Incorporating Santa Ana Winds into Short-Term and Long-Term Fire Policy and Management Recommendations for Santa Monica Mountains National Recreation Area, California

A 2010 Group Project Proposal

Researched and Produced by:
Adam Anderson
Kyung Koh
Danica Schaffer-Smith
Erin Shapiro
Wendy Su

Faculty Advisors:
Bruce Kendall
Christina Tague
ABSTRACT

The primary goal of this project is to make recommendations, taking Santa Ana winds into account, for short and long-term fire policy and management in Santa Monica Mountains National Recreation Area (SAMO). As the population within the wildland-urban interface (WUI) has grown, the severity and cost of fires have increased exponentially. In southern California, approximately 5 million homes are currently at risk from wildfires in the WUI. Santa Ana winds cause the most devastating fires, and so the areas of highest wind intensity are of particular interest to fire management planning and education programs. A better understanding of the spatial pattern of fire during Santa Ana winds could help managers make more accurate characterizations of fire spread. This in turn would make it easier to define defensible and indefensible locations within SAMO and assist with siting of fuel management zones. It could also help to focus education strategies, encourage hazard mitigation measures in the highest hazard locations, and identify areas where future construction should be avoided. An analysis of climate change impacts on fire hazard will be particularly important to planning in the vicinity of SAMO, as the population is projected to increase in the future.
EXECUTIVE SUMMARY

Wildfires in southern California threaten millions of homes and suppression costs have risen to more than $1 billion annually (Wells 2007, Stephens et al. 2009). The most costly wildfires are those which are wind-driven (Keeley and Zedler 2009, Radtke et al. 1982, Westerling et al. 2004). The main elements determining fire hazard (or the likelihood that an area will burn) are vegetation, weather (including wind) and topography. SAMO is dominated by chaparral and coastal sage scrub vegetation types, which provide an abundance of highly ignitable fuel and thus contribute to extreme fire danger (Witter et al. 2007). The area's steep terrain, with major canyons running north and south, is conducive to rapid fire spread (Radtke et al. 1982). Additionally, local patterns of warm temperatures and relatively low humidity similarly increase fire hazard. However, this conceptual model of hazard does not account for extreme wind conditions, such as Santa Ana wind events. Climate change effects add complexity to SAMO's future land management planning, as the current fire regime (e.g. fire frequency, seasonality and intensity) may be altered.

The primary goal of this project is to take Santa Ana winds into consideration in short and long-term fire policy and management in Santa Monica Mountains National Recreation Area (SAMO). With a more accurate model of the spatial pattern of fire spread under strong wind conditions, managers could improve 1) fire management, including prevention, suppression or modification of fire behavior through various landscape treatment practices, and 2) education, which may improve community and private landowner fire management. Wind intensity in SAMO has never been formally documented on a fine scale. Combined with other factors, such as topography, vegetation and weather, information on wind intensity could be used to identify the areas facing higher fire hazard and facilitate a more effective allocation of fire management and education resources. Due to future land development potential, it is important to know which areas will be indefensible during Santa Ana wind events, and where development should be avoided.

Santa Ana winds occur seasonally when a cool, dry air mass from the interior western U.S. flows towards the Pacific coast. The air mass sinks, compresses, strengthens and warms, desiccating vegetation and increasing fire hazard (Westerling et al. 2004). Multi-day Santa Ana wind events, occurring mostly between late September and December, are the primary drivers of fire danger in southern California (Witter et al. 2007, Dennison et al. 2008). In some portions of SAMO, canyons with high fuel loads run parallel with the prevailing north to northeasterly directions of the Santa Ana winds. In such areas, it will be particularly important to identify the spatial distribution of high intensity surface winds from the prevailing Santa Ana winds in order to plan for defensibility.

To model Santa Ana wind events in SAMO, WindWizard, a gridded wind-modeling program, will be used. Information from the National Weather Service (NWS) currently serves as the baseline for wind data. WindWizard provides finer scale results than the NWS without requiring high intensity computing power, and its validity can be checked against historical wind data. The WindWizard simulations will be used to create a Santa Ana wind intensity map for SAMO. The output can also be used to improve the accuracy of other models, such as Fire Area Simulator (FARSITE), a fire behavior and growth simulator that will be used to update fire hazard maps for SAMO. Hazard will be determined based on how frequently a given location burns in simulations, and how quickly a fire would reach a given location when started from various ignition points. The fire hazard map will be used to identify defensible and indefensible areas during Santa Ana wind events. Based on the mapping results, recommendations will be made for SAMO’s fire management planning and education programs for hazard mitigation and prevention.

Because SAMO is concerned about long-term management, the effects of climate change should be taken into account. There is consensus in the scientific community that fire hazard could increase as a result of changes in fuel loads and weather patterns (IPCC 2007, Moritz and Stephens...
2008). However, the precise effects on a local scale are uncertain, with 20-year predictions relying on hypothetical scenarios of population growth, regulatory decisions and technological advancements (IPCC 2007). Despite the uncertainty, managers can consider the effects of climate changes in the landscape with some certainty, and modify current policy, zoning and mitigation plans to address future fire hazard (Lenihan et al. 2003). Regional climate change scenario models could be used by fire and land managers to project a potential range of future fuel moisture levels. The FARSITE model can incorporate both the projected fuel moisture values and the previously calculated wind data to create SAMO-specific future fire regime models. Based on the analysis of these model-based scenarios, long-term recommendations for fire management and outreach program modifications for SAMO will be provided.

SAMO has long recognized the importance of education in preventing both the ignition and spread of fire. Given the potential for additional population growth in the WUI, a fire hazard map will help to articulate areas of highest hazard from uncontrollable wildfires. More precise information on fire hazard could be used to better inform land development decisions by residents and planners. Although education efforts are important and should continue, it may be more cost-effective in the long-term to advocate changes to zoning in areas of high fire hazard and limit population growth where practicable.
PROBLEM STATEMENT

Santa Monica Mountains National Recreation Area (SAMO), part of the U.S. National Park Service (NPS), is unique in its diversity, and proximate to one of the fastest growing regions in the country. SAMO spans a highly urbanized area from Los Angeles to Ventura County. The wildland-urban interface (WUI) creates a complex mosaic of public land, residential neighborhoods and private in-holdings within multiple jurisdictions, resulting in difficult fire management issues.

