averages 8 percent and the effective wind speed is 5 miles/hour, a fire in model 2 has a predicted flame length of 6 feet and will spread at a rate of approximately 2,310 feet/hour (Anderson 1982). In model 6, when dead fuel moisture averages 8 percent, live fuel moisture is 100 percent, and the effective wind speed is 5 miles/hour, a fire has a predicted flame length of 6 feet and will spread at approximately 2,112 feet/hour (Anderson 1982).


Figure 11. Pinyon - juniper - FM 2.


Figure 12. Pinyon - juniper - FM 6.

Pure or mixed stands of Gambel oak (*Quercus gambelii*) occur on various rocky sites within the County, and on some sites that have experienced disturbances such as fire or heavy logging. These stand types, while not discussed above, are characterized by FM 6 (figures 13 and 14), and exhibit fire flame lengths and rates of spread as described above.


Figure 13. Oak stand - FM 6.


Figure 14. Oak stand - FM 6.

The County's sparsely stocked ponderosa pine stand types typically have an understory dominated by grass or oak, and are represented by fuel models 2 (figure 15) and 6, respectively. Fire characteristics for these fuel models have been discussed above. Moderately-to-heavily stocked ponderosa pine types are dominated by an understory of pine litter and dead-down woody material, and are associated with fuel model 9 (figure 16). Fires in this model are typically moderately fast- burning surface fires, but concentrations of down material can contribute to the torching out of trees, spotting

(firebrands carried by the fire), and crowning. When dead fuel moisture content is 8 percent, live fuel moisture is 100 percent, and an effective wind speed at mid-flame height is 5 miles/hour, fire has a predicted flame length of 2.6 feet and will spread at a rate of approximately 495 feet/hour (Anderson 1982).

Figure 15. Ponderosa pine - FM 2.

Figure 16. Ponderosa pine - FM 9.

Mixed conifer and spruce-fir stand types occur throughout the County's mid-to-high elevation sites, and are associated with fuel models 8 and 10. Pure aspen (*Populus tremuloides*) stands also occur at these higher elevations, and are associated with fuel model 8 in the summer and fuel model 9 in the fall after leaves have been dropped. Fuel model 8 understories are characterized by needle and leaf litter, small twigs, and the occasional "jackpot" of heavily concentrated dead-down woody material. Fires in this model are typically slow burning surface fires with low flame lengths. Fuel model 10 understories are characterized by a significant volume of dead-down woody material, which can lead to torching, spotting, and crowning, and a corresponding difficulty with fire control. When dead fuel moisture averages 8 percent, live fuel moisture is 100 percent, and the effective wind speed at mid-flame height is 5 miles/hour, a fire in model 8 has a predicted flame length of 1 foot and will spread at a rate of approximately 106 feet/hour (Anderson 1982). In model 10, assuming the same fuel moisture and wind conditions as noted above, a fire will have a predicted flame length of 4.8 feet and will spread at approximately 521 feet/hour (Anderson 1982). Table 2 summarizes a number of fuel characteristics associated with the described vegetation types and fuel models.

Table 2. Fuel Model Characteristics.

Vegetation Type	Fuel Model	Fuel Bed Depth (feet)	*Flame Length (feet)	*Rate of Spread (feet/hour)	**% Moisture of Extinction (dead fuels)
Grasslands	1	1	4	5,148	12
Bosque	4	6	19	4,950	20
Pinyon-Juniper	2	1	6	2,310	15
	6	2.5	6	2,112	25
Oak	6	2.5	6	2,112	25

Table 2. Fuel Model Characteristics (continued).

Vegetation Type	Fuel Model	Fuel Bed Depth (feet)	*Flame Length (feet)	*Rate of Spread (feet/hour)	**% Moisture of Extinction (dead fuels)
Ponderosa Pine	2	1	6	2,310	15
	6	2.5	6	2,112	25
	9	1	2.6	495	25
Aspen	8	0.2	1	106	30
	9	1	2.6	495	25
Mixed Conifer	8	0.2	1	106	30
	10	1	4.8	521	25
Spruce-Fir	8	0.2	1	106	30
	10	1	4.8	521	25

* Flame length and rate of spread values correlate to weather conditions noted above in narrative
** % Moisture of Extinction equals moisture level at which fire will not spread

Two other points need clarification with respect to the fuel models. Any forest type can fall into model 10 if enough heavy down material is present. Examples of this might include insect or disease ridden stands, windthrown stands, overmature stands with deadfall, and aged light thinning or partially cut slash (tops and limbs from felled trees). Also, any forest type can fall into the slash models of 11, 12, and 13 if enough slash material is present on the ground. However, these slash models typically occur only during an active timber sale.

THREATENED and ENDANGERED SPECIES

Wildlife

A query of the New Mexico Game and Fish Department's Bison-M database (version 3, 2002) was used to identify Federal and State of New Mexico threatened and endangered (T&E) wildlife species known to occur in Rio Arriba County. A list of these species can be found in Appendix B.

Implementation of fuel reduction projects and/or other types of management projects on Federal lands will most likely be subject to T&E surveys, as will management on State or private lands funded with federal dollars. Private dollars used for private management are excluded from T&E surveys; however, if any known or suspected T&E species is encountered on these lands, then work should be immediately stopped and the U.S. Fish and Wildlife Service or New Mexico Game and Fish Department contacted.

Plants

The current website of the New Mexico Rare Plant Technical Council (version 15, 2002) was used to identify Federal and State of New Mexico threatened and endangered (T&E) plant species known to occur in Rio Arriba County. A list of these species can be found in Appendix B.

As with wildlife species, management on Federal lands will be subject to T&E surveys, as will management on State or private lands funded with federal dollars. And again, private dollars used for private management are excluded from T&E surveys; however, if any known or suspected T&E plant species is encountered on private lands, then work should be immediately stopped and U.S. Fish and Wildlife Service the New Mexico Game and Fish Department contacted.

WATER

Presence or absence of water sources, and where present, a general description of water source type, if present, has been recorded on the wildfire hazard rating forms. Additionally, field notes associated with the hazard assessment work have some written notes describing water sources. Further work to identify and map community water sources should be undertaken by the County GIS department. Good sources for this data include the U.S. Department of Commerce (Geography Division) TIGER database, local surveys of fire chiefs and others, and in-house interpretation of digital imagery. The wildfire hazard rating forms and field notes can be found in Appendix A.

ARCHAEOLOGICAL RESOURCES

As with T&E species, Federal lands require archaeological surveys and clearances for most projects, and private and other non-federal lands need archaeological site surveys if a project is federally funded. New Mexico statute regarding cultural sites on private lands prohibit only the disturbance of human burial sites. For further information on archaeological or other cultural resources, contact Michelle Enzy of the New Mexico Office of Cultural Affairs - Historic Preservation Division at 505-827-4064. Also, if any known or suspected archaeological sites are encountered on private lands, then work should be immediately stopped and the New Mexico Office of Cultural Affairs contacted.

UTILITIES

A Public Service Company of New Mexico (PNM) electric and gas transmission system map covering the entire State is enclosed. It is recommended that this map be acquired from PNM by the County's GIS Department so that electric and gas transmission layers could be readily identified for planning and emergency purposes.

With respect to management of power lines running through national forest lands, the Forest Service typically has right-of-way agreements with local power companies whereby the Forest Service permits the right-of-way to the utility company for general line maintenance purposes, which includes the clearing of hazardous vegetation. These power line right-of-ways are then generally inspected by the Forest Service with a formal inspection form to ensure maintenance, and copies of the inspection findings are sent to the utility.

With respect to management of power lines crossing San Miguel County lands, or lands such as subdivisions in which the County might have regulatory authority, a similar right-

of-way permit which mandates the utility company to maintain the lines free from vegetation and other hazards is recommended, if not already in existence. From a fire safety perspective, an even better approach would be an ordinance requiring all new power lines to be underground.

ROADS

Road data relating to community ingress/egress, road width, general road condition, fire service access, bridges, and presence or absence of street signs has been recorded on the wildfire hazard rating forms, and/or on the field notes associated with the hazard assessment work. If not already available, further work to identify and map County roads should be undertaken by the County GIS department. Good sources for this data include the U.S. Department of Commerce (Geography Division) TIGER database, and in-house interpretation of digital imagery. The wildfire hazard rating forms and field notes can be found in Appendix A.

Of particular note regarding roads is the Brazos Canyon area. The main road, State Road 512, is essentially the only road accessing this area. Furthermore, it is narrow and at one point in the lower canyon has a one-vehicle bridge crossing which, in the event of an emergency, would definitely serve to bottleneck traffic. As such, this road severely limits evacuation options and greatly increases personal risk to residents and recreational users.

