

ZONING PRACTICE

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PRACTICE WILDFIRE MITIGATION

An aerial photograph of a residential neighborhood, showing houses, trees, and a winding road. A large, white, stylized number '3' is overlaid on the bottom half of the image, partially obscuring the houses and trees. The entire image has a green tint.

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Models for Mitigating Wildfire Hazards Through Zoning

By Jim Schwab, AICP, and Stuart Meck, FAICP

Wildfires have a nasty habit of grabbing the entire nation's attention with televised images: forests aflame, conflagrations licking at and then overwhelming communities at the urban edge, people returning to a home that has been reduced to rubble.

If zoning even enters the discussion as people react, it is often as they ask, "Why are those people living out there anyway?"

In fact, however, growing numbers of communities are planning for wildfire hazards and taking specific steps to revise their land-use regulations to address the problem. In a newly released PAS Report, *Planning for Wildfires* (No. 529/530), we discuss not only why people choose to live in the wildland/urban interface (WUI), the term that has been applied to the area where the built environment and forests or grasslands intermingle, but how communities are revising their plans and zoning codes to mitigate the problem. This issue of *Zoning Practice* provides a preview of our findings with regard to zoning.

HOW ZONING APPLIES

Both zoning and subdivision ordinances can address wildfire hazards by implementing a number of policy options to curb the problem.

Most important are the community's criteria for designating the wildland/urban interface, a concept that is easily misunderstood. The WUI, notes Michele Steinberg, the Firewise Communities Support Manager for the National Fire Protection Association (NFPA), is not a fixed location but is defined by a set of conditions that can change over time. Purely undeveloped forest is *not* part of the WUI precisely because it lacks an interface with urban development, but a forested area can become part of the WUI if such development is introduced into the area. The implications for zoning are significant. A city can apply zoning restrictions to the WUI, but the WUI itself most closely resembles a floating zone, not a fixed geographic area. On the other hand, undeveloped areas can undergo severe wildfires, and planners can map areas according to their propensity for wildfires and zone them accordingly as more or less suitable for development in view of the dangers.

The essential issue in wildfire hazard mitigation is denying fuel to the fire. With that focus in mind, one can understand some unique features of zoning in wildfire hazard areas, including the use of vegetation management plans, fire control plans, public disclosure and information requirements, and standards for access, fuel reduction, water supply, and construction. All involve various means of trying to reduce the supply of combustible materials within probable reach of flames from a forest fire surrounding a subdivision, planned unit development, or other residential area. It is particularly important that planners understand that, unless measures are taken both in building codes and in landscaping, houses can magnify the intensity of a wildfire by increasing the ready supply of combustible materials in its path. When that happens, the homes themselves may be perpetuating a wildfire in ways that the surrounding forest cannot.

MODEL CODES

Two model codes exist that may serve to guide planners in drafting their own local requirements. NFPA's "Protection of Life and Property from Wildfire" (NFPA 1144) establishes standards used to provide minimum planning, construction, maintenance, education, and management elements for the protection of life, property, and other values that could be threatened by wildland fire. The International Code Council's *International Urban-Wildland Interface Code* contains similar provisions.

NFPA 1144 contains measurable standards for access, ingress, egress, evacuation, building design, location, and construction,



USDA Forest Service

ⓘ This subdivision has only one access route. Residents could be trapped if a wildfire closed off the entry road.

ASK THE AUTHOR JOIN US ONLINE!

From April 18 to 29, go online to participate in our “Ask the Author” forum, an interactive feature of Zoning Practice. Jim Schwab, AICP, and Stuart Meck, FAICP, will be available to answer your questions about this article. Go to the APA website at www.planning.org and follow the links to the Ask the Author section. From there, just submit your questions about the article using an e-mail link. The authors will reply, posting the answers cumulatively on the website for the benefit of all subscribers. This feature will be available for selected issues of Zoning Practice at announced times. After each online discussion is closed, the answers will be saved in an online archive available through the APA Zoning Practice web pages.

About the Authors

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as well as a series of appendices that allow the assessment of wildland fire risk for a particular home or subdivision. States adopting its provisions include Florida, California, and Washington, but states as diverse as Pennsylvania, Montana, North Carolina, Colorado, Minnesota, and New Mexico use the hazard assessment checklist as the basis for their local risk and vulnerability assessment activities. Hundreds of local governments have also adopted it by reference or with adaptations, or use the hazard assessment checklist. A searchable National Wildfire Programs Database at www.wildfireprograms.usda.gov/ offers full references.