SAMO’s current fire management plan incorporates years of observation and data on the relationship of topography, fuel loads and weather. These three “fire hazard elements” help define the hazard level in a given area and influence fire behavior. However, current weather inputs do not specifically address the geographic variability of wind events, such as the Santa Ana winds. Santa Ana wind events have been omitted from the modeling process because they are highly variable, making accurate modeling difficult and expensive. Additionally, while long-term residents and local fire personnel may be aware of the variation of Santa Ana wind patterns and the location of major wind corridors, this information has not been systematically documented. Consequently, SAMO currently lacks materials that incorporate both the spatial variability of wind intensity and the portions of the WUI most vulnerable to structure loss and other damage. The recently developed wind model, WindWizard, provides an inexpensive alternative to other fine-scale wind models applicable to the conditions at SAMO.

The risk of wildfire in SAMO is highest during late summer to early winter. More importantly, these wildfires can overlap with Santa Anas: seasonal strong, dry, offshore wind events. The 2003 and 2007 wildfires are prime examples of the damage and loss of life that can result when high temperature, low humidity and large fuel loads coincide with Santa Ana winds. Adding complexity to SAMO’s current and future land management issues are climate change effects, which may alter the current fire regime (e.g. fire frequency, seasonality and intensity).

SIGNIFICANCE

Southern California’s coastal shrublands can collectively be considered fire hazard areas. As urbanization continues in the WUI in the western United States, the costs of fire damage continue to outpace the resources allocated for prevention and suppression. Faced with these resource constraints, fire managers are looking for more appropriate offensive strategies. Knowledge about which parts of the WUI are most vulnerable to extreme fire weather would yield information about locations most susceptible to ignition by embers and potential structure loss. SAMO is an ideal case study for this analysis, and the methods and information produced could be transferable to other parks or high fire hazard areas.

The study area has experienced more damaging fires than any other part of the state. The population living within the WUI is increasing, and Santa Ana winds interacting with mountainous topography create complex surface wind patterns that have driven many large, uncontrollable fires. Wind modeling could be used as a method for analyzing and predicting the likelihood of an area burning and the rate at which it will burn, as well as identifying priorities for fire-safety enhancements and identifying areas where development should be avoided. If wind modeling proves insightful for SAMO managers, then the same process could likely be applied elsewhere. Additionally, the projected urban growth and ecological significance of the study area pose challenges for land management and planning, especially when climate change is considered. Land managers such as SAMO are beginning to demonstrate great interest in incorporating climate change into land management and planning. This project provides one example of planning for climate change in the context of managing resources to enhance community safety and natural resource integrity.
OBJECTIVES

The purpose of this project is to recommend how SAMO can direct current and future fire management resources and improve outreach in areas with high fire hazards. The principle objectives of this study are to:

1) identify locations of the greatest surface wind intensity during Santa Ana wind events within SAMO,
2) provide an assessment of WindWizard’s utility as an additional fire modeling tool for SAMO by comparing surface wind output results to historical wind data,
3) incorporate wind intensity data into fire models to create fire weather hazard maps,
4) based on the mapping output, make recommendations to SAMO on how to incorporate the information into fire management and prevention education programs for local communities and agencies,
5) incorporate changes in fuel moisture as a result of projected climate change into fire models and
6) provide recommendations to SAMO based on climate change fire models for future fire management and outreach programs.

LITERATURE REVIEW

Wildfire History in California and the Western U.S.

Until recently, wildfire suppression was the primary fire policy in the United States. Numerous devastating fires around the turn of the century led to the public perception that all fires were deleterious (Dombeck et al. 2004). Prescribed burning is the more recent philosophy in fire management, where fire is applied under specific weather conditions to a predetermined area (Wade et al. 1988). This method has proven effective at reducing fire hazard in coniferous forests, but not as useful in chaparral and coastal scrub ecosystems.

Wildfires occur naturally throughout the western United States but can be particularly devastating when combined with dense fuels, drought conditions and urban development. The intensity, severity and cost of fires have increased exponentially as the population density within the wildland-urban interface (WUI) has increased. The southern California Panorama Fire in 1981 resulted in the deaths of four people, burned more than 23,000 acres and destroyed 325 buildings (Gardner 1987). More recently, the 2003 firestorm in California burned approximately 4 million acres, destroyed 5,000 buildings and resulted in the deaths of 30 firefighters at a cost of more than $1 billion for suppression (Wells 2007).

Wildfire Management in SAMO

Fire management is the range of human activities, such as suppression, ignition or modification of fire behavior, that are implemented to protect human life or property or to modify ecosystem properties (SAMO 2005). SAMO has a large, sprawling WUI, in which the primary concern is development on private in-holdings. Another issue is the build-up of heavy fuel loads. The objectives of a fire management plan in a chaparral ecosystem such as SAMO are: 1) to contain wildfires strategically within easily defended boundaries; 2) to maintain a chaparral fire regime that fosters healthy, sustainable ecosystems in wildland areas; and 3) to protect urban interface areas from wildland fires and to protect wildlands from ignitions in the urban interface by separating urban interface areas from natural fuels (Conrad and Weise 1998).

SAMO’s current fire management plan calls for prescribed burning of chaparral to establish a shifting age-class mosaic of chaparral stands (SAMO 2005). The assumption is that creating age classes within the chaparral and coastal sage scrub will reduce both the intensity and spread of fire. While this approach may be effective in controlling fires under moderate fire conditions, a high-
intensity fire, especially those that occur during Santa Ana wind events, will burn through vegetation of all age classes (Conrad and Weise 1998). Therefore, SAMO’s current fire management practice of creating age classes within the chaparral and coastal sage scrub is ineffective in protecting lives and property during extreme fire conditions.

As of 2005, which marked the publication of the Final Environmental Impact Statement for a Fire Management Plan, SAMO is moving towards implementing a new fire management plan that attempts to meet the three objectives delineated by Conrad and Weise (1998) and which were listed above. Conrad and Weise (1998) advocate moving away from age-class mosaic burning and moving toward development of strategically placed fuel management zones. In areas of high fire hazard, such zones will allow firefighters access to the fire by providing areas of reduced fuel load and fire intensity. Additionally, these fuel management zones will provide intensive fire risk management zones in and around the WUI (Conrad and Weise 1998). Thus, SAMO’s new fire management plan will use prescribed burning not to establish age-class mosaics, but to strategically reduce hazardous fuel loads to reduce potential damage to life, property and natural and cultural resources (SAMO 2005).

