Dead Fuel Moisture

Dead fuel moisture responds solely to ambient environmental conditions and is critical in determining fire potential. Dead fuel moistures are classed by timelag. A fuel's timelag is proportional to its diameter and is loosely defined as the time it takes a fuel particle to reach two-thirds of its way to equilibrium with its local environment. Dead fuels in the National Fire Danger Rating System (NFDRS) fall into four classes: 1, 10, 100, and 1000 hour.[10]

Pre-conditioning of fuel moistures was calculated for this scenario. The models calculate separate dead fuel moistures for each landscape cell based on the topography and shading from forest canopy cover and clouds, as well as the recorded weather (precipitation, high and low temperatures and high and low relative humidity values) for the previous four days. The dead fuel moistures that have been calculated by the start date and time of the analysis are what are used to determine the outputs in fire behavior models.

Live Fuel Moisture

Live fuel moisture is the amount of water in a fuel, expressed as a percent of the oven-dry weight of that fuel. Fuel moisture between 300% and 30% is considered live. Anything below 30% is considered dead fuel. Fuel moistures can exceed 100% because the living cells can expand beyond their normal size to hold more water when available.

Landscape File Layers

A landscape file (.LCP) is a series of spatial layers that are required to run FARSITE and FlamMap. The following layers were downloaded from LANDFIRE Version 1.1.0: [11]

- Elevation
- Crown Bulk Density
- Aspect
- Crown Base Height
- Slope
- Stand Height
- Fuel Model[12]
- Duff Loading
- Canopy Cover
- Coarse Woody

[10] U.S. National Fire Danger Rating System Overview: INT-GTR-367 - FIRES: Fire Information Retrieval and Evaluation System - a Program for Fire Danger Rating Analysis

[11] "LANDFIRE," 8 June 2011, <www.landfire.gov>

[12] Scott and Burgan's *Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model*, a national standard guide to fuel modeling.

Fuel Models are a critical component to the modeling. Often some changes need to be made to more accurately represent local conditions. The following changes were made to the LCP:

- Fuel model 183 was converted to fuel model 147.
- Fuel treatment polygons such as the Todd Valley treatments and the pipeline treatment, the underlying fuel models were converted to fuel model 181 and the crown base height was raised to six feet.
- The evacuation centers were set to fuel model 99.

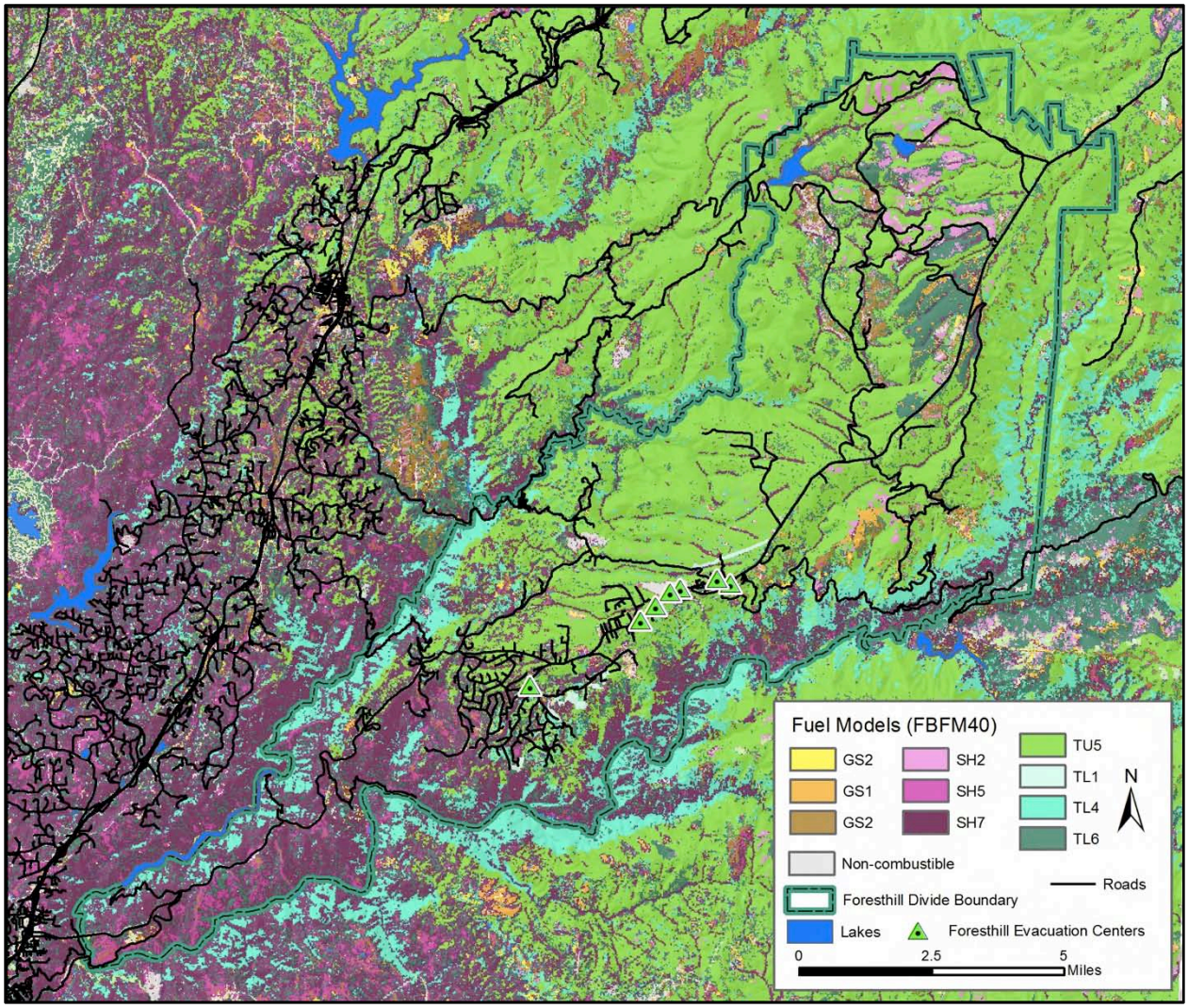
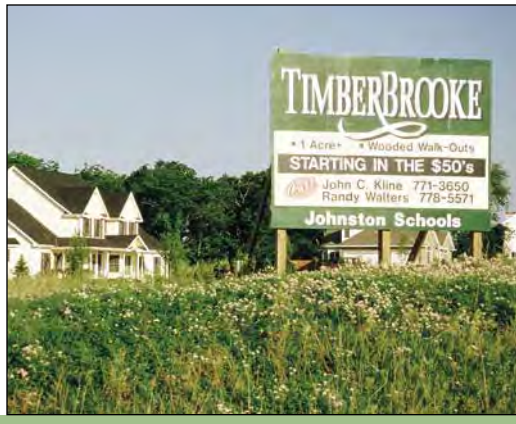


Figure 10. Fuel models present in the Plan Area.

EXHIBIT 9

FORESTS ON THE EDGE

HOUSING DEVELOPMENT ON AMERICA'S PRIVATE FORESTS



USDA Forest Service

Susan Stein

U.S. Department of Agriculture

Forest Service

Pacific Northwest Research Station

General Technical Report
PNW-GTR-636
May 2005

Susan M. Stein, Ronald E. McRoberts, Ralph J. Alig, Mark D. Nelson, David M. Theobald, Mike Eley, Mike Dechter, and Mary Carr

ABSTRACT

Stein, Susan M.; McRoberts, Ronald E.; Alig, Ralph J.; Nelson, Mark D.; Theobald, David M.; Eley, Mike; Dechter, Mike; Carr, Mary. 2005. Forests on the edge: housing development on America's private forests. Gen. Tech. Rep. PNW-GTR-636. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 16 p.

The private working land base of America's forests is being converted to developed uses, with implications for the condition and management of affected private forests and the watersheds in which they occur. The Forests on the Edge project seeks to improve understanding of the processes and thresholds associated with increases in housing density in private forests and likely effects on the contributions of those forests to timber, wildlife, and water resources. This report, the first in a series, displays and describes housing density projections on private forests, by watershed, across the conterminous United States. An interdisciplinary team used geographic information system (GIS) techniques to identify fourth-level watersheds containing private forests that are projected to experience increased housing density by 2030. Results indicate that some 44.2 million acres (over 11 percent) of private forests—particularly in the East, where most private forests occur—are likely to see dramatic increases in housing development in the next three decades, with consequent impacts on ecological, economic, and social services. Although conversion of forest land to other uses over time is inevitable, local jurisdictions and states can target efforts to prevent or reduce conversion of the most valuable forest lands to keep private working forests resilient and productive.

Keywords: Fourth-level watershed, land use change, private forest, water quality, ecological services.

AUTHORS

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Photo credits: All photos courtesy of USDA Natural Resources Conservation Service except where otherwise noted.

INTRODUCTION

America's private forests are changing. Many are located at the edges of growing towns and cities, or in prime recreation areas popular for second-home development. As more housing is built in private forests, their values and uses can be altered. Increases in housing density and associated development (such as power lines, septic and sewer systems, and shopping centers) can be linked to:

- **Decreases in native fish and wildlife and their habitats.**
- **Changes in forest health.**
- **Reduced opportunities for outdoor recreation.**
- **Poorer water quality.**
- **Altered hydrology.**
- **Greater loss of life and property to wildfire.**
- **Changes in traditional uses of forests.**
- **Decreases in the production of timber and other forest products.**

Concern about the effects of development on America's private forests has risen sharply since the 1990s, when the conversion of forest land to developed uses reached a million acres per year. Even when we consider that some agricultural lands are converted to forest each year, Forest Service researchers estimate that, by 2050, an additional 23 million acres of forest lands in net may be lost (Alig et al. 2003).

The Forests on the Edge project aims to increase public understanding of the contributions of and pressures on our private forests, and to create new tools for strategic planning. Many private forests are on the edge or interface where development pressures may affect forest attributes and management. The Forests on the Edge project seeks to improve our understanding of the processes and thresholds associated with increases in housing density in private forests and likely effects on the contributions of America's private forests to timber, wildlife, and water resources.

This report, the first in a series, displays and describes housing density projections on private forests, by watershed, across the conterminous United States (commonly called the lower 48, not including Alaska, Hawaii, and island territories, for which data were not available). Future reports will assess the contributions of private forests to timber, wildlife, and water resources; they will also provide housing density projections on a wider range of vegetation types, including the arid land vegetation found in the West.

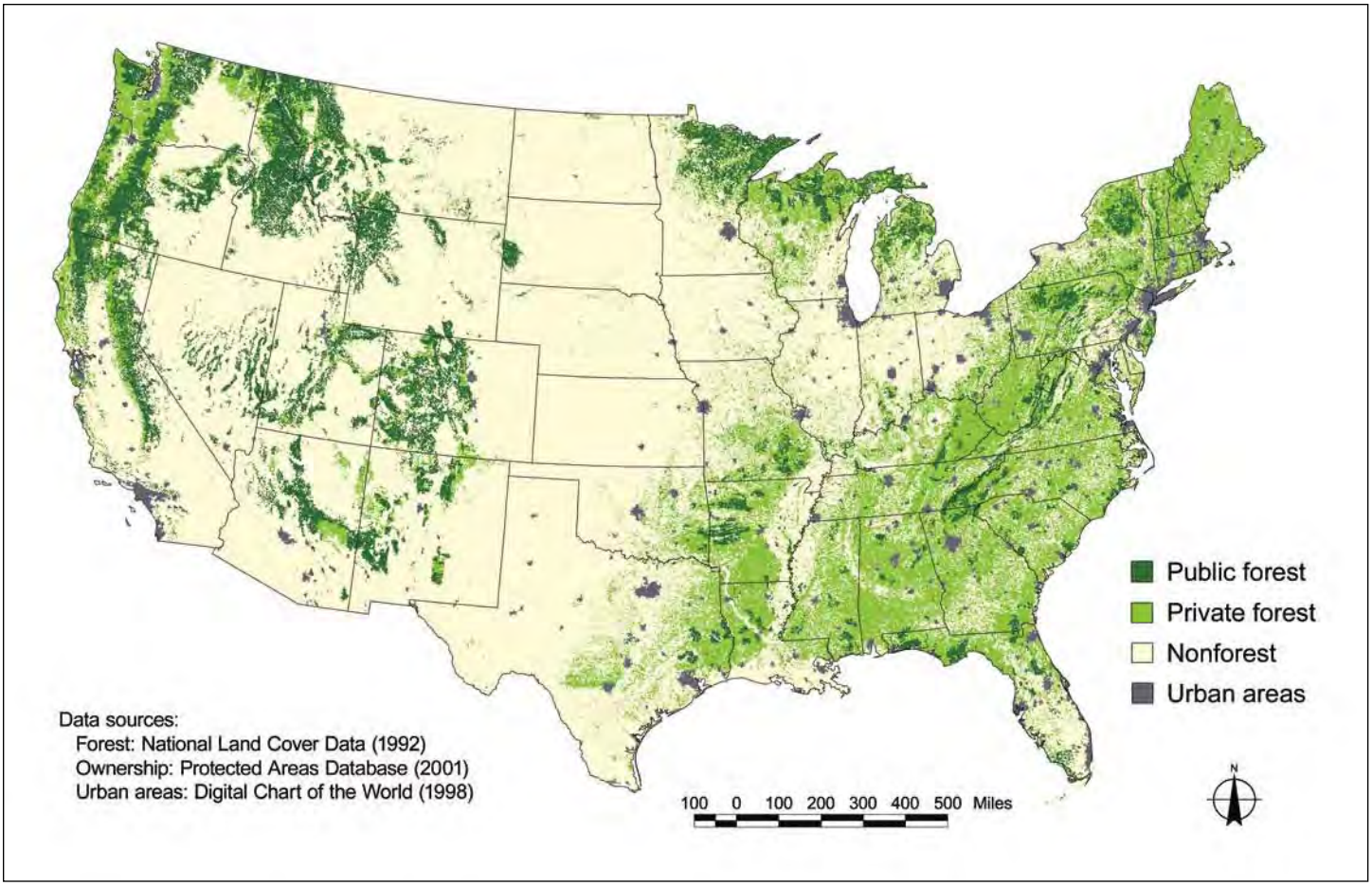


Figure 1—Location of private and public forest, nonforest, and urban areas. About three-quarters of America's private forests are in the East.

Results from this phase of the project indicate that many private forests—particularly in the East, where most private forests occur (fig. 1)—are likely to see dramatic increases in housing development in the next three decades, with consequent impacts on ecological, economic, and social services. Sustaining our forests and their benefits in the face of continuing population growth is and will be a key challenge.

What Is A "Private" Forest?

A private forest is forest land owned by individuals, families, corporations, organizations, tribes, or the forest industry.

PRIVATE FORESTS PLAY A KEY ROLE IN PROTECTING WATER QUALITY

Forests are critical to providing and protecting water. Covering nearly one-third of the Nation's land, forests supply over 50 percent of freshwater flow in the lower 48 States. Forests protect water quality by slowing runoff, stabilizing soils, preventing erosion and floods, and filtering pollutants. According to Forest Service estimates, some 180 million people depend on forests for their drinking water[1] (Stein and Butler 2004).

[1] Sedell, J. 2005. Personal communication. Station Director, Pacific Southwest Research Station, P.O. Box 245, Berkeley, CA 94701-0245.

Private forests constitute nearly 60 percent (about 430 million acres) of America's total forest land (Smith et al. 2004) and thereby provide nearly 60 percent of all waterflow originating on U.S. forests (and nearly 30 percent of all waterflow originating on land in the lower 48) in a typical year.[2]

[2]Brown, T. 2005. Personal communication. Hydrologist, Rocky Mountain Research Station, 2150 Centre Ave., Bldg. A, Suite 376, Fort Collins, CO 80526-1891.

Private forests provide many other benefits to the American public. They furnish diverse habitats for fish and wildlife, providing the key to the conservation of many species. In some regions, such as the Pacific Northwest, private forests provide a significant amount of habitat for threatened or endangered species, such as the threatened spotted owl (Holthausen et al. 1995). These habitats are important considerations for public land managers in the development and monitoring of recovery plans for such species (USDI FWS 1992). Private forests also provide

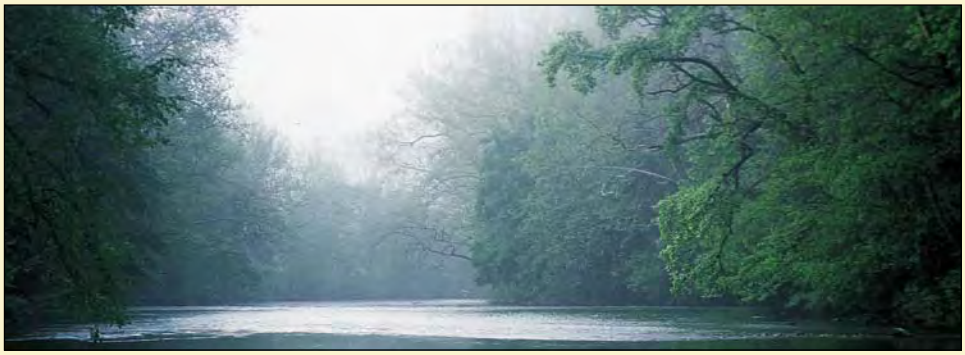
What Is A Forest?

The term "forest" has different meanings, depending on where you live or your interest in forests. For this project, we used "land that is at least 1 acre and at least 10 percent stocked by trees of any size" (Smith et al. 2004). This is the definition most commonly used by Forest Service Forest Inventory and Analysis scientists, who monitor the status of our Nation's forests each year. The source of our data for forest cover was the National Land Cover Data compiled by the U.S. Geological Survey, which divides the country into small units (or pixels) of 323 square feet and assigns each unit to 1 of 21 vegetation categories. We selected categories that contained vegetation that was closest to our definition of forest.

A. Price, Utah Division of Forestry

Forests cover 749 million acres of the Nation's landscape. Hardwoods, conifers, and mixed species paint a diverse forest palette that ranges from sparse dry forest in the arid, interior West to lush rain forests in the Pacific Northwest, and highly productive moist forests in the South.

Tom Iraci, USDA Forest Service



the foundation for timber and other forest products businesses and accounted for 92 percent of all timber harvested in the United States in 2001 (Smith et al. 2004). Private forests in the Southern United States alone produce more timber than both private and public forests in any other country (Wear and Greis 2002a).

LONG-TERM TRENDS IN FOREST CHANGES

Although the amount of private forest land is increasing in some places in the country, the total area of private forest land has been gradually declining since the mid 20th century. From 1953 to 1997, 26 states have had a net loss in forest area. In 15 years alone (1982 to 1997), 10.3 million acres of nonfederal forest land, most of which is private, were converted to developed uses and urban areas. This is the equivalent of 680,000 acres per year. The rate of conversion jumped to 1 million acres per year during the last 5 years of this period (1992 to 1997), when 5 million acres of nonfederal forest land were permanently converted (Alig et al. 2003). Although such statistics may seem inconsequential at a national scale, we are learning that, in certain localities, housing density is increasing dramatically. Forests on the Edge is helping to identify those areas where housing development is most likely to affect our private forests.

ASSESSING HOUSING DEVELOPMENT ON PRIVATE FORESTS, 2000 TO 2030

An interdisciplinary team of specialists used geographic information system (GIS) techniques to identify watersheds across the conterminous United States containing private forests that are projected to experience increased housing density by 2030.

Watershed selection criteria—

We selected only those watersheds that had 10 percent or more forest cover **and** that had 50 percent or more of their forests in private ownership. A total of 1,026 of the Nation's 2,149 fourth-level watersheds met the selection criteria. These criteria resulted in a focus on the Eastern United States, where private forest cover is more extensive than in other parts of the country and where most forest land is in private ownership. Only the conterminous 48 States were included because data for Alaska, Hawaii, and the island territories are not adequate at this time.

Housing density projections—

Housing density projections were based on many factors, including past and current statistics on housing density and population, road density, past growth patterns, and locations of urban areas. A more detailed description of this and other aspects of this study can be found in Stein et al. (in press).

Information sources—

The following data layers were used in this analysis:

- Fourth-level watershed boundaries (defined by eight-digit hydrologic unit codes) (Steeves and Nebert 1994).
- Forest cover (DellaSala et al. 2001).
- Land ownership (DellaSala et al. 2001, Vogelmann et al. 2001).
- Housing density for 2000 (U.S. Census Bureau 2001). Housing density projections for 2030.[3]

[3] Theobald, D.M. [N.d.]. Sprawling in the USA? Landscape effects of urban and exurban development. Manuscript in preparation.

Watersheds Come In Different Sizes

To highlight the important connection between private forests and water, Forests on the Edge studied projected increases in housing density in private forests across watersheds. A watershed is an area of land that drains into a river, stream, or other body of water (see diagram below). To facilitate the study of watersheds of different sizes, the U.S. Geological Survey devised a system that organizes the country into watershed units. There are 2,108 watersheds in the conterminous United States at the size used for this project (referred to as "fourth-level"), which have an average of a million acres (ranging from 21,760 to about 13 million acres).

U.S. Geological Survey

Documenting Change

A challenge for researchers is to document the net change compared to gross changes in forest area (Alig et al. 2003). Many acres converted to housing and thus **leaving** the forest land base may still have substantial tree cover and may have older trees. Many acres **entering** the forest base (by tree planting on agricultural land, for example) will not have substantial tree cover for many years, and the new forest cover may differ substantially from the forests lost in age, composition, quality, and ecological and productive value. Thus, forest conditions in a particular area can change substantially even when there is little or no net change in forest cover.

Definitions—

Private forest—For this project, included tribal, forest industry, and nonindustrial private ownerships; excluded public lands and private lands protected through conservation easements.

Rural—Private forest lands with 16 or fewer housing units per square mile. Forest lands with this housing density can generally support a diversity of economic and ecological functions commonly associated with private forests, such as management for timber, most wildlife species, and water quality.

Exurban—Private forest lands with 16 to 64 housing units per square mile. Lands with these higher housing densities can still support many wildlife species and other ecological functions, although perhaps at a reduced level. However, management for commercial timber may be less likely.

Urban—Private forest lands with 64 or more housing units per square mile. Such lands are less likely to be used for timber production or to contribute to wildlife habitat and water quality because of increased road density, infrastructure, and human population levels. Such forest patches, however, are often highly valued for their aesthetics, noise abatement properties, and positive effect on property values.

KEY FINDINGS

Some 44.2 million acres (over 11 percent) of private forest across the conterminous United States could experience substantial increases in housing density by 2030 (fig. 2). Private forests in watersheds across the Eastern United States and in parts of California and the Pacific Northwest are projected to experience the most extensive increases. The area projected to have the most overwhelming impacts is the Southeast, considered the "wood basket" of the United States and an area of high biodiversity.

