Potential for Future Development on Fire-Prone Lands

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ABSTRACT

Most studies of wildland fire and residential development have focused on the cost of firefighting and solutions such as fuel reduction and fire-safe home building. Although some studies quantify the number of homes being built near forests, little research has indicated the potential magnitude of the problem in the future. This article presents data illustrating this emerging problem for western communities. Our analysis takes a long view, looking at the potential for more home construction next to public forests and implications for future wildfire fighting costs. In a study of 11 western states, we found that only 14% of the available "wildland interface" in the West is currently developed, leaving great potential for new home construction in the remaining 86%. If just one-half of the wildland interface is developed in the future, annual firefighting costs could escalate to $4.3 billion. By comparison, the Forest Service's annual budget is about $4.5 billion.

Keywords: wildfire, forest fire, wildland–urban interface, residential development

Large areas of land are being converted to housing in the western United States. The current preference for rural landscapes (Johnson and Beale 1994, Johnson 1999), the increasing popularity of large lots (Theobald et al. 1997, Hammer et al. 2004), and the powerful draw of natural amenities (Rasker and Hansen 2000, Schnaiberg et al. 2002, Radeloff et al. 2005, Gude et al. 2006) have all contributed to this trend. Widespread population gains in nonmetropolitan counties have taken place since roughly 1970 (Brown et al. 2005), and housing has become increasingly dispersed, particularly in rural areas where land is more affordable. The popularity of low-density development has lead to large areas of land being converted to housing, because each home is consuming more land (Theobald et al. 1997, Hammer et al. 2004). Adjacency to lakes, seashores, forests, national parks and other protected areas are strongly related to the locations of recently built rural homes (Bartlett et al. 2000, Rasker and Hansen 2000, Radeloff et al. 2001, Schnaiberg et al. 2002, Radeloff et al. 2005, Gude et al. 2006, Gude et al. 2007).

The wildland interface is an area rich in natural amenities, where population growth and new housing is on the rise (Radeloff et al. 2005, Theobald and Romme 2007). In 2000, 4% of western homes were located within the wildland–urban interface (WUI), generally defined as areas where structures and other human development meet or intermingle with undeveloped wildland (Office of Inspector General [OIG] 2006). According to Theobald and Romme (2007), the states with the greatest proportion of residential land conversion in the wildland interface from 1970 to 2000 were mostly in the West. In addition, in many western states more than 50% of new housing areas fall within areas classified as severe-fire zones, which are prone to catastrophic fires (Theobald and Romme 2007).

Recent increases in the area burned annually by wildfire (National Interagency Fire Center [NIFC] 2007) and the number of homes burned by these fires have put the WUI in the national spotlight. Many studies communicated in the scientific literature, government documents, and the popular press have described the cost of firefighting, the risk to firefighter lives, and the damage to private property. A recent government audit identified the WUI as the primary factor escalating federal firefighting costs in excess of $1 billion in 3 of the past 6 years (Office of Inspector General [OIG] 2006). In 87% of large wildfires reviewed in the audit, the protection of private property was described as a major reason for firefighting efforts (OIG 2006). In addition to the financial costs, homes in the wildland interface are often difficult to protect and create dangerous situations for firefighters because of remoteness, steep slopes, and narrow roads. In the

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5-year period from 2002 to 2006, $6.3 billion in federal funds were spent fighting wildfires (NIFC 2007) and 92 people were killed during wildland fire operations (National Wildfire Coordinating Group Safety and Health Working Team 2007); but despite the firefighting efforts, 10,159 homes were lost to wildfires during this period (NIFC 2007).

Most discussions of possible solutions and existing federal wildfire policies have focused on improving wildland fuels management (Stephens and Ruth 2005). Most studies agree that a combination of thinning and prescribed burning is effective in reducing wildfire effects in specific habitats characterized by short fire-return intervals (Price and Rind 1994, Pollet and Omi 2002, Fried et al. 2004, Martinson and Omi 2006). However, many recent studies also conclude that wildfire damage and costs may continue to rise despite fuels management because of extreme weather conditions, such as the droughts, high winds, and increased lightning forecasted to occur in a warming climate (Price and Rind 1994, Pollet and Omi 2002, Fried et al. 2004, Pierce et al. 2004, Westerling et al. 2006). The forecasted growth in catastrophic wildfires implies that climatic change could cause an increase in both fire suppression costs and economic losses due to wildfires (Torn et al. 1998). The West is already experiencing fires, driven by drought and strong winds, that burn open forests, conventionally viewed as relatively fire resistant, and closed forests alike (Whitlock 2004).

