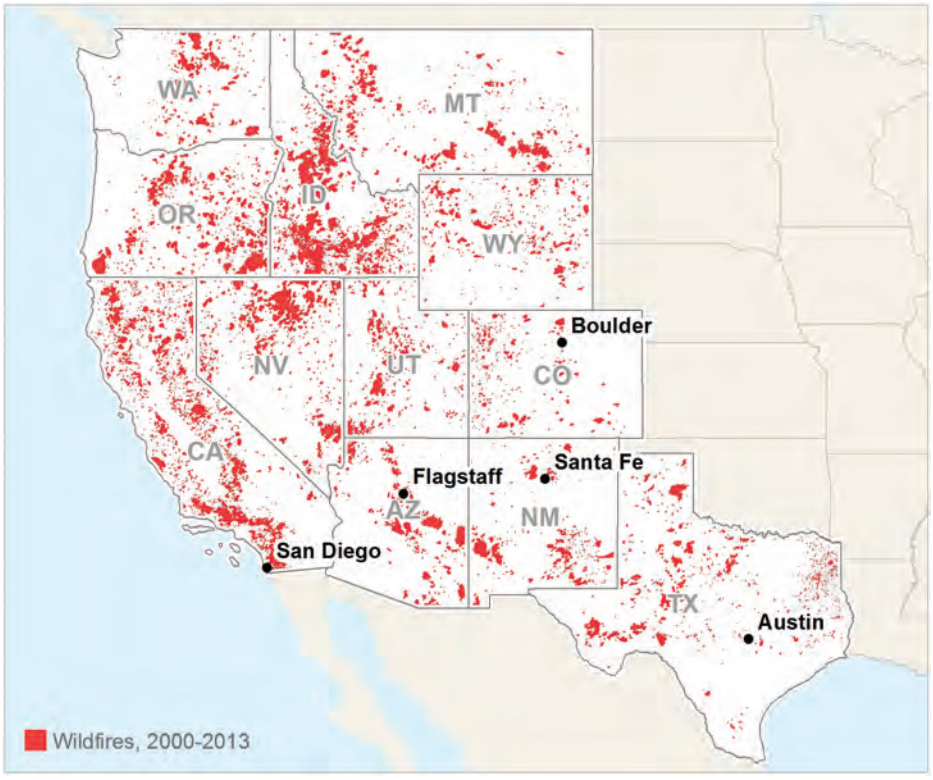
A Research Paper by

HEADWATERS ECONOMICS

Land Use Planning to Reduce Wildfire Risk:

Lessons from Five Western Cities



BOULDER COLORADO | **FLAGSTAFF** ARIZONA | **SANTE FE** NEW MEXICO | **SAN DIEGO** CALIFORNIA | **AUSTIN** TEXAS

January 2016

Land Use Planning to Reduce Wildfire Risk: Lessons from Five Western Cities

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ABOUT HEADWATERS ECONOMICS

Headwaters Economics is an independent, nonprofit research group whose mission is to improve community development and land management decisions in the West.

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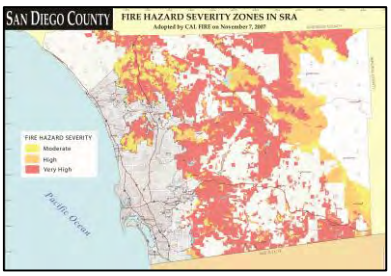
INTRODUCTION AND SUMMARY OF PLANNING TOOLS USED

Wildfires across the American West are increasing in frequency, size, and severity. The impacts from climate change, including rising average air temperatures, unpredictable precipitation patterns, and prolonged droughts further exacerbate wildfires. These changes, coupled with continued development within the Wildland-Urban Interface (WUI), present significant wildfire protection and recovery challenges for communities in the region.

This report documents how wildfires are increasingly an urban problem, affecting not just homes but also water and power supplies, transportation networks, and cultural resources, resulting in injuries, lost lives, and millions of dollars in damages. We then report on how five cities have used innovative land use planning techniques as a way to adapt to this growing threat. Headwaters Economics met with city planners, elected officials, and firefighters in Austin, Texas; Boulder, Colorado; Flagstaff, Arizona; San Diego, California; and Santa Fe, New Mexico—all communities with a recent history of wildfire and a reputation for being problem solvers. In each case study, we describe the urban nature of wildfires in the West, including fire history and associated impacts, and then profile how individual cities are responding to wildfire risk through improved land use planning (summarized in the table below).

We hope cities and towns across the West can learn from each other about how to implement land use planning tools to minimize the threat from wildfires. The audiences for this report are planners and elected officials, firefighters, federal land managers and Members of Congress who can play a significant role in helping communities become better adapted to wildfire risk.

Land Use Planning Strategies to Reduce Wildfire Risk		
Community Initiatives		
Voluntary Property Assessment	Complementary to regulations, communities can initiate voluntary assessment programs that assist homeowners in the mitigation process. *Wildfire Partners is a unique public-private collaboration.*	• **Boulder County, Colorado's** Wildfire Partners program helps property owners prepare for future wildfires by conducting property assessments with a trained mitigation specialist, identifying wildfire vulnerabilities, and other forms of assistance. Property owners who complete their required mitigation earn a certificate, which is accepted by local insurance companies to maintain or receive coverage. *To read more, see page 23.*
Partnerships and Coalitions	Collaboration between diverse stakeholders can facilitate proactive and transboundary risk planning. *A GFFP public workshop in Flagstaff, AZ.*	• In **Austin, Texas**, the fire department collaborates with other city staff to conduct prescribed burns within the city limits, reducing hazardous vegetation. *To read more, see page 15.* • The Greater Flagstaff Forest Partnership (GFFP) was formed in **Flagstaff, Arizona**, as a collaborative effort to enhance community awareness on issues related to forest health and wildfire impacts. *To read more, see page 28.*

	 *CAL FIRE launched "Cal-Adapt," an online resource illustrating areas of high wildfire severity throughout California, such as the map above for San Diego County.*	• In California, CAL FIRE works closely with the City of **San Diego** to pursue specific goals, policies, and land use planning practices to reduce wildfire risk. Examples include defensible space standards, open space management, post-fire safety and maintenance, among other wildfire-related topics. *To read more, see page 39.*
Land Use Regulations and Building Codes		
Overlay Zoning	Overlay zoning provides a set of standards that apply to properties within a defined area, often superseding the underlying base standards of a given zoning district. *Santa Fe's escarpment area is protected by an overlay district.*	• To avoid potential conflicts between resource protection (e.g. tree preservation) and hazardous fire-prone vegetation, the City of **Flagstaff, Arizona** prioritized within its regulatory and planning documents that Flagstaff's Wildland-Urban Interface (WUI) code applies *before* the application of resource protection standards within their Resource Protection Overlay Zone. This ensures that all future developments appropriately reduce wildfire risk prior to the development application process. *To read more, see page 32.* • The escarpment area in **Santa Fe, New Mexico** is covered by an overlay district aimed at protecting viewsheds and the surrounding foothills. Development within the overlay district is subject to heightened development regulations and landscape wildfire mitigation compliance measures. *To read more, see page 45.*
Site Plan Review Procedures	Wildfire mitigation can be incorporated into site plan review procedures to ensure safe development within the WUI. *Boulder, CO has integrated wildfire protection into the development review process.*	• In **Boulder, Colorado**, a site plan can be requested with each submitted development proposal prior to a building permit being issued—allowing for added wildfire mitigation measures, such as defensible space standards, adequate water supply, and multiple entry/egress options. *To read more, see page 22.*

Site Plan Review Procedures (Cont.)	 *The 2011 Pinnacle Fire in Austin, Texas destroyed 10 homes and threatened dozens of more structures situated within the city's WUI.*	• The City of **Austin, Texas**, works closely with Travis County in a joint design review process for proposed developments, ensuring that the city inherits a better planned WUI for wildfire mitigation. *To read more, see page 13.*
Development Standards	Development standards are the section of land use regulations that generally determine the quality of development. For wildfire, these can include specific requirements for adequate water supply, defensible space, resource protection, and ongoing maintenance.	• **Austin, Texas** is undergoing an initiative called CodeNEXT, which promotes compact development by directing new growth to existing areas rather than on "greenfield" sites. *To read more, see page 15.* • Development requirements for fire protection are part of the **Boulder County, Colorado** Land Use Code which requires appropriate water systems and other precautionary measures for homes rated high for wildfire exposure. *To read more, see page 22.*
Subdivision Regulations	Subdivision regulations determine how lots are created and divided, as well as site layout standards for new subdivision developments. Related to wildfire, subdivision review can include components such as adequate access, water supply, and other wildfire risk reduction features.	• The City of **San Diego, California** enforces a comprehensive brush management policy for any property containing a habitable structure *and* native vegetation. Homes that do not comply with the multiple-zone management requirements are billed the amount it costs to hire a private contractor to complete the brush thinning. *To read more, see page 38.*
Wildland-Urban Interface (WUI) Code	WUI codes provide a set of wildfire mitigation development standards, including structure density and location, building materials, and other fire protection requirements. *Flagstaff, Arizona's WUI code requires removal of snags and other potential hazard trees.*	• Well in advance of adopting a WUI code, the City of **Flagstaff, Arizona** required hazard mitigation on all properties prior to development, such as requiring non-combustible roof coverings. The early regulations laid the groundwork for the more stringent wildfire risk reduction measures outlined in the official WUI code. *To read more, see page 31.*

Planning Policies		
Comprehensive Plan	Wildfire mitigation can be integrated into comprehensive plans, which are overarching policy documents that provide guidance for future land use decisions at the local level.	• In updating its Comprehensive Plan, **Boulder, Colorado** addressed several different policies for wildfire risk reduction and dedicated an entire chapter to the hazards posed by wildfire. *To read more, see page 21.*
Community Wildfire Protection Plan (CWPP)	CWPP's are local plans designed to specifically address a community's unique conditions, values, and priorities related to wildfire risk reduction and resilience. CWPPs vary in scope, scale, and detail, but there are minimum requirements for their development and adoption.	• The City of **Austin, Texas** partnered with Travis County to form the Austin Travis County Wildfire Coalition. Their first major undertaking was the development of a joint city-county CWPP. *To read more, see page 13.* • The City of **Boulder, Colorado** extensively collaborated with public and private stakeholders in the development of its CWPP, which includes 45 different maps, video links, and resources for property owners regarding wildfire risk reduction strategies. *To read more, see page 21.*
Hazard Mitigation Plan	Hazard mitigation plans are local plans that are often multijurisdictional and identify risk, vulnerability, and mitigation actions for various natural hazards, including wildfire.	• In its Hazard Mitigation Plan, **Boulder, Colorado** identified wildfire-related risks and proposed actions to reduce these threats, such as creating fuel breaks along roadways, installing information kiosks and wildfire danger signage, and ensuring sufficient water supply to neighborhood hydrants. *To read more, see page 21.*
Planning for Climate Change	In managing for climate change impacts, including prolonged droughts, variable precipitation patterns, and other environmental stresses, community officials can identify key risks, implement mitigation measures, and develop approaches for long-term adaptation to climate change. *San Diego, California's WUI*	• In 2014, **Austin, Texas** adopted a Community Climate Plan, providing guidance for the city to achieve net-zero communitywide greenhouse gas emissions by 2050. *To read more, see page 16.* • In recognizing the inevitable challenges climate change poses, **Boulder, Colorado** developed a Climate Change Preparedness Plan and addressed the need to protect crucial water supply infrastructure. *To read more, see page 24.* • In **San Diego, California**, the State of California maintains Cal-Adapt, a website providing updated climate data to help users understand local climate change impacts. *To read more, see page 39.*

Watershed Management	Watershed Management plans and policies help communities protect their water supplies from catastrophic wildfire through forest management and agency partnerships. *Santa Fe, New Mexico funds a public-private collaborative effort to reduce fuel loading in nearby watersheds.*	• Following several significant fires near **Flagstaff, Arizona**, city residents approved a $10 million bond in 2012 to implement wildfire risk reduction measures and mitigate post-fire flooding impacts in nearby watersheds. *To read more, see page 30.* • Following the Cerro Grande Fire in 2002, **Santa Fe, New Mexico** established a forest treatment program in the Santa Fe National Forest to reduce the fuel load in portions of the watershed, requiring a concerted private-public partnership. Since the program began, the U.S. Forest Service has treated more than 5,500 acres within the watershed. *To read more, see page 46.*
Preservation of Open Space	Preserving open space between developed lands and the WUI provides a buffer between the built environment and encroaching wildfires. Parks, public lands, agricultural fields, and other undeveloped lands are considered open space.	• **Austin, Texas** has designated more than 30% of city land as conversation areas, limiting the number of future structures at risk to wildfires. *To read more, see page 15.* • In **Boulder, Colorado**, the county's Open Space and Recreation Department manages more than 100,000 acres of open space, which prevents further development within the WUI and lands prone to wildfire. *To read more, see page 21.*

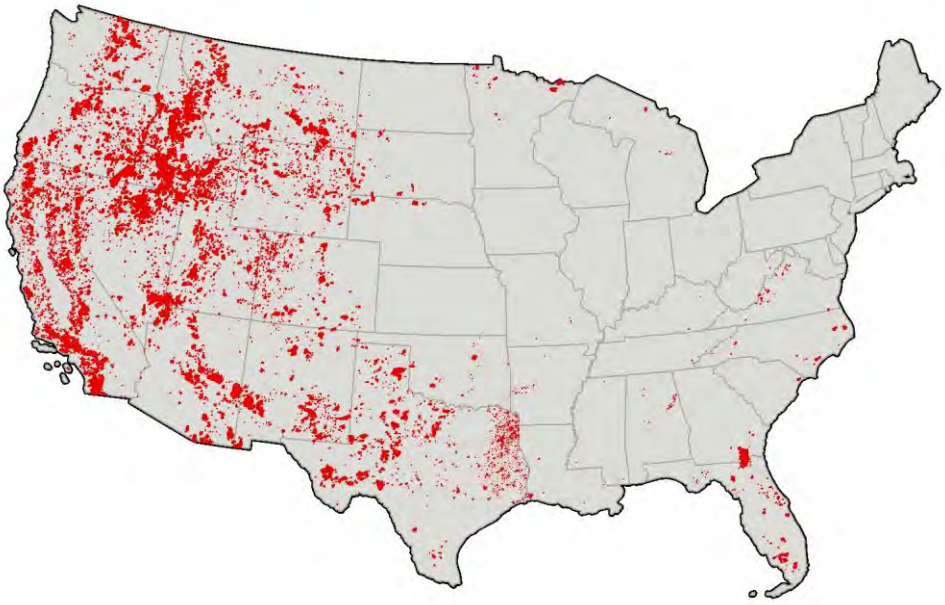
BACKGROUND: THE CHALLENGE OF WILDFIRE ADAPTATION IN THE WEST

Wildfire is Increasingly an Urban Issue

Geography of Wildfire Threats

More than 15,000 wildfires burned in the continental United States from 2000 to 2013. During that period, 78 percent of wildfires burned in the West, 11 percent burned in Texas, and the remaining 11 percent burned in the Midwest, South, and Northeast.[1] Cities in the West are particularly vulnerable to wildfire because the West contains conditions conducive to wildfire such as extensive and remote forest areas and frequent drought conditions.

Distribution of Wildfires, 2000-2013



Wildfires Threaten Urban Areas

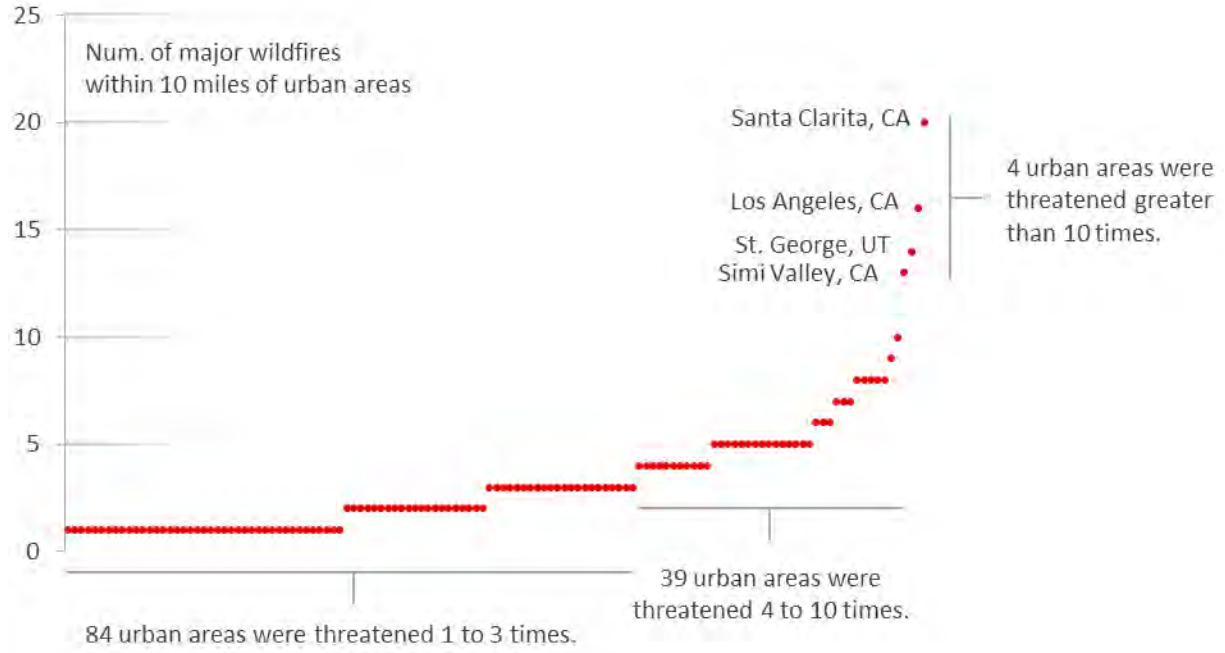
Urban areas are increasingly facing threats from wildfires, and those that have not yet experienced nearby wildfires are taking note. From 2000 to 2013, more than 100 urban areas, (cities with more than 75,000 residents) were threatened by major wildfires that burned within 10 miles. In many cases, urban areas have been threatened repeatedly by major wildfires events, (fires greater than 5 square miles in area).

