Forest Stewards Guild

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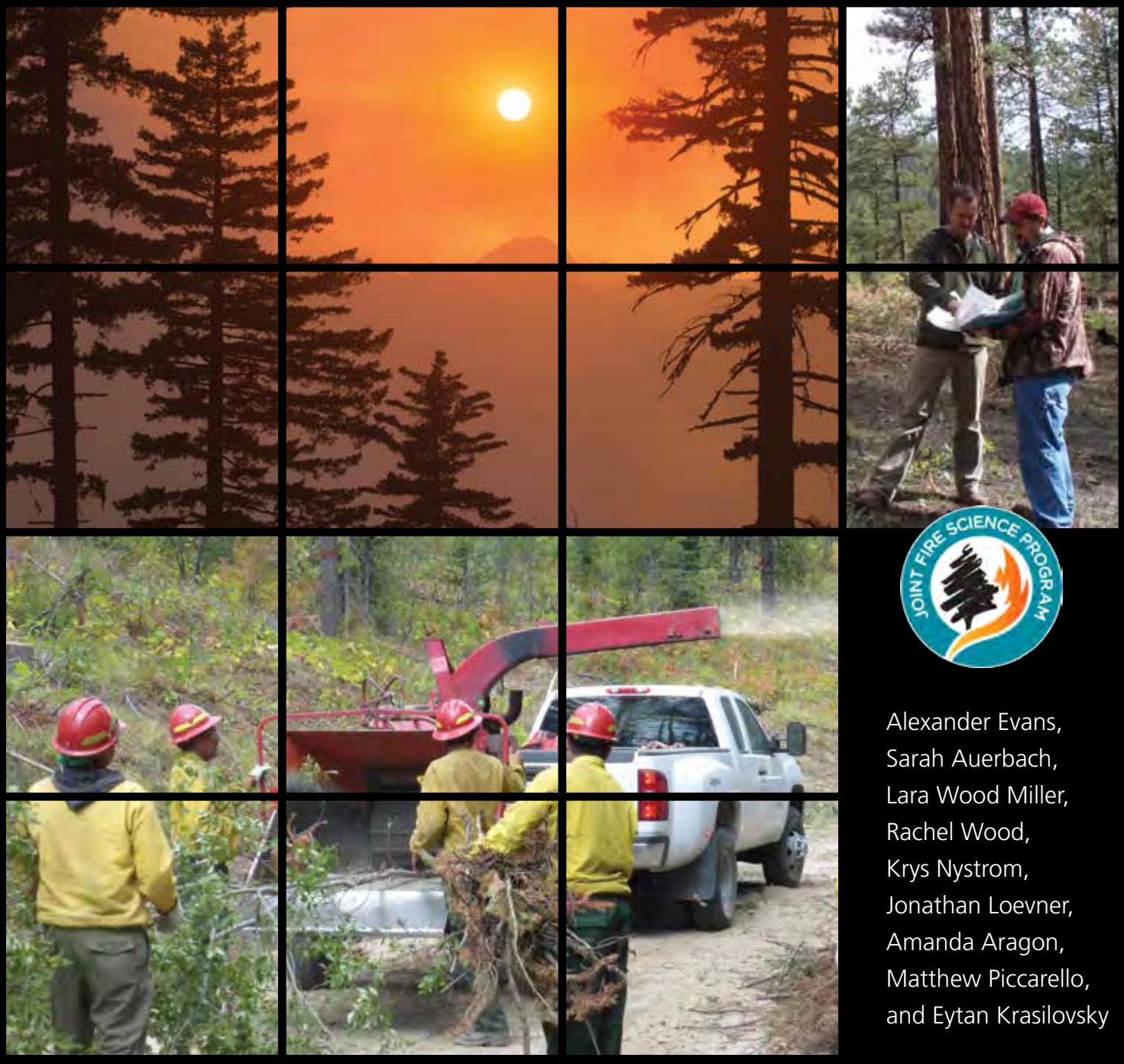
Evaluating the Effectiveness of Wildfire Mitigation Activities in the Wildland-Urban Interface



JOINT FIRE SCIENCE PROGRAM

Alexander Evans,
Sarah Auerbach,
Lara Wood Miller,
Rachel Wood,
Krys Nystrom,
Jonathan Loevner,
Amanda Aragon,
Matthew Piccarello,
and Eytan Krasilovsky

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Cover photos are the Happy Camp Fire via InciWeb (top), Eytan Krasilovsky (right), and the Kettle Complex via InciWeb (bottom). Photo on this page is from Wade Ward, Kaibab National Forest. This report and other research from the Forest Stewards Guild is available online at www.foreststewardsguild.org/publications/

CONTENTS

EXECUTIVE SUMMARY

We assessed wildfire mitigation activities in the wildland-urban interface (WUI) of New Mexico to identify which strategies are most effective. First, we modeled how fuel treatments change wildfire behavior in 12 WUI areas. The second element of our analysis used data from over 2,000 assessments of home wildfire hazard to better understand how those hazards are distributed and change over time. We examined the Firewise communities in New Mexico because of the important role the Firewise program plays in public wildfire education nationally. The fourth element of our assessment examined nine Community Wildfire Protection Plan (CWPP) case studies, which integrate the different elements of wildfire mitigation. The final section of this report synthesizes the lessons learned from WUI mitigation in New Mexico.

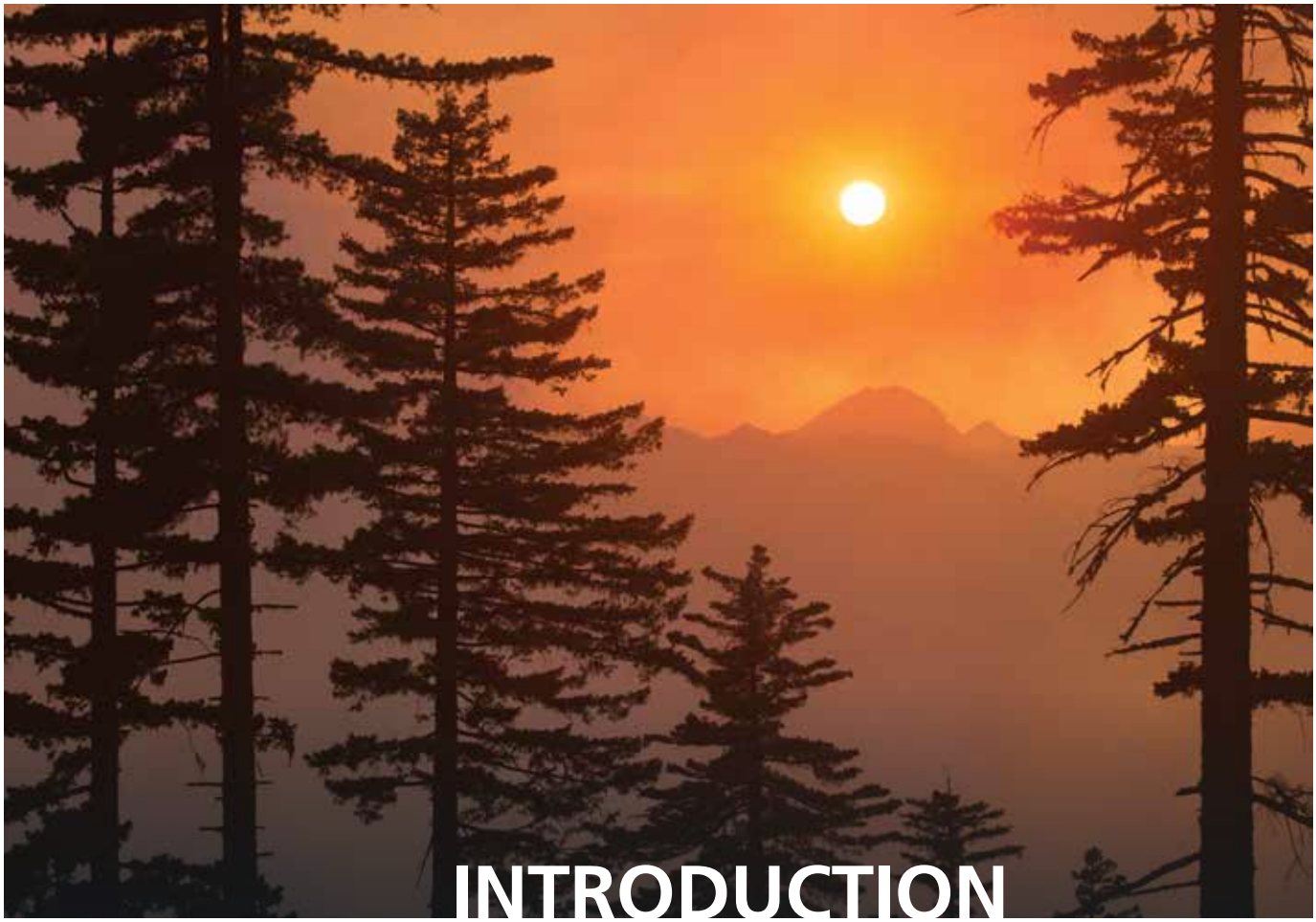
Our modeling indicated the fuel reduction treatments made in 12 WUI areas have changed fire behavior. These fuel reduction treatments will not stop all wildfires, but they will likely aid sup-

pression efforts and help save homes. For example, the modeling showed that areas that would have experienced active crown fire before treatment would instead burn as a surface fire or with individual trees torching (passive crown fire). By reducing active crown fire, treatments would also reduce the ember rain on homes, which can be a major source of home ignition. Modeling also indicates that the treatments reduced flame lengths, which can allow firefighters to suppress fires that would otherwise be too dangerous to approach.

Our review of over 2,000 home hazard assessments indicated considerable wildfire hazard at the home level in New Mexico. Two-thirds of homes lack key elements of defensible space. However, nearly 20 percent of the average home hazard could be reduced by undertaking easy mitigation steps. Based on our interviews with 16 Firewise representatives across New Mexico, the Firewise program is an effective tool that builds on the power of neighbors encouraging neighbors to undertake mitigation efforts. Firewise coordinators and activities have changed some minds about thinning and defensible space, but cost and negative attitudes toward cutting trees continue to be barriers to creating Firewise communities. Neighbors and community relationships also provide motivation to undertake WUI mitigation work in communities without the Firewise designation.

The nine CWPP case studies highlight the importance of individuals and collaboration for successful WUI mitigation planning. Communities, and managers who work with them, can improve fuel treatment effectiveness by continuing to focus on communication, particularly sharing documentation of where treatments have been implemented. Clear prioritization of future treatments facilitates implementation by streamlining planning and helping to match funding to projects. Where countywide CWPPs already exist, community-scale CWPPs are particularly effective at engaging the public and prioritizing treatments effectively. Maintaining momentum is a continual challenge for home mitigation and forest fuels reduction efforts, particularly when there are staff transitions. Prescribed fire can be an effective tool for expanding and maintaining fuel treatments. Documenting treatments can help sustain momentum, preserve community support, and magnify successes. The fire-adapted communities concept provides a framework for linking the wide range of WUI mitigation approaches while acknowledging that fire cannot be eliminated from fire-adapted ecosystems.

Jean Hawthorne, 2015 Okanogan Complex (top)
Whitewater-Baldy Fire, Gila National Forest (lower)
2015 Happy Camp Fire via InciWeb (page 1)



2015 Wolverine Fire via InciWeb (page 3), 2015 Happy Camp Complex via InciWeb

INTRODUCTION

Hundreds of millions of dollars have been spent on planning, education, and fuel reduction treatments in the wildland-urban interface (WUI), yet there is little information on the effectiveness of these efforts. New information is needed to help communities make informed decisions about which mitigation strategies are most effective and which are most appropriate based on individual social, economic, and ecological conditions. To address this need, we conducted an assessment of the mitigation activities in communities across New Mexico. We began with a review of the existing literature on wildfire mitigation in the WUI (in the section *Background*). Next, we examined how fuel treatments change modeled wildfire behavior in 12 WUI areas (*Fuel reduction treatments*). The second element of our analysis uses data from over 2,000 assessments of home wildfire hazard to better understand how those hazards are distributed and change over time (*Home Assessments*). We also examined the Firewise communities in New Mexico because of the large role they play in public education about wildfire risk (*Firewise*). The fourth element of our assessment integrates the different pieces of WUI mitigation efforts by studying how nine Community Wildfire Protection Plans (CWPPs) were implemented and highlights their successes and weaknesses (*CWPP case studies*). The final section synthesizes the lessons learned and provides recommendations for future WUI mitigation efforts (*Lessons learned: effective wildfire mitigation in the WUI*).

BACKGROUND

Larry Luckham

The need to protect communities from wildfire is not new, and past approaches to addressing wildfire influence the perception of wildfire risk and mitigation strategies today. The U.S. federal government has made numerous attempts to reduce the negative impact of wildfires on communities. Early efforts took a "war on fire" approach. The 1935 policy, often called the "10 a.m. policy," required quick suppression of all wildfires and hence the protection of communities (Booz Allen Hamilton 2015). U.S. Forest Service (USFS) policy was to protect structures even at the expense of natural resource protection (Davis 1990). In 2000, a report to the president called for federal land management agencies to identify and prioritize wildfire hazard reduction projects focused on communities most at risk (USFS and USDI 2000, Steelman et al. 2004). The National Fire Plan that emerged in 2000 included the protection of communities at risk as a key goal. Along with increased focus on communities threatened by wildfire came a new nomenclature as homes and communities at the edge of forests and grasslands were labeled part of the WUI. In 2001, federal land management agencies defined two zones within the WUI: *interface* and *intermix*. The interface is three or more structures per acre with shared municipal services, while intermix can be as sparse as one structure per 40 acres (USDA and USDI 2001).

More recently, the National Cohesive Wildland Fire Management Strategy renewed the guidance for federal wildfire response to focus on communities (WFLC 2014). The Cohesive Strategy vision is to live with fire, allowing it

to burn when appropriate and extinguishing when necessary. It gives three primary goals:

1. Restore and maintain landscapes: Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.
2. Fire-adapted communities: Human populations and infrastructure can withstand a wildfire without loss of life and property.
3. Wildfire response: All jurisdictions participate in making and implementing safe, effective, efficient, risk-based wildfire management decisions.

The second goal takes an important step in reframing the relationship between wildfire and communities. Instead of framing the issue to keep fire out of communities, the Cohesive Strategy emphasizes that wildfire is unavoidable and communities must be fire-adapted. This reframing to acknowledge the coexistence of communities and wildfire is a logical outcome of the expansion of the WUI. The fire-adapted communities concept integrates ongoing efforts to mitigate wildfire hazard in the WUI and acknowledges fire as part of the natural landscape (FAC 2015). The Nature Conservancy, The Watershed Research and Training Center, USFS, and five Department of the Interior agencies created a Fire Adapted Communities Learning Network to encourage the development and sharing of best practices to accelerate the adoption of fire-adapted community concepts nationwide (FACLN 2015).

Growth of the wildland-urban interface

Estimates of the total number of WUI acres in the U.S. are driven in part by the method used to map WUI (Haas et al. 2013). The most recent assessment estimated 190 million acres (771,066 km^2) of WUI in the U.S., 44 million houses in the WUI, and 99 million WUI residents or 32 percent of the U.S. population (Martinuzzi et al. 2015). Another panel put the estimate at close to 600 million acres of WUI for the entire U.S. with 100 million full-time WUI residents (ICC 2008). A recent risk-based analysis combined maps of population density with models of wildfire probability to estimate that about 40 million people, or 13 percent of the U.S. population, was at risk from wildland fire (Haas et al. 2013). The population density mapping by Haas and colleagues found 16 million acres of populated places at the highest wildland fire risk with another 33 million acres at medium risk (Haas et al. 2013). An analysis of properties at risk from wildfire for the western U.S. estimated 1.1 million homes, with a reconstruction cost of $268 billion dollars, in the highest risk category with another 1.2 million properties in the next highest risk category (Botts et al. 2015). Not only is the WUI in the U.S. extensive, but it is growing rapidly. The WUI area in the conterminous U.S. grew by nearly 20 percent during the 1990s (Hammer et al. 2009). Two estimates from a similar methodology suggest a 7 percent increase in the WUI area of the U.S. between 2000 and 2010 (Radeloff et al. 2005, Martinuzzi et al. 2015). Even wildfire does not necessarily reduce WUI growth; new WUI development often occurs inside fire perimeters within five years of a fire (Alexandre et al. 2015).

Increasing wildfire threat

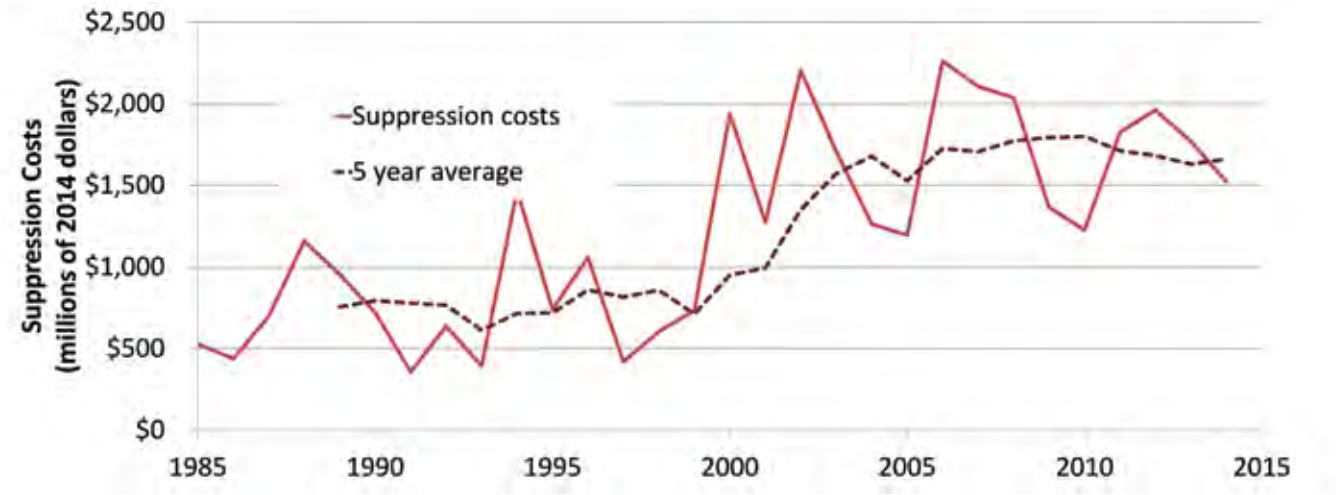
Even as the WUI has expanded, large wildfires are burning more acres and becoming more severe. An examination of wildfires in the western U.S. between 1984 and 2011 showed both the number of large fires and the acreage burned increased significantly (Dennison et al. 2014). Regional studies have

Zander Evans (top)
Heather Provencio, Coconino National Forest (lower)

documented an increase in burn severity in both California and the southwestern U.S. (Dillon et al. 2011, Miller and Safford 2012). The increase in severity and acres burned by wildfires is likely to continue because of changes in the climate, particularly in the western U.S. On average, the western U.S. is likely to be warmer and drier by the end of the 21st century than it was during the 20th century, with warmer spring and summer temperatures, reduced snowpack and earlier snowmelts, and longer, drier summer fire seasons (Westerling et al. 2006, IPCC 2007, Dominguez et al. 2010). The Quadrennial Fire Review documents the lengthening of the fire season in the western U.S. and the evolution toward a typical fire season of more than 300 days per year (Booz Allen Hamilton 2015). Three lines of evidence predict that warming and drying conditions are likely to cause increased fire activity: reconstructions of fire and climate in the past (Swetnam 1993, Frechette and Meyer 2009), trends over the last few decades (Westerling et al. 2006), and predictive models (Westerling and Bryant 2008). Increased drought and heat are already beginning to cause an increase in tree mortality (Allen et al. 2010). A warming and drying climate is also amplifying the risk of extreme fire behaviors such as longer flame lengths, torching, crowning, erratic changes, rapid runs, and blowups (Brown et al. 2004, Booz Allen Hamilton 2015).

It is not surprising that wildfire suppression costs have increased as the number and severity of fires has increased. The ten-year average for wildfire suppression costs between 2005 and 2014 was more than double the ten-year average between 1985 and 1994 using constant 2014 dollars (NIFC 2015).

Figure 1 Wildland fire suppression costs in 2014 dollars with five year running average (NIFC 2015)



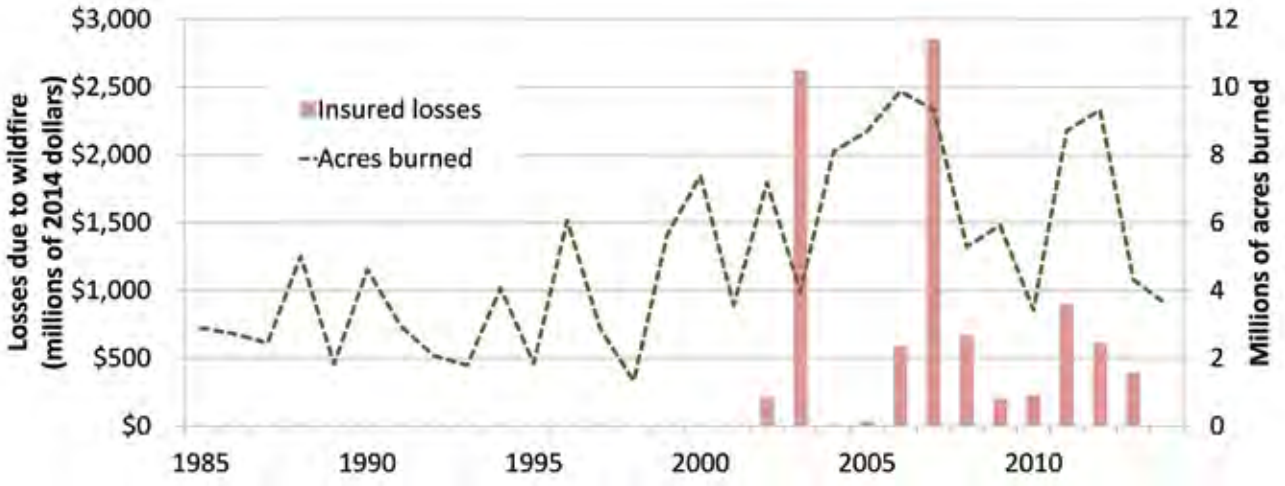
The growth of the WUI is likely an additional factor in the rising costs of fire suppression (Berry and Hesseln 2004, Calkin et al. 2005). Gude and colleagues (2013) documented that suppression of wildfires near homes costs more than suppression in the forest far from homes. Liang and colleagues (2008) showed that fires that burn onto private land have higher suppression costs, again implicating WUI growth as a cause for increasing suppression costs.

Wildfire impacts on the wildland-urban interface

This trend of more numerous large, high severity fires (often labeled mega-fires) challenges even the most aggressive fire suppression efforts and these fires result in devastating human and ecological impacts (Williams 2013). The list of communities impacted grows longer each year, but recent notable examples include the 2013 Black Forest Fire which killed two people, destroyed 489 homes, caused $420 million in insured losses, forced the evacuation of 38,000 people, and cost $9.2 million to suppress (McGhee 2014). California's 2013 Rim Fire destroyed 11 homes, cost $127 million to suppress, caused private property losses that could be as large as $265 million, and a loss of environmental benefits that could be as large as $736 million (Batker et al. 2013). New Mexico's 2011 Las Conchas Fire destroyed 63 homes, cost $48 million to suppress, caused massive flooding, destroyed archaeological sites, forced the shutdown of Albuquerque's drinking water intake, and devastated the traditional homelands of Santa Clara Pueblo (EPSCoR 2012). The full cost of wildfire that includes fatalities, injuries, property losses, post-fire flooding, air and water quality damages, healthcare costs, business impacts, and infrastructure shutdowns is anywhere from two to 30 times greater than the suppression costs (Dale 2009). For example, the 2010 Schultz Fire cost between $123 and $137 million dollars after the fire was contained because of post-fire flooding, reduced property values, habitat destruction, and other post-fire expenses (Combrink et al. 2013). Property losses due to wildfire in the U.S. were over one billion dollars in 2012, and only a little more than half were insured losses (Gardner 2014). Unfortunately, the 2015 fire season may break recent records for damage and suppression costs. Initial reports suggest the 2015 Valley Fire in California, which killed four people, destroyed 1,958 structures, caused over $1.5 billion in economic losses, and more than $925 million in insured losses (Aon Benfield Analytics 2015).

Matthew Keys

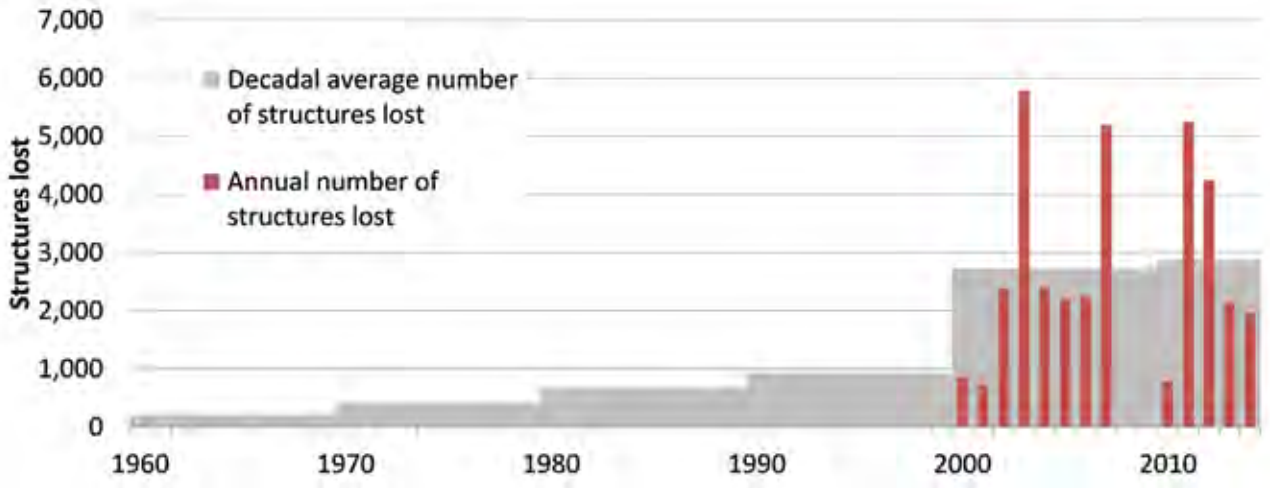
Figure 2 Insured losses from wildfire with acres burned (Gardner 2014, NIFC 2015)



Though the insured losses from wildfire vary a great deal each year, the number of structures lost to wildfire shows growing impact in the WUI. The decadal average number of structures lost to wildfire has increased tenfold since the 1960s (ICC 2008, NICC 2014).