This finding complements the conclusions of other recent studies such as the Southern Forest Resource Assessment (Wear and Greis 2002a), which identified development as the most pertinent force of change facing forests in the South. This region has been characterized as having the highest rate of urban development in the country (Macie and Hermansen 2003). In the 1990s, urban development in the South surpassed agriculture as the leading cause of forest loss. Causes of expansion of developed area in the South include above-average population growth, above-average consumption of land per additional resident, and income growth (Alig et al. 2004).

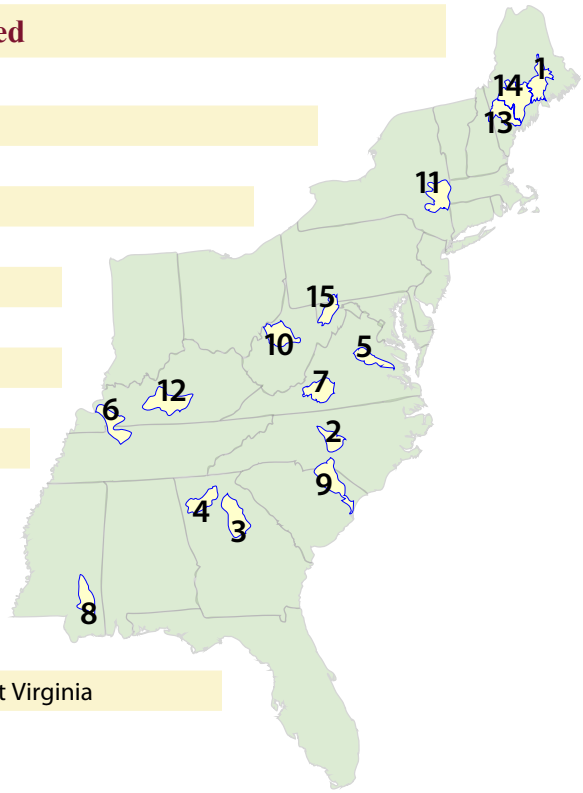
Although most watersheds meeting our selection criteria are projected to undergo significant housing density shifts on less than 5 percent of their surface area, these shifts could have significant impacts at the local level. Twenty-six watersheds were projected to experience increased housing development on more than 20 percent of the watershed's area. On a national level this may not be considerable; however, such a level of change could have tremendous impacts on many ecological values in these watersheds, including water quality.

The Top 15

More than 15 watersheds of the 1,026 that met the selection criteria are projected to experience housing density increases on more than 200,000 acres of their surface area. The following tabulation depicts the number of acres of forest expected to shift either (a) from rural to exurban or (b) from rural or exurban to urban in each of the top 15 watersheds (all these watersheds are located in the Eastern United States):

The top 15 watersheds with increased housing density projected

	Watershed	Acres[4]	State(s)
1	Lower Penobscot	310,206	Maine
2	Deep	269,817	North Carolina
3	Upper Oconee	269,003	Georgia
4	Etowah	265,961	Georgia
5	Pamunkey	262,003	Virginia
6	Lower Cumberland	259,035	Kentucky and Tennessee
7	Upper Roanoke	257,110	Virginia
8	Lower Lead	242,758	Mississippi
9	Lower Pee Dee	239,558	North and South Carolina
10	Little Kanawha	225,760	West Virginia
11	Middle Hudson	221,384	New York and Massachusetts
12	Upper Green	215,579	Kentucky
13	Lower Androscoggin	213,808	Maine and New Hampshire
14	Lower Kennebec	210,005	Maine
15	North Branch Potomac	209,187	Maryland, Pennsylvania, and West Virginia



[4] *Number of private forest acres projected to experience increase in housing density.*

Two Types of Shift Across the United States

From rural or exurban to urban—

- **A total of 21.7 million acres across the country are projected to shift from rural or exurban to urban by 2030.**
- **Two watersheds (one in Maine and one in California) are projected to experience this shift on 20 to 30 percent of their area (fig. 3).**
- **Thirty-eight watersheds may have a shift from nonurban to urban use levels on 10 to 20 percent of their area.**
- **Most affected watersheds are scattered across the Eastern United States, although some are located in the Sierra foothills of California and in northern Washington state.**

From rural to exurban—

- **A total of 22.5 million acres across the country are projected to shift from rural to exurban by 2030.**
- **Twenty-seven watersheds contain forests projected to experience this shift on more than 10 to 20 percent of their area (fig. 4).**
- **Hardest hit will be 12 states in the Northeast and the South.**

SPECIAL CONSIDERATIONS: URBAN AREAS AND THE WEST

Because this study focuses on future change, this report does not call attention to areas that are already urbanized—for example, around many northeastern cities such as Providence, Rhode Island. In such areas, the remaining acres of private forests, important at the local level, could be under intense development pressures.

Except for certain watersheds in California and the Pacific Northwest, most Western watersheds under high development pressures are not identified in our maps because relative to the country as a whole, little private forest occurs in most of the West.

Jeff Kline, USDA Forest Service

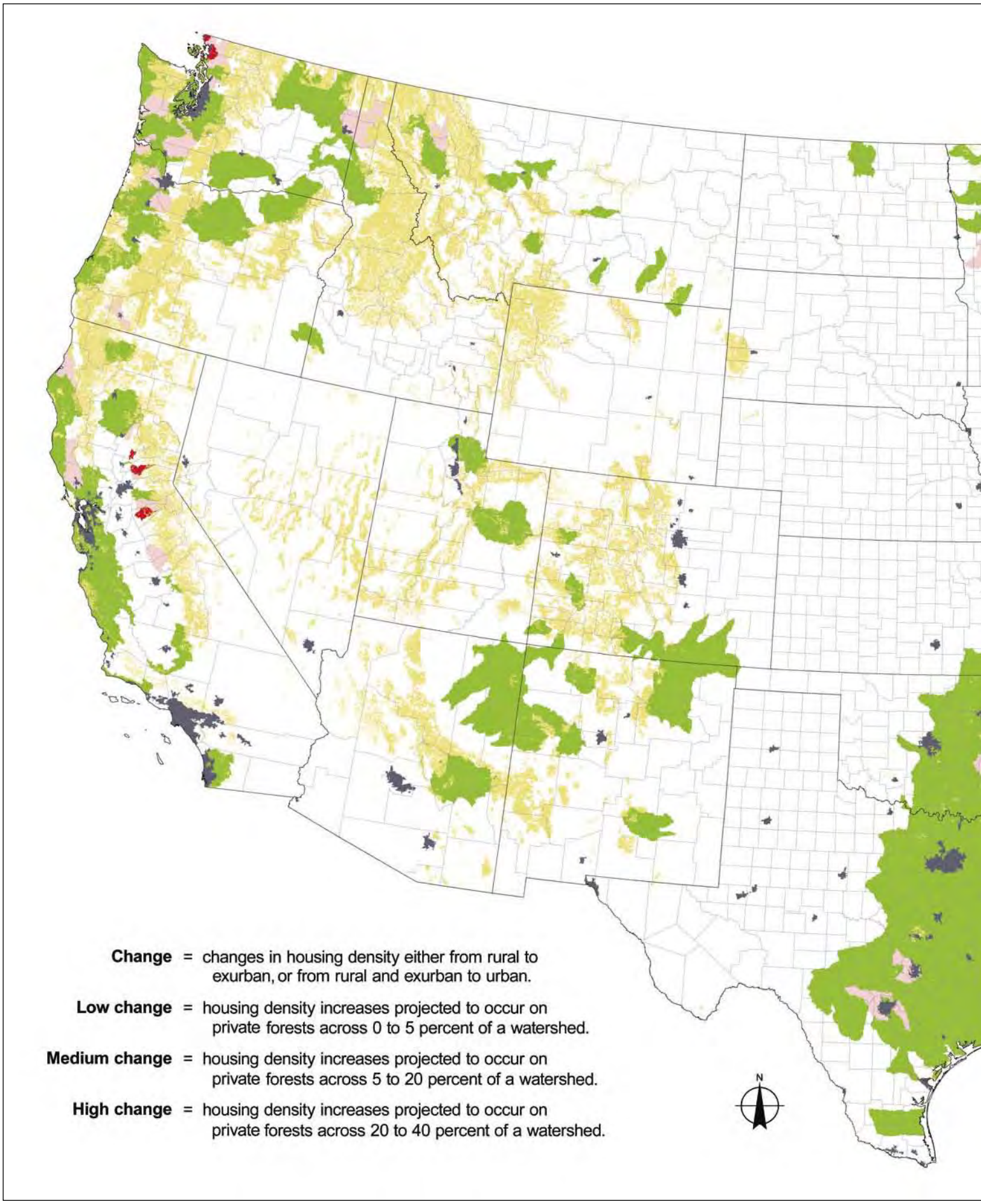
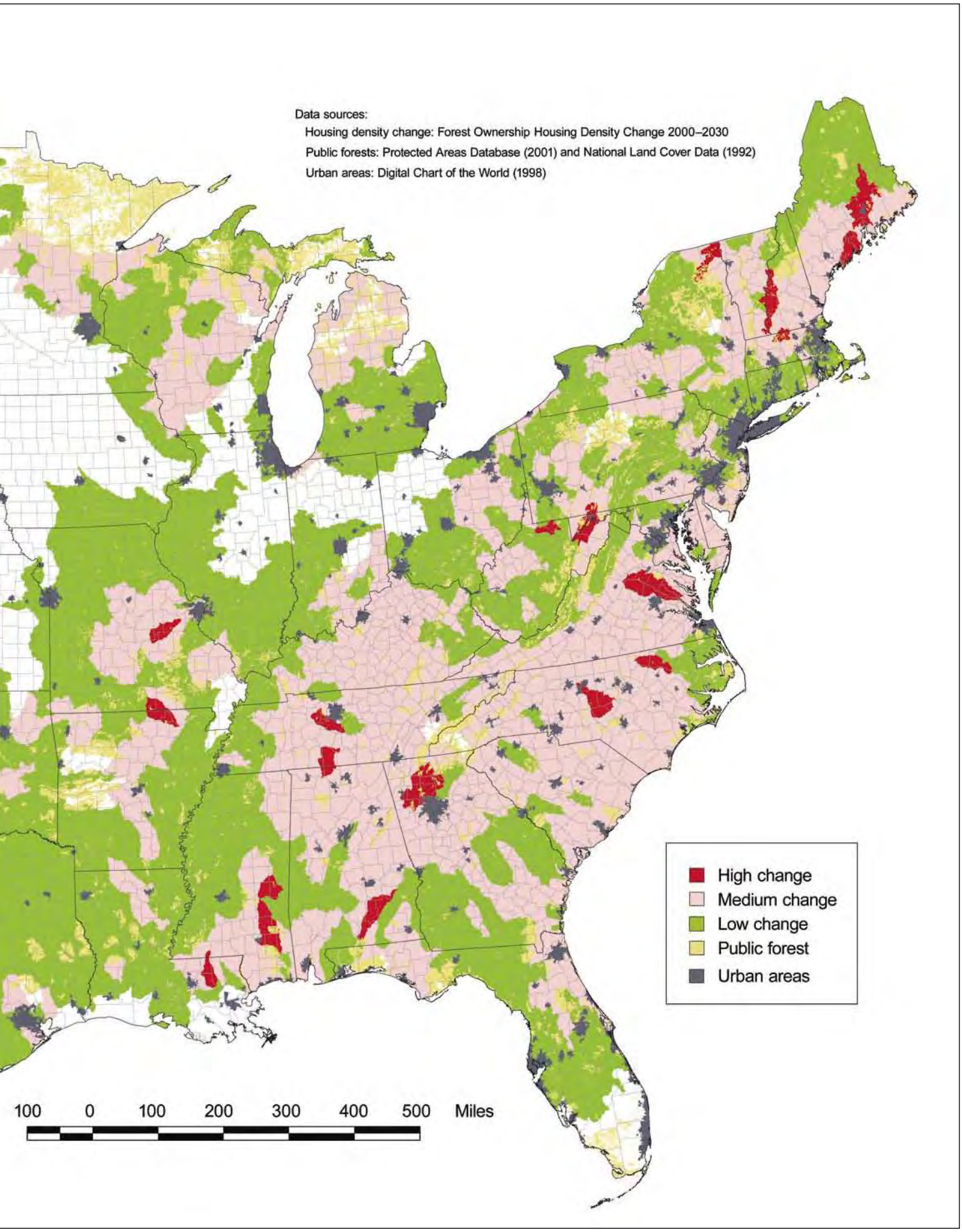


Figure 2—Watersheds in which housing density is projected to increase on private forests by 2030.


Data sources:
Housing density change: Forest Ownership Housing Density Change 2000–2030
Public forests: Protected Areas Database (2001) and National Land Cover Data (1992)
Urban areas: Digital Chart of the World (1998)
High change
Medium change
Low change
Public forest
Urban areas
100 0 100 200 300 400 500 Miles

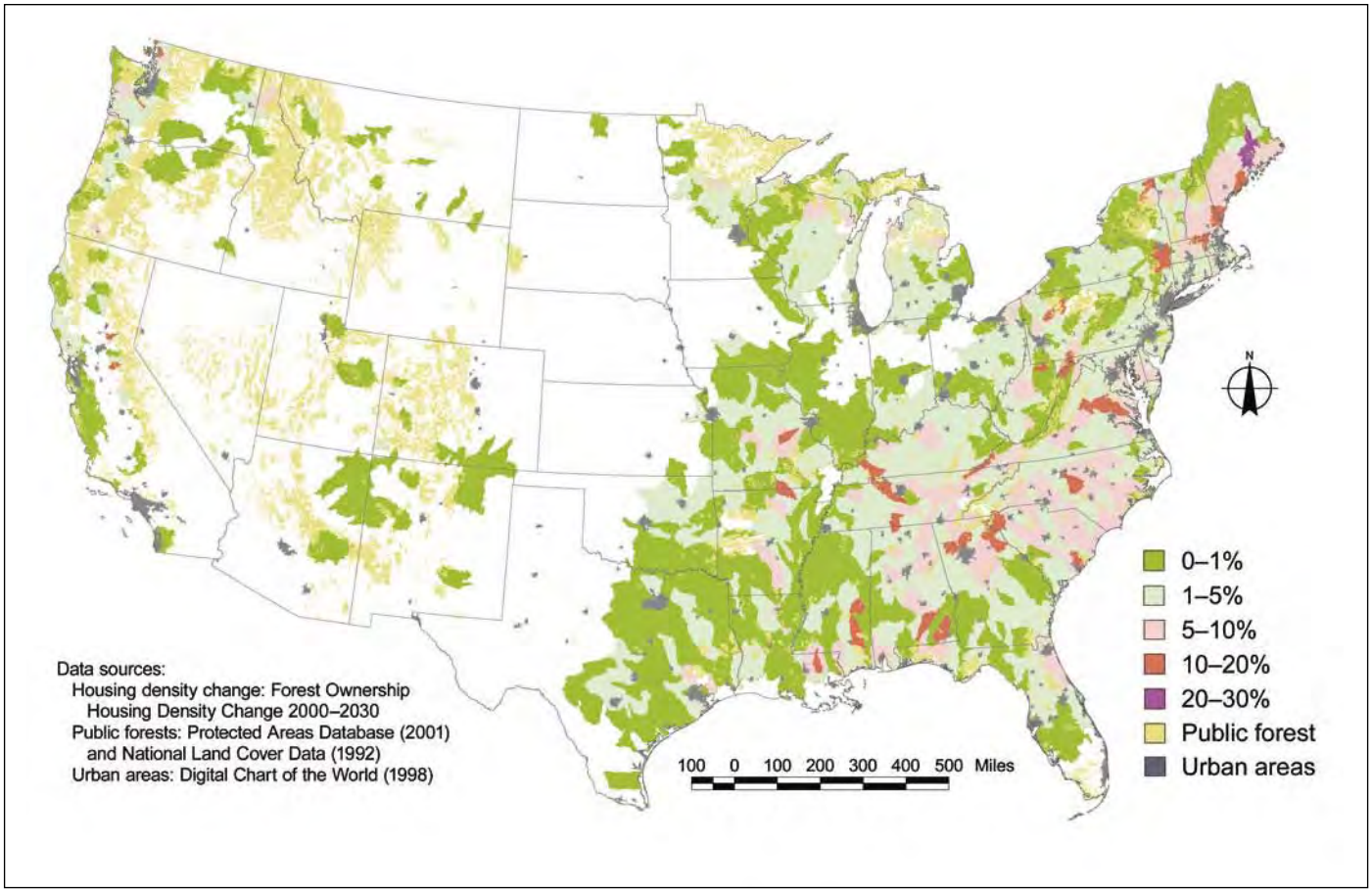


Figure 3—Percentage of watersheds with private forests that are projected to shift from rural or exurban to urban by 2030.

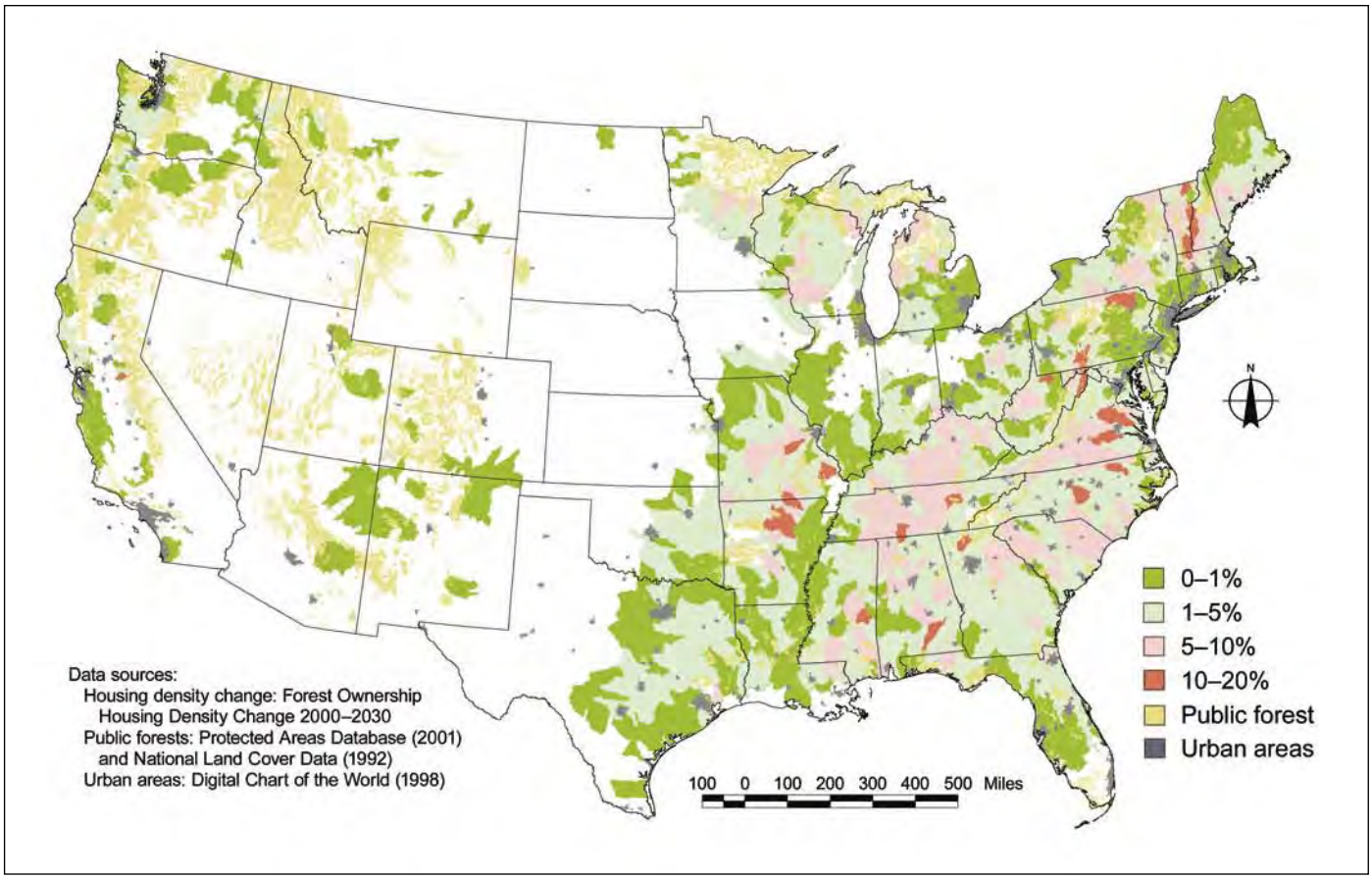


Figure 4—Percentage of watersheds with private forests that are projected to shift from rural to exurban by 2030.

Three of the fastest growing states—Utah, Nevada, and Idaho—contain only about 1.5 percent of our Nation's private forests. The predominance of public forest land in the West may overshadow the smaller but vital parcels of private forest whose loss could be critical at the local level and should not be discounted (see sidebar below).

The next phases of Forests on the Edge will focus more on development impacts on public and private forest in the West. Important parcels of private forest in the urbanized East and in the West have already been identified by state governments through forest-land protection programs such as the Forest Service's Forest Legacy Program and in coordination with nongovernmental land trusts.

IMPLICATIONS

The changes in housing density documented by Forests on the Edge have implications for the condition and management of affected private forests and the watersheds in which they occur. Increased housing density in forested areas and decreased parcel sizes can be associated with:

- **Decreases in native wildlife populations owing to decreased wildlife habitat quantity and quality, increased predation and mortality, and other consequences of human activity that change the relationships many wildlife species have with their environments (Engels and Sexton 1994; Harris 1984; Theobald et al. 1997; Vogel 1989; Wear and Greis 2002a, 2002b).**
- **Alterations in forest structure and function that can derail ecological processes on which forests and forest dwellers depend, resulting in less biodiversity and more opportunities for invasions of nonnative species, insects, and diseases (Ferreira and Laurance 1997, Meekins and McCarthy 2002) (fig. 5).**
- **Long-term modifications to and reductions in water quality and aquatic diversity when forests can no longer regulate the movement of storm water across the landscape, leading to changes in streamflows, increases in sediment, reshaped stream bottoms and banks, and impacts on water quality and aquatic species such as fish and mussels (Booth and Henshaw 2001, Bryan 1972, Fisher et al. 2000, Jones and Holmes 1985, Paul and Meyer 2001).**
- **Decreases in timber production and active forest management when population densities increase (Gobster and Rickenbach 2004, Kline et al. 2004, Wear et al. 1999) (fig. 6).**

Vulnerable Forests in the West: A Mapping Challenge

Pinyon-juniper shrubland.