Definitions

Urban Areas: In the following graphics, we define urban areas as cities with population > 75,000

Major Wildfires: Wildfires are considered "major" if the total area burned exceeds five square miles.

Urban Areas Within 10 miles of Major Wildfires, 2000-2013

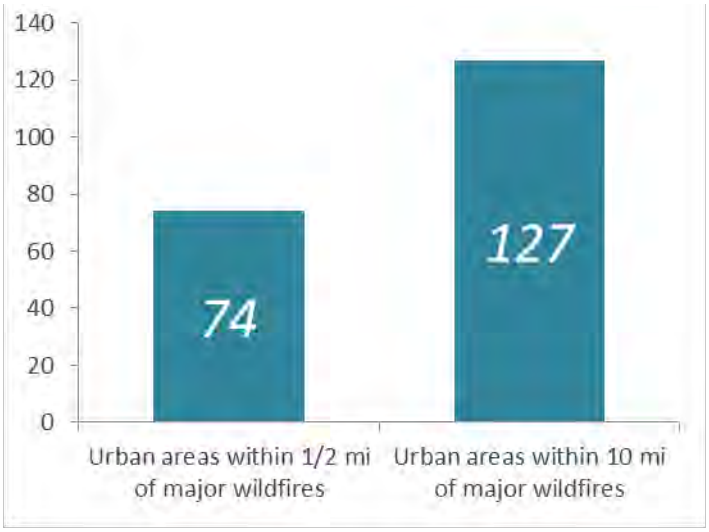


Even when a major wildfire is 8 to 10 miles away, it can be costly for urban areas. Wildfires often damage communications, energy, and transportation infrastructure, and degrade water supply and air quality. From 2000 to 2013, 127 urban areas were threatened by major wildfires that burned within 10 miles. Many of these urban areas were threatened multiple times. Thirty-nine urban areas were threatened between 4 to 10 times, and four urban areas were threatened more than 10 times. The urban areas that were threatened multiple times include Los Angeles, San Diego, and more than 30 other southern California cities; St. George, Orem, and Provo in Utah; Reno and Las Vegas in Nevada; Boise in Idaho; and Midland and Odessa in Texas (see Appendix for detailed tabular data).

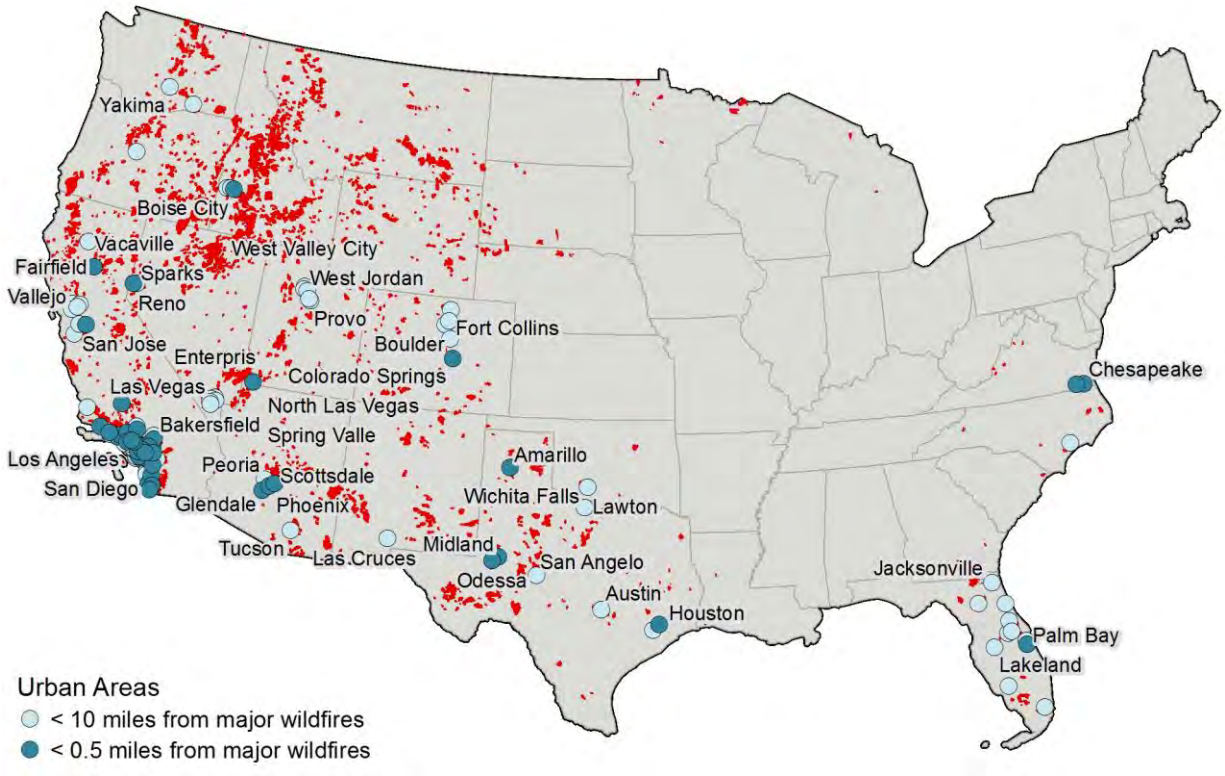
The most costly wildfires, in terms of both suppression and damages, are often those that burn near or in urban areas. From 2000 to 2013, 74 urban areas had major wildfires burn within a ½ mile of their incorporated boundaries.

The majority of urban areas that experienced major wildfires within a ½ mile were in southern California. Other urban areas within a ½ mile of major wildfires included: Chico and Tracy in northern California; Tucson and the greater Phoenix area in Arizona; Reno, Nevada; Boise, Idaho; Colorado Springs, Colorado; Houston, Odessa, and Amarillo in Texas; Chesapeake, Virginia; and Palm Bay, Florida (see Appendix).

Num. of Urban Areas Threatened by Major Wildfires, 2000-2013



Distribution of Urban Areas Relative to Major Wildfires, 2000-2013



Consequences of Urban Wildfires

As urbanization continues in the WUI, wildfires will increasingly threaten communities, incurring human and pecuniary costs. Between 2000 and 2013, 136 wildfires within 10 miles of urban areas burned more than 5 million acres with total suppression costs in excess of $1 billion. These "urban wildfires" threatened roughly 260,000 structures, damaged or destroyed nearly 16,000 structures, injured 1,250 people and killed 39 people.[2]

Characteristics of Major Wildfires Near Urban Areas, 2000-2013

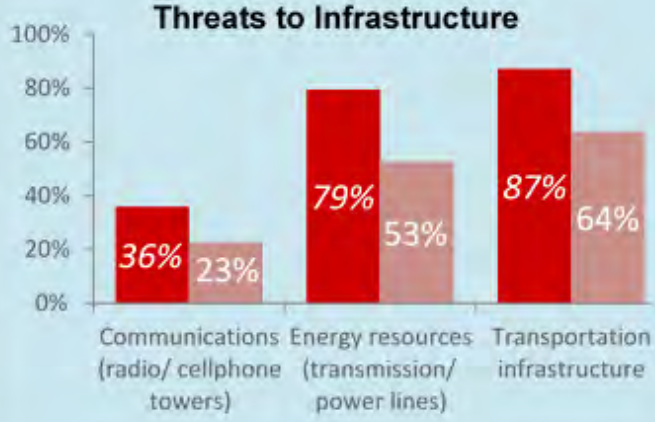
Distance from Urban Areas:	*< 0.5 mi*	*0.5 to 10 mi*	***0 to 10 mi***
Num. fires with available data	39	97	**136**
Total acres (thousands)	1,997	3,043	**5,040**
Total suppression costs	$538 M	$978 M	**$1,516 M**
Personnel involved	36,644	108,834	**145,478**
Structures threatened	181,443	79,060	**260,503**
Structures damaged/ destroyed	10,830	5,132	**15,962**
Injuries	430	820	**1,250**
Deaths	26	13	**39**

Percent of Major Wildfires that Threaten Urban Resources, 2000-2013

Threats to Residential Areas

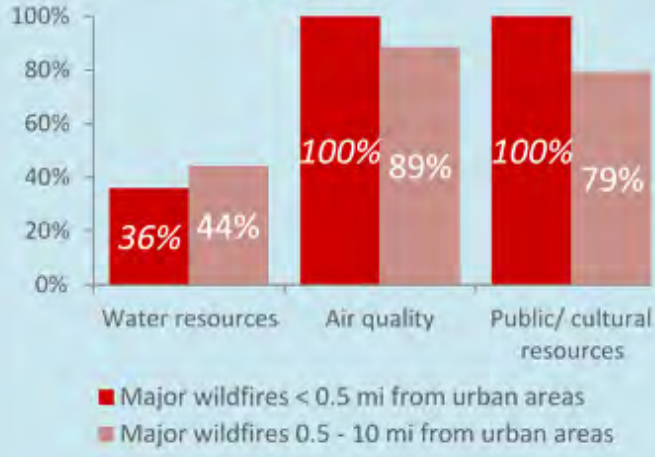
Urban wildfires disrupt the lives of millions of people each year, threatening residential areas and assets. Of major wildfires that threatened urban areas between 2000 and 2013, 95% of those that burned within ½ mile of an urban area threatened at least 100 structures, 69% threatened at least 1,000 structures, and 85% resulted in mandatory evacuations. Of major wildfires that burned ½ to 10 miles from urban areas, 81% threatened at least 100 structures, 26% threatened at least 1,000 structures, and 73% resulted in evacuations.

Threats to Infrastructure



Wildfires also disturb urban areas by damaging expensive infrastructure. Of major wildfire events within ½ mile of urban areas, 36% threatened communications infrastructure, 79% threatened energy resources (transmission lines, oil reserves, renewable energy sources, etc.), and 87% threatened transportation infrastructure (roads, interstates, railways, public transit, etc.). Of wildfires ½ to 10 miles from urban areas, 23% threatened communications, 53% threatened energy resources, and 64% threatened transportation.

Threats to Natural & Cultural Resources



Further, environmental and cultural resources are frequently threatened by wildfire. 36% of major wildfire events within ½ mile of urban areas threatened water resources (water quality, waste water treatment plants, etc.), 100% threatened urban air quality, and 100% threatened public or cultural resources (schools, hospitals, archeological sites, police stations, major landmarks, places of community value, statues/art, etc.). 44% of major wildfires ½ to 10 miles threatened water resources, 89% threatened air quality, and 79% threatened public or cultural resources.

What distinguishes wildfire from other forms of natural disaster (flooding, tornados, hurricanes, etc.) is that wildfire is frequently human caused.[3] More than one-third of wildfires within 10 miles of urban areas from 2000 to 2013 are known to have been a result of human activities[4]. As Americans continue to build in fire-prone areas, wildfires will become more frequent, threatening lives and structures. Moreover, climate change and other factors are catalyzing urban exposure to major wildfire events, and imperiling important urban resources like transportation infrastructure, transmission lines, natural resources, water transport infrastructure, cultural resources, schools, hospitals, public buildings, and air quality, causing inextricable costs to communities and governments (local, state, and federal) and impacting millions of people.

Climate Change Increases the Threat from Wildfires

Across the United States, evidence of climate change is being witnessed through a number of extreme weather events: record-breaking temperatures, extended periods of severe drought, changes in precipitation patterns, unprecedented glacial melt, increased oceanic temperatures, and sea level rise. The impacts are far reaching and bring economic, social, and environmental consequences. The National Climate Assessment (NCA) report comprehensively captures the challenges posed by climate change.[5] Released in 2014 and written by a team of experts, the NCA summarizes observed changes and recent trends, future climate change projections for extreme weather events and region-specific impacts, and potential response strategies.

As described by the NCA, regional impacts will vary across the United States. While some states will grapple with coastal issues such as sea level rise and increased hurricanes, other states—particularly those in the West—will face the reality of hotter summers, changes to forest conditions such as increased tree mortality from drought and invasive species, unpredictable precipitation patterns, decreased snowpack, and increased wildfires.

In the Southwest region, states such as New Mexico, Arizona, California, Nevada, Colorado and Utah are already experiencing climate change impacts. The region has been steadily becoming hotter in recent decades, and the decade 2001-2010 was the warmest on record with temperatures almost 2°F higher than historic averages. Temperature increases, in conjunction with recent drought, have led to widespread tree mortality, an increase in fire occurrence and area burned, forest insect outbreaks, reduced snowpack, and water shortages.

States in the Southwest can continue to expect temperature increases; regional annual average temperatures are projected to rise by 2.5 to 5.5°F by 2041-2070.[6] Summertime heat waves are projected to become longer and hotter. In addition, prolonged droughts are projected to increase across the Southwest and surrounding region. For major river basins such as the Colorado River basin, drought is predicted to become more frequent, intense, and longer lasting than in the historical record—presenting a huge quandary for regional management of water resources and wildfire. Wildfire "season" will continue to lengthen as spring and fall conditions are warmer and drier for extended periods of time. This will stretch both budgets and capacity. In some cases, tree species may migrate as precipitation patterns change, raising new questions about long-term forest management strategies.

As land managers face the increasing reality of climate change, it is important to note that there are already many current challenges to managing our landscapes and communities to live more safely with wildfire. Historically, "natural" fire varied in size, intensity and severity, creating a patchwork of native vegetation communities across a heterogeneous landscape that varied in patch size, species, and seral (maturation) stage. Since European contact, ecological diversity in vegetation and habitat has declined during the past two centuries due to a number of anthropological influences, such as fire suppression, forest management, and agriculture practices. These influences have significantly altered the natural fire regime and created extensive areas of homogeneous species and age classes, and caused a significant

decline in important species while increasing the susceptibility of the landscape to widespread native and non-native pathogens and insect epidemics. As a result, there has been a widespread change in fire effects and fires influence on ecosystems and people. Climate influences that appear to be trending towards warmer and drier conditions compound these effects—typically creating favorable conditions for increased forest health impacts, fire severity, fire intensity, fire size, and invasive species proliferation.

Development in or near wildfire prone areas is another contributing factor to a community's risk to wildfire, often requiring ongoing mitigation efforts to protect lives, property, and community amenities. The combination of these landscape and development influences affects a community's ability to safely manage wildfire for multiple objectives.

[1] US Historic Fire Perimeters, 2000-2013. U.S. Geological Survey, Geospatial Multi-Agency Coordination Group (GeoMAC). Available online: http://rmgsc.cr.usgs.gov/outgoing/GeoMAC/historic_fire_data/.
[2] Historic Incident Status Summary (ICS-209) reports. Available online: https://fam.nwcg.gov/fam-web/hist_209/report_list_209.
[3] Metropolitan Engineering Consulting & Forensics – Expert Engineers, Wildfires. June 18, 2015. Available online: http://metroforensics.blogspot.com/2015/06/as-many-as-90-percent-of-wildland-fires.html.
[4] Historic Incident Status Summary (ICS-209) reports. Available online: https://fam.nwcg.gov/fam-web/hist_209/report_list_209.
[5] Available online: http://nca2014.globalchange.gov/.
[6] NOAA's National Climatic Center. Sustainable Cities Network: Climate and Extremes Weather Season. January 2015. Available online: https://sustainability.asu.edu/docs/scn/AMS-panel-010815/AMS-2015-Owen.pdf.

WESTERN CITIES AND ADAPTATION TO WILDFIRE AND CLIMATE CHANGE

LEADERS IN WILDFIRE ADAPTATION

Austin, Texas—Managing for Growth, Healthy Landscapes, and Wildfire Risk Reduction

Austin, Texas, the state capital, is the fastest growing big city in the country. Between 2013 and 2014, Austin added more than 25,000 new residents, bringing the 2014 total population to 912,791 people.[1] Coupled with high growth, the city ranks third highest among 13 western urban areas for homes at risk for wildfire damage,[2] with more than 25 percent of its houses threatened by wildfires.