2013 Jaroso Fire via InciWeb, Reina Fernandez (page 9)

Figure 3 Number of structures lost to wildfire (ICC 2008 and NICC 2014)



Wildfire can have immeasurable impacts on communities. Often, people whose homes are destroyed by wildfire do not rebuild after wildfire, causing long-term community change (Alexandre et al. 2015).

Disasters, including wildfire, often have a disproportionately negative impact on the most vulnerable such as the poor, the elderly, and people with disabilities (Buckland and Rahman 1999, Morrow 1999). An examination of the 2002 Rodeo-Chediski Fire showed that when fire hits, working class residents are more vulnerable than their richer neighbors (Collins and Bolin 2009). In addition, research from Oregon suggests that poor households are more likely situated in areas with minimal or non-existent fire response capabilities than less economically vulnerable households (Lynn and Gerlitz 2005). Even where wildfire mitigation programs exist, socially vulnerable communities are less likely to participate (Collins 2008, Ojerio et al. 2011).

Wildfires present health risks for people near to and far from the flames. One estimate placed a value of $84 on avoiding one wildfire-induced symptom day per exposed person per day (Richardson et al. 2012). Firefighters themselves are exposed to greater risk when wildfires threaten homes and elicit an aggressive suppression response (Calkin et al. 2014). Wildfires in the WUI present unique, high-risk hazards for firefighters (Mangan 2000).

RESPONSES TO WILDFIRE RISK IN THE WILDLAND-URBAN INTERFACE

Community Wildfire Protection Plans

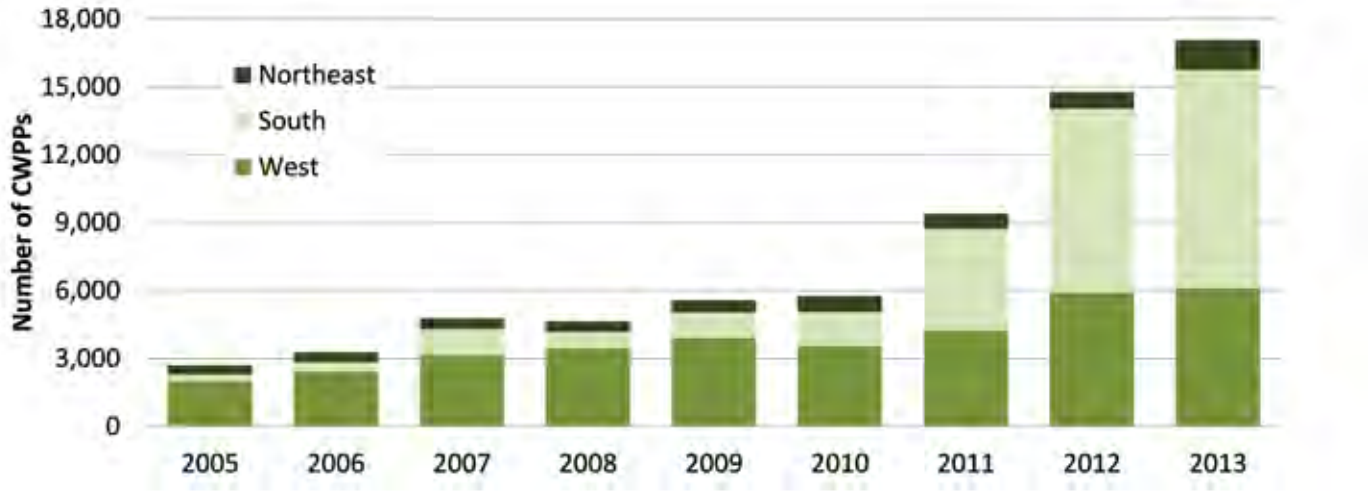
The Healthy Forest Restoration Act of 2003 (HFRA) introduced CWPPs as one of the key elements in planning wildfire mitigation activities in the WUI. HFRA's Title 1 included a provision for the creation of CWPPs to facilitate the public's participation in wildfire threat reduction. The goal was to have communities initiate a planning process to make themselves safer from wildfire threat. The HFRA guided federal agencies to collaborate with citizens on CWPPs and to prioritize treatment areas based on CWPPs (U.S. Congress 2003, Communities Committee et al. 2004). CWPPs can delineate the WUI, identify fuel reduction opportunities, and set priorities for implementation. CWPPs can recommend where and how treatment should be implemented on both federal and non-federal lands. Specifically, a CWPP is defined as a plan for an at-risk community that:

1. is developed within the context of the collaborative agreements and the guidance established by the Wildland Fire Leadership Council and agreed to by the applicable local government, local fire department, and State agency responsible for forest management, in consultation with interested parties and the federal land management agencies managing land in the vicinity of the at-risk community;
2. identifies and prioritizes areas for hazardous fuel reduction treatments and recommends the types and methods of treatment on federal and non-federal land that will protect one or more at-risk communities and essential infrastructure; and

3. recommends measures to reduce structural ignitability throughout the at-risk community (U.S. Congress 2003).

State fire assistance via the National Fire Plan helped to fund the initial round of CWPPs (McCarthy 2004), though the need for CWPPs remains greater than available funding (CWSF 2006). Since 2003, thousands of communities have developed and implemented community wildfire protection plans (NASF 2014). However, it is important to point out that because many CWPPs cover more than one community and some communities are covered by both a local and a more regional CWPP, the number of CWPPs is not directly related to the number of communities at risk (CWSF 2006).

Figure 4 Number of Community Wildfire Protection Plans (CWPPs) by region (NASF 2014)



Each CWPP can be very different because of local decisions about scale, approach, areas of emphasis, and depth (Grayzeck-Souter et al. 2009). Guidance for communities on developing CWPPs leaves a great deal of room for interpretation and adaptation to local conditions (Communities Committee et al. 2004, CWPP Task Force 2008, Jakes et al. 2012). For example, communities are able to include the people best positioned to create an effective CWPP regardless of title or organization because HFRA does not prescribe specific representation (Jakes et al. 2011). This same flexibility may also cause problems. Since the method of defining the WUI is not set, CWPPs have employed a number of different approaches, which creates potential for confusion and makes comparison difficult (Stewart et al. 2007, Platt 2010). Even the page length of CWPPs varies greatly; in one review of 113 plans, length ranged from 9 to 339 pages (Abrams et al. 2015). In general, research suggests that the flexibility allowed in CWPP development is a positive element of the program (Jakes et al. 2011, Williams et al. 2012, Abrams et al. 2015).

Some CWPPs focus on small areas such as a town or subdivision while many cover entire counties. For example, the first generation of CWPPs in Arizona were all countywide or regional, while in Washington, early plans focused on individual communities (CWSF 2006). Jakes and colleagues (2011) found that for some communities connecting CWPPs to other planning efforts and governmental structures could increase their relevance or sustainability, but in other cases, communities feared CWPP goals would be diluted if they were

tied to broader planning or government structures. Based on a review of over 100 CWPPs in the western U.S., most plans use the county scale (Abrams et al. 2015).

Figure 5 Spatial scale of CWPPs reviewed by Abrams and colleagues (2015)

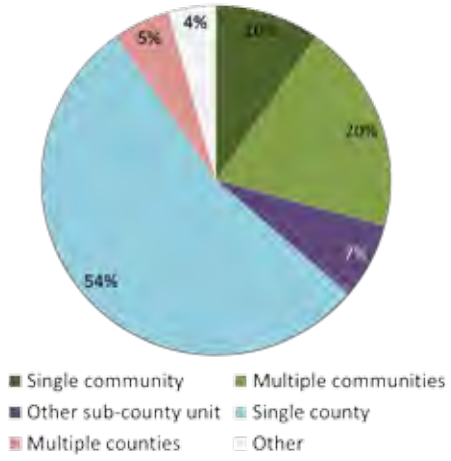


Figure 5

CWPPs are a requirement to access grant funding sources such as the National Fire Plan, and many state and federal sources for wildfire mitigation activities require or give priority to communities covered by CWPPs or projects identified in CWPPs (Steelman and DuMond 2009). Funding opportunities provide an incentive for communities to create at least a basic CWPP and a lack of detailed requirements allows for the development of *pro forma* CWPPs. In other words, some CWPPs are written but never used. Another difficulty created by the link between CWPPs and funding is the perception that the development of a CWPP will result in an immediate flow of funding to implement the plan. When CWPPs are viewed as a funding mechanism, communities often write plans that cannot be implemented without outside support (CWSF 2006).

Fuel treatment effectiveness

Most plans include creation of defensible space, creation of fuel breaks, and thinning of forest stands (over 85 percent of plans reviewed by Abrams and colleagues (2015)). This is driven by HFRA's requirement that CWPPs recommend the types and methods for fuel reduction treatment. In addition, the scientific consensus on the ability of fuel reduction treatments to change fire behavior has solidified. Modeling provides one avenue for testing the effectiveness of fuel treatments (Stephens and Moghaddas 2005, Finney et al. 2007, Mason et al. 2007, Mitchell et al. 2009, Vaillant et al. 2009, Moghaddas et al. 2010, Johnson et al. 2011, Loudermilk et al. 2014). Fuel treatments have also been tested by wildfire and proved to reduce severity (Pollet and Omi 2002, Dailey et al. 2008, Wimberly et al. 2009, Prichard et al. 2010, Cochrane et al. 2012, Safford et al. 2012, Stevens-Rumann et al. 2013), even under extreme conditions (Prichard and Kennedy 2013). Fuel breaks, as opposed to thinning, have been shown to be effective when they facilitate access for firefighting (Syphard et al. 2011). Thinning without treating the slash produced by the thinning can result in fire behavior that is more extreme than in untreated areas (Stephens 1998, Innes et al. 2006). Prescribed fire, particularly multiple burns, can reduce the threat of high severity wildfire (Stephens and Moghaddas 2005, Collins and Stephens 2007). In general, treatments that include both thinning and surface fuel reduction are the most effective at moderating wildfire behavior (Evans et al. 2011, Collins et al. 2013, Martinson and Omi 2013). Prescribed fire is usually the most cost-effective tool to reduce surface fuels, particularly over large areas (Cleaves et al. 2000, Hartsough et al. 2008).

Wade Ward, Kaibab National Forest

Research has also begun to focus on the ability of fuel reduction treatments to help protect the WUI (Graham et al. 2004). Modeled fires show the efficacy of thinning (Ager et al. 2010) and fuel breaks (Bar Massada et al. 2011) in the WUI environment. The Angora Fire of 2007 tested fuel treatments implemented before the wildfire. Detailed analysis showed that these treatments were able to modify fire behavior and protect homes (Safford et al. 2009). Similarly, fuel treatments implemented before the 2011 Wallow Fire were able to reduce fire severity (Waltz et al. 2014). Importantly, fuel treatments in the Wallow Fire area gave firefighters opportunities to protect residences during

the fire (Bostwick et al. 2011, Kennedy and Johnson 2014). Another example from Idaho showed that where slash was removed, fuel treatments were effective in the WUI (Hudak et al. 2011).

While existing research makes a strong case for the effectiveness of fuel treatments, residents of the WUI are not necessarily supportive of these treatments (Brunson and Shindler 2004, Rodriguez et al. 2003). Individuals and communities do not always perceive treatments as effective, and hence may not support thinning or prescribed burning to reduce wildfire hazard (Ascher et al. 2013). Support for fuel treatments is often linked to past experience with wildfire and the assets at risk (Fischer et al. 2014). Ascher and colleagues (2013) found communication efforts should focus on the benefits to forest health and future wildfire hazard reduction in order to build support for fuel treatments. Wilson and colleagues (2012) found that framing the conversation about the cost of recovering from wildfire losses is a particularly effective way to build support for forest fuel reduction. WUI treatments are more likely to garner support than more remote projects. USFS fuel reduction projects in 2001-2002 were 10 percent less likely to be litigated if they occurred in the WUI (Laband et al. 2006). Projects within a CWPP are less likely to be canceled or postponed than projects in areas without a CWPP (Evans and McKinley 2007) .

Public trust is particularly important when prescribed fire is one of the fuel treatments employed (e.g., Winter et al. 2002, Vogt et al. 2005). To build support for controlled burns, Ascher and colleagues recommend highlighting managers' ability to control prescribed fire to counteract negative opinions and perceived risk (Ascher et al. 2013). However, in any controlled burn, there is some element of risk and fire professionals cannot give the full guarantee of safety that some members of the public desire. Smoke from prescribed fire is a growing concern in many areas of the country (Shindler and Toman 2003). However, because prescribed fire is often the lowest-cost treatment per acre, it can be an important tool to reduce wildfire hazard at a meaningful scale.

Home mitigation and defensible space

Fuel treatments can change fire behavior, but research has also shown that the area around a house and the flammability of the house is an important driver

of wildfire hazard in the WUI. Thinning vegetation within 130 feet (40 m) of houses can significantly reduce house ignitions (Cohen and Butler 1996). Within 33 feet (10 m), fire can produce sufficient heat to cause combustion (Cohen 2004). The presence of herbaceous fuel near houses can result in loss during wildfire (Syphard et al. 2012). The density and flammability of houses themselves is a key determinant of wildfire spread in the WUI (Spyratos et al. 2007). Structure-to-structure spread has been a driver of home loss in a number of fires (Mell et al. 2010). Attributes such as roofing material can predispose a house to ignition, and then to destruction, under wildfire conditions (Cohen 2000). Firebrands, embers carried by the wind from the main fire, are a major cause of house destruction (Reinhardt et al. 2008).

A major question for policymakers, land managers, firefighters and community leaders is how best to encourage residents to create defensible space and reduce the ignitability of their homes. In general, the rate of adoption of hazard reduction techniques is significantly lower than policy goals (Brenkert-Smith 2011). Research has uncovered a number of reasons why residents do not take steps to reduce risk from wildfire, including not wanting to cut trees (a desire to protect amenity values), risk perceptions and knowledge, and economic issues (Collins 2005). Residents usually live in WUI environments because of the wildlands surrounding them. Residents are fond of the trees and plants around their homes and the wildlife, quiet, privacy, views, and recreational opportunities linked to the wildland (Nelson et al. 2004).

Perceptions and knowledge about wildfire risk can drive hazard mitigation. Residents who are knowledgeable about wildfire risk are motivated to take action based on their perceptions of risk severity (Martin et al. 2007, McCaffrey et al. 2011). In at least one case study, however, residents supported hazard reduction activities even though they perceived that risk was low (Blanchard and Ryan 2007). Perceptions of wildfire risk are also influenced by individual's assessments of the costs and benefits of a particular measure (McCaffrey 2015). In most cases, residents recognize wildfire exists, but their perceptions of effective prevention measures and willingness to take action still varies (Nelson et al. 2004). A study by Champ and colleagues (2013) shows that residents' age, income and previous experience with living in a fire-prone area are associated with taking actions to mitigate wildfire hazard. In another study, residents often undertook mitigation measures for reasons other than

Boise National Forest, Reina Fernandez (page 13)

reducing wildfire hazard; for example, to improve insulation or as part of regular maintenance (McGee 2005). Often, home mitigations are connected to larger wildfire hazard reduction strategies. In fact, a series of case studies has shown that residents are more likely to support policies that promote hazard reduction at the house level that are included within a larger wildfire hazard reduction strategy (Winter et al. 2009). Economic cost can be a barrier to implementing hazard reduction measures. This is compounded by the fact that fuel reduction treatments are generally more expensive in the WUI than in the wildland, 43 percent more expensive in one case (Berry and Hesseln 2004). Feasibility, including cost and debris disposal options, helps determine defensible space implementation (Winter et al. 2009).

Research suggests that neighbors can be the crucial factor that determines whether a resident will take steps to mitigate wildfire hazard (Brenkert-Smith 2010, Dickinson et al. 2015). WUI residents who characterize themselves as having less knowledge about fire are more likely to follow their neighbors' lead in hazard mitigation (Martin et al. 2007). In fact, the importance of neighbors as a motivator of hazard reduction activities cuts across the spectrum of communities from those with strong infrastructure to those with weak infrastructure (Brenkert-Smith 2010). However, WUI residents will create defensible space even when there are few relationships between community members (McCaffrey et al. 2011). When local volunteer fire departments and county wildfire specialists share information with residents about hazard reduction, it can also help motivate mitigation activities (Brenkert-Smith et al. 2012).

Boise National Forest, Left to right (page 16), Brady Smith, Coconino National Forest, Boise National Forest

Seasonal homes make up about 10 percent of the homes in the WUI across the conterminous U.S. In New Mexico, there are an estimated 29,000 seasonal homes in the WUI (Martinuzzi et al. 2015). These seasonal homes and their part-time residents are an important part of the hazard reduction equation. Part-time residents may be less likely to take mitigation actions than full-time residents (Collins and Bolin 2009). Often it is more difficult for part-time residents to find the time to implement fuel reduction activities than full-time residents (Bright and Burtz 2006). Some of the networks that are important for encouraging any WUI resident to implement wildfire mitigation actions are still key for connecting with part-time residents. In one study, interactions with their full-time-resident neighbors was the only link between part-time residents and their community (Brenkert-Smith 2010).

A crucial caveat to any discussion of resident and community understanding of and decisions about wildfire hazard is that there is great variety in WUI residents. Programs, ideas, and solutions are unlikely to work across all community contexts or for all WUI residents (Brenkert-Smith 2011, Stidham et al. 2014). The information sources residents find most useful and the factors that motivate residents to take hazard reduction measures vary significantly by location (McCaffrey et al. 2011).

Covenants, codes, ordinances, and insurance

For some communities or jurisdictions, covenants, codes, and ordinances provide a way to institutionalize wildfire mitigation actions and compel residents to reduce their wildfire hazard. One justification for this approach is the communal nature of wildfire hazard, highlighted by structure-to-structure wildfire spread. Loss from wildfire can be a strong motivator to improve building codes. Boulder, Colorado, adopted new building codes after the 1989 Black Tiger Fire, and codes in San Diego, California, were refined after the 2003 Cedar Fire (Alexandre et al. 2015). Colorado, Montana, Virginia, and Washington created guidance documents to help local jurisdictions develop regulatory wildfire hazard reduction programs (Haines et al. 2008). California, Florida, and Utah have model ordinances that include recommendations for administration and enforcement (Haines et al. 2008). California Public Resource Code 4291 limits plant choice, regulates property maintenance, and requires 30 feet of defensible space in high fire hazard areas (de Jong 2003).

Perceived hazard severity, opinions about the proper roles of government, and beliefs about alternatives to regulation all help determine acceptance of mandatory versus voluntary approaches to hazard reduction (Winter et al.

Boise National Forest (both)

2009). Enforcement of hazard reduction regulations is often the responsibility of the fire or building department, but in many cases neither department has training to enforce these rules (Duerksen et al. 2011). New regulations may often be met with a negative reaction because of strong beliefs in private property rights (Rasker 2014). In fact, most counties limit required hazard reduction programs (Muller and Schulte 2011). A recent review of regulatory tools for local governments to reduce wildfire hazard found that the most common WUI enforcement problem was the lack of defensible space maintenance because of limited political will or financial resources (Duerksen et al. 2011). In some cases, regulations or plans designed for other purposes can benefit wildfire hazard reduction efforts. For example, open space policies for Boulder County, Colorado, had the effect of pushing new development away from the wildland (Rasker 2014). Defensible space requirements are more likely to be accepted if they are perceived as being fairly applied to all residents (Winter et al. 2009).

Insurance companies and their decisions about coverage and costs can have the same effect as a regulation in some cases. Homeowners may be motivated by increases in insurance costs to implement hazard reduction measures—if those measures can reduce insurances costs. In some cases, insurance companies are requiring fuel mitigation before providing home insurance (Williams et al. 2012). For example, California's FAIR program provides economic incentives for residents to reduce fuel in a buffer zone of 200 to 300 feet around structures, use fire-resistant building materials, and improve firefighter access (Talberth et al. 2006). State Farm started wildfire hazard inspections in Colorado in 2003 and has expanded the program to 12 western states (McDaniel 2006). Other insurance companies such as AllState and USAA have followed suit, but so far there have been relatively few cancellations due to wildfire hazard (McDaniel 2006).

Some residents see their insurance as a substitute for mitigation actions, so insurance becomes a disincentive to mitigate wildfire hazard (Winter and Fried 2000). However, even if insurance covers the cost of rebuilding, the loss of other non-reimbursable values such as a forest setting provides an incentive for mitigation (Talberth et al. 2006). Owners of rental properties may be more likely to see insurance as an alternative to mitigation because the property represents an investment and non-reimbursable values are smaller (Collins 2005). In addition, insurance may not cover the cost of rebuilding if building codes have been updated. While older homes are often exempt from new codes, rebuilding a home incurs the cost of upgrading to fire-resistant materials or other required improvements (Carole Walker, Rocky Mountain Insurance Information Association, personal communication).

Insurance companies clearly recognize the impact of loss from wildfire, and many share information on reducing hazards with their customers. Paying for wildfire losses may have significant impact for smaller insurers or within a region with considerable wildfire activity in a particular year. However, for larger insurers, wildfire has had a relatively small business impact. Between 2005 and 2014, losses from thunderstorms (including hail and tornados) caused nearly three times the losses than from wildfire, and losses from hurricanes were five times greater than losses from wildfire (III 2015). Therefore, while the insurance industry can be a partner in increasing awareness of the risk of wildfire in the WUI, it is unlikely to drive change given the current incentive structure.

Zander Evans

Collaboration, capacity, and communities

Collaboration between different groups and organizations in the WUI, such as the insurance industry, residents, and the USFS, is an important determinant of how wildfire hazard is addressed. HFR, the act that guides much of the nation's WUI strategy, calls for collaboration between communities and federal, state, and local governments (U.S. Congress 2003). Research has shown that having a government agency representative involved in wildfire preparedness is critical for success (Jakes et al. 2007). One contribution land management agencies such as the USFS and Bureau of Land Management (BLM) can make is fire and fuel management expertise. Residents are more supportive of management activities such as controlled burns when experts who understand the local ecology and fire behavior are involved (Nelson et al. 2004). Agency representatives can also help communities access funds and equipment that facilitate many aspects of hazard reduction (Jakes et al. 2007). Since federal and state funding continues to be a crucial source for county-level hazard reduction efforts, access to funding is particularly important (Muller and Schulte 2011).

Collaboration can build on itself and lead to better outcomes over the long-term. A history of collaboration on wildfire issues led to collaboration among



all levels of government and community stakeholders in a case study from Arizona (Fleeger 2008). Essentially, years of working together can build trust. In a Montana example, a CWPP was able to progress with little controversy or resistance because of a history of transparency, leadership, and trust (Lachapelle and McCool 2011). Good communication and shared values can also help build trust (Liou et al. 2007, Steelman and McCaffrey 2013, Toman et al. 2013). A proven way to build communication and trust are interactive activities such as field trips that include managers and community members (Toman et al. 2006). Where trust has not been built, communities may be suspicious of agencies' motivations and question their strategies (Lachapelle and McCool 2011). It is important to note that trust can erode over time (Shindler and Toman 2003). Collaborative processes require maintenance and cannot be taken for granted.

Collaboration is important within a community as well. As discussed earlier, neighbors are an important motivating force to encourage adoption of hazard mitigation measures. Community networks can help engage new residents and part-time residents in the collaborative effort to reduce wildfire threat (Jakes et al. 2007). Wildfire has no respect for ownership boundaries and a hazard on a neighbor's property can be a threat to the whole neighborhood. This cross-jurisdictional threat can motivate collaboration. In an Oregon case study, non-industrial private forest owners (NIPF) who perceived that nearby public lands had conditions that added to the wildfire hazard to their properties were more likely to cooperate with public agencies (Fischer and Charnley 2012). Making public land fuel reduction efforts conditional on some level of nearby private land mitigation work is a mechanism to increase private efforts (Prante et al. 2011). The existence of wildfire threat on many different jurisdictions can also confound efforts to address the problem. Fleeger and Becker (2010) found that some communities lack the multijurisdictional decision processes to adequately address the full range of wildfire threats.

CWPPs provide a structure for collaboration and can help build community capacity. When CWPP development processes are structured well, participants can learn from each other (Brummel et al. 2010). A study of four CWPPs found the planning process improved relationships among agencies, clarified responsibilities and improved communication systems (Jakes and Sturtevant 2013). It is important to acknowledge that CWPPs are not isolated processes, but rather occur in a specific context of history and existing relationships (Lachapelle and McCool 2011). Consultants have been an important part of CWPP development. They can bring both a professionalism and experience to CWPP development but may limit development of trust and local capacity (Abrams et al. 2015). The Council of Western State Foresters (2006) suggested that in some cases it is difficult to ensure that communities



Zander Evans (page 19), Left to right (page 20), Meredith Flannery, Zander Evans, Joe Stehling

take the lead in CWPP processes, and staff from state agencies may end up carrying the burden.

Evaluation

Research has provided some important insights into the effectiveness of CWPPs, the most important planning tool for WUI hazard reduction. Lachapelle and McCool (2011) found the two CWPPs they assessed were effective in getting local equipment certified and improving communications among local officials, but the potential for future cooperative action was less certain. Another assessment of three CWPPs documented social learning, but did not assess efficacy of CWPP implementation (Brummel et al. 2010). Williams and colleagues (2012) evaluated the planning process for 13 CWPPs, but did not specifically study the implementation or sustainability of hazard reduction efforts. Three best management practices came out of the study including paying attention to problem framing, choosing a scale at which participants can make things happen, and taking steps to facilitate implementation and ensure long-term success (Williams et al. 2012). A recent case study of three CWPPs found that the direct benefits of a CWPP could be obscured when wildfire mitigation had been occurring prior to the CWPP's existence (Jakes and Sturtevant 2013). Less formal assessments of CWPPs have occurred as well. One survey of 11 state-level managers of wildfire hazard reduction programs indicated that many share the opinion that CWPPs were the most effective element in a wildfire mitigation program (Renner et al. 2010). However, the opinion survey provided little concrete evidence of the benefits CWPPs provide. The Council of Western State Foresters also suggested the process itself of writing CWPPs was a success in an early review (2006). Much of the CWPP evaluation to date is best summed up by McCaffery's 2015 review:

> *Efforts that facilitate development of relationships, within communities and between community members and fire personnel, can contribute to increased preparedness at the individual and community level by facilitating information exchange and helping to build a sense of community.*

Still, the basic question is difficult to answer. How useful in total are the hazard reduction efforts for reducing community wildfire threat? CWPPs often sum up mitigation efforts and are required to include collaborator planning, fuel reduction treatments, and structural ignitibility. Nevertheless, CWPPs are not easy to evaluate because of their variety and the breadth of activities they can include. A multifaceted assessment of fuel treatments, home mitigations, regulations, and community relationships is poorly suited to focused, academic study. However, for communities and policy-makers faced with the


Photos above, left to right, Joe Stehling, Incweb, Eytan Krasilovsky, Photos below, clockwise from left, Zander Evans, Zander Evans, Tom Berglund

question of whether to invest in CWPP creation or revision, the question is highly pertinent.