On a different note, right-of-ways adjacent to State roads are the responsibility of the New Mexico State Highway and Transportation Department. These right-of-ways are highly variable in their dimensions as a function of many variables. From a fire safety perspective, the obvious fire hazard reduction practice on these right-of-ways would be to implement "daylighting" operations in which hazardous roadside vegetation is cleared. This is a viable hazard/risk mitigation technique, and is the responsibility of the Highway Department. As such, future collaboration with this agency for the purposes of fire hazard reduction is recommended.

COUNTY WILDLAND FIRE ORGANIZATIONS

Federal and State government, along with local volunteer fire departments (VFD) serve as the primary firefighting entities within the County. The U.S. Forest Service represents the Federal government and has jurisdiction on national forest service lands. The New Mexico Forestry Division - Chama District - represents State government and has statutory responsibility for fire suppression on State and private lands. Additionally, as defined through a Joint Powers Agreement (JPA) between the Forestry Division and Rio Arriba County, the local volunteer fire departments also fight fire on State and private lands.

Volunteer Fire Departments

Departments

The County is comprised of 18 VFDs which are funded through the State Fire Marshal's Office (SFMO). Additionally, one new department is being planned for an area between Chamita and Abiqui off U.S. Highway 84 (Valdez pers. comm.) The VFD names, locations, and districts can be found on the enclosed Rio Arriba County Fire District Map.

Funding

The funding process for VFDs in New Mexico is complicated. Essentially, it begins with the State Insurance Division, which is a department within the Public Regulation Commission (LexisNexis 2001). All money received by the Insurance Division for fees, licenses, penalties, and taxes is paid daily by the superintendent of the State Treasurer and then credited to the "Insurance Department Suspense Fund." At the end of every month, all money derived from property and vehicle insurance are then transferred from this "suspense" fund to what is known as the "Fire Protection Fund."

The State Fire Marshal, who serves as the Bureau Chief of the Fire Marshal Bureau of the Insurance Division, then allocates these funds to incorporated cities, towns, and villages, and to county fire districts in proportion to their respective needs. This determination of need is based on:

- Whether or not a fire department has met various requirements of the SFMO (reporting requirements primarily).

- Whether or not the department possesses fire equipment in serviceable condition to respond to a fire incident.

- Whether or not a department has been regulated in accordance with a duly enacted ordinance for a period of at least one year.

Assuming all these requirements have been met, an annual allocation is then made to fire departments in accordance with what is known as the Insurance Services Office (ISO) Public Protection Classification (PPC) program. ISO is an independent organization that serves insurance companies, insurance regulators, fire departments, and others by providing information about risk. ISO's PPC program evaluates a community's fire protection according to a uniform set of criteria, incorporating nationally recognized standards developed by the National Fire Protection Association and the American Water Works Association. This data is then analyzed to assign a PPC rating from 1 to 10. Class 1 represents the best public protection, and Class 10 equals less than the minimum recognized standard (ISO 2002).

A community's PPC evaluation and final class rating depends on:

- Fire alarms and communication systems, including telephone systems, telephone lines, staffing, and dispatching systems.

- The fire department, including equipment, staffing, training, and the geographic distribution of fire companies.

- The water supply system, including condition and maintenance of hydrants, and a careful evaluation of the amount of available water compared with the amount needed to suppress fires.

A community's PPC rating is important because virtually all U.S. insurers of homes and businesses use ISO's PPC in calculating premiums. In general, the cost of fire insurance in a community with a good PPC is substantially lower than in a community with a poor PPC. ISO's PPC rating is also important to the VFDs because it directly influences their allocation of dollars from the SFMO. The 1999 SFMO allocations to VFDs, based on their PPC class ratings, can be found in table 3 (LexisNexis 2001).

All the VFDs are currently classified with an ISO PPC rank of between 5 and 10 (Valdez pers. comm.). Efforts focused on increasing the PPC rank of these departments will bring more money to the fire program, help to save lives and property, and help the community to save money on fire insurance.

Table 3. 1999 SFMO Allocations to Volunteer Fire Departments.

PPC Class Number	Main Station Allocation (dollars)	Substation Allocation (dollars)
1	58,245	21,584
2	53,957	20,145
3	49,641	18,705
4	45,323	17,266
5	43,164	15,827
6	41,007	14,388
7	38,848	13,670
8	36,691	12,950
9	27,339	10,797
10	24,460	none

Training

Some VFD personnel, because they are volunteers, have had little or no formal wildland firefighter training. The SFMO, with assistance and guidance from the New Mexico Firefighters Training Academy (NMFTA) Advisory Committee, has compiled a recommended training curriculum for the position of Firefighter 1. This curriculum is contained in a document entitled *New Mexico Firefighting Qualification System Task Book for the Position of Firefighter I*, and is especially suited to VFDs because it covers the basic skill requirements for both structural and wildland firefighters. However, the

SFMO-recommended curriculum explicitly states that local government, in conjunction with the fire departments under its jurisdiction, is responsible for determining local training policy. This local policy in Rio Arriba County, if it exists, is unknown to SEC. As such, a copy of the Firefighter I Task Book is included in Appendix C, and a recommended list of training courses is provided below.

The minimum recommended training for any wildland firefighter is the National Wildfire Coordinating Group S-130 (Firefighter Training), S-190 (Wildland Fire Behavior), and I-100 (Basic Incident Command System Module 1) series of courses, which are a 16-hour introduction to wildland fire and the formal management structure (Incident Command System, or ICS) used on many fires. These courses are often followed with S-131 (Advanced Firefighter/Squad Boss), which builds on S-130, and I-200 (Basic Incident Command System Modules 2-6), which builds on 1-100. Another good course for all the volunteers is S-290 (Intermediate Fire Behavior), which is a 32-hour course designed to meet the training requirements for any of the single resource boss positions in the ICS operations section. This "skill" course includes topics on the fire environment, weather processes, temperature and humidity relationships, atmospheric stability, general and local winds, topographic influences, fuels and fuel moisture, and environmental factors and indicators influencing fire. The prerequisites for this course are Basic Wildland Firefighting or equivalent (S-130 /S-190/I-100). This course is also required training for any single resource boss position.

For the local fire chiefs of each volunteer department, or for anyone wishing to pursue wildland firefighting in a seasonal or full-time position, S-230 (Crew Boss) is recommended. This is a 24-hour course which provides training for potential crew bosses for supervisory positions in the ICS organization. Subjects include fireline safety duties, placement of the crew in the fireline organization, crew boss or incident commander responsibilities and duties, crew boss or incident commander fireline tactics, fire as a tool of suppression, crew boss duties of a large crew on a complex fire, property accountability, and off shift responsibility. Emphasis is on managing a suppression crew. S-215 (Fire Operations in the Urban Interface) is another good course for those inclined to pursue a career fighting wildland fire. This is a 24-hour course designed to meet the training needs for initial attack incident commanders confronting wildland fire that threatens life, property, and improvements. Subjects include size up, initial strategy and action planning, structure triage, tactics, action plan assessment, public relations, and safety.

Two additional training recommendations relate to the need for first aid and hazardous materials training. Every volunteer should attempt to enroll in a basic cardiopulmonary resuscitation (CPR) class, or better yet, an American Red Cross first aid class. For those considering firefighting as a career, an Emergency Medical Technician (EMT) training course is recommended. Most states divide EMT training into three separate courses including basic, intermediate, and paramedic-level training. A “basic” course is approximately 100 hours of training. Upon completion of the training, a state-administered test for certification may be taken. A hazardous materials (HAZMAT) class is also important because of the potential harm these substances can cause. This is

especially important with structure fires, as hazardous materials are often stored in garages, sheds, and barns.

Lastly, wildland firefighting demands a high level of fitness to safely perform physically demanding work in difficult environments. Physical fitness should be maintained by all firefighters for their personal safety, coworker safety, and improved operations. The standard physical fitness test employed by most, if not all, state and federal firefighting agencies is the "Pack Test." The Pack Test is a work capacity test used to measure aerobic capacity, muscular strength, and muscular endurance; it qualifies individuals to work at three levels of wildland firefighting duty: arduous, moderate, and light. For those agencies requiring the test, an individual fighting fire in the field is required to pass at the "arduous" level. This requires a firefighter to walk with a 45-pound pack over a flat three-mile course in approximately 45 minutes. No jogging or running is permitted and the test is Pass/Fail only.