The Balcones Escarpment is a geologic fault zone several miles wide and appears from the plains as a range of wooded hills, separating the Edwards Plateau from the Coastal Plains. Photo Credit: Sylvia Jennette

The City of Austin and surrounding Travis County are also home to a geographically unique region of Texas known as the Balcones Escarpment, which separates the Edwards Plateau from the Blackland Prairie. As a result, the region contains diverse ecological landscapes, which in turn brings particular considerations regarding how wildfire mitigation efforts are managed alongside other sustainability objectives, such as habitat management and endangered species preservation.

As Austin grows, it must strike the right balance between development and wildfire safety, while also considering factors such as environmental protection and natural resource conservation. A combination of local stakeholders' creativity and commitment is steadily achieving that nuanced dynamic. Current and recent efforts with planning and regulatory updates are also providing opportunities for city officials to make a long-term difference in future land use outcomes.

History of Wildfire in Austin

Both Austin and Travis County have an active history of wildfire. Recorded wildfire incidents in Travis County date back to 1959, with more recent records documenting 7,885 wildfires in the county from 1998 to 2012. The most notable fire season was in 2011, when six large fires occurred during Labor Day weekend. In all, approximately 57 homes were destroyed in three of the fires and an estimated 7,000 acres were burned.[3] The same day these fires took place, the devastating Bastrop County Complex Fire started in neighboring Bastrop County, which burned more than 35,000 acres.[4]

Impacts of Wildfire on the City of Austin

The 2011 wildfire season, often referred to as the "Texas Firestorm," elevated public awareness about the potential impacts of wildfire. During that year, Austin residents witnessed areas within their city and surrounding lands burn, making wildfires a real and palatable threat. Specific impacts included:

AUSTIN, TX
Major Wildfires, 2000-2013

PEDERNALES BEND FIRE, 2011
6,500 Acres

Total Cost	$54K	Structures Threatened	500+
Total Personnel	24	Structures Damaged	67
Firefighters Injured	0	Evacuations Caused	Yes

This brush fire was caused by electrical lines pushed together by high winds. Thousands were evacuated, an elementary school and major highway closed.

BASTROP COUNTY COMPLEX FIRE, 2011
35,070 Acres

Total Cost	$8M	Structures Threatened	2000+
Total Personnel	1,210	Structures Damaged	1709
Firefighters Injured	8	Evacuations Caused	Yes

Classified as the worst wildfire in Texas history, the Bastrop fire left two dead and threatened private and public resources including a local hospital, essential communications infrastructure, major transmission lines, the California Aqueduct, and several highways. Over 5000 residents were evacuated.

- **Loss of life and property.** The Bastrop County Complex Fire (2011) was responsible for the deaths of two people and destroyed more than 1,700 structures. Total insured losses caused by the Bastrop Complex Fire were estimated at $325 million.[5]
- **Disruption of services.** The Bastrop County Complex Fire shut down electricity and water utilities for up to two weeks in some locations. The Labor Day weekend fires in Travis and Bastrop Counties forced the evacuation of thousands of residents, and some schools had to temporarily suspend classes.
- **Critical habitat loss.** A couple of years earlier, in 2009, the Wilderness Ridge Fire burned in Bastrop County and destroyed 1,491 acres of habitat for the endangered Houston toad.[6] The Houston toad was the first amphibian ever listed on the endangered species list in 1970, and lives solely within Texas. In 2011, the Bastrop County Complex further destroyed Houston toad habitat when it burned through Bastrop State Park. Together with prolonged drought conditions, habitat loss remains the most significant threat to the Houston toad.
- **Air quality effects.** The Bastrop County Complex and Labor Day weekend fires in Travis County brought a thick cloud of smoke to the region. Doctors warned children with asthma and adults with chronic respiratory problems to take health precautions.[7]

How Austin Is Addressing Wildfire Risk Through Land Use Planning and Regulations

Following the 2011 fire season, the City of Austin significantly expanded its approach to wildfire management. As part of this, Austin and Travis County officials formed the Austin Travis County Wildfire Coalition (ATCWC) to increase the region's wildfire preparedness and help communities in the region become fire adapted. The coalition's first major undertaking was to lead the development of a comprehensive joint city-county Community Wildfire Protection Plan (CWPP), which was ultimately adopted by

the Austin City Council and Travis County Commissioners Court in November 2014. In addition, the Austin Fire Department's Wildfire Division is working with other city departments to address the growing Wildland-Urban Interface (WUI) through interdepartmental collaboration and implementing development and regulatory mechanisms to actively integrate wildfire planning, as discussed below.

Elevating the Austin-Travis County Community Wildfire Protection Plan (CWPP)

CWPPs are local plans designed to address a community's unique conditions, values, and priorities related to wildfire risk reduction and community resilience. CWPPs can vary in scope, scale, and detail, but there are minimum requirements for their development and adoption.[8]

Wildfires in densely-populated WUI areas like Austin do not have to be large in size to have big consequences. As part of the "2011 Texas Firestorm," for instance, the Pinnacle Fire in Oak Hill burned only 100 acres, but destroyed 10 homes, and threatened dozens more homes and businesses.

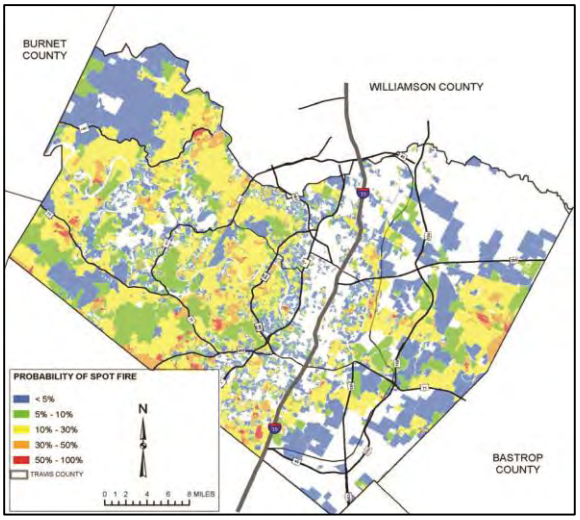
Photo credit: Justice Jones, Austin Fire Department

The Austin-Travis County CWPP is an impressive 900-page document that contains detailed fire history, local vegetation information, an analysis of community wildfire risk, and an exhaustive set of proposed mitigation measures. The plan makes a point to emphasize that all citizens, regardless of where they live, have a role in supporting wildfire risk reduction.

The CWPP will soon be included as an appendix to the city's Hazard Mitigation Plan, which was undergoing a review as of this writing. Integrating the CWPP into the Hazard Mitigation Plan will ensure implementation guidelines and recommended actions contained within the CWPP—such as the future development and adoption of wildfire regulations and wildfire risk reduction projects supporting home retrofits which are more fire resistant—will have a higher likelihood of receiving administrative support and resources at the city and county level.

Working with Travis County on Subdivision Reviews to Decrease Future WUI Risk

In Texas, two types of governments have land use authority: counties and municipalities. Texas counties have fewer controls over development, typically limited to the ability to regulate subdivisions, on-site sewage systems, floodplain development, and water supply. Counties do *not* have the authority to enact building codes, a zoning ordinance, or impact fees. (Travis County does have the power to require stormwater management, impose fire codes, and develop standards for water wells to prevent groundwater contamination). Alternatively, municipalities are allowed to regulate development comprehensively within their city boundaries, and they can also regulate some development in extraterritorial jurisdictions (ETJ)[9] to ensure that the development meets minimum standards, aligns with infrastructure investments, and minimizes impacts on natural resources.[10]



The Austin-Travis County CWPP contains detailed risk assessments of neighborhoods, such as this spot risk map.

Source: Austin-Travis County CWPP

Many Texas counties that surround large urban centers are expanding, and a large percentage of growth is occurring with limited restrictions on growth's location, quality, and development impacts—ultimately contributing to larger WUIs throughout an already drought-stricken and fire-prone state. This scenario is increasingly reflected in Austin as the surrounding population in Travis County grows. However, Austin has a vested interest in the county's current growth and development patterns because the city may annex some of this development in the future. To ensure the city inherits a "better planned WUI," including adequate access, water supply, and other wildfire risk-reduction features, the City of Austin has an agreement with Travis County to give both the city and county shared authority in the design review process. In doing so, Austin is able to guide future development in a way that minimizes exposure to wildfire threats.

The Austin Fire Department emphasizes wildfire education and outreach through a variety of public programs. Photo credit: Justice Jones, Austin Fire Department.

Leveraging Conservation and Compact Development Opportunities

Austin has designated nearly 30 percent of city land as conservation lands. Protecting this space for conservation purposes also limits the number of future structures at risk within high hazard areas. In addition, the city is undergoing an initiative called CodeNEXT that will revise its current Land Development Code (the code regulating development within the city's planning and zoning jurisdiction). Through the CodeNEXT process and previous planning policies promoted in Imagine Austin (the city's comprehensive plan), the city is emphasizing bringing nature back into the city and promoting compact development by directing new development to existing areas rather than on "greenfield" sites (raw land that has never been developed). Encouraging redevelopment of existing areas and infill development carries secondary benefits by managing growth and reducing the presence of structures within an expanding WUI.

Coordinating Wildfire Activities with Environmental Objectives

"One of our biggest challenges is that existing codes do not orient themselves to wildfire," says Justice Jones, Wildfire Division Program Manager for the Austin Fire Department. Jones and others within the fire department view existing city regulations that call for the retention of native vegetation to occasionally be at odds with wildfire risk reduction objectives. Yet, rather than choosing wildfire risk reduction treatments over environmental regulations, or vice versa, the fire department is working to modify internal operational guidelines to ensure vegetation management practices seeking to reduce wildfire risk are compatible with environmental regulations intended to protect endangered species and critical habitat. For example, the fire department recently paid for ecological assessments at five sites in the city prior to starting any fire mitigation work. The fire department is also initiating a new land management template for use on city owned property such as parks and nature preserves. This tool will be used to evaluate properties at risk for wildfire by tracking factors such as access points, fuel mitigation breaks, and the number of treatment acres needed to address existing hazardous vegetation.

In addition, the fire department is working with other city staff to conduct prescribed burns within the city. While the primary objective is to reduce hazardous vegetation, this practice also helps restore native vegetation and reduces the future likelihood of large catastrophic wildfires. It also provides firefighters with a keen understanding of local geographies and the fire landscape they are tasked with protecting. Ultimately Jones believes that these and other efforts on behalf of the fire department will build credibility and trust with other city departments and set a positive precedent for future work in ecologically sensitive areas.

Austin Prepares for Wildfire Risks and the Impacts of Climate Change

Texas has been experiencing shorter, wetter winters, and hotter, drier summers.[11] Climate change, including prolonged periods of drought and altered precipitation patterns, is influencing the composition and distribution of local vegetation, which is predicted to have an effect on where and how wildfires will burn throughout central Texas. Landscapes that have traditionally not experienced wildfire events in the past are more likely to burn due to the availability of fuels, such as grasses and brushes. Correspondingly, fire behavior will reflect altered vegetation patterns and when combined with increased drought periods, may become more frequent and severe, as witnessed during the 2011 Texas Firestorm.[12]

To address climate-related concerns, the Austin City Council passed a resolution on November 21, 2013 directing the Office of Sustainability to work with nine departments to determine how planning efforts integrate anticipated impacts of climate change and to identify a process for performing local and regional vulnerability assessments. On June 4, 2015, the City Council passed a resolution to adopt the Austin Community Climate Plan. This plan provides guidance and direction for the city to achieve net-zero communitywide greenhouse gas emissions by 2050. These efforts are intended to abate or halt the local environmental damage incurring from climate change and its side effects, such as increased drought, wildfire risk, watershed degradation, and habitat loss.

Key Takeaways

Partnerships pay dividends now and in the future. Although the Austin Fire Department may be seen as the primary champion for wildfire risk reduction efforts, partnerships are a hallmark of the community's successes. The city's commitment to coordinate with Travis County, preemptively addressing issues related to an expanding WUI, demonstrates foresight and creativity. The fire department also recognizes where other city departments may enable better success with the delivery of WUI-related messages. For example, the fire department is looking to the Office of Sustainability as a potential department for housing future "umbrella" programs addressing the environment, WUI, and climate-associated activities.

Tackling a mitigation strategy in small bites can be effective. Rather than adopting wildfire regulations in full, the Austin Fire Department is tackling different topics such as structural hardening (e.g., requirement of ember resistant vents and fire-resistant decking materials) and the implementation of vegetation management practices on high-risk properties throughout the city. The Department believes that by proactively familiarizing residents and land managers with these types of wildfire mitigation approaches, the foundational groundwork will be laid for a more successful outcome when future wildfire regulations are proposed for adoption.

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Key Resources:

City Departments	
Fire Department	http://www.austintexas.gov/department/fire
Development Services Department	https://austintexas.gov/department/development-services
Office of Sustainability	https://www.austintexas.gov/department/sustainability

Documents	
Austin/Travis County Community Wildfire Protection Plan	http://www.austintexas.gov/wildfireprotectionplan
City of Austin Hazard Mitigation Plan Update	https://www.austintexas.gov/sites/default/files/files/hsem/HMAP-Update-for-website.pdf
Austin Codes & Regulations (includes Land Development Code)	https://austintexas.gov/department/development-services/codes-and-regulations
City of Austin Master Plans (Comprehensive Plan, Climate Plan, and the Sustainability Action Agenda)	https://austintexas.gov/page/city-austin-master-plans

CodeNEXT	http://www.austintexas.gov/codenext

Other Resources	
Austin Urban Forest Plan	https://austintexas.gov/page/urban-forest-plan
Central Texas Extreme Weather and Climate Change Vulnerability Assessment of Regional Transportation Infrastructure	http://austintexas.gov/sites/default/files/files/Sustainability/Climate/CAMPO_Extreme_Weather_Vulnerability_Assessment_FINAL.pdf
Texas Forest Service Assessment	http://www.texaswildfirerisk.com/
Wildfire Ready Austin – Before and After the Fire (Environmental Best Management Practices for Wildfire Risk Reduction and Recovery)	https://www.austintexas.gov/sites/default/files/files/Watershed/wildfire/Firewise-before-and-after-the-fire.pdf.

[1] United States Census Bureau: http://www.census.gov/newsroom/press-releases/2015/cb15-89.html.
[2] A 2015 Wildfire Hazard Risk Report by CoreLogic lists Austin/Round Rock Texas as having 35,807 homes with the highest risk score for wildfire damage and home reconstruction values over nine billion dollars. Available online: http://www.corelogic.com/research/wildfire-risk-report/2015-wildfire-hazard-risk-report.pdf.
[3] Austin/Travis County Community Wildfire Protection Plan. 2014. Available online: https://www.austintexas.gov/wildfireprotectionplan.
[4] Texas Wildland Fire Annex: State of Texas Emergency Management Plan. 2014. Available online: http://www.bastropcbc.com/the-2011-bastrop-county-complex-fire.
[5] Insurance Council of Texas, Bastrop Wildfire Losses Rise. 2011. Available online: http://www.insurancecouncil.org/news/2011/Dec082011.pdf.
[6] Texas Forest Service, Wilderness Ridge Fire Case Study. 2009. Available online: http://txforestservice.tamu.edu/uploadedFiles/FRP/2WildernessRidgeCaseStudy.pdf.
[7] Available online:http://www.foxnews.com/us/2011/09/08/smoke-from-texas-fires-have-doctors-concerned-for-at-risk-citizens/.
[8] As described in Title I of the Healthy Forest Restoration Act (HFRA) of 2003 that authorizes communities to draft and implement a CWPP.
[9] Extraterritorial jurisdiction is the legal ability of a government to exercise authority beyond its normal boundaries.
[10] Imagine Austin, Comprehensive Report. Available online: http://www.austintexas.gov/sites/default/files/files/Planning/ImagineAustin/webiacpreduced.pdf.
[11] Cambridge Systematics, Inc. Central Texas Extreme Weather and Climate Change Vulnerability Assessment of Regional Transportation Infrastructure. January 2015. Available online: http://austintexas.gov/sites/default/files/files/Sustainability/Climate/CAMPO_Extreme_Weather_Vulnerability_Assessment_FINAL.pdf.
[12] Texas A&M Forest Service. 2011 Texas Wildfires. Available online: http://texasforestservice.tamu.edu/uploadedFiles/TFSMain/Preparing_for_Wildfires/Prepare_Your_Home_for_Wildfires/Contact_Us/2011%20Texas%20Wildfires.pdf.

LEADERS IN WILDFIRE ADAPTATION

Boulder County, Colorado—A Balance Between Regulation and Education

View of Longs Peak from Boulder County.
Photo credit: Boulder County

Boulder County is located 30 miles northwest of Denver, and is home to nearly 300,000 residents. Boulder County includes 10 municipalities: the cities of Boulder (county seat), Lafayette, Longmont, and Louisville; and the towns of Erie, Jamestown, Lyons, Nederland, Superior, and Ward. The western half of Boulder County includes vast public lands comprised of city and county open space, state parks, Bureau of Land Management (BLM) land, U.S. Forest Service land, including the Indian Peaks Wilderness, and a portion of Rocky Mountain National Park. Collectively, these lands and their abundant natural amenities make the county a world-class recreation area and a destination for a burgeoning high tech workforce. Yet, many of these forested and scenic landscapes also are highly prone to wildfires.

