Wildland Urban Interface: A Look at Issues and Resolutions

A Report of Recommendations for Elected Officials, Policymakers and All Levels of Government, Tribal and Response Agencies

June 2022

FEMA

U.S. Fire Administration
Working for a fire-safe America

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Cover photo: Homes burned in Coffey Park, California, October 2017. (iStock)

Mission Statement

We support and strengthen fire and emergency medical services and stakeholders to prepare for, prevent, mitigate and respond to all hazards.

U.S. Fire Administration

Working for a fire-safe America

Message from the U.S. Fire Administrator

June 7, 2022

The U.S. experienced staggering losses caused by wildfires, especially in the wildland urban interface (WUI). Wildfires in these areas resulted in devastating losses of life, health, and property, and cascading financial losses. Considering certain land and fire management decisions, along with climate change, wildfires are now moving with a speed and intensity previously unseen. Additionally, recent population growth and decades of growing housing development in the WUI is leaving our nation vulnerable to further loss.

Without significant collaborative efforts to facilitate change, our nation will continue to suffer catastrophic wildfire losses in the WUI. To trigger a sense of urgency and motivation to act, the U.S. Fire Administration, in collaboration with the U.S. Department of the Interior and U.S. Forest Service, developed this report, "Wildland Urban Interface: A Look at Issues and Resolutions," to document opportunities for organizations and partners at every level to work with each other and resolve the challenges identified in the WUI.

While the resolutions to the challenges identified may seem daunting, they are achievable. Developing federal, state, tribal, territorial, local and community wildfire prevention and control initiatives as recommended in this report will raise awareness about the WUI fire problem. These recommendations, if heeded, will also assist in the creation of greater fire-resilient communities, save lives and property, and help all partners better plan and prepare for, mitigate against, and safely and effectively respond to wildfires in the WUI.

Together, we can take action to change the trajectory of the ever-increasing wildfire threat in America and create resilient landscapes for generations to come.

Lori Moore-Merrell, DrPH, MPH
U.S. Fire Administrator
U.S. Fire Administration

Acknowledgments

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Insurance Institute for Business & Home Safety (IBHS)
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International Association of Fire Chiefs (IAFC)
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International City/County Management Association
International Code Council (ICC)
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National Association of Counties (NACo)
National Association of Home Builders
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Preamble

The wildland fire community has been working together across jurisdictional boundaries to address wildland fire challenges for decades. The National Fire Plan, developed in 2000, was the first framework to lay out new strategies to address the rising wildfire risks in the WUI, forests, rangelands and other public lands, and the increasing encroachment of communities on public lands. Recognizing the need to rethink the current policy and address the hazardous fuel problem, congressional funding for fuels and forest health treatments rose significantly. By 2008, there was a recognition that the wildfire challenges we faced called for a more comprehensive interdisciplinary and cross-jurisdictional approach. Building on the work of the National Fire Plan, a diverse group of federal, state, local, tribal and nongovernmental organizations (NGOs) worked together to develop the "National Cohesive Wildland Fire Management Strategy," which was released in 2014. Since that time, the interagency wildland fire community has been anchored to the 3 goals of the Cohesive Strategy: restoring and maintaining resilient landscapes, urging communities to become more fire adapted, and responding safely and effectively to wildfires.

The Wildland Fire Mitigation and Management Commission Act of 2021 mandates establishment of a Wildland Fire Mitigation and Management Commission that includes representation from federal, state, tribal, county, municipal governments, and nongovernmental stakeholders. The commission builds on existing interagency efforts, including the White House Wildfire Resilience Interagency Working Group, which works to coordinate wildfire prevention strategies across jurisdictional boundaries, and the implementation of the "National Cohesive Wildland Fire Management Strategy" under the guidance of the Wildland Fire Leadership Council. The commission is tasked with recommending federal policies and strategies to enhance the ability to effectively prevent, mitigate, suppress and manage wildland fires and conduct rehabilitation activities. The highest priority recommendations from this DHS/FEMA/USFA report will be important sources of key information for both the Interagency Working Group and the commission.

The USFS recently released a report entitled "Confronting the Wildfire Crisis," and the DOI released its "5-Year Monitoring, Maintenance and Treatment Plan"; both are focused on the Cohesive Strategy's first goal of restoring and maintaining resilient landscapes. However, this report focuses on the Cohesive Strategy's second goal of urging communities in the WUI to take steps to become more fire adapted. The WUI has seen exponential growth for the period of 1990-2010, experiencing a 43% increase or about 8 million new homes (Radeloff et al., 2018). Nationwide, approximately 89% of wildfires are human caused. In California, that number is approximately 94%. Human-caused wildfires have tripled the length of the wildfire season and tend to be more destructive because they are more likely to occur near homes in the WUI (National Aeronautics and Space Administration (NASA), n.d.). Given these sobering numbers, if we are to change the trajectory of wildfire and its devastating impacts in the United States, it is imperative that WUI communities work with the wildland and local municipal firefighting community to take steps to reduce their wildfire risk.