Photos by A. Price, Utah Division of Forestry, Fire and State Lands

Pinyon-juniper vegetation in the Southwest is an example of vegetation cover that is vulnerable to development in some areas but is not always considered forest. The land-cover layer we used for this study classified tall and dense pinyon-juniper vegetation as forest land, whereas sparse and stunted pinyon-juniper was classified as shrubland. Inclusion of shrubland would have resulted in a map portraying more pinyon-juniper lands as forest but would have also classified all Eastern shrublands as forest, thus portraying a substantially larger area of forest land than has been reported in national inventories of forest resources. Thus, shrubland areas are not highlighted on the current map.

USDA Forest Service

Figure 5—Private forest landowners in Georgia's metropolitan counties are less likely to participate in government incentive programs for protecting soils and tree planting than are landowners in more rural counties (Harris and DeForest 1993).

USDA Forest Service

Figure 6—In western Virginia, increasing human population densities have affected long-term timber management capabilities by reducing area of timberland and commercial volume of growing stock by some 40 percent from their measured values. Researchers found that the probability of forest management approaches zero at population densities of about 150 people per square mile (Wear et al. 1999).

- **Increases in fire risk because increased housing densities in forested landscapes generate more potential for ignitions; make firefighting and fire preparedness in such areas more difficult, dangerous, and expensive; and restrict available management options for mitigating threats to forest lands (Grace and Wade 2000, Podur et al. 2002, Russel and McBride 2003).**
- **Greater loss of life and property owing to wildfire because houses located in forested landscapes are more likely to experience threats from wildfire (Beringer 2000).**
- **Changes in scenic quality and recreational opportunities owing to loss of open space, decreased parcel size, and fragmentation, all of which can degrade the recreational experience for hikers, campers, and mountain bikers and lead to increased likelihood of land use conflicts (Gobster and Rickenbach 2004, Patterson et al. 2003).**

- **Shifts in price levels and economic benefits for forest-based products—including fewer options for timber management, recreation, and other uses whose economic benefits rely on large forested areas; shifts in forest-based products from large-scale recreation to specialty products that may still be cost-effective on smaller forest tracts; and potentially increased property values associated with trees in urban areas (Ellis et al., in press; Tyrväinen 1997; Tyrväinen and Väänänen 1998; Weeks 1990) (fig. 7).**

USDA Forest Service

Figure 7—Private forest stakeholders in Wisconsin indicated in a recent survey that parcelization resulting from development makes timber production less profitable and leads to a shift from commercially valued species to less valued species (Gobster and Rickenbach 2004).

FUTURE OPTIONS

This study is but one chapter in the story of constant flux experienced by our Nation's private forest lands. Although projections of this scope and nature do not necessarily provide precise predictions of the future in all parts of the study area, they do provide an important step toward understanding those factors that could alter the conservation functions and values of private forest lands. Spatial information about land use changes resulting from this and similar studies can help scientists, resource managers, and communities plan for future growth and implement plans and policies that conserve our natural resources.

The conversion of some private forest land over time is inevitable. Although development will occur, local jurisdictions and states can plan and target efforts to prevent or reduce conversion of some of their most valuable forest lands—such as large contiguous forest tracts, forests adjacent to headwaters or riparian areas, forests with high timber or wildlife values, and forests with valuable scenic and social qualities—to keep our private working forests resilient and productive long into the future.

ACKNOWLEDGMENTS

This publication would not have been possible without the dedicated help of many people. We especially thank Larry Payne, Director of the Forest Service Cooperative Forestry staff, for his outstanding leadership on issues relating to loss of open space; Ted Beauvais, Assistant Director of Cooperative Forestry, for his excellent advice and support; Sara Comas, Cooperative Forestry, for assisting with the management of the Forests on the Edge project; and Jimmy Daukas, American Farmland Trust, for sharing his experiences on American Farmland Trust's Farming on the Edge project. We also thank the following individuals for their detailed reviews of our draft report: Dave Wear and John Greis, Forest Service Southern Research Station; Mike Foreman, Virginia Department of Forestry; Don Van Hassent, Maryland Department of Natural Resources; and Gary Lettman, Oregon Department of Forestry.

What Can We Learn From Monitoring Changes in Land Use?

Knowledge of land use changes can help people and communities adjust to shifting demands for and supplies of renewable resources from the Nation's forest and aquatic ecosystems. Monitoring those changes over time can help us:

- Understand whether we can sustain increased consumption of forest products while preserving resource stewardship options for future generations.
- Compile data that can be used to project timber harvests, wildlife habitat, and other natural resource conditions.
- Appreciate the importance of looking across the landscape and across boundaries to determine the sustainability of our activities.
- Plan for sustainable growth.

Source: Adapted from Alig et al. 2003.

METRIC EQUIVALENTS

When you know:	Multiply by:	To find:
Feet	0.3048	Meters
Acres	.405	Hectares
Square feet	.0929	Square meters
Square miles	2.59	Square kilometers

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FORESTS ON THE EDGE: PRESSURES AND OPPORTUNITIES ON AMERICA'S PRIVATE FORESTS

Phase 1 of Forests on the Edge, documented in this report, identifies forested watersheds most likely to experience housing development. Future phases will explore:

- Private forest opportunities and threats in more detail—presenting additional data related to water quality, timberland, and wildlife values, as well as maps showing where private forests are most susceptible to development, fire, insects and diseases, and deterioration of air quality.
- Housing density projections in the vicinity of public forests.
- Detailed descriptions of the "top 10" watersheds of concern and of promise in the conterminous United States.

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EXHIBIT 10

DANGEROUS DEVELOPMENT

Wildfire and Rural Sprawl in the Sierra Nevada

SIERRA NEVADA ALLIANCE

Keeping light in the range.

September 2007

Dangerous Development

Wildfire and Rural Sprawl in the Sierra Nevada

SIERRA NEVADA ALLIANCE

Executive Summary

Wildfire and population growth are on a collision course in the Sierra

New research by Sierra Nevada Alliance finds that large numbers of people are moving to very high fire hazard areas of the Sierra, leading to more wildfires, more taxpayer expense, and more loss of life.

In the next 20-40 years, even more people and homes will be in harm's way. The population of the Sierra is expected to triple by the year 2040, and new research by Sierra Nevada Alliance finds that 94% of the land slated for rural residential development is classified as very high or extreme fire hazard by the California Department of Forestry and Fire Protection (also known as CDF or CalFire).

At the same time, climate change is already making summers in the Sierra hotter and drier, leading to an increase in the frequency and severity of catastrophic wildfire (Westerling, 2006).

The combination of population growth and climate change in our fire-prone region is creating a "perfect firestorm" where increasing numbers of people and homes will be at greater risk of catastrophic wildfire.

The Sierra's population is growing -- and so is the risk of catastrophic wildfire. Photo by Maria Mircheva.

New Findings of This Report:

- Between 1990 and 2000, the number of people living in *very high* or *extreme* fire threat areas of the Sierra grew by 16%.
- 94% of the land slated for rural residential development in the Sierra is classified by CalFire as *very high* or *extreme* fire threat.
- Between 1990 and 2000, the Sierra's wildland urban interface (or WUI) grew by 131,000 acres, a 12% increase.
- Better community planning can help reduce the number of lives and homes at risk.

This report examines the relationship between land use planning and wildfire prevention in the Sierra. We hope this report will help the public, decision makers and conservation leaders assess where and how we grow, to make better choices that will keep our homes and communities safer.

Local governments in the Sierra, along with state and federal agencies, must take action to limit the spread of residential development into dangerous areas. We must also end subsidies that encourage reckless development at taxpayer expense.

Fire is natural & unavoidable in the Sierra

The Sierra Nevada is a fire-dependent landscape. California's Mediterranean climate of wet winters and hot, dry summers creates the exact conditions for fire to flourish. Sierra plants, animals and forests evolved with fire for thousands of years, and have adapted to not only survive with fire, but to depend upon it. The health of the Sierra landscape depends upon frequent, low-intensity fires that thin crowded forests, recycle nutrients, and increase biodiversity (Barbour, 1993).

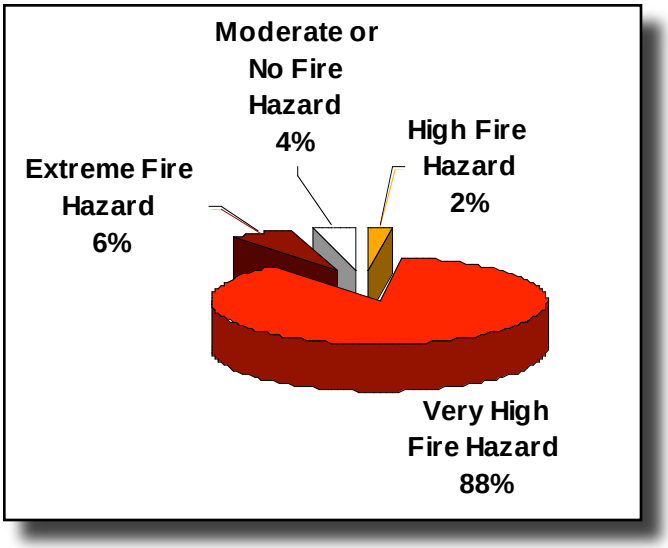
Decades of fire suppression and logging have created a tinderbox

After the gold rush, fire suppression became the standard practice, and these small, low-intensity fires were regularly put out. This seemingly good idea has had disastrous consequences. After 100 years of fire suppression and logging large, fire-resistant trees, Sierra forests have become virtual tinderboxes, crowded with dead brush and small trees. (Barbour, 1993). The continuing conversion of mature, fire-resistant forests to plantations and other industrial logging practices are compounding the fire threats in the Sierra Nevada, taking what was a fire-adapted forest system and making it much more vulnerable to catastrophic fire. Unlike the small, low-intensity fires that used to be the norm, Sierra wildfires today are much more likely to become catastrophic crown fires that char everything in their path.

The Sierra is growing – into wildfire areas

The Sierra is the third-fastest growing region of California, and that growth is putting more people directly in the path of catastrophic wildfire. By 2040, the population of the Sierra will triple to 1.5 million - 2.4 million residents (Sierra Nevada Ecosystem Project, 1996). New research by Sierra Nevada Alliance finds that 94% of the land slated for rural residential development is in areas classified by CalFire as very high or extreme fire hazard.

The 2007 Angora fire destroyed 242 homes near South Lake Tahoe. Photo by Autumn Bernstein.



This figure depicts fire hazard on lands slated for rural residential development in the Sierra.

Unsafe growth patterns increase fire danger

The wildland urban interface -- the area where houses and wildlands meet, and where catastrophic wildfires are likely to destroy lives and property -- is growing rapidly in the Sierra. New research by Sierra Nevada Alliance finds that between 1990 and 2000, the wildland urban interface (WUI) in the Sierra grew by 12%. As the size of the wildland-urban interface grows, so does the risk of catastrophic wildfire that destroys lives and property.

The WUI in the Sierra is characterized by low-density housing development scattered in a sea of flammable vegetation. This pattern of low-density development, with one house every 2-80 acres, is often referred to as "rural ranchette" development. Ranchette development in the WUI makes it more difficult and more costly for fire managers to prevent wildfires and protect homes and lives when major fires do occur.

Climate change is increasing wildfire danger

At the same time that population growth is putting more people in fire hazard areas, climate change is already making summers in the Sierra hotter and drier, leading to an increase in the frequency and severity of catastrophic wildfire (Westerling 2006). CalFire predicts that these impacts will become more severe in coming years (CalFire 2003), leading to a "perfect fire storm" where increasing numbers of people and homes will be at greater risk of catastrophic wildfire.

Poorly-planned growth is putting more homes in the path of wildfires like the 2007 Angora Fire. Photo by Eric Winford.

Taxpayers are subsidizing unsafe growth

Costs of fire prevention have increased exponentially in recent years as state and federal firefighters spend more time and money protecting new homes in wildland areas. The vast majority of these costs are shouldered not by the affected homeowners, but by state and federal taxpayers. A recent federal audit found that the US Forest Service is spending up to $1 billion annually to protect private homes adjacent to national forest land (USDA Office of Inspector General, 2006). CalFire's fire protection expenditures increased an average of 10% per year between 1994 and 2004, and much of that increased cost was due to increasing numbers of homes in wildland areas (California Legislative Analyst's Office, 2005).

Current policy is failing at-risk communities

Our current policy framework doesn't do enough to minimize risks to lives, assets, watersheds, wildlife and ecosystem health. In most parts of the Sierra, land use planning in wildfire areas focuses on site-specific requirements such as clearing defensible space and building with fire-retardant materials. Site-specific building policies are important, but fire-safe planning must look at the bigger picture: planning the *neighborhood* and the *community.*

"Fire-smart growth" can save lives and money

Development in high fire threat areas of the Sierra is inherently dangerous. However, community design can play a large role in minimizing exposure and reducing losses. Infill and clustered development, aka "fire-smart growth," has numerous advantages over low-density ranchette development when it comes to fire safety. These factors should be considered by counties, cities and developers when planning for new development in the Sierra.

Taxpayers are subsidizing fire protection for homes in high fire hazard areas. Photo by Shasta Ferranto.

Better planning can make our communities safer. Photo by CanyonFlorey.com

Principles for planning fire-safe communities

This report recommends that planning in high fire threat areas should adhere to five fire-safe planning principles. Implementation measures for each of these five principles are explored in chapter six of this report.

1. Make new development pay its own way: Landowners contemplating development in high fire threat areas should be required to pay the full cost for fire protection.

2. Cluster development in and around existing communities: Local governments should encourage infill development and concentric outward growth while discouraging low-density sprawl and leapfrog development in high fire hazard areas.

3. Don't build in unsafe places: Even within an area of high fire hazard, some places are more dangerous than others. New development should be curtailed in places that will put new or existing residents at greater risk.

4. Manage the forested landscape to restore resiliency and reduce fire risk: State, federal and local agencies should support responsible forest management practices that restore forest health and reduce the risk of catastrophic crown fire in the WUI.

5. Improve planning and budgeting processes to fully address risks: All levels of government involved in wildland fire prevention and protection need to improve planning and budgeting to prepare for coordinated wildfire prevention and response.

Conclusion: Better planning is the key

The threat of catastrophic wildfire in Sierra communities has increased dramatically in recent years, and will only get worse unless local, state and federal agencies, in partnership with Sierra residents, NGOs and community groups, work together to address the underlying issues of poor planning and unfair subsidies that encourage irresponsible development.

We can build thriving communities that are safer and sustainable, by making an upfront investment in good planning that will save lives and money in the long run. Or we can continue with business as usual, and deal with the consequences every fire season to come. The choice is ours.

Dangerous Development

Wildfire and Rural Sprawl in the Sierra Nevada

Table of Contents

Executive Summary..... i

Table of Contents.....v

Foreword: Lessons from the Angora Fire 1

Chapter 1: History and Ecology of Fire in the Sierra.....2

Chapter 2: Wildfire and Population Growth on a Collision Course..... 6

Chapter 3: How Does Development Affect Wildfire?..... 12

Chapter 4: Subsidizing Disaster: Who Pays for Protecting Unsafe Development?... 16

Chapter 5: Why Current Land Use Policy is Failing At-Risk Communities.....20

Chapter 6: Principles for Planning Fire-Safe Sierra Communities..... 22

Appendix A: Data for each County 28

Appendix B: References.....39

Appendix C: Maps of Fire Risk and General Plans in the Sierra 42

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About Sierra Nevada Alliance

The Sierra Nevada Alliance has been protecting and restoring Sierra land, water, wildlife and communities since 1993. The Alliance is a network of conservation groups that are based or work in the Sierra Nevada region. There are over 85 member groups that span the entire 400 mile mountain range.

The Alliance's Planning for the Future Campaign works to ensure that future growth protects our natural resources, working landscapes and rural communities.

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Foreword:

Lessons from the Angora Fire

by Autumn Bernstein, Land Use Coordinator

Sunday, June 24, 2007: When I saw the first plumes of smoke rising over the ridge behind my house, I went inside to make a sandwich.

It might sound crazy, but I've spent my entire life in California. After a while, you get used to seeing little plumes of smoke. You don't panic. You listen for the sirens, you keep one eye on the sky, you turn on the news, but you don't panic. Most of the time, these little fires are put out before they can become destructive. Most of the time, but not this time.

While I was in the kitchen slicing cheese and toasting bread, I felt a great gust of wind shuddering across the side of the house. I walked back outside and saw that the little plume of grey smoke had suddenly become a billowing orange column, arcing over my house and blocking out the sun. The wind blew again – it was coming my way, fast and hot.

I never got to eat that sandwich. My stomach was still growling as I drove down the road with my pets, laptop, sleeping bag, and a copy of *East of Eden* I'd bought at a garage sale that morning. As I drove, I thought about all the things I'd left behind, and wondering if they'd still be there tomorrow. Six days later, when I was allowed to return home, the hunk of cheddar cheese was still on the counter, the bread still in the toaster.

I live on Angora ridge near South Lake Tahoe. The fire came to the very edge of my neighborhood, within ¼ mile of my home. I am one of the lucky ones. 242 families lost their homes, and over a thousand experienced the same fear and suspense that I did, before returning to find homes and possessions intact.

I'd spent the last two years researching and writing this report on wildfire and rural development, only to have my own terrifying first-hand experience with wildfire just weeks before this report was scheduled to be released. It brought home the lessons of this report in a very personal way that I couldn't have imagined before.

My house was saved because of the remarkable efforts of the firefighters that kept the fire at the perimeter of our neighborhood. It was also saved because the US Forest Service had recently completed fuel treatment in the forest directly adjacent to our neighborhood, helping to create a defensible space around our homes. And it was saved because I simply got lucky.

Fire is natural and unavoidable in the Sierra. Equally natural and unavoidable are the impulses of people like myself, who want to make a home in this beautiful landscape. How do we reconcile this apparent contradiction?

Defensible space is one solution, and that issue has gotten a lot of attention in the aftermath of the Angora fire. But there is another, larger issue that has been largely ignored: How can we use the tools of urban planning to build safer communities?

While I love my home, I question whether or not my neighborhood should have been built in the first place. It is an isolated, leapfrog subdivision perched atop a steep, fire-prone ridge, surrounded by dense forests. All of these factors make it an extremely dangerous place in the event of a wildfire.

New subdivisions like mine are popping up all over the Sierra, with little thought about the implications for fire safety. Worse still, isolated rural ranchettes are sprawling across the landscape, putting people in even more remote, hazardous areas. This pattern of 'rural sprawl' increases the likelihood that more homes will be destroyed and more lives will be lost as wildfire makes its inevitable march across the landscape.

2007 is shaping up to be one of the worst fire seasons in recent memory. It is also the year that I stopped being a fire observer, and became a fire survivor. It is an experience I hope never to repeat. But unless we Sierrans start asking hard questions about where and how we grow, I fear that many more of us will have our own survivor stories to tell, and they won't all have happy endings.

Chapter 1
History and Ecology of Wildfire in the Sierra

The Sierra Nevada region

The Sierra Nevada is a 400-mile region characterized by tall granite peaks, coniferous forests and rolling, oak- and chaparral-covered foothills. It includes portions of 22 California counties and is home to approximately 600,000 people. The Sierra is also home to over half the plant and animal populations of the state, and provides 60% of California's drinking water.

Low-intensity ground fires were common in the Sierra before 1850. Photo by Zeke Lunder.

The forest that John Muir saw

Fire is an integral part of the Sierran landscape. Before the arrival of Europeans, low-intensity ground fires were commonplace and rarely catastrophic. Several studies have shown that prior to 1875, fires occurred every 8-15 years in pine forests, and every 16-30 in wetter fir forests (Barbour, 1993).

When fire was commonplace in the Sierra, our forests, woodlands and chaparral areas looked quite different than they do today. The forests were more open and park-like, with big, mature trees and carpets of grass and wildflowers, and much less woody brush and fewer small trees than we see today.

John Muir described the forests of the Sierra as:

> *"[among] the grandest and most beautiful in the world. . . The giant pines, and firs, and Sequoias hold their arms open to the sunlight, rising above one another on the mountain benches. . . The inviting openness of the Sierra woods is one of their most distinguishing characteristics. The trees of all the species stand more or less apart in groves, or in small irregular groups, enabling one to find a way nearly everywhere, along sunny colonnades and through openings that have a smooth, park-like surface," (Barbour ibid).*

This open, park-like setting was due largely to the beneficial influence of fire. It is hard to imagine today, when wildfires frequently char everything in their path, but fires used to be far less destructive and were in most cases beneficial. The frequent ground fires cleared away brush and smaller trees, but left the larger trees intact. Fire also cleared away the layer of dead leaves, pine needles and brush that covered the ground, leaving behind bare soil and stimulating the regeneration of grasses, wildflowers and other small plants that might otherwise be unable to grow.

Because fires came through frequently, brush and dead wood were eliminated before they could accumulate to dangerous levels. When brush piles up and small trees clutter the forest, they form a "ladder" which allows fire to climb from the ground into the treetops, resulting in catastrophic crown fires that kill the large trees and threaten homes and lives. In the Sierra before European arrival, such fires were less common than they are today and large, old trees survived dozens or even hundreds of fires (Barbour, ibid).

The Giant sequoia and fire

In some cases, fire also has a more specialized role in ensuring the health of Sierra ecosystems and even the survival of species. One example is the Giant sequoia,

which is the world's most massive living organism and is found nowhere else in the world outside the Sierra. With its huge size and majestic stature it is hard to imagine that the Giant sequoia is actually quite vulnerable.

But its lifecycle is intimately dependent upon fire. Giant sequoias produce huge amounts of cones, but unlike the cones of most conifers, these cones do not automatically open and release their seeds. Instead, the cones remain green, hanging onto the parent tree and holding their seeds for as long as twenty years. Hot air from a ground fire causes the cones to open and rain seeds upon the forest floor – up to 8 million seeds per acre fall after a fire (Harvey, 1980).

Survival and successful germination of Giant sequoia seeds also depends upon fire. The seeds have a hard time germinating and growing to maturity in the litter of needles and leaves which usually covers the forest floor. When fire has exposed the bare soil and reduced the amount of shade in the forest, then the seeds can germinate and grow successfully.

Land managers who steward Giant sequoia groves now understand the importance of fire and use controlled burns to ensure the long-term survival of the species. Since the reintroduction of fire into Kings Canyon National Park, the number of seedlings per acre has grown from virtually zero to 22,000 (Harvey ibid).

Native Californians and fire

For as long as there have been people in the Sierra, there has been management of fire. The Sierra Nevada has been inhabited for at least 10,000 years by peoples of the Miwok, Paiute, Washo, Maidu, Yokuts, Nisenan, Konkow and Mono cultures, and virtually all of these tribal groups actively managed the landscape until the arrival of Europeans. They used a variety of tools and techniques, but the tool that was most widely used, and had the most dramatic effect on the appearance and ecology of the Sierra, was fire. Indeed, it now appears that Native Americans used fire to manage forest throughout the New World (Mann, 2006).