From a land use and planning perspective, Boulder County is popularly known for its progressive and successful comprehensive open space management program. However, effectively managing growth and preserving thousands of acres of otherwise developable land is not the county's only strength. Indeed, Boulder County is an engine for innovation when it comes to dealing with planning and environmental issues. This case study highlights their ongoing and recent efforts related to wildfire risk reduction. Boulder County is also proactively addressing the present and predicted impacts from climate change, such as increasing average temperatures, frequent droughts, more severe heat waves, and other climate-related stresses which elevate wildfire potential. Changing climatic conditions and ongoing development pressures are forcing the county to increase the quantity and quality of wildfire mitigation strategies—something the county, its municipalities, and its property owners are committed to doing.

History of Wildfire in Boulder County

The Fourmile Canyon Fire in 2010.
Photo credit: Boulder County

Boulder County has experienced several large fires during the past century. The Fourmile Canyon Fire in 2010, at the time the most destructive wildfire in Colorado's history, totaled $217 million in claimed insurance losses ($235 million in 2014 dollars).[1] Since that time, two major wildfires near Colorado Springs, the Waldo Canyon Fire and the Flagstaff Fire (2012) surpassed that record, with an estimated $453.7 million in damages.[2]

Although summertime is often considered "fire season," data shows that Boulder County's history of major wildfires (fires more than 150 acres in size) have occurred during all four seasons. The Olde Stage Fire in 1990 burned over 3,000 acres in November of that year, and a fire by the same name burned 3,008 acres in January 2009.[3] According to historical incident records, many of these major fires were caused by humans, suggesting that prevention efforts and education are extremely important as Boulder County moves forward with its wildfire mitigation efforts.[4]

BOULDER, CO
Major Wildfires, 2000-2013

OVERLAND FIRE, 2003
3,227 Acres

Total Cost	$465K	Structures Threatened	256
Total Personnel	276	Structures Damaged	62
Firefighters Injured	0	Evacuations Caused	Yes

The Overland fire was human caused and resulted in the evacuation of Jamestown and Lefthand Canyon and the closure of Lefthand Canyon road.

FOURMILE CANYON FIRE, 2010
6,475 Acres

Total Cost	$10M	Structures Threatened	500+
Total Personnel	1,096	Structures Damaged	195
Firefighters Injured	7	Evacuations Caused	Yes

The Fourmile Canyon fire was human caused and resulted in the evacuation of 20 subdivisions west of Boulder and the closure of three major county roads.

Impacts of Wildfire on Boulder County

Aside from the immediate effects on Boulder County, wildfires have long-lasting repercussions on the community at large. Almost every major fire in Boulder County has damaged homes and infrastructure, leaving residents uneasy. Additional impacts include:

- **Watershed.** The Fourmile Creek watershed was significantly damaged during the 2010 Fourmile Canyon fire, burning 23 percent of the watershed (10 square miles) and degrading drinking water supplies for the communities of Pinebrook and Lafayette.[5]
- **Flooding and erosion.** Major wildfires carry heavy ash downstream, and cause significant local and regional flooding. For example, the 2003 Overland Fire caused major flooding in Jamestown, Colorado. Increased erosion following the Fourmile Canyon Fire was a concern because of mine tailings and waste rock from historical mines nearby which were feared to be transported into downstream flows.[6]
- **Home values.** Wildfire events are devastating to a neighborhood, and research has shown drops in home sale prices even in adjacent neighborhoods during and following major wildfire events.[7]
- **Air quality effects.** Heavy smoke and particulates during a wildfire event fill the air across the Colorado Front Range. For particularly vulnerable populations (older and younger populations, or those with illness), smoke and particulates can pose significant health risks.
- **Recreation and tourism.** Significant wildfires reduce the tourist draw to Boulder County, which is otherwise a major Colorado hub for outdoor enthusiasts.
- **Social and administrative implications.** Recovering from major fires can take its toll on residents, many whom require assistance with ash and debris removal, erosion control and revegetation, flood and debris flow preparation, rebuilding on their property, transportation conditions, and many other issues related to the recovery process.

Handling these myriad concerns is also an administrative challenge for local governments, requiring additional resources and enhanced coordination.

How Boulder County Is Addressing Wildfire Risk Through Land Use Planning and Regulations

Boulder County has incorporated wildfire mitigation and recovery strategies into several short-term and long-term planning mechanisms, discussed below.

Growth Management and Development Plans

As mentioned earlier, Boulder County is well known for its systematic approach to preservation of open space and growth management. The county's Open Space and Recreation Department manages more than 100,000 acres of open space, with 60,000 acres of publicly owned land and the remaining lands preserved through conservation easements. Although not the program's primary intention, the preservation of these areas prevents further encroachment of development into the Wildland-Urban Interface (WUI).[8]

Post- Fourmile debris flow, July 2011.
Photo credit: Boulder County

In addition, Boulder County addresses wildfire risk in their Comprehensive Plan (the document identifying community objectives and guiding future development in the county). The Boulder County Comprehensive Plan, most recently updated in July 2015, includes an entire chapter dedicated to natural hazards. As part of this plan, there is a wildfire-specific section explicitly addressing eight policies including:

- Development and site plan reviews in areas identified to be at risk for wildfires should describe site location, building construction, design, landscaping, and defensible space, fuel management, access, and water availability within the context of wildfire mitigation.
- The county should continue to work in partnership with the local fire protection districts and departments to improve fire protection services addressing the increasing concerns of wildfire and the increase in development in the mountainous areas of the county.

Complementing Boulder County's Comprehensive Plan is the Hazard Mitigation Plan and the Community Wildfire Protection Plan. The Hazard Mitigation Plan was formally adopted in 2008, and as of 2015, was undergoing an update. The plan identifies risk, vulnerabilities, and mitigation actions related to wildfires, such as creating fuel breaks along roadways, developing wildfire information kiosks, installing wildfire danger signage, and developing a water system loop in Lyons, Colorado (to increase water pressure at hydrants).

Looking east from the Boulder County WUI.
Photo credit: Molly Mowery, Wildfire Planning International

Following the Fourmile Canyon Fire in 2011, the county also developed a Community Wildfire Protection Plan (CWPP). CWPPs are local plans designed to specifically address a community's unique conditions, values, and priorities related to wildfire risk reduction and resilience. CWPPs can vary in scope, scale, and detail, but there are minimum requirements for their development and adoption.[9]

The Boulder County CWPP is an exemplary document containing 45 maps and was a collaborative process between hundreds of residents, fire personnel, and administrative staff. The plan also includes 10 links to video interviews detailing personal accounts of devastating wildfires, information for homeowners to insure their property, opportunities to create defensible space, and rehabilitation efforts following catastrophic fires, such as the Fourmile Canyon Fire.[10]

Land Use Codes and Development Standards

Development requirements for fire protection are part of the Boulder County Land Use Code, the set of regulations that guide how property is used and developed in Boulder County. Although less than a full page of text, this section (#7-1100) of code requires appropriate water systems, additional precautionary measures for areas rated high per the State of Colorado Forest Service or where the local fire protection agency identifies a specific danger, and additional requirements as deemed necessary by the Board of County Commissioners.[11]

In addition to development standards, another section of the Land Use Code (4-805.12) allows county staff to ask for a site plan with each development proposal.[12] As part of this, a standard was established (4-806.A.5) to allow staff to impose conditions for wildfire mitigation such as relocation of development, defensible space, water supply, and pullouts and turn-arounds on long driveways (in conjunction with the county's Transportation Standards).[13] Any mitigation conditions placed on a site plan review are subsequently placed on the building permit, and each development is inspected and verified to have fulfilled those wildfire mitigation requirements.

Lastly, Article 19 of the Land Use Code was adopted to lay out the procedures following major natural and human-caused hazard events in the county.[14] The article addresses disaster emergency response by granting temporary authority to staff (rather than the Planning Commission or the Board of County Commissioners), and it outlines regulations tied to specific events including the Fourmile Canyon Fire of 2010 and the major flooding events of September 2013. Article 19 also defines provisions for demolition, temporary housing, repair of damaged structures, and timelines for completion, among other regulations. Although not focused on wildfire mitigation explicitly, this article demonstrates Boulder County's long-term commitment to the community and dedication to learning from past experience.

Evolving Building Codes Based on History and Science

Building codes set the minimum construction standards for structures, offering protocols for sound construction principles, and are the regulatory review tool for building officials to approve initial construction permits, inspect properties under construction, and ultimately issue certificates of occupancy (final sign-off). Most communities have adopted them in some form, and they serve as the basis for ensuring safety in the community.

Adopting and Adapting

Boulder County has taken a calculated approach toward building regulations for wildfire mitigation–learning from other large fires in Colorado and applying the latest science to inform any adoption or amendment to the building code.

Since the Lefthand Canyon Fire in 1988 and the Black Tiger Fire in 1989, Boulder County's building codes have evolved to focus more heavily on preventing future structure loss from wildfire. Boulder County made several local amendments to the building code to address wildfire issues over the years, sometimes even before those provisions showed up in national building codes. The county started by introducing roof material requirements, and later, integrated standards for window screens. Roof material requirements reduced wildfire risk substantially by limiting the likelihood of an ember igniting the roof.

One of the most important wildfire risk reduction tools occurred in 1993 with amendments to the site plan review process. The county amended the land use process to review site plans for homes (new construction, additions, and remodels) and to include wildfire mitigation as part of that review process for forested areas prior to a building permit being issued. This gave the county the authority to require wildfire mitigation plans, and to send referral comments to the planning department for any discrepancies related to access, water supply, and other wildfire-related issues. Put simply, wildfire mitigation is a code requirement—if it is not integrated into the permitting process, then people are not allowed to occupy the structure.

***Gary Goodell** is the Chief Building Official for Boulder County and was essential in revising the site plan review process. With ten years of planning experience prior to becoming a building official, Mr. Goodell was uniquely qualified to bridge the gaps between the typical planning process, building permitting, and wildfire risk reduction.*

In November 2015, the county officially adopted a suite of 2015 International Code Council (ICC) Codes, the universal standard for design codes, with amendments to consistently apply ignition-resistant construction and to streamline the defensible space and vegetation requirements, regardless of the applicable hazard rating to any property. By learning from other large fires in Colorado, Boulder County has taken a calculated approach toward building regulations for wildfire mitigation and is applying the latest science to inform adoptions and amendments to their building codes.

Wildfire Education and Voluntary Site Assessments for Property Owners

Boulder County complements its regulatory approach to wildfire mitigation with an assessment program called "Wildfire Partners."[15] Launched in 2014, this unique public-private partnership is funded by Boulder County and grants from the Federal Emergency Management Agency (FEMA) and the Colorado Department of Natural Resources. Wildfire Partners helps property owners prepare for future wildfires by conducting individual site assessments with a hazard mitigation specialist, providing a customized report identifying priority risk reduction actions, offering financial awards to subsidize costs for mitigation contractors to complete recommended work, providing wildfire advisory contacts, and conducting follow-up inspections. Although eligibility for the program is broad, participation is limited to areas of the county designated as the WUI. The program has been largely successful, reaching more than 8,000 individual property owners and conducting more than 700 site assessments.[16]

Recently, some homeowners in the WUI have had trouble obtaining insurance. Wildfire Partners was designed to address this problem. From early on, insurance industry representatives have been active participants in the program to ensure that the mitigation work being performed by homeowners is recognized by insurance providers. Homeowners who successfully complete the required risk reduction actions are issued a Wildfire Partners Certificate, signifying compliance with sound wildfire preparedness practices. A homeowner then sends their certificate to their insurance company to obtain insurance. The certificate satisfies the need for insurance companies to document and verify that wildfire risk reduction measures have been implemented. The certificate is also benefitting the real estate industry; certificates can be uploaded into the Multiple Listing Service (MLS) so prospective buyers can verify adequate wildfire mitigation measures have occurred on properties. As of the end of September 2015, the program partners have issued 172 certificates.[17]

A site assessment was conducted on this Boulder home through the Wildfire Partners program.

Photo credit: Molly Mowery, Wildfire Planning International

Building Relationships Across Political Boundaries

Boulder County and the City of Boulder have a dynamic relationship, built on an understanding that protecting lives and property is not only the primary consideration but also a significant transboundary challenge. For example, the Office of Emergency Management is run jointly by the city and county. The City of Boulder has a fire department with a substantial budget, and offers free home assessments. Boulder County does not have a fire department, but rather 23 separate fire districts. The Wildfire Partners program is one demonstration of how the county accomplishes streamlined steps toward prevention even within multiple separate districts. The county also supports community chipping programs (when larger pieces of wood and vegetation are reduced to smaller pieces and hauled away) by offering reimbursement of 50 percent of direct costs, up to $4,000 per community in the county.[18]

Boulder Prepares for Wildfire Risks and the Impacts of Climate Change

Despite substantial efforts to reduce greenhouse gas (GHG) emissions, Boulder County recognizes the inevitable challenges that climate change will pose on the community and on local planning efforts. For instance, Boulder County expects average temperatures to rise by 2-3˚F by 2030, and 3.5-5˚F by 2050.[19] Some of the expected challenges are highlighted in the 2012 Boulder County Climate Change Preparedness Plan, including:

- increased heat waves and wildfires;
- stronger extreme summer precipitation events;
- more frequent droughts and flash floods;
- greater spread of vector-borne diseases;
- difficulty with water storage for municipalities.

In that plan, the county recognizes an increase in wildfire frequency and magnitude is likely in the western United States, and that intense wildfires will produce erodible soils leading to increased sedimentation of water sources and infrastructure, and a degradation of water quality. (During the Fourmile Canyon Fire, the Betasso Treatment Plant was nearly shut down, which would have resulted in a loss of treated water to the City of Boulder.) The plan "calls to action" the county and its municipalities to work with the U.S. Forest Service to prepare for wildfire-related threats to the water supply infrastructure.

Key Takeaways

Innovation and evolution. Boulder County is known for testing the waters of unique and progressive techniques to solve common problems. The county understands that planning for hazards cannot simply be "accomplished," but rather requires continual maintenance and evaluation. In addition, the county allows technology, science, history, and lessons from their peers to iteratively guide the codes and policy reform process. This is further evidenced by Boulder County's Wildfire Partners program, and their interactive Community Wildfire Protection Plan document that links to several videos which illustrate priorities for the entire community. Even during periods of great success, the county is always looking to improve their wildfire protection planning.

Community first. Boulder County and its municipalities and special districts work together toward solutions that protect their entire community, not just individual jurisdictions. The Wildfire Partners program is one example of a successful initiative that transcends individual district interests to reduce overall wildfire risk. In doing so, the county recognizes that wildfire, and other natural hazards, do not respect political boundaries; therefore, plans for mitigating those hazards are best suited for community-wide discussions.

Wildfire risk reduction is a common thread. Similar to other communities in this report, Boulder County has instilled a culture of collaboration. Local fire departments engage with their counterparts in the land use planning department and work to identify the various interdepartmental priorities with respect to overall wildfire protection. Most planners in the Land Use Department have some level of knowledge about mitigation plans, and developers are notified early during the pre-application process about wildfire risk reduction requirements. For Boulder County, it is less about one person providing expert opinion rather it is more about creating broad and consistent knowledge among staff and departments.

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Key Resources:

County Departments/Divisions	
Land Use Department	http://www.bouldercounty.org/dept/landuse/pages/default.aspx
Planning Division	http://www.bouldercounty.org/property/build/pages/luplanningmain.aspx
Boulder Office of Emergency Management	http://www.boulderoem.com/
Wildfire and Forest Health	http://www.bouldercounty.org/property/forest/pages/default.aspx
Boulder County Zoning	http://www.bouldercounty.org/property/build/pages/bczoning.aspx

Documents	
Boulder County Comprehensive Plan	http://www.bouldercounty.org/property/build/pages/bccp.aspx
Boulder County Land Use Code	http://www.bouldercounty.org/property/build/pages/lucode.aspx
Community Wildfire Protection Plan	http://www.bouldercounty.org/property/forest/pages/lucwppmain.aspx
Hazard Mitigation Plan	http://www.boulderoem.com/attachment/8631/
Boulder County Climate Change Preparedness Plan	http://www.bouldercounty.org/doc/sustainability/ccpp.pdf
Boulder County Wildfire Mitigation Quick Checklist	http://www.bouldercounty.org/doc/landuse/wildfiremitigationquickchecklist.pdf

Other Resources	
Wildfire Partners	http://www.wildfirepartners.org/
City of Boulder Colorado	https://bouldercolorado.gov/

[1] According to the Rocky Mountain Insurance Information Association (RMIIA), Catastrophe Facts and Statistics. Available online: http://www.rmiia.org/catastrophes_and_statistics/catastrophes.asp.
[2] RMIAA, Catastrophe Facts and Statistics.
[3] From the Boulder County Community Wildfire Protection Plan (CWPP), page 7. Available online: http://www.bouldercounty.org/property/forest/pages/lucwppmain.aspx.
[4] Ibid.
[5] United States Geological Survey (USGS) Fact Sheet 2012-3095, Wildfire Effects on Source-Water Quality—Lessons from Fourmile Canyon Fire, Colorado, and Implications for Drinking-Water Treatment. Available online: http://pubs.usgs.gov/fs/2012/3095/FS12-3095.pdf.
[6] From the USGS Fact Sheet 2012-3095.
[7] From the United States Department of Agriculture/Forest Service (USDA Forest Service), Fourmile Canyon Fire Findings, page 73. Available online: http://www.fs.fed.us/rm/pubs/rmrs_gtr289.pdf.
[8] For more on Boulder County's open space management system. Available online: http://www.bouldercounty.org/os/openspace/pages/default.aspx.
[9] As described in Title I of the Healthy Forest Restoration Act (HFRA) of 2003 that authorizes communities to draft and implement a CWPP.
[10] YouTube videos accessible from Boulder County's Wildfire Maps & Videos page. Available online: http://www.bouldercounty.org/property/forest/pages/mapsvideos.aspx.
[11] Boulder Land Use Code. 2015. Available online: http://www.bouldercounty.org/doc/landuse/landusecode.pdf.
[12] Ibid.
[13] Boulder County Multimodal Transportation Standards. 2012. Available online: http://www.bouldercounty.org/doc/transportation/multimodaltransstds.pdf.