The USFA, USFS and DOI are working with partners to address many of the WUI challenges discussed in this report. These efforts include increasing forest and rangeland resiliency by means such as prescribed burning and mechanical thinning, strengthening communication strategies and engagement operations through wildfire prevention and mitigation programs, and proactively planning for and mitigating the continued effects of climate change. Simultaneously, to help ensure safe and effective response, the USFA,

USFS and DOI are also focused on firefighter health and safety, especially mental and behavioral health, and public safety through improving evacuation procedures with efforts such as Reverse 911.

To effectively address wildfire challenges, the wildland firefighting community must continue to address the primary overarching issues that comprise the 3 goals of the Cohesive Strategy. This report highlights the WUI issues in the United States and will help the wildland and structural firefighting community and WUI communities to coalesce around key actions to reduce risk to themselves, firefighters and the environment.

Executive Summary

Wildfires are among the worst natural and man-made disasters currently facing our nation. The damage a wildfire causes is multifaceted as it affects multiple areas of civilization and the safety and health of responding firefighters. Today, factors such as climate change and reduced land management practices are significantly contributing to the cause, the increasing frequency and the greater intensity of wildfires, particularly in the WUI.

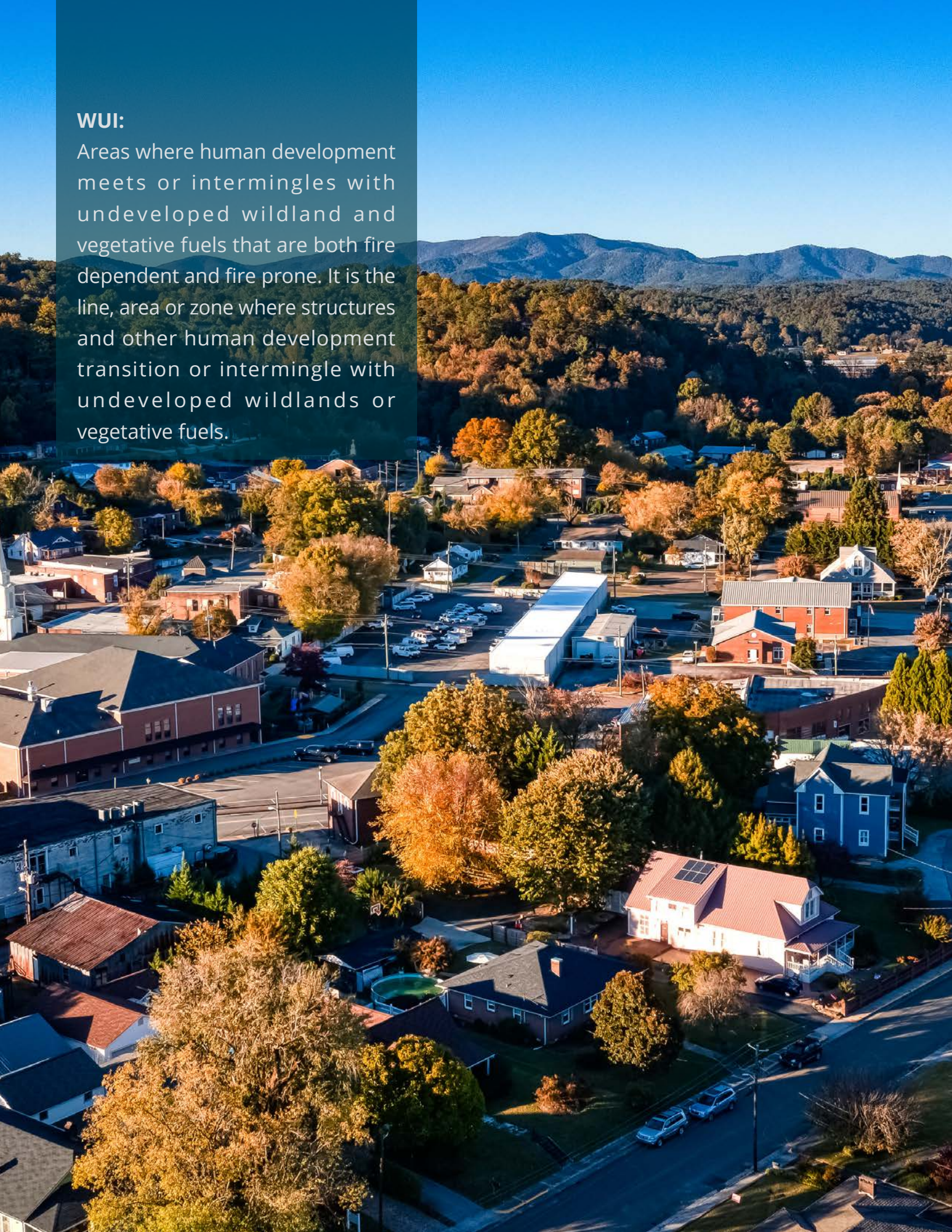
As wildfires enter the WUI, the area between undeveloped and developed land, the issues become more numerous and complex. Additionally, as the United States' population grows and development of wildland continues, the WUI expands, increasing vulnerability for thousands who choose to live in the space and the firefighters who respond to fight the fires that occur. This unique fire problem has become a high-risk public safety concern for life safety, public and responder health, private property and businesses, the economy, and the ecology in these regions. Without intervention, adverse consequences of wildfire in the WUI will worsen.