While both the effectiveness and the public approval of thinning and prescribed burns are being investigated (Beebe and Omi 1993, Shindler and Toman 2003, Youngblood et al. 2007), recent studies have pointed out that the likelihood of a house burning has more to do with home ignitability and landscaping than backcountry wildland fuels management (Cohen 2000). Guidelines for the amount of defensible space necessary to protect homes range from 40 to 500 m around the home, in which vegetation should be thinned sufficiently to break up any flame front and lower radiant heat (Butler and Cohen 1998, Cohen 2000, Nowicki 2002). However, because burning embers can travel great distances in high winds, protecting homes requires the use of fire-resistant building materials and regular maintenance, including clearing roofs and gutters of debris (Nowicki 2000, Firewise Communities Program 2007). Although the federal government is charged with protecting WUI homes, currently, there is no legislation in place that allows the federal government to regulate the construction or landscaping of WUI homes in ways that reduce wildfire risks (OIG 2006). In addition, reliance on the federal government to suppress wildfires may actually remove incentives for homeowners to construct and landscape WUI homes in ways that reduce wildfire risks (OIG 2006).

Clearly, the guarantee of wildfire occurrence in the WUI is a locally relevant problem, in which planning decisions must play a role. Furthermore, given the costs of firefighting by federal land-management agencies, there are also nationwide policy implications. This study aims to provide objective and relevant data that can help inform the decisions of planners, communities, landowners, and elected officials across the West and the nation. The objectives include

1. Describing the current status of residential development in the wildland interface.
2. Identifying counties with high existing risk and those with high potential future risk.
3. Discussing alternative planning policies, tailored for the type of risk a community is faced with.

Methods

In this article, we focus on housing that borders public forestlands in the West. Roughly, 70% of western forests are publicly owned. Because wildfire is a natural disturbance in many of these forests, this creates a potential risk to adjacent private lands. Private land owners expect federal agencies to protect private property from wildfire that spreads from the surrounding public lands, and the cost to US taxpayers of protecting privately owned properties adjacent to public lands has been estimated by Forest Service managers to be as high as $1 billion each year (OIG 2006). Additionally, the wildfire management options on public forestlands are severely constrained by nearby development, sometimes to the detriment of forest health (Kauffman 2004). Because fire risk is extremely difficult to quantify (Jaelith Hall-Rivera, pers. comm., The Wilderness Society, Sept. 20, 2007), most western forests burn at some point, and residential areas are rarely abandoned, all forested public lands were considered susceptible to wildfire.

A buffer of 500 m surrounding forested public lands, including federal, state, and locally managed forests, was mapped, and residential areas that fell within this buffer were identified. The Protected Areas Database (DellaSala et al. 2001) was used to map public lands in California, Colorado, Idaho, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming, and state data sources were used to map public land boundaries in Montana (Montana Natural Heritage Program [MNHP] 2007) and Arizona (Arizona Land Resources Information System [ALRIS] 1998). The forested public lands were identified based on the following classes from the National Land Cover Dataset (Vogelmann et al. 2001): evergreen needleleaf forest, evergreen broadleaf forest, deciduous needleleaf forest, deciduous broadleaf forest, mixed forests, and closed shrublands. Although open shrublands and grasslands are also prone to wildfire, defending homes in these habitats tends to be less dangerous and less expensive from a firefighting perspective (Marcel Potvin, US Forest Service, pers. comm., June 11, 2007). Because guidelines for the amount of defensible space necessary to protect homes range from 40 to 500 m around the home (Butler and Cohen 1998, Cohen 2000, Nowicki 2002), the threshold of 500 m was used to identify where residential development has occurred adjacent to fire-prone public lands. This is a conservative estimate of the WUI and the associated risk of fire, because it is unknown how many home owners within this zone have followed defensible space guidelines.

To identify where housing has occurred adjacent to forested wildlands in the West, maps of housing density were created at the scale of 2000 Census blocks. Forested areas where residential development (census blocks with mean lot sizes less than 40 ac) occurred within 500 m (0.31 mi) of public lands were identified. The threshold of 40-ac lot sizes was used to identify residential development because at this home density, areas are generally considered to be more populated than working agricultural lands (Gude et al. 2006), although some high-value agricultural operations, including orchards, can be profitable at this lot size (Theobald 2005).