Wildland-Urban Interface & Fire Hazard

The level of fire hazard corresponds with population pressure, topography, fuel loads and weather (Finney 1998). SAMO, the study site, has a large, sprawling, WUI, with most of the National Park land occurring in Los Angeles County. As the population of Los Angeles County increased 18.5% from 1980 to 1990, 7.4% from 1990 to 2000, and 3.8% from 2000 to 2007 (Census 2008), the number of people living within the WUI has also increased. The topography of SAMO consists of steep canyons covered with dense, shrubby vegetation, which makes it conducive to fire spread. When Santa Ana winds line up directionally with canyons, fire can become uncontrollable and threaten those that live within adjacent areas (Radtke et al. 1982). The close proximity of structures to dense vegetation increases the likelihood that lives and property could be lost during fires. Homeowners who reside in the WUI may not be informed of the risks inherent in living in these high fire hazard areas, or may not acknowledge that they are likely to be personally affected (Gardner et al. 1987, Huggett Jr. 2003).

The Grass Valley Fire in October of 2007 in the San Bernardino Mountains is one example of a fire that occurred in close proximity to a dense residential area. Dry Santa Ana winds blowing over rugged terrain of chaparral and conifer forests provided perfect conditions for the Grass Valley Fire (Cohen and Stratton 2008). Sparks from the fire moved south, igniting residential vegetation and several homes. A “domino effect” ensued as fire spread from structure to structure, destroying or damaging almost 200 homes by the end of the day. The post-fire evaluation concluded that destruction of private property resulted from fire spreading structure to structure. Contrary to popular dogma on wildfire damage, only six homes showed signs consistent with being engulfed by a high intensity wildfire; the rest were ignited by low intensity embers (Cohen and Stratton 2008). The Grass Valley fire illustrates the fact that homes within the WUI are threatened more by indirect ignition from embers than by direct ignition from fire.

When firestorms occur, such as those in 2003 and 2007, the usual response is to spend more state money on fire resources. However, the increased budget for preventative landscape treatments has not decreased the number of damaging fires in California. Fire prevention funds may be more effectively spent on additional public education in order to prevent or reduce fire hazard. The general public’s understanding of relative fire risk is limited due to the abundance and misuse of fire terminology and appropriate educational material could address this deficiency. Similarly, fire policy is inconsistent (Hardy 2005); instead of learning to live with fire, we have focused on fighting it (Stephens et al. 2009).
The Role of Education in the WUI

Although modeling fire growth and behavior can assist federal and state land management agencies in their efforts to manage fires, the importance of educating the general public about fire hazards and risks cannot be overemphasized. Many WUI residents do not understand the ecosystem in which they have chosen to live, or do not believe they will be affected, especially if a burn has already occurred relatively recently (Gardner 1987). While extreme wildfires most often affect residences along the edges of the WUI, most destroyed homes are a result of ignition from smaller flames or from firebrands (Cohen and Stratton 2008). The delineation of indefensible and defensible locations based on wind modeling and mapping may encourage homeowners within the WUI to take the necessary precautions to prevent damage to their property (e.g. maintaining defensible space). It may also raise awareness among land use planners and communities of the need to avoid further construction in these areas due to the high fire hazards.

Structure design can play an integral part in fire spread, as evidenced by the Grass Valley Fire. Additionally, maintenance of defensible space is very important in the WUI. The area within 100 feet of the home is considered the “home ignition zone” (HIZ), the most important area to manage (Sutherland 2004). The HIZ usually falls within the private property of the homeowner, and management is therefore the responsibility of the homeowner. However, there are numerous resources, including firewise.org, that could assist homeowners in creating a perimeter around infrastructure that allows firefighters a work area from which to better protect infrastructure and minimize wildfire spread (BOF 2006).

There are guidelines available for construction and landscaping, such as the Firewise Construction Checklist (NFPA 2009). The first item on the Construction Checklist is to choose a fire safe location for new construction. The Checklist goes on to suggest non-combustible materials for new construction, such as slate, clay tile or metal roofing, in place of traditional materials. Retrofits on existing homes are also possible, such as installing wire screens with mesh 1/8th inch or less on vents in order to exclude sparks (NFPA 2009). Choosing appropriate plantings and regularly maintaining vegetation in the HIZ can also greatly reduce fire hazard (Sutherland 2004). Unfortunately, an actual fire may be needed to make residents fully recognize the danger. For example, one study found that willingness to pay for fire resistant roofing was highest in the two years following a fire (Huggett Jr. 2003). Educational programs might be able to take greater advantage of such time-sensitive windows.

The Fire Regime in Southern California

Southern California has a Mediterranean climate characterized by variable winter and spring precipitation and a dry summer and fall. Most experts agree that the fire season in southern California tends to occur in the fall, coinciding with Santa Ana wind events and low fuel moisture levels (Dennison et al. 2008, Radtke et al. 1982, Conrad and Weise 1998). Fire intensity and fire severity vary with fuel loads, live fuel moisture levels, weather and topography, but most fires remain small, local problems. Only a small percentage of fires that coincide with large wind events, such as the Santa Anas, become large, uncontrollable regional threats (Keeley and Fotheringham 2001).

The Santa Monica Mountains, about 90,000 hectares in size and dominated by dense chaparral and coastal sage scrub ecosystems, is prone to intense, stand-replacing crown fires (Conrad and Weise 1998, Keeley and Zedler 2009, Witter et al. 2007). Historical fire regimes in chaparral ecosystems such as the Santa Monica Mountains are not well documented because these fires generally burn or destroy all biomass above the ground. (Conrad and Weise 1998, Keeley and Fotheringham 2001). Nevertheless, there is enough information about the factors that influenced fire history in the Santa Monica Mountains (i.e. land use, vegetation, topography and climate) to
make inferences about the past fire regime and how it may have changed over time (Conrad and Weise 1998, Radtke et al. 1982). The modern fire regime has fire-rotation intervals which work on an average of every 30 to 40 years (Keeley and Fotheringham 2001).

Some experts argue that the pre-suppression historic fire regime differs substantially from the modern fire regime. For instance, Radtke et al. (1982) claim that the Santa Monica Mountains used to experience frequent, small fires, but the fire suppression policies increased fuel loads, which led to larger fires. Similarly, Minnich (1983) hypothesized that fire suppression policies altered the historic regime of frequent, small fires that fragmented the landscape into a patchwork of young and old fuels (i.e. fine grain age patch mosaic model), which used to prevent the occurrence of large-scale fires (Keeley and Fotheringham 2001, Keeley and Zedler 2009). Other ecologists contend that the fire regime has remained largely unchanged and that large landscape-scale fires were, and are, driven by Santa Ana winds (Keeley and Fotheringham 2001, Keeley and Zedler 2009, Conrad and Weise 1998). They conclude that the differences are not fuel-based, but rather the increasing fire frequency may be due to human ignitions as populations in the WUI have grown (Keeley and Zedler 2009, Witter et al. 2007).

