

Arrowhead Communities Community Wildfire Protection Plan Update 2018



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MUTUAL AGREEMENT PAGE

This Community Wildfire Protection Plan developed by the Inland Empire Fire Safe Alliance and the Arrowhead Communities Fire Safe Council:

- Was collaboratively developed. Interested parties, fire management agencies and federal land management agencies managing land in the San Bernardino Mountains have been consulted.
- This plan identifies and prioritizes areas for hazardous fuel reductions treatments and recommends types and methods of treatment that will aid in protecting communities in the study area.
- This plan recommends measures to reduce ignitability of structures throughout the area addressed by the plan.

The following entities attest the standards listed above have been met and mutually agree with the content of this Community Wildfire Protection Plan:

Inland Empire Fire Safe Alliance, by Laura Dyberg, Chairman

Arrowhead Communities Safe Council, by Gerry Newcombe, President

San Bernardino County Fire, by Kathleen Opliger, Assistant Chief

CAL FIRE, San Bernardino Unit, by Glenn Barley, Unit/Fire Chief

USDA Forest Service, San Bernardino National Forest, by Jody Noiron, Forest Supervisor

INTRODUCTION

This CWPP update was developed by the Inland Empire Fire Safe Alliance (IEFSA) and the Arrowhead Communities Fire Safe Council (ACFSC) with guidance and support from San Bernardino County Fire Department (SBCFD), California Department of Forestry and Fire Protection (CAL FIRE), and the United States Department of Agriculture Forest Service (USFS). Information in this plan will be provided at the level of specificity determined by the community and appropriate agencies.

This document is the result of a study to identify and quantify changes in conditions or values at risk that could affect fire protection planning and response in the Wildland-Urban Interface (WUI) and/or Wildland Intermix (WI) portions of the study area. The WUI is also known as the Urban Edge Ember Zone. It is the area where encroaching wildland fuels could create a fire hazard to what would, in a different setting, be an urban development. The WI consists of communities where homes are surrounded by wildland fuels. As such, this update neither replaces nor intends to duplicate information found in the 2005 CWPP. This update will focus on evaluation, solutions and mitigations of these densely populated areas (described as Zone 1 in the 2005 CWPP) using updated methods and conditions.

Information regarding a current analysis of the probability of a severe fire occurrence and expected severity of fire effects using updated technology has been included as well as a detailed discussion of structural ignitability. This information allows for the prioritization of mitigation efforts. From an analysis of this data, solutions and mitigation recommendations are offered that will aid land managers, residents, fire officials and other collaborators in planning and implementation. This format is designed to help communities clarify and refine priorities for the protection of life, property, and critical infrastructure in the WUI/WI. It can also lead community members through valuable discussions regarding management options and implications for the surrounding watershed and any areas of special interest.

For the purposes of this report the following definitions apply:

FireShed - No-HARM divides the landscape into units based on topography. FireSheds tend to correlate to the vegetation and the direction fires will burn in the absence of wind. FireSheds are useful for dividing the landscape into planning units and providing data in a spatial context that matches fire behavior. FireShed units tend to be roughly 150 to 200 acres in size.

Frequency - A simulation-based prediction of the probability of future wildfire occurrences derived from No-HARM. No-HARM assigns a numeric value of 1-50 where 1 is the least likely for a wildfire occurrence and 50 is the most likely. Frequency is different from probability of ignition in that frequency only considers ignitions likely to develop into fires large enough to create a significant threat to Values at Risk.

Hazard is the combination of the Wildfire Hazard Ratings (WHR) of the WUI/WI neighborhood surveys and the analysis of fire behavior potential, which is derived from No-HARM Severity analysis outputs. Hazard attempts to quantify the severity of undesirable outcomes to the values at risk.

Inland Empire Community Mitigation Planner (WMP) - This web-based application provides capabilities for Fire Safe Councils within the Inland Empire Fire Safe Alliance to define and maintain information related to their CWPPs. This includes capabilities to digitize community boundaries and fuel reduction projects using interactive mapping tools. Utilizing the mapping capabilities provides Fire Safe Councils a way to easily update and maintain information about their mitigation planning activities and achievements. This site is available at www.ToBeDetermined.com.

No-HARM - The National Hazard and Risk Model (No-HARM) is a decision support tool for wildfire hazard assessment. No-HARM calculates relative fire danger ratings by taking the predicted severity and the predicted frequency of wildfire in a given location and incorporating elements that affect the vulnerability of structures in and around communities. No-HARM gives a comprehensive view of the threat context a structure, or group of structures, is exposed to during a wildland fire. The No-Harm model and its components are displayed visually in the WMP.

Probability - The likelihood of a significant fire occurrence. This is primarily determined by the fire history of the area and a probability model (Frequency) derived from No-HARM.

Risk 50 is the result of the No-HARM composite analysis of Frequency, Severity and other input variables. By combining the likelihood of a significant fire occurrence and the severity of undesirable fire effects to the values at risk, Risk 50 assigns a numeric value to FireSheds where a 1 represents the lowest level of risk and 50 represents the most extreme level of risk.

Severity - An estimate derived from No-HARM of how severe fire behavior would be in the event of an ignition. No-HARM assigns a numeric value of 1-50 where 1 is the lowest severity and 50 is the highest.

Values at Risk are the tangible values identified by citizens as being important to sustainable life in the study area (e.g., life safety, property conservation and critical infrastructure.)

Wildfire Hazard Rating (WHR) - A model designed to evaluate communities within the Wildland Urban Interface/Wildland Intermix (WUI/WI) for their relative wildfire hazard. WHR focuses on structural ignitability and suppression factors and uses a different rating system from No-Harm which focuses on the Frequency and Severity of fire in the wildland fuels of the FireSheds.

Wildland Intermix (WI) – Areas of concentrated residential development (communities) where homes are surrounded by wildland fuels. Homes in these areas exist in the context of natural fuels rather than as typical urban development.

Wildland-Urban Interface (WUI) – (AKA Urban Edge Ember Zone). The area where encroaching wildland fuels could create a fire hazard to structures that would normally be considered a traditional urban development.

COLLABORATION: COMMUNITY AND AGENCIES

Organizations involved in the development of the Arrowhead Communities CWPP are listed below with their roles and responsibilities.

Arrowhead Communities Fire Safe Council and Inland Empire Fire Safe Alliance

Primary development of the CWPP and community outreach. Provides information regarding community values. Coordinates the development of community protection priorities and community input regarding the feasibility and desirability of fuels treatment project areas and methods.

County of San Bernardino, Fire and Public Works

Aids in the planning and approval of the CWPP process and minimum standards. Provides information regarding critical infrastructure, fire suppression resources, and current and planned fuels treatment project areas and methods.

CAL FIRE

Aids in the planning process and approval of the CWPP process and minimum standards. Provides input and expertise on forestry, fire, fuels, and FireWise concepts. Provides information support for hazard assessment and defensible space. Operates a pre-fire engineering program to reduce or eliminate fire hazards and risks by removing or reducing the heat source, modifying or reducing fuels through the previously mentioned hazard assessment and defensible space assistance programs and modifying acts or omissions that allow a heat source to contact ignitable fuels.

USDA Forest Service

Provides input and expertise on federal lands, forestry, fire and fuels.

GOALS AND OBJECTIVES

The 2005 CWPP established six specific goals of ACFSC:

1. Achieve strategic fire breaks
2. Reduce forest fuels
3. Improve defensible space around structures
4. Expand educational programs and information outreach
5. Investigate biomass processing concepts to positively impact woody waste distribution issues.
6. Investigate watershed protection concepts to enhance ecological protections

Strategic goals for this project include the following:

1. Enhance life safety of the residents, visitors and responders.
2. Mitigate undesirable fire effects to property and infrastructure.
3. Maintain and enhance existing mitigation efforts.

To accomplish these goals the following objectives have been identified for this report:

1. Establish an approximate level of probability (the likelihood of a significant wildfire event in the study area).
2. Provide a scientific analysis of the fire behavior potential of the study area.
3. Identify and quantify factors that limit (mitigate) undesirable fire effects to the Values at Risk and recommend actions to reduce those hazards.
4. Evaluate existing mitigation efforts.
5. Quantify any significant changes related to hazards or Values at Risk that have taken place since the original CWPP was written in 2005.

ACFSC recognizes the potential for complex problems associated with the mission of achieving fire safety and healthy forest management throughout communities in the San Bernardino Mountains and a need to balance this mission with environmental and economic concerns of the residents.

STUDY AREA OVERVIEW

The study area is approximately 12,765 acres and 23 miles north of the City of San Bernardino. It encompasses the Greater Lake Arrowhead Communities including: Agua Fria, Arrowhead Villas, Blue Jay, Cedar Glen, Crest Park, Deer Lodge Park, Lake Arrowhead, Rim Forest, Sky Forest and Twin Peaks (see Figure 1). ACFSC and local experts consider wildfire to represent similar hazards to life and property in all of the residential areas surrounding Lake Arrowhead. Therefore, for the purposes of this update, no attempt has been made to separate these areas into individual hazard zones, as has been done in some other communities in the San Bernardino Mountains. The WHR model used to evaluate residential developments for their relative wildfire hazard due to structural ignitability has been calculated to represent the most common factors throughout the study area. Although relatively small areas may represent some variance in certain factors from this norm, the authors of this update do not believe those differences are great enough, nor exist in sufficiently large concentrations, to make a significant impact on the overall WHR rating.

Elevations in the study area range from 5,000 to 6,100 feet above sea level. The climate is mild with an average summer high temperature of 81 degrees F and average summer lows of 55-56 degrees F. Average winter low temperatures are 29-30 degrees F.¹

Residential and business concentration existing from the lake shore outward is composed of dense to moderately dense Wildland Intermix (WI). Primary access is via CA-18 or CA-330 from San Bernardino or CA-18 from Big Bear City. Other access is possible, but less frequently used. Most of the commercial development in the study area is centered around the lake and in the town centers.

Approximately 72% of the study area is covered by combustible vegetation. Of the remaining 28%, approximately 21% of the study area is covered by roads, most of which are surrounded by combustible vegetation. Vegetation in and around the residential areas of the study area is primarily mixed conifer forest and woodland. These forests are generally dense and have a diversity of canopy tree species. At least two conifer species co-dominate the forests of the study area and can include incense cedar, white fir, black oak, ponderosa pine, sugar pine, and big-cone Douglas fir. Oak, manzanita, juniper and other species may also be present in the sub-canopy (see Figure 2). Beetle damage throughout the study area is extensive and there are many standing dead trees.