The maps of housing density were prepared similarly to those described by Theobald (2005). Geographic information system (GIS) layers describing the Census block boundaries in 2000 were extracted from the TIGER/Line databases (US Census Bureau 2001a) for Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming. Tabular data describing the population and number of housing units in each block were extracted from Census Summary File 1 tables (US Census Bureau 2001b) and joined to the GIS layers. To calculate the mean lot size per Census block, the number of housing units was divided by the area of private land. Water, as identified in the National Hydrography Database (US Geological Survey 2001), and public lands, as identified in the Protected Areas Database (DellaSala 2001), were excluded from the area calculations. In Montana and Arizona, the Protected Areas Database was found to have substantial errors in the locations of public land boundaries, and other data sources (ALRIS 1998, MNHP 2007) were used instead.

For each western state and for the West as a whole, the area of forested wildland interface containing homes, i.e., the WUI, was compared with the area of undeveloped forested wildland interface. Per state, the number of homes in the wildland interface was calculated, as well as the percent of these homes that are second homes. The number of second homes within the WUI was calculated by adding the number of "seasonally occupied" homes, as specified in by the Census SF1 H005005 field, to the number of "other vacant" homes, as specified in the Census SF1 H005007 field. These counts do not include homes that are vacant because they are for rent or sale (US Census Bureau 2001b).

In addition to state metrics, two measures were used to identify counties with high existing and high potential risk of wildland fire to homes. Counties with extreme risk are listed in this table because many land policies with the potential to impact development in the WUI are implemented by county governments. Existing risk was measured in terms of the total area of WUI per county, and potential risk was represented by the area of undeveloped forested wildland interface, where homes construction could occur in the future. Importantly, these metrics show the total area at risk rather than the proportion of each county that is at risk. Had we expressed risk as a percent of each county's land area, a small county with a small amount area of WUI may have ranked as having relatively high existing risk.

Future annual firefighting costs were projected for a scenario where 50% (rather than the current 14%) of the wildland interface is developed. The projected costs were based on information provided in an OIG audit regarding the component of the Forest Service's suppression expenditures dedicated to WUI protection. The audit states that Forest Service managers and staff estimated between 50 and 95% of suppression costs are directly related to protecting private property and homes in the WUI (OIG 2006). Assuming the same is true for the Bureau of Land Management, the average annual firefighting costs in the WUI, from 2000 to 2005, ranged from $630 million to $1.2 billion for these two agencies alone. We chose to use the average annual costs of fire suppression over a 6-year period rather than the cost of fire suppression during a single year because fire frequency and behavior is variable from year to year and because 2000 was an above average year for fire suppression costs.

The range of 50–95% is quite wide, and we wanted our projections to take this uncertainty into account. We estimated the ratio of the average annual cost of fire suppression from 2000 to 2005 to the percent of the interface with development in 2000. Assuming that 50% of suppression costs ($630 million) are due to WUI protection when 14% of the interface is developed yields the ratio 630,371,513/14. Assuming that 90% of suppression costs ($1.2 billion) are due to WUI protection when 14% of the interface is developed yields the ratio 1,197,705,874/14. We assumed that cost was a linear function of the area of the interface with development and multiplied the two ratios by 50 to calculate a range in estimated costs of fire suppression if 50% (rather than the current 14%) of the interface was developed.

Results

By 2000, 9% of the private lands in the West were developed at residential densities (lot sizes less than 40 ac). Of the residential areas, 17% were developed at urban densities (lot sizes less than 1 ac), 30% were developed at suburban densities (lot sizes between 1 and 10 ac), and 53% were developed at exurban densities (lot sizes between 10 and 40 ac). Housing patterns in the WUI tended to be more skewed toward lower density developments than housing patterns in other western private lands (Figure 1). In the WUI, 2% of the land was developed at urban densities, 25% was developed at suburban densities, and 73% was developed at exurban densities. Consequently, per capita land consumption was much greater in the WUI. On average, each person in the West consumed 0.47 ac for housing, compared with the 3.21 ac/person consumed in the WUI. However, per capita land consumption, both in and out of the WUI, is highly variable among western states and tends to be highest in the northern Rockies (Figure 1).

