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**APPENDIX E**  
**SELECTED REFERENCES**

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# Wildland-Urban Fire—A different approach

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Abstract—Research results indicate that the home and its immediate surroundings within 100-200 feet (30-60 meters) principally determines the home ignition potential during severe wildland-urban fires. Research has also established that fire is an intrinsic ecological process of nearly all North American ecosystems. Together, this understanding forms the basis for a compelling argument for a different approach to addressing the wildland-urban fire problem. It argues for residential compatibility with wildland fire rather than the necessary prevention of fire encroachment on the community.

Wildland-urban fire occurs when a fire burning in wildland vegetation fuels gets close enough with its flames and/or firebrands (lofted burning embers) to potentially create ignitions of the residential fuels (Butler 1974). Residential fire destruction is the principal problem during wildland-urban fires, but homes that do not ignite do not burn. Recognizing the potential for wildland-urban home ignitions and preventing home ignitions is the principal challenge.

Understanding how homes ignite during wildland-urban fires provides the basis for appropriately assessing the potential for home ignition and thereby effectively mitigating wildland-urban fire ignitions. Fires do not spread by flowing over the landscape and high intensity fires do not engulf objects, as do avalanches and tsunamis. All fires spread by meeting the requirements for combustion—that is, a sufficiency of fuel, heat, and oxygen. In the context of severe wildland-urban fires, oxygen is not a limiting factor so this type of fire spreads according to a sufficiency of fuel and heat. Homes are the fuel and the heat comes from the flames and/or firebrands of the surrounding fires (*fig. 1*). Recent research (*fig. 2*) indicates that the potential for home ignitions during wildfires including those of high intensity principally depends on a home's fuel characteristics and the heat sources within 100-200 feet adjacent to a home (Cohen 1995; Cohen 2000; Cohen and Butler 1998). This relatively limited area that determines home ignition potential can be called the *home ignition zone* (*fig. 3*).

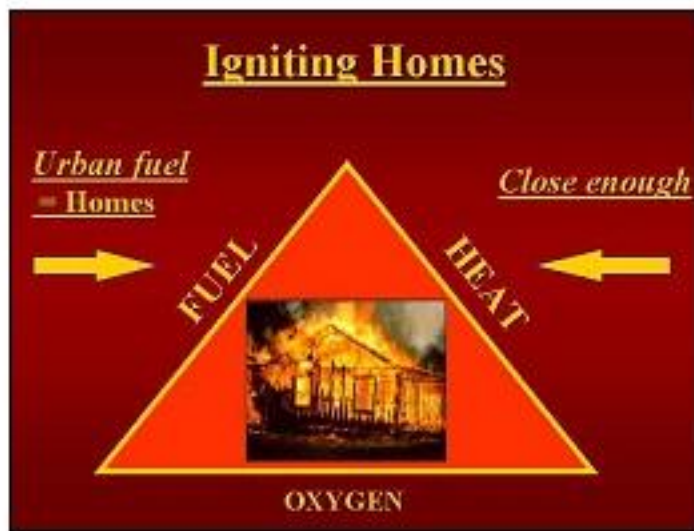


Figure 1—In the context of wildland-urban fires, the homes are the fuel. The heat comes from burning materials adjacent to the home (e.g., vegetation, wood piles, and buildings) and firebrands (lofted burning embers) on the home. How close flames are to the home and whether or not firebrands contact the home determines how much heat the home receives.



Figure 2—Home ignition research over the last several years has exposed wall sections to crown fires. (a) Wall sections were placed at 33, 66, and 98 feet from the forest edge. (b) Ignition of the 33 ft wall section occurred during 3 out of 7 crown fires. No ignitions or significant scorch occurred on wall sections at 66 ft and 98 ft during any crown fire.