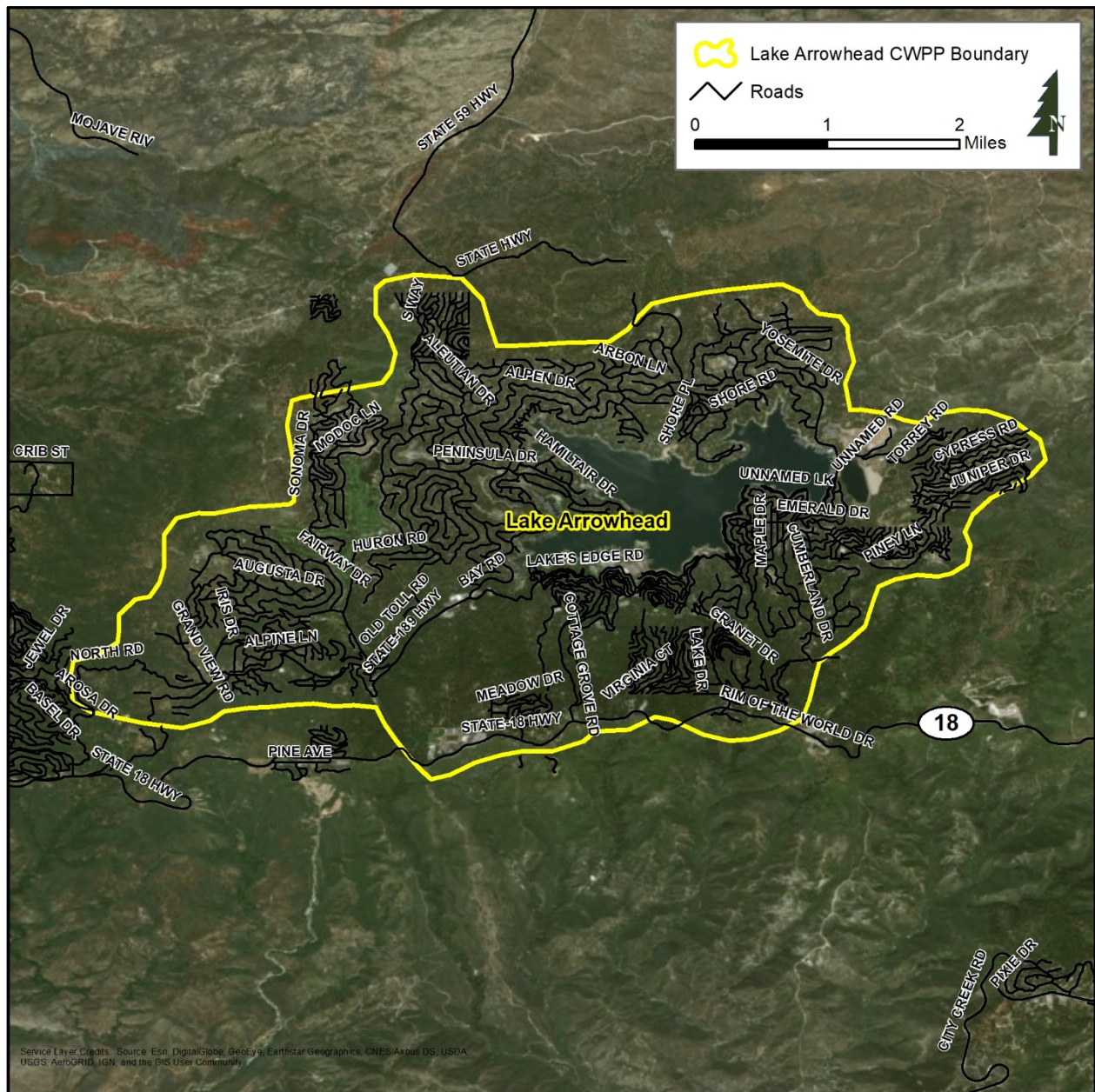


Figure 1 Study area boundary



Figure 2 Typical vegetation around Lake Arrowhead

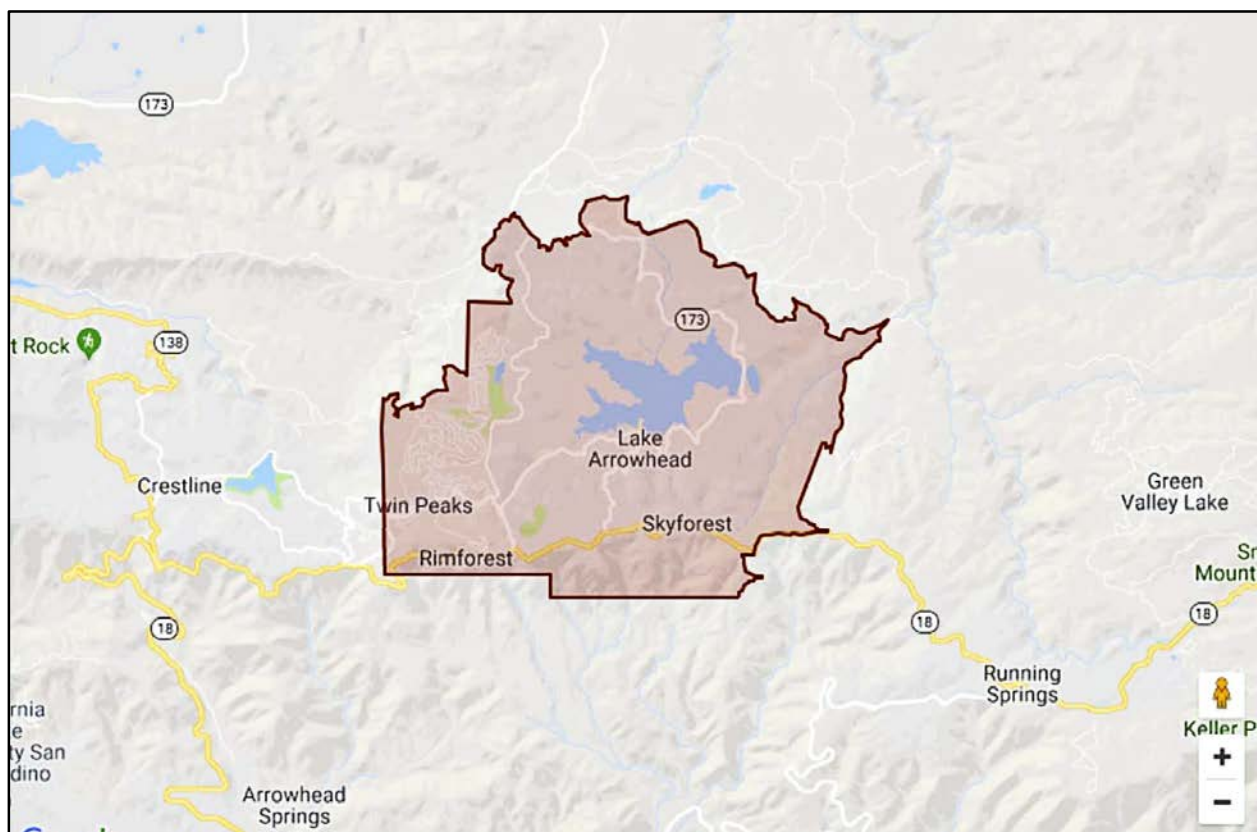


Figure 3 Lake Arrowhead CDP Boundary

VALUES AT RISK

Life Safety, Homes and Commerce

The Arrowhead Communities study area falls under the Lake Arrowhead Census County Division and is a Census Designated Place (CDP) with a reported population of 12,897 as of July, 2017.² The boundary of the Lake Arrowhead CDP is shown in Figure 3 and includes the entire study area of the CWPP.³

The 2005 CWPP reports 7,877 residential properties and 1,107 non-residential units. The tax assessor's database shows 18,650 parcels in the study area, indicating a likelihood for increasing density in the future. Full-time residents occupy an estimated 26% to 53% of the homes depending on their neighborhood.

ACFSC estimates that visitation may increase the number of people in the study area to as many as 80,000 on holiday weekends. Many area campgrounds, visitor lodging and recreation facilities are frequently filled to capacity in the summer. There is a substantial commercial area located on the south shore of Lake Arrowhead and other commercial interests located primarily in neighborhood centers. Tourism is the primary driver of the local economy. The area economy is estimated to employ 4,593 people.⁴

PROBABILITY SITUATION

For the purposes of this report, Probability is the likelihood of a significant fire occurrence. This is primarily determined by the fire history of the area and No-HARM Frequency modeling.

This area has an active fire history. Major fires (greater than 1,000 acres) that burned within three miles of the study area from 2000 to 2017 include Slide (2007), Grass Valley (2007), Pinnacles (2006), Old (2003), Bridge (2003) and Arrowhead (2002). These fires burned over 111,000 acres. Figure 4 shows the perimeters of some of the larger fires in the general area from 2000 to 2017.

To predict the likelihood of a significant wildfire event No-HARM inputs 300,000 points of ignition. These simulated fires are run across three weather scenarios. Areas where fires stack (modeling shows repeated fires in the same area) indicate an increased likelihood of a significant fire occurrence. No-Harm assigns a value between one and 50 to each FireShed based on an aggregation of all the pixels in that FireShed. A value of one indicates the lowest probability of significant wildfire and 50 the highest. Adjective ratings in No-HARM are as follows: 0-9 = Low, 10-23 = Moderate, 24-35 = High and >35 = Very High.

Figure 1 shows the study area boundary. The No-HARM Frequency analysis rates the Arrowhead Communities study area as 30 out of 50 (high probability for a significant fire in this location). See the WMP website for more details.

Based on the fire history and the No-HARM Frequency assessment, the study area should be considered at a high risk for significant fires.