[14] Boulder Land Use Code. 2015. Available online: http://www.bouldercounty.org/doc/landuse/landusecode.pdf.
[15] Information and logo from www.wildfirepartners.org.
[16] More than 8,000 residents have received two mailings with aerial photos showing their defensible space.
[17] From "Boulder wildfire mitigation program could become template for the state." September 24, 2015. The Gazette. Available online: http://gazette.com/boulder-wildfire-mitigation-program-could-become-template-for-state/article/1559989.
[18] Community Chipping Reimbursement Program website. Available online: http://www.bouldercounty.org/property/forest/pages/chippingreimbursement.aspx.
[19] Boulder County Climate Change Preparedness Plan. Available online: http://www.bouldercounty.org/doc/sustainability/ccpp.pdf.

LEADERS IN WILDFIRE ADAPTATION

Flagstaff, Arizona—Leveraging Long-Standing Partnerships and Public Support to Tackle Growing Wildfire Concerns

The City of Flagstaff has long been aware of the threat of catastrophic wildfires. Since the 1970s, local leaders have been advocating for stewardship and management of the region's ponderosa pine forests to reduce hazardous fuels and protect critical watersheds. Severe wildfire activity in recent years, coupled with a growing concern about the impacts from climate change, have reinforced the need for wildfire mitigation throughout the city and its surrounding landscapes.

Actively engaging the public in wildfire and forest health issues has been a key ingredient to building support for Flagstaff's mitigation efforts.
Photo credit: Mark Brehl, Flagstaff Fire Department

As a result of Flagstaff's wildfire history, citizens and stakeholders have been promoting a number of ambitious multi-scalar efforts to reduce potential wildfire impacts. These efforts include the well-established Greater Flagstaff Forest Partnership, the voter-approved Flagstaff Watershed Protection Project, and the adoption and ongoing implementation of a uniquely tailored Wildland-Urban Interface (WUI) code. These efforts are reinforced through the city's sustainability and climate resiliency programs. The combination of active leaders, coordinated city departments, and an informed public that understands the community's wildfire risk provides a compelling example of progressive and widely supported community wildfire adaption efforts.

History of Wildfire in Flagstaff

An active history of wildfire in Flagstaff and its surrounding areas has led agencies and local residents to view this natural hazard as their city's largest urban threat. In 1977 for instance, the Radio Fire burned 4,600 acres and destroyed communications towers on nearby Mount Elden. In addition, the fire threatened a number of homes and prompted the evacuation of several residences. The scar of that blaze remains to this day and is a visible signature of the immediate dangers wildfires pose to the city.

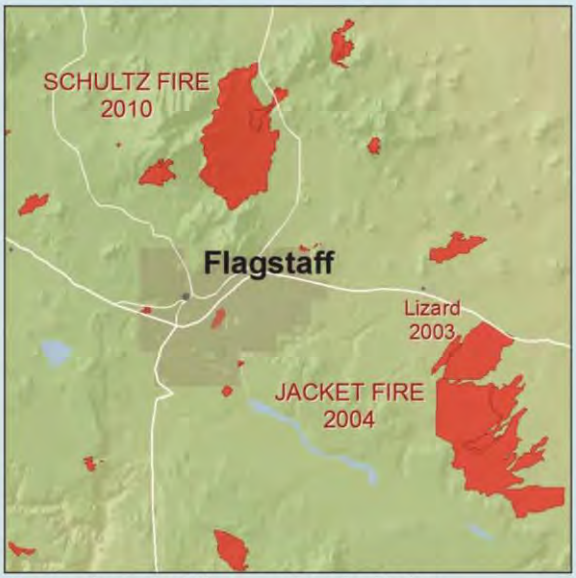
Subsequent wildfires during the next several decades reinforced local concerns about the risks of wildfires. Both the Horseshoe Fire and the Hochderffer Hills Fire in 1996 re-focused the public's attention on the plight and exposure of Flagstaff's forests to catastrophic wildfires, burning nearly 25,000 acres combined.[1] Several years later, the Pumpkin Fire (in 2000) resulted in severe local flooding events just north of the city. Fires have since continued, some of which have increased significantly in both their impacts and size.

Impacts of Wildfire on the City of Flagstaff

The scale of wildfires throughout Arizona has drawn attention to the myriad effects of such natural disasters, despite minimal structure loss. Closed highways, health warnings from smoke, flooding, and resident displacements are all common occurrences. Long-term recovery issues include post-fire flooding and impacts to the region's amenity-based economy.

FLAGSTAFF, AZ

Major Wildfires, 2000-2013



The two largest wildfires are described below.

JACKET FIRE, 2004
17,218 Acres

Total Cost	$625K	Structures Threatened	3
Total Personnel	128	Structures Damaged	1
Firefighters Injured	8	Evacuations Caused	No

The Jacket fire was lightening caused. A major resource threatened by the fire was the high voltage powerline between Flagstaff and Pinnacle Peak.

SCHULTZ FIRE, 2010
15,304 Acres

Total Cost	$10M	Structures Threatened	5000+
Total Personnel	961	Structures Damaged	0
Firefighters Injured	3	Evacuations Caused	Yes

The Schultz fire, ignited by an abandoned campfire, threatened homes, powerlines, buried gas lines, roads, communication sites, the municipal water supply, and other resources. Heavy floods followed the fire, resulting in extensive damage to property downstream.

Negative outcomes tied to wildfire events include:

- **Catastrophic consequences.** In 2002, Arizona residents witnessed the devastating impacts wildfires could impose across the state. The Rodeo-Chediski Fire, located 125 miles southwest of Flagstaff, burned more than 468,000 acres—resulting in more than 50,000 evacuations in various towns and ultimately destroying over 480 structures. It was the largest fire in Arizona's recorded history, until 2011, when the Wallow Fire burned over 538,000 acres.
- **Recreational and visual amenities.** In 2004, the Jacket Fire was one of the largest fires to burn within close proximity to Flagstaff. Located just 20 miles from the city, the Jacket Fire burned more than 17,000 acres and filled the sky with smoke for nearly two weeks. In 2010, the Schultz Fire started from an abandoned campfire in the San Francisco Peaks—an area treasured by Flagstaff locals for its beauty and recreation. The Schultz Fire burned more than 15,000 acres, degrading viewsheds and destroying popular recreation and archaeological sites. Although no structures were lost due to fire, more than 5,000 buildings and homes were threatened.
- **Post-fire flooding**. Following the Schultz Fire, post-fire flooding became a major issue causing a flash flood that killed a 12-year-old girl. In addition, the heavy ash debris flows and downstream erosion following the Schultz Fire damaged homes and critical infrastructure, including a major water pipeline. The Rural Policy Institute conducted a full cost estimate for the Schultz Fire/Flood and calculated suppression and recovery costs to total between $133 and $147 million. This accounted for official expenditures of government agencies and utilities, loss in personal wealth due to reduced property values, destruction of habitat, loss of life, structural damage and clean up, fire evacuation costs, flood insurance premiums and more.[2]

How Flagstaff Is Addressing Wildfire Risk Through Land Use Planning and Regulations

Between its ongoing fire activity and projected future climate impacts, Flagstaff has many reasons to minimize wildfire risk in the surrounding forests and watersheds. While partnerships and public involvement form the cornerstone of these efforts, other wildfire risk reduction measures focus on specific growth policies along the city's expanding Wildland-Urban Interface (WUI).

Collaborative Partnerships and Public Involvement Achieve Community-Based Resilience

Flagstaff is similar to Santa Fe, New Mexico and many other western communities that depend heavily on the health of their nearby watersheds for municipal drinking water. Flagstaff residents also enjoy the benefits of sustainable forests for recreational, aesthetic, and cultural values. Protecting these assets has been a huge driver for many of the city's long-term public-private partnerships who are committed to maintaining the overall health of the watershed.

Flagstaff's ponderosa pine forest, currently the largest contiguous one on the planet, is in jeopardy due to climate change.

Photo credit: Mark Brehl, Flagstaff Fire Department

Following the Schultz Fire and post-fire flooding, and 20 years of public engagement, the city's leadership seized an opportunity to put forward a ballot measure to fund hazardous fuel reduction treatments within at-risk watersheds. In November 2012, residents resoundingly approved a $10 million bond that provided funds to implement wildfire risk reduction measures and mitigate post-fire flooding impacts within the Rio de Flag and Lake Mary watersheds (the majority of which lies on federal land). The voter-approved bond resulted in the formation of the Flagstaff Watershed Protection Project—a collaborative effort between the state of Arizona, City of Flagstaff, and Coconino National Forest. Since its approval, additional funds have been raised and project planning and monitoring is underway. Treatment work, however, such as prescribed burns and forest thinning, will take several years to implement. More details about the project's history and current activities are available in the white paper, *Flagstaff Watershed Protection Project: Creating Solutions through Community Partnerships*.[3]

As a precursor to the funded bond measure to reduce community wildfire risk, the Greater Flagstaff Forest Partnership (GFFP) was established in the late 1990s as a way to focus community attention on issues related to forest health and wildfire impacts.[4] In particular, the GFFP is concerned with restoring the surrounding ponderosa pine forests, reducing the probability of catastrophic fire, and acting as a vehicle to test and share forest restoration information among private and public stakeholders. GFFP works across an 180,000 acre area within Coconino County. Partners are from local, state, regional, and national environmental, governmental, and business organizations, including the Flagstaff Fire Department, Four Forests Restoration Initiative (4FRI) Collaborative, Arizona State Forestry Division, Arizona Prescribed Fire Council, and the Ecological Restoration Institute—Northern Arizona University's nationally recognized program focusing on the application of scientific

Prescribed fire is one of the many fire reduction strategies that the Greater Flagstaff Forest Partnership promotes. Prescribed fire helps mitigate future catastrophic losses by reducing extra fuels such as needle litter and forest understory.

Photo credit: Mark Brehl, Flagstaff Fire Department

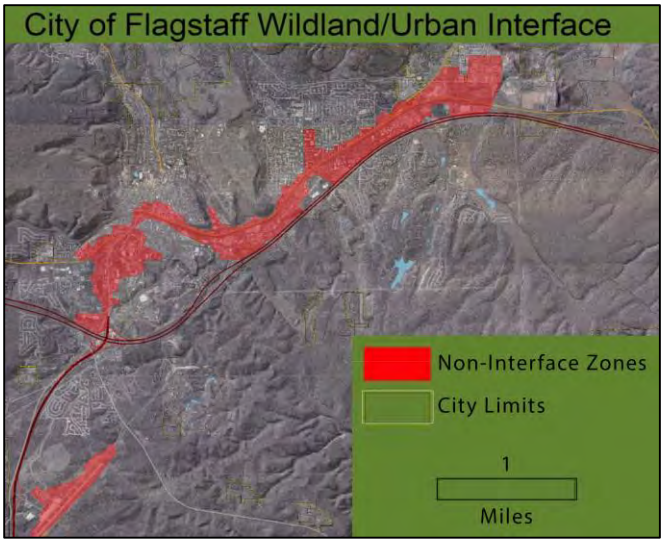
knowledge to solve the problem of unnaturally severe wildfire and degraded forest health. GFFP is also a member of the Fire Adapted Communities Learning Network.

Since its inception, GFFP has played a significant role in developing and assisting wildfire mitigation efforts, including the development of a Community Wildfire Protection Plan (CWPP) that was built off a previous Flagstaff Area Wildfire Risk Assessment in 2000. This preliminary effort to evaluate the city's wildfire risk identified various approaches to restore natural ecosystem structure, function, and composition in the ponderosa pine forests, promoted proactive forest management measures, and advanced the Flagstaff Watershed Protection Project goals, described below.

Planning and Regulatory Approaches Boost Flagstaff's Wildfire Risk Reduction Activities

In addition to landscape scale activities, Flagstaff has a number of regulations and planning policies in place to increase resident and community safety. For instance, the WUI codes are designed to reduce the risks from wildfire to life and property. WUI codes provide a set of wildfire mitigation development standards, including structure density and location, building materials and construction, vegetation management, emergency vehicle access, water supply, and fire protection.

In 2008, Flagstaff adopted the International Code Council's International Wildland-Urban Interface Code (IWUIC) with local amendments. In advance of Flagstaff adopting its WUI code however, the Flagstaff Fire Department took many steps to ensure a smooth and successful adoption process. For example, during the 1990s, the fire department personnel started working closely with the city's Community Development Department staff to develop an administrative procedure requiring hazard mitigation on all properties prior to development. This laid the foundational groundwork for provisions in the code that would later be seen as a natural evolution in regulations rather than an abrupt imposition of new requirements on property development.



The International Code Council's International Wildland-Urban Interface Code requires a jurisdiction to map the WUI in order to define where the code is legally applicable. Although the City of Flagstaff considers the entire city to be at risk for wildfire, for the purposes of their WUI code, the city determined its WUI boundaries include everything within city limits except those areas shaded in red. *Image source: Flagstaff Fire Department*

The Flagstaff Fire Department also prioritized stakeholder outreach that included extensive discussions with the homebuilders association, local real estate and insurance agents, community leaders, engineering firms, developers, and others. Public comments were received and many were integrated into the final code. In some cases these suggestions were even more stringent than the model IWUIC being used as the basis for Flagstaff's WUI code—which ultimately led to subsequent IWUIC code versions being updated to reflect Flagstaff's amendments.

Finally, Flagstaff's WUI code adoption process occurred in tandem with adherence to the 2006 International Fire Code (IFC)—a more general fire code that protects public health, safety, and welfare from hazards or fire, explosions, or dangerous conditions in buildings, structures, and on city premises. Several provisions of Flagstaff's IFC complement their WUI code, such as the requirement for non-combustible roof coverings, which have been shown to significantly reduce ignitability of structures

during wildfires.[5] For more detailed information on the code adoption process, see Flagstaff's WUI Code case study "How to avoid the agony" under Key Resources below.

Coordination of Wildfire Risk Reduction Measures with Environmental Resource Preservation

Collectively managing the preservation of natural resources alongside wildfire risk reduction measures is a complicated process. As part of Flagstaff's Zoning Code, for instance, a Resource Protection Overlay Zone is included, which requires compliance with standards to ensure the protection of natural resources, including floodplains, steep slopes, and forests.[6] These standards also are intended to help "manage healthy and sustainable forests to reduce fire risk." To avoid conflicts between preserving trees for resource protection and removing trees for wildfire risk reduction, the city clearly states in its regulatory and planning documents that Flagstaff's WUI code applies *before* the application of resource protection standards. This ensures that all future developments appropriately reduce wildfire risk prior to the application of resource protection standards. Resource protection standards are also applied subsequent to the implementation of the CWPP, the citywide Forest Stewardship Plan, and Vegetation Management Plan (which is a refinement of the citywide Forest Stewardship Plan for site specific operations to implement the WUI code on a development site).[7] Together, the WUI code and resource protection standards closely couple one another to provide a comprehensive vegetation management approach on properties throughout the city.

Flagstaff's WUI code requires removal of snags and other hazard trees threatening public safety or property. Where no threat exists, these trees are typically retained as valuable wildlife habitat.

Photo credit: Mark Brehl, Flagstaff Fire Department

In addition, Flagstaff's Environmental Planning and Conservation Section of the Regional Plan 2030 reflects the city's effort to address both wildfire risk and ecological health and provide guidance on how to best manage these closely related concerns.[8] The policies within the plan focus on: investments in forest health and watershed protection measures; public awareness of the region's ponderosa pine forest; protection, conservation, and ecological restoration of diverse ecosystems; and support for cooperative efforts for forest health initiatives or practices. For example, the Climate Change and Adaptation subsection within the Regional Plan lists wildfire mitigation activities, such as individual preparation measures for homes and community investments in forest health and watershed protection, as ways to reduce present and predicted wildfire risks. The Ecosystem Health subsection discusses the connection between declines in forest health, high-intensity wildfires, and post-fire flooding. In addition, this subsection mentions ongoing cooperative watershed protection efforts such as the Greater Flagstaff Forest Partnership and Four Forests Restoration Initiative. Having these policies in place signifies the importance of wildfire as part of future land use and development decision making processes. They also provide staff with a reference point when preparing planning reports for the City Council to help maintain community-wide support and overall momentum for wildfire mitigation and forest health projects.