In 2008, a research team out of the University of Oregon developed an in-depth guide to evaluating CWPPs with input from a wide range of experts (Resource Innovations 2008). The evaluation guide has over 100 questions on partnerships, risk, hazardous fuel reduction, structure ignitability, education, and emergency management. Although this guide has been mentioned in a number of CWPPs and is often cited as a resource for communities, it does not appear to ever have been put to use. The guide is designed to provide a long list of potential questions from which communities can pick and choose those questions that are most relevant. However, the list itself can be daunting. Our assessment of nine CWPPs from across New Mexico takes advantage of the 2008 evaluation guide.

The following sections provide an analysis of fuel reduction treatments, Firewise programs, and home mitigations in New Mexico. These four elements, in combination with detailed case studies and lessons learned from CWPPs, provide the most complete view to date of the effectiveness of mitigation activities in New Mexico's WUI.



2014 Mcrae Fire via InciWeb

FUEL REDUCTION TREATMENTS

In order to model the effect of fuel treatments on fire behavior, we compared standard fire modeling results from before and after treatments for 12 different CWPPs. CWPP boundaries were available as part of the CWPPs posted online by New Mexico State Forestry (NMSF).

Table 1 Community Wildfire Protect Plans included in the analysis

Name	CWPP	Area (acres)	County/community
Cibola	2006	2,906,880	County
Clauch-Pinto	2008	1,291,779	Community
Cuba	2006	263,589	Community
East Mountains	2006	141, 949	Community
Grant	2009	3,765,120	County
Lincoln	2008	3,091,840	County
Rio Arriba	2007	3,773,440	County
Ruidoso	2005	163,818	Community
Santa Fe	2008	1,223,040	County
Taos	2009	1,411,200	County
Torrance	2008	2,141,440	County
McKinley	2008	3,491,200	County

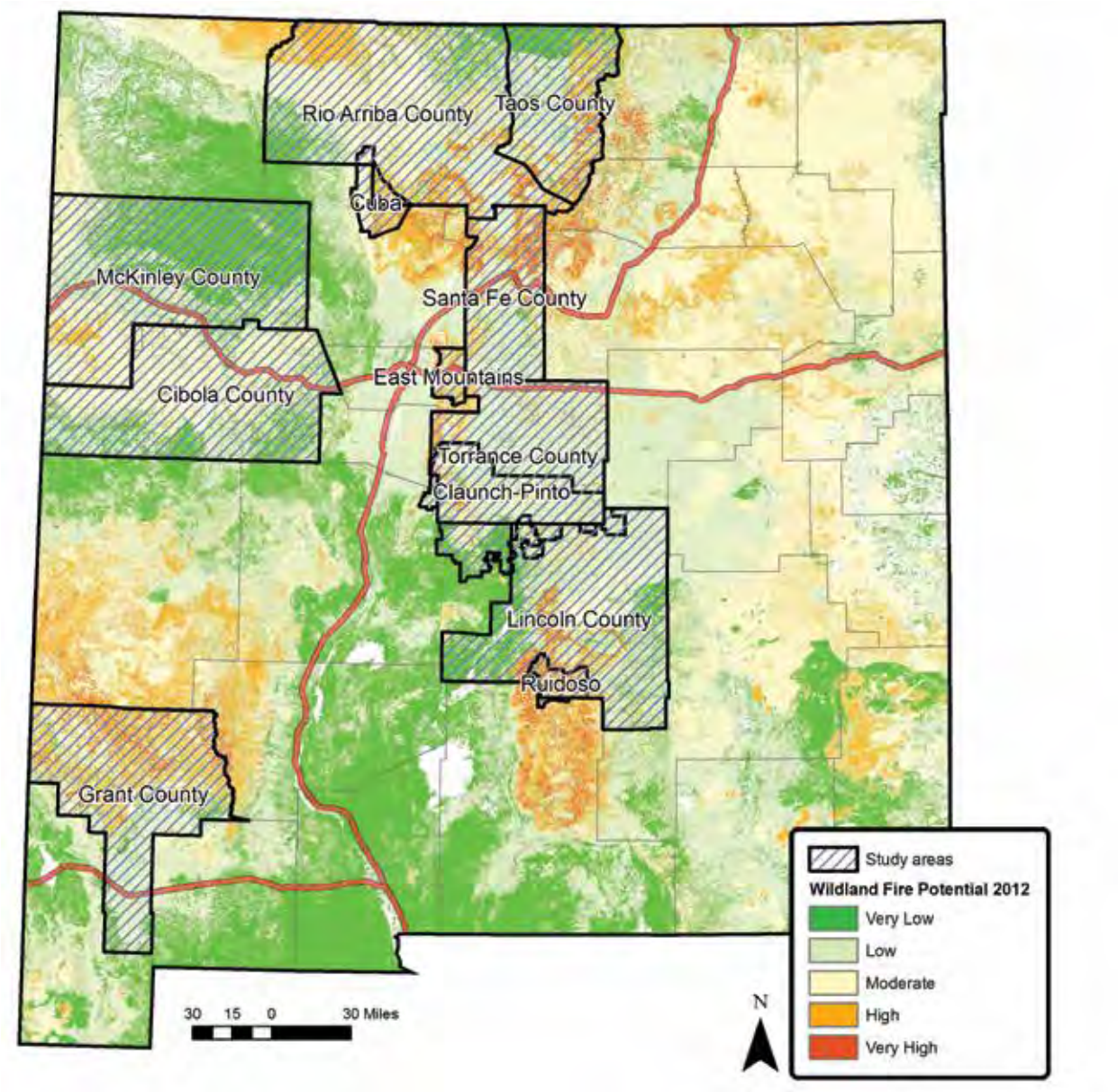
We used FlamMap, a widely used fire behavior mapping and analysis program that computes potential fire behavior characteristics (Finney 2006, Moghaddas et al. 2010). FlamMap uses eight spatial input data layers to represent biophysical conditions and weather parameters to simulate wind and fuel moisture conditions. The spatial input layers came from LANDFIRE and include elevation, slope, aspect, canopy closure, fuel model, canopy base height, and canopy bulk density (Ryan and Opperman 2013). We modeled the change in crown fire potential, flame length, and fire spread by running FlamMap for two time periods. The first was using data from the refresh 2008 LANDFIRE data (LF_1.1.0). We assumed that the conditions in 2008 were close to pre-treament conditions. The second was using LANDFIRE 2012 refresh (LF_1.3.0) modified using available treatment information. The fuel models were based on the 40 models presented by Scott and Burgen (2005). The weather parameters were collected from the nearest RAWS weather stations for each community CWPP. For modeling purposes, we used the 80th percentile weather conditions to replicate moderately severe but not extreme fire conditions (Stratton 2008).

WindNinja has been incorporated into FlamMap allowing the user to generate wind vectors for use during a FlamMap simulation, and wind conditions were modeled using this option. Gridded wind vectors often produce the most realistic fire behavior, particularly in complex terrain (Finney et al. 2006). The dominant wind direction and speed during the fire season, April to October, were obtained from the Wind Speed vs Direction Report in Fire Family Plus and were included in the model. The wind speed and direction values are used in FlamMap as inputs for all WindNinja simulations. (Forthofer 2007, USFS 2015b)

We used the minimum travel time module in FlamMap to model fire spread. The additional inputs needed for this fire spread module include ignitions and simulation periods. We used a set of ignition points based on density of recent fire starts from the USFS. The map of ignitions included fire starts that occurred between 1980 and 2013. We placed an ignition where two or more fire starts had occurred within a mile of each other. This method created 10 to 37 fire starts per CWPP. We chose a simulation period of 360 minutes to simulate the first 6 hours of fire spread.

Zander Evans

Figure 6 Map of fuel treatment area studies



We modeled the change in crown fire potential, flame length, and fire spread by running FlamMap with fuel treatments within the CWPP area. We also used the area identified as WUI within each CWPP as a second area of interest. For the post-treatment fire modeling we used LANDFIRE 2012 refresh (LF_1.3.0) and added specific treatment data for the area. We collected maps of fuel treatments from the USFS and NMSF. These treatments included thinning, prescribed fire, and a combination of thinning and prescribed fire. Though we were able to get spatial data for treatment locations and general prescription descriptions, not all treatments had post-treatment stand attribute data. Therefore, we based our estimates of post-treatment stand densities and canopy cover reduction on standard practices in New Mexico.

In ponderosa pine forests, standard fuel reduction practices reduce basal area to 40 to 70 ft^2 per acre (Hunter et al. 2007). In mixed conifer forests there is often higher levels of basal area retention, particularly in cool-

Zander Evans

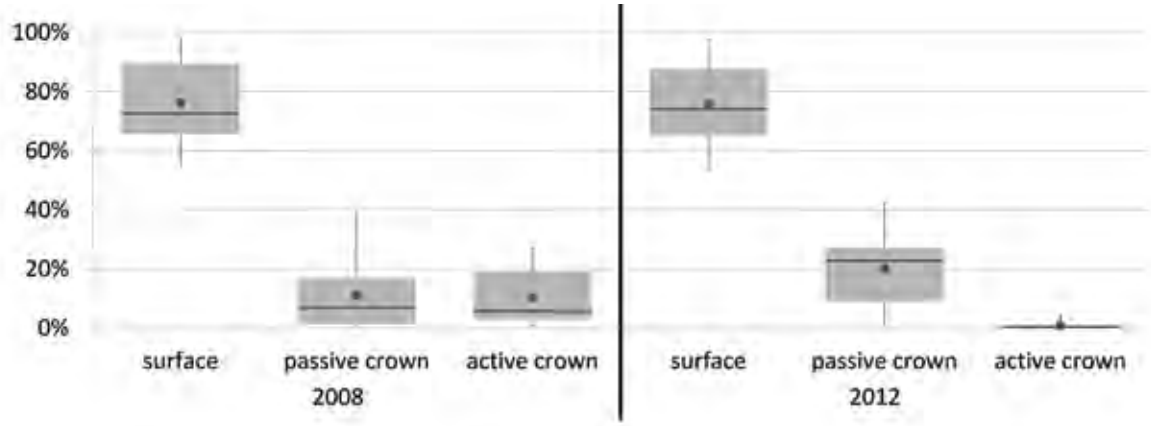
moist mixed conifer stands (Evans et al. 2011). The fuel models were adjusted to reflect the impact of fuel reduction treatments as well. In ponderosa pine, the fuel model was changed from fuel model number 188 to number 181, in mixed conifer the model was changed from number 165 to number 161, and in piñon-juniper woodlands the fuel model was changed from number 144 to number 142 (Scott and Burgan 2005). Canopy cover was reduced 35 to 55 percent depending on the initial stand condition. Stands with higher initial canopy cover reduced to 55 percent and stands with lower initial canopy cover reduced to 35 percent. No stand was modeled to have a final canopy less than 35 percent. For treatments that only used prescribed fire, our model did not reduce canopy cover because changing forest structure often requires more than one application of prescribed fire (Evans et al. 2011).

Canopy bulk density (CBD) is a measure of how closely canopy fuels are within an area. Canopy base height (CBH) is a measure of proximity of canopy fuels to surface fuels. For fire behavior and spread, these factors influence a likelihood that a fire will enter the canopy and spread. For all treatments, CBD and CBH were reduced by 20 percent.

Results

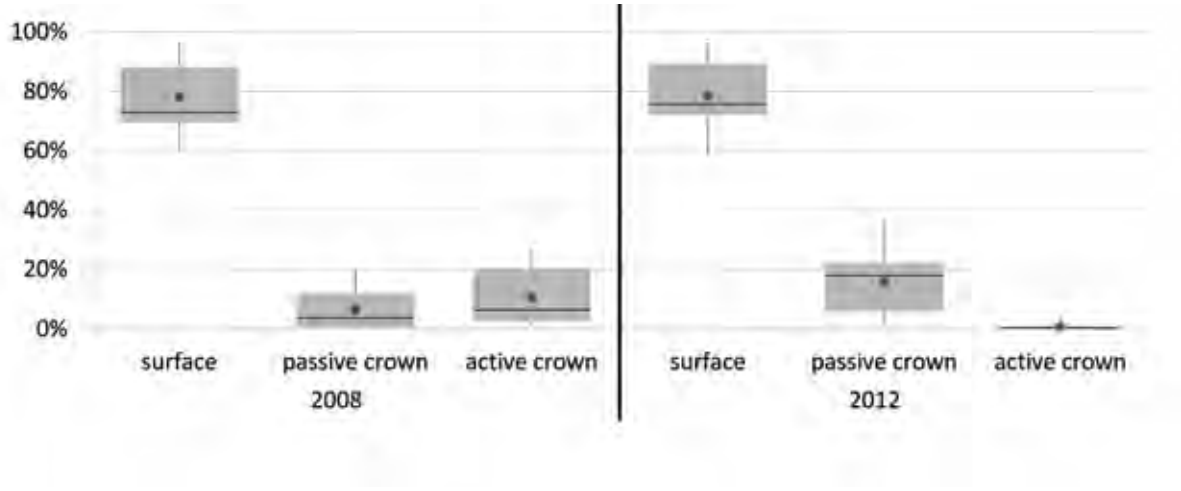
We used the 12 CWPP areas for which we had fuel treatment local data as independent samples. On average the CWPPs covered 2,510 acres (standard deviation [SD] 1850) and the area within each CWPP delineated as WUUI averaged 440 acres (SD 370). We found that the area modeled to have active crown fire within the CWPP was significantly reduced (p >0.009) between 2008 and 2012. In turn the area modeled to have surface and passive crown fire increased though not significantly (Figure 7).

Figure 7 Modeled fire behavior summarized from 12 CWPPs



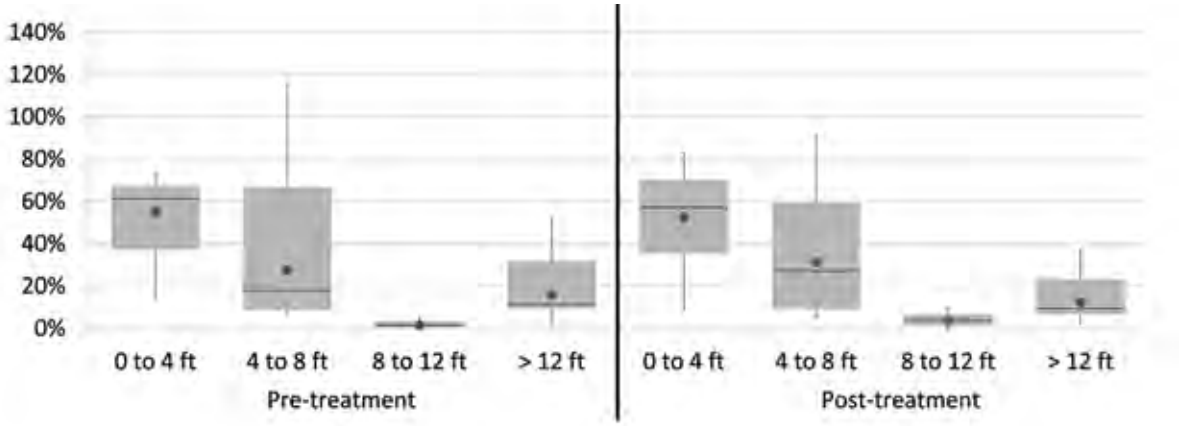
The CWPP with the least predicted percentage of its area in crown fire was Lincoln County (0.7 percent) while the CWPP with the highest predicted percentage was the Village of Ruidoso (27.2 percent). Since Ruidoso is a town within Lincoln County, this highlights the impact of choosing a large area of interest. We also analyzed the change in modeled fire behavior before and after treatments just in the area designated as WUI in each CWPP (Figure 8). Results were similar to the modeled fire behavior for the entire CWPP area. Again, treatments significantly (p >0.006) changed modeled fire behavior between 2008 and 2012 by reducing the percentage of the area with active crown fire.

Figure 8 Modeled fire behavior summarized from 12 WUI areas



The second fire behavior attribute we modeled was flame length. Results at the CWPP level and the WUI level showed similar patterns with the majority of the area modeled to have flame lengths from zero to four feet both before and after treatment (Figure 9 Modeled flame length summarized from 12 WUI areas). The area with flame lengths greater than eight feet was significantly different pre- and post-treatment ($p > 0.033$).

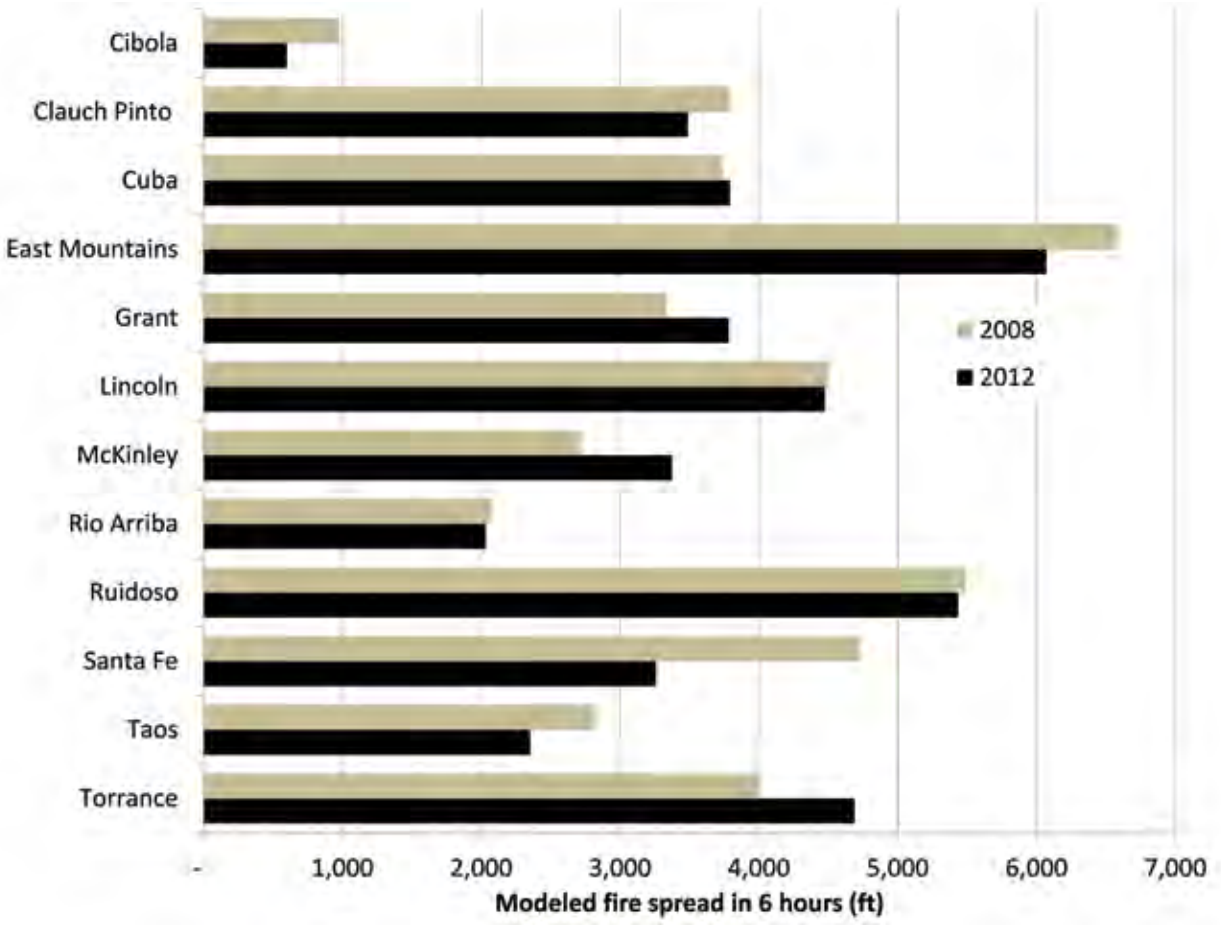
Figure 9 Modeled flame length summarized from 12 WUI areas



For some of the CWPPs, the area modeled to have greater than 12 foot flame lengths was reduced post-treatment. For example, in Ruidoso, the modeled area with greater than 12 foot flame lengths went from 45 percent of the total WUI area to 28 percent. This reduction from 82 acres to 51 acres with greater than 12 foot flame lengths could be important for firefighting in Ruidoso.

The third attribute we modeled was the travel time of a wildfire during the first six hours after ignition. In 2008 before treatment, the total distance from the ignition point modeled for the first six hours of wildfire spread varied considerably from an average of 970 feet (SD 1,526) in the Cibola CWPP to 6,100 feet (SD 2,119) in the East Mountain CWPP. Treatment had a mixed effect on modeled wildfire spread (Figure 10 Modeled distance of spread during the first six hours of wildfire spread).

Figure 10 Modeled distance of spread during the first six hours of wildfire spread

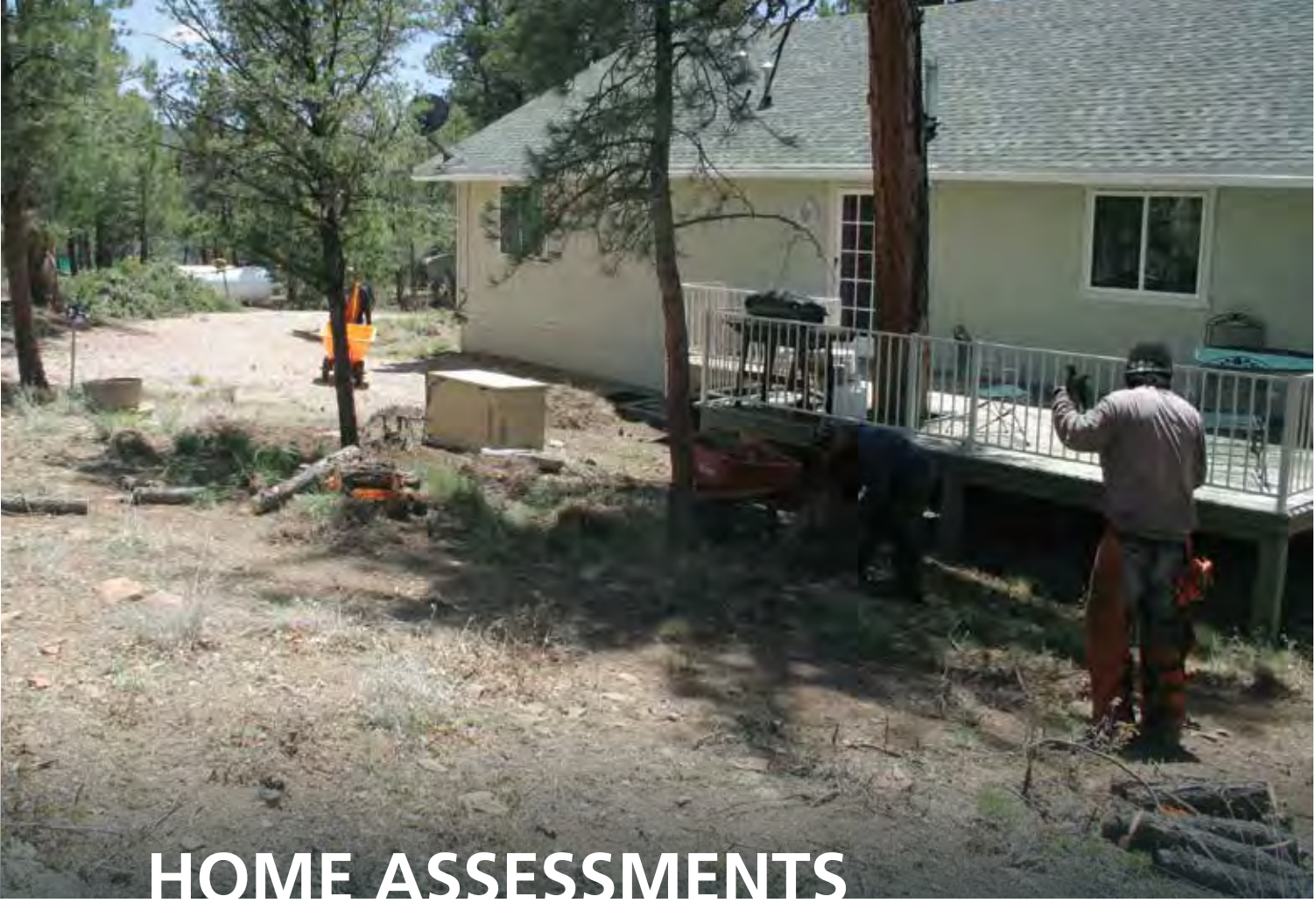


There was no statistical difference between the average distance pre- and post-treatment when all CWPPs were considered together. However, considered individually, Santa Fe had significantly reduced modeled fire spread post-treatment.

Summary

2014 Hammer Fire via InciWeb

The study suggests that fuel reduction treatments made in communities with CWPPs have changed fire behavior. The changes are not complete but may make a difference in saving homes. For example, in our study areas, modeled crown fire behavior was significantly reduced. The modeling suggests that areas modeled to burn with an active crown fire before treatment would instead burn at the surface or with individual trees torching (passive crown fire). By reducing crown fire, treatments would also reduce the ember rain on homes, which can be a main source of ignition. Treatments also significantly reduced the area with greater than eight foot flames in the model. Reducing crown fire and flame lengths can allow firefighters to suppress fires that would otherwise be too dangerous to approach. For example, once flames are above eight feet, wildfires present serious control problems, and control efforts at the head will probably be ineffective (NWCG 2014). However, modeling showed little difference in the fire spread during the first six hours after ignition pre- and post-treatment.



Matt Piccarello

HOME ASSESSMENTS

As mentioned in the section, *Home mitigation and defensible space*, home assessments are one way to measure the relative hazard of individual homes. For this study, we conducted assessments with the form developed by the Santa Fe County Fire Department's wildland fire division (see Appendix I – Home Wildfire Hazard Assessment Form). The assessment uses 28 questions about accessibility, surrounding trees, ladder fuels, fuel connection, ground cover, slope, debris, flammable materials, and structure hazard to arrive at a general hazard rating for the property. Many of these variables have been assessed in other studies of residents' wildfire mitigation efforts (e.g., Bright and Burtz 2006). The Santa Fe County form is similar to other home assessment forms (e.g., NFPA 2002). Assessments were performed by trained fire and forestry personnel from the road or driveway. This analysis includes assessments conducted by the Santa Fe County Fire Department and reassessments conducted specifically for this report.