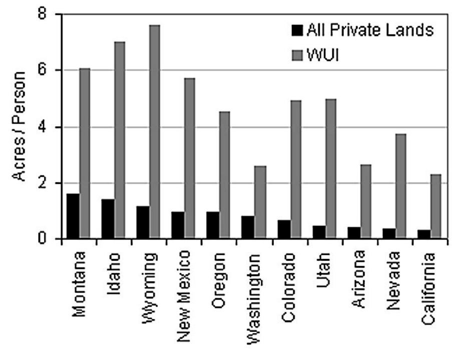

Figure 1. Per capita land consumption for residential development is extremely high in the wildland–urban interface (WUI) compared with other private lands and is highest in the northern Rocky Mountain states.

By 2000, 4% of western homes (91,541 homes) had been built on 3,290 mi^2 of private forestland adjacent to public forests. These homes occur on 14% of the forested wildland interface in the West, leaving 86% (20,350 mi^2) of the interface still undeveloped. Oregon had the largest area of total forested wildland interface (5,960 mi^2) of which 10% contains homes (Table 1, Figure 2). California has the second largest area of total forested wildland interface (5,129 mi^2), of which 17% contains homes. Oregon and California together contain nearly one-half (47%) of the West's total wildland interface and nearly one-half (45%) of the West's WUI. Over one-third of the homes built in the wildland interface occur within California. Oregon, California, Montana, Washington, Idaho, and Colorado each contain more than 1,000 mi^2 of total forested wildland interface, and New Mexico, Utah, Arizona, Wyoming, and Nevada each contain less than 700 mi^2 (Figure 2).

One in five homes in the western WUI is a seasonal home or cabin. In comparison, 1 in 25 homes is a seasonal home or cabin in other western private lands. The percent of WUI homes that are seasonally occupied ranges from 8% in Washington to 44% in Wyoming (Figure 3). The more urban, Pacific states (California, Oregon, and Washington) have fewer seasonal homes in the

Table 1. Percent of the wildland interface that is developed within each of the 11 western states.

State	Area of interface (mi^2)	Percent developed	No. of homes	Percent seasonal	Mean lot size (ac)
Arizona	482	17	54,634	34	2.6
California	5,129	17	341,175	19	2.3
Colorado	1,978	21	94,739	38	4.9
Idaho	2,148	10	30,026	31	7.0
Montana	3,025	9	31,394	24	6.1
New Mexico	245	17	24,899	34	5.7
Nevada	666	10	13,184	20	3.7
Oregon	5,960	10	110,563	15	4.5
Utah	604	5	11,734	36	5.0
Washington	2,969	21	198,119	8	2.6
Wyoming	434	4	4,604	44	7.6

The table also shows the number of homes within the interface, the percent that are seasonally occupied, and the average lot size.

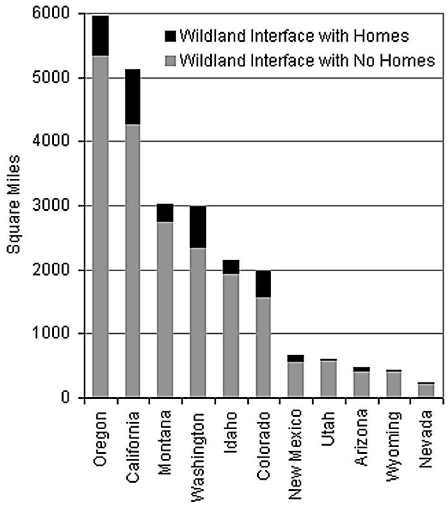

Figure 2. In every western state there is a strong likelihood that wildland–urban interface/fire problems will intensify as the interface continues to become developed.

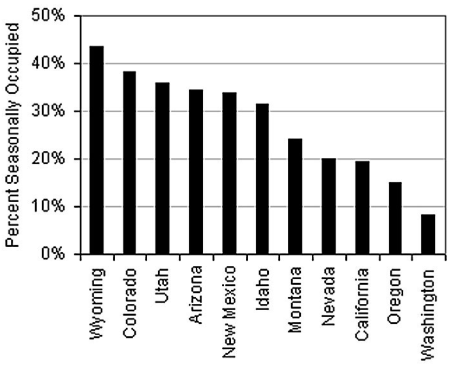

Figure 3. A large percent of homes in the wildland–urban interface are seasonal homes and cabins.