There are many natural resource impacts associated with wildfires. As fire frequency increases, the persistence of native ecosystems, e.g. chaparral, is put at risk. For example, fires in the same area over short time intervals can result in significant decreases in biodiversity and increases in non-native species composition (Keeley 2005). Post-fire intrusion of invasive species, which provides more fine surface fuels, further contributes to increased fire frequency (Witter et al. 2007). Positive feedback as a result of increased fire frequency can further alter the native plant community and can lead to type conversion of native shrubland to exotic grassland (Syphard et al. 2006). Repeated burns can also contribute to global warming by changing wildlands from carbon sinks into carbon sources (Wells 2007). Old growth chaparral scrub ecosystems are particularly susceptible to this effect (Luo et al. 2007).

SAMO is not only concerned with decreasing fire spread from public lands onto private property, but also with the effects that increasing urbanization has on natural resources. The growing human population has increased anthropogenic ignitions in the fire-prone scrubland community at an almost exponential rate (Syphard et al. 2006). Natural resource managers face the daunting task of first protecting life and property, and secondarily protecting natural resources.

**High Winds Increase Fire Danger and Damage in the Santa Monica Mountains**

The spatial pattern of fire under strong wind conditions (i.e. Santa Ana winds) is often the missing factor in fire management practices. Wind primarily controls the direction and spread of fire, but it can also affect fire behavior by decreasing fuel moisture levels (Radtke et al. 1982). Additionally, the rate of fire spread significantly increases in the presence of wind (Beer 1991). Fires in southern California often become large and catastrophic as a result of severe wind events known as Santa Ana winds, in conjunction with low live fuel moisture levels (Keeley and Fotheringham 2001). Some of the largest fires in southern California have occurred during strong Santa Ana wind events (Keeley and Zedler 2009, Radtke et al. 1982, Westerling et al. 2004).

Santa Ana winds result when a cool, dry air mass flows from the interior western United States towards the Pacific Coast. The sinking air compresses and warms, producing a strong, dry, warm, foehn-like wind that can decrease fuel moisture levels and increase the chance of fires (Westerling et al. 2004). Santa Ana wind events are seasonal, with the peak frequency occurring in December (Raphael 2003). From late September through December and sometimes even into February, Santa Ana winds are the primary drivers of the fire regime and of fire danger in southern California (Witter et al. 2007, Dennison et al. 2008).
Both the unique topography and vegetation of the Santa Monica Mountains are conducive to fire spread during high wind events (Keeley and Zedler 2009), particularly during Santa Ana winds that flow from the north to northeasterly directions (Radtk et al. 1982). As a part of the Transverse Ranges (i.e. east-west running ranges) of southern California (Witter et al. 2007), major canyons in the Santa Monica Mountains run north and south (Radtk et al. 1982). This geographic configuration is particularly important in the eastern part of the Santa Monica Mountains, where the canyons run parallel with the Santa Ana winds (i.e. south to southwesterly). As a result, winds tend to channel up and down the canyons, creating the conditions for rapid fire spread (Radtk et al. 1982). The vegetation of the Santa Monica Mountains is dominated by chaparral (50%) and coastal sage scrub (20%), both of which make good fuel because of the high-density and continuity of vegetation, small twig and stem size and a high proportion of dead biomass (Witter et al. 2007). Both chaparral and coastal sage scrub ecosystems burn readily; thus the area with this type of vegetation is extremely fire-prone.

Fuels are the third element of the fire hazard triangle with the other two elements being weather and topography. Specifically, live fuel moisture levels and fuel loads affect fire behavior, and the level of hazard is dependent on temperature and precipitation. Generally, the larger the fuel load, the hotter the fire due to the radiant heat that is released from a burning object (Randall 2003). Living and dead vegetation will both burn in warm, dry conditions, but how quickly they ignite, in addition to how long and how hot they burn, depends on plant size as well as horizontal and vertical structure (Randall 2003). Live fuel moisture (LFM) is the water content of live vegetation as a percentage of the dry biomass (Dennison et al. 2008). Many fire managers use LFM as a measure of fire hazard because the moisture of both live and dead fuels must be exhausted before actual combustion occurs (Dennison et al. 2008). Given the climatic patterns in southern California, LFM normally begins to decline following the spring rains, becoming increasingly lower through the dry summer and fall. The LFM may eventually reach a critical level that increases the risk of large wildfires. Most importantly, the timing of the lowest LFM occurs during the same period the Santa Ana winds move through the Santa Monica Mountains.

**Climate Change**

Warming of the global climate system is apparent in the measured worldwide increases in average air and ocean temperatures, widespread snowpack and glacial mantling and rising average sea level (IPCC 2007). The precise effects of global climate change are uncertain, as current concentrations of atmospheric greenhouse gases (GHGs) are unprecedented. Beyond 20 years into the future, the projections are completely dependent on hypothetical GHG emission scenarios (IPCC 2007), which depend on assumptions about regulatory decisions and technological advancements. To address this uncertainty, the IPCC Special Report on Emissions Scenarios grouped possible future climate scenarios into four families based on varying levels of population and economic and technological growth (IPCC 2007). Models based on these different scenarios vary in their predictions of increases in temperature, precipitation and sea level, with effects that vary at both regional and local scales (IPCC 2007). In California, some models predict increased precipitation and other models predict more intense drought (Lenihan et al. 2003).

Future fire regime predictions are dependent on these uncertainties in climate change forecasts (Morrizt and Stephens 2008, Krawchuk et al. 2009). There is consensus within the scientific community that climate change will generally increase fire risk due to its effects on fuel loads and weather (Moritz and Stephens 2008). Live fuel moisture (LFM), an important determinant of fire danger in the Mediterranean climate, is affected by environmental variables such as late spring rain delay and dry winters (Dennison et al. 2003). Fuel moisture levels of 80% or less are associated with conditions conducive to large Santa Ana wind-driven wildfires in southern California.
(Dennison et al. 2008). In addition, prolonged periods of low LFM can lead to dieback in the normally drought-resistant chaparral shrub species. According to the Los Angeles County Fire Department’s LFM database, there is an increasing trend in regional drought dieback. The increased fuel loads due to drought dieback create firestorm conditions throughout southern California (Franklin 1995).

The steep terrain of the Santa Monica Mountains, combined with the trends in dieback and climate, can result in intense fires. Based on predictions that increasing temperatures due to climate change will dry out vegetation and cause further dieback, the data can be extrapolated to predict future LFM ratios in wildlands. Other predictions include shifts in vegetation type and productivity due to climate change (Lenihan et al. 2003). An anticipated increase in fire danger due to climate change will require managers to consider landscape alterations and modify current policy, zoning and mitigation plans to address future needs.