Training courses are available from various institutions or agencies. The SFMO is responsible for firefighting training, and works in cooperation with the NMFTA, located in Socorro, to conduct a large number of both structural and wildland courses throughout the year. Further information regarding the NMFTA and their programs can be had by calling 505-835-7500. The State Forestry Division also conducts wildland fire training; information regarding their classes or the Pack Test can be had by contacting Joe Valdez at 505-588-7831.

Equipment

Equipment needs include personal firefighting clothing, tools, and engines. Appropriate clothing is the most basic piece of gear required of any firefighter. Wildland fire clothing is very different from that of the structural firefighter, and is referred to as personal protection equipment (PPE). Every firefighter needs a full set of PPE which meets the minimum standards established by the National Fire Protection Association. This PPE gear includes a set of nomex pants and shirt, leather gloves, an appropriate helmet, and a pair of high-topped leather boots with a vibram sole (no steel toe). Additionally, each firefighter needs a fire shelter, which has to be on their person at all times. Training in the proper deployment of the fire shelter is critical, and needs to be practiced periodically as a training exercise.

Other recommended items include a pack to carry a headlamp, sunglasses/goggles, water bottles, food, an emergency first-aid kit, maps, compass, ensolite pads, and sleeping bags. As a bare minimum, every fire department should allocate dollars to outfit each firefighter with the above-mentioned PPE gear (boots are typically bought by the firefighter), and at least a pack, headlamp, water bottles, and a small first-aid kit.

Each fire department also needs pagers and/or cell phones, hand held multi-channel radios that are compatible with other agency radios, chainsaws, hand tools, and bladder bags. With the exception of the pager and/or phone, these items are the basic tools which allow a firefighter to actually work at wildfire suppression. The pager and/or cell phone

is simply recommended so volunteers can be contacted in the event of a fire. Radios are essential to maintain communications between all support staff in the office and firefighting personnel in the field. The number of radios recommended for each department is a function of the number of personnel responding to and fighting a fire. The rule of thumb is that no firefighter should ever be out of radio contact with others. This means a hand crew of 10 men may be working together with only one radio, but in that situation, those 10 men would stay together. A radio call sheet listing channels and frequencies used, and the call sign for each radio-carrying volunteer needs to be available to all who possess a radio.

Chainsaws are essential for the felling of hazard trees on a fire, and occasionally for the clearing of fireline and roadways. Each engine (discussed below) should carry at least one chainsaw, and have an experienced sawyer assigned to that saw. Associated gear for the sawyer includes earplugs, eye protection, and chaps. Recommended firefighting hand tools include Pulaskis, McLeods, shovels, and flappers; each department should have a minimum of five Pulaskis, McLeods, and shovels, and three flappers. Bladder bags are 5-gallon water bags with an attached hose and nozzle apparatus. They are carried like a backpack and used for hot spots that a hose lay or engine cannot reach. Each department should have a minimum of two bladder bags, and some spare water bag liners.

At least one, preferably two, wildland firefighting engines are recommended for the most active departments and the most remotely isolated departments. A four-wheel drive, Type VI engine is recommended. This engine type is relatively small and maneuverable, and can carry approximately 200 gallons of water. Minimum equipment on a truck should include a multi-channel radio, a water tank and pump, hoses of varying lengths and diameters, various hose adapters/valves, various nozzles, a spanner wrench, and drafting equipment. A hard line hose mounted on a reel and a foam proportioner are nice additions. Also, a bolt cutter to access locked gates is essential. And finally, according to the County Fire Marshall (Sanchez, pers. comm.), large capacity water tenders are in short supply and sorely needed.

PRIVATE LANDS MANAGEMENT

The WUIP focus is on private lands, and with respect to timber harvest on non-municipal or non-federal lands, New Mexico State Forestry has legally mandated regulations. These regulations require a harvest permit for the removal of commercial species on any area(s) totaling 25 acres or more in a calendar year. Harvest permit applications must be completed and submitted to the Chama District of New Mexico State Forestry before the commencement of harvesting. Upon receipt, District personnel review permits and make approval or denial based upon merit and adherence to the law. Provisions within the regulations define, amongst other things, harvest unit sizes, slash treatment practices, erosion control practices, and tree utilization standards. After harvesting commences, State Forestry personnel make formal inspections of harvest activity to ensure compliance with the permit. Non-compliance may bring a written “Notice of Deficient Condition” outlining needed actions and timeframes for remedy of work. A failure to correct deficiencies may bring criminal penalties.

For further information regarding the status of forest management activity on private lands, contact Craig Doherty of the State Forestry Division at 505-588-7831.

SANTA FE -CARSON NATIONAL FOREST LANDS MANAGEMENT

Management on national forest land is the responsibility of the Forest Service - an agency of the U.S. Department of Agriculture. Because of public ownership on these lands and a myriad of environmental laws governing management, project-level work can take a long time to go from planning stages to on-the-ground implementation.

Nonetheless, partnering with the Forest Service to support local management is highly encouraged, especially as many of the County's communities are surrounded by national forest service lands.

Information regarding fire hazard reduction and other related projects on the Santa Fe National Forest can be perused online at www.fs.fed.us/r3/sfe/ or by calling 505-438-7840. Information for the Carson National Forest can be seen at www.fs.fed.us/r3/carson/ or by calling 505-758-6200.

Chapter 3: Values at Risk

COMMUNITY SUSTAINABILITY

Until recently, attempts to minimize wildfire hazard to communities have focused almost exclusively on the reduction of fuels around homes and perhaps a small buffer around the community, referred to as the wildland-urban interface (WUI). Research has shown that fuel mitigation immediately adjacent to homes and other structures is central to reducing the risk of property damage or loss from wildfires (Cohen 2000). The minimum distance between a structure and vegetation of various flammability, the type of construction materials used, and other variables can be defined by examining how far radiant heat, sparks, and embers are likely to travel in front of a fire, how long it will take for fire crews to reach a neighborhood, and so forth. These variables can be used to define the "home ignition zone" of structures in any community and have gained national acceptance through programs such as Firewise (www.firewise.org).

The above approach, which has been used in this plan, is effective for saving homes and realistically accomplished. However, it may not be a perfect fit for the fire-prone area around a community. The recent dramatic increase of "mega-fires" has led to a heightened awareness that homes and other structures are not the only highly valued items at risk. This being the case, the strategy and even the dimensions of the WUI depend on the community's values and priorities.

While the protection of human lives is an easily selected first priority, the prioritizing of values beyond that may vary by individual or community. Summerfelt (2001) suggests that to many communities the loss of structures may not necessarily be the second most important value. Discussions with Los Alamos, New Mexico residents following the 2000 Cerro Grande Fire support this premise. Many of these residents whose homes were saved said that they would rather have lost their homes, which could be rebuilt in a couple of years, than the environment in which they chose to build their homes, which will take many generations to heal.

This, and numerous other anecdotes, suggests that an expanded notion of what the WUI includes may be appropriate. Summerfelt (2001) offers the following definition of the WUI:

> "An area in-and-around a neighborhood or community where the immediate or secondary effects of a wildfire threaten values-at-risk and will be a serious detriment to the area's overall health and sustainability."

Of course, the same physical properties of fire and fuel used to define the home ignition zone apply in the WUI. However, for the WUI, the focus of the planning expands beyond the protection of structures to include the full range of values that the community hopes to protect. The WUI then becomes a planning area for fuel reduction activities that

not only will save many community structures, but also will protect many other community values at risk.

Choosing to address these additional values introduces an added layer of complexity to planning efforts. To simplify, it may be easiest to think of the things that individuals' value within their community in several broad categories: safety, prosperity, and quality of life. Although the specifics will vary by community, there are general value components that all communities share.

Safety of the Community

The May 2000 Cerro Grande and Viveash Fires, which destroyed 235 homes and burned approximately 77,000 acres, started at sites with similar topographic and fuel conditions as those found in Rio Arriba County. Had a fire similar to the Cerro Grande or Viveash occurred at the mouth of Brazos Canyon, hundreds of lives and homes (and other community values) might very easily have been lost.

A disadvantage of living in a place like Brazos Canyon is the likely inability to escape the area in the event of a fire. Evacuation, if possible at all, will be logistically complex and time consuming as a function of dispersed numbers of people throughout the area, limited communications, and limited escape routes. Motorist and pedestrian safety, the ability of firefighters to maneuver and even panic are some of the factors that can negatively affect defense efforts.