*Figure 3—The **home ignition zone** includes the home and an area surrounding the home within 100 to 200 feet. The potential for ignition depends on the home's exterior materials and design and the amount of heat to the home from the flames within the home ignition zone. Firebrand ignitions also depend on the home ignition zone either by igniting the home directly or igniting adjacent materials that heat the home to ignition.*

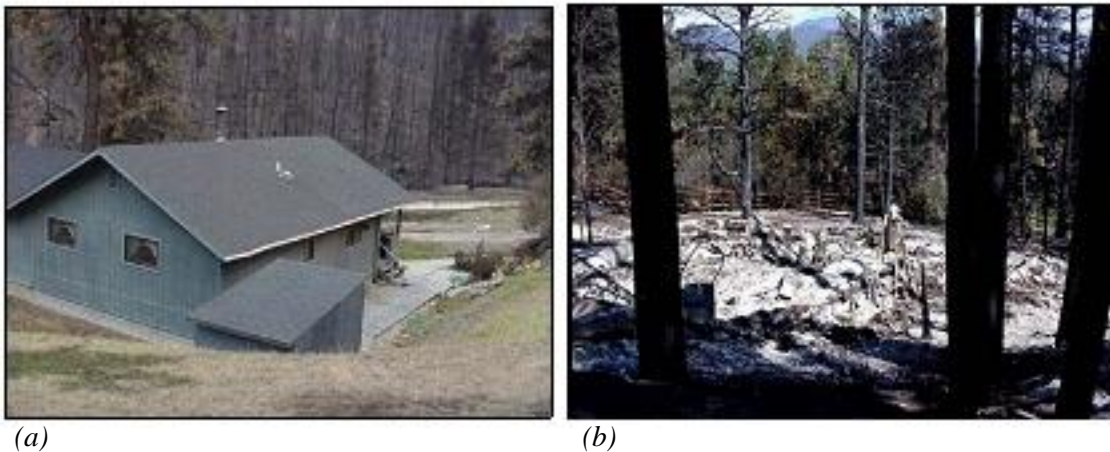
During a wildland-urban fire a home ignites from two possible sources: directly from flames (radiation and convection heating) and/or from firebrands accumulating directly on the home. Even the large flames of high intensity crown fires do not directly ignite homes at distances beyond 200 feet. Given that fires adjacent to a home do not ignite it, firebrands can only ignite a home through contact. Thus, the home ignition zone becomes the focus for activities to reduce potential wildland-urban fire destruction. This has implications for reducing home ignition potential before a wildfire as well as implications for emergency wildland-urban fire response strategy and tactics.

One might argue that preventing the occurrence of wildfires would prevent wildland-urban fire destruction. However, our current understanding indicates that wildland fire is an intrinsic ecological process in nearly all North American ecosystems (Arno and Brown 1989; Wright and Bailey 1982). Wildland fire will always occur in forest and rangeland fire environments and will thus have an impact on people, property and resources. We may have some choice of when and where we have wildland fire, but we do not have the choice of not having wildland fire occurrence. Thus, it is not reasonable to form agency and public expectations for the non-occurrence of wildland fires, including wildland fires encroaching on communities.

Recognizing the inevitability of wildland fire occurrence coupled with how homes ignite during wildland fires suggests a mitigation approach specific to wildland-urban fire. Given a wildland-urban fire, the home ignition zone principally determines the potential for home ignitions. This suggests a management approach that focuses on preventing home ignitions. That is, we reduce a community's vulnerability to wildland fire rather than attempting the elimination of wildland fire encroachment. This implies an approach of community compatibility with wildland fire.

Wildland-urban fire emergency strategy and tactics differ from either the standard wildland or the standard urban fire suppression practices. Wildland fire suppression largely attempts to keep a fire from spreading beyond its current location. That is, keeping the wildfire away from a valued area protects the values at risk. Urban fire suppression initially addresses life safety (principally building occupants) and then fire containment within a portion of the structure and/or prevents adjacent structure involvement. Neither of the wildland nor the urban suppression practices typically provide for home ignition potential reduction given an encroaching wildfire.