The model describes a multiagency operational plan for the protection of lives and property during a wildfire, which goes beyond the typical land-use and building requirements in most ordinances regarding wildfire. The operational plan must contain command, training, community notification and involvement, and evacuation and mutual assistance elements. These elements ensure a coordinated response among the various agencies and organizations, including fire departments, social service agencies, the local media, and law enforcement in responding to a wildfire.

The ICC code covers administration, definitions, WUI areas and requirements, special building construction regulations, fire protection requirements, and referenced standards. Communities around the country adopt the code, often with minor modifications to reflect local conditions. The local legislative body designates the WUI area within its jurisdiction based on findings of fact concerning climate, topography, vegetative character, and other characteristics affecting the area. The code requires the area to be recorded on maps and

filed with the local government clerk. The code official must reevaluate and recommend modification to the interface area at least once every three years, or more often if necessary. Under the code, a permit is required for buildings or structures in the area, unless the activity is covered by permits issued under the building or fire code. A variety of plans accompany the permit application: a site plan showing, among other things, topography, vegetation, types of ignition-resistant building construction, and roof classifications; a vegetation management plan; and a fire protection plan, where required by the code official.

Urban-Wildland Interface Area	Fuel Modification Distance (in feet)
Moderate hazard	30
High hazard	50
Extreme hazard	100

Source: International Code Council

The code uses a sliding distance scale, linked to the severity of the fire hazard, in setting standards for defensible space around new and existing structures. A “defensible space” is an “area either natural or manmade, where material capable of allowing a fire to spread unchecked has been treated, cleared, or modified to slow the rate and intensity of an advancing wildfire and to create an area for fire suppression operations to occur” (Chapter 2, Section 202). The code official is responsible for determining the nature of the severity. Appendix G of the code contains a fire hazard rating form incorporated into the code for this purpose. By evaluating subdivision design, vegetation, topography, roofing, fire protec-

tion water sources, existing building construction materials, and utilities, the code official can establish whether the hazard is moderate, high, or extreme.

FLORIDA MODEL ORDINANCE

The state of Florida has published an annotated model wildfire mitigation ordinance as part of a manual on best practices. It focuses on risk reduction in defined wildfire hazard areas. The ordinance assigns administrative and enforcement responsibilities to a wildfire mitigation official. A wildfire mitigation review board, which appoints the official, serves as an appellate body for affected landowners who wish to appeal the official’s actions. The overlay district regulations are applicable to land-use changes, subdivisions, site plans, building permits, and all special use permits, including conditional uses and variances.

This model does not contain standards for identifying the WUI or high-risk areas within the interface. Rather, it states that the WUI delineation must be based on findings of fact and the high-risk areas be based on data obtained from the Florida Wildfire Risk Assessment, the state-published *Wildfire Hazard Assessment Manual for Florida Homeowners*, or any study “supported by competent and substantial evidence.”

While the standards for fuel reduction and defensible space maintenance are similar to other wildfire ordinances reviewed, several interesting provisions in this model deserve consideration for application elsewhere:

- **Provisions for tree protection.** For communities that might have tree protection ordinances that would otherwise require local government permission to remove a tree, the

ordinance waives those permit requirements where the tree is a highly flammable native or ornamental tree as listed in the ordinance, and therefore it is very desirable to remove it. Like other wildfire ordinances, it goes on to identify a series of recommended replacement trees that are less flammable.

- **Public disclosure and education.** The model requires selling landowners, developers, and Realtors to disclose in writing the fact an undeveloped property is within a high-risk area or an overlay district as well as the wildfire risks and potential nuisances posed by fuel management activities, including but not limited to the smoke produced by prescribed burning activities. Under these provisions, the wildfire mitiga-

dramatic incentive is a landowner awards program in which the local government recognizes landowners who have undertaken notable wildfire mitigation programs.

The Florida manual also contains a model vegetation management ordinance that requires any person owning, leasing, or controlling any land upon or adjacent to wildlands to reduce brush around structures in the WUI in order to establish an effective fuel break and to take other actions, such as keeping the roof and gutters free of flammable debris. If a violation is found, the violator has 60 days to correct the problem, or the local government may correct the violation and assess the property owner and establish a lien on the property until paid.