A set of 2,008 home assessments conducted between 2009 and 2014 covered a wide range of site and structure hazards scores from 0 to 107 out of a possible 150. This is a relative scale in which a lower score represents lower hazard. A high score indicates a high hazard, but a score does not directly translate to the probability of home ignition because of other factors such as fire behavior. Site hazards averaged 40 (SD 0.3) out of 105 while structure hazards averaged 14 (SD 0.2) out of 45. The average combined site and structure hazard rating was 53 (SD 1.2) out of 150. The form also includes hazard reduction factors such as mowing grass and cleaning gutters that can reduce the hazard score by 15 points. In our dataset, reductions averaged 2.8 (SD 1.4). On average, site attributes made up a much larger proportion of the house hazard than struc-

Matt Piccarello, Nick Biemiller

ture attributes. Just two site attributes (trees within 30 feet of the house and the primary ground cover near the house) made up 30 percent of the average observed hazard. In fact, 96 percent of the homes assessed had some conifers within 30 feet of homes. Two-thirds of all homes we assessed lacked key elements of defensible space and had both conifers within 30 feet of homes, and highly flammable ground cover within three feet of the home. Our assessments match with other similar home hazard assessments. For example, estimates from State Farm Insurance company suggest that about a third of the 42,000 properties they inspected across the western U.S. required some mitigation activity and about 20 percent had major concerns such as property access or lack of defensible space (McDaniel 2006). In a study at Lake Tahoe, assessments of 102 parcels found an average score of 30 out of 80 in a similar hazard rating system (de Jong 2003). The same study found 75 percent of homes did not have 30 feet of defensible space.

Some elements of the home assessment are more difficult or more costly to change than others. For example, driveway length, bridge access, road grade, slope, roofing material, foundation, exterior walls, attachments, and water supply are the most difficult to change elements. Thinning overhead branches, making the address visible, removing ladder fuel, breaking the fuel connection, moving firewood, removing other flammable materials, mowing grass, raking foliage, and cleaning gutters are the easiest, lowest cost changes homeowners can make. In our dataset of home assessments, the most difficult to change attributes made up 22 percent of the hazard, while the easiest to alter attributes made up 17 percent of the hazard.

Home assessment estimates of wildfire hazard varied by community. In the Timberlake community in McKinley County, homes averaged 56 (SD 26). A sample of 46 homes in the Arroyo Hondo community in Taos County found an average hazard of 64 (SD 12). Apache Ridge, a wealthy neighborhood outside of the city of Santa Fe, had an average assessment value of 89 (SD 13) across 216 homes. Assessments in Cedar Grove and Edgewood at the southern end of Santa Fe County found hazards of 74 and 69 (SD 20 and 25) respectively.

The hazard rating form also includes a score based on the community hazard assigned by the CWPP. In our dataset, the CWPP hazard rating ranged from 10 to 35 and averaged 27 (SD 3.3). The CWPP hazard rating is excluded from the rest of this analysis for two reasons. First, it is generated by a course scale estimate unlike the site and structure hazard estimates and, second, it is largely outside of the residents' control.

Reassessment

Use of a consistent assessment form over multiple years allows for later reassesment to see how house hazard changes over time. In the Thunder Mountain subdivision, 94 homes were assessed for wildfire hazard in 2010 and then reassessed in 2015 using the same rubric. In 2010, the nine most difficult to change attributes made up 32 percent of the average home hazard, the easiest to change attributes made up 18 percent of the hazard, with the remaining hazard made up of moderately difficult to change attributes. Over half of the 94 homes assessed had decreased their hazard between 2010 and 2015, while nearly one-quarter had an increased hazard. In 2010, the community had an average home hazard of 51 (SD 14) out of 150 and by 2015, they had reduced the average home hazard to 46 (SD 15) out of 150 though this change was not statistically significant. Nearly half (46 percent) of the positive changes made were in relatively easy defensible space attributes such as making sure there was a visible address and firewood was not stacked near the house. On average, the proportion of hazard made up of easy to change attributes dropped from 18 to 14 percent in 2015.

Another remeasurement sample of 42 homes from the Apache Ridge and San Pedro communities exhibited similar patterns. The first measurements occurred mainly in 2009 and averaged 57 (SD 13) out of 150, and when remeasured between 2012 and 2014 the average dropped to 52 (SD 15). Most homes (65 percent) decreased their hazard between the two assessments, though 28 percent had increased hazard. About a third of the hazard reduction efforts occurred in both easy to alter attributes and difficult to alter attributes (32 and 29 percent respectively). Attributes that are moderately difficult to alter such as driveway width, trees within 30 feet of the home, and deck skirting, made up 39 percent of the hazard reduction activities. At the first assessment, easy to alter attributes made up 17 percent of the average home hazard and the most difficult to alter attributes made up 25 percent of the hazard. At the remeasurement, easy to alter attributes made up 15 percent and the most difficult to alter still made up 25 percent of the hazard. One element that may contribute to the reduction in hazard between the first and second assessments is that a high hazard rating motivates home residents to reduce their hazard. Anecdotal reports from the assessors suggest that residents who interact with assessors are motivated to reduce their hazards.

Repeated home assessments also highlight the variability of assessments. For example, in the Thunder Mountain assessment there were 13 disagreements between the 2010 and 2015 assessments in the slope of the property. Since it is unlikely the slope of the property changed, these cases are probably errors in either the assessment or reassessment. Overall, for the Thunder Mountain

Matt Piccarello

assessment there were 37 changes in the eight most difficult to change attributes that increased the hazard of wildfire between the two assessments, or 15 percent of all the changes observed. In the reassessments at Apache Ridge and San Pedro, 12 percent of all the changes occurred in difficult to change elements. Because these attributes are difficult to change in the five years between assessments, it is likely they point to assessment errors or different observations. The assessor may have had better access or assistance from the residents on the second assessment, which could lead to more accurate assessment of hazard. It is important to note that the difficult to alter attributes also tend to be difficult to observe. Easier to alter attributes such as overhead branches or visible addresses are also easy to assess in the field. Hence the error rate is likely to be lower for easier to alter attributes.

Difficulties in assessing home hazards are important when assessments have economic impacts. Home assessments can have cost implications for residents because of insurance or resale. When the wildfire hazard of a house is made clear by publicly accessible home assessments, high hazard homes can suffer price reductions (Donovan et al. 2007). The obvious corollary is that low hazard homes can attract a premium, which could be a motivator for homeowners interested in selling their home or borrowing on its value.

Coconino National Forest

Matt Piccarello

It is important to note that the potential errors in home hazard assessments and reassessments should be put in context with the errors in other wildfire hazard models and maps. For example, a test of LANDFIRE data found between 40 and 77 percent accuracy for modeling historic fire areas (Krasnow et al. 2009). Changes in definitions can change the area mapped as WUI by more than a factor of ten (Radeloff et al. 2005). However, efforts should be made to minimize the errors in assessment and reassessment. Providing assessors a copy of the first assessment for comparison on reassessments could be a simple way of improving the accuracy of change detection. Another improvement would be to indicate the assessor's confidence in the observation for each assessment. Finally, home assessments provide more benefit than just an estimate of hazard. Assessments can be a potent educational pathway when the assessor and residents discuss specific hazard factors.

Summary

A large sample of home hazard assessments indicates considerable wildfire hazard at the home level in New Mexico. Two-thirds of the homes assessed lacked key elements of defensible space. Defensible space was an important component of the total home hazard. Two elements of defensible space, trees within 30 feet of the house and the primary ground cover near the house, made up 30 percent of the average observed home hazard. While 22 percent of the average home hazard consisted of attributes that are difficult or expensive to change, relatively easy to change attributes made up 17 percent of the hazard. In other words, most residents could reduce their hazard 17 percent by making relatively easy changes to their homes and yards.

Our study presented novel data from the reassessment of home hazards. By looking at the same homes on two different occasions, our analysis uncovered the potential for error in home hazard assessments. Difficulties in observing home hazards and differences between assessors should be taken into account when home hazard assessments are used, particularly if important decisions such as protecting a home or providing insurance are at stake. Coding home assessments by the assessor's confidence in the observation would help to improve assessments and protect against basing decisions on faulty data. The difficulties of reassessments aside, there was a reduction in home hazard between the first and second assessment (though these changes were not statistically significant). Changes occurred about equally in difficult-to-change and easy-to-change attributes.

Eytan Krasilovsky

FIREWISE

Firewise, a program designed to give local communities tools and incentives to reduce their wildfire hazard, builds on the power of neighbors and other trusted sources to motivate hazard reduction. The program grew out of a partnership between USFS, the U.S. Department of the Interior (USDI), and the National Fire Protection Association (NFPA). In 1997, NFPS launched the Firewise website with information on wildfire safety for homes (NFPA 2015). The Firewise community recognition program started in 2002 and now includes over 1,100 communities across the country. A similar movement started in California after the 1991 Oakland-Berkeley Hills Fire and developed into the fire safe councils that now operate in over 100 California communities (CFSC 2015). Fire safe councils work to include local agencies and fire departments in planning to reduce fire hazard beyond the residents' mitigations on which the Firewise program focuses. Many communities in California have both a fire safe council as well as Firewise designation.

Firewise incorporates many of the elements discussed in the earlier section *Home mitigation and defensible space.* Research and actual wildfire have shown these mitigation measures to be successful. New research is beginning to assess the effect on home survivability by the Firewise project specifically. A careful analysis of 74 homes lost during the 2007 Witch Fire in San Diego, California, demonstrated that the majority of the Firewise treatments evaluated appeared to be applicable even if individually they were not fully effective (Maranghides et al. 2013). More specifically, treatments such as having low flammability plantings within 30 feet of the home, lawns or gravel fuel breaks, pruning, removing overhanging branches, fire-resistant construction materials, clearing dead wood within 30 feet, and removing attached wood fences were all associated with reduced damage (Maranghides et al. 2013).

In order to better understand the motivations and impacts of the Firewise program in New Mexico, we interviewed key individuals at 16 of the 27 Firewise communities now recognized in the state (Table 2). We developed open-ended questions aimed at soliciting information from Firewise community representatives about their experience and satisfaction with the Firewise organization. The Firewise state liaison provided contact information for 19 Firewise communities active when the interviews began in fall of 2014. Of the 19 active Firewise communities, we were able to reach 13 by phone. Three Firewise representatives responded to emailed questions. The phone interview structure was that of a guided conversation that allowed for opinions and personal impressions from the interviewees. The guided conversation format also facilitated follow-up questions. The questions were geared toward getting a personal testimony regarding the experiences each person had throughout the application process and were often accompanied by anecdotes that helped illustrate the points.

Figure 11 Firewise Communities in New Mexico

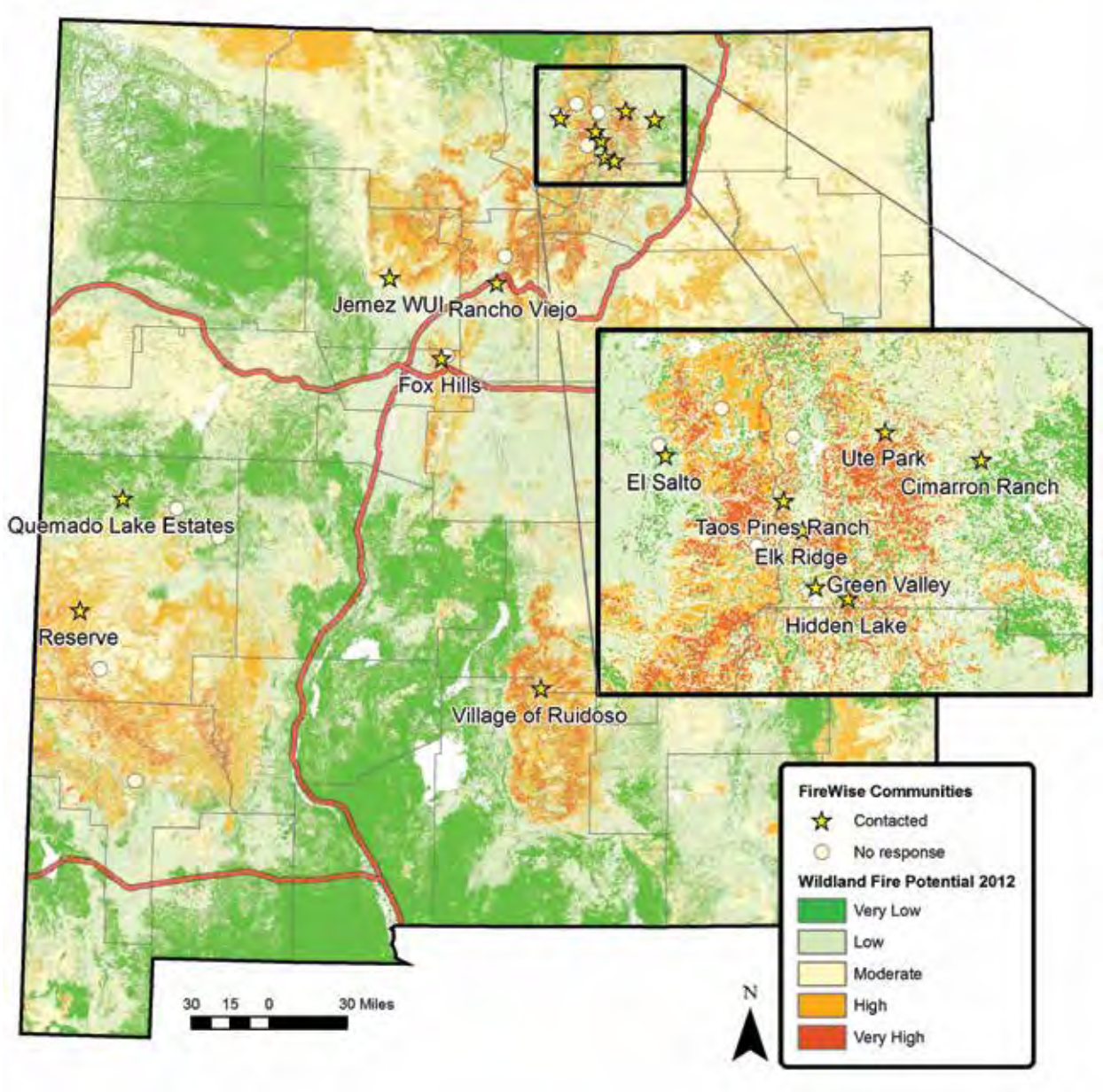


Table 2 Firewise Communities Interviewed

Name	Year Recognized	County	Total Population	Median Annual Household Income
Greater Jemez WUI Corridor	2002	Sandoval	250	$59,886
Village of Ruidoso	2003	Lincoln	8,029	$47,379
Hidden Lake	2006	Mora	135	$43,750
Ute Park	2006	Colfax	71	$22,821
Elk Ridge	2006	Colfax	1,216	$50,917
Fox Hills	2007	Bernalillo	237	$72,566
Quemado Lake Estates	2011	Catron	228	$44,779
Cimarron Ranch	2012	Catron	228	$44,779
Reserve	2012	Catron	289	$26,807
Taos Pines Ranch	2005	Colfax	1,216	$50,917
Green Valley	2013	Colfax	N/A	$50,917
El Salto	2013	Taos	1,785	$44,239
Rancho Viejo	2013	Santa Fe	67,947	$50,446
Homestead	2012	Catron	54	$26,992
Paa-Ko	2008	Bernalillo	237	$72,566
Taos Canyon	2014	Taos	5,716	$29,953

Results

Although none of the 16 residents interviewed had been through a fire personally, experience with fire was an important impetus for seeking Firewise recognition. Three of the communities were inspired to become Firewise because of a fire that had burned close by. In addition, residents of two communities had experience in wildfire suppression and helped increase awareness about wildfire risk based on their involvement with fire. Three communities were inspired to become Firewise because a neighboring community was already Firewise. The main wildfire concerns articulated in the interviews were overgrown brush, ladder fuels, and access in and out of communities. In some of the communities, vegetation hazards extended beyond trees to include tumbleweeds, which are very flammable.

Half of the Firewise communities interviewed had CWPPs. Six had a CWPP in place prior to becoming a Firewise community and one developed a CWPP in conjunction with applying for Firewise recognition. The communities that completed a CWPP prior to seeking recognition mentioned that it made the wildfire hazard assessment, required for Firewise recognition, much easier to prepare.

Residents indicated the Firewise application process was a positive and straightforward experience. Four of the communities did it from scratch with help from people within the community, while seven had help from neighboring communities who had already gone through the process. Communities said they found the Firewise recognition process was easy to complete

and not time consuming. One representative mentioned that the only part that took a long time to complete was the wildfire hazard assessment because the local foresters were very busy and it took some time for them to schedule the assessment. Communities felt that the process was made easier by following in the footsteps of communities that had already been through the Firewise process.

As part of their Firewise activities, all of the communities interviewed had chipper days during which residents thinned, pruned, and cleared brush away from homes. Chipper days often included some kind of informational and social event with food and beverages to encourage participation. Based on the interviews, some residents completed thinning work on their own, while others hired crews to perform the work. There were also people in each community who chose not to do any thinning. Generally, communities reported good support and participation in Firewise efforts however, all interviewees expressed some frustration with the level of participation and the difficulty of maintaining motivation. Often, after people had put in some initial work clearing their properties, enthusiasm waned. In Hidden Lake, a scheduled chipper day had to be cancelled because of lack of interest. In Fox Hills, the first few years had good participation, but work dwindled and people started to lose interest. Communities reported that participation in Firewise activities increased through education as people began to understand the importance of protecting their homes. All interviewees said that increasing educational opportunities for residents was effective and a priority for the future.

Matt Piccarello

Another focus for the Firewise communities was improving access. Fifteen of the 16 communities mentioned that poor access, usually only one road in and out of the community, increased their wildfire hazard. Fox Hills was able to add an emergency exit. Although most communities tried to tackle this problem, they found it difficult to move forward with improvement projects due to lack of funding or logistical reasons. Five communities felt that, while not perfect, improvements had created adequate access for their community for the time being. Some of the improvements included creating additional roads for ingress or egress, widening roads, and pruning branches that overhung roads. Other efforts focused on improving firefighting resources. Elk Ridge worked with other communities to build a small fire station to serve the local communities which was then donated to the county. Quemado Estates also built a fire station for the community and put in fire hydrants so that there was one within 500 feet of every home for easier water access in the event of a wildfire.

Another issue keeping residents from participating in Firewise activities was resistance to cutting down trees. More than half of the interviewees reported that many residents in their communities explained that they had moved to that area or bought a second home there in part because of the trees, and they were not interested in cutting any down. Many residents felt tree cover provided a natural fence. All 13 interviewees said that although there were residents that were uncooperative in completing Firewise activities, once they became more educated about the danger they were facing, many became more open to the idea. Other residents saw thinning and defensible space on their neighbors' property, realized it was not as dramatic as they had thought, and changed their opinions about Firewise. In other cases, residents, particularly seasonal or low-income households, did not have the time or money to create defensible space. Seven of the interviewees expressed issues with absentee or part-time residents. One representative summed it up well by saying, "partic-

ipation is good overall but there are always going to be people who just don't have the time, interest, or money."

Seven out of 16 interviewees said they thought community members felt safer after Firewise. One representative from the Jemez WUI Corridor stated that even if they didn't all feel that they were safer, they did feel like they had more control now that they had done something. Another representative said that many people may not reap the benefits and feel safer until a wildfire comes through and their home is saved because of the work they had done. In a few communities, representatives said they felt the Firewise process brought the community closer together, while three representatives felt that the community was already close, so Firewise had less of an impact. Becoming a Firewise community encouraged outside organizations to help. In the communities we interviewed assistance came from the USFS, BLM, National Fire Protection Agency, NMSF, county management offices, county fire departments, county fire marshals, volunteer fire departments, local fire stations, local businesses, neighborhood associations, and other Firewise communities.

Zander Evans (top), Catherine Hibbard (lower)

Community representatives interviewed felt the Firewise organization was important to help reduce wildfire hazard in their community. Reasons communities mentioned were Firewise educational materials, a large organization to advocate for smaller communities, and help with getting grants and making policies. For example, the Hidden Lake Firewise coordinator emphasized the importance of the added weight Firewise has with residents and policy makers as an outside expert. The state Firewise liaison for New Mexico has helped by answering questions and visiting communities to help with completing Firewise projects and educational presentations. Three representatives of communities that had not been visited mentioned that it would be nice if Firewise could come out to see and then report on their progress.

Interviewees suggested that while their communities might have taken some of the fuel reduction measures without help from Firewise, they would not have completed as many or such big changes. All 16 interviewees would recommend the Firewise recognition program, or something similar, to other communities. They all felt that the structure and support they received from Firewise made it easy to become recognized. They indicated that without the driving force of Firewise, they probably would not have had the ability to organize the community or have the credibility to inspire participation.

The continuation of Firewise in the communities we interviewed was mixed. Nine out of 16 interviewees were confident that their community would con-

Matt Piccarello (before/after photos)

tinue in the Firewise program. The Jemez WUI Corridor representative said that once they started Firewise, it became habit and it was easy to continue. Four of the respondents expressed a fear that participation was waning and felt that if they stepped down as representative, the community's participation in Firewise may not continue.

Not only is there an investment associated with becoming a Firewise community ($2 per capita per year), there can also be a substantial cost for residents to create defensible space. One of the services that Firewise provides is an updated webpage that lists grant opportunities for wildfire mitigation actions. Quemado Estates received a grant from the water company to put in fire hydrants and another community bought a chipper with grant money. Ruidoso received a grant from the USFS to clear around the highway leading into the community. However, applications take considerable work and time, and can be very competitive. Even when a grant is awarded, implementation is not straightforward. One representative who secured a hazardous fuel reduction grant found he still needed to work hard to get residents to participate. When grant money is not available, the homeowner or homeowners association must pay for fuel reduction, which can be costly. One community reported thinning costs of $2,500-$3,000 per acre.

Summary

Based on our interviews, the Firewise organization is an important and appreciated partner in the effort to reduce the risk of wildfire for communities. The educational resources and reputation of Firewise are key benefits for communities. Mitigation activities varied across communities, though chipper days were a constant. Communities with a CWPP in place and other nearby Firewise communities had an easier time with the recognition process. The representatives we interviewed were friendly, approachable, and dedicated people. They cared enough about their homes, neighbors, and the community to take the time to organize and inspire fuel reduction. One person can be the spark that catalyzes a whole community. Firewise coordinators and activities could change some minds about thinning and defensible space, but cost and negative attitudes toward cutting trees continue to be barriers. There is some risk that Firewise communities will lose momentum, particularly if an active coordinator leaves or steps down. In fact, some communities that received Firewise recognition in New Mexico such as Glorieta Estates and the Village of Cimarron appear to be inactive now.

Meredith Flannery

COMMUNITY WILDFIRE PROTECTION PLAN (CWPP) CASE STUDIES

The diverse social and economic conditions within New Mexico provide an ideal set of WUI wildfire mitigation case studies because communities in the state have taken a wide range of approaches to reduce the threat of wildfire. Some communities, like Ruidoso, New Mexico, have strict ordinances that enforce defensible space activities, while other communities leave the responsibility of mitigation activities up to residents, ranches, and landowners. Unfortunately, New Mexican communities also have experience with the direct effects of wildfire in the WUI. Our analysis includes communities that have recently experienced fire events such as the Encebado Fire 2003, Kokopelli Fire 2002, Ojo Peak Fire 2007, and Whitewater-Baldy Fire 2012.

To create these case studies, we first collected the CWPPs for each area. In some cases, multiple CWPPs covered the same communities, often smaller community-level CWPPs are within large county CWPPs. We analyzed each CWPP to identify as many of the questions from the 2008 evaluation guide as possible (Resource Innovations 2008). Then we searched for contact information for the CWPP Core Team. In some cases, CWPP Core Team members had moved on to other positions or could not be found. In total we interviewed 76 people who represented homeowners, non-governmental organizations, federal, state, tribal, county, and municipal governments. Lessons learned for each case study were identified by the interviewer or came directly from the interviewees.

ANGEL FIRE

Angel Fire and the surrounding communities are part of the Colfax County and Enchanted Circle CWPPs (ECRFPA 2006, Colfax County 2008). The 2009 Village of Angel Fire CWPP was created in part to access federal and state grants, as stated in its introductory paragraph. The plan focuses on public information, reducing structural ignitability, fuel treatments, evacuation planning, and increasing fire department capacity. The Village of Angel Fire and the surrounding communities provide useful lessons about both defensible space ordinances and prescribed fire in a WUI context.

Two fires in 1998, the Osha Canyon Fire and Zia Fire, spurred community action in Angel Fire to address wildfire threat. In August 2005, a village ordinance (2005-07) was passed that addressed defensible space and lot thinning. This ordinance required fuel modification at least 20 feet from structures including removal of dead material, pruning up to six feet, and thinning to a 10 foot spacing. Village ordinances for defensible space have been harmonized with the Association of Angel Fire Property Owners covenants for houses within the Angle Fire Resort. In October of 2010, the Village ordinance was updated and the fuel modification area expanded to 30 feet. The 2010 update also emphasized its applicability to existing dwellings as well as new construction. The lot thinning requirements remained the same. In 2014, the Angel Fire Village Wildfire Protection Committee wrote a new draft of the defensible space ordinance and requested input from the community. The Committee sought to simplify thinning requirements and to integrate information from Firewise and the Insurance Institute for Business and Home Safety. In the draft ordinance, the Committee introduced potential changes such as increasing pruning to eight feet, removal of ladder fuel and dead trees along driveways, and thinning vacant lots adjacent to existing homes.

Without enforcement, ordinances do little to spur the development of defensible space. The Village of Angel Fire's 2009 CWPP included recommendations to, "establish a position knowledgeable in forestry or natural resources to implement and enforce WUI ordinances" (Angel Fire 2009). However, neither the 2005 or 2010 ordinances have been enforced (Weinstein 2014a).