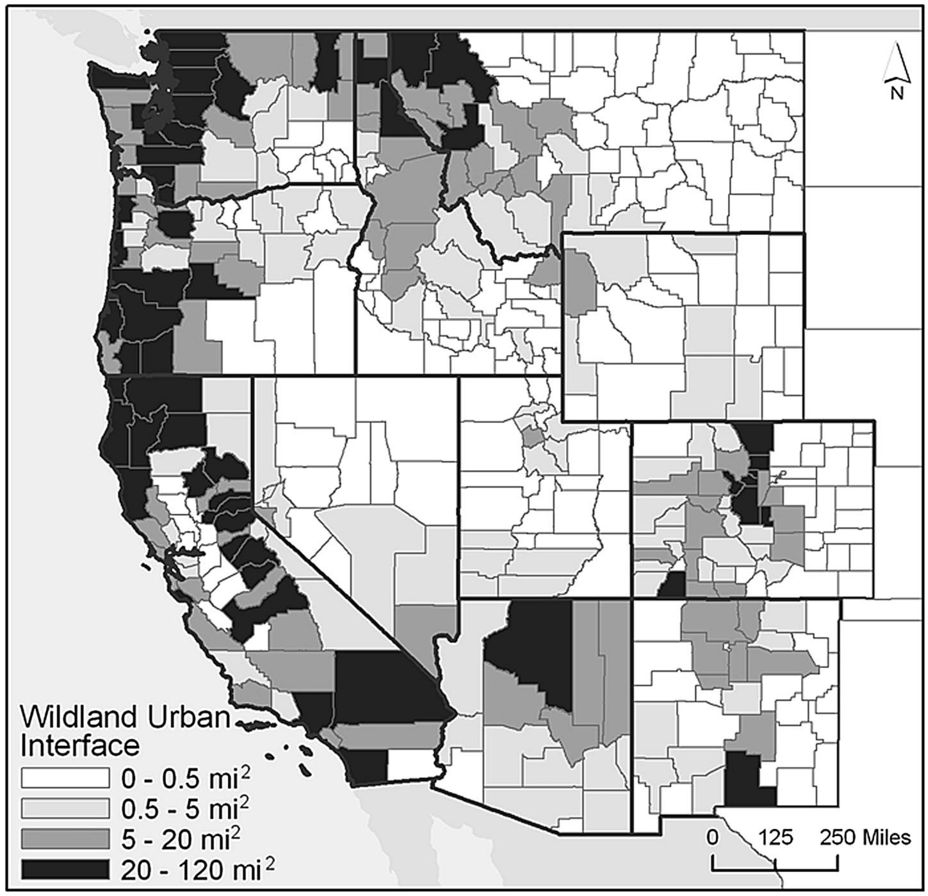

Figure 4. Counties with large areas of forested wildland–urban interface (WUI) are shaded darkly in this map. These counties have extensive areas of housing at risk from forest fire.

WUI (15%), compared with the interior mountain states (Arizona, New Mexico, Nevada, Utah, Colorado, Wyoming, Idaho, and Montana), where 33% of homes in the WUI are seasonal homes or cabins.

Each western state, with the exception of Wyoming, Utah, and Nevada, has at least one county with more than 20 mi^2 of WUI and more than five counties with more than 5 mi^2 of WUI (Figure 4). The largest areas of WUI are concentrated in northwest Montana; northern Idaho; throughout the Cascades and Sierra Nevada ranges of Washington, Oregon, and California; northern Arizona; and along the Rockies in central New Mexico and Colorado. The most severely at-risk counties among western states in terms of number of square miles of WUI are located in the northwestern states, California, and Colorado (Table 2).

Because most of the wildland interface, the forested areas where public and private lands meet, is currently undeveloped, there remains a large potential for continued expansion of the WUI (Figure 5). Montana, Idaho, Washington, Oregon, California,

Table 2. Top 10 western counties ranked by the number of square miles of developed land in the wildland–urban interface (WUI).

County	Population center	Area (mi^2) WUI	Area (mi^2) Undeveloped interface	WUI homes	Seasonal homes (%)
Josephine, OR	Grants Pass	119	186	12,451	5
Jackson, OR	Medford	83	464	7647	5
Lane, OR	Eugene	79	627	13,704	7
Bonner, ID	Sandpoint	77	231	8,020	31
Clallam, WA	Port Angeles	72	167	13,271	6
El Dorado, CA	Lake Tahoe	70	164	20,233	24
Trinity, CA	Douglas City	64	311	5,331	25
Flathead, MT	Kalispell	61	223	7,846	24
Snohomish, WA	Everett	60	75	17,740	4
Boulder, CO	Boulder	57	38	5,409	25