Residents' fortunate enough to not be in immediate danger from the flames of a large fire may still have to cope with smoke. Smoke from intense wildfires contains particulate matter of a size and composition that can be very harmful to human health. Residents with pre-existing respiratory problems are particularly vulnerable. Smoke can also lower visibility, slowing evacuation traffic, causing vehicle accidents, and increasing emergency response times.

After the smoke has cleared, new threats emerge. Standing dead trees begin to decay and become hazardous to people and property. Just walking through a severely burned area can be dangerous because rocks have been dislodged from the heat of the fire and waist-deep holes, remnants of tree root systems, may be hidden beneath a thin layer of freshly fallen needles.

Perhaps the greatest post-fire dangers come with the monsoon rains. Rainfall that was once intercepted (and quickly evaporated) from tree foliage now strikes the ground directly. Gone are the roots, understory plants, leaf litter, and fungi that once absorbed moisture, buffered the soil-compacting properties of raindrop impacts during heavy rains, and held soil together. In areas that have burned particularly hot, the soil may become hydrophobic – unable to absorb water. Soil erosion, flooding, and watershed degradation of an unprecedented magnitude may threaten public health and safety for years after a wildfire.

Flames, smoke, and the secondary effects of a fire can have severe negative effects on mental health leading to depression, post-traumatic stress, and other health problems. The loss of pets, family heirlooms, financial stability, neighborhoods, schools, and places of employment can have an enormous emotional impact. Catastrophic events can also undermine residents' sense of security and confidence in their government.

Economic Health of the Community

The culmination of individual financial losses plus the loss of productivity and revenues during a catastrophic fire affects the short-term prosperity of an entire community. The cost of cleanup and repair to infrastructure may be an additional strain. Although the effort to rebuild a community after a large wildfire may be assisted by the state and federal governments, community coffers are still likely to be drained.

A community's ability to generate revenue through sales and property taxes and to develop economically is in many ways dependent upon its environmental setting. The potential long-term economic effects of a catastrophically burned setting and degraded forest health present a chronic, but equally harmful, threat to the community. Just the perception of a large wildfire threat can affect the long-term economic health of the community. During the massive Rodeo-Chediski Fire near Payson, Arizona, newscasts and government officials reported the location of the fire as "between Payson and Show Low." This led prospective visitors to the Regional Payson Area to call from across the country to cancel hotel reservations, and lost tourist revenue was estimated at nearly one million dollars. Additionally, insurance companies began withdrawing underwriting of properties in escrow shortly after the fire began, high-lighting how obtaining fire insurance in the Payson area has become increasingly difficult, and will remain so until the real and perceived threat of catastrophic wildfire diminishes.

After a catastrophic fire, businesses or second-home buyers may be unwilling to relocate to an area because of degraded aesthetic qualities, fewer outdoor recreation amenities, damaged infrastructure, or even the perceived dangers of another catastrophic fire.

The types of businesses willing to relocate, or able to grow within an extensively burned area are also limited. For example, wood-based industries, which are very sensitive to transportation costs and consistent raw material supplies, would be much less likely to develop in deforested areas.

Then there is tourism, which accounts for a major proportion of the County's economy. Although unquantified, a large proportion of County residents are directly involved with the sales and service industry either on a primary or secondary basis. On a typical summer weekend, many tourists pass through the County's idyllic mountain villages and communities, stopping for gas, food, or perhaps to spend the night in one of the many area lodges, hotels, or bed and breakfast rooms.

In summary, most visitors come to the County because of its environmental setting. Outdoor recreation accounts for much of the region's tourism. A catastrophic fire could

affect many aspects of this: fisheries would be degraded by siltation, the Santa Fe and Carson National Forests might close roads where soils are sensitive to damage, wildlife populations could drop, and scenic beauty would certainly be diminished.

Quality of Life in the Community

Hunting, fishing, hiking, camping, scenic drives, and other outdoor activities are important activities to tourists and locals alike. Additionally, some who live or visit the area have developed deep bonds, spiritual or otherwise, to particular sites. These activities, the area's scenic value, and these emotional and spiritual ties are primary reasons that people choose to live and work in the area.

WILDFIRE DAMAGES

There are over 100 critical fire weather days per year in the area when high temperatures, low humidity, and wind create the potential for catastrophic wildfire. This condition, coupled with forest conditions, population growth, the recreational appeal of the area, and the current drought creates a prescription for disaster. Catastrophic wildfire is now the natural condition in the area as evidenced by the Cerro Grande, Viveash Fires, and other fires. Considering the current fire-prone nature of the area's forests, it is only a question of when, not if, a catastrophic wildfire will occur.

Human safety issues related to fire were broadly discussed in the preceding section. However, to further highlight the severity of the current situation, a spectrum of damages from past fires is discussed here. These damages are for Rio Arriba, Los Alamos, and San Miguel County (the latter two counties border Rio Arriba), and include the following:

- In the 16-year period from 1987 to August of 2003, 1,233 fires requiring some type of response occurred in Rio Arriba County alone. These fires burned a collective acreage of just under 17,871 acres and cost an estimated $472,879 to suppress (EMNRD 2003, Appendix D). In reality, many more starts probably occurred, but did not get reported for any number of reasons.

- In the three-year period from 2000 to 2002, six large fires – the Cerro Grande, Viveash, Dalton, Roybal, Trampas, and Borrego Meas Fires – burned a collective area of approximately 95,600 acres, or slightly under 150 square miles.

- Fire behavior on the Cerro Grande and Viveash Fires was frightening. In one burn period (that part of each 24-hour period when fires spread most rapidly, typically from 10:00 a.m. to sundown), the Viveash fire traveled an estimated eight miles and incinerated approximately 18,000 acres.

- Subsequent to the Viveash Fire, the Surface Water Quality Bureau of the New Mexico Environment Department conducted water quality studies of the

Upper Pecos and Gallinas Rivers downstream of the fire (Hopkins 2001). Their findings revealed that the fire did extensive damage to a tributary of the Pecos River known as Cow Creek, thereby potentially destabilizing the Pecos River. Damages included significant ash and sediment deposits, severe erosion, fish and invertebrate die-offs, and compromised water quality. Figures 17 and 18 show extensive erosion on low gradient uplands of Upper Cow Creek, and Cow Creek flooding.

Figure 17. Severe erosion on Upper Cow Creek (photo courtesy of Charlie Wicklund - NM Forestry Div.).

Figure 18. Cow Creek in flood stage (photo courtesy of Charlie Wicklund - NM Forestry Div.).

- The Viveash burned just under 4.5 percent of the Upper Gallinas River Watershed, thereby preventing the City of Las Vegas from diverting 112 million gallons of water to their storage reservoirs (Tafoya, pers. comm.).

- The Cerro Grande and Viveash forced the evacuations of over 18,000 residents collectively destroyed over 240 homes and structures.

WILDFIRE RISK

To gain a better appreciation of the County's past fires, a New Mexico State Forestry "Morning Report" from the period 1987 to 2003 has been included in Appendix D. This document is a fire report and lists, amongst other things, a fire's geographical location and a fire's cause. This data could be entered into a County GIS program to better understand wildfire risk and the spatial distribution of past fires. This type of data would be immensely helpful as a tool to prioritize future treatment areas.

WILDFIRE EVACUATION

Given that certain portions of the County are prone to catastrophic fire, a conservative, well conceived, and practical evacuation plan is essential to the safety and welfare of the County's populace. The WUIP details both a traditional and contemporary approach to evacuation, as one approach will never fit every possible scenario.

Traditional Approaches

The traditional evacuation strategy is to remove all living beings, especially humans, from an area threatened by wildfire. This approach has been well documented to take a long time to implement and complete, and it requires tremendous human resources to be

effective. In many cases, the human resources and equipment involved in these evacuations must be diverted from initial attack of the fire event, thus allowing the fire to grow beyond an early controllable size.

Contemporary Approaches

Contemporary evacuation strategies center on what is known as "sheltering in place". This practice relies on creating relatively safe havens for people (and animals) to go to until the main front of a fire passes. The idea is based on the theory that in many cases it is safer for evacuees to move to a safe place, such as a structure with defensible space, than it is for them to try to escape a fast-moving fire. There has been adequate research conducted most recently by Jack Cohen of the U.S. Forest Service that shows that the front of a passing wildfire is generally a relatively short-term event. Depending on slope and wind, the flaming front of a wildfire can pass a building within a 15-to-30 minute period. Cohen's research also shows that with a clearance of only 100 feet, a passing wildfire will not significantly ignite a structure (many of the structures lost in a wildfire are actually ignited by a creeping surface fire long after the catastrophic crown fire has passed by the area).