Matt Piccarello (above, page 39)

Though the draft ordinance does not differ dramatically from the current Village codes, the new proposal drew heated reaction from residents because it had an accountability mechanism via the recommendation to establish a forestry position. In fact, the meetings surrounding the 2014 draft ordinance had the highest attendance of any wildfire-related meeting. While there was some discussion in public meetings about using the best science, most complaints from numerous letters to the editors of the *Sangre de Christo Chronicle* newspaper focused on a dislike of regulations, the negative aesthetic implications of thinning, the impact on home values, and the cost of hiring a forester to enforce the ordinance. For example, one letter called the ordinance "oppressive governmental intrusions," while another said, "I did not move to Angel Fire to have our atmosphere stripped of its natural beauty."

Angel Fire implemented a slash disposal program before their 2009 CWPP which included free disposal and in some cases free removal by a Village-owned grapple truck. One of the difficulties in enforcing a defensible space ordinance was the limited capacity of the Village to dispose of slash

(Weinstein 2014c). Through a partnership with the Forest Stewards Guild, the Village of Angel Fire obtained a small scale cordwood boiler in 2014 to aid in slash utilization and showcase how waste from fire mitigation can be used. Part of the cost of slash disposal is covered by a monthly wildfire protection fee that generates about $300,000 a year and is scaled according to lot size (Chaney 2013a). The wildfire protection fee was also designed to cover some of the costs of enforcing the defensible space ordinances.

While Angel Fire has not yet been able to meet the 2009 CWPP recommendation of hiring a forester, the Village has made progress. A number of areas recommended for thinning have been treated including the Back Basin and El Camino Real neighborhoods that received "Very High" community hazard ratings in the 2009 CWPP. Similarly, thinning has occurred along highways and other evacuation routes. The addition of a million gallon water tank, a new fire station and new equipment, contributed to the improvement of Angel Fire's Insurance Services Office (ISO) rating. The drop in the ISO rating from 7 to 5 can save homeowners 10 to 15 percent in insurance costs (Duregger 2015).

Angel Fire already had a number of progressive efforts in place to address the threat of wildfire before the 2009 CWPP, including a defensible space ordinance, a slash removal program, and partnerships with neighboring public land managers to coordinate fuel reduction. The Angel Fire Fire Department has been successful since the 2009 CWPP in expanding its capacity and thereby reducing the village's ISO rating. As mentioned above, fuel reduction treatments have been implemented along major evacuation routes as recommended in the 2009 CWPP, and in some of the neighborhoods identified as very high hazard. The nearby communities of Hidden Lake and Elk Ridge

Zander Evans

Eytan Krasilovsky

secured grant funding for thinning and hazardous fuel reduction in 2014. Managers from the Carson National Forest and New Mexico State Land Office (NMSLO) are actively working to reduce the wildfire threat on nearby public lands.

In other areas, little progress has been made since the 2009 CWPP. One of the highlighted recommendations from the CWPP was "an aggressive program of evaluating and implementing defensible space for all homes." Though efforts are currently underway to encourage adoption of defensible space by improving the ordinance and hiring a forester, it is not clear this will be possible. The 2009 CWPP suggested Angel Fire use the program but did not specifically recommend that the village become an official Firewise community. Though the village of Angel Fire itself is not a Firewise community, a subdivision, Elk Ridge, and two nearby communities, Taos Pines and Hidden Lake, are part of the program. Since 2006, no additional subdivisions of Angel Fire or nearby communities have become Firewise.

Controlled burning in the WUI

The southern border of the Village of Angel Fire abuts 12,000 acres of forest managed by NMSLO. The 2009 CWPP identifies treatments on state land as critical to an overall fire protection plan. These forests have high densities of small diameter trees because of a history of fire suppression, high-grade logging, and overgrazing, making them susceptible to uncharacteristic crown fires (Roybal and Krasilovsky 2010). The NMSLO has implemented a number of fuel reduction projects to reduce the threat of wildfire in the village and help restore healthy forest conditions. In 2006, contractors thinned 40 acres of mixed conifer forest with state funding. The NMSLO implemented the 2009 Valley of the Utes fuel break project in conjunction with a new subdivision. The fuel break also connects to a previous fuel treatment project to the west and has an anchor point at Mountain View Boulevard (Angel Fire 2009). The NMSLO worked with local contractors and the Forest Stewards Guild to thin 590 acres south of Angel Fire through funding from the Collaborative Forest Restoration Program (CFRP). Funding from the CFRP also paid in-part to prepare 5,000 acres of state trust forests near Black Lake and Angel Fire for thinning and burning along with needed cultural surveys. This large planning area has enabled fuel reduction and forest restoration treatments to continue through multiple funding streams, the largest of which has been from the

State of New Mexico 2014 appropriated funds. These state appropriated funds have led to almost 2,000 mechanically treated acres.

In 2002, the NMSLO conducted a small controlled burn near the El Bordo Trailer Park, south of Angel Fire. In 2013 a collaborative effort between the NMSLO, the Forest Stewards Guild, the Nature Conservancy, Angel Fire Fire Department, Moreno Valley Fire Department, HR Vigil Small Products, NRG Consulting, Alcon Wildfire Attach, Santa Clara Pueblo, and others brought fire back to 105 acres. The following year the collaborative team conducted a controlled burn across 255 acres. Both burns occurred between the community of Black Lake and the Village of Angel Fire. The Carson National Forest has also conducted controlled burns near Angel Fire in recent years such as the November 2013 operation that burned slash piles across 200 acres on the north end of Angel Fire.

As noted in the 2009 CWPP, local residents were concerned about controlled burns. Public meetings before the 2013 controlled burn brought out concerns about risk to homes from escaped prescribed fire, smoke impacts on people and animals, and long-term benefits for the forest. One resident said, "I'm scared to death of it" (Chaney 2013b). However, the team implemented the controlled burn with no escapes, minimal smoke impacts, and positive ecological effects. The successful 2013 burn built community trust so that a 2014 burn would also be successful. In 2014, residents were much less concerned. In 2014, the burn team also stepped up efforts to reach out to the public by increasing use of social media and going door-to-door at local businesses to explain the controlled burn and to leave information. One nearby resident indicated that the public meeting and steady stream of e-mail updates calmed her fears (Weinstein 2014b). Positive engagement of local fire department staff and volunteers helped build trust.

Zander Evans

Editorials from the local paper provide another example of the significant shift in public sentiment toward greater acceptance of controlled burns from before the 2013 burn to after the 2014 burn. In 2013, an editorial in the Sangre de Cristo Chronicle said, "igniting 900 acres of forested land near residences will pose risks no matter what officials do or say" (Editorial board 2013). The following year their editorial took a distinctly different tone by saying controlled burns would, "likely deliver us a high return to our forests and help our firefighters do what they do best—protect us," (Editorial board 2014). The shift in public sentiment about controlled burning in Angel Fire provides a fundamental, but not surprising, lesson for other communities: communication is a key to build support for controlled burns in the WUI. Publicizing past successes, good communication, and involving trusted locals, all helped build trust and support around Angel Fire for controlled burning. However, in the Angel Fire example, smoke was not a major problem because of favorable dispersal.

Highlights

- Ordinances can be difficult to implement even when they are passed; an individual promoting defensible space may be more important than an ordinance.
- Controlled burning is possible in the WUI, but is easier when good communication, past successes, and local involvement build trust.

2012 Whitewater/Baldy Fire, Gila National Forest

CATRON COUNTY

The greatest strength of the 2005 Catron County CWPP is the specificity of the GIS-based wildfire risk assessment which interviewees considered outstanding (Citizens of Catron County 2006). In addition, all of the Core Team interviewed ranked collaboration and participation for the plan as high. The plan brought together the County, the Gila, Cibola, and Apache National Forests, the Socorro BLM, 13 volunteer fire departments (VFDs), NMSF, Soil & Water Conservation Districts, and the public who all provided input. The CWPP and the wildfire risk assessment data were considered valuable because all the partners were on the same page. They knew where and how high the risk of catastrophic wildfire was, what needed to be done, and what the equipment and capabilities of the fire departments were. The USFS generously provided unlimited access to equipment, personnel, and GIS mapping services. USFS staff also helped design and analyze the risk assessment data. NMSF and the BLM were also very helpful. The risk assessment covered the entire county and 196 WUI communities were identified. Eleven WUI areas were defined as highest priority and supplemental CWPPs were completed for each of these in 2007. The countywide CWPP provided information, data, guidelines, and priorities from which specific, on-the-ground planning and actions were later developed and detailed in the individual community CWPP plans.

From 2006 to 2011, a total of 117,910 acres were treated in Catron County through either mechanical treatments, prescribed fire, or through wildfires. The number of acres treated each year has not met the CWPP's goal, mostly due to lack of funding. Interviewees mentioned the three large wildfires in the county (2006 Bear, 2011 Wallow, and 2012 Whitewater/Baldy Fires) may be another reason treatment targets were not met. For the first five years, Core Team meetings were held monthly resulting in more acres being treated. In later years, the number of meetings dropped off and fewer treatments were completed. The decrease in the number of meetings is attributed to personnel

changes, agencies emphasizing different priorities, and staff time restrictions. Residents feel that if new agency personnel do not see the CWPP as an active, relevant document, then the CWPP will sit on a shelf. Since so much acreage in Catron County is federally owned, it is important that federal agencies are onboard with the priorities identified in the CWPP. Some of the highest priority WUI communities are 75 to 99 percent USFS land, so the need for agency engagement is obvious. CWPP partners have come to understand that the USFS and BLM are required to address their own regional priorities and that these priorities do not always match the priorities outlined in the CWPP. However, CWPP partners feel the federal agencies do the best they can within their constraints. In general, the overarching focus is always the same: reduce the risk of catastrophic wildfire. If treatments are implemented in areas labeled as moderate or even low priority in the CWPP, they are still important because of the vast acreages in need of treatment.

The Catron County CWPP was recently updated and approved by the Catron County Commission in September 2015. The Core Team hopes that the 2015 CWPP update will 1) enable federal agencies to meet the priorities of the Catron County CWPP; 2) direct more funding for treatments on private land; and 3) improve fire department capabilities. The biggest issue identified in the 2015 CWPP is the difficulty of tracking results and showing accomplishments. Documenting accomplishments has been a weakness in the past. It has been difficult getting accurate information especially for treatments completed on private land since they are not always reported. Records are few and scattered at the many partners' offices and there have been difficulties in combining two agency databases. For this reason, three new tables were designed and placed in the updated CWPP that are titled as follows: 1) Risk Mitigation Treatment Needs; 2) Fire Suppression Needs; and 3) WUI Mitigation Treatments Accomplished and Planned. The 2015 CWPP emphasizes the need for the Core Team to be more defined and active and ensure they update the monitoring information annually for each individual CWPP community so they have a living document to apply an adaptive management approach to mitigating wildfire hazard in the County. The Core Team believes it would be best to have one entity gather and document all the information so it is in one place. They plan to explore this as an action item in the future and have considered seeking grant funds to develop a system, create an interactive website, and/or have the project completed by an upper level college student studying for an advanced degree. This important monitoring issue applies to areas throughout New Mexico.

Keri Nieto

The development and implementation of the CWPP has resulted in direct and indirect benefits. In 2014, the County was able to start an Emergency Management section that never previously existed. Emergency management and related plans are now being updated, which will be beneficial. The thirteen VFDs were said to be barely alive in 2006 and now they meet once a month with the County Fire Chief/Emergency Manager and they have better equipment, more water resources, and therefore, better ISO ratings that reduce insurance costs for communities. Collaboration has led to the USFS working with the VFDs for wildfire suppression preparation and activities. Seven communities have achieved Firewise certification in Catron County covering at least 740 people since 2011 and three more certifications are expected in the near future. The County was able to hire a full-time Firewise Coordinator four to five years ago, which has increased public education and the number of defensible space treatments completed. The County purchased

a chipper that the Firewise Coordinator uses to chip slash on the private land treatments, and the coordinator also hauls slash to designated slash disposal areas on USFS land. The County and NMSF continue to do Firewise/Defensible Space assessments but more are needed.


NASA

The USFS has conducted numerous mechanical treatments, prescribed burns, a timber sale, fuelwood projects where landowners can cut and remove firewood up to a certain diameter limit, and hazardous fuel reduction treatments along many miles of electric transmission line. The USFS maintains three to five slash disposal pits where landowners can haul slash, which is then burned by the USFS and VFDs. The USFS has worked with landowners to implement fuel reduction treatments on USFS land adjacent to their private properties. The USFS explains the prescription to the landowners, the landowners cut the trees, and then the USFS implements slash treatments. The BLM also has completed many fuel reduction treatments in WUI areas of Catron County.

Education and outreach takes place at the County fair, health fair, youth career days, HOA meetings, VFD outreach meetings, and other events. The county and volunteer fire departments have been very active in education. Educational materials and equipment obtained by the county include a Firewise trailer and a SimTable (a digital sand table) that simulates wildfire behavior on area landscapes and communities. Education and outreach was rated as average or better and, of course, recent wildfires have raised awareness. No new wildfire-related ordinances or codes have been introduced in the county since residents have an independent nature and are not expected to be receptive. The theme of presentations to the public always focus on "what you *can do* to protect your property" rather than "this is what you *should do.*" Some subdivision homeowner associations have made their own regulations.

As far as socioeconomics, the sawmill in Reserve continues to employ people and the county ensured its continuing operation by purchasing it. The mill processes small diameter trees and trees salvaged from wildfires. Sawdust from the mill and other wood is taken to mills in nearby Arizona. The other increase in jobs that could be attributed to WUI wildfire mitigation is for a couple of contractors who now implement treatments seasonally. Most agency treatments are contracted out to the lowest bidder, so while there is an opportunity for local work, the award usually goes to an outside contractor. A major concern is that funding is decreasing yearly for the USFS and BLM in the county and throughout the western U.S.

Highlights

- A larger area, county-scale CWPP can set the context while community-scale CWPPs within the larger CWPP can focus on specific treatments.
- A good map-based risk assessment and high participation can get everyone, especially the public, on the same page about wildfire hazard and the need for treatments.
- An active Core Team is essential for tracking and overseeing implementation.
- One central organization/entity to track treatments and accomplishments is recommended.

Zander Evans

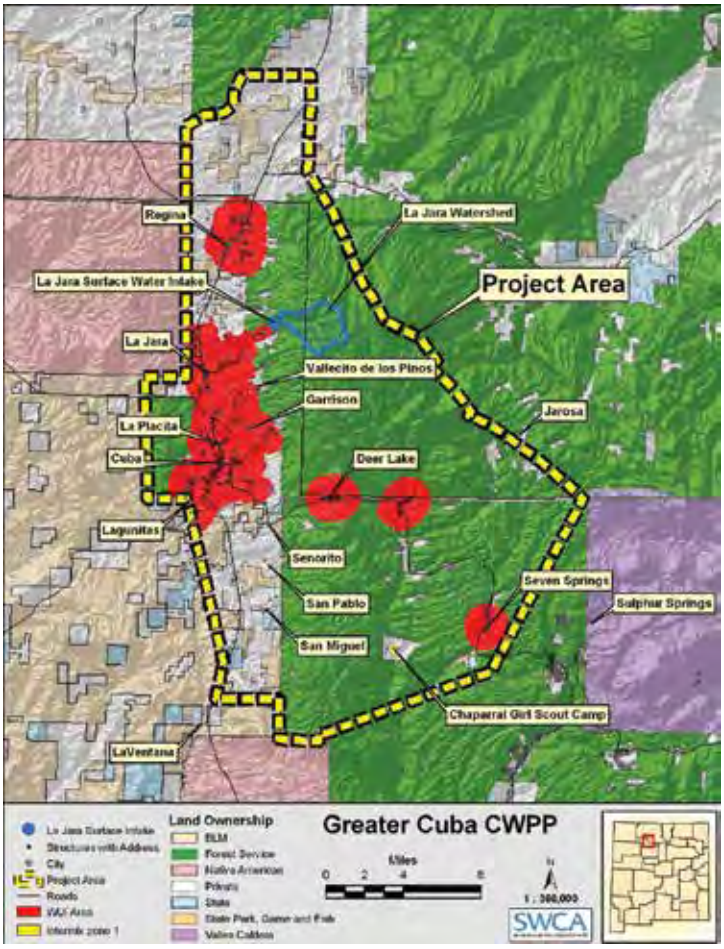
CUBA

A CWPP covering Cuba, New Mexico, and surrounding communities was completed in 2006 (Krasilovsky et al. 2006). The CWPP sets forth objectives for hazardous fuel treatments, designating specific high-priority WUI areas for treatment; structural ignitability ordinances; and community outreach and education. While opinions among stakeholders vary regarding the success of the implementation of the Greater Cuba CWPP, the general consensus appears to be that some benefits came from the CWPP in the years immediately following the completion of the plan, but that progress soon stalled and implementation fell short of goals.

In evaluating the implementation of the Greater Cuba CWPP, NMSF noted that at least some of the identified treatment projects were completed making it more successful than other CWPPs in the state. The Cuba Soil and Water Conservation District indicated that the farmers and ranchers in the area were generally satisfied with the plan, as they had benefited from defensible space projects. Ultimately, however, implementation fell short of meeting the objectives set forth in the plan. Residents of Deer Lakes, a WUI community covered by the CWPP, have been disappointed that more thinning has not occurred.

All of the interviewed stakeholders agreed that the partners that participated in the planning process failed to remain engaged during the implementation phase. Local planning partners seemed to view the writing of the plan as a "box to be checked." Rather than pursue funding to implement the treatments identified in the plan, local partners assumed that the CWPP guaranteed funding for these projects. Federal and state agencies were left to implement the plan on their own. This is not an uncommon pattern for the implementation of the CWPPs in New Mexico.

The economic impact of the thinning projects identified in the CWPP appears to be minimal, though defensible space projects resulted in free fuelwood for the community. No local contractor capable of performing defensible space projects could be identified. Operators from Santa Fe, Albuquerque, and Farmington traveled to Cuba to implement projects, and a few locals were hired as subcontractors for seasonal work. Contractors stayed in the com-



munity for three months and spent money at local businesses, but in general these projects had little to no economic impact on the local community.

Stakeholders generally agreed that the CWPP had not appreciably improved public awareness of wildfire hazard. Some local residents contended that as a farming and ranching community, Cuba residents were already well aware of fire hazard because they "live in the woods." Some increase in awareness of wildfire issues in recent years was attributed to the Cerro Grande and Las Conchas fires. One sign that the CWPP had not improved awareness or involvement is that community members have not been in contact with NMSF to request funding or assistance to implement fuel reduction. Others in the community offered a dissenting view, arguing that awareness in the community has increased.

Highlights

- Perceptions of CWPP effectiveness differ depending on perspective.
- When planning partners failed to remain engaged during the implementation phase, WUI mitigation efforts lost momentum and could not meet the CWPP goals.
- Large wildfires can have a bigger impact on awareness than CWPP implementation.

2007 Ojo Peak Fire via InciWeb

CLAUNCH-PINTO

The Claunch-Pinto Soil and Water Conservation District (SWCD) CWPP covers sections of four different counties east of the Manzano Mountains (Williams et al. 2008). The Claunch-Pinto CWPP was completed in 2008 as a collaborative effort with input from the community members, government agencies, and other local entities. Overall, interviewees felt the CWPP was successful in building awareness, community involvement, hazard reductions, education and outreach. The goals of the CWPP were to build trust through a partnership of all the relevant agencies to create a comprehensive plan that weighed wildfire risk. The focus was to reach out to the community to raise awareness of wildfire hazard. The CWPP was responsible for setting preparedness guidelines and encouraging residents to be responsible. The CWPP also provided emergency management information so residents could plan out safety zones and evacuation routes. The CWPP highlighted the most vulnerable areas for fuel reduction treatments, particularly in the WUI and to protect structures. Community members became quite knowledgeable about creating defensible space.

A risk assessment conducted as part of the CWPP ranked areas high to low risk in order to prioritize treatments. Ground assessments, maps, and models where completed to feed into the risk assessment. The Claunch-Pinto SWCD was the driving force behind much of the planning and follow-through of the CWPP. The SWCD District Manager was the lead in much of the project and she focused primarily on education and outreach. The community members interviewed referred to the District Manager as the person who ran the majority of the meetings and put the plan into place. In many cases, CWPPs are seen as a way to access additional funding. In the Claunch-Pinto case, the SWCD and partners were able to apply for and secure funding to complete fuel reduction treatments and create defensible spaces.

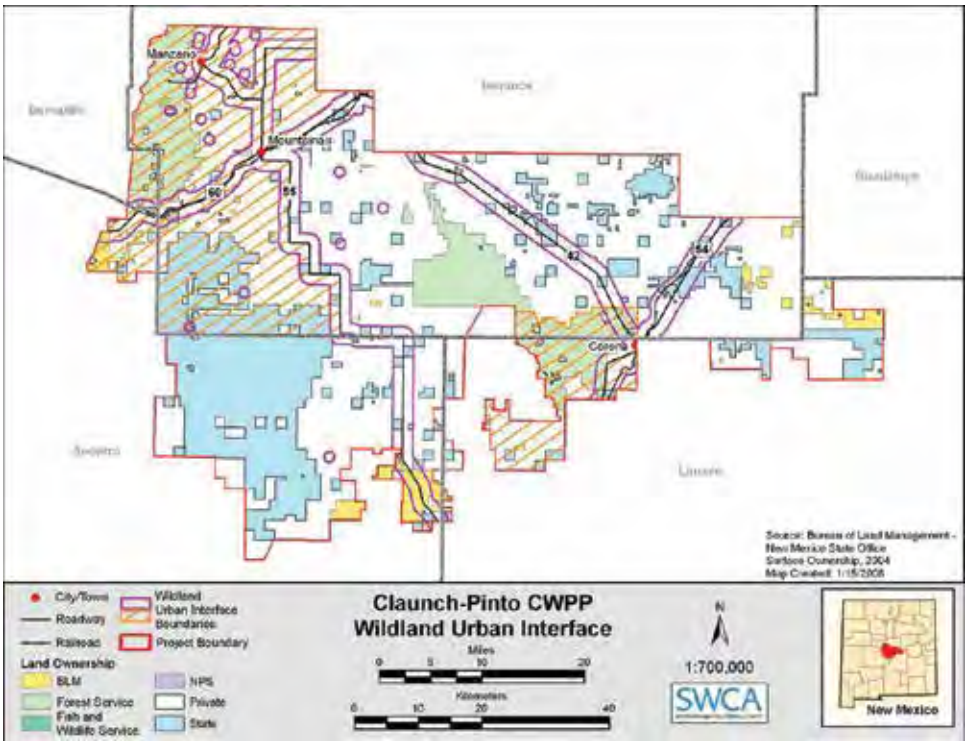
Within the CWPP area, the majority of the communities at risk are low-income populations, especially among mountain communities. The WUI mitigation efforts under the CWPP umbrella generated approximately 200

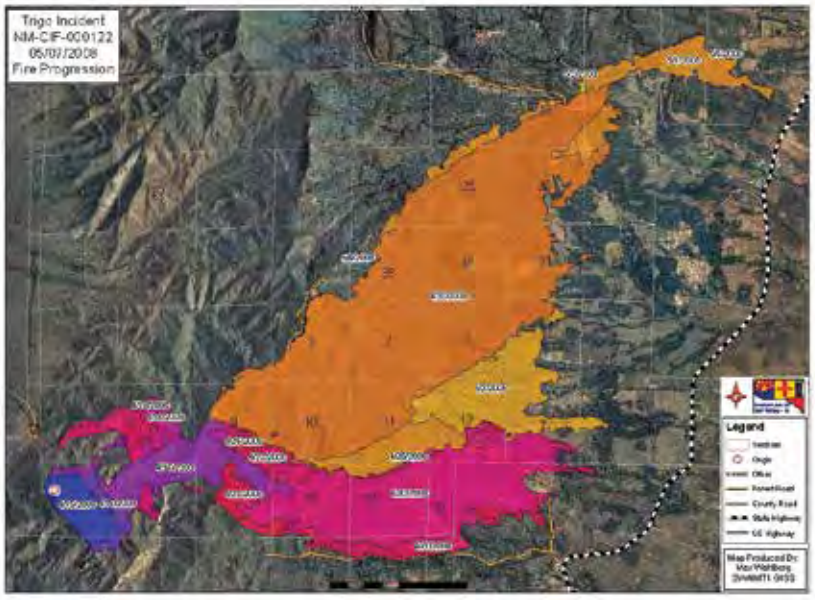
jobs from about 50 projects over the course of six to seven years. In addition, private contractors were hired and contributed to an unknown number of jobs for private landowners. Landowners also benefited from the fuel reduction work by selling some of the wood produced as firewood. They had access to instruction by NMSF from a one-day training that taught the proper thinning and safety measures to use when preparing the areas around their homes. There are no codes or regulations that dictate home mitigations, but the community took the initiative to promote adoption of defensible space. In general, interviewees emphasized the utility of training and education as opposed to regulation. Major thinning efforts have and are still being made by private landowners and contractors.

Claunch-Pinto CWPP

The CWPP linked together a number of agencies that would not have joined together under regular circumstances. At the beginning stages of the plan there was some hostility toward federal agencies as a result of conflicting goals. The communities within the designated areas were also in some disagreement with one another regarding fire protection due to a lack of awareness and misconceptions. Community meetings that brought in experts in the field to meet with the Core Team helped forge a common understanding. An important outcome of the CWPP process was the recognition of common problems. Another factor that pushed the successful implementation of this plan was a wildfire that happened to be burning during the time of the initial meeting.

Community members were aware of the Firewise program, but there were no Firewise communities in the CWPP area. Interviewees viewed Firewise as a useful guide that provides insight to residents on common problems faced living in the WUI. However, to move toward Firewise designation required an individual to take on the responsibility to oversee the project. Communities without that catalyst had not been able to move toward Firewise designation.





The CWPP produced a prime example of how the community took on the responsibility of educating themselves and becoming aware of the dangers and risk of living in and around potential fire dangers. The Core Team was an essential part of the planning effort, but planning also took a great deal of input from all concerned citizens. In addition to providing protection from wildfires and enhancing public awareness of the dangers of living in high hazard zones, work under the CWPP helped establish a silvicultural practice that was good for overall forest health of the areas.