Flagstaff Prepares for Wildfire Risks and the Impacts of Climate Change

While residents may still be coping with post-fire impacts from previous wildfires, future climate challenges present significant concerns for the Flagstaff community. Climate experts warn the American Southwest can expect a rise in overall temperatures, in some cases by more than 3° F by 2100, with higher increases seen during the summer months. Snowpack and spring/early summer runoff are also projected to decrease in a warmer climate. Droughts are likely to become more intense and last for a longer period of time—up to 12 years or more. All of these factors may alter local fire behavior through changes in fuel condition (e.g., fuel moisture), fuel loading, and ignitions. Short- and long-term ecosystem changes may vary based on the ecosystem's response to climate change. For example, climate change may initially

accelerate catastrophic wildfire activity, but this may decrease in the long-term future depending on the type of replacement vegetation that returns.

Key documents underscore the links between climate change, forest health, and wildfire. For example, the Flagstaff Regional Plan 2030 discusses drought, wildfire, and tree mortality as part of its climate adaptation section. The City of Flagstaff also conducted a Resiliency and Preparedness study in 2012 that listed a suite of potential climate impacts to the city's operations, including:

- an increase in demand on city resources able to respond to wildfire events;
- an increase in frequency and duration of forest closures and related tourism;
- an increase in frequency and number of threatened structures; and
- a loss of long-term water storage.[9]

Key Takeaways

"At least 19 years of dedicated collaborative work set the stage for voter approval of [Flagstaff's watershed protection] bond."

(Flagstaff Watershed Protection Project)

Diverse stakeholder involvement. The successes in Flagstaff—the Flagstaff Watershed Protection Project and an innovative WUI code, among many others—were the result of years of collaboration, capacity building, outreach, public education, visible action, and proven results. These events may be marked by milestones such as voter approval of a bond or the City Council's code adoption, but the ongoing commitment by stakeholders to reduce community wildfire risk plays a key role in maintaining forward momentum. Each successive step was built on decades of conversations with stakeholders, teachable moments, information sharing, and the successful demonstration of projects. Dedicated leadership from the Greater Flagstaff Forest Partnership, Flagstaff Fire Department, and academic partners, such as the Ecological Restoration Institute, also provide consistent and trusted sources of information and resources for the public. In this sense, no project is an isolated success and no leader is an isolated change maker. Every part of Flagstaff's wildfire adaptation activities is linked to previous efforts, and today's successes stand on the shoulders of others before them.

Local networks of communication assist in community success. Success also occurs through engagement and coordination with multiple stakeholders—from the local resident to the City Council. Similarly, the Community Development Department works closely with the Fire Department. In addition, the Sustainability and Environmental Management Section has increased its staffing capacity to ensure cross-communication with other city departments, including support for wildfire management and forest health activities. A group of engaged citizens provides ongoing input to guide local planning decisions. In this way, a constant network of communication, feedback, and integration of information supports community decision making efforts.

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Key Resources:

City Departments	
Fire Department	http://www.flagstaff.az.gov/index.aspx?NID=2977
Comprehensive Planning	http://www.flagstaff.az.gov/index.aspx?nid=1342
Sustainability and Environmental Management	http://flagstaff.az.gov/index.aspx?NID=921

Documents	
Greater Flagstaff Area Community Wildfire Protection Plan	http://gffp.org/wp-content/uploads/2015/09/Combined-2012-CWPP-Review-Report.pdf
Multi-Jurisdictional Hazard Mitigation Plan	http://www.coconino.az.gov/index.aspx?NID=1376
City of Flagstaff Zoning Code	http://www.flagstaff.az.gov/index.aspx?nid=1416
City of Flagstaff Regional 2013 Plan	http://www.flagstaff.az.gov/index.aspx?NID=2945
Municipal Sustainability Plan	http://flagstaff.az.gov/DocumentCenter/Home/View/14041
Wildland-Urban Interface Code Adoption, "How to avoid the agony"	http://www.flagstaff.az.gov/DocumentCenter/Home/View/12911
City of Flagstaff Resiliency and Preparedness Study	http://www.flagstaff.az.gov/DocumentCenter/Home/View/38841

Other Resources

Wildland Fire Management	http://www.flagstaff.az.gov/index.aspx?NID=132
Greater Flagstaff Forests Partnership	http://gffp.org/ and http://facnetwork.org/wp-content/uploads/2015/07/GFFP_June2015.pdf
Flagstaff Watershed Protection Project	http://www.flagstaffwatershedprotection.org/
Ecological Restoration Institute	http://nau.edu/eri/

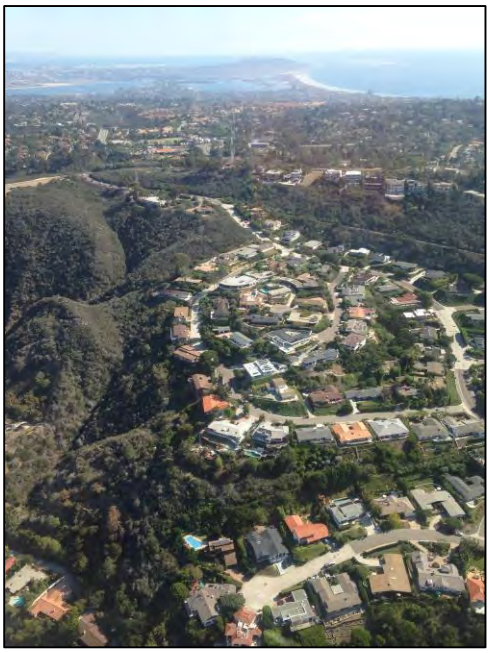
[1] NC State University. Community Response to Wildland Fire Threats. Steelman, T. and Kunkel, G. 2003. Available online: https://www.ncsu.edu/project/wildfire/Arizona/FlagstaffCaseStudy.pdf.
[2] The report, A Full Cost Accounting of the 2010 Schultz Fire, was published by the Ecological Restoration Institute. Available online: http://nau.edu/eri/banner/schulz-fire/.
[3] Published by the Ecological Restoration Institute. Available online: http://nau.edu/ERI/Banner/Flagstaff-Watershed-Protection-Project--Creating-Solutions-through-Community-Partnerships/.
[4] Available online: http://gffp.org/.
[5] Wood shake roof coverings are prohibited, with the exception of decorative accent coverings or historical buildings as reviewed and approved by the Community Development Department and Fire Department.
[6] Described in further detail in the Flagstaff Zoning Code Division 10-50.90: Resource Protection Standards.
[7] Described in further detail in the Flagstaff Zoning Code Appendix 5.020: Implementation of the Flagstaff Fire Department Firewise Process.
[8] Flagstaff Regional Plan: 2030 Place Matters. 2014. Available online: http://www.flagstaff.az.gov/DocumentCenter/View/43827.
[9] City of Flagstaff Resiliency and Preparedness Study. 2012. Available online: http://www.mayorsinnovation.org/images/uploads/pdf/9_-_City_of_Flagstaff_Resiliency_and_Preparedness_Study_September_2012_20121001134212552 8.pdf.

LEADERS IN WILDFIRE ADAPTATION

San Diego, California—A Unique Regulatory Approach to an Expansive Wildland-Urban Interface Challenge

The City of San Diego is intimately familiar with wildfire and its impacts. Located on the southern coast of California and bordering Mexico, this city of nearly 1.4 million people has witnessed firsthand the devastation from the Cedar Fire (2003) and Witch Creek-Guejito Fire (2007), among many others. Although these catastrophic fires have led to important policy, planning, and response improvements, the shrubland landscape, steep canyons, prolonged regional drought, and pockets of open space throughout the city remain an ongoing concern for fast-moving wildfires.

Most of the available land within San Diego's city limits has already been developed and is skirted by a 500 linear mile stretch of Wildland-Urban Interface (WUI). The thousands of structures and flammable brush within the WUI correspondingly makes managing this landscape the primary wildfire challenge. More than 42,000 properties are considered at risk due to their location—particularly where backyards meet dense stands of native or naturalized vegetation in canyons and other open space areas. Further exacerbating wildfire danger to the city, is the present and predicted impacts from climate change. For instance, climate scenarios for San Diego project an increase in average annual temperatures between 3.4-5.9°F by 2090.[1] As such, the city has enforced strict brush management regulations as a way to augment defensible space standards and reduce wildfire risks to properties situated within the WUI.



Long and narrow "open space islands" extend throughout the City of San Diego. These areas create a need for brush management to reduce the wildfire risk to homes and neighborhoods while preserving native habitat.

Photo credit: Molly Mowery, Wildfire Planning International

Although the culture throughout California increasingly favors heightened wildfire awareness, the task to mitigate wildfire impacts to neighborhoods remains a daunting prospect for city fire officials and planners. While San Diego's planning staff and fire personnel work to integrate science and experience with its wildfire risk reduction program, they must additionally factor in other environmental considerations into their decision making efforts, such as habitat preservation for endangered species, hillside erosion, and drought conditions. This requires coordination, communication, and the quest to provide proper guidance for a management framework where there is no "one size fits all" approach.

History of Wildfire in San Diego

San Diego County has experienced three of the top 20 largest wildfires in California history, many of which have also affected the City of San Diego. In 1970, the Laguna Fire burned 175,425 acres, destroyed 382 structures and killed five people. The Cedar Fire that occurred in 2003 in both the City and County of San Diego remains the largest California wildfire to date; the fire burned 273,246 acres, destroyed 2,820 homes and claimed 15 lives. Four years later, the Witch Fire burned 197,990 acres, destroyed 1,640 structures and left two people dead.[2] While these fires are most notable for their size and unfortunate consequences, numerous other wildfires have also affected this wildfire-prone region.

SAN DIEGO, CA

Major Wildfires, 2000-2013

The two largest wildfires are described below.

CEDAR FIRE, 2003
288,369 Acres

Total Cost	$33M	Structures Threatened	21,500
Total Personnel	5,203	Structures Damaged	2,883
Firefighters Injured	39	Evacuations Caused	Yes

The Cedar fire was largest in California history. Fifteen people died, entire communities were destroyed, and air traffic control for San Diego and Los Angeles was evacuated -disrupting air traffic across the U.S.

WITCH FIRE, 2007
245,582 Acres

Total Cost	$20M	Structures Threatened	6,800
Total Personnel	2,807	Structures Damaged	1,025
Firefighters Injured	35	Evacuations Caused	Yes

The Witch fire led to two civilian fatalities and evacuations of hundreds of thousands of residents of coastal communities and Indian reservations. High schools, fairgrounds, and Qualcomm Stadium were used as shelters. Major roads including I-15 closed.

Impacts of Wildfire on the City of San Diego

The varying size and severity of wildfires occurring throughout the city and surrounding areas have resulted in a number of different impacts, including:

- **Community-scale devastation.** Many of San Diego's catastrophic wildfires have heavily impacted entire neighborhoods. The losses that occurred during the Cedar Fire and Witch Creek Fire, for example, destroyed hundreds of homes in relatively small geographic areas of the city. This led to communities such as Scripps Ranch, Tierrasanta, and Rancho Bernardo bearing the brunt of devastation and requiring long-term rebuilding efforts.
- **Death, injuries, and displacement.** Due to the widespread chaparral landscape, wildfires in the San Diego region spread quickly and residents can easily become trapped. While several of San Diego's wildfire incidents have resulted in death, mass evacuations are more common. For instance, during the Witch Creek Fire, more than 500,000 people were evacuated; 200,000 of them within the city.[3] More recently, the 2014 wildfires in San Diego County resulted in a number of evacuations and school district closures. In addition, injuries and illnesses associated with fire and smoke (e.g., burns, asthma, and respiratory distress) are difficult to quantify, but can have real and long-lasting effects on victims.
- **Far-reaching economic impacts.** Following the Cedar Fire, Otay Fire, and other wildfires in 2003, San Diego State University conducted a study to highlight the actual economic costs of wildfire. The researchers concluded that the 2003 fires cost approximately $2.45 billion in suppression and recovery costs. Estimates included lost business economic activity, watershed restoration, Federal Emergency Management Agency (FEMA) loans and assistance, property loss, medical costs, and fire suppression costs.[4]

How San Diego Is Addressing Wildfire Risk Through Land Use Planning and Regulations

The State of California is known for its robust wildfire protection requirements, as primarily addressed in the California Fire Code and Building Code. San Diego has not only adopted both of these codes into their Municipal Code, but made them more stringent due to local environmental concerns and decades of wildfire incidents. Brush management regulations are chief among their wildfire mitigation approaches.

Brush Management Regulations

San Diego Municipal Code's Landscape Regulations seek to fulfill multiple objectives: minimize erosion of slopes and disturbed lands; conserve energy by shading streets and other paved surfaces; improve appearances of the built environment; and reduce the risk of fire through site design and the management of flammable vegetation.[5]

To help property owners better understand brush management regulations and landscape standards, the San Diego Fire-Rescue Department worked with planning staff to issue an in-depth policy guide. This guide clarifies existing requirements and includes descriptive illustrations such as the one above.

Image source: City of San Diego FBP Policy B-08-1

The city's comprehensive brush management regulations apply to any property containing a habitable structure *and* native or naturalized vegetation. These properties are required to follow a two-zone approach, where activities such as weed control, vegetation thinning, and tree removal occur according to each zone.

The San Diego Fire Marshal's office inspects properties to ensure they are in compliance with brush management requirements. If an inspection reveals that the property does not meet the requirements, the legal due process can take up to a total of 70 days for compliance. If the property owner still fails to comply, the city will hire a private contractor and send the bill to the property owner. Failure to pay may result in a lien (special assessment tax) being placed on the property.

Evolving Standards and Alternative Means

San Diego's brush management requirements are complicated by a host of factors. For example, the city's Land Development Code requirements related to brush management originated in 1989, and have already been modified eight times. The definition of zones has changed over time, from using three zones and a total length exceeding 100 feet of brush management to a modern adoption of two zones totaling 100 feet or less. This means that older established communities have been grandfathered in to comply with one code while newer, post-1989 homes fall under a different set of code requirements.

Location, lot size, ownership, and date of development can all influence the type of brush management each property must comply with. Photo credit: Molly Mowery, Wildfire Planning International

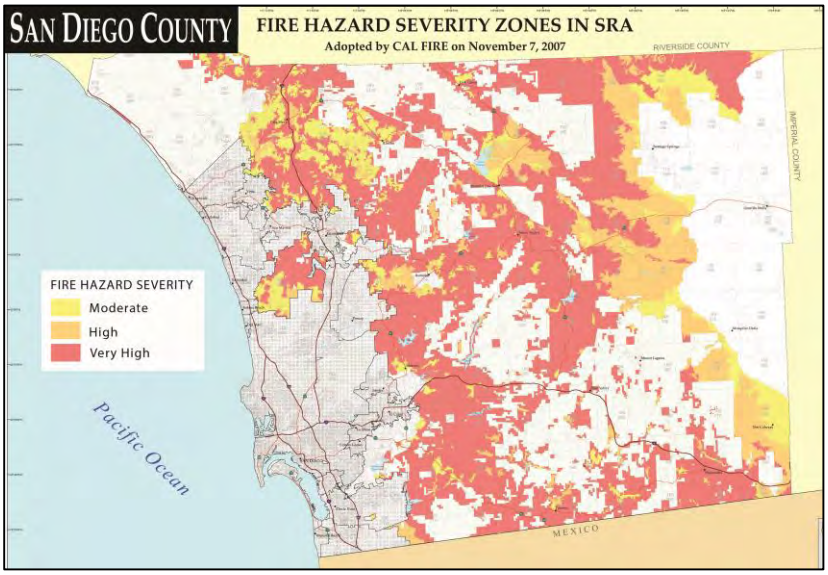
Requirements are also detailed and strict—brush management must be done in a manner that both reduces the local fire hazard *and* minimizes impacts to undisturbed vegetation to protect sensitive biological resources. Property owners that "over clear" (i.e., remove too much vegetation, even with the best of intentions) may be fined thousands of dollars to repair environmental damage to these sensitive landscapes.

Finally, some homeowners simply may not have enough property to satisfy the required 100 total feet of brush management. In this case, the fire department must sign off on the "alternative means" allowed during the development application process—that is, property owners may still develop in wildfire-prone areas if they incorporate additional structural hardening features (e.g., sprinklers, highest rated ember-protective vents, and heat-resistant windows).