Wildland-urban strategy and tactics assume the wildfire may pass through the residential area without wildfire containment. The wildland-urban strategy and tactics principally focus on preparing the home for the wildfire by reducing the potential for home ignition within the home ignition zone. Because of time constraints, most preparation has to occur before a wildfire occurs. Major changes to the home ignition zone (the home and its immediate surroundings) such as replacing a flammable roof and removal of vegetation such as forest thinning cannot occur during the approach of a wildfire. Removal of firewood piles, dead leaves, conifer needles, dead grass, etc. from on and next to the home should also occur seasonally before severe fire conditions (*fig. 4*). The ignition potential of the home ignition zone largely influences the effectiveness of protection during a wildfire. Given low ignition potential and enough time, homeowners and/or wildland-urban suppression resources can make significant reductions in the little things that influence ignition potential before wildfire encroachment. Then, if possible, homeowners and/or wildland-urban firefighting resources can suppress small fires that threaten the structure during and after the wildfire approach.



*Figure 4—The home ignition zone principally determines the home ignition potential. (a) This ignition resistant home survived an intense crown to its front (background) and a crown fire of lesser intensity to its side and back. The immediate area next to the home was sprinkled but no suppression action occurred (Montana 2000). (b) This highly ignitable home did not survive a low intensity surface fire (unburned wood rail fence and non-scorched trees in the background). A continuous pine needle fuel bed extended to, through and on this home and its neighbors. No suppression action occurred at this home (Los Alamos 2000).*

Agencies need to recognize that wildland-urban fire strategy and tactics are fundamentally different from their traditional tasks. The principal efforts for reducing ignitions focus on the home ignition zone before the wildfire occurrence. Since homeowners largely own the home ignition zone, agencies must function as partners and facilitators for implementing wildland-urban mitigations. During the wildfire, wildland-urban protection activities continue to focus on the home ignition zone for the prevention of home ignitions. Even with ignition resistant homes, protection effectiveness relies on an understanding of how homes ignite during wildland fires along with recognizing operational and logistical fire suppression limitations. These differences suggest the need for wildland-urban fire specialists both before a wildfire and during a wildfire. Before the wildfire, the wildland-urban fire specialist uses home ignition expertise to identify vulnerable residential areas and facilitate community efforts to reduce home ignitability. During wildfires, the specialists work with homeowners and multi-agency wildland-urban fire protection teams to identify and implement effective actions for reducing home destruction during wildfires.

The above article is based on technical information that can be found at [www.firelab.org](http://www.firelab.org)

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## Wildland - Urban Fire: Beware the Home Ignition Zone

This paper by Jack D. Cohen, Research Physical Scientist, Missoula Fire Sciences Laboratory, Rocky Mountain Research Station, USDA Forest Service, Missoula, MT was presented during the October 2001 PERI Symposium "Reducing the Community Risk of Wildland - Urban Interface Fires."

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Wildland-urban fire occurs when a fire burning in vegetation fuels gets close enough with its flames and/or firebrands (lofted burning embers) to potentially create ignitions of residential fuels. Residential fire destruction is the principal problem during wildland-urban fires, but homes that do not ignite do not burn. Recognizing the potential for wildland-urban home ignitions and preventing home ignitions is the principal challenge.

Understanding how homes ignite during wildland-urban fires provides the basis for appropriately assessing the potential for home ignition and thereby effectively mitigating wildland-urban fire ignitions. Fires do not spread by flowing over the landscape, and high intensity fires do not engulf objects, as do avalanches and tsunamis. All fires spread by meeting the requirements for combustion—that is, a sufficiency of fuel, heat, and oxygen. In the context of severe wildland-urban fires, oxygen is not a limiting factor so this type of fire spreads according to a sufficiency of fuel and heat. Homes are the fuel and the heat comes from the flames and/or firebrands of the surrounding fires. How close flames are to the home and whether or not firebrands contact the home determines how much heat the home receives.