Florida Department of Agriculture and Consumer Services, Division of Forestry, from *Wildfire Mitigation in Florida*, page 93.



➡ This Gyratractor is removing heavy fuels in an undeveloped lot in the Palm Coast subdivision in Flagler County, Florida.

tion official is to conduct public workshops, publish informational brochures, and make public announcements via the Internet and in written form on the risks posed by wildfires and the steps to be taken to mitigate potential damage.

- **Incentives.** The ordinance requires the local government to grant a one-time ad valorem tax exemption that applies to all improvements to real property made by or for the purpose of wildfire mitigation and completed in accordance with the approved wildfire mitigation plan approved by the official. In some states, it may be necessary to have clear statutory authority for the local government to grant such exceptions. Another less

ASHLAND, OREGON

Ashland, Oregon, has established a series of development standards that apply to preliminary plats and applications to partition land that contains designated wildfire areas. Such developments trigger the preparation of a “fire prevention and control plan” as part of the application process. These are reviewed by the fire chief as part of the record of the action. Such a plan must contain:

- an analysis of the fire hazards on the site from wildfire, as influenced by existing vegetation and topography;
- a map showing the areas to be cleared of dead, dying, or severely diseased vegetation;

- a map of the areas to be thinned to reduce the interlocking canopy of trees;
- a tree management plan showing the location of all trees to be preserved and removed on each lot. In the case of heavily forested parcels, only trees scheduled for removal shall be shown;
- the areas of primary and secondary fuel breaks required to be installed around each structure [as required by the code]; and
- roads and driveways sufficient for emergency vehicle access and fire suppression activities, including the slope of all roads and driveways within the wildfire lands area.

The hearing authority has the discretion to approve the plan and to impose conditions including:

- delineation of areas of heavy vegetation to be thinned and a formal plan for such thinning;
- clearing of sufficient vegetation to reduce fuel load;
- removal of all dead and dying trees; and
- relocation of structures and roads to reduce the risks of wildfire and improve the chances of successful fire suppression.

The plan must be implemented before building permits are issued. For subdivisions, provisions for maintenance of the plan must be included in the covenants, with the city named as a beneficiary of the covenants, restrictions, and conditions. For partitions, the property owner is responsible for maintaining the plan.

All new construction and any construction expanding the size of an existing structure must have a fuel break. A primary fuel break extends a minimum of 30 feet from all structures or to the property line, whichever is less, in order to remove ground cover that will produce flame lengths in excess of one foot. The regulations require the fuel break’s depth to be increased by 10 feet for each 10 percent increase in slope over 10 percent. Where surrounding landscape is owned and under the control of the property owner, a secondary fuel break extending 100 feet beyond the primary fuel break must be provided.

HAYWARD, CALIFORNIA

Hayward’s WUI guidelines contain construction standards that apply to certain areas of the Hayward Hills that the city’s fire department has designated as “urban/wildland

interface zones.” According to the guidelines, these are areas that will typically include development sites adjoining steep slopes, open grasslands and brush lands, woodland and riparian zones, or major drainage swales. In such areas, existing vegetation may cause structures to be exposed to rapidly spreading fire that is difficult for the Hayward fire department to control.

Hayward’s guidelines differ according to structure categories. Category I structures are those located on sites where “maximum built-in fire protection measures are necessary due to nearby steep slopes or wildland fuel loading.” These structures are to exceed minimum State of California Fire Safe Guidelines.

Category II structures are those located in the balance of the WUI. These meet minimum California guidelines. Hayward’s fire department designates which sites or lots must comply with either set of standards. In some cases, developers may be required to obtain, at their expense, a qualified WUI fire management consultant to assist in this designation.

The guidelines address both construction standards and fuel management. Building construction standards, listed below, can be applied either to Category I or II structures, or both.

1. Enclose all roof eaves (I).
2. Provide double-paned windows for exterior window (I).
3. Specify a one-hour fire-resistive rating or greater for exterior building material (I).
4. Within 10 feet of a structure, construct fences with an open wire mesh or noncombustible material to prevent fire from spreading to the structure (I).
5. Design roofs that comply with a “Class A” noncombustible roof rating as outlined in [California] State Building Code Section 3202, 1991 edition (do not use wood shake or treated wood shake roofs) (I & II).
6. Provide metal enclosures with one-quarter inch metal mesh screens on all attic vents (side vents) and basement vents (I & II).
7. Provide spark arrestors with one-quarter inch mesh screens on all chimneys (I & II).