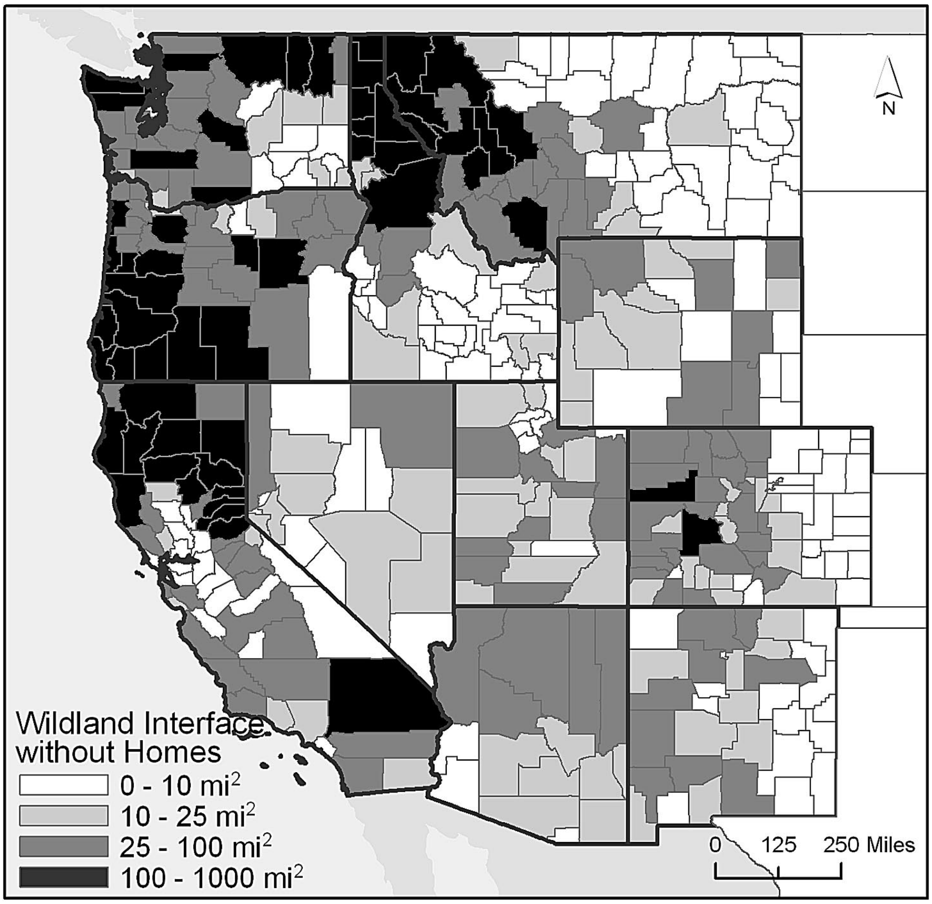

Figure 5. Counties with large areas of undeveloped forested wildland interface, in which future housing could be built, are shaded darkly in this map. These counties have high potential future risk of new homes being developed in fire prone lands.

and Colorado each have counties that contain more than 100 mi^2 of undeveloped interface, where future homes could be built. All 11 western states have multiple counties with more than 25 mi^2 of undeveloped interface. The counties that rank highest in the West in terms of potential future risk (number of square miles of wildland interface that remains undeveloped) are concentrated in southwestern Oregon, northern California, northeastern Washington, northwestern Montana, and northern Idaho (Table 3).

In our estimates of current and future costs of firefighting due to development in the wildland interface, we found that, currently, fighting fires to protect private structures in the interface costs between \$630 and \$1.2 billion/year, with only 14% of the interface developed (Table 4). Another 86% of the interface that could potentially be built on still has not been developed. Not all interface properties are likely to be developed, but if 50% of the interface is developed, the average annual cost of fighting fires to protect private structures could range from \$2.3 to 4.3 billion (Table 4).

Discussion

The dynamics of land-use change have serious implications for our quality of life, our environment, and our safety. Understanding these dynamics will improve our ability to craft policies that are in the best interest of people and sustain our natural environment. In this study, we examined residential development trends in the western wildland interface, the forested areas where public and private lands meet. We quantified the extent to which the interface has been developed and measured several characteristics of the WUI, the part of the interface containing homes. We also ranked western counties by existing and potential future risk of wildland fires to homes. Our hope is that this study will provide clarity regarding the potential future magnitude of the wildfire/housing issue and help national, state, and local decisionmakers identify policies that are appropriate for communities in need of planning in the wildland interface.