**Wind Modeling as a Tool**

The ability to model fire intensity and fire spread gives agencies the tools to create fire hazard maps and to identify indefensible locations, such as areas where firefighters could not safely defend property. This information is of the utmost importance in planning for fire preparedness, including choosing locations where specific fuel management techniques may be applied. Previous studies (i.e. FireModels.org) have used fire hazard models embedded within a geographic information system (GIS) to map regional and neighborhood risk, and to assist decision makers to better mitigate future firestorms. GIS provides a systematic framework to estimate potential fire hazard over several jurisdictions, and can bring attention to areas where agencies and private landowners may have overlapping concerns and responsibilities for fire management that should be managed under collaborative policies (Radtke 1995). Predictive models which measure rates of change in fuels can also track the success of mitigation efforts that have been implemented to reduce fire hazard (Radtke 1995).

As described previously, fuels, topography and weather are major drivers of fire in southern California. Many experts have modeled and studied fuels and the effect of fuel moisture on fire spread (Dennison et al. 2008, Conrad and Weise 1998). Although it is well known that wind significantly contributes to fire spread (Beer 1991, Radtke et al. 1982), little has been done to identify areas of high fire hazard during high winds. Since winds, particularly Santa Ana wind events, can become the primary drivers of the fire regime, the areas with the highest intensity winds are of particular interest. Fine-scale wind analysis to identify these high intensity wind areas has been missing from SAMO’s past fire analysis and management planning. Knowing the areas in which the winds blow the strongest, synthesized with other fire factors, could help to define spatial areas of highest fire hazard and to delineate defensible and indefensible locations within SAMO. In addition to being difficult and expensive to model (Butler et al. 2006), winds are highly variable. Wind modeling can assist fire managers in estimating local wind patterns and the potential for wind-based increases in fire spread rate and intensity (Butler et al. 2006). Recurrent wind patterns, such as those that arise during Santa Ana wind events, can be modeled to help identify local areas within SAMO that have high potential for Santa Ana wind-based increases in fire spread and intensity.

To date, SAMO has been unsuccessful in securing funding for a project modeling and mapping the variability of Santa Ana winds at a fine scale (NPS 2008) due to the high cost of fine-scale wind modeling. In recent years, WindWizard, a low-cost alternative for modeling surface wind, was developed by the Fire Behavior Project at the Fire Sciences Laboratory in Missoula, Montana. The WindWizard program has already proven helpful to National Weather Service analysts in local fire interpretation (Thompson, R.A., personal communication, 2008).

There are several benefits associated with using WindWizard. WindWizard is a fluid
dynamics model used to simulate the effect terrain has on wind (Stratton 2006). The WindWizard program uses a gridded wind method that provides information about the effect of topography on local wind regimes at the 100-300 foot scale, yielding more detail than offered by the Weather Service (Firemodels.org 2009). Additionally, WindWizard simulations can predict surface wind direction and magnitude given general area prevailing wind information. WindWizard output can also increase the accuracy of fires spread models in programs such as FARSITE.

Fire Area Simulator (FARSITE) is the program most widely used by the U.S. National Park Service, the U.S. Forest Service and other federal and state land management agencies for predicting fire spread and behavior (Firemodels.org 2009). The program links multiple empirical and deterministic models to predict two-dimensional spatial and temporal spread and behavior of wildfires under heterogeneous conditions of fuel, weather and topology (Stratton 2006). FARSITE is used to determine where a fire will go, how large a fire can become and the rate at which the fire will move through an area.
METHODS

In an effort to propose feasible recommendations for SAMO that would reduce fire damage in the WUI and thereby contribute to a healthy chaparral landscape, the project will be restricted to the “core” of SAMO. The “core” is defined as the area south of Highway 101, from Pt. Mugu to Topanga Canyon State Park. The project will assess the fire hazard in the “core” through a five-step process:

1. Model Santa Ana wind events with WindWizard,
2. Model fire hazards in FARSITE incorporating WindWizard output,
3. Create Fire Weather Hazard Map of defensible and indefensible locations from FARSITE results,
4. Review climate change literature and extrapolate fuel load and fuel moisture data to produce a map of future fire hazards under climate change scenarios,
5. Conduct an analysis of current fire prevention and management practices and provide additional recommendations.

WindWizard

WindWizard, developed by the Fire Behavior Project at the Fire Sciences Laboratory in Missoula, Montana, offers a gridded wind method that can provide information about the effect of topography on local surface wind regimes at the 100-300 foot scale (Firemodels.org). The scale is finer than that available from the National Weather Service. WindWizard software can run on desktop or laptop computers with at least 512 MB of RAM and a Windows 2000 or newer operating system. A WindWizard simulation would help determine what surface wind conditions would be under general wind speed and direction scenarios. A local National Weather Service fire incident analyst found WindWizard helpful and accurate in predicting wind patterns during a local fire (Personal communication to Marti Witter from Richard A. Thompson, NOAA National Weather Service regarding the Goleta, California Gap fire). WindWizard simulates surface air flow by incorporating detailed information about the terrain, in the form of digital elevation model (DEM) files, and user-specified prevailing air flow and direction (Firemodels.org). The accuracy of WindWizard predictions of surface wind speeds during Santa Ana events can be determined using historical wind gauge data from past Santa Ana wind events. The gridded wind model can be used to identify areas of exceptionally high surface wind velocity during Santa Ana wind events in the Santa Monica Mountains. Additionally, WindWizard output can be used to increase the accuracy of FARSITE simulations (Firemodels.org). WindWizard will be used to model several different Santa Ana wind events using input data that is based upon historical records of Santa Ana wind conditions in the Santa Monica Mountains. The areas within SAMO that experience high intensity surface winds during Santa Ana wind events will be identified and mapped using GIS.

FARSITE

Fire Area Simulator (FARSITE) is a fire growth simulation model used by fire behavior analysts from the United States Department of Agriculture (USDA) Forest Service (USFS), United States Department of the Interior (USDOI) National Park Service, USDOI Bureau of Land Management (BLM), and USDA Bureau of Indian Affairs (BIA) (FireModels.org) that links multiple empirical and deterministic models to predict fire growth and behavior (Stratton 2006). The model incorporates spatial data on fuel, topography, wind and weather conditions as well as existing models for surface fire, crown fire, spotting, post-frontal combustion and fire acceleration. FARSITE simulates the spatial and temporal spread and behavior of wildfires in two-dimensions. WindWizard
output can be incorporated into FARSITE in order to produce more refined simulations. Additionally, FARSITE outputs are compatible with GIS software for further analysis. This technological compatibility will allow us to analyze the data and create a map which can be distributed to a wider audience. In order to assess the accuracy of FARSITE incorporating WindWizard output, a historic fire driven by Santa Ana winds will be modeled and results compared with the actual spread observed during that fire event.