The guidelines call for the establishment of a fuel management program and recommend that, if feasible, the program be implemented by a homeowners association through covenants and restrictions applicable

CHARACTERISTICS OF FIRE-RESISTIVE VEGETATION

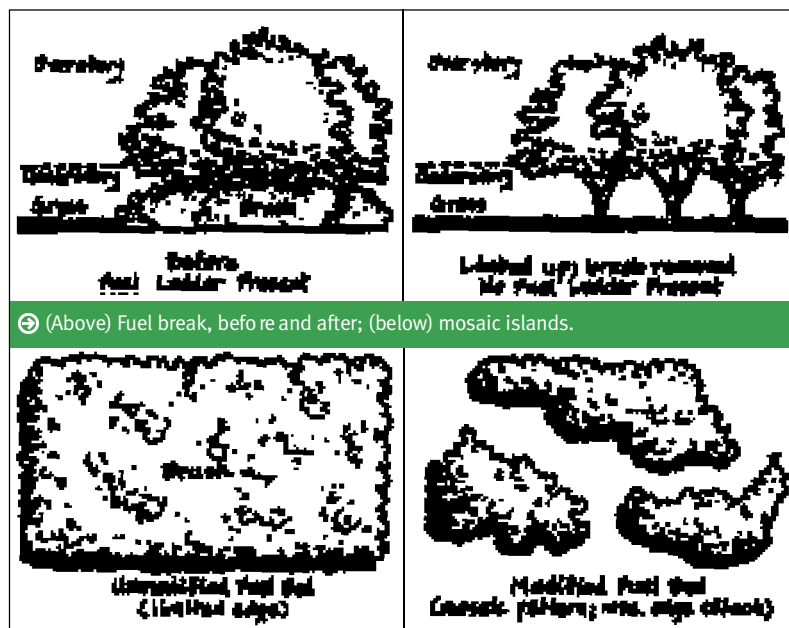
Codes affecting development in the WUI may propose the planting of fire-resistive vegetation, which burns at a relatively low intensity and has slow rates of spread with short flame lengths. Characteristics of such vegetation include:

- Growth with little or no accumulation of dead vegetation, either on the ground or standing upright
- Nonresinous plants, such as willow, poplar, or tulip trees
- Low volume of total vegetation, such as a grass area as compared to a forest or shrub-covered land
- Plants that contain a large amount of water in comparison to their dry weight
- Drought-tolerant plants—deeply rooted plants with thick, heavy leaves
- Stands of plants without ladder fuels—fine, small branches and limbs between the ground and the canopy of overtopping shrubs and trees
- Plants requiring little maintenance
- Plants with woody stems and branches that require prolonged heating to ignite

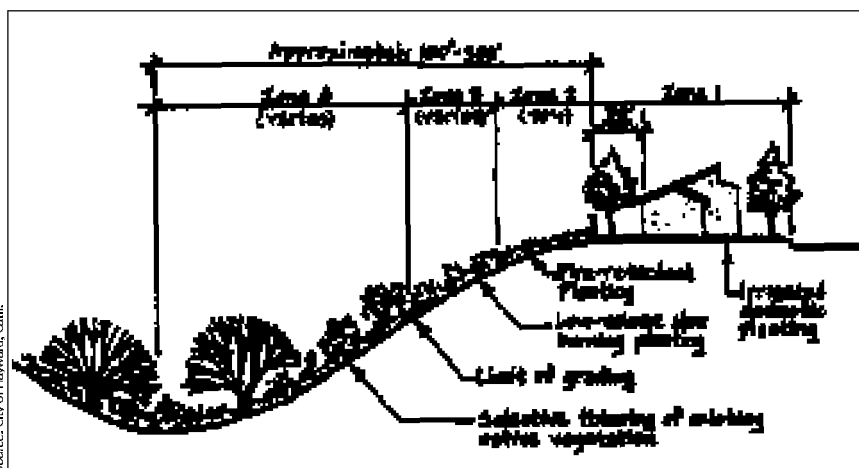
Source: International Code Council (ICC), *International Urban-Wildland Interface Code*

to the development, not individual homeowners. The program is to consist of:

1. *Homeowner education.* This includes preparation of a pamphlet on fire safety, the fire cycle, and the ecological factors related to fire.
2. *A shaded fuel break.* This interrupts the fire ladder or the transfer of fire from the ground (via shrubs and ground covers) to tree canopies. In such an area, brush and selected understorey are removed from the ground, and lower limbs of trees are pruned back.
3. *“Mosaic islands” of brush and shrubs.* In such areas, stands are selectively thinned—from 60 to 70 percent removed—to reduce fuel loading and break up the continuity of the fuel bed.
4. *Fire-resistant plants for domestic and replacement planting.* The guidelines recommend a series of species.
5. *Establishment of fuel management zones.* The guidelines propose four levels of zones to limit the exposure of a structure to radiant heat and debris from an advancing fire.



Source: City of Hayward, Calif.



➡ Fuel management zones.

Zone 1 is the minimum 30-foot firebreak immediately adjacent to the house or structure limited to fire-resistant species, trees with high canopies, and low-growing shrubs and ground covers. The guidelines call for the annual removal of dead leaves and the installation of an automatic irrigation system for domestic landscaping during hot, dry periods. Zone 2 is an additional firebreak of 70 feet or more that may be required depending on the fire department's judgment on the sufficiency of Zone 1. Zone 3 is a fuel break transition zone. Here domestic plants should be low-growing, slow-burning, and low-volume species that blend with the landscape and require no water once established. Zone 4 is natural open space where fuels have been modified through shaded fuel breaks and mosaic islands to reduce fuel loading, fuel continuity, and fire ladders. Where a roadway abuts open space in such a zone, the guidelines recommend reducing or modifying vegetation for a minimum distance of 10 feet from the roadway.

PRESCOTT, ARIZONA

Prescott has adopted the ICC model code but modified some of its language to fit the specifics of its area and to add detail to certain sections. For example, the ICC code calls for the local government to incorporate findings of fact that serve as a justification for the designation of wildland areas. One of the aspects of the findings is to designate a specific fuel model—a description of the mix of potentially flammable vegetative materials. The nature of the fuel model affects the flame

length and rate of spread, as described in the Prescott code:

The seasonal climatic conditions during the late spring and early summer create numerous serious difficulties regarding the control of and protection against fires in the City of Prescott.

Average maximum temperatures of 88.9 degrees in July

Relative humidity: 10 to 15 percent in May and June

Twenty-eight days of extreme fire weather conditions from end of April through July

Live fuel moisture in chaparral from 61.8 percent in April to 86.4 percent in August. (Anything under 80 percent will burn)

Fuel moisture in 1,000-hour fuels is 5 percent

Winds: 35 to 40 miles per hour

Numerous dry lightning strikes

Prescott has predominantly fuel model 4 (chaparral), which is found in all of the "at risk neighborhoods." This includes oak brush (scrub oak) and manzanita.

Utilizing fuel model 4 scenarios as an example, the rate of spread could be 721 feet per minute. The flame lengths could be 57 feet high. Burning brands can jump ahead of the fire for a distance of 2.1 miles and ignite additional fires. The fire could consume 5,641 acres in one hour and spread a distance of 8.1 miles. The perimeter of the fire would be 90,321 feet. This type of fire is uncontrollable by the on-duty fire forces due to lack of staffing and lengthy response times. This fire could result in a major structural conflagration. The fire could spread across the Prescott Basin at the interface.

Further, the Prescott code amplifies the requirements for the vegetation management plan. The code requires that the modification of vegetative fuel—removal of slash, snags, other ground fuels, ladder fuels, and dead trees and

the thinning of live trees—within 30 feet of the house or to the property line, whichever is less, be completed prior to any vertical construction. Beyond 30 feet and up to 150 feet of the house or property line, the vegetative fuel modifications must be completed before a certificate of occupancy can be issued.

The code details requirements for the defensible space surrounding the structure. It prescribes the following defensible space practices:

- Decreasing the amount of flammable vegetation
- Increasing the amount of open space
- Increasing the moisture content of vegetation
- Planting less flammable plants
- Rearranging existing plants
- Reducing trees to a maximum of 200 hydrated or 85 nonhydrated, healthy trees per acre with understory pruned and maintained
- Removing all combustible materials and vegetation from under decks
- Continuing maintenance of the area
- Maintaining the defensible space requirements by the homeowners association and/or owner of the property.