Foothill areas were routinely burned to reduce brush and stimulate the production of herbaceous plants and tubers, which were important to the diet of Native Californians, both because people ate the plants directly, and because they provided food for deer, elk and other game. Fire also helped maintain the productivity of oak woodlands, important for the acorns they provided, and stimulated the growth of shrub shoots, used for basketry, buildings and, in the case of fruit-producing shrubs like chokecherry and manzanita, food. Burning was also important to Native Californians because it reduced the risk of catastrophic crown fires that destroyed homes and food-producing trees, and eliminated habitat for game and fish. According to UC Davis ethnobotanist M. Kat Anderson, "burning to keep the brush down" was a maxim adhered to by all Sierran peoples (Anderson, 1996) .

The impacts of regular and widespread burning by Native Americans were significant. Approximately 100,000 Native Americans lived in the Sierra Nevada before the arrival of Europeans, and virtually every tribal group regularly burned large areas. While it is impossible to know how many fires were historically caused by lightning and how many by Native Americans, it is likely that both natural fires and human-caused fires played an important role in shaping the Sierra. What is clear is that the open, park-like forest which so enchanted John Muir and other early settlers was not a pristine wilderness, but a landscape that was managed by those who inhabited it for thousands of years (Anderson, 1996).

Changing regimes: fire suppression and logging

As Europeans moved in and replaced Native Americans as California's land managers, the fire regime in the Sierra changed dramatically. It became the norm to extinguish fires caused by lightning or other natural causes and deliberate human-caused fires were seen as a menace rather than as a management tool. Fire suppression became the official policy of the Forest Service in 1905 and the California Department of Forestry followed suit in 1924.

In addition, the widespread industrial logging which began during the mining era has also changed the composition of Sierra forests. The practice of clearcutting replaced diverse forests with vast plantations of small trees that are all the same age. Most of the Sierra's national forests and private

forestlands were clearcut regularly for decades. Today, clearcutting continues on a large scale on some private forestlands. The Sierra Nevada Ecosystem Project (SNEP) characterized the effect of logging in this way:

> *"Timber harvest, through its effects on forest structure, local microclimate, and fuel accumulation, has increased fire severity more than any other recent human activity." (SNEP, 1996).*

The results of a century of fire suppression and logging large, fire-resistant trees have been dramatic. Sierra forests and woodlands today are more crowded and shrubbier. Shade-tolerant trees such as the white fir have thrived under these conditions and vastly expanded their numbers and range, while fire-dependent species such as the Giant sequoia have suffered (Barbour, ibid). High meadows have been invaded by thickets of conifers (Taylor, 1990), and oak woodlands have been overtaken by deerbrush (Barbour, ibid).

This scene from the aftermath of the 2007 Angora fire is typical of a crown fire in a dense, crowded forest. Photo by Autumn Bernstein.

In these conditions, the likelihood of catastrophic crown fire has increased dramatically. Dense stands of young, small trees are very flammable. Accumulated brush and dead wood are also highly flammable. Taken together, small trees, brush and dead wood form a "ladder" that allows fire to climb from the ground into the canopy and spread quickly from tree to tree. This type of fire is difficult to control.

Fire suppression has changed the behavior of fires, but the effects vary by forest type. For example, high elevation red fir forests historically experienced fairly long intervals between fires, so the recent departure from the natural fire regime has been less pronounced in these forests. By contrast, fires were historically far more frequent in lower-elevation ponderosa pine forests, so the effects of fire suppression in this forest type have been more pronounced.

Beyond fire suppression: new methods for fire management

In recent years, fire and land managers in the Sierra and throughout the West have become aware of the unintended consequences of fire suppression and logging, and they are taking proactive steps to undo the damage of a century's worth of mismanagement. The removal of brush and small trees, in conjunction with prescribed burning, are techniques now widely used to restore forests to a condition similar to that which existed before fire suppression.

Making a forest more fire safe usually involves cutting young trees and tall brush first, which are then piled and burned safely. Once these fuel sources are removed, a ground fire is set to burn the remaining small brush and accumulated debris on the forest floor (pine needles, fallen branches, etc.). After the ground fire has run its course, what remains are large, living trees and bare soil – a forest in which catastrophic crown fire is less likely to occur. The following spring, the forest floor turns green as shrubs re-sprout and annual herbs and wildflowers flourish in the rich, newly-fertile soil.

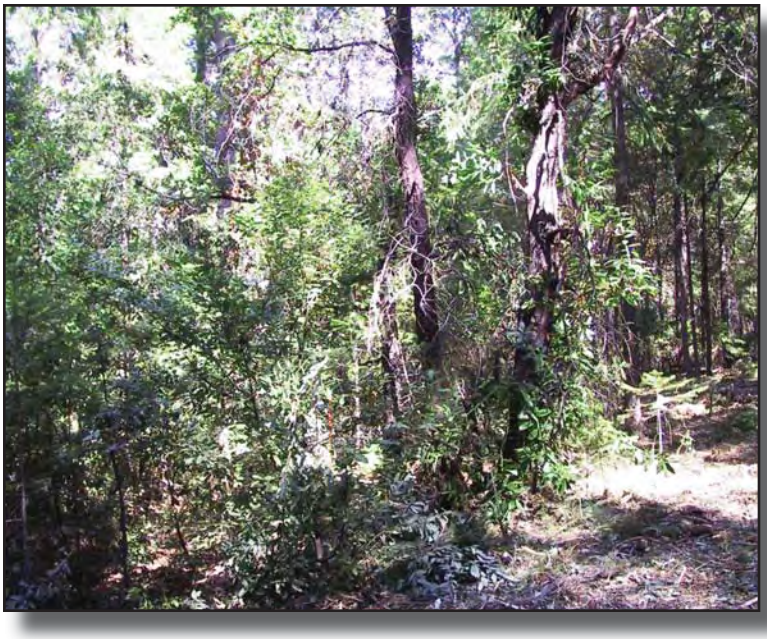
While these new management techniques are widely believed to be effective at both restoring forest health and preventing catastrophic fire, they are resource-intensive, requiring large amounts of both capital and labor. Over time, brush and small trees will accumulate once again, so effective fuel reduction programs require an ongoing investment of resources. In addition, fuel treatments are more difficult and costly to implement on steep slopes and in fragile areas such as stream environments. Efforts to

implement fuel reduction programs on a large scale are complicated by funding shortfalls, competing management priorities and the mishmash of state, federal and private lands.

The continuing hazard of timber plantations

The conversion of forests to plantations continues on some private forestlands in the Sierra, increasing fire hazard in adjacent forests and communities. Tree plantations stocked with densely-stocked, even-aged, nursery-grown conifers have their needles and branches close to the ground and tend to have interlocking crowns; consequently, they form a continuous aerial fuel mass that can easily ignite and spread as a crown fire. This is why plantations are susceptible to severe fire damage even from low-to-moderate intensity fires.

Because young timber plantations pose such extreme fire risks and fuel hazards, they must be managed with complete fire exclusion. It takes just a few scattered plantations to put whole areas at risk of uncharacteristically severe fire, and thus, plantations zones are managed for fire exclusion, causing hazardous fuel loads to accumulate over time. The presence of these plantations compels adjacent public land management agencies to design expensive thinning treatments near plantations to increase successful suppression operations and induces fire fighters to take risky actions to aggressively fight fires burning in plantation zones—even fires that otherwise could have been used for fuel treatment and ecological benefits (Ingalsbee, 1997).



Sierra forest before and after mechanical fuel treatment. Photos by Zeke Lunder.

The new threat: Rural development

In recent years, the Sierra has begun to experience a development boom, fueled by retirees and second homeowners. In contrast to previous eras where growth was clustered around small, tight-knit towns, today's population growth is characterized by low-density rural "ranchette" development and leapfrog subdivisions where houses are scattered across the landscape. In some parts of the Sierra, rural residential development is outstripping all other types of development by a ratio of 10 to 1 (California Department of Conservation, 2006). This type of development makes forest management with regular controlled burning very difficult. Rural development also puts more lives and homes in danger. This newthreat to fire management is the central issue explored in this report.

Conclusion

In recent decades, forest managers and residents in the Sierra have begun to recognize the integral role of fire in Sierra forests. We now understand that fire cannot be eliminated or suppressed – it must be carefully managed. In the next chapter, we explore how population growth and wildfire are both on the rise in the Sierra, with potentially dangerous consequences.

Chapter 2
Wildfire and Population Growth on a Collision Course

For the last several decades, the number of people living in high fire threat areas of the Sierra has increased dramatically, resulting in increasing conflicts between people and fire. That growth is projected to continue over the next forty years. Other factors, such as climate change and the conversion of private forestland to highly-flammable plantations, are also contributing to a 'perfect firestorm' where more lives and homes will be at risk of catastrophic wildfire.

Ranchettes and the wildland urban interface

In many parts of the rural west, including the Sierra, the predominant form of new development is low-density "rural ranchettes" where houses are scattered at low densities (1 house per 2-80 acres) in a sea of wildland vegetation.

In many parts of the Sierra, ranchette development is the only game in town. For example, between 2002 and 2004, 261 acres of ranchland in Amador County were converted to urban development (commercial, industrial and medium density housing). During that same time period, 3,100 acres of agricultural land in Amador County were converted to ranchettes. In other words, ranchette development is outstripping urban development by a ratio of 10 to 1 (California Department of Conservation, ibid).

This type of development creates a 'wildland urban interface' (see sidebar) that is extremely problematic for fire management. Preventing and fighting wildfire in the wildland urban interface (WUI) is extremely difficult and resource-intensive.

Fires in the WUI tend to burn fast and fierce, and cause many homes to be lost at once. A case in point is the 2007 Angora fire, which began in the WUI and spread quickly to adjacent homes. All 242 houses and 67 commercial buildings destroyed by the fire were lost during the first twelve hours (Norman, 2007). In the 1990 Painted Cave fire in Santa Barbara, 479 homes were destroyed, most within two hours of the initial report (Cohen, 2000).

What is the Wildland Urban Interface?

The wildland urban interface, or WUI, is a term developed by fire managers to designate places where development is interspersed with areas that are prone to wildland fire. The USDA defines the WUI as "the area where houses meet or comingle with undeveloped wildland vegetation."

There are two types of wildland urban interface: In areas where developed cities share a distinct boundary with the adjacent wildland, the WUI is known as interface WUI. In areas where low-density development is intermingled with wildland vegetation, it is know as intermix WUI.

Source: USDA and USDI. 2001. Urban wildland interface communities within vicinity of Federal lands that are at high risk from wildfire. Federal Register 66: 751-777.

The wildland urban interface in the Sierra and the rural West is growing larger, and exposing more people to risk, every year. Population growth and wildland fire are, quite literally, on a collision course in the Sierra.

Fire and population growth: Recent trends in the western US

In states throughout the West, increasing numbers of homes are being built in high fire threat areas, dramatically increasing the size of the wildland urban interface. According to a study by researchers at the University of Wisconsin, in the Rocky Mountain states (AZ, CO, ID, KS, MT, ND, NE, NM, NV, SD, UT, WY), the number of homes in the WUI grew by 67.8% between 1990 and 2000 (Radeloff, 2005).

As the number of homes has grown, so has the sheer size of the wildland urban interface itself. From 1990 to 2000, the WUI in the Rocky Mountain states grew by 2,089,895 acres, an increase of 30.2%. In Nevada, the number of homes in the WUI grew by a whopping 91.7% during the same time period (Radeloff, ibid).

At the same time that the size of the wildland urban interface is growing, the frequency and severity of wildfires in the West is also growing. In 2006, a study in Science reported there were four times as many wildfires in the last sixteen years than during the previous sixteen years. The total area burned by those fires also increased dramatically, by 650%. Much of this increased fire activity was concentrated in mid-elevation forests in Northern California and the Northern Rockies (Westerling, 2006).

The same study also found that the recent increase in wildfire activity is correlated with an increase in average spring and summer temperature. This indicates that global climate change has probably begun to increase the frequency and severity of wildland fire in the western US (Westerling, ibid). Projections of further temperature rises, then, most likely will entail further increases in wildfire.

Fire and population growth: Recent trends in California

California is infamous for wildland fires that take lives, destroy homes, and char vast expanses of wildlands. The 2003 Old Fire killed six people, destroyed 1,000 homes and scorched about 100,000 acres in the San Bernardino Mountains above San Bernardino (USFS, 2003). Three years later, the Esperanza Fire killed five people, destroyed 34 homes, and charred 42,000 acres in the same area (CalFire, 2006). Thirty-six firefighters with the U.S. Forest Service and California Department of Forestry have died battling California wildfires since 1990.

Part of the reason California wildland fires are so destructive is that California has the most homes in the wildland urban interface of any state. According to the University of Wisconsin study, between 1990 and 2000, the number of homes in California's wildland urban interface increased by 14.5%, to 5.1 million. There are a total of 12 million homes in California, meaning that nearly one out of every two California homes is in the wildland urban interface.(Radeloff, ibid).

There are 8 million acres of WUI in California. Of those 8 million acres, about 5.5 million are classified by CalFire as high, very high, or extreme wildfire threat (see sidebar) (California LAO, 2005).

The real and potential economic costs of fire in California's WUI are staggering. CalFire estimates that the replacement value for homes in the wildland urban interface is $107 billion for the structures alone. On average, 703 homes in California are lost to wildfire every year, at a cost of $163 million (California Fire Plan, 1996).

Nearly one out of every two California homes is in the wildland urban interface.

These averages belie the enormous social and economic costs associated with large, devastating fires. The costs of the 2003 Old, Grand Prix and Padua fires, including, among other things, firefighting expenditures, private insurance payments, and FEMA assistance, were estimated by the Forest Service at $1.3 billion (Dunn, 2003).

CalFire's Fire Threat Classes

CalFire's Fire and Resource Assessment Program (FRAP) has developed a rating of wildland fire threat based on the combination of potential fire behavior (Fuel Rank) and expected fire frequency (Fire Rotation) to create a 4-class index for risk assessment. Impacts are more likely to occur and/or be of increased severity for the higher threat classes.

The Fire Threat classes are: Extreme, Very High, High, and Moderate. Areas that do not support wildland fuels (e.g. open water, agricultural lands, etc) are omitted from the calculation and are considered 'Non-fuel.' Most large urbanized areas receive a moderate fire threat classification to account for fires carried by ornamental vegetation and flammable structures.

CalFire is currently in the process of developing new hazard severity zone maps for California which will contain more current information. However, at the time of publication, these new maps were not finalized.

Source: http://frap.cdf.ca.gov/projects/fire_threat/

Fire and population growth: Recent trends in the Sierra Nevada

Much of the Sierra, particularly the western foothills, are classified by CalFire as "very high" or "extreme" fire threat. These areas are also the fastest-growing parts of the Sierra.

According to new research by Sierra Nevada Alliance, between 1990 and 2000, over 88,000 people —a 16% increase—moved into areas of the Sierra Nevada categorized by CalFire as either a "very high" or "extreme" fire threat.

Our data show that approximately 97% of the population growth in the Sierra took place in these very high or extreme fire threat areas.

Table 2.1 on page 8 shows the growth in population in "very high" and "extreme" threat portions of Sierra Nevada counties between 1990 and 2000.

Between 1990 and 2000, 97% of the Sierra's population growth was in areas considered* very high *or* extreme *fire threat by CalFire.

At the top of the list is El Dorado County, where over 140,000 people now live in these high fire risk areas, an increase of over 27,000 since 1990. Nevada and Placer Counties follow with 92,000 and 77,000 people respectively.

Table 2.1 Population growth in *very high* and *extreme* fire threat areas (in Sierra portions of counties)

County	1990	2000	change	% change
El Dorado	113,029	140,261	27,232	24%
Nevada	78,461	91,981	13,520	17%
Placer	66,241	76,877	10,636	16%
Tuolumne	46,732	52,449	5,717	12%
Butte	31,913	35,975	4,062	13%
Calaveras	25,339	30,005	4,666	18%
Amador	24,646	27,998	3,352	14%
Lassen	22,927	25,319	2,393	10%
Madera	18,453	24,303	5,850	32%
Plumas	19,062	20,064	1,001	5%
Mariposa	14,294	17,120	2,826	20%
Kern	15,330	15,754	424	3%
Fresno	13,030	15,652	2,622	20%
Tulare	12,388	13,196	808	7%
Mono	9,000	11,756	2,756	31%
Inyo	10,479	10,325	-155	-1%
Yuba	7,911	8,488	577	7%
Tehama	4,720	4,538	-182	-4%
Sierra	3,133	3,357	224	7%
Alpine	991	1,075	85	9%
Total	**538,079**	**626,492**	**88,413**	**16%**

Methodology: These data were compiled using GIS to compare CalFire's fire threat data map (CalFire 2004) with population information from the California Department of Finance. GreenInfo Network, 2004.

The Sierra's wildland urban interface is growing quickly

As population in high fire threat areas grows, so too does the size of the wildland-urban interface. For this report, Sierra Nevada Alliance analyzed regional data from the University of Wisconsin study (Radeloff, ibid) to identify how quickly the WUI in the Sierra grew between 1990 and 2000. (Note: this analysis only includes the 13 'core' Sierra Nevada counties. See sidebar for details). This is the first time this WUI data for the Sierra has been analyzed at this regional scale. The results are consistent with state and national trends: Between 1990 and 2000, the area of the WUI in the core Sierra region grew by 11.55% -- 131,000 acres.

Table 2.2 on page 9 shows the size of the WUI in each core Sierra Nevada county in 2000. Not surprisingly, the counties with the largest populations also have the largest WUI.

Core and Peripheral Sierra Counties

The 'core' Sierra Nevada counties are those whose populations and land area are entirely or almost entirely within the Sierra Nevada. These include: Alpine, Amador, Calaveras, El Dorado, Inyo, Lassen, Mariposa, Mono, Nevada, Placer, Plumas, Sierra and Tuolumne.

Peripheral Sierra Nevada counties are the foothill counties whose population and land area are predominately in the Central Valley: Butte, Yuba, Tehama, Madera, Fresno, Tulare and Kern.

Climate change is increasing the prevalence of wildfire

Even as the Sierra's wildland urban interface is growing, wildfire in the region is becoming more prevalent, according to a recent study published in Science. In the last sixteen years, wildfire activity in the Sierra and Northern California has increased "substantially."

Between 1990 and 2000, the area of the WUI in the core Sierra region grew by 11.55% -- 131,000 acres.

Most of this increased wildfire activity happened in years where spring came early, leaving the forests very dry by late summer and vulnerable to wildfire. The study found that mid-elevation forests are particularly sensitive to these changes, which are brought on by increasing temperature, a direct result of global climate change (Westerling, ibid).

Table 2.2
Area of the Sierra Nevada Wildland Urban Interface in 2000 (in acres)

County	Area of WUI
El Dorado	280,129
Placer	204,784
Nevada	190,892
Calaveras	138,588
Tuolumne	112,350
Mariposa	92,268
Amador	80,067
Lassen	54,006
Plumas	52,409
Mono	35,534
Inyo	16,401
Sierra	6,230
Total:	**1,263,658**

Source: Radeloff, 2005

Projections for the future: More growth in very high risk areas

The California Department of Finance predicts that by 2040, the population of the Sierra will triple to somewhere between 1.5 million and 2.4 million residents.

According to new research by Sierra Nevada Alliance, nearly all of this growth will happen in areas of 'very high' fire threat. We used GIS mapping to identify the amount of land currently designated for rural residential development (parcels from 2 acres to 80 acres in size) that is also classified as very high, or extreme fire threat by CalFire. The results are troubling:

94% of the land designated for rural residential development in the Sierra is in areas classified as very high or extreme fire threat.

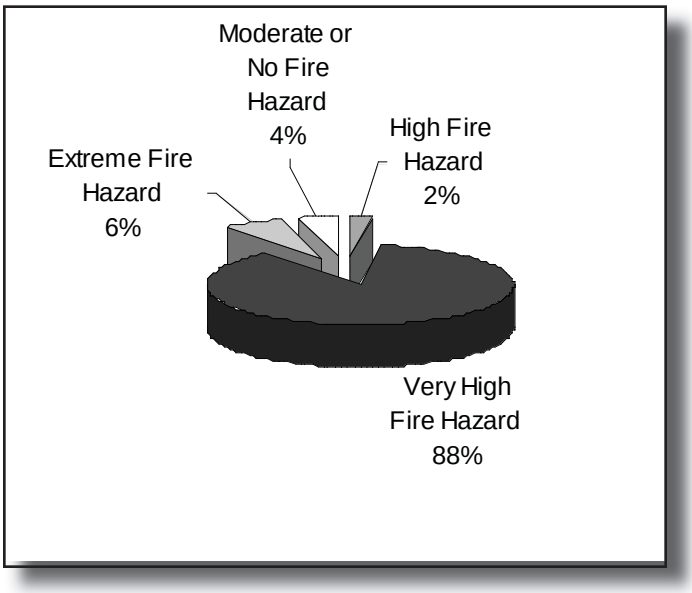
The maps in Appendix C (pages 42-45) illustrate the extent of lands slated for development in high fire threat areas. A summary of results for each county is in Table 2.3 on page 11. More detailed results for each county can be found in Appendix A. Figure 2.4 on page 10 shows the breakdown of lands slated for development by fire threat.

Our analysis clearly shows that the problem of population growth in high fire threat areas of the Sierra will only increase in coming years. As more people move into these areas, the size of the wildland urban interface will increase, bringing with it increased risk of catastrophic wildfire and loss of life and property.

Climate change will compound threat

This problem will be compounded by global warming, which will lead to larger and more frequent wildland fires in the Sierra. According to a 2003 California Department of Forestry report, fire behavior models predict "a sharp increase in both ignitions and fire spread under warmer temperatures combined with lower humidity and drier fuels. . . the net result being an expected increase in both fire frequency and size," (CalFire, 2003).

Figure 2.1 Fire Threat on Lands Designated for Rural Residential Development in the Sierra Nevada



As noted earlier, there is already ample evidence to demonstrate that climate change is already leading to drier, hotter summers and increased frequency and severity of wildfire.

Conclusion: The risk of catastrophic wildfire will grow exponentially

As more and more people look for a home in the Sierra, the compounding effects of climate change and the expansion of the wildland-urban interface will continue to put more lives and property at risk, unless we take a hard look at where -- and how -- we grow. In the next chapter we explore how population growth and development in the wildland-urban interface affects fire management.