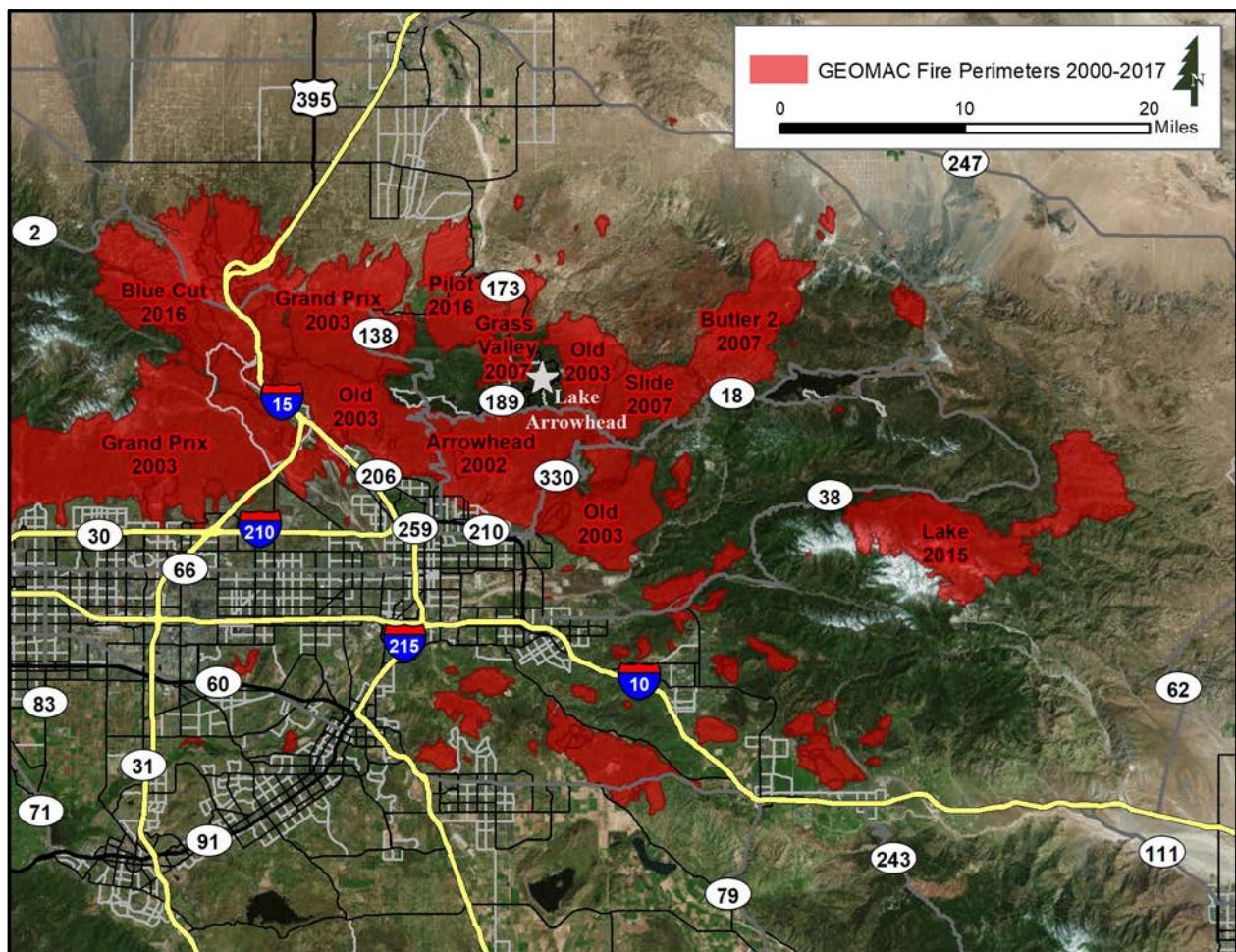


Figure 4 Major Fire Perimeters 2000-2017

NO-HARM SEVERITY AND RISK 50 RATINGS

No-HARM Severity ratings attempt to quantify the severity of fire effects on values at risk and the ecosystem by combining flame length and crown fire development into a single rating. Like other numeric ratings generated by No-HARM, Severity assigns a value between one and 50 to each FireShed based on an aggregation of all the pixels in that FireShed. A value of one indicates the lowest severity of damaging fire effects and 50 the highest. No-HARM is based on an analysis of wildland fire behavior and, other than the exclusion of non-burnable areas, does not take structural flammability into consideration. For a discussion of the impact of structural flammability please see the *Community Ignitability Analysis* section of this report.

The No-HARM Risk 50 rating is a mathematical model combining Severity with Frequency. That is to say the model takes into account both the likelihood of a significant fire developing within the rated FireShed and the severity of damaging fire effects to create a composite rating of fire risk in that FireShed. Although the majority of the weighting in the model is in these two elements, other factors are included in the Risk 50 rating and vary depending on whether FireSheds are located in the Wildland-Urban Interface (WUI), Wildland Intermix (WI) or wildland. As with other No-HARM ratings, a value of one indicates the lowest risk and 50 the highest.

In the study area an aggregate value of 26 (high) for Severity and a Risk 50 rating of 35 (on the border between high and very high) has been calculated. It is important to note there is no true WUI (urban fringe) in the study area. Homes are located in wildland fuels and even the most densely populated areas should be considered WI. Fuels are relatively heavy and continuous throughout the area which contributes to the high rating. Topography is steep and complex and the effect of ember cast should not be underestimated. Please see the WMP website for more details.

FIREFIGHTING CAPABILITIES AND LOCAL PREPAREDNESS

The communities of the study area are serviced by the following fire departments, San Bernardino County Fire Department (SBCFD) and CAL FIRE. Initial response to all fire, medical and associated emergencies in the residential areas of the Arrowhead Communities study area is the responsibility of SBCFD.

SBCFD has five fire stations located in the study area. Initial response is the responsibility of one of four career-firefighter staffed stations: Lake Arrowhead, Station #91 located at 301 CA-173, Lake Arrowhead Station #94 located at 27470 N. Bay Road, Lake Arrowhead Station #92 located at 981 CA-173, and Twin Peaks Station #26 at 737 Grandview Road. SBCFD also maintains a paid-call volunteer station in Rim Forest. Rim Forest Station #30 is located at 26330 CA-18. Lake Arrowhead Station #93, located in Cedar Glen, is currently inactive. The ISO rating for the Arrowhead Communities is 4/4X. SBCFD has a comprehensive automatic aid system with state and local firefighting resources through the *2014 San Bernardino County Fire and Rescue Mutual Aid Operational Plan*.

Fire protection in all designated State Responsibility Areas (SRA) is handled by CAL FIRE. The nearby Crestline Station is a state-owned facility that seasonally houses a Type 3 fire engine. CAL FIRE also has Type 3 engines co-located with the US Forest Service at Sky Forest (seasonal) and with the Running Springs Fire Department at Station 51 (year-round). The Pilot Rock Conservation Camp, also located in Crestline, is home to four, type-one handcrews. In addition to suppression resources, CAL FIRE provides personnel to develop pre-fire management solutions and implement cooperative projects to reduce the potential of wildfire losses within the study area. CAL FIRE supplies mutual aid to local responders in the study area through the California Master Mutual Aid Agreement. CAL FIRE also maintains an agreement with federal wildfire agencies (such as the USDA Forest Service) to exchange fire protection services. The goal of this agreement is to have the closest agency respond to a wildfire, regardless of jurisdiction. This arrangement also allows CAL FIRE to access federal and state resources throughout the U.S. when CAL FIRE resources are stretched thin or depleted.⁵

Wildland fire responsibilities within the San Bernardino National Forest (BDF) are managed by the USDA Forest Service (USFS). The study area falls under the jurisdiction of the Mountain Top Ranger District. The Arrowhead Ranger Station is located in Sky Forest at 28104 Highway 18. Headquarters are located at the Mountain Top Ranger District Office and Discovery Center in Fawnskin, which is 21 miles from the Arrowhead Ranger Station.

In addition to providing fire suppression resources, the above departments and agencies cooperate in vegetative treatments and wildfire response planning through mutual aid agreements. The Mountain Area Safety Taskforce (MAST) is also actively working to prevent catastrophic wildfire. MAST is a coalition of local, state and federal government agencies, private companies and volunteer organizations in San Bernardino and Riverside counties that are partners in wildfire prevention.

In high severity periods, agreements with the California Military Department allow for California National Guard resources to provide aid in wildfire response including their Modular

Airborne Fire Fighting System (MAFFS), helicopters, support personnel, communications equipment and other resources.⁶

Recommendations

CAL FIRE is recognized nationally for its high level of training and equipment. San Bernardino County is the largest county in the contiguous United States. SBCFD is a full service fire department covering over 19,000 square miles and more than 60 communities/cities.⁷ Some, perhaps all, of the recommendations below may already be in practice by these departments, therefore the following recommendations focus on maintenance of policy for those entities as well as providing a guideline of recommended minimum standards.

Training/Equipment

- Require or continue to require S130/190 for all firefighters.
- Require or continue to require the annual refresher or certification for all firefighters in the mountainous areas, similar to how CAL FIRE annually certifies their fire season readiness with their Fire Preparedness Exercise every spring.
- Maintain training opportunities sponsored, or funded, by federal, state and local resources.
- Seek agreements that allow for cooperative training between volunteers (Paid Call Firefighters) SBCFD professional firefighters and county, state and federal responders.
- Encourage personnel to take additional beneficial courses including; S-215 *Fire Operations in the Urban Interface*, S-290 *Intermediate Fire Behavior*, L-380 *Fireline Leadership* as well as I-200 *Basic ICS*.
- Encourage personnel to seek higher qualifications and participate in out-of-district assignments.
- Ensure all firefighters have adequate wildland PPE including radios and new generation fire shelters.
- Be sure enough additional PPE is on hand to outfit new recruits.
- Pursue grants and other funding opportunities to purchase additional wildland PPE and apparatus, such as the FEMA Assistance to Firefighters Grant Program.⁸
- Acquire additional wildland fire packs that are fitted for new generation fire shelters and retire from service any wildland fire pack designed for the older fire shelters as these are not compatible with new generation shelters.
- Familiarize all fire fighters with the Inland Empire Community Wildfire Mitigation Planner website (WMP). This tool is helpful for communicating with residents, resort staff and guests.

COMMUNITY IGNITABILITY ANALYSIS

Purpose

As previously discussed, No-HARM is based on an analysis of wildland fire behavior and, other than the exclusion of non-burnable areas, does not take structural flammability into consideration. In order to perform a structural ignitability analysis for prioritization of recommendations, this report uses the Wildfire Hazard Rating (WHR) tool which is intended to analyze Wildland Urban Interface and Wildland Intermix (WUI/WI) development.

Methodology

WHR was developed specifically to evaluate communities within the WUI/WI for their relative wildfire hazard. The WHR model combines physical infrastructure such as structure density and roads, and the fire behavior Severity modeling of No-HARM, with the field experience and knowledge of wildland fire experts. It has been proven and refined by use in rating thousands of neighborhoods throughout the United States. Much of NFPA 1144 has been integrated into this methodology to ensure compatibility with national standards. Additionally, aspects of NFPA 1142 regarding water supply for rural and suburban firefighting are included in the assessments by looking at proximity and capacity of the water supply.

The model was developed from the perspective of performing structural triage on a threatened community in the path of an advancing wildfire with No-HARM predicted fire behavior for average conditions on a fire season day. The WHR survey and fuel model ground-truthing are accomplished by field surveyors with WUI/WI fire experience. The rating system assigns a hazard rating based on categories such as: No-HARM Severity, topographic position, construction and infrastructure, suppression factors, and other factors including frequent lightning, railroads, campfires, etc. The rankings are also related to what's customary for the area. For example, a high-hazard area on the plains of Kansas may not look like a high-hazard area in the Sierra Nevada. The system creates a relative ranking of community hazards in relation to other communities in the area.

Introduction

For this report the WHR has been calculated to represent the most common factors throughout the study area. Although relatively small areas may represent some variance in certain factors from this norm, the authors of this update do not believe those differences are great enough, nor exist in sufficiently large concentrations, to make a significant impact on the overall WHR rating. The WHR model calculates a score which falls into one of five hazard categories: low, moderate, high, very high and extreme. The Arrowhead Communities study area received a rating of very high based on this score.

Structural Ignitability Discussion



Figure 5 Typical Residential Area

Hazard Rating:

Very High

Utilities Above or Below Ground:

Above ground

General Construction:

Primarily combustible siding with ignition resistant roofs

Average Lot Size:

< 1 acre

Dual Access Roads:

Yes

Road Widths, Slope and Surface:

Variable

Water Supply:

Hydrants

Proximity to Fire Station:

Stations 91, 92 and 94

Area Characteristics and Hazards

Single-family homes on small lots are the dominant structures. The average lot size is 0.25 acres. Most of the homes are older construction and the dominant construction type is combustible siding with an asphalt roof. Many, perhaps most, homes have flammable decks, projections or fences. Many homes have flammable ornamental plantings and/or native vegetation too close to the structure and most do not have conforming defensible space. Heavy loads of wildland fuels are continuous throughout the area and insect damage has resulted in high vegetative mortality. Utilities are above ground in most neighborhoods. The area is served by a municipal hydrant system and water supply for fire suppression is not normally an issue. The terrain is generally steeply sloping with most homes built on moderate to steep slopes. Most roads are paved, but many are narrow and winding. Some have very steep grades. There are also many narrow, steep driveways. Many dead ends exist. Quite a few of these dead ends and some community driveways are unmarked, or poorly marked. Turnarounds for apparatus would be difficult in many areas. Gated single entrances to some neighborhoods, particularly on the north shore of Lake Arrowhead, create additional difficulty for suppression resources. Structure protection for many homes would require hose lays from the access road. Primary access is via CA-18 or CA-

330 from San Bernardino or CA-18 from Big Bear City. Other access and evacuation routes are possible, but generally less useful.