We found that development in the wildland interface occurs at substantially lower densities than development on other western private lands. Because homes adjacent to forested wildlands tend to be built on larger lots, the area of WUI will likely grow quickly. Firefighters will likely have to protect dispersed housing over an extremely large area of fire-prone forest. In many cases, ingress and egress to remote homes spread over large areas can be challenging because of lack of infrastructure. The popularity of low-density development on forested private lands adjacent to public wildlands also im-

Table 3. Top 10 western counties ranked by the number of square miles of undeveloped land in the wildland–urban interface (WUI).

County	Population center	Area (mi^2)		WUI homes	Seasonal homes (%)
		WUI	Undeveloped interface		
Douglas, OR	Roseburg	40	964	4,735	8
Lane, OR	Eugene	79	627	13,704	7
Siskiyou, CA	Yreka	35	528	3,613	16
Jackson, OR	Medford	83	464	7,647	5
Shasta, CA	Redding	32	413	6,289	10
Missoula, MT	Missoula	34	351	3,936	13
Lincoln, MT	Libby	54	348	5,109	15
Klamath, OR	Klamath Falls	15	339	2,421	23
Clearwater, ID	Orofino	9	325	1,242	12
Stevens, WA	Colville	26	315	3,272	10

Table 4. If 50% of the interface becomes developed, the average annual cost of fighting fires to protect private structures could range from \$2.3 to 4.3 billion.

Percent of interface with homes	Projected annual fire suppression costs assuming:	
	50% of costs due to WUI	95% of costs due to WUI
14 (current level)	630,371,513	1,197,705,874
50	2,251,326,831	4,277,520,978

WUI, wildland–urban interface.

plies that unless homeowners assume the responsibility for protecting their homes from wildfire, extensive areas of public forestlands will have to be managed to protect homes rather than to meet natural resource, wildlife management, or recreation needs.

We also found that the proportion of homes that are only seasonally occupied is substantially higher in the WUI (1 in 5 homes, compared with 1 in 25 homes in other western private lands). It is easy to understand why people want to live or own second homes in beautiful forested areas. However, our analyses indicate that if current building trends continue, the losers will be US taxpayers, public land–management agencies, and the communities that can potentially benefit from more sustainable growth.

Most importantly, we found that the current level of financial burden, property damage, and disruption caused by wildfires is occurring in a wildland interface that is only 14% developed, leaving high potential for new home construction in the remaining 86%. If the incidence of catastrophic wildfires increases, as is predicted to occur in a warming climate (Price and Rind 1994, Torn et al. 1998, Pollet and Omi 2002, Fried et al. 2004, Westerling et al. 2006), and the area of WUI increases, as is forecasted to occur by growth models (Theobald and Romme 2007), we will likely see skyrocketing firefighting costs for taxpayers and more difficult and dangerous fire seasons for firefighters.

With only 14% of the wildland interface developed, the average annual cost to the Forest Service and Bureau of Land Management of protecting private property from wildfire from 2000 to 2005 ranged from \$630 million to \$1.2 billion. With the current level of expenditure on fire suppression, these agencies are already facing difficulties in funding other management objectives such as trail maintenance and habitat improvement. If 50% of the wildland interface was developed, the cost could range from \$2.3 to 4.3 billion. By comparison, the Forest Service's annual budget is about \$4.5 billion. In this scenario, firefighting costs could consume close to 100% of the Forest Service's annual budget. Without improved land-use planning in the wildland interface, the future costs of fire suppression, both monetary and social, will likely become politically unacceptable.

Policy Review and Implications. To date, existing federal wildfire policies have mainly focused on improving fuels management (Stephens and Ruth 2005). Since 2000, the major wildland fire policies and initiatives have been the National Fire Policy established in 2001, designed to be a long-term, multibillion dollar effort at hazardous fuels reduction (General Accounting Office [GAO] 2003), and the Healthy Forests Initiative and Healthy Forests Restoration Act, introduced in 2002 and 2003, respectively, aimed at shortening administrative and public review by limiting appeals processes. Critics point out that national policies promote treatments that are assumed to be effective, but the appropriateness of treatments across forest types and fire regimes are not adequately considered (Kauffman 2004, Schoennagel et al. 2004, Stephens and Ruth 2005).