Table 2.3 Percentage of rural residential land that lies within *very high* or *extreme* fire threat areas

County	Land Designated for Rural Residential Development	Amount in *Very High* or *Extreme* Fire Threat Areas	% in *Very High* or *Extreme* Fire Threat Areas
Lassen	537,779	487,753	91.0%
Nevada	247,686	247,686	100.0%
Madera	218,865	216,744	99.0%
Fresno	207,052	206,459	99.7%
El Dorado	177,611	177,611	100.0%
Amador	176,857	176,857	100.0%
Butte	155,434	155,434	100.0%
Shasta	158,592	155,184	97.9%
Calaveras	144,477	144,462	100.0%
Yuba	128,766	128,766	100.0%
Plumas	163,127	120,039	73.6%
Placer	103,340	103,340	100.0%
Tulare	99,864	99,596	99.7%
Mariposa	95,663	95,663	100.0%
Modoc	127,126	87,161	69.0%
Tuolumne	64,226	64,069	100.0%
Kern	67,806	39,523	58.3%
Mono	36,552	31,779	86.9%
Inyo	24,613	13,143	53.4%
Tehama	11,478	11,478	100.0%
Alpine	10,683	9,913	92.8%
Sierra*	0	0	0.0%
Total	**2,957,596**	**2,772,658**	**93.7%**

Methodology: *We used GIS data of the General Plans for all 21 California counties that lie partially or fully within the Sierra Nevada Region (Johnston, 2004). Our analysis only includes those portions of the counties that lie within the Sierra Nevada region, as defined by the Sierra Nevada Ecosystem Project study area boundary. We focused on lands classified as low density residential (density range 1 house per 2-20 acres) and very low density residential (density range 1 house per 20-80 acres).We then overlaid CalFire's statewide Fire Threat map to compare areas where high, very high or extreme fire threat overlap with areas classified for rural residential development. This analysis does not distinguish between lands that are already developed and lands that are not yet developed. Also, we did not examine other land classifications, such as commercial, industrial, medium or high density residential, which constitute a very small fraction of development in our region. The General Plan data used for this analysis were compiled in 2000.*

Note: *Sierra County's General Plan does not designate any areas for rural residential development. However there are some areas in which the General Plan does not reflect the reality on the ground. Because of pre-existing entitlements and grandfathered zoning, there are growing rural residential areas in Sierra County (Duber, 2007). This analysis looked only at General Plans, and therefore does not reflect the full potential for rural residential development in Sierra County or, indeed, in other Sierra Nevada counties.*

Chapter 3

How Does Development Affect Wildland Fire?

Development in high fire threat areas affects every aspect of the fire cycle, from prevention to ignition to recovery. As we plan for future growth in the Sierra, thoughtful consideration of how and where we build new homes and businesses, will have a huge impact on our ability to co-exist with fire.

Impact # 1: Development leads to more ignitions. In California, 90-95% of fires are caused by humans. The vast majority of these ignitions are unintentional: Cars, equipment, and debris burning are among the major culprits. Statewide, just 5% of fires are caused by lightning (CalFire, 2005).

Human-caused fires are most numerous in the wildland-urban interface, where people are living in close proximity to flammable vegetation (Cardille, 2001). As the density of people living in the WUI increases, so too does the number of ignitions. CalFire estimates that an increase in density from one house every 50 acres to one house per acre increases the number of ignitions by 189% (CalFire, 1997). A study of wildfire in the Great Lakes region found that the number of ignitions also increases with road density (Cardille, ibid).

Traditional Sierra neighborhoods, like this one in Quincy, have numerous advantages for fire protection. Photo by Autumn Bernstein.

Impact # 2: Development makes it more difficult and costly to fight fires. Protecting houses and other structures in the wildland-urban interface is expensive and difficult, and firefighters are often put in dangerous places they would not otherwise be (Rice, 1991). In the Esperanza fire, for example, five firefighters were killed while trying to protect homes on steep slopes where fire moves quickly.

When a wildland fire occurs, local, state and federal firefighting agencies must make it their highest priority to protect homes from the fire. Thus when there are homes in the path of a major wildland fire, protecting those homes necessarily diverts resources away from fighting the blaze directly. (Winter, 2001). When there is a fire truck parked in the driveway of every home, there are fewer trucks doing 'perimeter control' fighting the fire directly.

This cost difference can be dramatic, as illustrated by two recent fires in Wyoming, one of which occurred in the WUI, and the other in an undeveloped wilderness. The Boulder Creek Fire of 2000 charred 4,500 acres in the Gros Ventre Wilderness, far away from developed areas, and cost $750,000 to extinguish.

In contrast, the Green Knoll Fire of 2001 charred 4,470 acres in the Bridger Teton National Forest near the town of Jackson, where homes were at risk. Firefighters saved 240 homes at a cost of $13 million, or roughly $54,000 per house. This fire was over 17 times more costly than the Boulder Creek fire, despite being the same size (Stanionis, 2006).

Impact # 3: Development limits options for fuel reduction and fire prevention. Once homes are introduced into a high fire threat area, fire managers no longer have the same range of options to manage fire and reduce fuels. In undeveloped areas, fire managers may allow naturally-caused fires to burn, thus reducing the fuel load and allowing the natural fire cycle to run its course. During periods when fire danger is low (late fall or early spring) they may also set prescribed burns for the same reasons.

The incursion of homes into a wildland area makes it vastly more difficult to do prescribed burns or allow natural fires to burn, requiring more hand-thinning and other labor-intensive techniques that allow for fuel removal without using fire that could spread to homes. This increases the costs of fuel reduction and means that limited resources are spread more thinly across the landscape, thereby increasing the risk of catastrophic wildfire (California LAO, ibid).

Clustered vs. low density development: which is better for living with fire?

Development that is clustered in a traditional town design avoids many of these problems. Historic Sierra towns like Auburn, Jackson, Quincy and Truckee were built at urban densities, with little or no wildland vegetation remaining within the historic town areas.

The advantages of infill and town-centered development include:

Compact neighborhoods have a smaller boundary to defend. When houses are clustered together rather than spread out, the perimeter of the community is smaller, and thus firefighters have a smaller boundary to defend in the case of an approaching wildland fire. When the community is spread out over dozens or even hundreds of square miles, it takes many more resources to defend every home.

There's usually less wildland fuel in a town. At higher densities, brush, small trees and other wildland vegetation are reduced and/or discontinuous, so there is often less wildland fuel that can cause a fire to start or spread. The prevalence of irrigated landscaping and paved surfaces also contributes to reducing fuel load in urbanized areas. There is an important caveat, however: once a fire is established in a developed area, the houses themselves become a source of fuel, and firebrands can quickly spread fire from house to house (Sapsis, 1999). This was true of the Angora wildfire.

There are fewer ignitions in a town. Numerous studies have shown that as population increases in wildland areas, the number of ignitions also increases. However, once development reaches an urban or suburban density, it has been shown that the number of ignitions drops off dramatically (Cardille, ibid). This may be due to the decreased amount of flammable fuel in urban settings. Burning yard waste and using machinery such as tractors and large mowers are also two major sources of ignitions, and these practices are also less common in urban areas.

Infill and compact development gets more bang for the fuel reduction buck. Fuel reduction programs are very expensive and resource-intensive. These costs are magnified at low densities, where many acres often need to be cleared for the sake of protecting a single home. At higher densities, residents in a neighborhood or town can pool their resources and invest in fuel reduction projects around the perimeter of the neighborhood or town, thereby sharing both the benefits and the costs.

Infill and compact development allows for faster response times. Houses in and around a town generally have better road networks and are located in closer proximity to fire stations. In low-density areas, homes may be located along roads that are too narrow, too steep, and lack the turnarounds necessary to accommodate large fire equipment (Rice, ibid). Proximity to fire stations is also an issue. Fires that start in remote wildland-urban interface areas take longer to access, and thus are more likely to develop into major fires before crews can reach them (Cardille, ibid). Clustered development makes it easier to locate fire stations within closer proximity to all the homes in the area. These two factors – better roads and proximity of fire stations – make it easier for fire crews to respond quickly to fires and protect assets in a clustered development (Sapsis, ibid).

Water and power are more available in central areas. Towns and denser neighborhoods more often have centralized water supply and better infrastructure, compared to rural development which usually relies upon wells for water and often loses electricity during major fires. Wells are hard to access, especially if the electricity isn't working, and wells also have a lower capacity and are less reliable than municipal water systems. These factors can be important in ensuring that firefighters have quick, easy access to water and electricity to power well pumps. (Sapsis, ibid and Rice, ibid).

Compact development uses fire protection resources more efficiently. Where homes are closer together, less equipment and crews are needed to defend the same amount of homes. When fire threatens homes that are scattered throughout the WUI, one fire truck and crew might be parked outside every single wildland home in the vicinity of a fire to protect it. In a town setting, the same truck and crew could defend a larger number of homes, thereby freeing up resources to protect other areas or attack the fire directly (Rice, ibid).

A tale of two foothill communities

To illustrate how clustered development is better for fire protection than sprawling development, let's take a hypothetical example. Imagine you have two Sierra foothill communities of 1000 homes each. Both communities are located in identical environments: a mix of mid-elevation forest and chaparral. Both have a historic town center that is one square mile across (640 acres), and both have recently added 1,000 new homes. In one community, let's call it Ranchetteville, those new homes are low-density ranchettes. In the other community, Townville, those 1,000 new homes were added in a compact, town-centered fashion. Let's examine the fire implications of each.

Ranchetteville:
Maximum risk, Minimal protection

In Ranchetteville, the new development is a 5,000 acre ranch adjacent to the historic town center that has been divided into 1,000 parcels. Each new home is on a 5-acre ranchette, intermixed with forest and chaparral. There is a fire station along the main road leading through the area, and most homes are accessed via a maze of paved and dirt roads, some public, some private. Conditions on these roads vary according to the landowner, the time of year, the grade and the county budget for road maintenance. There is no centralized water district, so every home has its own well and septic system.

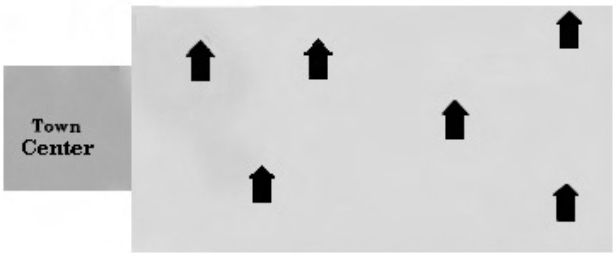
Because this new development is so large, it has increased the length of the perimeter of Ranchetteville by 9.8 miles, an increase of 245%. Local fire managers in Ranchetteville have a very large boundary to defend in the case of a wildland fire.

The average rate of ignitions in this new community is very high, since there are so many people driving cars, burning debris, and using heavy equipment in this forested, low-density setting. The cost-benefit ratio of fuel-reduction projects in this community is very low, because the perimeter of the community is long, and there is a large amount of flammable wildland vegetation within the community itself. Large amounts of forest must be cleared and thinned around every home. The fire station has a large territory to cover, and thus the average response time is relatively long, increasing the likelihood that fires will burn out of control before firefighters can respond. Road conditions, water supply and power generation are all challenges. In the case of a large fire, many trucks and crews are needed to protect homes.

Townville: Lower risk, more protection

In our other hypothetical community, the new 1,000 homes were added a traditional, compact neighborhood design on 480 acres directly adjacent to the historic town center. Each home is on slightly less than half an acre. All homes are connected to a municipal water system, and the number of people living in close proximity means that the road network is smaller and better maintained, and every home is within easy reach of the fire station.

Figure 3.1 Ranchetteville



In Ranchetteville, new development is scattered on 5-acre parcels far from the existing town center.

Figure 3.2 Townville

In Townville, new development is clustered around the existing town center.

Low-density development near the town of Arnold illustrates what Ranchetteville might look like. Photo by Darin Dinsmore.

Tuolumne City, near Sonora, illustrates what Townville might look like. Photo by Darin Dinsmore.

Table 3.1 Perimeters of Ranchetteville and Townville after new development

	Ranchetteville	**Townville**
Number of new homes	1,000	1,000
Average parcel size	5 acres	.48 acres
New perimeter to defend	9.8 miles	2.5 miles

In this case, the perimeter of Townville has grown by 2.5 miles, an increase of just 62% for the same amount of population growth. Fire managers in Townville have a much smaller perimeter to protect in the case of a wildland fire.

Within both the community itself and the surrounding wildland, the average rate of ignitions is lower. This is because there is less wildland vegetation within the community itself – landscaped yards, driveways and roads provide fuel breaks.

The cost-benefit ratio of doing fuel reductions in this community is high, because the perimeter is small and there is less wildland vegetation within the community itself. Fire managers might want to extend fuel treatment into the surrounding wildlands, but the bare-bones area that must be treated to keep the community safer is dramatically smaller than in the case of Ranchetteville.

When a fire starts inside the community, fire crews can respond quickly because the fire station is within easy reach of every home. Water and power are in ready supply. In the case of a large wildland fire bearing down on the town, crews have a much smaller perimeter to defend, and smaller numbers of trucks and crews are needed to defend each home. Thus, more resources can be directed toward the fire itself.

Conclusion: Town-centered development can save lives, assets and money

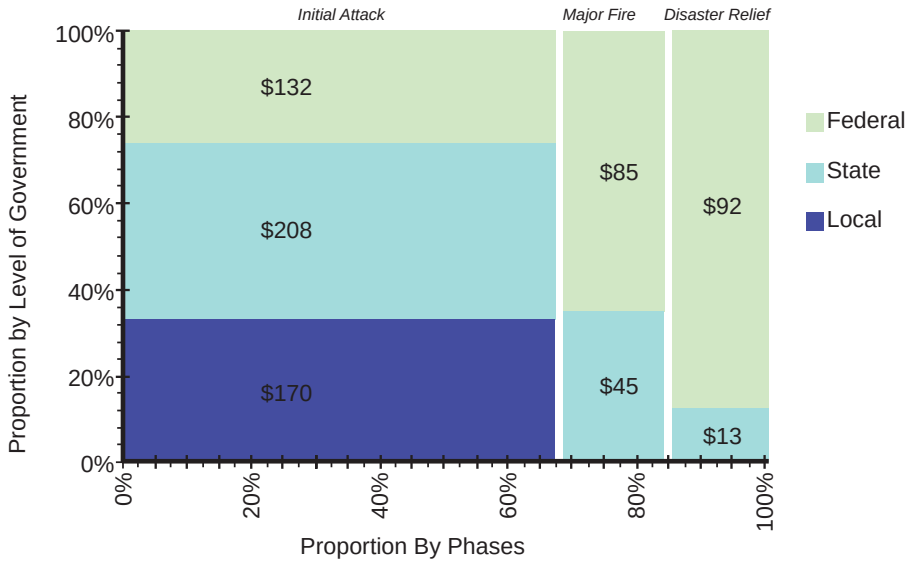
Development in high fire threat areas of the Sierra is inherently dangerous, and the risk of catastrophic wildfire and its associated loss of life and property is, to a certain extent, unavoidable. However, community design can play a large role in minimizing exposure and reducing losses. Town-centered development has numerous advantages over low-density, rural residential development when it comes to fire safety, and these factors should be considered by counties, cities and developers when planning for new development in the Sierra.

Chapter 4
Subsidizing Disaster: Who Pays for Protecting Unsafe Development?

The costs of fighting wildfire are staggering, and they continue to grow every year. Protecting and rebuilding homes in the wildland urban interface adds substantially to these costs, much of which are borne by the taxpayers and the public at large.

The federal government, the State of California and local governments all have a role in managing wildfire in the Sierra and each of them plays some role in subsidizing unsafe development. Currently the state and federal governments shoulder a disproportionately large burden of fire protection costs, while it is local governments that are approving development that compounds fire danger. Figure 4.1 on page 16 shows a breakdown of fire agency budgets.

Figure 4.1
State, local and federal wildlife agency budgets



Automatic aid agreements

Most fire protection agencies in the Sierra operate under agreements that the closest firefighting unit will respond to a fire, regardless of whose jurisdiction it falls in. Thus, if a fire breaks out on national forest land and the nearest fire station is operated by the California Department of Forestry and Fire Protection, then CalFire will respond until the Forest Service is able to take over. The Forest Service will then reimburse CalFire for the costs it incurred in fighting the fire.

Local Governments: Stretching thin resources even thinner

Fire Responsibility: Local government agencies – in the Sierra, usually county governments- are responsible under state law for providing fire protection in densely populated communities (known as 'Local Responsibility Areas' and defined as more than 3 houses per acre). To do so, most local governments have established fire districts and/or fire departments that protect homes and businesses within fixed geographic boundaries. Local governments also frequently take the lead in protecting homes and structures in wildland areas known as State Responsibility Areas, or SRAs, discussed below.

Some Sierra counties, cities and fire districts contract with CalFire to provide fire protection and emergency services in Local Responsibility Areas, rather than have their own separate fire departments. These contracts are referred to as "Schedule A" agreements. These agreements are common in rural Sierra counties with small populations, where it makes better economic sense to pay CalFire to provide these services. In these instances, CalFire is reimbursed by the county or city for providing local fire protection.

Annual spending on wildfire in California: For the last several years, California counties have experienced double-digit increases in fire protection spending. In 2004-2005, California counties spent $352 million on fire protection, a 12.5% increase over the year before (California State Controller, 2007).

Where the money comes from: Local fire agencies are usually funded by the County's general fund, special property taxes, or special assessment districts. As a result of Proposition 13 and other state fiscal policies, local governments in California have far fewer discretionary funds than they did 30 years ago. As a result, general funds are stretched thinner, even while development puts more and more pressure on existing fire resources.

How local governments are subsidizing unsafe development: Every time a new house is built in the WUI, that home is added to the growing pool of homes sharing a finite resource: the local fire response system. This includes fire stations, trucks and engines, firefighters and dispatchers, roads, fuel reduction programs and emergency water supplies. Increasing the number of homes in a fire district without increasing the capacity of the district itself means longer response times, fewer proactive inspections, and fewer fuel reduction and community education programs.

Thus, existing residents are subsidizing every new home that is built in their district. A report by the California Legislative Analyst's Office found that:

> *"As the number of structures in and adjacent to wildland areas continues to grow, the costs for structure protection in connection with wildland fires have increased significantly." (California LAO, ibid)*

Some jurisdictions now levy impact fees on every new home to offset the additional burden on local fire districts. However, nationwide studies of impact fees consistently find that most impact fees fall far short of fully offsetting the true costs of new development. A study by Virginia Tech found that impact fees need to be increased an average of 8 to 22 times.

State of California: Robbing Peter to protect Paul?

Fire responsibility: The California Department of Forestry and Fire Protection, also known as CDF or CalFire, is responsible for fire protection on all rural lands in California that are not owned by the federal government. This includes private forest and ranchlands and rural lands owned by the state and local governments. These lands are known as "State Responsibility Areas," or SRAs. There are 31 million acres classified as SRAs in California. Less than 1% of SRAs are public land. Figure 4.2 lists the acreage of SRAs in all Sierra counties. Other state agencies, including the Office of Emergency Services, Department of Corrections, and Department of the Youth Authority also play a limited role in fighting fires in conjunction with CalFire (California LAO, ibid).

Table 4.2
State Responsibility Areas (SRAs) by County
(includes entire county, not just Sierra portion)

County	Acres	County	Acres
Alpine	38,200	Modoc	628,600
Amador	291,400	Mono	198,100
Butte	525,100	Nevada	386,900
Calaveras	526,700	Placer	384,400
El Dorado	564,600	Plumas	428,800
Fresno	763,500	Shasta	86,900
Inyo	218,600	Sierra	794,800
Kern	1,764,500	Tehama	1,276,600
Lassen	1,028,200	Tulare	603,000
Madera	373,000	Tuolumne	356,100
Mariposa	442,900	Yuba	213,700
		Total	**11,894,600**

When the SRA system was originally set up during World War II, State Responsibility Areas in the Sierra were sparsely populated timber and ranchlands, where very few lives and homes were jeopardized by wildfire. They were considered worthy of statewide protection because of the timber and watershed values they provided. Today, however, SRAs include some of the fastest-growing parts of the Sierra.

CalFire's role is supposed to be fighting wildland fire, while local fire districts protect homes and structures. In practice, however, protection of life and property is rightly CalFire's top priority and frequently local districts lack the capability to protect all homes, so CalFire often winds up playing this role as well.

In some counties, CalFire is the sole fire protection agency, having entered so-called 'Schedule A agreements' to provide all the County's fire protection services, even in local responsibility areas. These are usually very rural counties that lack the tax base and/or population density to sustain an independent fire district. These counties essentially 'contract' out their fire protection to CalFire.

CalFire's role doesn't stop there. As rural parts of the Sierra become increasingly developed, CalFire's costs for responding to non-fire (usually medical) emergencies in those areas also increases. According to the California Legislative Analyist's Office:

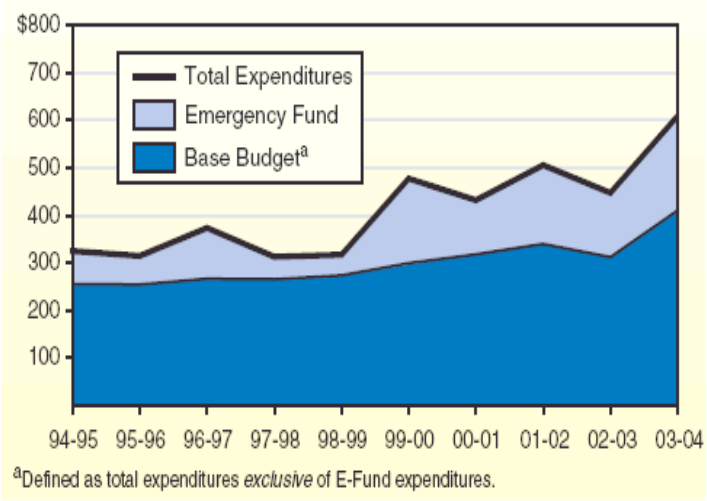
> *"In the fast-growing foothill region of the Sierra, CalFire reports that the number of its life protection-related emergency responses more than doubled between 1993 and 2000 – increasing from 10,000 to 25,000 responses." (California LAO, ibid).*

Annual spending on wildfire: $500 million

Where the money comes from: CalFire's firefighting programs are almost exclusively funded by the State of California's General Fund. Reimbursements from local fire districts account for 3% of CalFire's budget. Another 3% comes from federal trust funds, and the remaining 94% comes from the General Fund (California LAO, ibid).

How the State of California is subsidizing unsafe development: CalFire's firefighting operations are funded almost exclusively by the General Fund – in other words, by California taxpayers. But where is the public benefit to justify this public financing? The SRA system was originally set up to protect undeveloped wildlands that provide benefit to the general public by providing quality drinking water and timber. Besides, the cost of fighting fires in undeveloped wildlands remained relatively low for many years.