DEFENSIBLE SPACE AND GENERAL RECOMMENDATIONS

Defensible space is defined as an area around a structure that has been modified to reduce fire hazards. Both natural and manmade fuels are treated, cleared, reduced and/or substituted with ignition resistant species to slow the spread and intensity of fire. Development of defensible space involves zones in which different techniques are deployed. Every structure on the property including detached garages, storage sheds, barns, etc. as well as the home should be considered when creating defensible space zones. Specific design depends on many factors including, but not limited to, the size and shape of buildings, construction materials, topography and vegetative type.

The State of California provides literature regarding creating defensible space in the different ecosystems that present wildfire hazards in the state. This information is targeted toward protecting homes in the interface. It should be used to supplement the information contained in this report and is included as Appendix A. Some of this information will not be directly applicable to the residential areas of the Arrowhead Communities due to the various ecosystems represented; however, this information is valuable and well-reviewed.

In addition to California Public Resource Code 4291, all properties in the study area must comply with the San Bernardino County Fire Hazard Abatement Ordinance, to achieve defensible space. The complete text of this ordinance is included with this report as *Appendix B San Bernardino County Fire Hazard Abatement Ordinance*. Enforcement of this ordinance in the study area is key to limiting damage and possible loss of life should a large fire move through the populated areas.

Along with the removal of flammable fuels and the creation of non-combustible buffers around the structures, ignition resistant re-vegetation should be considered at least as far as the 100-foot perimeter of the reduced fuels zone (Zones 1 and Zone 2).⁹ In areas where it's practical and desirable, replanting with fire-wise native species and practices will provide the following benefits:

- Reduce the ability of invasive and flammable species to return.
- Protect bare soils from erosion.
- Promote natural beauty and ecological stability without sacrificing adequate wildland fire protection.

Examples of fire-wise planting practices would be to space trees widely to interrupt the continuity of aerial fuels, plant low-fuel volume shrubs (usually no greater than 18 inches in height) and integrate decorative rocks and non-combustible natural features into the landscape architecture design. Deep watering trees through the summer /fall or dry winters will keep trees alive and deter insects. Emphasis should be placed on the use of native drought-resistant plants and irrigation systems in newly planted areas. Existing native plants that are fire adapted do not have to be replaced in order to reduce the fire risk. They just need to be maintained at a "natural"

fuel level and arrangement. Healthy, well-irrigated plants are less flammable and irrigation systems can be used to reduce the intensity and spread of surface fires. Vegetation within a fire-wise landscape must also be maintained to continue to provide protection from undesirable fire effects. On-going maintenance should include the removal of dead material, weed control, cutting of grasses to six inches or less in height, and tree and shrub pruning as necessary to prevent the buildup of ladder fuels and fuel jackpots that could contribute to spotting during fires.

It is clearly not possible to develop fully conforming individual defensible space where homes are spaced very close together on small lots; however, it is possible to develop linked defensible space by building defensible perimeters around clusters of homes and replacing native and flammable ornamental plantings near and between structures with ignition resistant plantings. For the purposes of this report when we use the term “linked defensible space” it is meant to refer to extending Zone 2 (30 to 100 feet from the structure, also known as the “reduced fuel zone”) and Zone 3 (forest health maintenance extending from 100 feet from the structure to the property line, where such distances exist) treatments so they overlap between parcels forming a continuous buffer of modified fuels around a perimeter. (See Figure 6). Cooperation between neighbors and SBCFD to promote development of linked defensible spaces is strongly encouraged to protect homes in the Arrowhead Communities.

The general measures listed below should be noted and practiced through the study area. Some of these recommendations may already be in place on some properties.

1. Remain aware of the current fire danger in the area.
2. Clean roofs and gutters at least twice a year.
3. Don't store combustibles or firewood under decks or wooden projections.
4. Maintain an irrigated greenbelt around buildings.
5. Maintain and clean spark arresters on any chimneys.
6. Connect and have available a minimum of 50 feet of garden hose near all buildings to extinguish small fires before they spread. For large buildings two or more hoses may be required to provide adequate coverage.
7. Trees, large shrubs and other vegetation along roads and driveways should be thinned as necessary to maintain a minimum of 15 feet of vertical clearance for emergency vehicle access. Ladder fuels (low-lying branches that allow fire to climb from the ground into trees) should be removed to a height of at least eight feet above the ground for trees taller than 25 feet, or 1/3 the tree height for smaller trees. This includes both conifers and deciduous trees.
8. Maintain the defensible space around buildings by:
 - a. Mowing grass and weeds to a height of six inches or less
 - b. Removing any branches overhanging roofs or chimneys.
 - c. Remove all trash, debris and cuttings from the defensible space. Debris and cuttings should be completely removed from the area and never dumped into adjacent wildlands or vacant lots.

In 2013, 2014 and 2016 ACFSC had grants from USFS and CAL FIRE for roadside chipping for homeowners creating defensible space. We strongly recommend USFS and CAL FIRE reinstitute funding for this program. It's very important to remember creating defensible space is

not a one-time job. Defensible space should be maintained on an annual basis. For more information, please see *Appendix A, Creating Defensible Space*.



Figure 6 Defensible Space Examples

STRUCTURE HARDENING RECOMMENDATIONS

One of the most important recommendations in this report is for any new structures in the study area to be built in accordance with California's Wildland-Urban Interface Code and for existing structures to be fire hardened to the greatest extent practical.

Structure hardening is critically important in areas where homes are built with flammable materials on small lots. The average residential lot size in the study area is 0.25 acres. Some of the homes in the Deer Park Lodge neighborhood are built on tent camping lots. In such areas house-to-house transmission could become the primary carrier of fire. The authors and stakeholders of this report recognize the difficulty involved in coordinating the significant number of owners in the Arrowhead Communities; however, the creation and maintenance of defensible space combined with structure hardening will produce the greatest benefits for the protection of life and the conservation of property from the effects of wildfire. SBCFD and MAST may be able to assist property owners in obtaining grants to aid with outfitting existing homes with ignition resistant siding and roofs. Further information regarding California's Wildland-Urban Interface Code can be found on this website:

http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_codes

In their 2013 publication *How Risk Management Can Prevent Future Wildfire Disasters in the Wildland-Urban Interface* David E. Calkin, Jack D. Cohen, Mark A. Finney, and Matthew P. Thompson come to the following conclusion:

“The demonstrated inability to suppress wildfires under extreme weather conditions and the fact that many homes are not destroyed when exposed to these wildfires indicates that reducing home ignition potential is key to effectively reducing home destruction. Because home ignitions are primarily determined by conditions on private property, the principal authority, and thus, primary responsibility for preventing WUI home destruction lies with homeowners rather than public land managers.”¹⁰

Individual home hazard assessments can provide a road map for home owners to reduce the ignition potential of the Home Ignition Zone (HIZ), see Figure 7; however individual assessments rely heavily on the evaluation of conditions existing from the structure to a minimum of 100 feet out. As such, they are most effective when lot sizes are 1 acre or greater. As mentioned earlier, the average residential lot size in the study area is 0.25 acres. Most homes are too close together and lots too small for individual parcel assessments to yield much actionable information. For that reason, we recommend individual parcel assessments only for areas where the average lot size is one acre or greater. Throughout the areas of residential development dominated by small lots we recommend focusing on reducing HIZ ignition potential through linked defensible space and structure hardening tactics which are discussed in this section and the previous one.



Figure 7 The Home Ignition Zone

Although some of the factors impacting the survivability of structures are best addressed before the home is built, there are still steps that should be taken to improve the survivability of existing homes.

The role of embers in structure losses cannot be overstated. Embers are generated by burning materials and lofted by wind and/or convective heat ahead of the main fire front. Structures are vulnerable to ember penetration in numerous ways. Some of the more common weaknesses are outlined below.

Fortunately since the original CWPP was written, San Bernardino County enacted an ordinance prohibiting wood shake roofs. A few flammable roofs may remain, particularly on outbuildings, but they are a rarity. The roof of a home has a significant impact on its ignitability as well as the likelihood of house-to-house spread. Class A roofing materials such as asphalt shingle, metal and tile are all considered ignition resistant. We highly recommend any roofing added or replaced to new or existing structures, including outbuildings and other non-residential structures, be constructed of Class A materials.

A large number of homes in the study area have combustible wooden decks, exterior stairs or other projections. The shape of decks and outdoor stairs makes them excellent traps for heat and embers. Nothing flammable should ever be stored under decks or projections because of this. We recommend that as wooden decks and projections become in need of repair or replacement, non-flammable materials, such as plastic composites or aluminum decking, should be strongly encouraged. The quality and number of choices for wood substitute building materials has grown exponentially in the last decade and homeowners are no longer limited to materials with an inferior look and finish. In addition to reducing fire hazards, these materials usually require much less maintenance than wood. In areas where fire behavior predictions call for low to moderate intensities it's helpful to isolate existing wooden decks from the energy of fires by building a non-combustible patio and wall below the deck to limit the heat trap effect. The best design is to enclose the deck completely to create a solid form.

Windows quickly fail when exposed to the radiant heat of a wildfire. Once windows have failed they provide a direct path for embers and heat to enter the home and ignite the inside. Although newer homes in the study area may have more heat resistive windows, such as low E Thermopane (double glazed), and tempered glass patio doors, most of the residences are older constructions which are more likely to have conventional single pane window glass. We recommend replacing single pane windows with modern double pane windows that will improve the resistance to breakage from heat exposure by as much as double the exposure time.¹¹ Homes near heavy fuels should consider installing heavy, non-flammable window coverings that will afford the home some additional protection from embers in the event windows break. Homes in these areas should also consider replacing large windows (2 feet or more wide or tall) with smaller panes more likely to stay in place even if fractured by heat.

Vents are another location where embers can enter the structure. Vents, especially vents on the downhill side of the home, should have flammable vegetation removed as per applicable Zone 1 defensible space standards and be protected by non-flammable landscaping features such as stone or brick that will block the heat path of the fire. Vents in eaves and soffits should be covered with a non-combustible mesh with openings ¼" or smaller. Any open eaves should be enclosed to prevent them from becoming a trap for heat and embers. When enclosing an open eave, a flat soffit is preferred over a sloping soffit to limit the heat trap effect.

To reinforce the message of the research quoted at the beginning of this section, historic fire events have proven that flammable construction is linked directly to structure loss. The Insurance Institute for Business and Home Safety (IBHS) wildfire research center has developed a series of videos demonstrating how various home constructions burn (<https://www.youtube.com/watch?v=IvbNOPSYyss>).

More information regarding structure hardening can be found at the following links:

- <http://www.firesafemarin.org/hardening-your-home/siding>
- <https://disastersafety.org/wildfire/ibhs-wildfire-research/> (IBHS videos on embers)
- https://www.fema.gov/media-library-data/20130726-1652-20490-4085/fema_p_737.pdf
- <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1141> (National Fire Protection Association (NFPA) 1141, Standard for Fire Protection Infrastructure for Land Development in Wildland, Rural, and Suburban Areas.)