Home ignition research over the last several years has exposed wall sections to crown fires. Wall sections were placed at 33, 66, and 98 feet from the forest edge. Ignition of the 33 ft. wall section occurred during 3 out of 7 crown fires. No ignitions or significant scorch occurred on wall sections at 66 ft. and 98 ft. during any crown fire. Recent research indicates that the potential for home ignitions during wildfires, including those of high intensity, principally depends on a home's fuel characteristics and the heat sources within 100-200 feet adjacent to a home (reference wildland-urban fire research at [www.firelab.org](http://www.firelab.org)). This relatively limited area that determines home ignition potential can be called the **home ignition zone**.

During a wildland-urban fire a home ignites from two possible sources: directly from flames (radiation and convection heating) and/or from firebrands accumulating directly on the home. Even the large flames of high intensity crown fires do not directly ignite homes at distances beyond 200 feet. Given that fires adjacent to a home do not ignite it, firebrands can only ignite a home through contact. Thus, the home ignition zone becomes the focus for activities to reduce potential wildland-urban fire destruction. This has implications for reducing home ignition potential before a wildfire as well as implications for emergency wildland-urban fire response strategy and tactics.

One might argue that preventing the occurrence of wildfires would prevent wildland-urban fire destruction. However, our current understanding indicates that wildland fire is an intrinsic process in nearly all North American ecosystems. Wildland fire will always occur in the forest and rangeland landscapes and will always have an impact on people, property and resources.

Thus, it is not reasonable to form agency and public expectations for the non-occurrence of wildfires. This implies that communities will be impacted by wildfire; that is, we must assume that wildfires will continue to encroach on communities. This suggests an approach that minimizes the impacts, not one that necessarily

eliminates the impacts. This implies an approach of community compatibility with wildland fire and the previously mentioned research substantiates the possibility for such an approach.

Wildland-urban fire emergency strategy and tactics differ from either the standard wildland or the standard urban fire suppression practices. Wildland fire suppression largely attempts to keep a fire from spreading beyond its current location. That is, keeping the wildfire away from a valued area protects the values at risk.

Urban fire suppression initially addresses life safety (principally building occupants) and then fire containment within a portion of the structure and/or prevents adjacent structure involvement. Neither of the wildland or the urban suppression practices typically provide for home ignition potential reduction given an encroaching wildfire.

Wildland-urban strategy and tactics assume the wildfire may pass through the residential area without wildfire containment. The wildland-urban strategy and tactics principally focus on preparing the home for the wildfire by reducing the potential for home ignition within the home ignition zone. Because of time constraints, most preparation should occur before a wildfire occurs. Major changes to the home ignition zone (the home and its immediate surroundings) such as replacing a flammable roof and removal of vegetation -- such as forest thinning -- cannot occur during the approach of a wildfire. Removal of firewood piles, dead leaves, conifer needles, dead grass, etc. from on and next to the home should also occur seasonally before severe fire conditions.

The ignition potential of the home ignition zone largely influences the effectiveness of protection during a wildfire. Given low ignition potential and enough time, homeowners and/or wildland-urban suppression resources can make significant reductions in the little things that influence ignition potential before wildfire encroachment. Then, if possible, homeowners and/or wildland-urban firefighting resources can suppress small fires that threaten the structure during and after the wildfire approach.

Agencies need to recognize that wildland-urban fire strategy and tactics are fundamentally different from their traditional tasks. The principal efforts for reducing ignitions focus on the home ignition zone before the wildfire occurrence. Since homeowners largely own and control the home ignition zone, agencies must function as partners and facilitators for implementing wildland-urban mitigations. During the wildfire, wildland-urban protection activities continue to focus on the home ignition zone for the prevention of home ignitions.