Figure 4.3
CalFire's Wildland Fire Protection Expenditures 1994-2004 (in millions)



Source: California LAO, ibid

But as development increases in SRAs, bringing with it increased hazards and costs, who is paying for those increased costs, and who is benefiting?

In theory, local fire districts reimburse CalFire for costs incurred in protecting homes and structures, but these reimbursements cover only 3% of CalFire's annual budget. Meanwhile, the costs of fighting fire in SRAs have increased an average of 10% per year over the last decade, and much of this increased cost is due to increasing numbers of homes in SRAs. According to the Legislative Analyst's Office, "Increasing development in the WUI translates into increased fire protection costs." (California LAO, ibid).

Figure 4.3 shows CalFire's increasing expenditures for wildland fire protection between 1994 and 2004. The budget is divided into two figures: base budget and emergency fund. The base budget includes the day-to-day costs of operating CalFire facilities, fighting fires, payments to contract counties, and fire prevention costs. When additional resources are needed to fight large fires, these come out of the Emergency Fund.

As development continues in SRAs, these costs will also continue to rise, increasing the disparity between who pays for fire protection -- all taxpayers; and who benefits -- homeowners in the WUI.

Federal Government: Protecting more than just national forests

What they do: The USDA Forest Service is primarily responsible for managing fire on federal lands. In the Sierra, there are 8.5 million acres of land managed by the Forest Service (Sierra Nevada Ecosystem Project, 1996). Like CalFire, the Forest Service areas of responsibility co-mingle with private lands in many places, so the Forest Service also has agreements with local agencies to help respond to nearby fires, even if those fires don't occur on federal land (California LAO, ibid).

The federal government also plays a role in post-fire recovery, usually through the Federal Emergency Management Agency. FEMA provides loans and grants to assist fire victims in rebuilding their homes and businesses.

Annual spending on wildfire (nationwide): $1-1.5 billion (USDA Office of Inspector General, ibid).

Where the money comes from: The USDA Forest Service is funded primarily by general fund allocations from Congress, with limited reimbursements from local fire districts.

How the federal government is subsidizing unsafe development: A 2006 audit by the USDA's Inspector General found that protecting WUI homes adjacent to federal land was responsible for 50-95% of the $1 billion spent annually by the Forest Service to suppress large wildfires nationwide. (USDA Office of Inspector General, 2006). If that number is correct, then the federal government is providing subsidies of $500 million to $1 billion per year for individual homeowners in the wildland urban interface.

By doing so, the audit contends, the Forest Service is removing incentives for homeowners to take responsibility for their homes. The audit recommends that state and local governments that approve development in the WUI should shoulder more financial responsibility for fire suppression in those areas. (USDA Office of Inspector General, ibid).

Conclusion: State, federal and local agencies are all subsidizing unsafe development

Local, state and federal agencies all play an important role in fire management in the Sierra. CalFire and the US Forest Service are larger and better funded than local fire districts, so when a major wildfire sweeps through the region, these two agencies often shoulder most of the burden. Both agencies are funded by the taxpayers at large, not the individual WUI homeowners whose homes are in danger. Thus, homeowners in the WUI are essentially getting a public subsidy from the state and federal governments to build homes in unsafe places.

Local governments are also responsible for subsidizing unsafe development because they are the agencies which approve new development in the first place. Local governments can help ensure that new development pays a fair share of fire protection costs, by imposing impact fees on new homes that flow to local fire districts. However, very few local governments in the Sierra charge any impact fees whatsoever, let alone fees that are adequate to cover the costs of fire protection.

State, federal and local agencies all play a role in subsidizing unsafe development in fireprone areas. Photo by Zeke Lunder.

Chapter 5

Why current land use policy is failing at-risk communities

The interrelationship of fire and development in the WUI is not news to fire managers, land use planners and decision makers. However, the status quo doesn't do enough to ensure that we are minimizing the risk to lives, assets, watersheds, wildlife and ecosystems.

Current fire prevention policy focuses on site-specific solutions such as clearing defensible space, selecting building sites to minimize fire danger, and building with fire-retardant materials. In this chapter we discuss the limitations of this approach, and argue that fire-safe planning must evolve to look at the neighborhood and community scale.

The current policy framework: Site-specific requirements

Currently, fire-safe planning relies primarily upon building and zoning codes that apply to individual homes and/or building sites, or sometimes new subdivisions. This system places the burden of responsibility on individual homeowners or developers, who implement the standards at a site- or subdivision-specific level during and after construction. When new homes are sold, the owners are responsible for ensuring the homes stay up to code.

These codes often mandate that new homesites provide adequate road access, water and power. Non-flammable building materials and fire-retardant vegetation may be required. Builders may be required to site a new building away from steep slopes, ridgelines or other especially hazardous areas. Homeowners may be required to maintain defensible space around the home by cutting trees and shrubs.

The creation of these codes has been an important step toward improving fire safety and decreasing losses of life in the WUI. However, current research and the historical record show that this site-specific approach to fire safe planning has serious shortcomings. For example, many of the 1,000 homes that burned in the 2003 Old and Grand Prix Fires in Southern California were in compliance with local fire safety codes. In the 18 months after these devastating fires, cities and counties in the Inland Empire issued permits for another 2,500 homes in areas of 'extreme' or 'very high' fire danger (Miller, 2005).

Homeowner reluctance: An obstacle to implementing codes

One major problem confounding the success of firesafe codes targeted at individual homeowners is the reluctance of the homeowners themselves. Numerous studies have shown that fire safety programs focused on changing individual homeowner behavior have limited success, because many homeowners are concerned about the cost and aesthetics of firesafe strategies, and they question the effectiveness of the programs (Nelson, 2005). Nationwide, the majority of new homeowners in the WUI take no action to reduce their home's risk of wildfire (National Academy of Public Administration, 2002).

Many of the 1,000 homes that burned in the 2003 Old and Grand Prix Fires in Southern California were in compliance with local fire safety codes

Yet most firesafe building and zoning codes are predicated on the assumption that homeowners in high fire risk areas will keep their homes up to code. While many codes impose fines on homes that are out of compliance, enforcement of the codes in most parts of California is sporadic at best, due to lack of funds. Enforcement duties generally fall upon local fire departments that often don't have the resources to enforce the code.

For instance, in 2004 Riverside County firefighters issued 20,000 warning notices to homes that were out of compliance with fire safety codes, but were

unable to follow up on most of the warning notices. In total, only 15 citations were issued (Miller, ibid)

Clearly, the current practice of requiring individual homeowners to implement fire safety practices is important and shouldn't be discarded. However, given the documented shortcomings of these programs with regard to homeowner reluctance and lack of enforcement, planning and zoning codes need to look beyond individual homes and building sites to ensure that new development is safer.

What we're missing: The big picture

What all these zoning and building codes fail to do is look at fire in the larger planning context. In every community there are areas which are more dangerous to develop and areas which are safer. Topography, vegetation, slope, proximity to existing emergency services, roads, and municipal water supply are just some of the features which can help determine which areas are safer for development, and which are more dangerous. By looking at fire danger at the scale of the entire community, rather than the individual property, city planners and fire managers can direct growth into safer areas, and limit development in areas of extreme hazard (Schwab, 2005).

Disconnect between who approves development and who protects it

So why are local governments not looking at fire in this larger context? Why are they relying upon site-specific planning for fire safety?

One major reason is the disconnect between who approves new development and who pays the cost of protecting that development from fire. As discussed in the previous chapter, state and federal agencies shoulder the vast majority of firefighting costs in California's wildlands. However, it is local governments – in the Sierra, usually counties – who are responsible for developing land use policies and zoning codes and approving development. As the California Legislative Analyst's Office puts it:

> *"The decisions on where and how these homes are built are generally made at the local level. However, the consequences of these decisions are experienced at both the state and local level. . . when a large wildland fire threatens a development, firefighting resources for structure and life protection beyond those available at the local level are often needed. The cost of those additional resources is generally borne by state taxpayers rather than local residents." (California LAO, ibid).*

Local governments in California, especially rural counties like those in the Sierra, are cash-strapped and often struggle to sustain important programs like health care and road maintenance as well as public safety. The reasons for this poor fiscal situation are many and complicated, but the end result is that cities and counties across California, particularly in rural areas, are desperate for cash. New development of any kind generates short-term revenue that local governments can use to meet their budgets. This creates a powerful incentive for local governments to approve new development despite potential consequences to public safety and the environment.

Because local governments shoulder just a fraction of the costs of fighting wildland fire and receive most of the short-term economic benefits of approving new development, there is little financial incentive for them to keep development out of dangerous areas.

The myth of subdivision rights

In addition, some local government officials operate under the mistaken assumption that landowners have a legal right to subdivide and develop their land as much as they wish, regardless of the impacts to the community as a whole. This assumption is not legally correct, as State and Federal Courts have repeatedly held that there is no right to subdivide and split parcels. Both the state and federal governments delegate land use planning responsibilities to local governments, and require only that landowners must be allowed some economic use of their land, not any economic use. Since most landowners do enjoy some economic use of their land (such as farming, grazing, logging and building one house per parcel), there is no legal justification for allowing new subdivisions that jeopardize public safety. California Government Code section 66474 states that a subdivision may be denied if it is "likely to cause public. . . safety problems."

In the next chapter, we explore ways that federal, state and local policy can be reformed to encourage fire-safe planning at the community scale.

Chapter 6
Principles for Planning Fire-Safe Sierra Communities

"Including fire standards in general plans and subdivision regulations is not enough to prevent the devastation of a major fire. The fact is that 32 million Californians live in a tinderbox. And with a half-million more per year on the way, it's impossible to change the situation – unless public officials and the voters who elect them decide they're willing to pass regulations that would keep people from building in the woods."

- Bill Fulton, California planning expert (Fulton, 1995)

So what can local communities and state and federal agencies do to improve land use planning to prevent catastrophic wildfire in the Sierra?

We propose that land use planning in high fire threat areas should adhere to the following principles:

1. **Make development pay its own way**
2. **Cluster development in and around existing communities**
3. **Don't build in unsafe places**
4. **Manage the forested landscape to restore resiliency and reduce fire hazard**
5. **Improve planning and budgeting processes to fully address risks**

An initial investment in improving and updating General Plans and zoning codes will be cheaper than trying to fight fires in poorly-planned communities twenty years from now. This chapter explores each principle and recommends actions that communities and government agencies can take to implement them.

Fire-Safe Planning Principle 1: Make development pay its own way

Landowners contemplating development in high fire threat areas should be required to pay the full cost for protecting new development from fire. Such a policy would both discourage irresponsible development and ensure that taxpayers aren't unfairly shouldering the burden for protecting new homes in unsafe areas. The State of California used to impose a state fire protection fee on homeowners in areas where CalFire is the only source of fire protection (State Responsibility Areas or SRAs). In the years since the State of California suspended this fee, CalFire's costs for providing fire protection have skyrocketed. We suggest that the State of California and local governments should work together to reinstate such a fee that helps offset both state and local costs in protecting these homes.

To implement this principle, local, state and federal agencies can take the following actions:

Local Government Actions:

Impose impact fees that pay true costs: Cities and counties should levy fire impact fees on new development that reflect the true cost of providing fire protection and fuel reduction over the long term. These fees should be collected annually by the local government in conjunction with property taxes. The fees should be used to fund local fire districts and fuel reduction programs. The fee program should be structured to reflect relevant factors such as development intensity, fire risk, and proximity to existing roads and services. Voluntary fuel reduction measures by homeowners should be rewarded with lower fees.

Assist CalFire in collecting a state fire protection fee: When local governments approve new development in areas where CalFire must provide fire protection (State Responsibility Areas, or SRAs), they should work with

CalFire to impose and collect a reinstated fire protection fee (see State of California recommendations, below). Local governments should also help CalFire impose reinstated fire protection fees when existing homes within SRAs are sold or transferred.

Establish fire assessment districts in already-developed areas: To improve fire safety in already-developed areas, local governments and voters can establish fire assessment districts (see sidebar). Revenue generated from annual assessments should be used to fund the local fire districts and fuel reduction programs.

State of California Actions:

Reinstate fire protection fees linked to development: The State of California should reinstate fire protection fees that are linked to development intensity in SRAs. Unlike the flat fee which was debated in the California Legislature in 2004-2005, this fee should only apply to parcels which are developed. To minimize costs associated with administering such a program, the state could work with local governments to collect the fee in conjunction with subdivision approvals, issuance of building permits, and property tax reassessment.

Fire-Safe Planning Principle 2: Cluster development in and around existing communities

While no development in high fire threat areas is completely safe, clustering development in and around existing communities has numerous benefits for fire response and prevention. Local governments should encourage infill development and concentric outward growth while discouraging rural sprawl. There is a range of planning tools available to help local governments direct growth into appropriate locations.

Local Government Actions:

Promote infill first: Putting new development within existing communities, rather than allowing it to sprawl outward, can help prevent the expansion of the WUI, keep emergency response times short and make fuel-reduction programs more cost-efficient. Local governments should identify infill sites and encourage development of these areas. Tools such as redevelopment, transfer of development rights programs, and

Definitions

Fire Assessment District: An Assessment District is a special district formed by a local government agency and includes property that will receive direct benefit from the new public improvements or from the maintenance of existing public improvements. Fire Assessment Districts often pay for fuel reduction programs, construction of new fire stations, and other improvements. The local agency that forms the assessment district sells bonds to raise the money to build or acquire the public improvement. The agency then levies a special assessment against each parcel of land within the district, which is included on the County's general property tax bill.

Impact fee: An impact fee is a fee assessed on new development, usually by a local government. The purpose is to pay for expansion of new infrastructure such as fire stations, sewer and water, parks, and other government services. Impact fees may also be assessed to offset impacts to the environment or surrounding community. The fees are used to mitigate the impacts of the development.

State fire protection fee: Historically, the state of California collected a fire protection fee from all private properties located in a State Responsibility Area (areas that receive fire protection from CALFIRE). This fee used to offset CALFIRE's cost for protecting these properties from fire. The fire protection fee was suspended and recent attempts to reinstate the fee were unsuccessful.

Transfer of Development Rights (TDR): TDR is a market-based approach used by local governments to encourage development in certain places, and discourage development in others. TDR programs allow landowners to sever development rights from properties in areas that are to be protected as open space, and sell those development rights to landowners to increase the density of development in areas targeted for intensive development.

Redevelopment: California law authorizes local governments to identifydeteriorated areas where market forces alone aren't sufficient to revitalize the area. In Sierra communities, these areas are often abandoned railyards or lumber mills, or historic downtowns that have been left behind by highway bypasses or strip development on the edge of the community. Through a process known as 'redevelopment,' agencies develop a plan and provide the initial funding to encourage private investment in those areas. Redevelopment actions include capital improvements, direct public investments, and providing tax benefits to new development.

other incentives can be used to encourage infill development.

Concentric outward growth: Where there is no room for infill development, local governments should encourage concentric outward growth that is compact and orderly. As with infill development, such growth patterns will discourage rapid WUI growth and use fire prevention and response services efficiently. Concentric outward growth will also help avoid creating isolated pockets of wildland vegetation that can cause fires to spread to surrounding homes. Tools such as general plans, urban growth boundaries and urban reserve systems can be used to foster concentric growth patterns.

Cluster development: New development in remote areas far from existing towns and communities should be strongly discouraged. However, in situations where development is unavoidable due to existing entitlements, communities should be designed to minimize fire danger. New subdivisions in remote areas should be designed to optimize safety and access, by clustering new lots in low-threat areas close to access roads. These new clustered developments should provide a permanent ¼ mile buffer of defensible space on all sides. This buffer must be maintained on an ongoing basis. Local governments can require clustering and buffers as part of the General Plan, zoning code, and/or subdivision regulations.

California and Federal Government Actions:

Assist in developing local codes and regulations: CalFire and the USFS already play an important role in reviewing proposed plans, codes and development applications in some parts of the Sierra. CalFire and USFS could expand their role in local policy development by providing technical assistance, planning grants, stakeholder convening, and policy development in partnership with local governments.

Better land use planning can help protect communities from wildfire while preserving the health of Sierra forests, watersheds and wildlife. Photo by Autumn Bernstein.

Fire-Safe Planning Principle 3: Don't build in unsafe places

Within a given community or county, some places are more prone to fire danger than others. Brushy areas, steep slopes, ridgelines and south-facing hillsides, for example, are often more hazardous than other areas within the surrounding landscape. Other areas may pose a particular threat to an established community, such as a brushy canyon that sits adjacent to a town. New development should be curtailed in places that put new or existing residents at increased risk of catastrophic wildfire.

Local Government Actions:

No new parcels in high fire hazard areas: Use zoning and the development code to restrict the creation of new parcels in high risk areas outside fire district boundaries. Maintain zoning in these areas at very low densities, such as 160 acres or 320 acres per parcel. Existing smaller parcels are grandfathered in such ordinances, but at least further parcelization is prevented.

Limit development of existing parcels in high fire hazard areas: Use tools such as conservation easements, transfer of development rights programs and fee-title acquisition to limit development of existing parcels in high fire hazard areas that have multiple resource values (e.g. wildlife, watershed, agriculture etc)

Create fire protection boundaries: Establish a service boundary for the local fire district, and require new development outside the boundary to reimburse the fire district for 100% of costs rendered to protect structures from fire.

California and Federal Government Actions:

Enact legislation limiting further subdivision of lands in State Responsibility Areas. Since the State of California is responsible for fire protection in SRAs, the state should take action to limit development that will increase fire danger and drive up taxpayer-funded fire protection costs in these areas.

Definitions

Incentives for infill development: In addition to redevelopment, local governments can offer other incentives to encourage infill development. These include streamlining the permit process, creating flexible zoning codes for infill areas, and creating a community plan or specific plan for the area that undergoes environmental review at the plan level, thereby reducing the amount of review necessary for individual projects within the plan area.

Urban growth boundaries: UGBs designate where urban growth will be allowed to occur, and which areas will remain as forest or rangeland. A UGB is essentially a line drawn around a community that divides urban from rural. Some UGBs are permanent, while others have a 'sunset' provision and must be reconsidered after 10-30 years.

Clustering ordinance: Local governments use clustering ordinances to minimize the footprint of new development in remote areas. New development is 'clustered' into the portion of the property that is the least hazardous, is close to existing roads and infrastructure, and/or avoids environmentally-sensitive areas. The remainder of the property is permanently protected.

Urban reserves: Urban reserves are areas set aside for development at a future time, usually 10-20 years in the future. The designation of urban reserve is usually accompanied by a set of 'triggers' or thresholds that must be achieved in order for development to begin. Urban reserves are used to preventing premature or 'leapfrog' growth.

Conservation easements: Conservation easements are used by local governments, land trusts or other entities to purchase the development rights for a piece of property to keep it undeveloped, while allowing the private owner to retain ownership of the land and use it a manner consistent with the easement (such as agriculture, timber harvesting or recreation).

Fee-title acquisition: When a local government, land trust or other entity purchases a property outright for the purpose of conservation, this is known as 'fee-title acquisition.'

Support efforts to protect undeveloped lands: State and federal government agencies can provide grants to assist with conservation easements and fee-title acquisition of certain lands which should remain undeveloped, such as those with multiple resource values. In addition, agencies can provide planning grants and technical assistance to help communities establish local districts to manage conservation easements, land acquisition, and transfer of development rights programs.

Assist in developing local plans and codes: CalFire and the USFS already play an important role in local planning in some parts of the Sierra. CalFire and USFS staff often review draft plans, codes and development applications and make recommendations. CalFire and USFS could expand their role in local policy development by providing technical assistance, planning grants, stakeholder convening and policy development in partnership with local governments.

Fire Safe Planning Principle 4: Manage the forested landscape to restore resiliency and reduce fire risk

100 years of fire suppression and logging large, fire-resistant trees have made our forests a tinderbox. State, federal and local agencies should support responsible forest management practices that restore resiliency and reduce the risk of catastrophic crown fire. In forests near communities that are important for protecting life and property, we should not allow forest management that increases fire danger.

Local Government Actions:

Work in partnership to manage the local wildland urban interface: In those places where local community meets the forest, do thinning and treatment to manage the WUI. Partner with community organizations, fire safe councils to work at making fuels management viable and cost-effective.

Require and enforce defensible space: Require new and existing homeowners to create defensible space and implement fire safe measures around their homes. Boost staffing and budgeting for enforcement.

Encourage safe timber harvest: Local governments have limited authority over forest practices which are governed by the state. They do have the authority to determine land zoning which does affect forestlands in their jurisdiction. If approved by the state Legislature, local governments should create a wildland-urban interface timber production zone designation that would guide timber harvest near communities to ensure that any logging that occurs does not increase fire severity behavior that can threaten homes.

State of California Actions:

Support fuel reduction effort in the WUI: Increase investment in programs to help local communities reduce fuels in the WUI. Provide technical assistance, stakeholder convening, grants and personnel to develop and implement local fuel reduction plans.

Develop a WUI timber harvest zone: The state should develop a wildland urban interface zoning designation for forestlands in California so that local governments can control forest practices near communities to reduce wildfire risks. The state should also pass forest regulation changes that limit forest conversion to plantations and require shaded fuel breaks in areas adjacent to communities and in high priority areas identified in existing emergency regulations promulgated by the Board of Forestry.

Federal Government Actions:

Support responsible forest management: Increase funding for community pre-fire suppression activities and stewardship contracts. Increase investment into restoration on public lands. Encourage fire-resilient management on private lands.

State, federal and local agencies should partner to restore healthy forests. Photo by Zeke Lunder.

Fire-safe planning principle 5: Improve planning and budgeting processes to fully address risk

Lastly, all levels of government involved in wildland fire prevention need to improve planning and budgeting to adequately plan and prepare for coordinated wildfire prevention and response efforts. If we are to take action, we must first understand the full scope of the problem.

Local Government Actions:

Bring fire agencies to the table: Local governments should ensure that fire safe councils, local fire departments, CalFire and USFS have a meaningful role in land use planning efforts and decisions. Representatives from all fire agencies should be invited to the table early on in planning processes to ensure that their concerns are adequately addressed.

Improve understanding of threats: New analytical tools such as fire behavior modeling can be used to assist planners and landowners in mapping how wildfire is likely to burn through an existing community or planned development. These tools can identify high wildfire hazard areas, inform land use decisions, and prioritize areas for fuels treatment.

Assess true costs of fire protection – and budget accordingly: Most Sierra counties lack the funding to adequately fund fire prevention. Funding mechanisms such as impact fees and assessment districts are non-existent or woefully inadequate. Local governments should examine the true, long-term costs of fire prevention and protection and create or expand these mechanisms to attain budgetary needs.