Traditional Versus Contemporary Approaches

Obviously, both strategies offer alternatives to public safety managers charged with life safety during a fire event. Given the science however, the decision to evacuate or shelter in place should not be made lightly; especially where traditional evacuation methods are constrained by access/egress points as is the case in Brazos Canyon. The choice between the two evacuation strategies should be based on the following:

- Length of time available to begin an evacuation (warning).
- Time it takes to remove threatened occupants (withdrawal).
- Places and methodologies for tracking and housing evacuees (sheltering).
- Ability to return to normalcy (return).

The first and most important element to consider when planning an evacuation is to determine how many potential evacuees exist and where they are located. Public safety officials should work with local residents to identify this through the mapping of residences and the identification of residents who live and work in the area. This should be a known variable and will form the basis from which to coordinate an evacuation should one be ordered. The unknown variable will be the transient recreational population that will be present in some areas during the fire season. This population could be extremely high on public lands and the location of these people virtually unknown. This complicates planning strategies.

A system to track recreational uses should be implemented and maintained during the fire season. High use public land access points should be staffed and inventories maintained of all who use these areas during fire season.

In addition to the above, the following points need consideration when developing a planning strategy:

- Involve all stakeholders in the planning process.
- Identify a central coordination point and a central lead agency.
- Identify resources available to assist evacuation efforts.
- Identify roadways and their capacity to move traffic.
- Identify roadways that will also be handling the response of emergency equipment toward the wildfire event.
- Immediately seize control of access/egress points and track activity into and out of the area.
- Identify mechanisms for informing occupants and users to leave the area, such as:
    - Zone coordinators are individuals responsible for evacuation notifications in a specific area; they are typically locals who know the area and its residents well.
    - Emergency broadcast systems on radio and television.
    - Loudspeakers from emergency vehicles and helicopters to cover the backcountry.
    - Telephone trees, which are especially effective for locals.
    - Signs at key locations, especially at recreation points of contact.
    - Reverse 911 systems or automatic dialers that inform people simultaneously.
- Provide maps for everyone involved in the effort.
- Provide for a common communication method, especially between field resources.
- Provide safety equipment and the training on how to use it.
- Develop a basic operations plan and practice using it.
- Develop a pre-established set of instructions for homeowners.
- Establish a process of tracking human resources, especially those implementing the evacuation.
- Identify appropriate vehicles and equipment for use during evacuations.
- Establish a plan for animal and pet evacuation.
- Identify shelter facilities, preferably those with cooking and restroom capabilities.
- In certain communities, such as Brazos Canyon, identify “safety zones” where large numbers of people and/or animals can be sheltered in place.
- Provide material and guidance on ways for property owners to make their structures fireproof.

Organizational Structures and Processes

The New Mexico State Police is the lead agency for actually instituting evacuations. It is suggested that a County emergency preparedness division, or some similar County

authority, in conjunction with the County Fire Marshal's Office, be the lead agencies for evacuation preparedness and planning.

The planning structure should emulate the Incident Command System (ICS) for planning purposes. This will familiarize local agencies with the ICS system and how it works. The ICS system should be used to implement evacuation decisions during emergencies.

Planning meetings should begin immediately and address the planning strategies listed above. Site-specific plans can be developed, especially for local homeowner use. Planning meetings should be held frequently during development of the specific evacuation plan and the plan should be updated every winter in preparation for the spring fire season. The plan should also, to the extent practical, dovetail into the County's Draft Hazard Mitigation Plan prepared by URS.

A variety of additional information on evacuations, including New Mexico State Forestry's Draft Brazos Canyon Structure and Evacuation Plan can be found in Appendix E.

Chapter 4: Management Recommendations

SHORT-TERM RECOMMENDATIONS

Below are a series of comprehensive recommendations based on the needs of the study area and the successful components of other WUI projects that have demonstrated effectiveness. Some of these actions will lie primarily in the hands of municipalities, elected officials, and resource managers, while others will need tremendous collaboration-building efforts.

As defined here, these recommendations are short-term and should be implemented within the next year, or as soon thereafter as practical.

Adopt an Ecological Restoration Approach to Planning and Projects

Ecological restoration is the process of helping degraded ecosystems recover. It is generally conducted through an examination or knowledge of the ways in which an ecosystem evolved and functioned in the past, and then using that reference condition as a guide to making beneficial changes to the current system. With respect to forests, restoration typically involves restoring ecosystem structure (species composition, vegetation density, vegetation continuity across the landscape, etc.) and function (energy flow, nutrient cycling, fire regimes, grazing, etc.) to a point where the system is resilient to a normal range of environmental stresses and disturbances, while at the same time providing for economic and social sustainability.

Adoption of a restoration approach to management rests on the belief that our southwestern forests are not healthy because they have departed from a range of natural conditions, and this in turn has led to serious negative consequences for both ecological and human values. The most commonly cited example of departure from natural conditions relates to fire size and intensity in southwestern ponderosa pine forests – large-scale, stand-replacing fires seem to be the norm today whereas they were generally unknown in this forest type until the middle of the 20th century.

Restoration of any landscape is complicated, but this especially true of the WUI because of high land costs, multitudes of landowners, small parcel sizes, and overriding concerns for aesthetics and safety. As an example, the dominance of humans in the WUI can directly affect basic ecosystem functions such as nutrient cycling and fire behavior because of fire suppression activities; however, restoration of natural fire may not be feasible because of danger to humans and their property. Therefore, in the interface, restorationists must abandon many tenets of restoration designed for wild landscapes and clearly define what can and cannot be managed.

One important WUI restoration goal that typically can be planned for is management aimed at reducing the spread of invasive species (and/or other agents of ecosystem alteration) to wildlands. This may sound inconsequential, but is critical because of the

increasing potency and extent of edge effects associated with development, and the fact that without effective buffering of human-dominated landscapes restored or protected areas will not function properly (Marzluff and Bradley 2003).

Other WUI restoration considerations include landscape-scale planning that interconnects restored areas with neighborhoods, cities, unmanaged patches, riparian areas, etc. When thoughtfully planned out, this type of management can create wildlife habitat corridors, fuel breaks, and other landscape patterns that optimize the effect of restoration across the landscape.

The unique social, political, and biological qualities of the WUI will profoundly affect restoration possibilities. The importance of socio-political and ethical components of restoration cannot be underestimated. Whether or not an ecosystem is "healthy" depends as much on human values of risk as it does on scientific definitions of ecological structure and process. To move forward with an ecological restoration approach, it will be imperative to include a broad spectrum of stakeholders in the process. This is discussed below.

Encourage and Support Implementation of a Community-Led Group That Could Carry Out Collaborative Forest Restoration Projects

Broad agreement exists on the issues of forest restoration, fire hazard reduction, and the general need to "do something" to increase long-term sustainability of communities. However, the devil is in the details, and the types, levels, and locations of project-level treatments are often disputed, effectively slowing down or in some cases completely stopping good projects.

One way to build consensus and consolidate efforts is with community partnerships. These organizational models have become increasingly common because of their success, which is attributed to, amongst other things, the fact that people want access to information and the decision-making process, and they want some sort of power to influence the process and its outcomes (Tuler and Webler 1999). Specifically, the following actions are recommended:

- Form a group whose goal is to address forest restoration. The makeup of this group might include local, State, and Federal government, as well as public utilities, private businesses, environmental interests, and other key stakeholders.

- Define the role of this group. It may function most effectively by facilitating neighborhood-level grassroots efforts, i.e., providing information and acting as a conduit between these groups and others such as the Santa Fe or Carson National Forest. Alternatively, the group could provide organized advocacy to get projects funded, help entrepreneurs develop restoration by-product markets, produce fire risk reduction incentives through County regulatory changes, and so forth.

- Build a group project team (coordinator, utilization specialist, secretary) to pursue multilateral project planning, outreach, utilization, and other efforts. The team could lead and manage grant opportunities, plan and implement projects, explore innovative restoration by-product uses and business development, and network with other regional projects similar in scope.

- Define procedures for participation with the Forest Service that are consistent with the National Environmental Policy Act, the National Forest Management Act, the Federal Advisory Committee Act, and other laws and regulations which govern that agencies management.

- Develop a decision-making process that addresses issues of inclusiveness and openness.