**Fire Weather Hazard Map**

The WindWizard output will be incorporated into FARSITE simulations to predict fire spread and behavior under Santa Ana conditions. Multiple ignition points will be simulated in the areas of high intensity surface winds. All of the results from the FARSITE simulations will then be incorporated into a fire hazard map. The fire hazard of a given location within the study area will be classified based upon how frequently that location burned in the simulations and how quickly the fire reached the location from various ignition points. These two measures will be weighted, based on communications with fire managers, and combined to quantify the potential fire hazard under Santa Ana conditions for each cell in a GIS. The GIS will then be used to produce an easily readable fire weather hazard map for SAMO.

**Incorporation of Predicted Climate Change Impacts on Fuels into FARSITE**

The project will review available literature on regional climate change models and scenarios to determine how climate change is likely to impact fire regime in the Santa Monica Mountains. Climate change impacts will be modeled by estimating a range of potential changes in fuel moisture and incorporating these changes into the FARSITE model. Additionally, dieback data provided by the Los Angeles County Fire Department on Malibu chamise (Adenostoma fasciculatum) will be incorporated as a modeling parameter in FARSITE by extrapolating current trends into the future. In order to address the high level of uncertainty associated with regional climate change models, several climate change scenarios will be evaluated based on varying temperatures and precipitation patterns. For instance, how the potential effects of climate change may alter the current fire regime will be evaluated.

**Education**

As a management agency that interacts with numerous municipalities and other agencies in a large WUI, SAMO has an important role in fire hazard awareness and management in southern California. This project will produce visual tools and recommendations for SAMO’s outreach and education program, to help them collaborate with other managers as well as communicate with the public. Digital fire hazard maps for SAMO’s core area will be produced that can be readily used for presentations and in educational materials. SAMO may direct outreach effort more efficiently by targeting those communities in the highest fire hazard areas, and can use these visuals as a compelling case to convince homeowners to make their homes and properties more defensible. Viewing this information at an expansive spatial scale can also highlight the importance of cooperation between managers and planners to guide existing residents in better property management and to hopefully prevent the introduction of more structures in the highest hazard areas. These recommendations will be based upon the analysis of fire hazard based on existing data from the park, the output from WindWizard and the changes in predicted fire spread and behavior when wind is added to FARSITE. Additionally, our recommendations will incorporate a comprehensive review of current management practices and land use policies in the study area to identify opportunities for more cohesive strategies across management areas. Our recommendations will also supplement the information currently available to the public about specific measures they
can take for their own properties. The assumption is that given more information, homeowners will modify their behavior with respect to management of their private property.

**DELIVERABLES**
- Evaluation of WindWizard
- Wind intensity map(s)
- Fire weather hazard map(s)
- Present and future fire management and outreach recommendations
- Presentation poster
- Project brief
- Final technical report

**STAKEHOLDERS**
The following local stakeholders may have an interest in the outcome of our project:
- Mountains Restoration Trust
- Santa Monica Mountains Conservancy
- The Resource Conservation District of the Santa Monica Mountains
- California State Parks
- Adjacent landowners
- Recreational park users
- California Costal Commission
- Santa Monica Mountains FireSAFE Alliance
- Los Angeles County Fire Departments
- Residents of Los Angeles and Ventura Counties
- Coastal Conservancy
- Center for Fire Research and Outreach at UC Berkeley
- The California Chaparral Institute
- Mountains Recreation and Conservation Authority
- University of California Stunt Ranch Santa Monica Mountains Reserve
MANAGEMENT PLAN

1) Group Structure and Management
Please refer to the organization chart below.

Project Manager: The Project Manager shall be responsible for scheduling time and location of, and running all meetings. They shall also have the responsibility for delegating tasks, in addition to some conflict management responsibilities.

Financial Manager: This individual shall be responsible for knowing the group project financial policies and procedures and managing the Cost Center and printing funds for the group. They shall be the lead person responsible for keeping records of all expenses and ensuring that activities are within the project budget.

Data Manager: The Data Manager shall be responsible for maintaining the group’s shared information. In order to ensure consistency, only this manager shall have the authorization to modify the data. The Data Manager will also be responsible for briefing group members on the use of directory and file permissions and managing information within the group’s information architecture. They will also be authorized to install software on the group’s computer.

Web Manager: This individual will have the primary responsibility for overseeing the creation and maintenance of the group’s website. They will collaborate with the computer team when necessary.

Deadline Manager: The Deadline Manager shall be responsible for maintaining a calendar of deadlines and for checking task status during group meetings.

Record Manager: The Record Manager shall take minutes during meetings, type them, and transmit a digital copy to the group.

Contacts Manager: The Contacts Manager will be responsible for maintaining an updated list of contacts for the group.

Resource Appreciation Coordinator: This individual shall have the responsibility of keeping consistent appreciative contact with clients, advisors, and other resource persons.

2) Group Member Responsibilities and Expectations

Organization
• Attend meetings regularly, be punctual, and always bring a calendar.
• Keep corporate time and personal calendars up to date. Notify group members if there is a change.
• Meet deadlines agreed to by the parties involved.

Communication
• Developments relating to any of the management roles, or to specific tasks with deadlines, should be communicated to all group members.

Professionalism
• Act respectfully and honestly.
• Be open-minded and accepting of different ideas and opinions.
• Make all criticism constructive. In written work, criticism should be content-based. Personal attacks are not acceptable.
• As a courtesy, each member should notify the group if they will be unavailable, including the period of time, and by what modes of communication they might (and cannot) be reached.
• Members must endeavor not to take things personally.
• All members must take responsibility and ask questions if they do not understand something.

**Balancing Workload**
• Members must know and communicate their limits. They should self-evaluate and ask for help when it is needed.
• Deadlines must be agreed upon by the parties involved in the task.
• All members must remain flexible and be willing to delegate or take on tasks to balance the workload.

3) Meeting Structure
The Project Manager shall schedule meeting times and locations. The group shall hold an internal weekly meeting in addition to the weekly meeting held with the Faculty Advisor.

**Meeting with Faculty Advisor:** Each member shall report any important information or status updates related to the responsibilities of their position. The meeting shall subsequently follow a predetermined agenda. At the end of the meeting, any goals for the upcoming week shall be identified, tasks shall be delegated, and deadlines shall be decided.

**Internal Meeting:** Each meeting shall begin with five minutes for group members to check in and express one personal high and one low for the past week, if they wish to do so. The internal meetings are not to exceed one hour unless the members vote to extend the meeting by a simple majority.