LANDSCAPE SCALE RECOMMENDATIONS

When most people think of a fuelbreak they envision a line usually 10 to 30 feet wide where all vegetation has been removed to mineral soil (Figure 8); however, the concept of a fuelbreak can describe any area where fuels have been manipulated to strategically reduce the spread and intensity of wildfire. Since the concept of a fuelbreak is more nebulous than the specific definitions of “fireline” and “firebreak” as used by wildland firefighters, the effectiveness of fuelbreaks has been the subject of debate among fire scientists and forest managers for many years. The concept of a “shaded fuelbreak” is most applicable to forested areas. Unlike firebreaks, which imply the removal of all vegetation down to mineral soil, shaded fuelbreaks are created by altering the surface fuels, increasing the height to the base of the live crown and opening the canopy by removing trees.¹² It is important to note the purpose of a fuelbreak is not to stop a fire, but to give firefighters a higher probability of successfully attacking the fire.¹³ Once installed, fuelbreaks require regular maintenance to ensure they will perform the task of altering the behavior of fire entering the treated area. Some of the concepts of shaded fuelbreak creation and maintenance may also be applicable to shrub lands, depending on the type, canopy height and density of shrubs.

There is much discussion as to how far fuels modifications must extend for fuelbreaks to be effective. In this report when distances are given they are intended as minimums. Depending on the fuels and topography, larger treatment areas may be necessary. The recommendations in this report are general in nature and the specific design of any fuelbreak should be referred to qualified experts familiar with both the vegetation and fire behavior of the area.



Figure 8 Firebreak in Mendocino County

Current and Planned Projects

In March of 2018 USFS released a proposal for a community defense and ecological restoration project in the study area. This proposal is for mechanical thinning, prescribed fire and hand work in 1,000 acres adjacent to residential development east of Lake Arrowhead that were burned in the 2007 Grass Valley Fire. Much of the burned area has regrown with thick shrubs since the fire. A full description of the project can be read at; <https://www.fs.usda.gov/project/?project=43428>. ACFSC has indicated they are very concerned about fires originating in the North Shore and Deer Park Lodge areas. The proposed project works directly to provide wildland fuels management adjacent to those areas and is highly recommended.

Recommendations

Work with property owners adjacent to national forest lands to create defensible space to their property lines. (See the linked defensible spaces description on page 21). If this could be accomplished, ACFSC could request fuels reduction on forest lands under the Good Neighbor Authority that could be used to create shaded fuelbreaks bordering residential developments.

The proposed Grass Valley Fire Restoration Project, described above, is directly adjacent to private land and when combined with linked defensible spaces will result in improving safety throughout these neighborhoods. A similar collaboration between ACFSC and USFS should be considered for the Cedar Edge neighborhood where much of the adjacent wildland fuel that was burned during the Old Fire in 2003 has grown back, making those fuelbeds as hazardous as before the Old Fire.

Stands throughout the entire area have experienced high mortality due to pine beetle infestation. CAL FIRE has identified portions of the study area as stands where tree mortality has reached 16% - 50%.¹⁴ The San Bernardino County Hazardous Tree Division was closed in 2012 due to lack of funds. We highly recommend grant funding be pursued to re-establish this program which was instrumental in removing bark beetle mortality from residential neighborhoods of the study area.

Work that has been completed throughout the Inland Empire by USFS can be seen in the WMP. These project areas should be evaluated periodically for maintenance needs to be sure they remain effective. Additional projects can tie into properly maintained existing work, to create larger fuelbreaks and landscape scale treatments.

ACCESS/EGRESS ROUTES & EVACUATION RECOMMENDATIONS

In the residential areas of Arrowhead Communities streets are generally paved and most major streets are of adequate width. Streets are often winding and some grades are steep. Areas exist where apparatus turnaround would be difficult. There are dead end roads that are unmarked and some community driveways that are unmarked or poorly marked. For properties accessed by steep driveways it will be critical to maintain a good, all-weather driving surface as well as an adequate clearing for emergency vehicles.

The main access and evacuation routes into and from the study area are shown in Figure 9. For the Arrowhead Communities the most direct routes are to use either CA-18 west to San Bernardino or CA-18 east to CA-330 south to San Bernardino. CA-18 east to Big Bear City is an alternative route if conditions make the routes to San Bernardino too hazardous. Depending on conditions and the direction of the fire, CA-138 and CA-189 within and around the Lake Arrowhead area could also be alternatives to the most direct routes depending on conditions and circumstances. CA-173, between Lake Arrowhead and Hesperia, is not a viable evacuation route and is currently closed to the public.

In the past, evacuation of residents during major fires has been generally smooth and efficient; however as noted earlier in this report visitors can outnumber residents especially during holidays and weekends in the summer. The recommendations below are suggested to enhance safe evacuation for both residents and guests as well as improve access safety for firefighting resources.

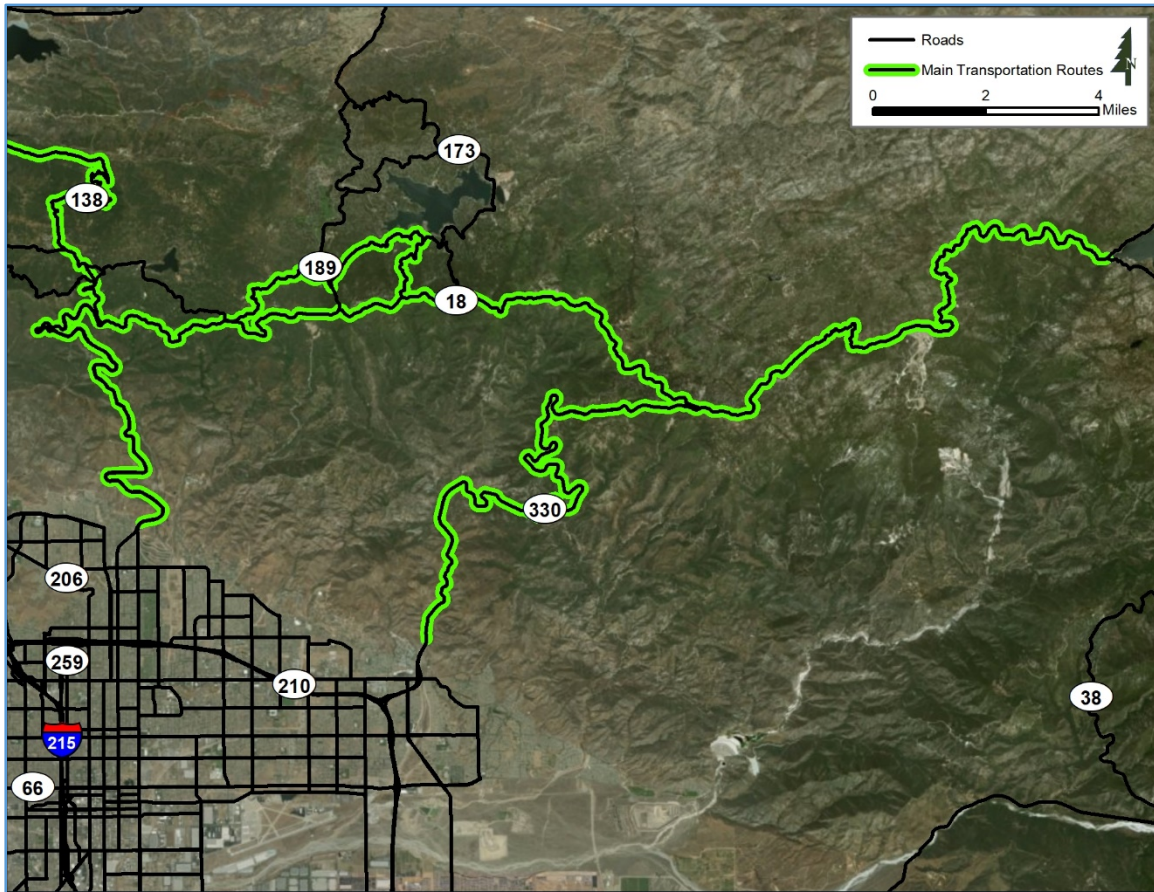


Figure 9 Access and Evacuation Routes

Recommendations

Maintenance of the major access routes shown above is critical to effective evacuation during fires. Along these major routes maintenance cutting to remove understory species and limbing trees to a height of at least eight feet within 10 feet of the roadway should be implemented on an on-going basis. Although the primary access routes are the priority for treatment, maintenance cutting should also be considered on the more heavily traveled streets within the study area such as CA-173 and North Shore Drive.

Although local residents are very familiar with access and egress routes into their communities, visitors can easily become lost especially in areas with a high density of side streets and twisty mountain roads. A program to mark all dead end roads should be a priority. Also consider the use of color and shape coded routes leading from the major highways in and out of the communities to easily identified landmarks such as the south lakeshore commercial area and the Lake Arrowhead Country Club. These routes should serve the dual purpose of helping visitors find major landmarks in the study area as well as facilitating evacuation. The signs should not be marked as evacuation routes. Instead directions could be given something like this; “Visitors in the Lake Arrowhead area should follow the blue diamond signs to CA-330 to return to San Bernardino.” The signs should also show the destination of the route. Avoid the use of red or

green as those colors could cause confusion with other road signs. Simple, colored geometric figures such as circles, triangles, diamonds and stars should be effective and attention getting.

Create mobile device friendly PDF maps showing the routes from major gathering places where visitors could connect with the color/shape signed routes described above.

Print public education brochures showing the routes mentioned above. Distribute these brochures to hotels, camps and conference centers in the area and encourage their use for both emergency and non-emergency purposes. Ground truthing should be done initially and periodically to ensure the accuracy of these brochures as well as the PDF maps.

Street signage is generally good in the study area; however, missing or inadequate address markers are an issue. Many homes do not have an address marker visible from the street and those that do are of all types with no particular system for size or position. Although mapping applications such as Google Map and Waze have made it easier for responders to locate specific structures, reflective addressing that is visible from the street is still desirable. Most applications relying on GPS technology have some difficulty pinpointing addresses from time to time. While some residents may consider reflective address signage to be unattractive, it is essential for quick and effective response. The value to responders, especially at night and under difficult conditions, is not to be underestimated. This is especially true during large wildland fires where poor addressing will create an additional challenge for outside responders who do not have local knowledge and training on local access.

Although consistent, reflective address markers seem less important with today's technology it is important to remember that technology does fail and a program of improving address markers throughout the study area is still desirable. We recommend SBCFD, area government, and property owners work together to create and implement a consistent system of reflective address markers.

Evacuation is the first priority for homes threatened by wildfire. In the event residents became trapped by a fire before evacuation could be completed, safety zones could be essential to life safety. SBCFD, and the ACFSC should collaborate to create a pre-plan to identify safety zones that could be used as a last resort if all attempts at evacuation fail. Areas that are to be considered should be large enough to hold all of the intended residents and still represent a minimum buffer of 1.5 times the average fuel height. For safety zones to be effective, trigger points must be established at which fire resources would prepare the area and notify residents. Schools with large parking lots such as Mary Putnam Henck on Rhine Road could be investigated as a possibility (Figure 10). Easy, safe access is important. The Lake Arrowhead Country Club would not be a good choice as the access is long, winding and surrounded by flammable vegetation. Although there is a golf course there, significant native vegetation is mixed into the fairways that could be ignited by embers. Similarly, the south lakeshore commercial area would not be recommended due to the structural ignitability of many of the buildings and the potential for heavy ember cast. Careful pre-fire planning and preparation is necessary for any of the options considered to be viable.