Highlights

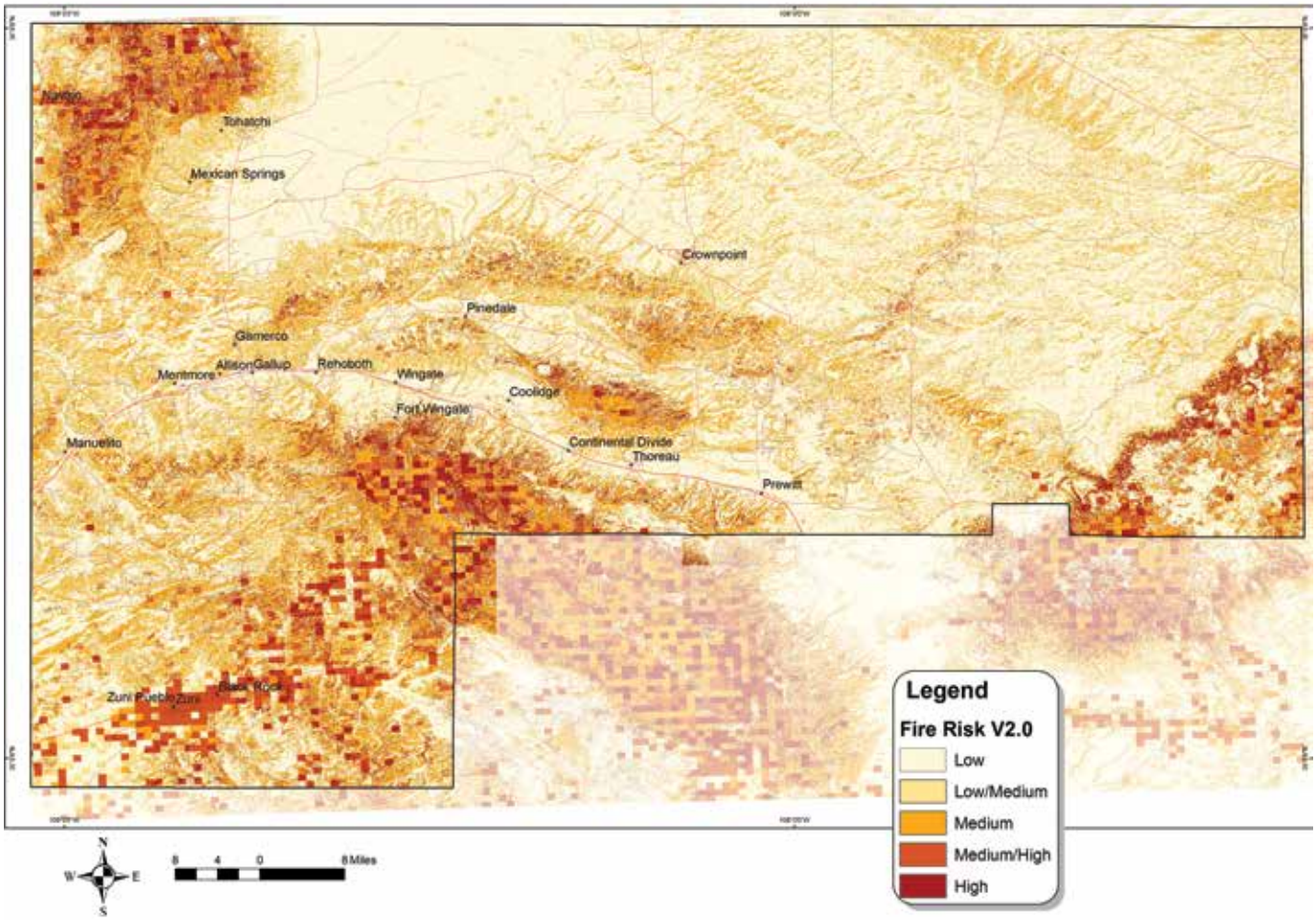
- An individual can be the engine that drives CWPP development and implementation.
- A combination of grant funding and trainings to employ local landowners resulted in fuel reduction across many high hazard areas.
- While the CWPP promoted defensible space, communities lacked leaders who could push for Firewise designation.

Matt Piccarello

MCKINLEY COUNTY

The 2008 McKinley County CWPP was a plan created to sit on the shelf and to provide access to funding, not to be implemented (Walsh 2006). No projects were implemented based on the 2008 CWPP and it failed to initiate any organizational momentum to reduce wildfire hazard. However, the CWPP did help the county recoup firefighting costs. Long after the 2004 Segwick Fire, the county was able to get reimbursed for some of their firefighting. One of the reasons the 2008 CWPP sat on the shelf is that new people took over the jobs of County Emergency Manager and County Fire Chief after the plan was completed. The new Emergency Manager and the Fire Chief did not have direct experience with the 2008 CWPP and may not have even been told it existed. Clearly, knowledge of the CWPP and its status should have been part of job transition plans, and the lack of it, also underscores the low value the county administration placed on the 2008 CWPP. In other words, if the CWPP was a high priority or useful to the county, it would not have been forgotten in the transition process.

In some cases, contractors writing CWPPs use standard templates and insert local information in a formulaic way. While the 2008 McKinley County CWPP may not have been written in this way, there are some suggestions that it is not well tailored to the specifics of the county. For example, there are a number of references to the lack of structure sprinkler systems. Though sprinklers are part of the NFPA 1144 rating system, they are impractical in McKinley County where water resources and infrastructure severely limit sprinkler use.



The action items presented in the 2008 CWPP are also too general to be of use to the county or its partners. For example, the 2008 CWPP recommends fuel breaks around many of the communities and the associated maps depict these fuel breaks as square boxes following ownership lines. The generalized recommendation to put in a fuel break around a particular community leaves managers with more questions such as: where exactly should the fuel break be located? How wide should the fuel break be? How should slash generated by the fuel break be dealt with? More realistic and focused recommendations are more likely to result in on-the-ground changes. The 2013 CWPP update attempts to be more specific by providing maps of wildfire risk in the WUI for each of the volunteer fire distracts along with detailed descriptions of specific roads where treatment should occur (Forest Guild 2013). Even with its increased specificity, the 2013 CWPP update still does not provide a list of actionable projects.

The McKinley County CWPP also highlights the importance of personal relationships and local politics. The 2008 plan only covered part of the county, largely because of political divisions. Much of the area excluded from the 2008 CWPP was part of the Navajo Nation. Within McKinley County there is some tension between communities where the majority of the population is majority white (or anglo in the local delineation) and communities where the majority of the population is Native American. These tensions have deep historical roots and are complicated by modern bureaucracy, which separate some administrative duties and funding streams. The implications for the CWPP include data sharing difficulties, administrative confusion, and some

distrust. For example, some of the participants in the 2013 update process expressed concern that inclusion of Navajo communities might reduce the funding opportunities for other communities that didn't have access to tribal funding sources. In another example of the potential for personal relationships to create difficulties, the 2008 CWPP assigned responsibility for implementing the CWPP to the Office of Emergency Management and did not include the County Fire Chief on the Core Team.

The 2013 CWPP facilitated a successful application for funding to reduce hazardous fuels around homes in a high-risk community identified by the 2013 CWPP update, Timberlake Ranches. The thinning project employed a local crew that also works on public lands forest restoration projects. Grant funding covered most of the costs of the thinning and required only a 10 percent match from the landowner. Treatments focused on reducing structural ignitability and improving access for firefighters by thinning around homes and along roads. Even though grant funding covered 90 percent of the treatment cost, landowners were hesitant to participate at first. As the crews thinned the first properties, neighbors became more interested in participating. Managers took a conservative approach to thinning, i.e., leaving some trees near homes in order to engage hesitant homeowners. Prescriptions were tailored to each landowner and property and in some instances included hauling flammable trash to the dump and in others, thinning heavily under power lines or near electrical boxes. Initial community response suggested this approach would result in more hazard reduction overall. Residents who had been skeptical of thinning prescriptions liked the results they saw and even said, "I guess we should have cut more." Building community acceptance for defensible space was the most important accomplishment because the grant program could not fund treatment on all the properties that needed hazard reduction.

Highlights

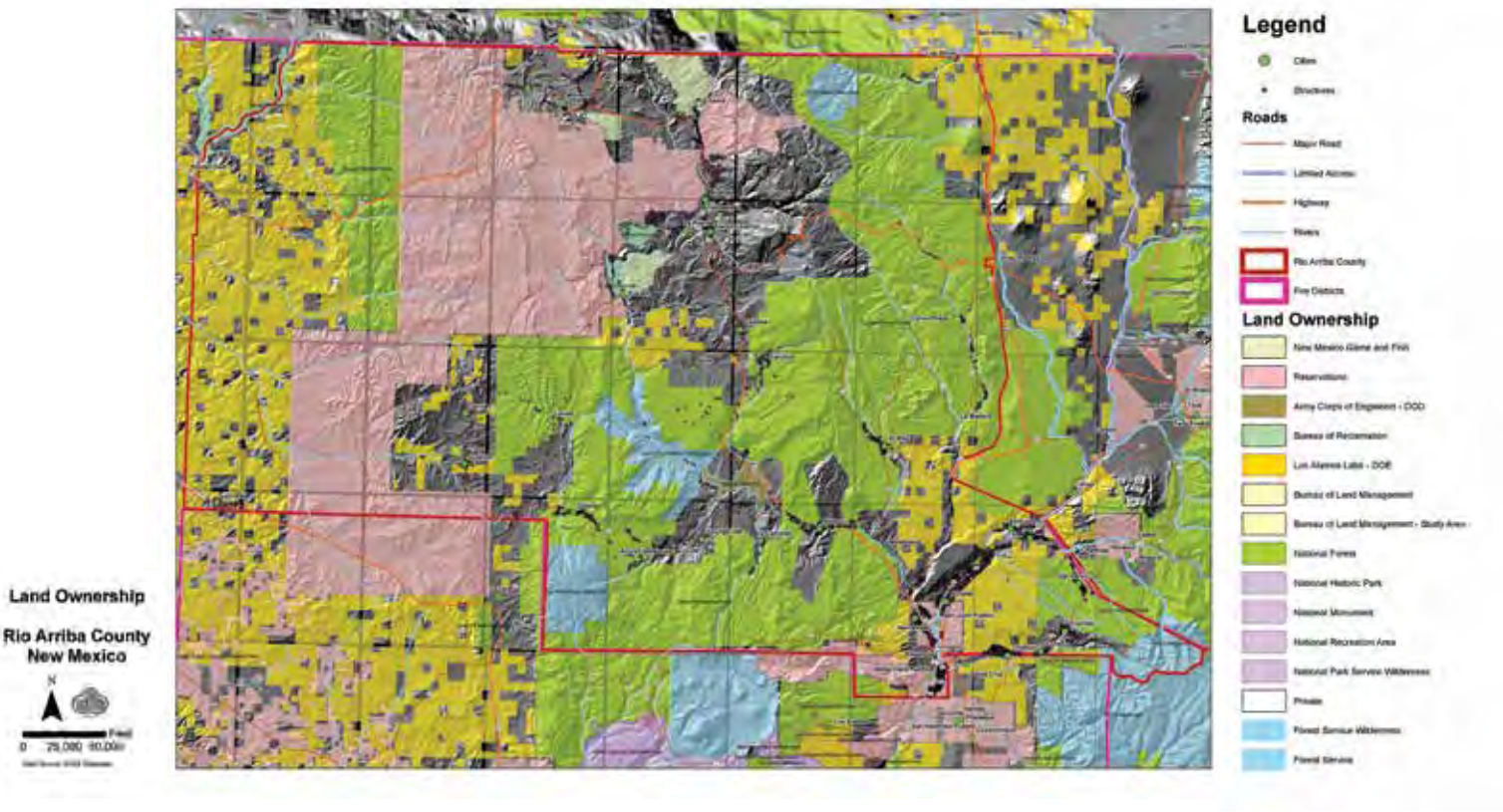
- The first CWPP was a failure because the consultant who wrote the plan did not engage the local agencies and public sufficiently.
- Staff transition and county commitment negatively affected the implementation of the 2008 plan.
- A CWPP with an engaged Core Team can lead to additional funding and mitigation projects.
- Building support for defensible space may take time and local examples.

Matt Piccarello

RIO ARRIBA AND ARCHULETA COUNTIES

The consulting firm SEC updated the Rio Arriba County CWPP in 2007 and used the Wildland-Urban Interface Plan they had written for Rio Arriba County in 2003 as the foundation (SEC 2003, 2007). The Rio Arriba plan emphasizes that because it includes an entire county, landscape-scale data is used and recommendations are general in nature. A key improvement between the 2003 WUI plan and the 2007 CWPP is the addition of 19 specific project areas. While the description of these project areas and suggested treatment is very general, they are prioritized so managers can focus on the highest priority first. However, the lack of geographic or treatment specificity means the prioritization fails to provide clear direction.

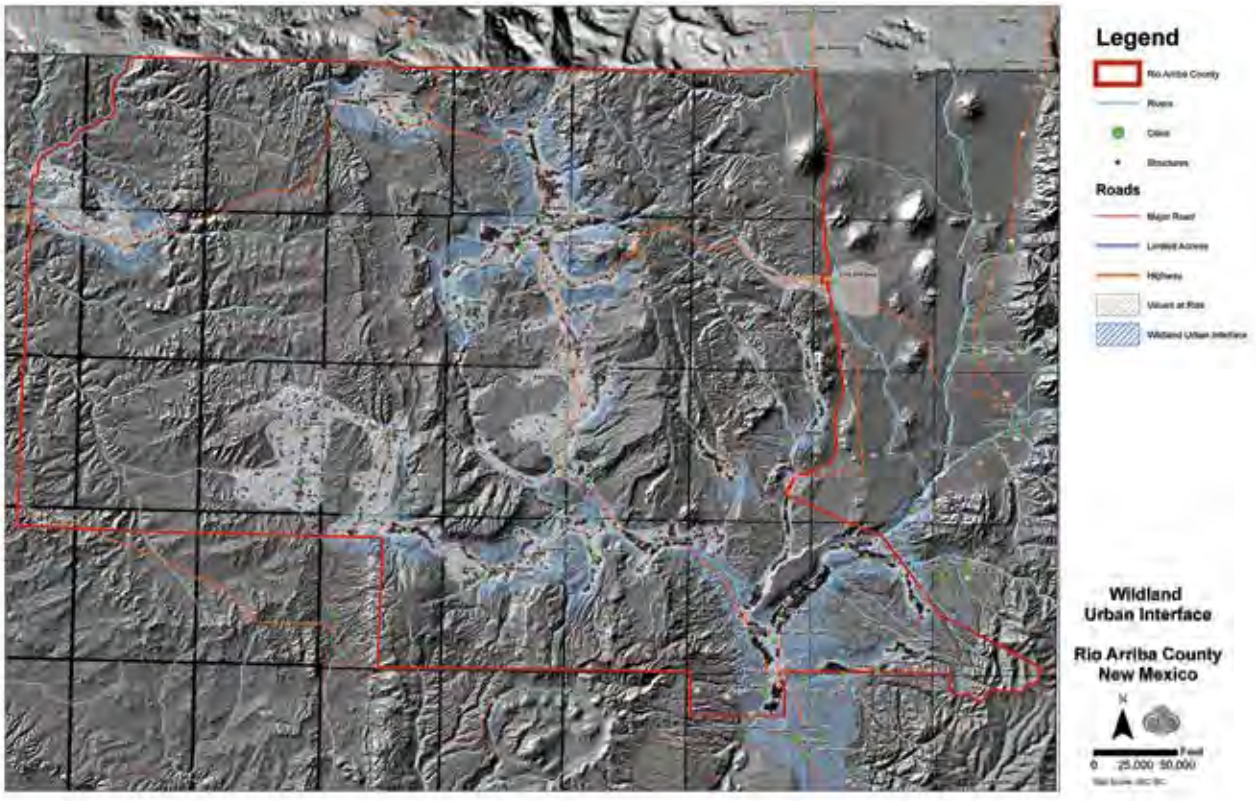
There has been significant fuel treatment work in Rio Arriba County, but little or no activity appears to be driven by the CWPP. For example, the BLM has invested significant resources in treatments in the county, but those treatments have occurred outside the WUI zones from the CWPP or in low priority zones. The BLM's Cebolla Forest and Range Restoration occurred outside most of the Northern Rio Arriba County WUI zone and 2,188 acres of thinning and prescribed fire occurred outside the East WUI zone. Other agency projects, such as the USFS project along the highway 84 corridor, have reduced wildfire hazard for communities in Rio Arriba County, but these projects were not driven by the CWPP.

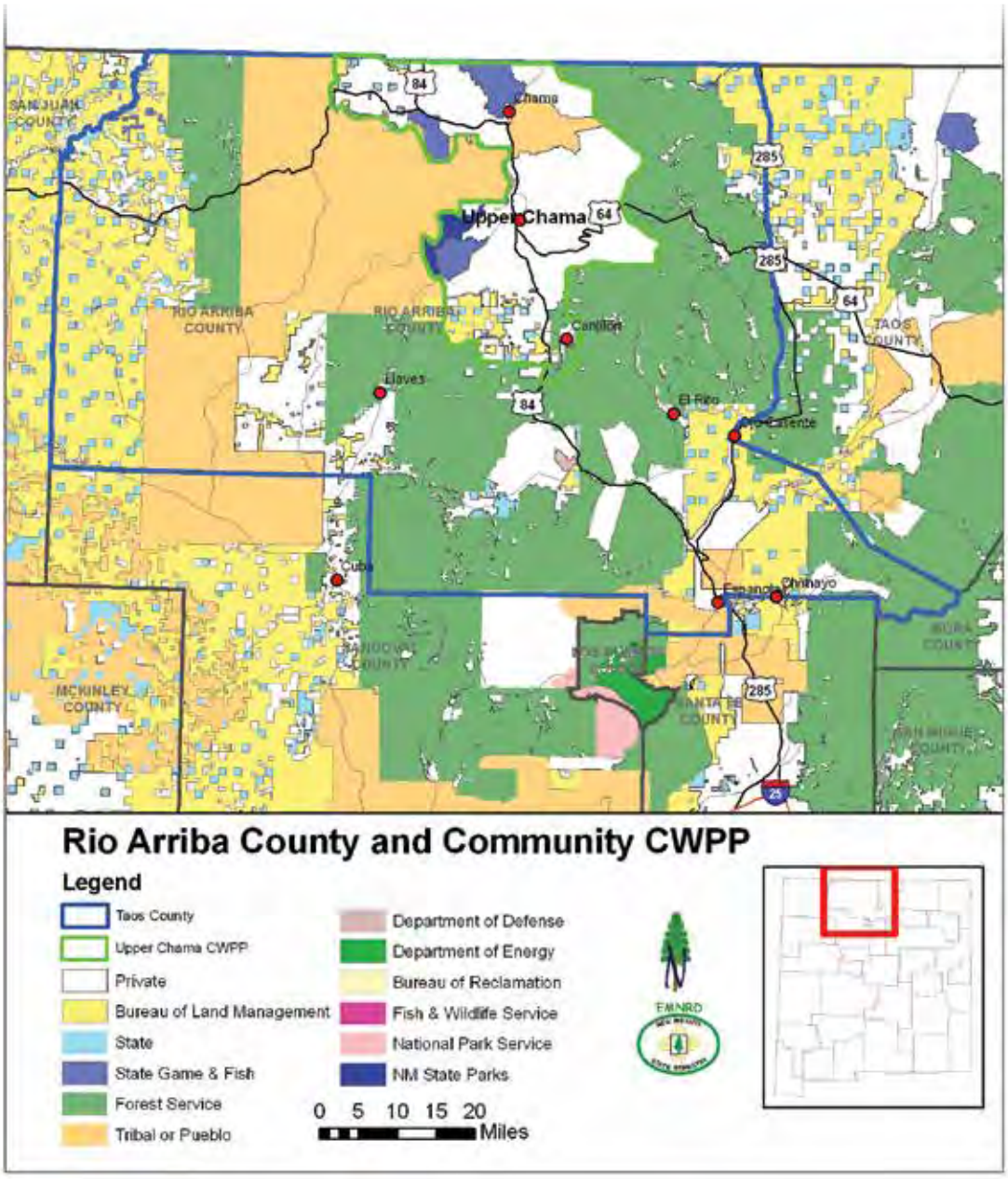


Another example of the limited impact of the Rio Arriba CWPP is that the recent countywide Hazard Mitigation Plan makes no mention of the CWPP and uses a completely different definition of WUI (BOLD Planning 2013). Even though NMSF and other agencies, which should have been aware of the CWPP were consulted for the Hazard Mitigation Plan, there is no connection between the two plans. The lack of influence of the Rio Arriba plan may be due to its initial development. The plan was developed by an out-of-state consultant with minimal local expert or public engagement. An 11-member Core Team had just two meetings with the consultants and the two public meetings held to engage the public were poorly attended. The community wildfire hazard assessments took place in 2003 as part of the WUI plan and were not updated for the 2007 plan.

Other CWPPs cover smaller areas within Rio Arriba County. The Upper Chama Community Wildfire Protection Plan covers a large swath of the center of Rio Arriba County (Walsh 2008). The Upper Chama plan provides more detail than the Rio Arriba plan. For example, in addition to general recommendations about encouraging the development of defensible space, the plan includes specific routes in need of roadside thinning. The Upper Chama plan included more Core Team meetings and community outreach. As the Upper Chama plan states, the responsibility for implementing and sustaining the CWPP falls to the Core Team. In the case of the Upper Chama, the Core Team did not last long after the plan was completed. The lead organization, Northern Rio Arriba Wildland-Urban Interface Corporation, effectively dissolved by 2010.

Neither of the CWPPs in Rio Arriba mentions working with local ranches or large landowners. Only the Upper Chama plan includes even a cursory recognition of the important values and resources of tribes at risk in the county.





Though both mention the Firewise program briefly, no Firewise communities exist in the county.

Just north of Rio Arriba County, Archuleta County updated its 2001 community fire plan by creating a CWPP (Archuleta County 2008). The CWPP was linked to the San Juan Public Lands 10-Year Strategy. Because half of Archuleta County is under public or tribal land management, those agencies' 10-year strategies are crucial to understanding fire threat and ongoing fuel reduction efforts. The map of existing and planned fuel treatments on public land included in the CWPP provides clear, visual documentation of the important role public land management plays in fire management in the county. The Archuleta County plan includes an explicit goal to work with ranches and rural landowners to improve watershed health and wildfire mitigation. Strategies call for expanded use of the Wyden Amendment, which allows for the USFS to enter into agreements with local governments, nonprofit entities, and private landowners to reduce wildfire threat. Another specific strategy the CWPP identifies is prescribed fire. The plan does not include a list of projects

that could be implemented in the short term. However, it does emphasize the importance of partnerships with public land management agencies to implement treatments. The Archuleta County plan includes a delineation and prioritization of communities of concern across the county.

Education and public involvement recommendations in the Archuleta plan emphasize recruiting Firewise ambassadors from local communities. The Firewise Council of Southwest Colorado started the Neighborhood Ambassador program in 2004 to capitalize on the positive impact neighbors and friends can have on wildfire mitigation efforts. Two communities in Archuleta County received Firewise recognition in 2014: Echo Canyon Ranch and Loma Linda Development. In nearby La Plata County, Deer Valley Estates has been a Firewise community since 2010.

In addition to being a Firewise community, Echo Canyon Ranch created its own CWPP in 2013 (Echo Canyon Ranch 2013). The Echo Canyon Ranch plan covers the 21,000 acres of the WUI area around the subdivision. Because of the tight focus on 24 parcels of the subdivision, the plan is able to provide detail on the structural vulnerability of the homes. For example the plan highlights that six of the parcels have pine trees within 20 feet of the homes. Even the number of pets in the community is listed.

Of the 39 people who live in the community, only 16 are full-time residents. However, significant outreach had already occurred before the plan was written. Nine of the lots had home assessments completed and everyone within the community received a voluminous information package on defensible space and Firewise. The Echo Canyon Ranch even had a customized brochure on the "Ready, Set, Go" program developed for their community. The plan includes a list of readily implementable activities to improve education, reduce structural hazards, increase defensible space, and improve community policies and covenants. In general, the Echo Canyon Ranch CWPP demonstrates how a motivated community with ample resources can link a plan for a small area to a large, county effort to reduce wildfire hazard.

Highlights

- Lack of local engagement in CWPP development leads to formulaic and unimplemented plans.
- Effective CWPP should be referenced in other planning efforts such as county all-hazard plans.
- There is a clear contrast between the Rio Arriba plan and the neighboring Archuleta County plan. In Archuleta County there is an engaged Core Team activating efforts to mitigate wildfire hazards.

2012 Little Bear Fire via InciWeb

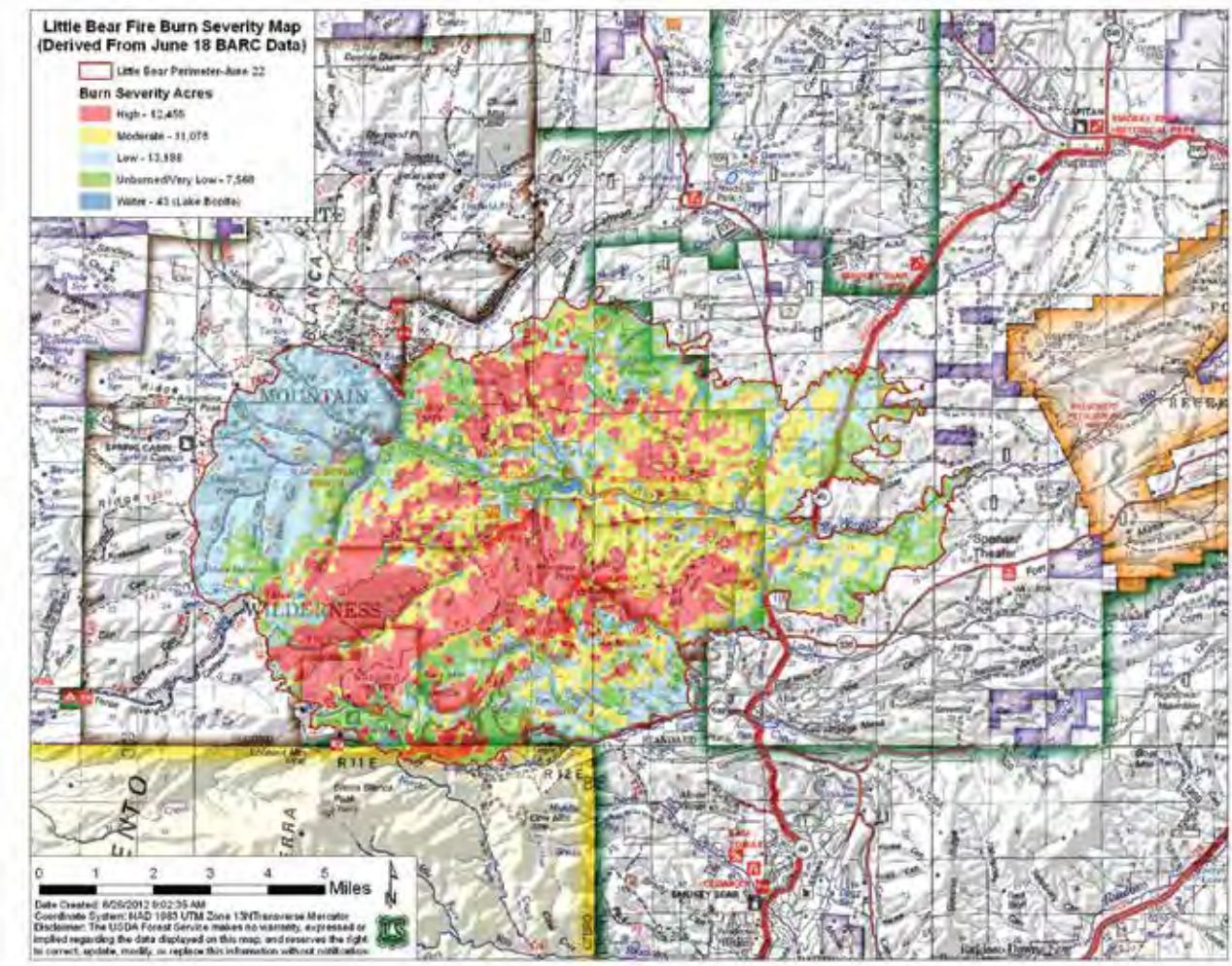
VILLAGE OF RUIDOSO

Ruidoso has more experience with wildfire than most communities in New Mexico. In 2000, the Cree Fire destroyed three houses and burned 6,500 acres (Steelman and Kunkel 2004). The next year, the Trap and Skeet Fire burned over 450 acres. Then, the 2002 Kokopelli Fire destroyed 29 structures and burned nearly 1,000 acres. In 2008, the South Tularosa Fire burned 3,671 acres on nearby Mescalero Apache land. There were two notable fires in 2001. The White Fire burned five homes and 10,348 acres and the Donaldson Complex burned 103,537 acres. The 2012 Little Bear Fire was one of the most disastrous fires yet: it burned 242 houses, 12 structures, and 44,330 acres (McCaffrey et al. 2013).