4) Decision-making
Any contentious decisions shall be resolved with a simple majority vote.

5) Internal Conflict Resolution Process
• The individuals having a conflict should first attempt to settle their issues on their own.
• If the issue cannot be resolved, they should approach the Project Manager.
• If the issue is beyond the abilities of the Project Manager to resolve, the members should approach an outside neutral party, such as utilizing the counseling services on campus.
• Discussion of issues within the group should stay between the members.

6) Writing and Editing Process
• Bullet lists shall be kept at all stages of the project to document methods and results.
• Full citations shall be recorded by the individual who reads and summarizes a source document. A working citation list shall be kept in a designated file. The full citations and in-text citations shall follow the format in the reference document prepared by Adam.
• Writing shall proceed by section. A second reviewer shall perform quality checks.
• All group members shall review the final version of all assignments/deliverables.
• When there is a great deal of editing to be accomplished, Wendy, Adam, and Erin shall serve as content editors, while Kyung and Danica shall be the final editors for grammar/tone.
• If there is a great deal of writing/editing to be accomplished, members shall be assigned designated work times to ensure that only one person is modifying a document at any given time.
7) Procedures for documenting, cataloging, and archiving information

**Documents:**
- All project files should be maintained within the group’s computer drive managed by the Data Manager.
- Working documents shall be kept in a writeable directory that is viewable by all members.
- Final documents should be kept in a separate directory of read-only files that only the Data Manager can modify.
- File names shall not include spaces or hyphens and should be as follows:
  - descriptive_name_yymmdd_hhss.dbf
- Reference source files (pdfs, etc.) will be filed separately and be named as follows:
  - lastname_yr_descriptive_title.pdf

**Calendar:**
- Corporate Time shall be used to maintain schedules of all group members.

8) Guidelines for Interacting with Faculty Advisors, Clients, Customers, or Consultants

Interactions with individuals outside the group must be conducted with the utmost professionalism (see responsibilities):
- An agenda shall be prepared ahead of time for all meetings with advisors, clients, customers, or consultants.
- A minimum of 2 members of the group must attend scheduled meetings with any individuals outside the group. The attending members will have the responsibility to summarize the meeting for the other members.
- If a new potential resource person is identified, they must be presented to the group and approved before initial contact is made.

**Interactions with External Contacts:**
- A dress code will apply for any in-person interactions with individuals outside the Bren School. Members shall not be permitted to wear jeans or flip-flops in these interactions.
- In addition to an agenda, 1-2 individuals will be the designated main speakers during these interactions. The individuals will vary based on the specific contact person and the agenda items.
- Following any meeting with an external contact, a note of appreciation shall be sent to the individual(s).

9) Roles
- Project Manager: Wendy P Su (Spring 2009)*
- Data Manager: Erin Shapiro, Adam Anderson
- Web Manager: Kyung Koh, Adam Anderson
- Financial Manager: Danica Schaffer-Smith
- Deadline Manager: Wendy P Su
- Appreciation Coordinator: Danica Schaffer-Smith
- Contacts Manager: Kyung Koh
- Records Manager: Erin Shapiro, Kyung Koh
- Technical Specialist: Adam Anderson

*The Project Manager role will rotate each quarter.*
SAMO Group Structure

Project Manager
(Wendy)

Data Manager
(Erin)

Financial Manager
(Danica)

Web Manager
(Kyung)

Deadline Manager
(Wendy)

Record Manager
(Erin/Kyung)

Contact Manager
(Kyung)

Resource Appreciation Coordinator
(Danica)

Technical Specialist
(Adam)

*The Project Manager role will rotate each quarter*
**MILESTONES**

*Spring Quarter 2009*

<table>
<thead>
<tr>
<th>Task</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Literature Review</td>
<td>April 28, 2009</td>
</tr>
<tr>
<td>Methods Outline</td>
<td>May 5, 2009</td>
</tr>
<tr>
<td>In-Class Presentation</td>
<td>May 14, 2009</td>
</tr>
<tr>
<td>Proposal Draft</td>
<td>May 18, 2009</td>
</tr>
<tr>
<td>Final Proposal Review Completed</td>
<td>May 26, 2009</td>
</tr>
<tr>
<td>Final Proposal Submitted</td>
<td>May 26, 2009</td>
</tr>
<tr>
<td>Proposal Review Meeting</td>
<td>June 2, 2009</td>
</tr>
<tr>
<td>Website Operational</td>
<td>June 12, 2009</td>
</tr>
<tr>
<td>Submit Peer Evaluation</td>
<td>End of quarter</td>
</tr>
</tbody>
</table>

*Fall Quarter 2009*

<table>
<thead>
<tr>
<th>Task</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gather Data</td>
<td>End of October</td>
</tr>
<tr>
<td>Analyze Data</td>
<td>Mid-November</td>
</tr>
<tr>
<td>Progress Review</td>
<td>November 13, 2009</td>
</tr>
<tr>
<td>Written Progress Report</td>
<td>December 4, 2009</td>
</tr>
<tr>
<td>Draft of Final Report</td>
<td>December 4, 2009</td>
</tr>
<tr>
<td>Submit Peer Evaluation</td>
<td>December 4, 2009</td>
</tr>
</tbody>
</table>

*Winter Quarter 2010*

<table>
<thead>
<tr>
<th>Task</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create Project Defense Presentation</td>
<td>Three Weeks Before Presentation</td>
</tr>
<tr>
<td>Project Defense</td>
<td>TBA</td>
</tr>
<tr>
<td>Draft of Final Report to Advisors</td>
<td>February 15, 2010</td>
</tr>
<tr>
<td>Submit Presentation Program Abstract to GP Coordinator</td>
<td>March 10, 2010</td>
</tr>
<tr>
<td>Final Report Signed by Advisor &amp; Submitted</td>
<td>March 19, 2010</td>
</tr>
<tr>
<td>Project Brief Hard Copy Submitted</td>
<td>March 19, 2010</td>
</tr>
<tr>
<td>Submit Peer Evaluation</td>
<td>March 19, 2010</td>
</tr>
<tr>
<td>Submit Advisor Evaluation</td>
<td>March 19, 2010</td>
</tr>
</tbody>
</table>

*Spring Quarter 2010*

<table>
<thead>
<tr>
<th>Task</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submit PowerPoint Presentation to Faculty Advisor</td>
<td>One-Two Weeks Before GP Presentation</td>
</tr>
<tr>
<td>Poster Submitted to Printer</td>
<td>One Week Before Presentation</td>
</tr>
<tr>
<td>Group Project Presentation</td>
<td>TBA</td>
</tr>
<tr>
<td>Submit Project Poster to Bren</td>
<td>One Week After Presentation</td>
</tr>
</tbody>
</table>
CONTACT INFORMATION