Figure 10 Mary Putnam Henck School

CONCLUSION

The scientific and historical analysis performed during the preparation of this report shows the entire study area to have a high likelihood for continued wildfires. Furthermore, fires in this area have a high potential for loss of life and damage to property. This especially true in light of the popularity of this area as a summer getaway. In addition to the residents, literally thousands of visitors could be endangered by wildfire. The following summary is a distillation of what we think should be the highest priority actions to preserve life and property:

- Individual property owners must realize the survival of their homes will rely heavily on their ability and willingness to create defensible space and harden their structures to the greatest extent practical against ignitability from embers and firebrands.
- SBCFD and CAL FIRE should support mitigation efforts of residents by advising and assisting those efforts wherever possible and by ensuring the existing statutes regarding fire hazard abatement are enforced, even if property owners are not residents of the area.
- Continue to work with USFS and CAL FIRE to be sure projects like the Grass Valley Fire Restoration Project are combined with defensible space on private property to reduce fire hazards to all residents.
- Efforts to remove any dangerous fuels along CA-18, CA-330 and CA-189 that could create hazards to responders and evacuees should be a priority. These efforts must continue on an ongoing basis to be effective.

GRANT RESOURCES

One of the biggest obstacles to overcome when trying to implement CWPP recommendations and wildfire mitigation projects is funding. A certified CWPP opens a multitude of funding sources to complete work outlined in the plan. For many mitigation projects, federal, state and county funds are available to begin treatments. The list below is not inclusive, but rather serves as a starting point for the most commonly available sources of funding and outreach.

Federal Emergency Management Agency (FEMA)

- **Assistance to Firefighters Grant Program**
 - Purpose: to improve firefighting operations, purchase firefighting vehicles, equipment and personal protective equipment; fund fire prevention programs; and establish wellness and fitness programs.
 - Necessary information includes a DUNS number, Tax ID number and Central Contractor Registration
 - <https://www.fema.gov/welcome-assistance-firefighters-grant-program>
- **SAFER: Staffing for Adequate Fire and Emergency Response**
 - Purpose: to provide funding directly to fire departments and volunteer firefighter interest organizations in order to help them increase the number of trained, “front line” firefighters available in their communities. The goal of SAFER is to enhance the ability of local fire departments to comply with staffing, response and operational standards established by NFPA and OSHA.
 - <https://www.fema.gov/staffing-adequate-fire-emergency-response-grants>
- **Fire Prevention and Safety Grants (FP&S)**
 - Purpose: FP&S Grants are part of the Assistance to Firefighters Grants and are under the purview of the Grant Programs Directorate in FEMA. Their purpose is to support projects that enhance the safety of the public and firefighters from fire and related hazards.
 - <https://www.fema.gov/fire-prevention-safety-grants>
- **Hazard Mitigation Assistance Grant Program (HMA)**
 - Purpose: to provide grants to state and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The goal of HMA is to reduce the loss of life and property due to natural disasters and enable mitigation measures to be implemented during the immediate recovery from a disaster.
 - https://www.fema.gov/media-library-data/1441133724295-0933f57e7ad4618d89debd1ddc6562d3/FEMA_HMA_Grants_4pg_2015_508.pdf

- **Pre-Disaster Mitigation Grant Program (PDM)**
 - Purpose: to provide funds to states, territories, Tribal governments, communities, and universities for hazard-mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces the overall risks to the population and structures.
 - <https://www.fema.gov/pre-disaster-mitigation-grant-program>

CAL FIRE grants

- **SRA Fire Prevention Fee Grant (SRAFPF)**

Purpose: provides funding for projects related to fuel (vegetation) hazard reduction, fire prevention education and training, and fire prevention planning. Projects funded by the SRAFPF will reduce the risk of fire ignition and spread in and adjacent to communities, educate owners of habitable structures about wildfire risks, or allow for strategic, long-term planning to reduce the risk of wildfire to communities in the SRA throughout the State
- **California Forest Improvement Program (CFIP)**

Purpose: encourage private and public investment in, and improved management of, California forest lands and resources. This focus is to ensure adequate high quality timber supplies, related employment and other economic benefits, and the protection, maintenance, and enhancement of a productive and stable forest resource system for the benefit of present and future generations.
- <http://www.fire.ca.gov/grants>

Natural Resources Conservation Grants

- **Environmental Quality Incentives Program (EQIP)**

Purpose: provides financial and technical assistance to agricultural producers to plan and implement conservation practices that improve soil, water, plant, animal, air and related natural resources on agricultural land and non-industrial private forestland. EQIP may also help producers meet Federal, State, Tribal, and local environmental regulations.

Firewise Communities

- Purpose: a multi-agency organization designed to increase education of homeowners, community leaders, developers, and others regarding the Wildland-Urban Interface and the actions they can take to reduce fire risk to protect lives, property and ecosystems.
- <http://www.firewise.org>

National Volunteer Fire Council

- Purpose: to support volunteer fire protection districts. Includes both federal and non-federal funding options and grant writing help.
- <http://www.nvfc.org/>

National Resources Conservation Service Emergency Watershed Protection Program

- Purpose: to undertake emergency measures including the purchase of flood plain easements for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed.
- <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/ewp/>

USFS Cooperative Forestry Assistance

- Purpose: to assist in the advancement of forest resources management, the control of insects and diseases affecting trees and forests, the improvement and maintenance of fish and wildlife habitat, and the planning and conduct of urban and community forestry programs.
- <http://www.fs.fed.us/cooperativedforestry/programs/loa/>

REFERENCES/CITATIONS

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- ¹ <https://www.usclimatedata.com/climate/lake-arrowhead/california/united-states/usca0578>
- ² <https://california.hometownlocator.com/ca/san-bernardino/lake-arrowhead.cfm>
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- ⁴ <https://datausa.io/profile/geo/lake-arrowhead-ca/#economy>
- ⁵ http://calfire.ca.gov/communications/downloads/fact_sheets/CoopResponse.pdf
- ⁶ http://calfire.ca.gov/communications/downloads/fact_sheets/CoopResponse.pdf
- ⁷ <http://www.sbcfire.org/about/AboutSBCFire.aspx>
- ⁸ <https://www.fema.gov/welcome-assistance-firefighters-grant-program>
- ⁹ Zone 1 extends from the structure out to 30 feet and Zone 2 extends from 30 feet from the structure to 100 feet or the property line if that distance is less than 100 feet.
- ¹⁰ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3896199/>
- ¹¹ <https://www.coloradowildfirerisk.com/Help/FireWiseHome>, Page 30.
- ¹² James K. Agee, Benii Bahro, Mark A. Finney, Philip N. Omi, David B. Sapsis, Carl N. Skinner, Jan W. van Wagtendonk, and C. Phillip Weatherspoon, "The Use of Fuelbreaks in Landscape Fire Management", <http://www.qlg.org/pub/miscdoc/agee.htm>
- ¹³ *Ibid*
- ¹⁴ http://www.fire.ca.gov/resource_mgt/images/beetle_damage_maps/SoCAmap.jpg

Appendix A Creating Defensible Space

Purpose

Throughout this report, the focus has been on the importance and effectiveness of creating and maintaining defensible space. This appendix contains information produced by the state of California focused on creating defensible space in the different ecosystems that pose wildfire hazards in the state. This information should be used to supplement the information contained within the body of the report. There will be some crossover of information and techniques regarding how to protect homes from wildfire. Some of the information in this appendix will not be directly applicable to areas within the Arrowhead Communities WUI/WI due to various ecosystems addressed by this literature and some of the specific challenges related to these communities. This information, however, is valuable and well-reviewed.

General Guidelines for Creating Defensible Space

State Board of Forestry and Fire Protection (BOF)
California Department of Forestry and Fire Protection

Adopted by BOF on February 8, 2006
Approved by Office of Administrative Law on May 8th, 2006



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A. Purpose of Guidelines

Recent changes to Public Resources Code (PRC) 4291 expand the defensible space clearance requirement maintained around buildings and structures from 30 feet to a distance of 100 feet. These guidelines are intended to provide property owners with examples of fuel modification measures that can be used to create an area around buildings or structures to create defensible space. A defensible space perimeter around buildings and structures provide firefighters a working environment that allows them to protect buildings and structures from encroaching wildfires as well as minimizing the chance that a structure fire will escape to the surrounding wildland. These guidelines apply to any person who owns, leases, controls, operates, or maintains a building or structure in, upon, or adjoining any mountainous area, forest-covered lands, brush-covered lands, grass-covered lands, or any land that is covered with flammable material, and located within a State Responsibility Area.



Effective defensible space

The vegetation surrounding a building or structure is fuel for a fire. Even the building or structure itself is considered fuel. Research and experience have shown that fuel reduction around a building or structure increases the probability of it surviving a wildfire. Good defensible space allows firefighters to protect and save buildings or structures safely without facing unacceptable risk to their lives. Fuel reduction through vegetation management is the key to creating good defensible space.

Terrain, climate conditions and vegetation interact to affect fire behavior and fuel reduction standards. The diversity of California's geography also influences fire behavior and fuel reduction standards as well. While fuel reduction standards will vary throughout the State, there are some common practices that guide fuel modification treatments to ensure creation of adequate defensible space:

- Properties with greater fire hazards will require more clearing. Clearing requirements will be greater for those lands with steeper terrain, larger and denser fuels, fuels that are highly volatile, and in locations subject to frequent fires.
- Creation of defensible space through vegetation management usually means reducing the amount of fuel around the building or structure, providing separation between fuels, and or reshaping retained fuels by trimming. Defensible space can be created removing dead vegetation, separating fuels, and pruning lower limbs.
- In all cases, fuel reduction means arranging the tree, shrubs and other fuels sources in a way that makes it difficult for fire to transfer from one fuel source to another. It does not mean cutting down all trees and shrubs, or creating a bare ring of earth across the property.
- A homeowner's clearing responsibility is limited to 100 feet away from his or her building or structure or to the property line, whichever is less, and limited to their land. While individual property owners are not required to clear beyond 100 feet, groups of property owners are encouraged to extend clearances beyond the 100 foot requirement in order to create community-wide defensible spaces.
- Homeowners who do fuel reduction activities that remove or dispose of vegetation are required to comply with all federal, state or local environmental protection laws and obtain permits when necessary. Environmental protection laws include, but are not limited to, threatened and endangered species, water quality, air quality, and cultural/archeological resources. For example, trees removed for fuel reduction that are used for commercial purposes require permits from the

California Department of Forestry and Fire Protection. Also, many counties and towns require tree removal permits when cutting trees over a specified size. Contact your local resource or planning agency officials to ensure compliance.

The methods used to manage fuel can be important in the safe creation of defensible space. Care should be taken with the use of equipment when creating your defensible space zone. Internal combustion engines must have an approved spark arresters and metal cutting blades (lawn mowers or weed trimmers) should be used with caution to prevent starting fires during periods of high fire danger. A metal blade striking a rock can create a spark and start a fire, a common cause of fires during summertime.