Against this backdrop of numerous wildfires in the WUI, it is not surprising that the Village of Ruidoso has been actively engaged in wildfire mitigation for a long time. The Greater Ruidoso Area WUI Working Group began meeting in 2000. The WUI Group includes federal agencies, the Mescalero Apache Tribe, state agencies, county emergency management, municipalities, fire departments, homeowners associations, and local businesses. Working together was made possible by a willingness to reach across agencies and by particular individuals who were willing to think collaboratively. This WUI Group has been very important to mitigation efforts in Ruidoso. There are four subcommittees for the effort: information sharing committee, planning committee, assessment committee, and public outreach committee. Public outreach was very important early on and the WUI Group was able to do a lot of outreach through public service announcements, the Kiwanis Club, Ruidoso's Mountain Living Home and Garden Show, and the public library. As awareness built, local organizations began to support the WUI Group's efforts. For example, after the WUI Group paid $400 to participate in the Home and Garden show for a couple years, they were allowed to exhibit for free at a

recent show. Interviewees emphasized that the WUI Group plays a central role in linking treatments together to form a coherent wildfire protection strategy.

Agencies and individuals have found it difficult to stay engaged with the WUI Group because of other time commitments and short staffing. Still, interviewees reiterated the importance of collaboration. For example, the Mescalero tribe worked with the USFS on a stewardship contract for Seven Spring and learned they need to be involved early on, during the National Environment Policy Act process. So, during the Perk Grindstone project, they prioritized staff involvement from the beginning. Members of the WUI Group identified staff turnover as a challenge to continued collaboration, particularly when it is abrupt. USFS can often be a source of turnover because of the practice within the USFS of transferring staff to different regions. In contrast, when outgoing staff was able to introduce a replacement, transition was easier. Another example of transition on the Mescalero side was the way the defensible space program bounced around between the Fire Department and the Forestry Department.

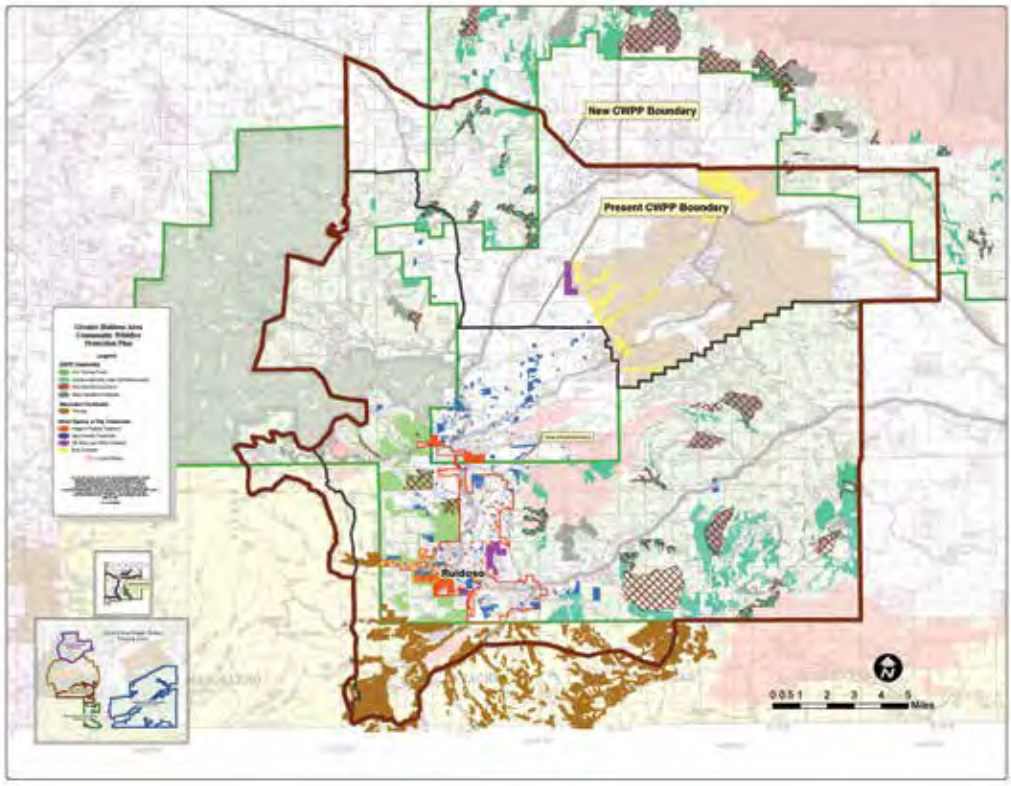


In 2004, Ruidoso completed one of the first CWPPs in New Mexico. The CWPP was brief but included a detailed map of fuel reduction treatments (Ruidoso WUI Group 2004). Ruidoso's CWPP is not as important as other ongoing efforts to mitigate wildfire hazards. The WUI Group was already sharing information about treatment plans and accomplishments so less detail was needed in the CWPP than in communities where the CWPP

initiated information sharing. Similarly, the CWPP updated ordinances that were already in place codifying the creation of defensible space. A set of village ordinances from 2002 included a section (42-80) on Fuels Management Standards that required mitigation measures. For example, the standards required removal of flammable ground materials, ladder fuels, and thinning of trees (or tree clumps) to 10 foot spacing within 10 feet of structures. The village enforced the ordinance and required residents to create defensible space.

While there was some resistance to requiring defensible space, the timing was ideal for the passage of the ordinance. While the ordinance was being debated, smoke was blowing in from the Rodeo-Chediski Fire. Interviewees felt that residents of Ruidoso were eventually won over regarding aesthetics of defensible space. At first the idea of cutting trees was not well received, but now people appreciate the way a thinned stand looks. The prevalence of nearby wildfires also helped build support for the ordinance. Residents report that after the Trap and Skeet Fire of 2004, the real estate community began to worry about the ability to insure, and hence, sell homes in Ruidoso. However, while there is general acceptance of the ordinance, some residents still have issues with certain aspects of the requirements. For example, the village ordinance requires pruning, which one interviewee felt contributed to the death of spruce trees. There is also a feeling that parcels greater than five acres need to have a different set of rules than small urban lots.

The Mescalero Apache Nation, adjacent to the Village of Ruidoso, provides another example of partial acceptance of defensible space. Interviewees felt the tribal members are well educated on natural resource issues, in part because many of them heat with wood, hunt, work at the sawmill, fight fires, or have a family member employed in natural resources. Tribal members are interested in managing the forest but do not necessarily want trees cut near their houses. One reason some people are hesitant to implement defensible space is because they want to have teepee poles (Douglas-fir from 2 to 4



inches to 4 to 6 inches in DBH) available in their backyards, which can be 40 acres according to interviewees. There is also a perception among some tribal members that lop and scatter prescriptions are wasteful.

Another unique aspect of wildfire mitigation work in the Ruidoso area is the recent history of the forest industry. The presence of the Mescalero sawmill meant some treatments, particular overstory thinning, were more economically feasible. Though the sawmill had closed, the assistance a forestry industry can provide was still fresh in managers' minds. The cost of slash removal is significant for the village of Ruidoso (on the order of $1 million a year). There was hope that a biomass power project in Alamogordo might provide a market for fuel reduction material, but that has yet to come to fruition. Even with economic challenges, a good deal of treatment has occurred in the Ruidoso area.

The recent wildfires have tested the fuel treatments. Unfortunately, the White Fire showed that fuel reduction treatments are largely ineffective during extreme wind events (SWFSC 2014).

Treated areas within the Donaldson Fire did seem to slow fire spread, but fireline intensity appeared similar to untreated areas (SWFSC 2014). One fire manager pointed out that rather than measure the effectiveness of fuel treatments from the perspective of changing fire behavior, they may be more important in giving firefighters more options. Specifically, by ensuring retardant actually gets to the ground, providing opportunities for back burns, and increasing safety through reduction of ladder fuels.

Another example of the importance of collaborative processes potentially reducing conflict is the Bonito Project. The 11,600 acre project was designed to reduce wildfire hazard but was stopped by legal action. The Center for Biological Diversity won a court challenge that effectively shut down the Bonito Project in 2011 (Stallings 2011). After the 2012 Little Bear Fire, some managers and residents felt that if the project had been implemented, it might have reduced the severity of the Little Bear Fire (LeDuc 2012). Other interviewees suggested that a more collaborative process to plan the project in the Bonito area might have avoided the legal wrangling.

The future of the fuel reduction efforts in the Ruidoso area will be focused on maintenance. There are many acres that have been treated once, but need a second or third treatment to maintain their effectiveness in changing fire behavior. However, some managers feel maintenance treatments are a more difficult sell to the public than first-time treatment because they require substantial funding, and the results are not necessarily as obvious.

Highlights

- An active and engaged WUI wildfire mitigation group (i.e., a Core Team) is more important than a complex or prescriptive CWPP.
- Staff turnover can jeopardize cohesion of collaborative groups and limit implementation.
- Wildfire nearby can motivate change that might not be possible at other times.
- Maintenance of fuel reduction treatments and support for regulation can be a challenge.

SANTA FE COUNTY

The Santa Fe County CWPP was completed in 2008 to address the hazards and risks of wildland fire (SWCA 2008). Interviewees reported that the CWPP has been very beneficial in providing the framework and focus for where the priorities are and what needs to done. This has resulted in more funds for implementation of the plan. The County and City Fire Department Wildland Divisions and the many other collaborators have built relationships and taken advantage of opportunities to collaborate to implement the CWPP. Prioritized recommendations of the CWPP fall into four main categories as follows: 1) completion of more than 55 fuels reduction projects; 2) public outreach and education directed at homeowners to help them prepare for wildland fire; 3) improved fire response capabilities through improved communication, professional training, and equipment; and 4) reduction of structural ignitability by providing public education on defensible space. Other at-risk community values such as the Santa Fe Watershed and County Open Space lands are important areas needing fuels treatments and are CWPP priorities.

The Wildland Division was started from scratch in 2008 with funding from a Collaborative Forest Restoration Program (CFRP) grant and a New Mexico Association of Counties (NMAC) grant that allowed for the hiring of a WUI Specialist and two other staff. The Wildland Division continues to expand due to grant funding and now has a five to ten person fire suppression/fuels reduction treatment crew and a Youth Conservation Corps (YCC) crew on board for six months of the year. The City of Santa Fe Fire Department also has grown a Wildland Division and now has a WUI Specialist, a five-person permanent crew, and 12 seasonal workers for fuels reduction treatments and fire suppression. The city crew works on city and private land, Nature Conservancy land in the city, and some USFS land in the Santa Fe Water-

shed. Funding to expand the City and County Fire Departments, implement education and outreach, and fuels treatments has come from CFRP, New Mexico Association of Counties, YCC, Environmental Quality Incentives Program, and Santa Fe-Pojoaque SWCD. Fire departments in the county have also been able to obtain new fire engines and water resources through grant funding. People implementing treatments are the county Wildland Division crew, the city Wildland Division crew, YCC crews, NMSF's Inmate Working Crew, Returning Heroes Veterans Crew, Chimayo Conservation Corp, and private contractors. At a minimum, 20 new jobs have been created since 2008 to implement the CWPP.

The Santa Fe County Fire Department's Wildland Division has been very active in implementing the 2008 CWPP. In fact, the National Association of Counties granted Santa Fe County a 2015 Achievement Award for their "Wildfire Hazard Assessment and Prevention Program" in the category of Emergency Management and Response. A highlight has been the innovative use of home hazard assessments for public education and outreach. The county's home assessments are provided on a website (www.sfcfire-wildland.com/2/) where they are used for public outreach, preparation of pre-plan maps for several fire districts, neighborhood fire plans, and for overlay on a SimTable for both firefighter training and public education. Assessment data published on the website includes the use of colored dots on community maps indicating the level of wildfire hazard on individual parcels. The Wildland Division also created a custom Wildland Fire Guide for Santa Fe County that is an asset to structural and wildland firefighters by providing specific, local information. Education and outreach in the county also consists of community meetings, radio ads, local conferences, Facebook and Twitter postings, and emergency management meetings. Pre-planned triage is presented by the county fire departments at community meetings and explains how firefighter response is based on home accessibility and fuels. Since 2009 over 75 community educational meetings have taken place in the county. Rancho Viejo is currently the one Firewise-certified community in Santa Fe County, though another community is about to be certified and a couple more communities are completing requirements to become certified. Collaborative partnerships, the CWPP risk assessment, and education and outreach, has led to fuel reduction treatments on close to 900 acres of state land in WUI communities identified as high risk. The USFS has completed thousands of acres of mechanical and prescribed burning treatments in the Santa Fe Watershed, which is a top priority. In addition, the USFS did treatments along boundaries of high-priority private lands with homes near Santa Fe. The CWPP risk assessment priorities, the parcel-level assessments, and other public outreach is reaching more private landowners, who then implement more treatments.

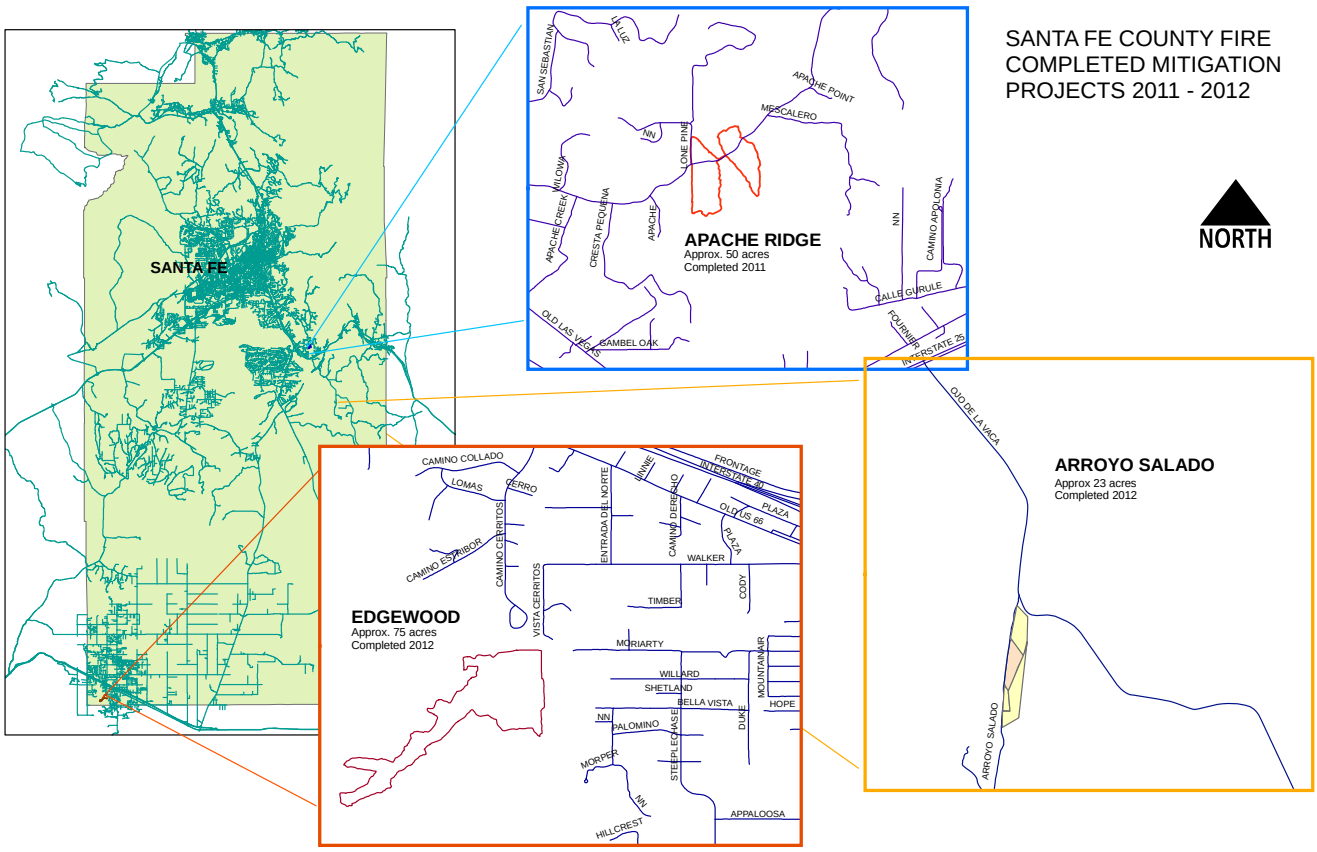
A five-year update of the CWPP was completed by the Santa Fe County Fire Department in 2013 although it was difficult getting collaborators and the public interested in attending meetings for the update. The update expands to include the city of Santa Fe, Tesuque Pueblo, and small-area community action plans. In part because of staff transitions, the 2013 update has not been finalized or officially signed. The 2013 CWPP update contains excellent documentation on what has been accomplished in the county to date for each item of the action plan in the 2008 CWPP. The recommendations and priorities in the 2013 CWPP are on a general landscape level, therefore, when possible, the city and county fire departments develop more specific individual community level action plans for areas at high risk.

Santa Fe County CWPP, Zander Evans (page 63)

As described in the 2013 CWPP update, Santa Fe County hopes to: encourage more homeowner responsibility in land stewardship; provide more demonstration sites; include government leaders in the educational process; and create more robust and meaningful incentives and disincentives for creating defensible space and home hardening through codes, tax incentives, or other incentives-based programs. Other goals are to continue training paid staff in wildland fire techniques, re-establish volunteer wildland firefighting capability, update the County Emergency Operations Plan, utilize federal funding for pre-hazard mitigation and focus more educational time on post-fire preparedness.

Creating a more fire-adapted community

Santa Fe is one of the hubs for the Fire Adapted Communities Learning Network and has received additional funding to help create fire-adapted communities, which is one of three overarching goals of the National Cohesive Wildland Fire Strategy. The Learning Network helped fund Santa Fe County Fire Department's pursuit of a fire-adapted community approach in the WUI community of La Cueva. La Cueva was ranked high risk in the 2009 CWPP in part because of the single gravel road in and out of the community. The 2013 Tres Lagunas Fire underscored the community's risk when it burned nearby. In La Cueva, each landowner owns several acres with some owning up to 100. As part of the fire-adapted communities project, all landowners were asked to reduce fuels near their structures on their own, so that treatments could focus on the continuous canopy of dense trees outside of the 30 to 50-foot zone around structures. A contractor who lived in the community and employed wildland firefighters as sawyers implemented the



Eytan Krasilovsky

thinning treatments. The USFS had already thinned 520 acres adjacent to the La Cueva community.

With over 45 acres of treatments across nearly 20 landowners completed, the Santa Fe County WUI Specialist began development of a community action plan and held well-attended community meetings to develop the action plan. Another result of the thinning treatments was the realization that on some parcels, there were too many heavy fuels on site, even after firewood was removed and accessible areas were chipped. This led to piling of heavy fuels across 15 acres. Prescribed pile burns were not a regular occurrence on private land in Santa Fe County. In fact, the burn permit issued by the County was only designed for burning one pile at a time. Learning Network hub partners developed a prescribed burn plan template that included a complexity analysis and the county issued a permit for more extensive pile burning. Area volunteers and professional firefighters participated in the collaborative pile burn in early 2015. Since then, the City of Santa Fe began planning its own pile burn, a first for the city, using the La Cueva burn plan as a template.

Taken as a whole, the collaborative efforts in La Cueva represent many of the different elements of becoming fire-adapted, including risk identification, dialogue with residents about that risk, wildfire planning, home mitigations, and fuel reduction through multiple means (thinning, chipping, and prescribed fire). This approach helped residents, who had not recognized their wildfire

Jessica Griffin

risk, change their perspective and take steps to reduce hazards. The community is more aware of the wildfire threat and has begun to plan for a safe and orderly evacuation. Creating a fire-adapted community is an on-going process, and La Cueva has started moving towards the goal.

Highlights

- The CWPP provided a foundation to build relationships and increase opportunities for collaboration with a wide range of partners.
- Dedicated WUI specialists helped speed hazard mitigation work and expand public outreach.
- Technology and internet distribution helped with the implementation, maintenance, and positive impact of the home hazard assessment program.
- The CWPP provided the guidelines and priorities to get people on the same page and obtain funding, which in turn led to implementation.
- Collaboration around building fire-adapted communities can overcome barriers such as landowner hesitation to reduce hazards and limitations of routine policies.

Zander Evans

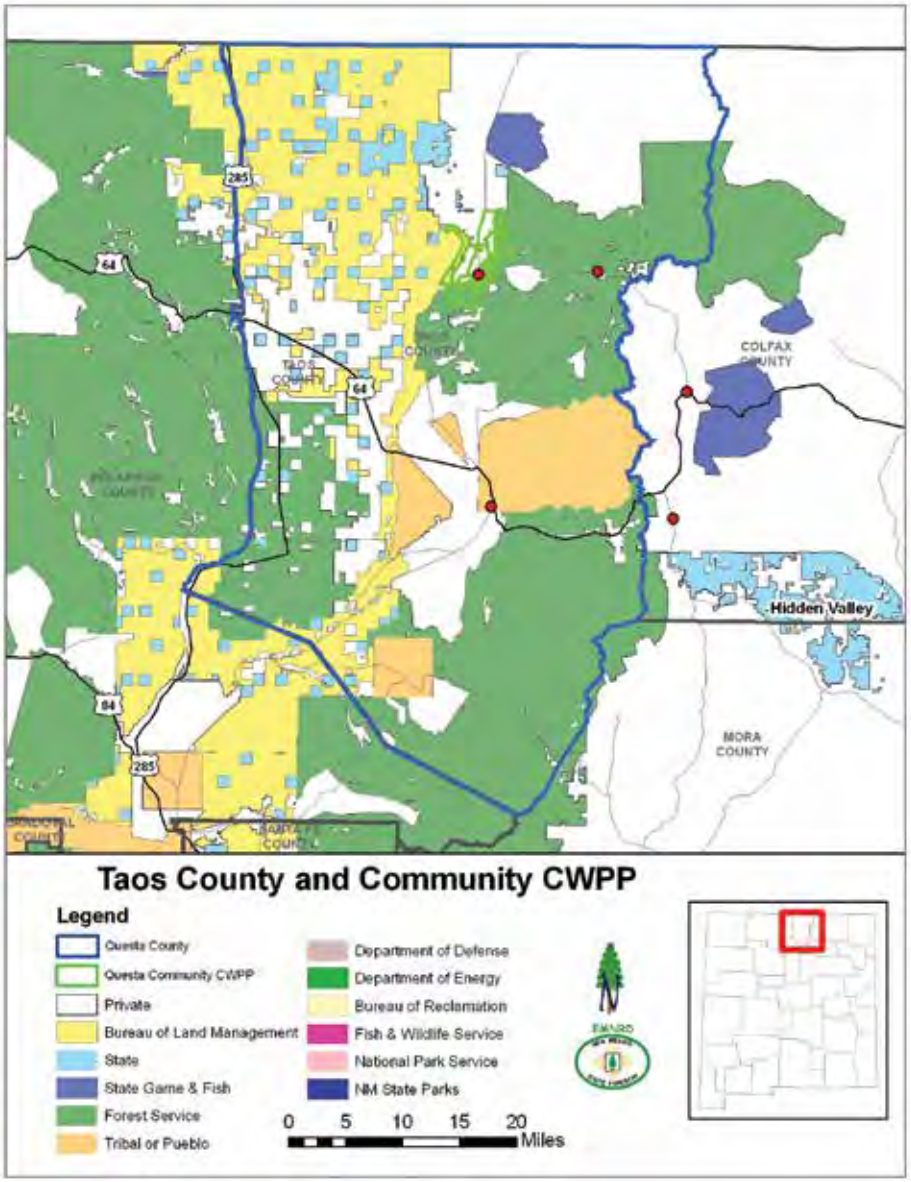
TAOS COUNTY

Taos County has a number of overlapping CWPPs dating back to a 2006 Enchanted Circle Regional plan that included sections of Taos and Colfax counties (ECRFPA 2006). The 2006 CWPP set forth an ambitious agenda with 38 specific fuel reduction projects and a goal for the adoption of the International Code Council's Wildland-Urban Interface Code (ICC 2012). In 2007, a consulting firm produced a CWPP that was rejected by the New Mexico Wildfire Planning Task Force because of omissions. A second process with Core Team meetings was initiated and completed during 2008. The Core Team continued to meet quarterly during 2009. The Core Team included a shifting group of 37 people representing the community, businesses, non-governmental organizations, federal, tribal, state, county, and local land managers (Gardiner 2009). Taos County is currently working to update its CWPP.