UCSB Bren Faculty Advisor
  School year 2009-2010
    Bruce Kendall – Applied Ecology Associate Professor kendall@bren.ucsb.edu
  Spring 2009
    Christina Tague – Hydrology Assistant Professor etague@bren.ucsb.edu

Project Members
  Adam Anderson aanderson@bren.ucsb.edu
  Kyung Koh kkoh@bren.ucsb.edu
  Danica Schaffer-Smith dschaffer-smith@bren.ucsb.edu
  Erin Shapiro eshapiro@bren.ucsb.edu
  Wendy Su wsu@bren.ucsb.edu

Client
  Marti Witter – NPS Fire Ecologist, Mediterranean Coast Network Marti_Witter@nps.gov

UCSB Bren Faculty Reviewers
  Frank Davis – Landscape Ecology and Conservation Planning Professor fd@bren.ucsb.edu
  Christina Tague – Hydrology Assistant Professor etague@bren.ucsb.edu

External Reviewers
  Max Moritz – UC Berkeley Environmental Science, Policy & Management Adjunct Assistant Professor and Assistant Cooperative Extension Specialist mmoritz@nature.berkeley.edu
  Dar Roberts – UCSB Geography Associate Professor dar@geog.ucsb.edu
  Charles Jones – Institute for Computational Earth System Science (ICEES) Researcher cjones@icess.ucsb.edu
  Catherine Shields – UCSB Bren School Ph.D. student cshields@bren.ucsb.edu

Other Information
  Project Email samo@bren.ucsb.edu
  Website http://fiesta.bren.ucsb.edu/~samo/
**BUDGET AND JUSTIFICATION**

The Bren School of Environmental Science and Management will provide $1300 to cover necessary costs, as well as up to $200 for printing costs. Any necessary modifications to the budget will be addressed through the Financial Manager and the budget will be updated within one business day.

<table>
<thead>
<tr>
<th>Budget Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copying</td>
<td>100</td>
</tr>
<tr>
<td>Printing*</td>
<td>200</td>
</tr>
<tr>
<td>Final Presentation Expenses</td>
<td>50</td>
</tr>
<tr>
<td>Final Poster Production</td>
<td>200</td>
</tr>
<tr>
<td>Conference Attendance</td>
<td>200</td>
</tr>
<tr>
<td>Administrative Supplies</td>
<td>50</td>
</tr>
<tr>
<td>Hospitality</td>
<td>50</td>
</tr>
<tr>
<td>Travel</td>
<td>450</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1500</strong></td>
</tr>
</tbody>
</table>

*fixed cost

- **Printing**: The printing allotment of $200 will be used for printing literature resources and drafts of project documents. Approximately $400 in expenses are expected for production of the draft and professionally printed final copies of the project briefs and poster.
- **Copying**: $50 has been allocated for making duplicates of literature resources as well as financial records.
- **Administrative supplies**: Costs for office products, such as markers and folders are expected to amount to no more than $50.
- **Final presentation**: Expenses of approximately $50 are expected for the final presentation.
- **Conference Attendance**: The Pacific Coast Fire Conference in Fall 2009 may be a relevant venue for the group to exchange information with other fire researchers. Up to $200 will be allotted for attending this symposium.
- **Travel**: The group plans to attend quarterly meetings with the client at SAMO’s headquarters in Thousand Oaks, California. Mileage expenses when using a personal vehicle are estimated at approximately $90 per trip. One additional field trip to the study area is also planned within the total travel budget of $450.
- **Hospitality**: The client and other stakeholders are expected to visit the Bren School for the proposal presentation in Spring 2009 and the final presentation in Winter quarter 2010. An allotment of $50 will be available to provide parking passes (at $8 each) as well as light refreshments for visitors.
- **Miscellaneous**: An allocation of $200 is planned for any unforeseen expenses. For example, there is currently no phone budget because the primary method of contact between the client and the group is email. Should this change, or should the group expect phone conversations with other stakeholders, this will be added to the budget.
ACRONYMS AND DEFINITIONS

BIA – Bureau of Indian Affairs, a dedicated agency within the USDA for U.S. Federal Government relations with Native American Indian Tribes

BLM – Bureau of Land Management, an agency within the USDOI that administers the nation’s public lands

Defensible location – areas that firefighters will be able to defend without loss of life

Defensible space – area around structures where vegetation modification is maintained in order to slow the rate and intensity of advancing wildfires, prevent the spread of fire from structure to the surrounding environment and provide room for firefighters to work

DEM – digital elevation model; a model that represents topography or terrain; also known as a digital terrain model (DTM)

FARSITE - Fire Area Simulator, a fire spread and growth simulator model

Fire hazard – likelihood that an area will burn

GHG – greenhouse gases; gases in the earth’s atmosphere that contribute to the greenhouse effect

GIS – geographic information system; integrates and displays geographic information with spatial data

HIZ – home ignition zone; usually defined as the area within 100 feet of a structure

ICEES – Institute for Computational Earth System Science

Indefensible locations – areas that firefighters will most likely not be able to defend without loss of life

LFM – live fuel moisture

NOAA – National Oceanic Atmospheric Administration, a scientific agency within the U.S. Department of Commerce that focuses on the state of the oceans and the atmosphere

NPS – National Park Service; SAMO is a part of this agency which cares for natural, cultural and recreational sites across the U.S.; overseen by USDOI

NWS – National Weather Service, formerly known as the Weather Bureau and is a part of NOAA

RAM – random-access memory; a form of computer data storage

SAMO – Santa Monica Mountains National Recreation Area, part of the National Park Service; our client

UC – University of California, a public university system in the state of California

USDA – U.S. Department of Agriculture; the USFS falls under this federal government department

USDOI – U.S. Department of the Interior; the federal executive department of the U.S. government that is charged with management and conservation of most federal land

USFS – U.S. Forest Service, an agency under the USDA that administers that nation’s forests and grasslands

WindWizard – a gridded wind model that provides information on the effect that topography has on local wind flow at the 100 to 300 foot scale

WUI – wildland-urban interface
REFERENCES


[NPS] National Park Service. 2008. Californian Cooperative Ecosystem Studies Unit Task Agreement. Mitigation of fire hazards in the wildland-urban interface (WUI) of the southern California Mediterranean coast network of the National Park Service – Mapping patterns of extreme fire weather as guidance for fire management actions in the Santa Monica Mountains National Recreation Area. (unapproved)


U.S. Census Bureau. www.census.gov