Vegetation removal can also cause soil disturbance, soil erosion, regrowth of new vegetation, and introduce non-native invasive plants. Always keep soil disturbance to a minimum, especially on steep slopes. Erosion control techniques such as minimizing use of heavy equipment, avoiding stream or gully crossings, using mobile equipment during dry conditions, and covering exposed disturbed soil areas will help reduce soil erosion and plant regrowth.

Areas near water (riparian areas), such as streams or ponds, are a particular concern for protection of water quality. To help protect water quality in riparian areas, avoid removing vegetation associated with water, avoid using heavy equipment, and do not clear vegetation to bare mineral soil.

B. Definitions

Defensible space: The area within the perimeter of a parcel where basic wildfire protection practices are implemented, providing the key point of defense from an approaching wildfire or escaping structure fire. The area is characterized by the establishment and maintenance of emergency vehicle access, emergency water reserves, street names and building identification, and fuel modification measures.

Aerial fuels: All live and dead vegetation in the forest canopy or above surface fuels, including tree branches, twigs and cones, snags, moss, and high brush. Examples include trees and large bushes.

Building or structure: Any structure used for support or shelter of any use or occupancy.

Flammable and combustible vegetation: Fuel as defined in these guidelines.

Fuel Vegetative material, live or dead, which is combustible during normal summer weather. For the purposes of these guidelines, it does not include fences, decks, woodpiles, trash, etc.

Homeowner: Any person who owns, leases, controls, operates, or maintains a building or structure in, upon, or adjoining any mountainous area, forest-covered lands, brush-covered lands, grass-covered lands, or any land that is covered with flammable material, and located within a State Responsibility Area.

Ladder Fuels: Fuels that can carry a fire vertically between or within a fuel type.

Reduced Fuel Zone: The area that extends out from 30 to 100 feet away from the building or structure (or to the property line, whichever is nearer to the building or structure).

Surface fuels: Loose surface litter on the soil surface, normally consisting of fallen leaves or needles, twigs, bark, cones, and small branches that have not yet decayed enough to lose their identity; also grasses, forbs, low and medium shrubs, tree seedlings, heavier branches and downed logs.

C. Fuel Treatment Guidelines

The following fuel treatment guidelines comply with the requirements of 14 CCR 1299 and PRC 4291. **All persons using these guidelines to comply with CCR 1299 and PRC 4291 shall implement General Guidelines 1., 2., 3., and either 4a or 4b., as described below.**

General Guidelines:

1. Maintain a firebreak by removing and clearing away all flammable vegetation and other combustible growth within 30 feet of each building or structure, with certain exceptions pursuant to PRC §4291 (a). Single specimens of trees or other vegetation may be retained provided they are well-spaced, well-pruned, and create a condition that avoids spread of fire to other vegetation or to a building or structure.
2. Dead and dying woody surface fuels and aerial fuels within the Reduced Fuel Zone shall be removed. Loose surface litter, normally consisting of fallen leaves or needles, twigs, bark, cones, and small branches, shall be permitted to a depth of 3 inches. This guideline is primarily intended to eliminate trees, bushes, shrubs and surface debris that are completely dead or with substantial amounts of dead branches or leaves/needles that would readily burn.
3. Down logs or stumps anywhere within 100 feet from the building or structure, when embedded in the soil, may be retained when isolated from other vegetation. Occasional (approximately one per acre) standing dead trees (snags) that are well-space from other vegetation and which will not fall on buildings or structures or on roadways/driveways may be retained.
4. Within the Reduced Fuel Zone, one of the following fuel treatments (4a. or 4b.) shall be implemented. Properties with greater fire hazards will require greater clearing treatments. Combinations of the methods may be acceptable under §1299(c) as long as the intent of these guidelines is met.

4a. Reduced Fuel Zone: Fuel Separation

In conjunction with General Guidelines 1., 2., and 3., above, minimum clearance between fuels surrounding each building or structure will range from 4 feet to 40 feet in all directions, both horizontally and vertically.

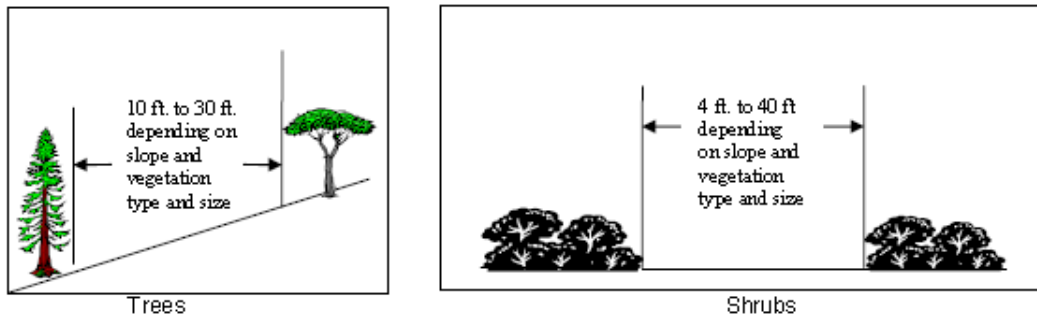
Clearance distances between vegetation will depend on the slope, vegetation size, vegetation type (brush, grass, trees), and other fuel characteristics (fuel compaction, chemical content etc.). Properties with greater fire hazards will require greater separation between fuels. For example, properties on steep slopes having large sized vegetation will require greater spacing between individual trees and bushes (see Plant Spacing Guidelines and Case Examples below). Groups of vegetation (numerous plants growing together less than 10 feet in total foliage width) may be treated as a single plant. For example, three individual manzanita plants growing together with a total foliage width of eight feet can be "grouped" and considered as one plant and spaced according to the Plant Spacing Guidelines in this document.



Grass generally should not exceed 4 inches in height. However, homeowners may keep grass and other forbs less than 18 inches in height above the ground when these grasses are isolated from other fuels or where necessary to stabilize the soil and prevent erosion.

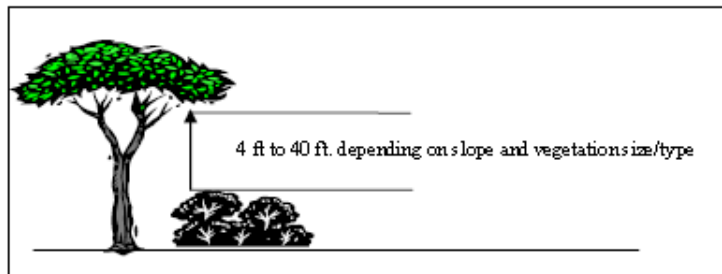
Clearance requirements include:

- Horizontal clearance between aerial fuels, such as the outside edge of the tree crowns or high brush. Horizontal clearance helps stop the spread of fire from one fuel to the next.



Horizontal clearance between aerial fuels

- Vertical clearance between lower limbs of aerial fuels and the nearest surface fuels and grass/weeds. Vertical clearance removes *ladder fuels* and helps prevent a fire from moving from the shorter fuels to the taller fuels.



Vertical clearance between aerial fuels



Effective vertical and horizontal fuel separation
Photo Courtesy
Plumas Fire Safe Council.

Plant Spacing Guidelines		
Guidelines are designed to break the continuity of fuels and be used as a "rule of thumb" for achieving compliance with Regulation 14 CCR 1299.		
Trees	Minimum horizontal space from edge of one tree canopy to the edge of the next	
	Slope	Spacing
	0% to 20 %	10 feet
	20% to 40%	20 feet
	Greater than 40%	30 feet
Shrubs	Minimum horizontal space between edges of shrub	
	Slope	Spacing
	0% to 20 %	2 times the height of the shrub
	20% to 40%	4 times the height of the shrub
	Greater than 40%	6 times the height of the shrub
Vertical Space	Minimum vertical space between top of shrub and bottom of lower tree branches: 3 times the height of the shrub	

Adapted from: Gilmer, M. 1994. California Wildfire Landscaping

Case Example of Fuel Separation: Sierra Nevada conifer forests

Conifer forests intermixed with rural housing present a hazardous fire situation. Dense vegetation, long fire seasons, and ample ignition sources related to human access and lightning, makes this home vulnerable to wildfires. This home is located on gentle slopes (less than 20%), and is surrounded by large mature tree overstory and intermixed small to medium size brush (three to four feet in height).

Application of the guideline under 4a. would result in horizontal spacing between large tree branches of 10 feet; removal of many of the smaller trees to create vertical space between large trees and smaller trees and horizontal spacing between brush of six to eight feet (calculated by using 2 times the height of brush).



Case Example of Fuel Separation: Southern California chaparral

Mature, dense and continuous chaparral brush fields on steep slopes found in Southern California represents one of the most hazardous fuel situations in the United States. Chaparral grows in an unbroken sea of dense vegetation creating a fuel-rich path which spreads fire rapidly. Chaparral shrubs burn hot and produce tall flames. From the flames come burning embers which can ignite homes and plants. (Gilmer, 1994). All these factors results in a setting where aggressive defensible space clearing requirements are necessary.



Steep slopes (greater than 40%) and tall, old brush (greater than 7 feet tall), need significant modification. These settings require aggressive clearing to create defensible space, and would require maximum spacing. Application of the guidelines would result in 42 feet horizontal spacing (calculated as 6 times the height of the brush) between retained groups of chaparral.

Case Example of Fuel Separation: Oak Woodlands

Oak woodlands, the combination of oak trees and other hardwood tree species with a continuous grass ground cover, are found on more than 10 million acres in California. Wildfire in this setting is very common, with fire behavior dominated by rapid spread through burning grass.

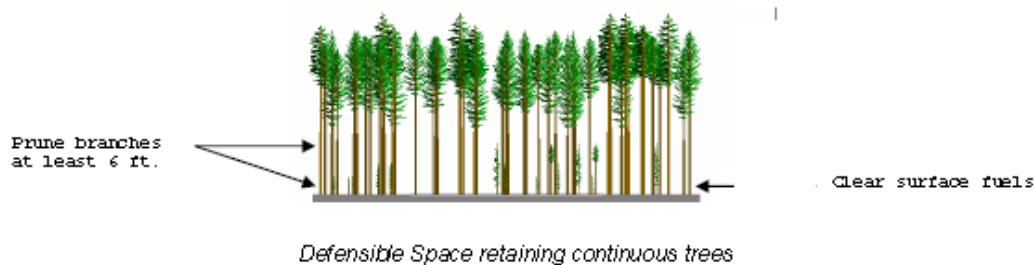
Given a setting of moderate slopes (between 20% and 40%), wide spacing between trees, and continuous dense grass, treatment of the grass is the primary fuel reduction concern. Property owners using these guidelines would cut grass to a maximum 4 inches in height, remove the clippings, and consider creating 20 feet spacing between trees.



4b. Reduced Fuel Zone: Defensible Space with Continuous Tree Canopy

To achieve defensible space while retaining a stand of larger trees with a continuous tree canopy apply the following treatments:

- Generally, remove all surface fuels greater than 4 inches in height. Single specimens of trees or other vegetation may be retained provided they are well-spaced, well-pruned, and create a condition that avoids spread of fire to other vegetation or to a building or structure.
- Remove lower limbs of trees ("prune") to at least 6 feet up to 15 feet (or the lower 1/3 branches for small trees). Properties with greater fire hazards, such as steeper slopes or more severe fire danger, will require pruning heights in the upper end of this range.