The majority of western states have also enacted legislation in recent years that addresses wildfire, and in particular the WUI. The extent to which these laws are regulatory, incentive driven, or a mix, varies widely. Within Arizona, New Mexico, Idaho, and Colorado, the language in the states' legislation addressing the WUI is rather adaptable: recommending building standards or encouraging counties to prepare plans that would reduce wildfire problems. In Oregon, California, Utah, and Montana, state laws clarify that counties can legally deny subdivisions that do not mitigate or avoid threats to public health and safety from wildland fire. The state laws within Oregon, California, and Utah go beyond this to set minimum standards for development in high wildfire hazard areas. For example, California state law requires that homeowners in the WUI clear and maintain vegetation-specific distances around structures; Utah sets minimum standards for ordinance requirements based on the 2003 International Urban Wildland Interface Code; and Oregon sets standards for defensible space, fuel breaks, building materials, ingress and egress, and open burning on the property.

Even in the western states with more progressive laws, it is unlikely that existing policies addressing the wildland interface will slow the growing cost of fighting wildfires. Importantly, the state laws that do address defensible space, ingress, egress, and water supply for protecting homes from wildfire can provide a safer environment for firefighters and enable more structures to be saved. These policies may also create a safe enough environment to allow some homeowners to "shelter-in-place," a strategy being promoted in Australian communities in which a homeowner remains to protect his or her property (Cova 2005). However, given enough time, evacuation is generally the best option for protecting life (Cova 2005), and sheltering-in-place may be problematic in the United States, where individuals are fond of litigation and homeowners expect protection from wildfires. Ultimately, many of the resources dedicated to fire suppression, including fire engines, bulldozers, helicopters, and personnel, will likely be the same whether or not the homes are constructed from fire-safe building materials and have adequate defensible space.

Another potential problem with existing state laws is that in cases where counties are required to identify wildfire hazard areas (Oregon, California, and Montana), the hazard areas are designated by local jurisdictions or county committees. It is likely that this will result in omission of some high-risk areas and misidentification of others, because accurate identification of fire hazard areas is data intensive and scientifically challenging. This is a key issue, because the misidentification of wildfire hazard areas could risk human life and property as well as contribute to the increasing financial burden on taxpayers. One possible solution would be for a federal agency to take on the responsibility of identifying wildfire hazard areas, as is done for Special Flood Hazard Areas for managing floodplains.

Currently, no state laws require zoning the wildland interface, which would allow counties to regulate housing densities in high-risk areas or require current and future structures to be compliant with standards that help protect them from wildfire. This is not surprising because in much of the rural West, zoning is controversial due to its perception as a regulatory taking, where the government effectively takes private property when zoning laws limit how it can be used. Despite this viewpoint, statewide "zoning" already exists in many forms, including statewide building codes and subdivisions regulations. For local ordinances, most western county commissions ultimately control whether or not policies pass. Even in cases where state laws allow for citizen initiated zoning, the county commissions vote whether or not to pass each resolution. However, national and state mandated land-use policies are not subject to commission approval, making them a key instrument in addressing wildfire problems, particularly in the rural West.

To effectively reduce the risk of wildfire, policies should be implemented at more than one level of government. The wildland interface could be treated more similarly to floodplains, where national and state policies mandate that communities adopt and enforce ordinances that meet or exceed the minimum criteria for wildfire hazard areas identified by a federal agency such as the US Forest Service. In addition, local policies aimed at reducing sprawl, such as urban growth boundaries and transfer of development rights, should have a positive impact on reducing development in the wildland interface. Incentives also play a significant role. Currently, the cost of the firefighting efforts by the Forest Service, Bureau of Land Management, and other agencies are borne mostly by the US taxpayers in general and not by those who build at-risk homes or by local governments who permit them.

Most importantly, national, state, and local policies that address wildland fuels management need to be coupled with policies that address existing and future development in fire-prone private lands. Clearly, existing homes built on the 14% of the WUI that has already been developed should be defended from forest fires. The policy challenge is whether the remaining 86% of land should be allowed to be developed without regard to the fiscal, safety, and ecological realities of forest fires. With this study, we hope to refocus the attention of policy makers and western communities on the ramifications of current growth trends and set the stage for discussion about the need for a course correction to keep homes and firefighters safe and firefighting costs in check. By incorporating wildfire risk into land-use planning, national, state, and local government can play an important leadership role in guiding new construction away from fire-prone areas.

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