Equally important, fire officials see education as part of the solution. "Defensible space compliance is driven by codes *and* public education," emphasizes Eddie Villavicencio, Supervising Deputy Fire Marshal for San Diego Fire-Rescue Department. City fire officials believe that the best defense against wildfire is through brush management and in doing so, actively engage in ongoing efforts to meet with homeowners' associations, attend workshops, and educate property owners about the importance of wildfire safety through defensible space.

New Efforts from CAL FIRE Further Promote Land Use Planning

Every county and city in California is required to adopt a General Plan, which is a comprehensive planning document that provides a blueprint for a community's long-term future growth. General Plans must address land use, conservation, safety, circulation, noise, open space, housing, and other applicable issues. The California State Board of Forestry and Fire Protection recently rolled out a new initiative to ensure that communities are adequately addressing wildfire as part of each community's General Plan.[6] Through this process, California's Department of Forestry and Fire Protection (CAL FIRE)—which oversees wildfire prevention, education, and mitigation programs across the state—works with local planning and fire departments to ensure that the Safety Element of a General Plan includes specific goals, policies, and references related to land use planning and protection against wildfire. Specific topics may include development codes, conservation and open space, circulation and access, defensible space, emergency services, and post-fire safety recovery and maintenance. Counties and cities will have different requirements depending on their fire hazard severity zone rating assigned by the state. Including this information in the General Plan helps prioritize wildfire as a planning directive for the local community and also offers the opportunity for the local agencies to mutually engage with state agencies about transboundary wildfire hazards and community protection.



CAL FIRE maintains state and local responsibility area maps that show fire hazard severity zones, as required by state law. The City of San Diego is currently designated as being within a Very High Fire Hazard Severity Zone, and therefore their upcoming General Plan Safety Element update will require a more comprehensive set of review and policy recommendations to incorporate wildfire.

Image Source: CAL FIRE (fire.ca.gov)

San Diego Prepares for Wildfire Risks and the Impacts of Climate Change

The State of California maintains "Cal-Adapt," a website providing climate data and information from the scientific and research community to help users understand how climate change might affect California at the local level. For instance, a local climate snapshot provided by Cal-Adapt suggests that future temperature ranges for San Diego will significantly increase, as much as 6˚F by 2090, and precipitation patterns will become increasingly unpredictable.[7] Future wildfire risk is additionally expected to increase

in terms of area burned, particularly for the eastern part of the city where wildfires are already a threat from neighboring county lands.

The City of San Diego, along with other communities throughout southern California, has also been experiencing prolonged drought and other changes in precipitation patterns. Due to the severity of the drought, the city has been mandated by the state to cut its collective water use by 16 percent between June 1, 2015 and February 13, 2016.[8] As mandatory water use restrictions have taken effect, fire officials have reviewed and updated relevant brush management practices to ensure all recommendations are compatible with both wildfire risk reduction and water conservation. It is, however, an ongoing concern that will continue to be evaluated and updated accordingly.

Key Takeaways

Implementing and enforcing regulations can result in measurable risk reduction. Significant wildfire tragedies have shaped San Diego's past while resulting in sophisticated brush management regulations and other proactive approaches to improve wildfire response and public safety. The city's detailed mitigation approach considers many diverse factors, such as reducing flammable vegetation while protecting sensitive habitat, conserving water, and controlling for erosion. It also achieves something rare: the ability to regulate and enforce fire risk reduction on all properties threatened, not just those that may be undergoing development. Tracking more than 42,000 homes at risk is no small feat, but staff are successfully implementing and enforcing regulations across the city. The ability to implement a comprehensive set of landscaping requirements may be a formidable reponsibility to consider for less regulatory-friendly communities. However, San Diego provides a successful example of what can be achieved when regulations are part of the community wildfire reduction approach.

Incorporating wildfire education as part of the risk reduction process. Even as the city has boosted its ability to respond to and reduce the likelihood of large wildfires throughout its WUI, it still faces a number of small but high-risk open space pockets throughout its jurisdiction. These areas leave a number of neighborhoods vulnerable to fast-moving brush fires. As fire officials have emphasized, regulations are only part of the overall approach to risk reduction. Efforts also must include public education to counteract apathy resulting from fewer recent wildfire losses on a local scale. As part of this education, extensive outreach is involved, including engaging with the public at workshops, forums, door-to-door site visits, and through educational handouts. Together, the holistic mitigation strategy of fuel management, outreach, regulations, and enforcement is helping San Diego become an increasingly fire-adapted community.

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Key Resources:

City Departments	
Development Services Department	http://www.sandiego.gov/development-services/index.shtml
Fire-Rescue Department	http://www.sandiego.gov/fire/
Water (Public Utilities)	http://www.sandiego.gov/water/

Documents	
San Diego Municipal Code, Chapter 14: General Regulations, Article 2: General Development Regulations, Division, 4: Landscape Regulations	http://docs.sandiego.gov/municode/MuniCodeChapter14/Ch14Art02Division04.pdf#page=25

Brush Management Guide	http://www.sandiego.gov/fire/pdf/brushpdf.pdf
The City of San Diego, Clarification of Brush Management Policy and Landscape Standards	http://www.sandiego.gov/fire/pdf/brushpolicy.pdf

Other Resources

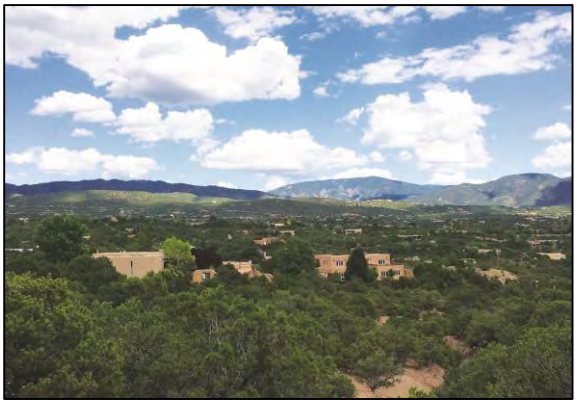
Brush Management and Weed Abatement, Very High Fire Hazard Severity Zones, Very High Fire Hazard Severity Zone Map	http://www.sandiego.gov/fire/services/brush/severityzones.shtml
cal-adapt, Exploring California's Climate Change Research	http://cal-adapt.org/
CAL FIRE	http://www.fire.ca.gov/
California Office of the State Fire Marshal	http://osfm.fire.ca.gov/

[1] Temperature range depends on a low versus high emissions scenario. Additional details and information available online: http://cal-adapt.org/.
[2] Source: CALFire, Top 20 Largest California Wildfires, published 9/11/2015. Available online: http://www.fire.ca.gov/communications/downloads/fact_sheets/20LACRES.pdf.
[3] As described under the San Diego Fire-Rescue Department website, Major Fires and Incidents. Available online: http://www.sandiego.gov/fire/about/majorfires/index.shtml.
[4] Diaz, John M. Southern Fire Exchange, Economic Impacts of Wildfire (SFE Fact Sheet 2012-7). Available online: http://www.southernfireexchange.org/SFE_Publications/factsheets/2012-7.pdf.
[5] San Diego Municipal Code, Chapter 14 General Regulations, Article 2: General Development Regulations, Division 4: Landscape Regulations.
[6] In accordance with California Government Code Section 65302.5.
[7] Temperature range depends on a low versus high emissions scenario. Additional details and information available online: http://cal-adapt.org/.
[8] Source: City of San Diego Public Utilities, Drought Information and Resources. Available online: http://www.sandiego.gov/water/conservation/drought/.

LEADERS IN WILDFIRE ADAPTATION

Santa Fe, New Mexico—A Coordinated Approach to Protecting the Escarpment

The City of Santa Fe is well known for its historic resources, unique architecture, and boundless recreational, and cultural opportunities. Its arid climate makes Santa Fe prone to extreme heat, drought, and wildfire, among other natural hazards. City planners in Santa Fe are balancing several competing priorities, such as protecting community aesthetic values, managing long-term growth, improving economic development, and preserving Santa Fe's natural landscape.



Development in and around the City of Santa Fe escarpment presents challenges to planning and wildfire mitigation efforts. Photo credit: Clarion Associates

Climate projections showing upward trends in the frequency and intensity of wildfire have planners and other city officials pressing to integrate climate preparedness strategies into city policies and regulations. With limited funding available, city employees have made significant headway in this regard, largely due to a culture of innovation and collaboration. The Santa Fe Fire Department is interested in how land use planning affects their ability to protect the citizens of Santa Fe, especially in the Wildland-Urban Interface (WUI). City planners actively integrate wildfire mitigation into their decision making framework, continually reviewing planning mechanisms through a lens of protecting people, property, and the environment from the damaging impacts of wildfire.

The city's escarpment (where the foothills climb sharply into the neighboring plateaus), is one of the city's leading priority areas to implement wildfire protection efforts. WUI specialists work side-by-side with city planners and emergency management personnel to ensure future development within this pristine landscape addresses the competing interests of protecting views and reducing wildfire risks. Through zoning tools, mitigation projects, and interdepartmental coordination, the City of Santa Fe is a leader in a unified approach to reduce the risks from wildfires.

History of Wildfire in Santa Fe

Wildfire is an inherent component of Santa Fe's natural environment. The Santa Fe National Forest borders the city to the east, and is also approximately five miles to the west of the city. Because of its close proximity to forested lands, the City of Santa Fe is susceptible to wildfires and to the indirect impacts of fires that occur outside the city limits. The city has been fortunate to have avoided major wildfires within its municipal boundaries; however, it has experienced the impacts of wildfires within Santa Fe County and beyond. Though not explicitly within the city boundaries, there have been more than a dozen fires, each burning more than 100 acres, on record within Santa Fe County since 1970.

Nearly 20 miles west of the City of Santa Fe, two of the largest fires in New Mexico history burned more than 200,000 acres collectively. The 2011 Las Conchas Fire alone burned 156,593 acres and destroyed 63 homes. The Cerro Grande Fire, in 2000, burned more than 47,000 acres, destroyed 280 homes, and 40 lab buildings at the Los Alamos National Laboratory.[1] That fire was also recognized as the first in U.S. history with more than $1 billion in documented economic impacts. In 2003, the Molina Complex Fire burned within 10 miles of the City of Santa Fe. Started by lightning, the fire burned nearly 7,000 acres and threatened around 300 structures.[2]

SANTA FE, NM

Major Wildfires, 2000-2013

The two largest wildfires are described below.

MOLINA COMPLEX FIRE, 2003
6,804 Acres

Total Cost	$4M	Structures Threatened	248
Total Personnel	351	Structures Damaged	0
Firefighters Injured	3	Evacuations Caused	No

The Molina Complex fire was caused by lightning and threatened the Nambe Pueblo watershed and sacred tribal sites.

PACHECO FIRE, 2011
10,114 Acres

Total Cost	$10M	Structures Threatened	34
Total Personnel	728	Structures Damaged	0
Firefighters Injured	8	Evacuations Caused	No

An escaped campfire caused the Pacheco fire, which threatened the City of Santa Fe Watershed. The fire also threatened the Nambe and Tesuque tribal land, communication sites, power lines, Santa Fe ski area, and closed a state highway and park.

With increasing temperatures and more severe droughts expected in the future, the City of Santa Fe expects wildfire to remain one of its most immediate concerns. The city has taken a systematic view to managing wildfire risk, including remarkable interdepartmental coordination, creation of task forces and citizen advocate committees, and continual review and maintenance of its policies, procedures, and regulations.

Impacts of Wildfire on the City of Santa Fe

Hundreds of other fires have occurred in and around Santa Fe, with varying impacts. Those direct and indirect impacts include the following:

- **Air quality.** Heavy smoke and particulates during a wildfire event fill the air, and depending on the wind speed and direction, can inundate a community for days or even weeks.
- **Watershed.** The Santa Fe watershed, supplying about 40 percent of the city's water, is located in the Santa Fe National Forest. Wildfires that occur nearby correspondingly threaten the quality and supply of city water resources.[3] For instance, the Cerro Grande Fire significantly affected the nearby City of Los Alamos's watershed, resulting in water runoff levels more than 200 percent greater than pre-fire averages and diminishing surface water quality.[4]
- **Recreation and tourism.** Large catastrophic wildfires reduce the tourist draw to the City of Santa Fe and the regional draw for recreation activities. For example, the Pacheco Fire in 2011 resulted in the closure of the Santa Fe National Forest, Valles Caldera National Preserve, and nearby recreation sites such as Hyde Memorial State Park and Morphy Lake State Park, popular destinations with fisherman and hikers[5].
- **Costs for rehabilitation and restoration.** Following suppression of a major fire, the city bears a share of the burden to restore the built and natural environment to its pre-fire state. For example, it is estimated that for a high-severity wildfire burning more than 7,000 acres near the municipal watershed, the

cost to the city for rehabilitation activities, including fees associated with water treatment, sediment regulation, initial fire suppression, and land restoration, are close to $22 million.[6]

How Santa Fe Is Addressing Wildfire Risk Through Land Use Planning and Regulations

The City of Santa Fe has gone to great lengths to protect its people and property from the impacts of wildfire. This is evidenced by the amount of documentation and planning during the past decade to increasingly emphasize wildfire as part of the common dialogue among city officials, and to draw linkages from wildfire to other citywide policies addressing climate change, sustainability, and community resilience.

Escarpment Overlay District

An overlay district sets standards that apply to properties within a defined overlay boundary that often supersede the underlying base standards within a given zoning district. One of the most instrumental land use mechanisms for managing wildfire mitigation in Santa Fe is its Escarpment Overlay District. The overlay district was established to protect viewsheds along the ridgetops and foothills along the escarpment as a major community asset. In doing so, the overlay also reduces wildfire risk and protects the valuable watershed by limiting development. The escarpment overlay covers approximately 500 acres within the city, and contains most of the high wildfire risk areas. Development applications in the escarpment overlay district are subject to higher scrutiny, and the city performs a more thorough site assessment for wildfire risk reduction for all new development applications.

A Balancing Act

Working within the Escarpment Overlay District requires striking a balance between competing community priorities of protecting views of the historic hillside, while providing adequate defensible space.

Noah Berke, a Senior Planner with the City of Santa Fe, spends a significant amount of his time managing development and conducting site assessments within the escarpment. During his site assessments, Berke works with applicants to manage forested areas while also protecting visual aesthetics. For example, the city may reduce the required trees in the escarpment if necessary to reduce wildfire risk. Landscaping in the escarpment overlay is treated differently than other areas of the city, requiring vegetation with a lower burn risk. The mapping of the escarpment overlay district is an essential component to its functionality, and new modeling is currently being reviewed for future mapping updates.[7]

***Noah Berke** conducts individual site inspections of homes proposed within Santa Fe's Escarpment District, including working with homeowners to manage vegetation while also protecting the scenic viewshed.*

Hazard Mitigation Plan and the Community Wildfire Protection Plan

The City of Santa Fe adopted a Hazard Mitigation Plan in October 2014. The plan identifies risk, vulnerabilities, and mitigation actions related to wildfires. Berke and other Santa Fe planners are currently reviewing the Hazard Mitigation Plan and trying to merge wildfire-related content into the General Plan (which states the community's goals, policies, and objectives) and the Land Development Code (which implements the General Plan by regulating development). The city also partnered with Santa Fe County to prepare the 2008 Community Wildfire Protection Plan (CWPP). CWPPs are local plans that are designed to specifically address a community's unique conditions, values, and priorities related to wildfire risk reduction and resilience. CWPPs can vary in scope, scale, and detail, but there are minimum requirements for their development and adoption.[8] The 2008 CWPP describes risk in further detail, and provides recommendations for projects to reduce fuels and raise awareness of the wildfire threat to individual property owners.

Consideration of a Wildland-Urban Interface (WUI) Code

WUI codes are specifically designed to mitigate the risks from wildfire to life and property, primarily by providing a set of wildfire mitigation development standards, including structure density and location, building materials and construction, vegetation management, emergency vehicle access, water supply, and fire protection. The city's fire department employs WUI specialists that work closely with land use planners to manage risk and identify areas for wildfire risk reduction, especially in the escarpment overlay. Santa Fe has long considered adoption of the WUI Code—a more rigorous set of building and site standards than otherwise applied through International Building and Fire Codes. Advocates for a WUI Code in Santa Fe believe the higher level standards will help disperse costs and risks associated with wildfire to individual property owners, and are conducting further analysis to develop political support. The city's land use planners are working with WUI specialists to integrate components of a WUI code into the Land Development Code. In the meantime, the Santa Fe Fire Department also collects parcel-level data for homes that have been assessed for their wildfire risk. This level of detail allows for more accurate analysis and planning for future WUI activities.