Authority cited: Section 4102, 4291, 4125-4128.5, Public Resource Code. Reference: 4291, Public Resource Code; 14 CCR 1299 (d).

Appendix B San Bernardino County Fire Hazard Abatement Ordinance

REPORT/RECOMMENDATION TO THE BOARD OF SUPERVISORS SAN BERNARDINO COUNTY, CALIFORNIA AND RECORD OF ACTION

October 7, 2008

Continued from Tuesday, September 23, 2008, Item 83

**FROM: DENNIS HANSBERGER, Third District Supervisor
Board of Supervisors**

**SUBJECT: 2nd Reading/Final Adoption - ORDINANCE PERTAINING TO THE
ABATEMENT OF FIRE HAZARDS AND HAZARDOUS TREES AND FIRE
ACCESS ROAD OBSTRUCTIONS**

RECOMMENDATION(S)

Adopt **Ordinance No. 4058** amending Sections 23.0301, 23.0304, 23.0307 and 23.0308 of Chapter 3 of Division 3 of Title 2 of the San Bernardino County Code relating to abatement of fire hazards and hazardous trees and fire access road obstructions.

(Presenter: Peter S. Brierty, Assistant Chief/Fire Marshal, 909-936-5533)

BACKGROUND INFORMATION

The proposed ordinance amending relating to abatement of fire hazards and hazardous trees and fire access road obstructions had its first reading on September 23, 2008. The recommendation before the Board of Supervisors today will adopt this ordinance on the consent calendar.

SUPERVISORIAL DISTRICT(S)

All

Page 1 of 1

w/ Ordinance
cc: Co. Fire-Brierty
BOS 3rd-Hansberger
Co. Counsel-Messer
CAO-Thies
ed File-SDD-Fire Districts-SBCFPD
10/8/08
Ordinance No. 4058
ITEM 107

Rev 0706R1

Record of Action of the Board of Supervisors

APPROVED (CONSENT CALENDAR)

COUNTY OF SAN BERNARDINO
Board of Supervisors

MOTION	AYE 1	AYE 2	SECOND 3	ABSENT 4	MOVE 5
DENA M. SMITH, CLERK OF THE BOARD					
BY					

DATED: October 07, 2008

ORDINANCE NO. 4058

AN ORDINANCE OF THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA,
AMENDING SECTIONS 23.0301, 23.0304, 23.0307 AND 23.0308 OF
CHAPTER 3 OF DIVISION 3 OF TITLE 2 OF THE SAN BERNARDINO
COUNTY CODE, RELATING TO ABATEMENT OF FIRE HAZARDS AND
HAZARDOUS TREES AND FIRE ACCESS ROAD OBSTRUCTIONS.

The Board of Supervisors of the County of San Bernardino, State of California,
ordains as follows:

SECTION 1. Section 23.0301 of Chapter 3 of Division 3 of Title 2 of the San
Bernardino County Code is amended, to read:

23.0301 Duty to Abate Fire Hazards or Hazardous Trees.

Every owner or person in control of any land or interest therein in the unincorporated
area of the County of San Bernardino shall abate all fire hazards and hazardous trees from
such land and from all sidewalks, parkways, road easements and all other easements on
such land. All such fire hazards and hazardous trees are declared to be a public nuisance
for which the costs of abatement may be specially assessed pursuant to Government Code
Section 25845. To provide firefighters defensible space and to minimize the spread of
fire within one hundred (100) feet of a building or structure and pursuant to the California
Public Resources Code Section 4291, every owner and person in control of any buildings
or structures in, upon, or adjoining any mountainous area, forest-covered lands, brush-
covered lands, grass-covered lands, or any land that is covered with flammable material
within the unincorporated area of the County of San Bernardino shall at all times do the
following:

(a) Maintain a firebreak by removing and clearing away, for a distance of
not less than thirty (30) feet on each side of the building or structure or to the property line,
whichever is nearer, all flammable vegetation or other combustible growth. Single
specimens of trees or other vegetation may be retained provided they are well-spaced,
well-pruned as defined in section 23.0304 for mountain areas in this chapter, and create a
condition that avoids spread of fire to other vegetation or to a building or structure.

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1 (b) Provide a fuel break within thirty (30) feet to one hundred (100) feet of
2 a building or structure by disrupting the vertical and/or horizontal continuity of flammable
3 and combustible vegetation with the goal of reducing fire intensity, inhibiting fire in the
4 crowns of trees, reducing the rate of fire spread, and providing a safer environment for
5 firefighters to suppress wildfire and provide structure protection in and around wildland
6 urban interface communities. Additional fire protection or firebreak shall be made by the
7 removal of brush, flammable vegetation, or combustible growth that is located within one
8 hundred (100) feet from the building or structure or to the property line or at a greater
distance if provided by law.

9 (c) Property owners who do fuel reduction activities that remove or
10 dispose of vegetation should make every effort to properly reuse and/or recycle the
11 resultant materials either on site or at an appropriate off site facility, without creating
12 additional fire hazards and are required to comply with all federal, state or local
13 environmental protection laws and obtain permits when necessary. Environmental
14 protection laws include, but are not limited to, threatened and endangered species, water
15 quality, air quality, and cultural/archeological resources.

16 SECTION 2. Section 23.0304 of Chapter 3 of Division 3 of Title 2 of the San
17 Bernardino County Code is amended, to read:

18
19 **23.0304 Mountain Area Fire Hazard Abatement.**

20 (a) "Mountain Area" means that portion of the unincorporated area of the
21 County of San Bernardino located within the Fire Safety Overlay of the General Plan,
22 whether publicly or privately owned, and does include National Forest land.

23 (b) Flammable vegetation which constitutes a fire hazard in the "Mountain
24 Area" means:

25 (1) All foliage and branches within six (6) feet from the ground on
26 trees over twelve (12) feet in height that stand within one hundred (100) feet of structures.
27 Limbs should be cut no less than one quarter (¼) inch from the trunk of the tree to preserve
28 the health of the tree.

(2) All trees that are within thirty (30) feet of structures that are

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- 1 (2) Combustible rubbish, waste or discarded materials.
2 (3) Leaves, needles or other dead vegetative growth on roofs or
3 structures.

4 (d) When neighboring persons or properties are especially vulnerable to
5 the effects of fire, including, but not limited to schools, hospitals, mobilehome parks,
6 residential occupancies, it is the responsibility of the property owner to adhere to the
7 provisions of this section when flammable vegetation stands within one hundred (100) feet,
8 measured on the ground, of all neighboring structures. Additional clearance may be
9 required at the discretion of the County Fire Chief/Fire Warden or their designee on
10 buildings listed above that may be used as evacuation centers, medical facilities and/or
11 places of public gatherings and/or critical infrastructure.

12 SECTION 3. Section 23.0307 of Chapter 3 of Division 3 of Title 2 of the San
13 Bernardino County Code is amended, to read:
14

15 **23.307 Enforcement.**

16 For the purpose of enforcing this chapter, the County Fire Chief/Fire Warden may
17 designate any person as his/her deputy in the performance of the duties enjoined upon him
18 or her by this chapter. In addition, each of the following officers within the County of San
19 Bernardino is hereby designated to perform the same duties within the territory of the
20 political subdivision which they serve. Whenever the term "County Fire Chief" is used in
21 this chapter, the following officers are included in the meaning of such phrase, except that
22 the County Fire Chief/Fire Warden shall coordinate all such officers in the performance of
23 these duties:

24 (a) The Deputy Director of Code Enforcement, Fire Hazard Abatement
25 Program and their designees.

26 (b) The San Bernardino County Land Use Services Director or designee.

27 (c) Other officers hereafter designated by the Board of Supervisors or the
28 County Fire Chief/Fire Warden.

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1 SECTION 4. Section 23.0308 of Chapter 3 of Division 3 of Title 2 of the San
2 Bernardino County Code is amended, to read:

3
4 **23.0308 Notice and Order to Abate.**

5 (a) It shall be the duty of the County Fire Chief/Fire Warden or any
6 designated person, whenever such officer deems it necessary to enforce the provisions of
7 this chapter, to issue a "Notice and Order to Abate" by any or all of the following methods:

8 (1) By mailing a notice to the owner at the address shown on the
9 latest tax roll.

10 (2) By personal service to the owner as shown on the latest tax roll.

11 (3) By posting the property.

12 (b) The form "Notice and Order to Abate Fire" shall include, at a minimum,
13 the following information:

14
15 (1) List of hazards.

16 (2) List of locations.

17 (3) Due date by which abatement must be completed.

18 (4) Appeal rights.

19 (5) Landowner's name and address (situs and assessor's).

20 (6) Parcel number of affected property.

21
22 (c) The Notice and Order to Abate shall be placed in the mail by the
23 issuing agency at least thirty (30) days prior to the "due date" for abatement on the notice.

24 (d) A ten (10) day extension for compliance is sent when the owner has
25 removed greater than 51% of the fire hazard and notified the agency that the hazard has
26 been abated, but nevertheless the agency determines the fire hazard still exists. A ten (10)
27 day extension for compliance shall be placed in the mail by the issuing agency at least ten
28 (10) calendar days prior to the "due date" for abatement on the notice.

 (e) Compliance will be considered "In-Progress" and the Non-Compliance
Notice and Order will be held in abeyance if the responsible property owner contracts with

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1 State or Federal agencies or non profit organizations, such as Forest Care or Fire Safe
2 Councils, that are approved by the County Fire Chief/Fire Warden as capable of providing
3 compliance through said contract.

4
5 SECTION 5. This ordinance shall take effect thirty (30) days from the date of
6 adoption.

7
8 
9 PAUL BIANE, Chairman
Board of Supervisors

10 SIGNED AND CERTIFIED THAT A COPY
11 OF THIS DOCUMENT HAS BEEN DELIVERED
12 TO THE CHAIRMAN OF THE BOARD

13 DENA M. SMITH, Clerk of the
14 Board of Supervisors

15 
16

17
18 STATE OF CALIFORNIA)
19) ss.
COUNTY OF SAN BERNARDINO)

20 I, DENA M. SMITH, Clerk of the Board of Supervisors of the County of San
21 Bernardino, State of California, hereby certify that at a regular meeting of the Board of
22 Supervisors of said County and State, held on the 7th day of October, 2008,
at which meeting were present Supervisors: Mitzelfelt, Biane, Hansberger
23 and Gonzales

24 _____, and the
Clerk, the foregoing ordinance was passed and adopted by the following vote, to wit:

25 AYES: SUPERVISORS: **Mitzelfelt, Biane, Hansberger, Gonzales**

26 NOES: SUPERVISORS: **None**

27
28 ABSENT: SUPERVISORS: **Ovitt**

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1 IN WITNESS WHEREOF, I have hereunto set my hand and affixed the official
2 seal of the Board of Supervisors this 7th day of October, 2008.

3 DENA M. SMITH, Clerk of the
4 Board of Supervisors of the
5 County of San Bernardino,
6 State of California

7 Deputy

8
9 Approved as to Form:
10 RUTH E. STRINGER,
11 County Counsel

12 By: Kenneth C. Hardy
13 Kenneth C. Hardy
14 Deputy County Counsel

15 Date: 9/30/08
16
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