Even with ignition resistant homes, protection effectiveness relies on an understanding of how homes ignite during wildland fires, along with recognizing operational and logistical fire suppression limitations. These differences suggest the need for wildland-urban fire specialists both before a wildfire and during a wildfire. Before the wildfire, the wildland-urban fire specialist uses home ignition expertise to identify vulnerable residential areas and facilitate community efforts to reduce home ignitability. During wildfires, the specialists work with homeowners and multi-agency wildland-urban fire protection teams to identify and implement effective actions for reducing home destruction during wildfires.

### **About the Author**

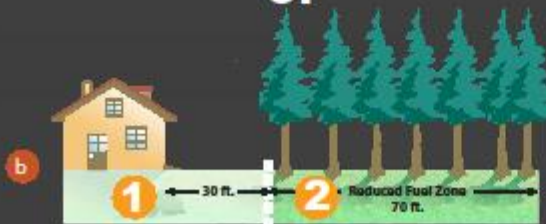
Cohen has been involved in fire management and fire research since 1972. His current research involves understanding and modeling structure ignitions during wildland fires, and he is developing the Structure Ignition Assessment Model (SIAM), a method for assessing wildland fire threat to homes. He has developed or had a hand in developing the National Fire Danger Rating System, the hand-held Fire Danger/Fire Behavior Calculator (TI-59), and the FIRECAST interactive wildland fire behavior information system. He is one of the principal scientists involved in the International Crown Fire Modeling Experiment, NWT, Canada, where he is investigating the thermal characteristics of crown fires related to structure ignitions and fire spread.



# 100' DEFENSIBLE SPACE Make Your Home FIRE SAFE



or



Contact your local CAL FIRE office, fire department,  
or Fire Safe Council for tips and assistance.

[www.fire.ca.gov](http://www.fire.ca.gov)

## Why 100 Feet?

Following these simple steps can dramatically increase the chance of your home surviving a wildfire!

A Defensible Space of 100 feet around your home is required by law.<sup>1</sup> The goal is to protect your home while providing a safe area for firefighters.

### 1 "Lean, Clean and Green Zone."

– Clearing an area of 30 feet immediately surrounding your home is critical. This area requires the greatest reduction in flammable vegetation.

### 2 "Reduced Fuel Zone."

– The fuel reduction zone in the remaining 70 feet (or to property line) will depend on the steepness of your property and the vegetation.

Spacing between plants improves the chance of stopping a wildfire before it destroys your home. You have two options in this area:

**a** Create horizontal and vertical spacing between plants. The amount of space will depend on how steep the slope is and the size of the plants.

**b** Large trees do not have to be cut and removed as long as all of the plants beneath them are removed. This eliminates a vertical "fire ladder."

When clearing vegetation, use care when operating equipment such as lawnmowers. One small spark may start a fire; a string trimmer is much safer.

Remove all build-up of needles and leaves from your roof and gutters. Keep tree limbs trimmed at least 10 feet from any chimneys and remove dead limbs that hang over your home or garage. The law also requires a screen over your chimney outlet of not more than 1/2 inch mesh.

<sup>1</sup> These regulations affect most of the grass, brush, and timber-covered private lands in the State. Some fire department jurisdictions may have additional requirements. Some activities may require permits for tree removal. Also, some activities may require special procedures for, 1) threatened and endangered species, 2) avoiding erosion, and 3) protection of water quality. Check with local officials if in doubt. Current regulations allow an insurance company to require additional clearance. The area to be treated does not extend beyond your property. The State Board of Forestry and Fire Protection has approved Guidelines to assist you in complying with the new law. Contact your local CAL FIRE office for more details.



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**List of References which could not be reproduced electronically as part of this Word document:**

**Colorado Brochure:**

<http://www.ext.colostate.edu/pubs/natres/06302.pdf>

**California Brochures:**

<http://www.firesafecouncil.org/education/attachments/Homeownerchecklist.pdf>

<http://www.firesafecouncil.org/education/attachments/landscapingtimberland.pdf>

**Living With Fire (2008 New Mexico)**

<http://www.emnrd.state.nm.us/fd/documents/NMLivingwFireOct.2008.pdf>