WUI areas within Taos County have been recognized as at risk since 2001, and USFS and BLM land managers have been working to reduce fuels in these areas. The CWPP Core Team meetings provided an opportunity to highlight federal land management efforts. The 2009 CWPP also emphasized a WUI education program and support for the 14 volunteer fire departments in the county. Grants from the New Mexico Association of Counties allowed the Rocky Mountain Youth Corps to provide communities and property owners with information about defensible space and Firewise (Gardiner 2009). The high density of Firewise communities in the Taos area (five currently) is due at least in part to these outreach efforts.

Notably, the Taos County CWPP Core Team has continued to meet in part because of support from staff of the Carson National Forest, BLM Taos Resource Area, NMSF, and Taos County Planning Department. The New Mexico Forestry and Watershed Restoration Institute has also contributed both digital mapping services and forest management advice. The Taos SWCD runs a program to provide technical and financial assistance to landowners to create defensible space by thinning trees. To ensure the program is accessible to low income landowners, the Taos SWCD adjusts its cost-share rates to meet the ability of the applicants to pay.

Taos County CWPP (top), Zander Evans (lower)



Within Taos County, four individual community CWPPs have been created. The Enchanted Circle CWPP included the Pot Creek Community Wildfire Protection Plan as an appendix (ECRFPA 2006). In 2004, a CFRP project was funded to thin around the Pot Creek community, though as the CWPP points out, the $175,000 project was too small to provide significant protection. In 2008, the Village of Questa completed a CWPP which highlighted unique risks (Gardiner 2008). For example, acequias, community irrigation ditches, define property boundaries and severely constrain emergency access or egress. Since many homes are heated by fuelwood, the number and size of wood piles presents an increased wildfire hazard. The Questa CWPP includes a brief section on post-fire recovery and soil stabilization. The Peñasco Valley 2012 CWPP update focuses on 13 communities in the southeast of Taos County (Gardiner 2012). The Peñasco Valley CWPP identifies four complete USFS WUI fuel reduction projects, five ongoing BLM projects, and two treatments on private land funded by NMAC and a USFS Non-Federal Lands grant.

Taos Pueblo has a separate CWPP, though Pueblo representatives have also been engaged in the larger Taos County CWPP (Lissoway 2009). As with many other CWPPs, Taos Pueblo indicated that having an approved CWPP was important for accessing funding. They have been able to secure support

from CFRP, the 2009 American Recovery and Reinvestment Act (ARRA), and the state, for fuel reduction projects. Over the last decade, they implemented a landscape strategy that includes a fuel break between the lower elevation WUI areas and the upper elevation wilderness. Although not explicitly detailed as a landscape strategy, the 2009 CWPP suggested the linkage was possible between fuel reduction projects to create an effective fuel break.

Fuel reduction projects occurred in Taos County before the advent of CWPPs in the region, and have continued as CWPPs have been completed and updated. While projects such as the BLM's Cerro Wildland-Urban Interface Project are clearly designed to reduce the hazard for communities (in this case the community of Cerro), it is more difficult to identify a direct link to CWPP planning or coordination. WUI fuel reduction projects in Taos have combined a number of funding sources. For example, the La Jara project area included 100 acres of thinning funded by the CFRP program in conjunction with thinning on adjacent private land. The USFS is planning to conduct a controlled burn to complete the public lands portion of the treatment in 2015. Taos County projects also benefited from ARRA funds and partnerships with the National Resource Conservation Service. Taos County has been able to assemble enough funding to hire a WUI coordinator, who is working to implement treatments and update the CWPP.

Highlights

- Agency support for and participation in CWPP Core Teams can help keepthe entire team engaged.
- An emphasis on education and outreach in the CWPP resulted in communities' successful efforts to become Firewise.
- The county CWPP provides a vision for hazard mitigation at the landscape scale and smaller, community CWPPs can identify local, implementable projects.
- A range of funding sources are available to help implement treatments.

Zander Evans

2015 Rough Fire via InciWeb and page 71

LESSONS LEARNED: EFFECTIVE WILDFIRE MITIGATION IN THE WUI

CWPPs integrate many WUI mitigation activities from forest fuel reduction treatments to community education. Our nine case studies highlight elements that appear to lead to success and also some potential pitfalls. In summary, our case studies demonstrate the importance of an active Core Team, engaged agency staff, avoiding formulaic consultant driven plans, and the benefits of combining county and community plans. The lessons learned from this study fit well with the recommendations from Williams and colleagues (2012): pay attention to problem framing, choose a scale at which participants can make things happen, and take steps to facilitate implementation and ensure long-term success.

People are the key

If there is one element that seems to make the difference between a living CWPP that helps drive real wildfire mitigations and an unused CWPP, it is an actively-engaged Core Team that meets regularly and has strong personal relationships. For example, the paper version of the Ruidoso CWPP is brief and unimpressive, but the Core Team has achieved impressive results. The Core Team met before, during, and after the development of the CWPP and was able to implement a range of treatments and drive a reduction in home hazard throughout the village. Interviews from Taos and Catron County point to a paid WUI coordinator as one way to promote an engaged Core Team. In Angel Fire, the inability to hire a WUI coordinator has limited efforts to promote home mitigations.



Left to right, Rough Fire via InciWeb, Salmon Challis National Forest, Valerie Blair

Planning process

Successful planning processes are determined by how CWPPs are created and the people involved. Processes that are inclusive and build trust are linked to successful outcomes (Fleeger and Becker 2010, Toman et al. 2013). In Catron County, a partnership between federal agencies, county staff, and others, resulted in an effective risk mapping process and thousands of acres of fuel treatment. Trust-building helped convince hesitant landowners in McKinley County to create defensible space. In contrast, CWPPs developed through processes that omit affected parties and disregard local relationships do little good. In Taos County, the first consultant-written CWPP failed to pass muster and was rewritten. In McKinley County, a formulaic plan called for sprinkler systems without recognizing that they were a poor fit for the infrastructure and water resources of the county. Consultants with little connection to the local community often use boilerplate CWPPs and undervalue public engagement. Engaging agency support for the CWPP process is important because agency staff can bring resources and expertise, as well as, instill confidence that the plan will drive treatment on public land (Jakes et al. 2007, Fleeger 2008, Toman et al. 2013). The Claunch-Pinto CWPP shows an example of an agency staff person who led an effective CWPP process. Flagstaff, Arizona, is another community which demonstrates that a collaboration between forest managers and the community can help ensure the success of wildfire mitigation activities (Farnsworth et al. 2003).

Fuel treatments and home mitigations

The pace and scale of fuel reduction treatments does not seem to be fast enough or to cover enough area to keep wildfire from communities in New Mexico. Our modeling shows that where communities and land managers have made a concerted effort, treatments can change wildfire behavior enough to give firefighters the opportunity to protect lives and properties. Modeling showed a reduction in active crown fire and some reductions in flame length. This modeling fits well with the growing body of research that shows fuel treatments can change fire behavior, particularly when thinning is combined with removal of surface fuels. Prescribed fire is often the most efficient way to remove surface fuel over large areas. The Angel Fire case study shows how prescribed fire can be an effective tool for wildfire mitigation if trust is built with the community.

Even with effective fuel reduction in the forest, wildfires are part of fire-adapted ecosystems. Residents need to reduce home ignitibility as a complement to forest fuel reduction. Our analysis of home hazard assessments indicates that two-thirds of homes lack key elements of defensible space. However, nearly 20 percent of the average home hazard could be reduced by undertaking the easy mitigation steps. The Firewise program is one tool that can build on the pow-

er of neighbors encouraging neighbors to undertake mitigation efforts. Our interviews indicate residents like the Firewise program and feel it has made a difference in their communities.

Weathering transitions

Where mitigation efforts like Firewise have been successful, it is important to document and trumpet successes. The spread of Firewise to nearby communities underscores the positive impact that sharing successes can have. The same is true for fuel treatments. Mapping where treatments have occurred can build momentum and communication across agencies. The sharing of information between land management agencies means managers from different agencies are talking, and can see the spatial connections between their efforts on a map. Data tracking and sharing can also help protect against the negative impact of staff transition. In both Ruidoso and Catron County, interviewees emphasized the potential for disruption when staff left. Most of the case studies stressed the importance of particular individuals as catalysts for hazard mitigation. Keeping an accessible record of projects and successes reduces the risk that the departure of an individual will mean loss of important information and momentum.

Economic impact

The economic effect of fuel reduction treatments and wildfire mitigations is a potentially positive impact of WUI mitigations that may be too time consuming or costly for communities to document. Only two of the CWPPs we examined could provide evidence of the positive economic impact of fuel reduction treatments. In some cases such as Catron County and Cuba, there was a perception that much of the fuel reduction work went to contracts from outside the area. Efforts to measure and highlight the economic benefits to local communities may help build support for wildfire hazard reduction. Evidence from other areas suggests the positive economic impact of WUI mitigations can be significant. In Oregon, a study found that every million dollars invested in restoration supported 16 jobs (Nielsen-Pincus and Moseley 2013). At the national scale, the Collaborative Forest Landscape Restoration Program claims 4,360 local jobs created each year are linked to the $40 million dollar annual appropriation (USFS 2015a).

Planning scales

Our analysis included both countywide plans as well as community-specific plans. In most cases, community plans are nested within county plans. While county plans fit well with many administrative boundaries and provide a synoptic view of the wildfire hazard, the community scale is better suited to identifying individual projects. Taos and Catron Counties explicitly aimed at getting the best of both worlds by initiating community-level plans as part of the larger county CWPP process. Limited resources, particularly the time of key agency staff and community catalysts, may have forced a choice between these two scales as the first CWPPs were developed. However, now that almost all New Mexico counties have CWPPs in place, the choice is less stark. Managers and residents can develop new plans at the community scale that build off of the existing county CWPPs and avoid duplicating time consuming efforts such as mapping wildfire risk. Though county plans may be a little out-of-date, key changes can be noted without revisiting the entire countywide process.

Top to bottom, InciWeb, InciWeb, Gila National Forest, Salmon Challis National Forest

Moreover, since the written plan is less important than the process, Core Team time is better spent on project planning than adjusting risk maps. A third scale exists: regional CWPPs that include parts of multiple counties. An early plan in the Taos region, the Enchanted Circle CWPP, and the Claunch-Pinto CWPP focus on operational areas that cut across county boundaries.

Prioritizing treatments

Clear prioritization of implementable projects makes a CWPP useful for managers and can speed implementation. The importance for prioritization is clear: it focuses resources and attention on the most at-risk areas and the most important projects. Prioritization facilitates implementation by providing fire departments and others a "to do" list and removes the time lost in wondering what to do next. County fire personnel in Santa Fe credited CWPP prioritization lists with keeping them focused and increasing their efficiency in treating acres. Prioritization streamlined planning and helped match funding to projects. The challenge for prioritizing projects and treatment areas in a CWPP is created by a concern about leaving a community out or not sharing resources equally. CWPP participants worry that prioritizing one area will mean another area is ignored. The CWPP Core Team in McKinley County struggled with the need to prioritize fuel reduction and community projects because of equality concerns. In this case, each community, regardless of risk rating, was given an actionable list of recommendations. In New Mexico, almost every community is at some level of risk from wildfire, so prioritization requires admitting that some level of fire hazard will not be explicitly addressed in the CWPP. Prioritization requires acceptance of some risk, albeit small, in some areas to focus on the high risk in other areas. Communities or areas represented at CWPP development meetings are more likely to be prioritized. In addition, there is a strain of selfishness that is hard to exclude from any regional planning process which encourages people to fight for resources for their own community.

InciWeb

Ensuring that plans work

In addition to important elements to include in a CWPP, our analysis also points to a number of elements to avoid. The first is to avoid creating a plan that will just sit on the shelf and not be put to use. A number of plans including the 2008 McKinley County plan, the Rio Arriba plan, and the 2007 Taos County plan, were essentially written to meet the basic requirements of a CWPP and to access funding sources that required a CWPP. Another example comes from Colfax County, where most officials involved in wildfire planning knew little about the plan and it had negligible influence on wildfire preparedness (Carroll et al. 2014). One way to avoid creating plans that sit on the shelf is for funding sources to require concrete evidence of engagement (such as Core Team meetings or maps of implemented treatments) rather than simply a CWPP. A related issue is the lack of integration between CWPPs and other plans. For example, in Rio Arriba, the CWPP was not even mentioned in the more recent countywide Hazard Mitigation Plan. This lack of integration contributes to duplication and wasted effort. However, all-hazard and other planning efforts are likely to involve many of the same agency staff and engaged residents as CWPPs, so relationships built within CWPP Core Teams could be advantageous to other planning efforts. Some CWPPs such as that for Summit County, Colorado, are beginning to recognize the importance of linkages across planning efforts (Rasker et al. 2015).

Vulnerable populations

Our case studies suggest a lack of focus on vulnerable populations such as the poor, the elderly, and people with disabilities. Vulnerable populations are at increased risk from wildfire (Buckland and Rahman 1999, Morrow 1999). In general, our case studies showed little attention to vulnerable populations. However, Ruidoso's fire department identified vulnerable populations and prioritized their evacuation in their wildfire planning. Also, in Taos County, a fuel reduction program adjusts its cost-share rates to meet the ability of the applicants to contribute. It may be easier to plan for the needs of vulnerable populations at the community rather than the county scale. Future plans should consider the needs of the poor, the elderly, and people with disabilities.

Top to bottom, InciWeb, InciWeb, Gila National Forest

Maintaining treatments and momentum

One of the biggest challenges facing communities is the maintenance of treatments and home mitigation efforts. Fire hazard reduction is not a one-time task. Forest fuel reduction treatments only affect fire behavior until trees and vegetation grow back. In ponderosa pine or mixed conifer forests, fuel reduction treatments are likely to require some sort of maintenance within ten years (Hunter et al. 2007, Evans et al. 2011). Managers in Ruidoso are concerned that it will be more difficult to generate public support for maintenance treatments because the results are less obvious than with the initial treatments. Similarly, campaigns to promote home mitigation can lose momentum, particularly because of the importance of individuals as community catalysts. Future wildfires may reinvigorate mitigation programs just as wildfires helped motivate communities like Ruidoso and Claunch-Pinto to begin mitigation programs. Wildfires have also inspired communities to come together and focus on mitigation efforts in other regions (Fleeger 2008). Communities and managers should be ready to channel the concern and attention that nearby wildfires generate, into productive mitigation efforts.

Rough Fire via InciWeb

Planning for post-fire

Even the most effective wildfire mitigation cannot eliminate wildfire from fire-adapted ecosystems, so communities need to plan for their post-wildfire response and recovery even as they reduce wildfire hazard. Some CWPPs, like Taos County, already include recommendations to develop post-fire Burned Area Emergency Rehabilitation protocols for each local watershed. Preplanning can significantly reduce the impact of wildfires on communities. For example, the city of Raton set aside funds from water user fees, which were used in the immediate aftermath of the 2011 Track Fire as match for Natural Resource Conservation Service Emergency Watershed Protection funds to protect drinking water (EWP 2014). NMSF and partners worked together to create a guide to help communities plan for coping with the effects of wildfire (EMNRD 2015). The guide covers a wide range of issues from emotional support to post-fire flood mitigation. Acknowledging that fire is inevitable in fire-adapted ecosystems is part of the concept of fire-adapted communities. The Fire Adapted Communities Learning Network also provides a way to connect the whole range of WUI mitigation efforts including fuel reduction, home mitigations, codes and ordinances, evacuation planning, incident response and post-fire recovery.

Conclusion

The challenge of wildfires in the WUI will continue to grow. More houses will be built and wildfires will likely grow in size and severity. Our review of past studies and an-in depth look at WUI mitigation in New Mexico shows there is no perfect solution, no silver bullet, to protect lives and properties in fire-adapted ecosystems. Creating fire-adapted communities requires a combination of fuel treatments and home hazard mitigations. The fire-adapted communities concept provides a framework for linking the wide range of WUI mitigation approaches while acknowledging that fire cannot be eliminated from fire adapted ecosystems.

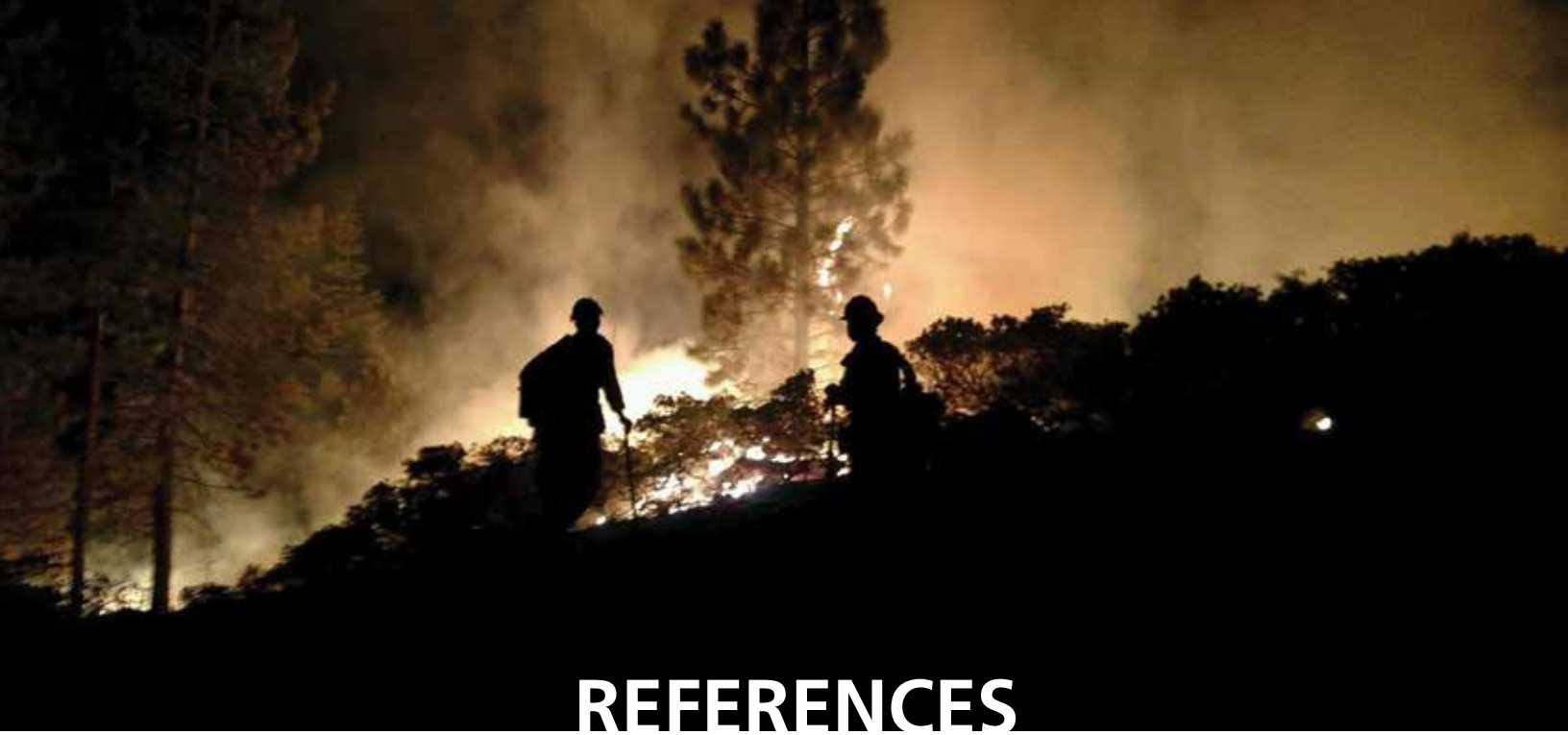
This assessment adds to past research by emphasizing the importance of engaged people to make WUI mitigations happen. Communities, and managers who work with them, may be able to expand and improve fuel treatments by continuing to focus on communication, particularly by sharing documentation of where treatments have been implemented. Our modeling adds to the research showing that fuel treatments can change wildfire behavior in the

WUI and provide opportunities for suppression. Effective WUI mitigation requires treatments that include both thinning and surface fuel reduction. Prescribed fire is an efficient tool for fuel reduction and may be especially useful as communities move toward maintenance of initial treatments.

Neighbors and community catalysts are crucial for expanding and deepening the adoption of home mitigation measures. Any program to expand the adoption of defensible space should take advantage of the power neighbors have to encourage that neighbors to undertake mitigation efforts. Assessing home hazards may help motivate residents to make changes, but more work needs to be done to ensure that reassessments can document improvements accurately. Currently, most homes in the areas we assessed lacked key elements of defensible space, but residents could substantially reduce their home hazard by undertaking some of the easy-to-implement mitigation measures. The strong support for the Firewise program indicates that building home mitigation efforts around this program is worthwhile, especially if a there is a local resident, a catalyst, willing to take the lead. Maintaining momentum is a looming challenge for both home mitigation programs and forest fuel reduction efforts.

Fire is inevitable in fire-adapted ecosystems, but communication, planning, and preparedness can protect communities. Together neighbors, homeowners, land managers, planners, and leaders have the power to build fire-adapted communities and mitigate the threat of wildfire.

Rough Fire via InciWeb



Rough Fire via InciWeb

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2013 Doce Fire via InciWeb

APPENDIX I – HOME WILDFIRE HAZARD ASSESSMENT FORM

Santa Fe County Fire Dept.
Wildland Division

http://www.sfcfire-wildland.com/

Wildfire Hazard Assessment

address

community

SITE HAZARD RATING:			RATING
ACCESS and VISIBILITY: Can emergency personnel find and access?			
Driveway < 150 feet long		0	
Driveway > 150 feet with adequate turnaround		3	
Driveway > 150 feet with inadequate turnaround		5	
Driveway width more than 12 feet		0	
Driveway width less than 12 feet		5	
No overhead branches below 14 feet		0	
Obstructing overhead branches below 14 feet		5	
No bridges or bridges with no restrictions		0	
Inadequate surface / bridges for emergency vehicle		5	
Road grade level or less than 10%		0	
Road grade over 11%		5	
No gate / non=-locking gate		0	
Locked gate restricting access		5	
Address visible from road (on house/end of drive)		0	
Address not visible from road or not found		5	
SURROUNDING TREES: Choose predominate type within 30ft of home			
No trees within 30 feet		0	
Hardwoods (trees with deciduous leaves)		4	
Mixed (hardwoods and conifers/evergreens)		7	
Conifers / Evergreens (non-deciduous)		10	
LADDER FUELS: Can fire spread from surface to aerial fuels?			
Include low limbs,	No	0	
underbrush, vines, etc.	Yes	5	
FUEL CONNECTION: Are ground fuels touching or within 3ft of home?			
Include ornamental shrubs, leaves,	No	*0*	
grass, weeds, mulch beds, etc.	Yes	5	

			RATING
GROUND COVER: Choose primary type of ground cover within 30ft of home			
Sand, gravel, etc. (non-combustible)		0	
Grasses, up to 6" tall		3	
Grasses over 6" tall (heavy weeds, etc)		10	
Herbaceous understory or forest leaf litter		15	
Shrubs with leaves		5	
Shrubs with needles (spreading juniper, etc)		7	
SLOPE OF PROPERTY: What is average slope around structure?			
Gradual (0-10%)		0	
Moderate (11-30%)		5	
Steep (over 30%)		10	
FIREWOOD, DEBRIS or COMBUSTIBLES: Where are the jackpots located?			
Include firewood piles, brush piles, stored lumber, outdoor furniture, etc.	None	0	
	More than 30ft from home	1	
	3ft -30ft from home	5	
	0ft - 3ft from home	10	
FLAMMABLE MATERIALS: Where are highly flammable materials stored?			
Include gas cans, gas grills, lawnmowers, pesticides, etc.	None/Unknown	0	
	More than 30ft from home	1	
	3ft -30ft from home	5	
	0ft - 3ft from home	10	
OTHER POTENTIAL HAZARDS: Are there any external hazards present ?			
Include outbuildings, propane tanks, etc.	No	*0*	
within 30 feet of structure	Yes	5	
TOTAL SITE HAZARD RATING:			

Wildfire Hazard Assessment

STRUCTURE HAZARD RATING:			RATING
ROOFING MATERIALS: What is the roof covering of the home?			
Metal, Slate, Tile or Class A Shingles		0	
Rolled roofing or non-rated roof material		5	
Wood (cedar shingles or shakes)		15	
FOUNDATION: What type of foundation does the home have?			
Enclosed (fireproof ie: concrete, metal, adobe)		0	
Enclosed with wood or vinyl sheeting		5	
Open air foundation (piers, stilts, etc.)		10	
EXTERIOR WALLS: What is predominate outer wall covering?			
Brick, Stone or Metal		0	
Vinyl or Wood		5	
VENTS and EAVES: Are these protected from flying embers?			
Enclosed with plastic or metal screens		0	
Exposed wood, open soffits or unscreened vents		5	
ATTACHMENTS: Are there any attachments to the structure?			
Includes decks, overhangs, fenced, trellises, etc..	No	0	
	Yes	5	
FUEL TRAPS: Any areas where leaves/debris can accumulate?			
Include window wells, under steps, foundation indents, etc.	No	0	
	Yes	5	
TOTAL STRUCTURE HAZARD RATING:			

recommendations

HAZARD REDUCTION FACTORS: (Choose any)		RATING
SITE:		
Ladder fuels removed within 30ft of house	-1	
Grass mowed/watered within 30ft of house	-1	
Leaves/needles raked within 30ft of house	-2	
3 feet of gravel or non-flammable material around house	-3	
STRUCTURE		
Regularly cleaned roof and gutters	-1	
Deck skirting non-flammable / screened	-3	
OTHER		
Firefighting equipment available (hose, ladders, etc)	-1	
Useable water supply nearby(pool, pond, hydrant, etc)	-3	
TOTAL HAZARD REDUCTION RATING:		

CWPP HAZARD RATING FOR AREA

Low=0
Moderate=10
High = 20
Very High=30
Extreme= 35

grand total

CWPP + **SITE** + **STRUCTURE** - **REDUCTIONS** =

Bob Williams

Forest Stewards Guild

National Office

612 W. Main St., Suite 300
Madison, WI 53703

Southwest Region Office

2019 Galisteo St., Suite N7
Santa Fe, NM 87505

www.foreststewardsguild.org

The Forest Stewards Guild practices and promotes ecologically, economically, and socially responsible forestry as a means of sustaining the integrity of forest ecosystems and the human communities dependent upon them. Our members are foresters, conservationists, resource managers, scientists, students, forestland owners, policy makers, and land stewards working in forests throughout the United States and Canada. Our research program synthesizes existing knowledge and conducts novel scientific studies as a complement to Guild member's place-based experience.

This report is available in digital format at: www.foreststewardsguild.org

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