To help "jump start" the formation of such a group, it is recommended that representatives from a similar successful group be recruited to do a workshop on their efforts. One such group – the Northern Rio Arriba Wildland-Urban Interface Corporation – is based in Brazos Canyon and has had some success with grant writing and implementation of defensible space work. Other successful local groups include La Montana de Truchas (based out of Truchas) and Las Humanas (based out of the Manzano Mountain area. Outside regional groups include the Greater Flagstaff Forest Partnership (www.gffp.org), the Boulder County Wildfire Mitigation Group (www.lamar.colostate.edu/~csfsbo/wildfire/index.htm), and the Applegate Partnership (www.arwc.org). All of these groups, with the exception of the Brazos group, have been in existence for over five years and could be a valuable source of knowledge and experience.

Develop Innovative Structural and Policy Approaches to Fire Management

A community-based fire group like the one described above, if successful, could immensely improve forest health and fire safety in the County if planning efforts can be realized on the ground. However, policy makers and resource managers have learned from recent attempts to implement restoration that throwing money at a problem and expecting immediate results is not realistic. In many cases, implementation fails because the appropriate infrastructure, personnel, resources, procedures, and regulations are not yet in place. The following recommendations address some of these problems:

- Consider hiring, if not already done, a fuels management officer as a shared position between fire departments to lead and coordinate unilateral efforts on non-federal lands.

- Eventually develop a County WUI fuels reduction/restoration crew.

- Integrate fuels management and fire risk reduction techniques and education into the core technology of local fire departments.

- Use a fire code or other locally adopted ordinances to compel new development to be fire safe. Require forest stewardship before development and the utilization of limited combustible building products (discussed in greater detail below).

Pursue Community Outreach and Education

The behavior exhibited by community members toward WUI treatments is directly related to their beliefs about the outcomes of the treatments. Knowledge of how values are affected by thinning and burning and an understanding of why these activities need to occur are factors that form a person's belief system, which in turn dictates the intention and eventual action of supporting or not supporting a treatment (Delost 2001).

Educational programs have long been suggested as a way to foster public support for fire reduction treatments. It is likely that many area residents already have a positive attitude toward fuel reduction in wake of the devastating Cerro Grande and Viveash fires of 2000. However, this support needs to be maintained over the long periods of time that it takes to implement meaningful forest restoration. Specific recommendations include:

- Emphasize all the values that are at risk because of a degraded forest ecosystem.

- Educate homebuilders about Firewise construction standards (Firewise is a national WUI fire program).

- Educate homeowners about vegetation management around the home.

- Target all educational programs to produce action. A survey conducted before the Rodeo-Chediski Fire in Arizona found that over half the survey respondents would be willing to consider support of a tax increase, volunteering time, or donating money to support restoration causes.

- Utilize a variety of public education strategies, including both mass media tools and targeted grassroots-level, neighborhood meetings. Ideas on mass media educational tools include strategically located signs explaining fire hazards/restrictions, a website, videos, television spots, radio spots, newspaper ads, printed fact sheets to be handed out at various businesses and/or bulk mailed, and utility bill/tax assessor informational inserts.

Define and Prioritize Projects

Project priorities should focus on fuel reduction treatments aimed at reducing the potential for catastrophic fire. This work should target the WUI communities' first, then high hazard community buffer areas and watersheds. Additionally, developed recreation sites such as picnic grounds and campgrounds should also be a high priority because of the greater fire risk in these sites.

Also, continuing efforts should be made to attain geographically explicit data showing County-wide fire hazard conditions. Spatial databases of hazard conditions are extremely helpful for emergency response. They also show how dense fuel conditions relate to adjacent areas; this aids in prioritizing potential projects by showing that a strategically located 500-acre treatment can accomplish as much as a 5,000-acre treatment because of its juxtaposition and connectedness to other treatments or sites of lower fire hazard.

Priority 1 - WUI Defensible Space

Community work should focus on the creation of defensible space for individual homes. Defensible space is that area between a home and an oncoming wildfire where the vegetation has been cleared or modified to reduce wildfire hazard. In some cases, defensible space can also provide an opportunity for firefighters to defend a home.

Common sense might suggest that those communities with the highest hazard and/or greatest number of residents should be prioritized for treatment. However, many people will never implement defensible space treatments, and prioritization of those who might receive money based on hazard is exclusionary to those living in a less hazardous, but still potentially dangerous environment. Therefore, with any program, the recommendation is to allocate dollars to any resident who wants to participate.

A logical approach to implementation might include public meetings, and newspaper and radio promotion. Homeowners should have some choice in how the work is implemented on their property (that is, which trees are cut and which are retained), and for those interested, a property site visit should be conducted. This visit should include an evaluation of the property's current condition, and the development of a defensible space prescription. A standardized site evaluation form should be used in this process to ensure program consistency, and a record of what occurred on the ground. As a general guideline, the site evaluation form should include the following:

- Landowner name, project legal description and size.
- Landowner objectives and priorities.
- Property improvement types and locations.
- Elevation, slope and aspect.
- Vegetation types, estimated height and diameter size classes.
- Forest health – problems, severity, and location.
- Crown fire potential.
- Soil conditions – erosion, existing and potential as a result of treatment.
- Cultural resources.
- Presence of threatened and endangered species and habitat.
- Aesthetics – impact of treatment.
- Treatment prescription – special instructions and slash disposal recommendations.
- Property/treatment plan map.

In addition to the site visit and evaluation form, flagging on all cut trees is recommended to help ensure that the defensible space goals are met. The value of designating cut trees

with flagging cannot be overstated, as no designation of trees places all cut-tree/leave-tree decisions solely upon the cutter.

If program dollars can be secured, a "Request for Proposals" solicitation should be prepared and sent to various consultants and local thinning crews, and a contract drawn up for whoever is awarded the work. If grant dollars cannot be secured, some agency or group will need to take the lead and organize fire education awareness/defensible space workshops. Individual homeowners will then need to take responsibility for the work.

Appropriate defensible space standards can be found in table 4. These are only general guidelines and will certainly be implemented in different ways on many properties.

Table 4. *Defensible Space Fuel Management Standards.

Firewise Environment	Requirements	Recommendations	Comments
Zone 1			
0-10 feet from structure	• Remove all pine needles and flammable ground materials. • Remove all ladder fuels. • Min. 10 feet between crowns of native trees or "clumps" (max. 4 trees/clump). • Prune trees extending over eave of roof. • Remove branches within 15 feet of chimney. • Use only approved decking materials. • Use non-flammable landscape material (ex: no wooden fences, railroad ties, etc.). • Prune limbs to min. 8 feet from ground or 25% of tree height, whichever is less.	• Minimize flammable vegetation in this zone. • Maintain non-combustible ground material 2-3 feet around structure (planting beds, rock gardens, gravel or bare soil). • Keep roof and rain gutters clear of needles and leaves	Wildfire is the number 1 threat to many communities of the Southwest and Intermountain West. The goal in this zone is to reduce creeping ground fire. What is done now will greatly enhance structure survivability and firefighter safety.
Zone 2			
10-50 feet from structure	• Remove pine needles and flammable ground materials. • Remove all ladder fuels. • Min. 10 feet between stems of native trees or "clumps" (max. 5 trees/clump). • Crowns of stems or between "clumps" do not touch. • 10-15 feet between planting islands and groups of shrubs.	• Maintain low combustible ground covers. • Keep lawns watered (as conditions allow). • Consider planting beds, rock gardens, xeriscaping, and fire resistant plants. • Use bedding plants (less 18 inches high). • Consider non-flammable landscape material. • Prune native tree limbs min. 8 feet from ground or 25% of tree height, whichever is less.	The goal in this zone is to reduce radiant heat and short-range spotting.
Zone 3			
From 50 feet to property boundary	• Max. densities for native trees per local fire department, state forestry, or other "expert" (dependent upon site). • Remove all ladder fuels. • 15 feet between stems of native trees or "clumps" (max. 5 trees/clump). • 20 feet between planting islands.	• Consider coordination with neighboring properties. • Prune native tree limbs min. 8 feet from ground or 25% of tree height , whichever is less. • Store firewood and other combustibles in this zone.	Treatment in this zone will create conditions unfavorable to crown fire.

* Slightly modified from Flagstaff Fire Department (Flagstaff, Arizona July 2002).

Priority 2 and 3 – WUI Buffers-Watersheds

The second priority for project work should include fuel reduction treatments in buffer areas around communities, and restoration of watersheds to protect against compromised water quality and flooding. This work might include thinning, the creation of fuelbreaks, the introduction of prescribed fire, or other types of treatments.

In the context of fire safety, thinnings utilize selective harvests to reduce stand density and thus fire hazard. Other benefits include increased growth and yield as a function of reduced competition, increased stand resiliency as a function of improved health, and often a more aesthetically appearing stand.