State of California Actions:

Strengthen CEQA requirements for fire threat: The California Environmental Quality Act (CEQA) encourages agencies to consider wildfire threat as a potential impact that should be examined and mitigated. However, this provision is rarely utilized and many projects are approved without mitigation. The State of California should revise CEQA to clarify how impacts should be analyzed and suggest mitigation measures.

Definitions

Fire behavior modeling: GIS mapping technology has led to the creation of powerful new computer programs which allow fire experts to 'map' the likely behavior of wildfire in a community or landscape. These programs use fuels, weather, and topographic information to create graphical portrayals of potential wildfire spread patterns, rates of spread, and burn intensities.

CEQA: CEQA is short for the California Environmental Quality Act. CEQA requires government agencies, including cities and counties, to analyze the potential environmental impacts of a proposed action – such as approving a new subdivision – and 'mitigate' those impacts to the extent possible. CEQA is the premiere law governing the approval of new development in California.

Mitigation: Under CEQA, actions that are taken to offset the impacts of a project are called mitigation. Mitigation measures are the specific requirements which will "minimize, avoid, rectify, reduce, eliminate, or compensate" for significant environmental effects. See Section 15370 of the CEQA Guidelines for a full definition.

Conclusion: The choice is ours

The threat of catastrophic wildfire in Sierra communities has increased dramatically in recent years and will only get worse unless local, state and federal agencies, in partnership with Sierra residents, NGOs and community groups, work together to address the underlying issues of poor planning and subsidies that encourage dangerous development.

Bold leadership and decisive action are needed to address these challenges. Every day that we avoid dealing with this problem, more Sierra residents, communities, and ecosystems are put at risk.

We can build thriving communities that are safer and sustainable, by making an upfront investment in good planning that will save lives and money in the long run. Or we can continue with business as usual and deal with the consequences every fire season to come. The choice is ours.

Appendix A:
Fire and Land Use Statistics by County

Alpine County

Area of Wildland Urban Interface [1]: 4,850 acres

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	1,867	8,816	10,683
Acres in Very High Fire Threat Class	1,841	8,072	9,913
% in Very High Fire Threat Class	99%	92%	93%
Acres in Extreme Fire Threat Class	0	0	0
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**1,841**	**8,072**	**9,913**
% in Very High or Extreme Fire Threat Class	**99%**	**92%**	**93%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	991	1,075	85	9%

Amador County

Area of Wildland Urban Interface [1]: 80,067 acres

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	34,735	142,122	176,857
Acres in Very High Fire Threat Class	34,735	142,122	176,857
% in Very High Fire Threat Class	100%	100%	100%
Acres in Extreme Fire Threat Class	0	0	0
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**34,735**	**142,122**	**176,857**
% in Very High or Extreme Fire Threat Class	**100%**	**100%**	**100%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	24,646	27,998	3,352	14%

1. Data is for entire County. Source: Radeloff, VC, RB Hammer, SI Stewart, JS Fried, SS Holcomb, and JF McKeefry. 2005. The Wildland Urban Interface in the United States. *Ecological Applications* 15:799-80

2. Data is for Sierra Nevada portion of County. Methodology: We used GIS data of the General Plans for all 21 California counties that lie partially or fully within the Sierra Nevada Region (Johnston, 2004) and overlaid CalFire's fire threat data map (CalFire 2004)

3. Data is for Sierra Nevada portion of County. Methodology: These data were compiled using GIS to compare CalFire's fire threat data map (CalFire 2004) with population information from the California Department of Finance. GreenInfo Network, 2004.

Butte County

Area of Wildland Urban Interface [1]: data not available

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	5,601	149,833	155,434
Acres in Very High Fire Threat Class	5,601	98,626	104,228
% in Very High Fire Threat Class	100%	66%	67%
Acres in Extreme Fire Threat Class	0	51,207	51,207
% in Extreme Fire Threat Class	0%	34%	33%
Total Acres in Very High and Extreme Fire Threat Class	**5,601**	**149,833**	**155,434**
% in Very High or Extreme Fire Threat Class	**100%**	**100%**	**100%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	31,913	35,975	4,062	13%

Calaveras County

Area of Wildland Urban Interface [1]: 138,588 acres

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	5,666	138,811	144,477
Acres in Very High Fire Threat Class	5,666	138,796	144,462
% in Very High Fire Threat Class	100%	100%	100%
Acres in Extreme Fire Threat Class	0	0	0
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**5,666**	**138,796**	**144,462**
% in Very High or Extreme Fire Threat Class	**100%**	**100%**	**100%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	113,029	140,261	27,232	24%

1. Data is for entire County. Source: Radeloff, VC, RB Hammer, SI Stewart, JS Fried, SS Holcomb, and JF McKeefry. 2005. The Wildland Urban Interface in the United States. *Ecological Applications* 15:799-80

2. Data is for Sierra Nevada portion of County. Methodology: We used GIS data of the General Plans for all 21 California counties that lie partially or fully within the Sierra Nevada Region (Johnston, 2004) and overlaid CalFire's fire threat data map (CalFire 2004)

3. Data is for Sierra Nevada portion of County. Methodology: These data were compiled using GIS to compare CalFire's fire threat data map (CalFire 2004) with population information from the California Department of Finance. GreenInfo Network, 2004.

El Dorado County

Area of Wildland Urban Interface [1]: 280,129 acres

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	132,516	45,095	177,611
Acres in Very High Fire Threat Class	132,516	45,095	177,611
% in Very High Fire Threat Class	100%	100%	100%
Acres in Extreme Fire Threat Class	0	0	0
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**132,516**	**45,095**	**177,611**
% in Very High or Extreme Fire Threat Class	**100%**	**100%**	**100%**

Population Growth from 1990 to 2000[3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	113,029	140,261	27,232	24%

Fresno County

Area of Wildland Urban Interface [1]: data not available

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	88,599	118,453	207,052
Acres in Very High Fire Threat Class	88,176	118,283	206,459
% in Very High Fire Threat Class	100%	100%	100%
Acres in Extreme Fire Threat Class	0	0	0
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**88,176**	**118,283**	**206,459**
% in Very High or Extreme Fire Threat Class	**100%**	**100%**	**100%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	13,030	15,652	2,622	20%

1. Data is for entire County. Source: Radeloff, VC, RB Hammer, SI Stewart, JS Fried, SS Holcomb, and JF McKeefry. 2005. The Wildland Urban Interface in the United States. *Ecological Applications* 15:799-80

2. Data is for Sierra Nevada portion of County. Methodology: We used GIS data of the General Plans for all 21 California counties that lie partially or fully within the Sierra Nevada Region (Johnston, 2004) and overlaid CalFire's fire threat data map (CalFire 2004)

3. Data is for Sierra Nevada portion of County. Methodology: These data were compiled using GIS to compare CalFire's fire threat data map (CalFire 2004) with population information from the California Department of Finance. GreenInfo Network, 2004.

Inyo County

Area of Wildland Urban Interface [1]: 16,401 acres

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	8,695	15,917	24,613
Acres in Very High Fire Threat Class	6,328	6,815	13,143
% in Very High Fire Threat Class	73%	43%	53%
Acres in Extreme Fire Threat Class	0	0	0
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**6,328**	**6,815**	**13,143**
% in Very High or Extreme Fire Threat Class	**73%**	**43%**	**53%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	10,479	10,325	-155	-1%

Kern County

Area of Wildland Urban Interface [1]: data not available

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	67,806	0	67,806
Acres in Very High Fire Threat Class	39,523	0	39,523
% in Very High Fire Threat Class	58%	0%	58%
Acres in Extreme Fire Threat Class	0	0	0
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**39,523**	**0**	**39,523**
% in Very High or Extreme Fire Threat Class	**58%**	**0%**	**58%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	15,330	15,754	424	3%

1. Data is for entire County. Source: Radeloff, VC, RB Hammer, SI Stewart, JS Fried, SS Holcomb, and JF McKeefry. 2005. The Wildland Urban Interface in the United States. *Ecological Applications* 15:799-80

2. Data is for Sierra Nevada portion of County. Methodology: We used GIS data of the General Plans for all 21 California counties that lie partially or fully within the Sierra Nevada Region (Johnston, 2004) and overlaid CalFire's fire threat data map (CalFire 2004)

3. Data is for Sierra Nevada portion of County. Methodology: These data were compiled using GIS to compare CalFire's fire threat data map (CalFire 2004) with population information from the California Department of Finance. GreenInfo Network, 2004.

Lassen County

Area of Wildland Urban Interface [1]: 54,006 acres

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	405,269	132,510	537,779
Acres in Very High Fire Threat Class	358,972	100,247	459,219
% in Very High Fire Threat Class	89%	76%	85%
Acres in Extreme Fire Threat Class	16,076	12,458	28,534
% in Extreme Fire Threat Class	4%	9%	5%
Total Acres in Very High or Extreme Fire Threat Class	**375,048**	**112,705**	**487,753**
% in Very High or Extreme Fire Threat Class	**93%**	**85%**	**91%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	22,927	25,319	2,393	10%

Madera County

Area of Wildland Urban Interface [1]: data not available

Residential Land and Fire Threat [2]	**Residential Low**	**Residential Very Low**	**Residential Total**
Total Acres in Land Use Designation	86,166	132,699	218,865
Acres in Very High Fire Threat Class	86,166	130,578	216,744
% in Very High Fire Threat Class	100%	98%	99%
Acres in Extreme Fire Threat Class	0	0	0
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**86,166**	**130,578**	**216,744**
% in Very High or Extreme Fire Threat Class	**100%**	**98%**	**99%**

Population Growth from 1990 to 2000 [3]	**1990**	**2000**	**Change**	**% Change**
Popn in Very High or Extreme Fire Threat Areas	18,453	24,303	5,850	32%

1. Data is for entire County. Source: Radeloff, VC, RB Hammer, SI Stewart, JS Fried, SS Holcomb, and JF McKeefry. 2005. The Wildland Urban Interface in the United States. *Ecological Applications* 15:799-80

2. Data is for Sierra Nevada portion of County. Methodology: We used GIS data of the General Plans for all 21 California counties that lie partially or fully within the Sierra Nevada Region (Johnston, 2004) and overlaid CalFire's fire threat data map (CalFire 2004)

3. Data is for Sierra Nevada portion of County. Methodology: These data were compiled using GIS to compare CalFire's fire threat data map (CalFire 2004) with population information from the California Department of Finance. GreenInfo Network, 2004.

Mariposa County

Area of Wildland Urban Interface [1]: 92,268 acres

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	88,424	7,239	95,663
Acres in Very High Fire Threat Class	88,424	7,239	95,663
% in Very High Fire Threat Class	100%	100%	100%
Acres in Extreme Fire Threat Class	0	0	0
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**88,424**	**7,239**	**95,663**
% in Very High or Extreme Fire Threat Class	**100%**	**100%**	**100%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	14,294	17,120	2,826	20%

Modoc County

Area of Wildland Urban Interface [1]: data not available

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	61,114	66,012	127,126
Acres in Very High Fire Threat Class	48,092	30,095	78,186
% in Very High Fire Threat Class	79%	46%	62%
Acres in Extreme Fire Threat Class	8,160	815	8,975
% in Extreme Fire Threat Class	13%	1%	7%
Total Acres in Very High or Extreme Fire Threat Class	**56,251**	**30,910**	**87,161**
% in Very High or Extreme Fire Threat Class	**92%**	**47%**	**69%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	data not available			

1. Data is for entire County. Source: Radeloff, VC, RB Hammer, SI Stewart, JS Fried, SS Holcomb, and JF McKeefry. 2005. The Wildland Urban Interface in the United States. *Ecological Applications* 15:799-80

2. Data is for Sierra Nevada portion of County. Methodology: We used GIS data of the General Plans for all 21 California counties that lie partially or fully within the Sierra Nevada Region (Johnston, 2004) and overlaid CalFire's fire threat data map (CalFire 2004)

3. Data is for Sierra Nevada portion of County. Methodology: These data were compiled using GIS to compare CalFire's fire threat data map (CalFire 2004) with population information from the California Department of Finance. GreenInfo Network, 2004.

Mono County

Area of Wildland Urban Interface [1]: 35,534 acres

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	8,520	28,033	36,552
Acres in Very High Fire Threat Class	7,836	23,943	31,779
% in Very High Fire Threat Class	92%	85%	87%
Acres in Extreme Fire Threat Class	0	0	0
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**7,836**	**23,943**	**31,779**
% in Very High or Extreme Fire Threat Class	**92%**	**85%**	**87%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	9,000	11,756	2,756	31%

Nevada County

Area of Wildland Urban Interface [1]: 190,892 acres

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	156,375	91,311	247,686
Acres in Very High Fire Threat Class	156,375	91,311	247,686
% in Very High Fire Threat Class	100%	100%	100%
Acres in Extreme Fire Threat Class	0	0	0
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**156,375**	**91,311**	**247,686**
% in Very High or Extreme Fire Threat Class	**100%**	**100%**	**100%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	78,461	91,981	13,520	17%

1. Data is for entire County. Source: Radeloff, VC, RB Hammer, SI Stewart, JS Fried, SS Holcomb, and JF McKeefry. 2005. The Wildland Urban Interface in the United States. *Ecological Applications* 15:799-80

2. Data is for Sierra Nevada portion of County. Methodology: We used GIS data of the General Plans for all 21 California counties that lie partially or fully within the Sierra Nevada Region (Johnston, 2004) and overlaid CalFire's fire threat data map (CalFire 2004)

3. Data is for Sierra Nevada portion of County. Methodology: These data were compiled using GIS to compare CalFire's fire threat data map (CalFire 2004) with population information from the California Department of Finance. GreenInfo Network, 2004.

Placer County

Area of Wildland Urban Interface [1]: 204,784 acres

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	82,673	20,667	103,340
Acres in Very High Fire Threat Class	82,673	20,667	103,340
% in Very High Fire Threat Class	100%	100%	100%
Acres in Extreme Fire Threat Class	0	0	0
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**82,673**	**20,667**	**103,340**
% in Very High or Extreme Fire Threat Class	**100%**	**100%**	**100%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	66,241	76,877	10,636	16%

Plumas County

Area of Wildland Urban Interface [1]: 52,409 acres

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	34,167	128,961	163,127
Acres in Very High Fire Threat Class	33,424	85,274	118,698
% in Very High Fire Threat Class	98%	66%	73%
Acres in Extreme Fire Threat Class	552	790	1,341
% in Extreme Fire Threat Class	2%	1%	1%
Total Acres in Very High or Extreme Fire Threat Class	**33,975**	**86,063**	**120,039**
% in Very High or Extreme Fire Threat Class	**99%**	**67%**	**74%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	19,062	20,064	1,001	5%

1. Data is for entire County. Source: Radeloff, VC, RB Hammer, SI Stewart, JS Fried, SS Holcomb, and JF McKeefry. 2005. The Wildland Urban Interface in the United States. *Ecological Applications* 15:799-80

2. Data is for Sierra Nevada portion of County. Methodology: We used GIS data of the General Plans for all 21 California counties that lie partially or fully within the Sierra Nevada Region (Johnston, 2004) and overlaid CalFire's fire threat data map (CalFire 2004)

3. Data is for Sierra Nevada portion of County. Methodology: These data were compiled using GIS to compare CalFire's fire threat data map (CalFire 2004) with population information from the California Department of Finance. GreenInfo Network, 2004.

Shasta County

Area of Wildland Urban Interface [1]: data not available

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	58,267	100,325	158,592
Acres in Very High Fire Threat Class	19,459	46,293	65,752
% in Very High Fire Threat Class	33%	46%	41%
Acres in Extreme Fire Threat Class	38,808	50,624	89,432
% in Extreme Fire Threat Class	67%	50%	56%
Total Acres in Very High or Extreme Fire Threat Class	**58,267**	**96,917**	**155,184**
% in Very High or Extreme Fire Threat Class	**100%**	**97%**	**98%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	data not available			

Sierra County

Area of Wildland Urban Interface [1]: 6,230 acres

Residential Land and Fire Threat [2]	**Residential Low**	**Residential Very Low**	**Residential Total**
Total Acres in Land Use Designation	Sierra County's General Plan does not designate any areas for rural residential development. However there are some areas in which the General Plan does not reflect the reality on the ground. Because of pre-existing entitlements and grandfathered zoning, there are growing rural residential areas in Sierra County (Duber, 2007). This analysis looked only at General Plans, and therefore does not reflect the full potential for rural residential development in Sierra County.		
Acres in Very High Fire Threat Class			
% in Very High Fire Threat Class			
Acres in Extreme Fire Threat Class			
% in Extreme Fire Threat Class			
Total Acres in Very High or Extreme Fire Threat Class			
% in Very High or Extreme Fire Threat Class			

Population Growth from 1990 to 2000 [3]	**1990**	**2000**	**Change**	**% Change**
Popn in Very High or Extreme Fire Threat Areas	3,133	3,357	224	7%

1. Data is for entire County. Source: Radeloff, VC, RB Hammer, SI Stewart, JS Fried, SS Holcomb, and JF McKeefry. 2005. The Wildland Urban Interface in the United States. *Ecological Applications* 15:799-80

2. Data is for Sierra Nevada portion of County. Methodology: We used GIS data of the General Plans for all 21 California counties that lie partially or fully within the Sierra Nevada Region (Johnston, 2004) and overlaid CalFire's fire threat data map (CalFire 2004)

3. Data is for Sierra Nevada portion of County. Methodology: These data were compiled using GIS to compare CalFire's fire threat data map (CalFire 2004) with population information from the California Department of Finance. GreenInfo Network, 2004.

Tehama County

Area of Wildland Urban Interface [1]: data not available

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	7	11,471	11,478
Acres in Very High Fire Threat Class	7	2,860	2,867
% in Very High Fire Threat Class	100%	25%	25%
Acres in Extreme Fire Threat Class	0	8,611	8,611
% in Extreme Fire Threat Class	0%	75%	75%
Total Acres in Very High and Extreme Fire Threat Class	**7**	**11,471**	**11,478**
% in Very High or Extreme Fire Threat Class	**100%**	**100%**	**100%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	4,720	4,538	-182	-4%

Tulare County

Area of Wildland Urban Interface [1]: data not available

Residential Land and Fire Threat [2]	**Residential Low**	**Residential Very Low**	**Residential Total**
Total Acres in Land Use Designation	25,935	73,929	99,864
Acres in Very High Fire Threat Class	25,935	73,661	99,596
% in Very High Fire Threat Class	100%	100%	100%
Acres in Extreme Fire Threat Class	0	0	
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**25,935**	**73,661**	**99,596**
% in Very High or Extreme Fire Threat Class	**100%**	**100%**	**100%**

Population Growth from 1990 to 2000 [3]	**1990**	**2000**	**Change**	**% Change**
Popn in Very High or Extreme Fire Threat Areas	12,388	13,196	808	7%

1. Data is for entire County. Source: Radeloff, VC, RB Hammer, SI Stewart, JS Fried, SS Holcomb, and JF McKeefry. 2005. The Wildland Urban Interface in the United States. *Ecological Applications* 15:799-80

2. Data is for Sierra Nevada portion of County. Methodology: We used GIS data of the General Plans for all 21 California counties that lie partially or fully within the Sierra Nevada Region (Johnston, 2004) and overlaid CalFire's fire threat data map (CalFire 2004)

3. Data is for Sierra Nevada portion of County. Methodology: These data were compiled using GIS to compare CalFire's fire threat data map (CalFire 2004) with population information from the California Department of Finance. GreenInfo Network, 2004.

Tuolumne County

Area of Wildland Urban Interface [1]: 112,350 acres

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	48,880	15,346	64,226
Acres in Very High Fire Threat Class	48,722	15,346	64,069
% in Very High Fire Threat Class	100%	100%	100%
Acres in Extreme Fire Threat Class	0	0	
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**48,722**	**15,346**	**64,069**
% in Very High or Extreme Fire Threat Class	**100%**	**100%**	**100%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	46,732	52,449	5,717	12%

Yuba County

Area of Wildland Urban Interface [1]: data not available

Residential Land and Fire Threat [2]	Residential Low	Residential Very Low	Residential Total
Total Acres in Land Use Designation	82,701	46,065	128,766
Acres in Very High Fire Threat Class	82,701	46,065	128,766
% in Very High Fire Threat Class	100%	100%	100%
Acres in Extreme Fire Threat Class	0	0	
% in Extreme Fire Threat Class	0%	0%	0%
Total Acres in Very High or Extreme Fire Threat Class	**82,701**	**46,065**	**128,766**
% in Very High or Extreme Fire Threat Class	**100%**	**100%**	**100%**

Population Growth from 1990 to 2000 [3]	1990	2000	Change	% Change
Popn in Very High or Extreme Fire Threat Areas	7,911	8,488	577	7%

1. Data is for entire County. Source: Radeloff, VC, RB Hammer, SI Stewart, JS Fried, SS Holcomb, and JF McKeefry. 2005. The Wildland Urban Interface in the United States. *Ecological Applications* 15:799-80

2. Data is for Sierra Nevada portion of County. Methodology: We used GIS data of the General Plans for all 21 California counties that lie partially or fully within the Sierra Nevada Region (Johnston, 2004) and overlaid CalFire's fire threat data map (CalFire 2004)

3. Data is for Sierra Nevada portion of County. Methodology: These data were compiled using GIS to compare CalFire's fire threat data map (CalFire 2004) with population information from the California Department of Finance. GreenInfo Network, 2004.