PINETOP-LAKESIDE, ARIZONA

The Pinetop-Lakeside code relating to forest health and fire protection contains detailed guidance on the establishment of a three-zone plan to satisfy the defensible space requirements on all parcels where there is a building or structure and for vacant parcels of less than two acres. The code describes a set of mandatory and recommended actions for property in each zone. Most notable is the reduction of tree density through on-site thinning to lower risk from fires.

- A. **Zone 1:** Zero feet to 10 feet from buildings, structures, decks, etc.
 1. Required Zone 1 Fuel Modification:
 - a. Remove fuel ladders and reduce non-fire-resistant brush, leaving primarily fire-resistant specimens.
 - b. Remove and destroy all insect-infested, diseased, and dead trees to prevent spread to healthy vegetation.

- c. Remove all dead plant material from the ground that may create fuel ladders or contribute to the spread of fire.
 - d. Where applicable, trim coniferous trees to where the lowest branches or canopy are above the roofline and a minimum of 10 feet from chimneys or other sources of ignition.
 - e. Remove flammable debris from gutters and roof surfaces.
 - f. Remove all combustible materials and vegetation from under decks. Non-fire-resistant vegetation within three feet of buildings, structures, and decks should be spaced to limit ignition from surrounding vegetation and the creation of fuel ladders.
2. Recommended Zone 1 Fuel Modification:
- a. Defensible space should be regularly maintained during periods of high fire danger.
 - b. Provide adequate hydration for all vegetation.
- B. **Zone 2:** Ten feet to 30 feet from buildings, structures, decks, etc.
1. Required Zone 2 Fuel Modification:
- a. Remove all ladder fuels and dead material.
 - b. Remove and destroy all insect infested, diseased, and dead trees to prevent spread to healthy vegetation.
2. Recommended Zone 2 Fuel Modification:
- a. Zone 2 defensible space shall be maintained at least annually.
 - b. Create separation between trees, tree crowns and other plants based on fuel type, density, slope, and other topographical conditions that may adversely affect fire behavior.
 - c. Reduce continuity of fuels by creating clear space around brush or planting groups.

“Basal area” is a measurement of tree density. The basal area is the cross-sectional area of a tree 4.5 feet above ground. The basal area of all trees in a given land area describes the degree to which an area is occupied by trees and is generally expressed in square feet per acre. The basal area calculation is: $X^2 \times .005454$, where X equals tree diameter in inches at 4.5 feet above ground, or diameter at breast height (dbh). For example, the basal area of a 12-inch dbh tree is calculated as follows: $12^2 \times .005454 = .7854$ square feet.

Source: City of Pinetop-Lakeside Code

- d. Control erosion and sedimentation from exposed soils through terracing, gravel beds, rocks, or other appropriate ground cover. Emphasis is placed on slopes greater than 20 percent gradient, in which case, additional vegetation treatment may be required.
 - e. Remove all but one inch of pine needle or leaf droppings. It is important to leave a layer of decomposing plant material to maintain adequate moisture levels for further decomposition and plant hydration.
- C. **Zone 3:** Thirty feet to 100 feet from buildings, structures, decks, etc. where slopes do not exist and undeveloped lots are less than two acres.
1. Required Zone 3 Fuel Modification:
- a. Remove all ladder fuels and dead material.
 - b. Thin coniferous trees to achieve an overall average density of not more than 100 trees or 60 square feet basal area per acre.
 - c. Remove and destroy all insect infested, diseased, and dead trees to prevent spread to healthy vegetation.
2. Recommended Zone 3 Fuel Modification:
- c. Zone 3 defensible space should be maintained at least annually.

CONCLUSION

As larger numbers of people have sought the scenic and natural amenities of living in the wildland/urban interface, planners in communities facing wildfire hazards have faced an increasing need to draft and implement regulations that can direct such development to appropriate locations and to minimize the hazards for those living there. They also face a growing need to become knowledgeable about what has worked and what does not. Although models exist for crafting such regulations, the nature and the scope of the hazard will be different in every community, so model codes must be adapted to local circumstances. However, as the new PAS Report documents, it is possible to enlist public support through education and the direct involvement of residents to achieve workable and effective solutions.

Cover photo by James Smalley. Photo shows an area in Bel Air, California, where a massive wildfire occurred in 1961 before being rebuilt.

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