Fuelbreaks are strategically located blocks or strips of land in which a cover of dense or heavy vegetation has been permanently changed to one of lower fuel volume and reduced flammability. Like defensible space, a well-designed fuelbreak may provide an area in which firefighters can attempt to stop an oncoming fire. However, they are not intended to stop all fires. Even with advanced placement of suppression crews, long-range spotting associated with extreme fire behavior may breach the widest of breaks.

Prescribed fire, judiciously used, can also reduce fuels and improve forest health. Prescribed fire is a planned burn, designed with specific objectives in mind, and conducted under a tight set of constraints. In addition to reducing fuels, it can also improve wildlife habitat, prepare seed beds, increase water yields, and enhance aesthetics. Prescribed fire can be harmful as well as beneficial. Properly selected stands and sites, clearly defined burning goals, a burn plan, and trained personnel and resources are essential for success. If a fire escapes, it may burn unintended timber or other resources. It can also compromise air and water quality.

Combinations of thinning, fuelbreaks, and prescribed fire would be appropriate in some areas. For example, mechanical thinning treatments to reduce stand density will often be required before a safe prescribed burn can be conducted.

Given treatment choices in buffer areas, target high hazard sites that occur downwind (generally sites to the south or south-west because of regional prevailing winds) or below a community. Other considerations include slope, access, and proximity to homes. In general, most slopes greater than 40 percent should be excluded because of operating constraints associated with ground-based logging equipment on steep slopes.

Also, because of buffer area public ownership, and the desire to maximize benefit from any number of projects and promote landscape-scale forest recovery, coordination and partnering efforts with the Santa Fe and Carson National Forests will be essential. This needs to be a high priority.

Get Financial Support

Collaborative approaches not only help to build consensus and consolidate efforts, but also allow successful grant writers to work for a community by reducing competition for funding within that community. Collaboration also increases a group's probability of securing grants dollars because many funding agencies specifically require collaboration as an eligibility requirement.

Funding for restoration and fire hazard reduction is primarily through the Federal government. Over the past couple of years, grants for restoration and fire hazard reduction activities in Arizona and New Mexico have been awarded by:

- USDA, Forest Service, Region 3 for, "Community Planning for Fire Protection" as part of the Title IV Community Assistance Program. In 2001, grants were awarded to "…support planning, assessments, and project reviews to help accomplish hazardous fuels management expeditiously and in an environmentally sound manner.

- USDA, Forest Service, Collaborative Forest Restoration Program funded through the Community Forest Restoration Act of 2000. This program provides cost-share grants for forest restoration projects on public lands in New Mexico only. Projects must include a diversity of stakeholders in their design and implementation, and address specified objectives. These include, amongst other things, wildfire threat reduction, ecosystem restoration, reestablishment of historic fire regimes, reforestation, increased utilization of small diameter trees, and the creation of forest-related local employment (www.fs.fed.us/r3/spf/cfrp/).

- USDA, Forest Service, Southwestern Region, State and Private Forestry under the Title II Community Assistance Rural Development Program. In 2002, this program funded efforts that addressed the, "…economic use of small diameter and under-utilized tree species derived from forest restoration, urban-wildland interface, fuel reduction and pilot projects within Arizona and New Mexico.

- The Four Corners Sustainable Forests Partnership 2002 Grant Program funded, "…forest restoration, maintenance and risk reduction through sustainable community-based forest enterprises." (www.fourcornersforests.org).

- The Western States Fire Assistance Competitive Grant Program, administered by the Arizona State Land Department will award $17 million throughout the west to conduct hazardous fuel reduction and develop programs for information and education in the WUI (www.fs.fed.us/r4/sfa_grants/sfa_grants.htm).

- USDA, Cooperative State Research, Education, and Extension Service, "Improved utilization of wood and wood fiber" (www.reeusda.gov/1700/funding/rfadoc/rfanri03_02.doc).

Many of these federal programs have their origin in the National Fire Plan (www.fireplan.gov). However, the forestry provision of the Farm Bill (www.Fsa.usda.gov), the Federal Emergency Management Agency's Hazard Mitigation Program (www.fema.gov), and any number of private foundations are also potential sources for funding. Also, a new "one stop shopping" fire grant website listing both Federal and state grants is recommended (http://www.southwestareagrants.org/).

Implement Projects

When beginning restoration and hazard reduction projects, start small and incrementally increase project size and complexity to give the community time to participate and adjust to the changes. Test plots and public demonstration sites will produce valuable group interest and community feedback for larger projects. Planning for larger projects could coincide with these smaller plots, using the feedback to modify the larger projects (i.e. adaptive management) during the typically lengthy planning period. Some general guides for implementing projects are:

- Work with each community/neighborhood to clearly define ecological goals based on that community's priorities.
- Begin with areas of critical importance that also have broad consensus regarding the project goals.
- Use research and monitoring such as before-after photographs and test plots to evaluate effectiveness, and document progress.
- Use lessons learned from research and monitoring to improve future projects through adaptive management.
- Use all available techniques for reducing vegetation density: manual clearing, timber harvesting, selective grazing, prescribed burning, and combinations of these.
- Celebrate incremental successes to keep morale high and to maintain momentum.

Adopt Firewise Planning and Zoning Ordinances

The adoption of regulatory approaches to fire hazard reduction is not easy. This is because regulatory policy is often set by multiple parties, each with its own constituency and institutional objectives. Furthermore, there may be a perception that regulations place an undue burden on developers and consumers, and that wildfire in the WUI is not a major problem, either in absolute terms or by comparison with other types of fire. Nonetheless, in order to provide for increased wildfire safety, it is imperative to build-in fire safeguards whenever the opportunity presents itself.

Traditional planning and zoning approaches designate land for compatible uses and density. Structures are built using model building and fire codes such as the Uniform Building and Fire Codes or the building and fire codes produced by the International Code Committee. These model codes are satisfactory as minimum requirements for buildings in urban and suburban environments, but they usually fall short of providing a reasonable degree of safety from the effects of catastrophic wildfire.

When new subdivisions or lot splits are proposed for WUI areas, it is at this point that wildfire risk reduction measures are most appropriate and effective. There are multiple current regulatory sources for consideration for local adoption. Some regulatory documents are:

- The National Fire Protection Association (NFPA) – NFPA produces consensus standards and codes aimed at specific hazardous areas. There are a number of wildfire risk reduction standards such as:

    - NFPA 299 – Standard for Protection of Life and Property from Wildfire.
    - NFPA 1141 – Standard for Fire Protection in Planned Building Groups.
    - NFPA 1231 – Standard on Water Supplies for Suburban and Rural Fire Fighting.
    - NFPA 211 – Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.

- The Uniform Fire Code (UFC) – The UFC is published by the Western Fire Chiefs Association in conjunction with the NFPA. This code contains access and water supply requirements. This code also contains language about modifying hazardous vegetation.

- The Uniform Building Code (UBC) – The UBC is published by the International Conference of Building Officials and contains construction related minimum standards.

- The Urban-Wildland Interface Code (UWIC) – The UWIC is published by the International Fire Code Institute in conjunction with the International Conference of Building Officials. This code is dedicated to prescriptive measures for wildfire risk reduction.

- The International Fire Code (IFC) – The IFC is published by the International Code Committee and is relatively new on the code scene having first appeared in 2000.

- The International Building Code (IBC) – The IBC is published by the International Code Committee and is relatively new on the code scene having first appeared in 2000.

There are a number of other codes and regulations but the ones listed above are the most predominate in the industry. As with all codes, they can be amended (either upwards or downwards in intensity) to fit local circumstances.

In addition to the above, and if state law allows, local safety measures can be enacted during the planning and building permit stage of development. Safety measures that should be considered in the study area include, but are not limited to, the following:

- Vegetation manipulation and management.
- Defensible zones and use of fire resistant plant material.
- Use of limited combustible exterior siding products.
- Use of Firewise construction methods to limit possibility of ignition.
- Use of non-combustible roof coverings.
- Use of chimney and roof vent screens.
- On-site water storage for firefighting purposes.
- Control of exterior storage of combustibles such as woodpiles, propane tanks, etc.
- Use of limited combustible decking material and safe construction practices.
- Control of the location of buildings relative to slope, aspect, etc.
- Site access and egress location and construction.
- Location of community and site safety zones.
- Location of community evacuation zones and areas of refuge.
- Use of automatic internal fire sprinkler systems.

Additional information on these safety measures can be found in Appendix F.