Appendix B:
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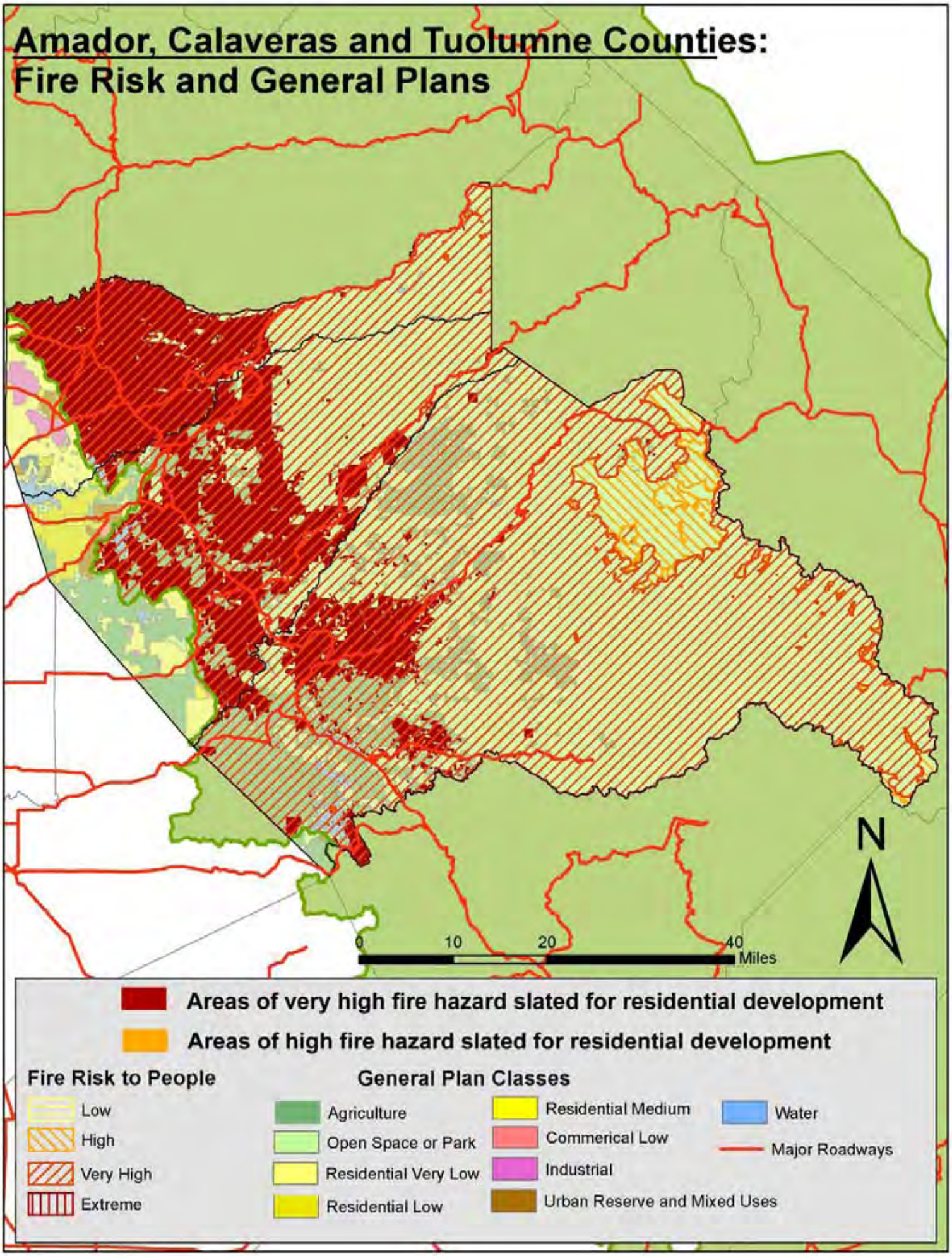
Appendix C:

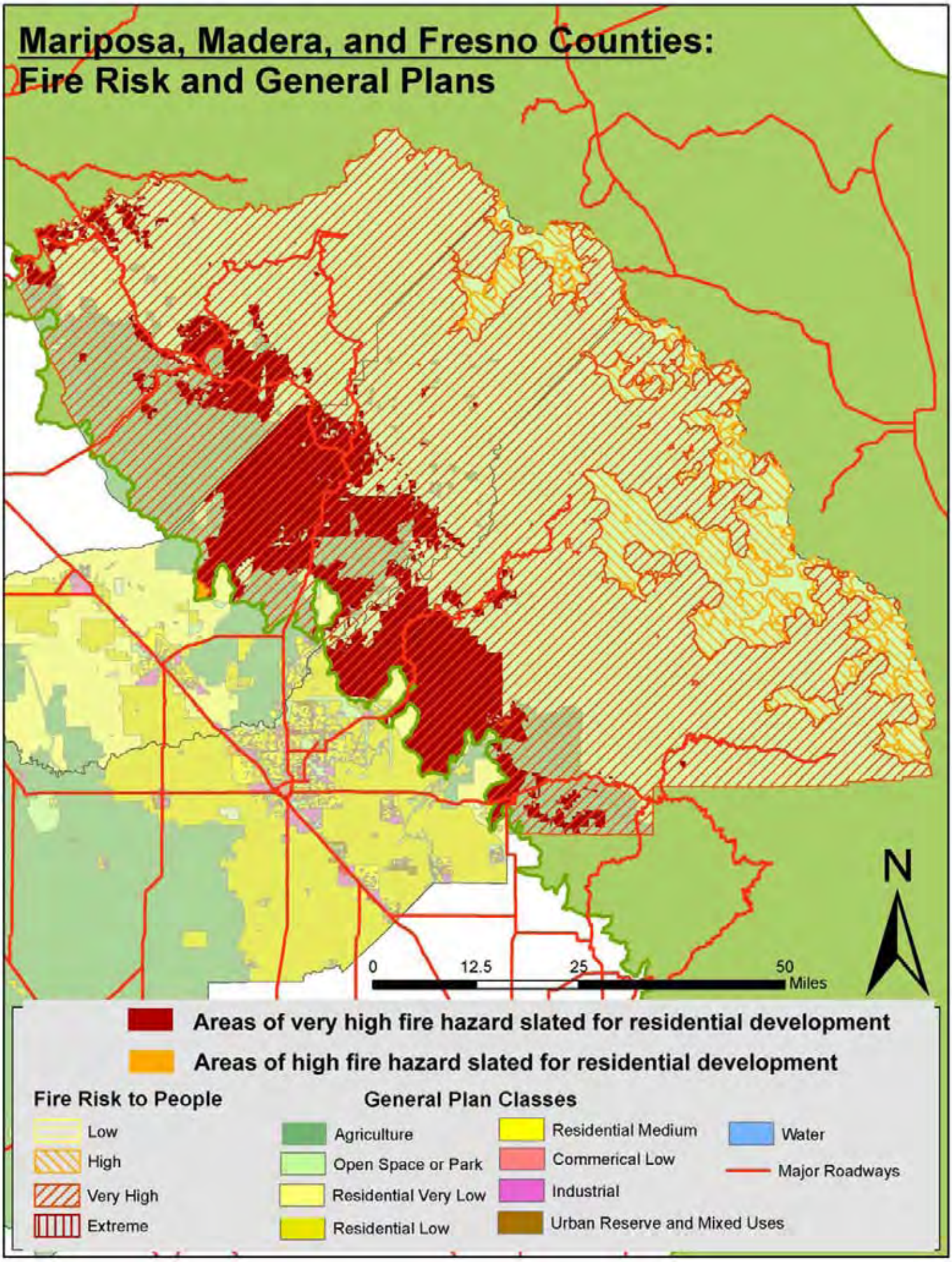
Maps of Fire Risk and General Plans in the Sierra Nevada

The following maps identify areas that are slated for rural residential development that are classified as "very high" or "extreme" fire threat by CalFire.

To create these maps, we used GIS data of the General Plans for all 21 California counties that lie partially or fully within the Sierra Nevada Region (Johnston, 2004). Our analysis only includes those portions of the counties that lie within the Sierra Nevada region, as defined by the Sierra Nevada Ecosystem Project study area boundary. We focused on lands classified as low density residential (density range 1 house per 2-20 acres) and very low density residential (density range 1 house per 20-80 acres).

We then overlaid CalFire's statewide Fire Threat map to compare areas where high, very high or extreme fire threat overlap with areas classified for rural residential development. This analysis does not distinguish between lands that are already developed and lands that are not yet developed. Also, we did not examine other land classifications, such as commercial, industrial, medium-density residential and high density residential, which constitute a very small fraction of development in our region. The General Plan data used for this analysis were compiled in 2000.


Amador, Calaveras and Tuolumne Counties:
Fire Risk and General Plans
N
0
10
20
40
Miles
Areas of very high fire hazard slated for residential development
Areas of high fire hazard slated for residential development
Fire Risk to People
Low
High
Very High
Extreme
General Plan Classes
Agriculture
Open Space or Park
Residential Very Low
Residential Low
Residential Medium
Commerical Low
Industrial
Urban Reserve and Mixed Uses
Water
Major Roadways


Mariposa, Madera, and Fresno Counties:
Fire Risk and General Plans
N
0
12.5
25
50
Miles
Areas of very high fire hazard slated for residential development
Areas of high fire hazard slated for residential development
Fire Risk to People
Low
High
Very High
Extreme
General Plan Classes
Agriculture
Open Space or Park
Residential Very Low
Residential Low
Residential Medium
Commerical Low
Industrial
Urban Reserve and Mixed Uses
Water
Major Roadways

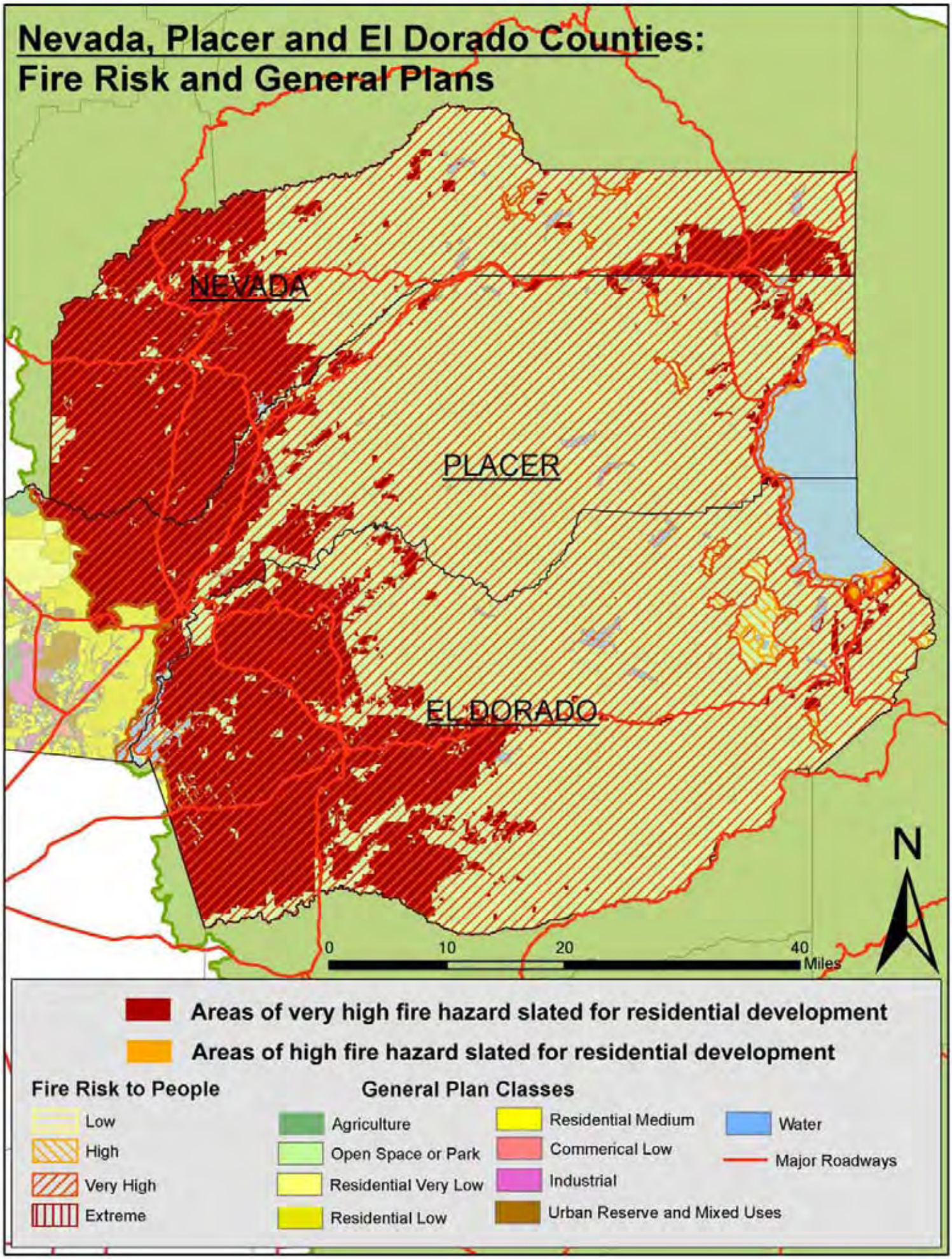

Nevada, Placer and El Dorado Counties:
Fire Risk and General Plans
NEVADA
PLACER
EL DORADO
N
0
10
20
40
Miles
Areas of very high fire hazard slated for residential development
Areas of high fire hazard slated for residential development
Fire Risk to People
Low
High
Very High
Extreme
General Plan Classes
Agriculture
Open Space or Park
Residential Very Low
Residential Low
Residential Medium
Commerical Low
Industrial
Urban Reserve and Mixed Uses
Water
Major Roadways

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EXHIBIT 11

Foresthill Public Utility District

Serving the Divide since 1950

Volume 2, Issue, 1 **Spring 2010**

FPUD Facing Tough Budget Decisions

As with all governing entities, the Foresthill Public Utility District is facing its share of budget challenges. Over the last few years the Board of Directors have had to make some difficult decisions on virtually every aspect of district operations.

RUNNING A TIGHT SHIP:

Unlike larger districts, FPUD has not seen large increases in the employee ranks over the years; in fact there have been only two field positions added in the last twenty four years. This is a good example of how the District makes every effort to operate as efficiently as possible. Furloughs or layoffs are just not a viable option with such a lean crew. In fiscal year 2009/2010 the board chose to freeze employee wages which meant foregoing the potential five percent salary increase contained in employee salary schedules. The District contribution to employee benefits was capped as well which means that the employees are responsible for a larger portion of their benefit premiums than in the past. This could mean that future increases in benefit plan premiums will be paid by employees as well.

Still, there are forces beyond the control of the Board or the employees; costs for water delivery are rising at every turn.

Numerous increases in state fees, an almost 100 percent increase in Department of Health Services fees, and the rising costs of fuel and materials have all contributed to the financial condition of the District.

There are also new EPA emissions regulations coming that will effect District equipment such as trucks, backhoes, backup generators and dump trucks that are sure to cost the District

Continued on page 3

New Director Appointed to FPUD Board; Three Seats Open in 2010

On February 17, 2010 the FPUD Board appointed Stevan Graham to replace resigning Director William Sadler.

Born in Auburn, Graham has lived in Foresthill all his life. He worked at the Georgia Pacific Lumber Company in Foresthill for 19 years until the mill shut down. He currently works for Pacific Coast Optics in Roseville as an optical technician working in a fabrication shop making optical components for lasers. He also worked for Coherent Inc. in Auburn for fourteen years doing the same kind of work.

"I became interested in applying for the District Board because I wanted to be more involved in the community in which I reside", Graham said. "As a board member I have no preconceived ideas and am willing to listen to both sides of a question with an open mind. I would like to represent the interests of the community in regard to the concerns of water rates, growth issues, and customer service."

New Director Stevan Graham

Longtime Director George Shaw has been a director on the FPUD Board for over 25 years. Shaw has also been very involved in the community in other ways by volunteering with the Fire Department for twenty four years, thirty years of cooking the prawns for the Lions Club, eight years with the Saftey Club, twenty six years as a member of the American Legion, and many more years with other community service organizations. Shaw's seat is coming up for re-election in November of this year as is Grahams' and Director Duane Frink's.

FPUD Directors are elected by the voters in Foresthill for four year terms.

The Board seats are staggered so that all of the seats do not come up for re-election at the same time. The only qualifications those seeking to be elected to the board need are that they be 18 years of age and reside in the District.

About FPUD

The District was formed in 1950 pursuant to the provisions of Section 15501 et. seq. of the California Public Utilities Act for the purpose of operating a water system (the "Enterprise"). The District's service area comprises the unincorporated community of Foresthill.

The District is governed by a five member Board of Directors and currently employs 10 full time employees. The District boundaries include an area of approximately 13,000 acres and contains primarily residential development. The District has a population of approximately 5,800 and as of July 1, 2008 provides 1,967 water service connections.

The District's goals are:

"To provide its customers with the highest quality drinking water at affordable rates with courteous and professional service;

To manage District resources responsibly for future generations and to maintain a superior workforce through encouragement of creativity and productivity."

Planning for the Future

To plan for the future the District takes the past and present into consideration.

In 2007 the engineering firm ECO-Logic analyzed data provided by FPUD to develop the 2008 Master Plan which will be used as a guide for future District decisions.

A close look at historical data such as precipitation, drought and customer use patterns is crucial in planning for future District operations. Current conditions are also an important part of this planning process. The Plan contains an inventory of existing District infrastructure (treatment plant, storage capacity, transmission lines, fire hydrants and of course Sugar Pine Dam), and compares that to projected future growth patterns within District boundaries.

After more than a year of analysis and preparation, the completed Master Plan was presented to Placer County to be included in their Foresthill Divide Community Plan (FDCP). While the FDCP comprises over 100 square miles of area on the divide, the FPUD Master Plan considers only the approximately 13,000 acres that are within the District boundaries.

The Foresthill Public Utility District

The FPUD Board of Directors

Brett Grant *President* **George Shaw** *Vice President* **Adam Larsen** *Treasurer*

Duane Frink *Director* **Stevan Graham** *Director*

The FPUD Board of Directors meets on the second Wednesday of every month at 7:00 p.m. at the District Office at 24540 Main St. Foresthill. The public is welcome to participate.

Fax: **(530)- 367-4385**

Web: **www.foresthillpud.com**

Telephone: **(530)-367-2511**

Paul Chamberlain
District Counsel

Office Hours:
Monday to Friday
8 a.m. to 5 p.m.

Kurt Reed
District Manager

Designed for FPUD by Daniel West

Budget

money in order to come into compliance.

WATER IS WHAT WE SELL:

Residential and commercial growth on the Divide has practically come to a stand-still much like other areas, which has translated into fewer new hook-ups and consequently less consumption of water. The District has also seen a drop in the amount of water used by current customers during the last couple of years. In 2008 the District sold 1,183 acre feet (AF) of water; in 2009 the District sold 1,015; a 14.2% reduction.

This reduction in use may be due to a cooler, wetter spring in 2009 and it is theorized that with all the drought in Southern California and the valley, people may be taking steps to conserve water in Foresthill. Another possible explanation is that hard economic times have caused people to conserve to save money on their monthly bills. The result is less water sales and consequently less revenue for District operations.

While the District does advocate wise water use and certainly does not want to see people wasting water uneccessarily, the ratepayers of FPUD can rest assured that their water district has plenty of water. Sugar Pine reservoir is currently spilling right now and the district looks forward to having plenty of water for its customers this summer.

POLITICS:

It must be noted though that the politics in other areas of the state can and indeed may have a real and possible negative effect on not just the community of Foresthill, but many Northern California water districts on water issues.

Southern California has always had water supply problems and even now have their eyes on the Sierras and other water sheds because this is where much of California's water originates. In fact there has already been an attempt to force the FPUD to give up some of its water rights. The Ryan family, (promoters of the Forest Ranch development project), have filed an application with the State Water Resources Control Board to appropriate 450 acre feet of water from the existing delivery system that the citizens of Foresthill have paid to develop.

Other surrounding water districts including PCWA have pledged to join FPUD in fighting the application since if successful, such an "appropriation" could set precedent for larger water claims from powerful Southern California interests.

Defending against these unfortunate events of course costs the District money in legal fees and employee time for research and added record keeping.

During these challenging times the pledge of FPUD is the same as it ever was: To provide our customers with the highest quality water at affordable rates with courteous and professional service.

Aging Water Infrastructure Due For Replacement

The water system that services the town of Foresthill that has been installed in stages since 1950 (when the District was formed) is coming to the end of its expected lifetime.

An inventory completed in 2009 of all components of the water delivery system has shown that while there have not been any major problems to date, the District knows that it is only a matter of time before costly replacement and repairs must be addressed.

The old cast-iron, tar-paper coated pipes that make up a portion of the FPUD water lines have a life-expectancy of 40-50 years before they need to be replaced. Many of the pipes are far beyond this threshold, as is evidenced by the frequent leaks in the lines north of town and in some areas of Todd Valley.

PLANNING FOR THE FUTURE:

In 2008 the Board of Directors implemented the first of a planned four year phase-in of a Repair and Replacement Surcharge of $3.32 per month for each hook-up which is earmarked for a dedicated account that can be drawn on to pay for the replacement of key components of the water delivery system.

That $3.32 per month per rate-payer amounts to around $89,000 per year. A study performed by the District in 2007 showed that a total of $13.28 per month per hook up would be necessary to collect the needed funds for the eventual replacement of key features of the system.

Due to current economic conditions, the board has not been willing to implement the next phase of the surcharge ($6.64/mo) for fiscal year 2009/2010.

As the need for replacing certain parts of the aging system becomes more and more evident, the board is taking a hard look at funding sources that could provide for a more appropriate replacement schedule.

The Foresthill Public Utility District will be holding a public meeting on April 22, 2010 starting at 7:00 p.m. at the Memorial Hall at 24601 Harrison St. in Foresthill to discuss the water rates/financial planning study the district has been working on and to present to the public the proposed rate systems the district is looking to install.

The public is welcome to come and make their voice heard on these issues.

FPUD Has Allies in the World of Water

The Foresthill Public Utility District is not alone in its efforts to provide and protect our community's water supply.

There are several organizations that FPUD is associated with that all stand together to provide mutual protection for the interests of several communities in Northern California:

The Placer County Water Agency (PCWA) is probably the best known in our immediate area and provides not only water to their specific area, but also generates and sells electricity. Just last year PCWA provided FPUD with a $26,000 grant that FPUD used to hire a consulting firm to do a study of the District's financial history and water rate system.

The Assosiation of California Water Agencies (ACWA), is an organization of some 500 or so water districts in California that represents its members in a whole host of efforts such as legislative, insurance, education, promotion, etc...

Mountain Counties Water Resource Assn. (MCWRA), is an organization made up of about twelve executive members comprising Water Districts in the area on the west slope of the Sierra Nevada from Mariposa County north to Plumas County, representing the majority of the Water Rights holders of the County of origin, (where most of California's water originates). MCWRA strongly believes in the area of origin water right and has made numerous inroads promoting this issue to the State Legislature even though there are those who are trying to find ways to spirit some of these rights to other areas.

The Local Agency Formation Commission (LAFCO), is responsible for annexations, detachments, dissolutions and formation of municipal service providers, prevention of urban sprawl, what services are provided and many other issues effecting water districts as well as other dual service providers.

These organizations work together to protect the interests of communities such as Foresthill. Such alliances are important. If each small water district had to fend for itself against the larger, wealthier and water hungry districts such as those farther south, the odds that our water rights could be "appropriated" for their use elsewhere might become a reality.

Foresthill Public Utility District
P.O. Box 266
Foresthill, CA 95631

Bulk Rate U.S. POSTAGE PAID Permit No. 113 Foresthill, CA

The Foresthill Public Utility District Quarterly Newsletter

EXHIBIT 12

FORESTHILL
PUBLIC UTILITY DISTRICT

FINANCIAL STATEMENTS
AND INDEPENDENT AUDITOR'S REPORT
for the year ended June 30, 2008

ROBERT W. JOHNSON
Certified Public Accountant