Much of the residential construction in Santa Fe's forested areas is adobe or similar composite with flat roofs—an inherently fire-resistent type of construction. Photo credit: Clarion Associates

Managing the Forest to Protect Santa Fe's Watershed

The City of Santa Fe's water supply is provided by watersheds located in the Santa Fe National Forest. Accordingly, protecting the watershed from catastrophic wildfire is a top priority for city water officials. As an additional protective measure, the municipal watershed has been closed to public access since 1932.[9] Following the Cerro Grande Fire in 2002, the City of Santa Fe established a forest treatment program in the Santa Fe National Forest to reduce the fuel load in portions of the watershed. This program required a concerted effort by partnering agencies including the U.S. Forest Service, the Santa Fe Watershed Association, the Nature Conservancy, the City of Santa Fe Watershed Division, and other private and public groups. Since the program began, the U.S. Forest Service has treated more than 5,500 acres within the watershed.[10]

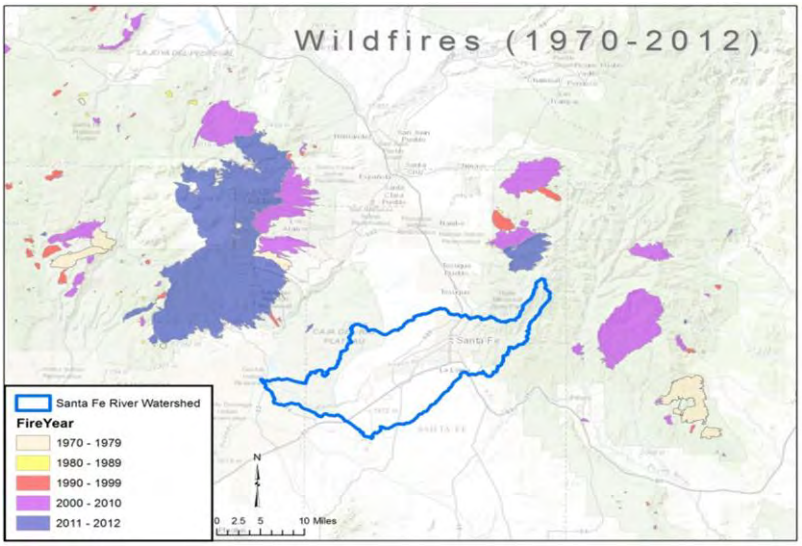
The City of Santa Fe and their partners have been actively engaged in protecting crucial regional watersheds, such as the McClure Reservoir..

Photo credit: Molly Mowery, Wildfire Planning International

Although funding for the original fuels treatment program has since expired, the city now collects revenues from water utility rate payers (local water customers). The watershed division estimates that a 10,000- to 40,000-acre fire impacting some portion of the watershed could result in suppression and rehabilitation costs up to $48 million, and dredging and disposing of reservoir sediment costs up to $240 million.[11] At those numbers, the City of Santa Fe realizes the immediate benefits of continued fuel treatment and forest management.

Santa Fe Prepares for Wildfire Risks and the Impacts of Climate Change

In 2014, and in response to growing concerns regarding present and predicted impacts from climate change, Santa Fe Mayor Javier Gonzales assembled a climate action task force. The task force includes elected officials, climate experts, and other representatives from the community. With more frequent and intense droughts expected in the future, this task force addresses various concerns related to the adverse impacts from climate change, including the health of the neighboring forest, changing precipitation patterns, and increasing wildfire potential. The city also partnered with the county and the Bureau of Reclamation to prepare a climate change assessment of vulnerabilities and adaptation alternatives. That 2013 study focused on water resources, but recognized wildfire as a major issue within the watershed.[12] The city also has a Sustainable Santa Fe Commission comprised of citizens that developed the Sustainable Santa Fe Plan, which outlines opportunities to enhance the city's resiliency against climate change and increase environmental stewardship efforts. The city works with area businesses and residents to implement this plan, as well as identify areas for future actions to improve overall community sustainability.[12]



The map above from the City of Santa Fe Municipal Watershed Investment Plan illustrates the proximity of wildfires near the Santa Fe River Watershed (outlined in blue).

Key Takeaways

A culture of collaboration and innovation. The City of Santa Fe epitomizes the concept of interdepartmental coordination. As part of this, the fire department, with assistance from the planning department, is interested in partially shifting their focus away from response time in the WUI to land use and property owner support. Internal cooperation and interagency communication is part of city staff culture in Santa Fe. Community input is also a high priority and involves a robust early neighborhood notification program and regular communication of wildfire-related activities. The city's elected and appointed officials support initiatives to improve the resilience of Santa Fe, recognizing climate change as an indicator of future hazard risk.

Balancing multiple objectives. The City of Santa Fe comprehensively reviews proposed ordinances, planning documents, and other citywide policies or regulations for opportunities to incorporate wildfire risk reduction measures. One example is the city's Escarpment Overlay District, which was primarily established to protect the aesthetic values of the surrounding hillsides from incompatible development. Over time, administration of the overlay has adapted to include a more refined focus on wildfire mitigation. Additionally, the city is pursuing other updates to its land development regulations as a way to implement principles identified in the hazard mitigation plan and the CWPP. Ongoing maintenance of the city's policy and regulatory documents is essential to maintain political support for wildfire risk reduction and to educate Santa Fe residents about the inherent dangers of living in the WUI. In this way, the City recognizes the synergies between planning for wildfire risks while meeting the other resource needs of its residents.

> *"We've been shifting from what was previously a sole focus on a cohesive response in the WUI to more emphasis on land use and getting people vested in their own protection."*
>
> **Erik Litzenberg**
> Fire Chief
> City of Santa Fe

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Coordination is essential to planning, emergency management, and fire protection. Pictured from left to right are Noah Berke, senior planner; Molly Mowery, project consultant; David Silver, emergency manager; and Porfirio Chavarria, WUI specialist.
Photo credit: Clarion Associates

Key Resources:

City Departments	
Land Use	http://www.santafenm.gov/land_use
Fire Department	http://www.santafenm.gov/fire_department
Emergency Management	http://www.santafenm.gov/emergency_management
Long Range Planning	http://www.santafenm.gov/long_range_planning

Documents	
Santa Fe County Community Wildfire Protection Plan	http://www.emnrd.state.nm.us/SFD/FireMgt/documents/SantaFeCountyCWPP2.pdf
Hazard Mitigation Plan	http://www.santafenm.gov/hazard_mitigation_plan_1
Santa Fe Land Development Code	http://clerkshq.com/default.ashx?clientsite=Santafe-nm
City of Santa Fe General Plan 1999	http://www.santafenm.gov/general_plan_1999
Sustainable Santa Fe Plan	http://www.santafenm.gov/sustainable_santa_fe_plan

Other Resources

City of Santa Fe Climate Action Task Force	http://www.santafenm.gov/climate_action_task_force
City of Santa Fe Water and Climate Change webpage	http://www.santafenm.gov/climate_change
City of Santa Fe Watershed Association, Climate Adaptation	http://www.santafewatershed.org/climate-adaptation/
City of Santa Fe Fire Department Wildland Fire Preparedness webpage	http://www.santafenm.gov/wildland_fire_preparedness
City of Santa Fe Wildfire Preparedness Day	http://www.santafenm.gov/news/detail/fire_department_encouraging_neighborhoods_to_join_national_wildf

[1] Las Conchas Fire Factsheet. 2012. Southwest Fire Consortium. Available online: From the City of Santa Fe, Hazard Mitigation Plan. Available online: http://www.santafenm.gov/hazard_mitigation_plan_1.

[2] From the Farmington District Fire Management Plan. 2010. Available online: http://www.blm.gov/style/medialib/blm/nm/programs/fire/fire_management_plans/farmington_fmp.Par.47436.File.dat/ffo_fmp.pdf.

[3] From the City of Santa Fe, Hazard Mitigation Plan. Available online: http://www.santafenm.gov/hazard_mitigation_plan_1.

[4] From the Los Alamos National Laboratory, Cerro Grande Fire Impacts to Water Quality and Stream Flow near Los Alamos National Laboratory:Results of Four Years of Monitoring report Available online: https://www.env.nm.gov/swqb/Wildfire/4.CerroGrande-Postfire_Report.pdf.

[5] From an article in the Examiner. June 30, 2011. Available online at: http://www.examiner.com/article/las-conchas-wildfire-closes-new-mexico-s-santa-fe-national-forest.

[6] From the City of Santa Fe Municipal Watershed Plan, 2010-2029. Available online: https://www.santafenm.gov/municipal_watershed_plan.

[7] The city of Santa Fe's Land Development Code. Available online: http://clerkshq.com/default.ashx?clientsite=Santafe-nm. The Escarpment Overlay District is Section 14-5.6 of the Land Development Code.

[8] As described in Title I of the Healthy Forest Restoration Act (HFRA) of 2003 that authorizes communities to draft and implement a CWPP.

[9] From the History of the Santa Fe River Watershed. Available online: http://www.santafenm.gov/upper_watershed_history.

[10] From the Municipal Watershed Investment Plan. Available online: http://www.santafenm.gov/municipal_watershed_investment_plan.

[11] From Municipal Watershed Investment Plan, Avoided Costs vs. Program Costs. Available online: http://www.santafenm.gov/municipal_watershed_investment_plan.

[12] Water and Climate Change. Available online: http://www.santafenm.gov/climate_change.

[12]Available online: https://sustainablesantafe.wordpress.com/the-commission/.

CONCLUSION

Wildfires always have been a defining feature of the American West, yet risk to life and property is accelerating as a result of development trends directed towards the region's Wildland-Urban Interface (WUI). In addition, extended droughts, unseasonably warm temperatures, and other climate-induced impacts are influencing the frequency and size of wildfires. Some urban areas in the West, such as the cities and counties of Austin, Boulder, Flagstaff, San Diego, and Santa Fe, are effectively responding to the increasing threat of wildfires in creative ways. In profiling these urban case studies, several important lessons can be gleaned regarding land use planning for wildfires:

- Planning successes took years of effort, and an in-depth application of planning tools was not the first strategy communities utilized when seeking to reduce wildfire risks. Forest management (e.g., thinning and other fuel treatments), Community Wildfire Protection Plans (CWPPs), and initial building code regulations were typically pursued prior to adoption of more stringent land use standards or the pursuit of a Wildland-Urban Interface (WUI) Code.

- While each community might have unique wildfire concerns, all of them take a multi-pronged approach to wildfire risk reduction. This comprehensive framework is likely a common denominator for achieving success with land use planning efforts. In other words, implementing land use planning tools to reduce wildfire risk, absent other mitigation and outreach activities, may be challenging without incorporating a broader and more holistic outlook.

- Communities *are* addressing new and existing development, but such approaches often require extra innovation and resources. Boulder County's Wildfire Partners Program and San Diego's brush management policies provide compelling examples of applying integrative land use planning mechanisms to reduce overall wildfire risk to the community.

Practitioners, policymakers, and the public all have an important role in adapting a community's built environment to wildfire risks and associated climate change impacts. Examples of wildfire risk reduction strategies described in this report demonstrate a community's collaborative capacities when residents, city officials, and land agencies combine forces to manage wildfire risk.

On an additional note, the process of research and discussion was highly facilitative for some of the cities that participated in these case studies. In the City of Austin for example, our interviews with key contacts from the Development Services, Office of Sustainability, and local Fire Department prompted subsequent internal discussions aimed at pursuing how wildfire should be explicitly addressed in key planning and regulatory documents. The collaboration has since formed into the "Austin Wildfire Planning Team," which has evolved into a broader group of stakeholders including public works and watershed planners. In addition, Austin was recently selected as one of three communities in the Community Planning Assistance for Wildfire (CPAW) program. The selection decision was based in part on the city's broad participant commitment and the timing of upcoming updates to development plans and land use regulations.

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APPENDIX

Frequency of major wildfire events within ½ mile of an urban area, 2000-2013

Urban Area	Major Wildfire Incidents
Santa Clarita, CA	11
Los Angeles, CA	10
Simi Valley, CA	7
Chino Hills, CA	6
Chino, CA	5
Ontario, CA	5
San Diego, CA	5
Corona, CA	4
Pomona, CA	4
Rancho Cucamonga, CA	4
San Bernardino, CA	4
Thousand Oaks, CA	4
Upland, CA	4
Anaheim, CA	3
Burbank, CA	3
Chula Vista, CA	3
El Cajon, CA	3
Escondido, CA	3
Fontana, CA	3
Fullerton, CA	3
Glendale, CA	3
Hesperia, CA	3
Irvine, CA	3
Moreno Valley, CA	3
Orange, CA	3
Riverside, CA	3
Santa Ana, CA	3
Tustin, CA	3
Victorville, CA	3
Baldwin Park, CA	2
Chesapeake, VA	2
Garden Grove, CA	2
Lake Forest, CA	2
Lancaster, CA	2
Midland, TX	2
Odessa, TX	2
Oxnard, CA	2

Urban Area (cont.)	Major Wildfire Incidents (cont.)
Palmdale, CA	2
Phoenix, AZ	2
Reno, NV	2
Rialto, CA	2
San Buenaventura, CA	2
San Marcos, CA	2
Suffolk, VA	2
Vista, CA	2
West Covina, CA	2
Alhambra, CA	1
Avondale, AZ	1
Bakersfield, CA	1
Buena Park, CA	1
Carlsbad, CA	1
Chico, CA	1
Colorado Springs, CO	1
Costa Mesa, CA	1
East Los Angeles CDP, CA	1
El Monte, CA	1
Glendale, AZ	1
Houston, TX	1
Melbourne, FL	1
Menifee, CA	1
Mission Viejo, CA	1
Newport Beach, CA	1
Oceanside, CA	1
Palm Bay, FL	1
Pasadena, CA	1
Santa Barbara, CA	1
Scottsdale, AZ	1
Sparks, NV	1
St. George, UT	1
Sugar Land, TX	1
Tracy, CA	1
Tucson, AZ	1
Westminster, CA	1
Whittier, CA	1

Frequency of major wildfire events within 10 miles of an urban area, 2000-2013

Urban Area	Major Wildfire Incidents
Santa Clarita, CA	20
Los Angeles, CA	16
St. George, UT	14
Simi Valley, CA	13
Palmdale, CA	10
Rancho Cucamonga, CA	9
Murrieta, CA	8
San Bernardino, CA	8
San Diego, CA	8
Temecula, CA	8
Thousand Oaks, CA	8
Fontana, CA	7
Hesperia, CA	7
Lancaster, CA	7
Chino Hills, CA	6
Oceanside, CA	6
Upland, CA	6
Bakersfield, CA	5
Chino, CA	5
Chula Vista, CA	5
El Cajon, CA	5
Escondido, CA	5
Hemet, CA	5
Ontario, CA	5
Pomona, CA	5
Redding, CA	5
Reno, NV	5
Rialto, CA	5
Riverside, CA	5
San Buenaventura, CA	5
Victorville, CA	5
Vista, CA	5
Boise City, ID	4
Corona, CA	4
Las Vegas, NV	4
Midland, TX	4
Moreno Valley, CA	4
Odessa, TX	4
Orem, UT	4
Oxnard, CA	4
Provo, UT	4
Tracy, CA	4
West Covina, CA	4

Urban Area (cont.)	Major Wildfire Incidents (cont.)
Anaheim, CA	3
Baldwin Park, CA	3
Burbank, CA	3
Chico, CA	3
Fort Collins, CO	3
Fullerton, CA	3
Garden Grove, CA	3
Glendale, CA	3
Irvine, CA	3
Livermore, CA	3
Menifee, CA	3
Orange, CA	3
San Jose, CA	3
San Marcos, CA	3
Sandy, UT	3
Santa Ana, CA	3
Santa Barbara, CA	3
Sparks, NV	3
St. George, AZ	3
Tucson, AZ	3
Tustin, CA	3
West Jordan, UT	3
Bend, OR	2
Boulder, CO	2
Carlsbad, CA	2
Chesapeake, VA	2
Colorado Springs, CO	2
Deltona, FL	2
El Monte, CA	2
Houston, TX	2
Jacksonville, GA	2
Lake Forest, CA	2
Las Cruces, NM	2
Mission Viejo, CA	2
North Las Vegas, NV	2
Pasadena, CA	2
Phoenix, AZ	2
San Angelo, TX	2
Santa Maria, CA	2
Scottsdale, AZ	2
Suffolk, VA	2
Wichita Falls, TX	2
Yakima, WA	2

Urban Area (cont.)	Major Wildfire Incidents (cont.)
Alafaya CDP, FL	1
Alhambra, CA	1
Amarillo, TX	1
Austin, TX	1
Avondale, AZ	1
Buena Park, CA	1
Costa Mesa, CA	1
East Los Angeles CDP, CA	1
Enterprise CDP, NV	1
Fairfield, CA	1
Gainesville, FL	1
Glendale, AZ	1
Highlands Ranch CDP, CO	1
Jacksonville, FL	1
Jacksonville, NC	1
Kendall CDP, FL	1
Kennewick, WA	1
Lakeland, FL	1
Lawton, OK	1
Lehigh Acres CDP, FL	1
Longmont, CO	1
Melbourne, FL	1
Meridian, ID	1
Nampa, ID	1
Napa, CA	1
Newport Beach, CA	1
Norwalk, CA	1
Orlando, FL	1
Palm Bay, FL	1
Palm Coast, FL	1
Peoria, AZ	1
Reno, CA	1
Santa Monica, CA	1
Spring Valley CDP, NV	1
Sugar Land, TX	1
Sunrise Manor CDP, NV	1
Vacaville, CA	1
Vallejo, CA	1
West Valley City, UT	1
Westminster, CA	1
Whittier, CA	1

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