Formalize an Evacuation Plan

The following recommendations should be implemented before the start of next year's fire season.

- Establish a local wildfire evacuation planning group of all agencies and local stakeholders.

- Meet during the winter each year to organize and plan for the upcoming wildfire season.

- Dovetail, where appropriate, into existing State, County, and local plans, and other guidelines developed by local resources, specifically Search and Rescue Groups.

- Consider upgrading the roadway systems into Brazos canyon to accommodate two-way traffic for evacuation and fire response purposes.

- In the Brazos Canyon area, consider the creation of safety zones that are large enough to accommodate many people (and animals) who might not be able to escape the area. Educate all involved on concepts of sheltering in place.

- Quickly gain control of ingress/egress routes in the event of a wildfire.

- Do not send evacuees over rough roads with which they may be unfamiliar. If you cannot evacuate over a primary roadway system, consider sheltering in place.

- Everyone involved with wildfire evacuation procedures must receive basic wildland fire training, fire shelter use, and be equipped with fire shelters and protective clothing.

- Adopt local ordinances to assist with built-in fire safe construction and development practices.

- Educate all who will be involved in evacuation processes on the Incident Command System or another incident management system of choice.

- All agencies in the area should train on and exercise an evacuation plan at least once per year. The springtime would be the most beneficial time. Summer residents must be educated and trained when they arrive in the area each year.

These recommendations are the minimum suggestions made pursuant to this plan and are not intended to be all-inclusive.

LONG-TERM RECOMMENDATIONS

Most of the long-term recommendations - defined as being implemented in 5 years or less - should fall into place if a majority of the short-term recommendations can be realized. This is because the short-term recommendations establish a comprehensive framework for long-term management of fire hazard.

Strengthen Local Capacity in Wildland Fire Preparedness, Suppression, and Mitigation

Implement all of the previously discussed topics relating to this area, including firefighter training, evacuation training, acquisition of additional equipment (and fire stations), and grant dollars to begin fire hazard reduction programs.

Find Innovative Utilization Strategies

Fire hazard reduction and forest restoration is expensive. Recent restoration efforts in the region have cost $500 to $1000 per acre, or more. The high costs of logging operations reflect a host of economic factors including the traditionally low value of small diameter timber and a lack of primary wood processing companies in the area. Loggers often have

to compete for tiny regional post-and-pole or firewood markets to get rid of medium-sized trees (9 to 16 inches), and the smallest trees are often burned on-site to avoid prohibitively expensive transportation or chipping costs. Until a solution to the problem of "utilization" of restoration by-products can be found, it is unlikely that any amount of money will be enough to achieve the landscape scale restoration that is needed to save our forests.

To address the utilization question, the Greater Flagstaff Forests Partnership (GFFP), based in Flagstaff, Arizona, commissioned a study with Oregon-based Mater Engineering. This study, released in July of 2002, identified several pathways that partnerships could take to begin to bring down the price of restoration. One of the findings in the report is that small and medium diameter ponderosa pine can be used in existing markets if transportation costs can be overcome, or if primary processors move into the area. Oregon mill operators who participated in materials testing of ponderosa pine from GFFP restoration projects stated that, “The Partnership logs are equal to or better to the small pine logs we typically process. If we can get their logs to our mill at a reasonable rate, we’ll take all the logs the Partnership can send.”

The positive results of the preliminary testing of small and medium-sized ponderosa pine in Flagstaff has generated interest among several new technology manufacturers, and many have already become partners by financing some of the testing costs. Some of the new technologies that add value to this material include:

- Indurite - An environmentally safe wood hardening and fire resistance treatment that renders pine suitable for uses such as flooring.

- E-Grader - This small, automated machine measures lumber strength and can augment more conservative human visual grading. Test showed that up to 30% of visually inspected pine lumber could have been upgraded to a higher and more valuable grade using E-Grader.

- Sorbite - A recycled plastic and wood waste composite material that can be molded into doors, furniture and other complex, high value parts.

- Glulam Beams - Sandwiched layers of Kevlar fiber and low-grade lumber.

Many of these new technologies offer the potential of participation in the "green market." Green products are produced from recycled, reused, or sustainably harvested materials, and contain environmentally safe components, or were manufactured with low water or energy consumption. According to the Mater study, northern Arizona may be uniquely poised to take advantage of the green market or other opportunities to create the nation’s first sustainable forest products industry based on restoration by-products.

To tap into these markets, further materials testing and market research will be needed, and investment in the industry will need to be rigorously pursued. For this to happen, the uncertainty of a consistent supply of raw materials will need to be overcome. According

to the report, "The key to attracting investments to northern Arizona in new technology is consistency/coordination of volume and log mix over an extended period of time (5-year minimum)."

Although this all pertains to the Flagstaff area, there is reason for optimism with respect to the quality of northern New Mexico ponderosa pine, as the environmental site conditions for the two areas are quite similar, and the unique land base of private commercial forests theoretically positions the County to assist in better coordinating an assured supply of material.

Specifically, partnerships and the region's national forests need to:

- Find a way to initiate longer term (3-5 year) resource planning so that financial institutions will have enough confidence in raw material supplies to fund investors.

- Develop an "intra-regional resource offering protocol." In other words, stabilize the wood flow across (and minimize competition between) national forests in the region.

- Invest in a small log sawmill.

- Create regional National Environmental Policy Act Teams to coordinate and maintain progressive planning efforts on national forest lands.

In addition to pursuing these recommendations, the GFFP commissioned a consultant from California to assess the feasibility of a biomass energy cogeneration facility in northern Arizona. Similar efforts, through support of the Forest Service and State Forestry, are underway for Highlands University, the New Mexico State Hospital, the Las Vegas public schools, and other institutions in nearby San Miguel County, and possibly Rio Arriba County.

The advantage of biomass energy is that it is a clean technology which can utilize all parts of a tree, including needles and bark. The idea of using needles and bark to produce energy rather than burning them in piles is an attractive one. However, biomass energy production can be a substantial user of water, and there are several hurdles related to the economics. Nevertheless, bio-energy shows some promise for the region, and indeed, the development of a bio-energy plant in Raton is rumored to be moving forward. According to Ben Sanchez of La Jicarita Enterprises (pers. comm.), the company promoting the plant - Cohen and Maddox - have signed a lease for both the location of the facility and the use of City grey water. Anticipated supply is said to be approximately 500 tons/day, with the facility paying $10/ton. Although $10/ton will not cover treatment costs on most projects, efforts to develop this market for restoration by-products should continue and should be coordinated on a regional level.

Likewise, efforts to develop new products and support start-up businesses should be supported through community business development programs. Even the production of non-timber products or other endeavors that reconnect people with their forests could potentially help pay for restoration activities.

Some caution is needed when attempting to capture economic value from restoration by-products - wood utilization is the most controversial component of ecological restoration. Past harvesting often involved "taking the best and leaving the rest" in order to maximize timber revenues - a practice that is partially responsible for our current forest health problems and largely responsible for mistrust of the Forest Service and wood products industries on the part of some community members and environmental groups.

There is, however, nearly universal agreement that economics is a major player in conservation. Pragmatic environmentalists have argued that in order for people to conserve resources, they must have an economic stake in that resource. Great strides in conservation have been made throughout the world by providing economic incentives for local communities to develop sustainably harvested products or services, such as eco-tourism or non-timber forest products like mushrooms. The premise of this new brand of environmentalism is “use it or lose it” (Swanson 1992). Of course, economics can also play a major role in the degradation of ecosystems. Crook and Clapp (2001) refer to this ironic love-hate economic component as, “the paradox of market-oriented conservation.” The paradox is that markets may become the driving force that ultimately destroys the resource. Crook and Clapp (2001) argue that:

> “…profit is no panacea. The process of finding new markets usually means the creation of external, not local, markets, and external markets easily become commodity markets, with their attendant periods of oversupply and competition. Given the oscillating pressures imposed by market cycles, economic success may be as dangerous as failure. Low prices may generate overharvesting to meet revenue goals and make alternative uses more attractive, leading to the liquidation and replacement of the resource and its ecosystem. High prices in turn can promote the degradation of some species by attracting too many harvesters or too much capital investment, by encouraging pulse-harvesting in anticipation of falling prices later on…or by promoting intensive management of the target resources, with consequent ecosystem simplification…”

Reducing the fear of "re-creating the timber beast" among many in the environmental community relates directly to re-building a trusting relationship with the U.S. Forest Service. It also involves ensuring that market forces are guided in a way that creates the institutional conditions under which sustainability can rule.

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