Our nation is on the precipice of an all-hands moment in which landowners, citizens, communities, infrastructure organizations, academia, researchers, not-for-profit organizations, governmental agencies and others have critical roles in coordinating a collaborative approach to contain and control the threat of wildfire in the WUI. It is essential that elected officials and other government leaders allocate resources and support this imperative to address the WUI wildfire problem.

FEMA/DHS/USFA developed the "Wildland Urban Interface: A Look at Issues and Resolutions" to stimulate action by raising awareness of the crisis that our nation faces related to wildfire in the WUI and lay out a unified, strategic approach to risk reduction at the national, state, regional and local levels. In developing this report, a cross-functional group of stakeholders and subject matter experts (SMEs) from across the nation convened to identify 33 challenges within 13 key WUI issues and develop recommendations to address each challenge. In total, 112 recommendations are presented. These recommendations address challenges in firefighter health and safety, public health and safety, evacuations, forest and rangeland health and resiliency, climate change, community planning and resiliency, infrastructure and utilities, communication strategy and engagement operations, socioeconomic impacts, recovery, emerging technology, data use and modeling, and risk management in wildland fire. The recommendations should be pursued together, forming a system of strategies that require urgent, sustained and actionable implementations. These recommendations are not quick fixes, but solutions for the long term. Leadership on and commitment to the implementation of these recommendations results in a safer America.

WUI:

Areas where human development meets or intermingles with undeveloped wildland and vegetative fuels that are both fire dependent and fire prone. It is the line, area or zone where structures and other human development transition or intermingle with undeveloped wildlands or vegetative fuels.



Introduction

Much of America's landscape is a fire-adapted ecosystem, which means it depends on recurring fire to renew the forests, rangelands and habitats that support the plant and animal ecosystems. Before there were houses and roads, wildfires were primarily ignited by lightning and Indigenous peoples, and they naturally stopped at rivers and wetlands. These wildfires reduced overgrowth and sustained the natural ecosystems.

Today, however, wildfires have become more frequent, more intense, larger and harder to contain. A wildfire "season" no longer exists. Instead, wildfires are a year-round event nationwide. In addition, wildfires impact entire communities in the United States, and these annual occurrences are not limited to the West.

When wildfire enters WUI areas, where human development meets or intermingles with undeveloped wildland or vegetative fuels (NWCG, 2022) that are both fire dependent and fire prone, the effects on communities can be catastrophic, causing environmental and socioeconomic devastation. Wildfires within the current WUI create conditions that overwhelm response capabilities, resulting in billions of dollars in economic losses, damage to natural resources, devastation to communities and tragic loss of human life (The White House, 2021).

Wildfire entering the WUI has become the norm each year as first responders deal with ever-increasing impacts and catastrophic property losses throughout the nation, but with the most dramatic increases in the western and southeastern states. Between 2005 and 2020, wildfires have destroyed more than 89,000 structures in the United States, including homes and businesses. The most damaging wildfires have occurred in the last few years, accounting for 62% of the structures lost over the last 15 years (Headwaters Economics, 2020). In addition, as America's WUI continues to grow by approximately 2 million acres per year (USFA, 2021), conditions may become worse.

Wildland fire:
Any non-structure fire that occurs in vegetation or natural fuels. Includes wildfires and prescribed fires (NWCG, 2022).

Wildfires in the United States inflict an estimated economic loss of between $77.4 to $378.7 billion each year. This includes everything from fire suppression to evacuations to property loss and recovery efforts (Environmental Protection Agency (EPA), 2021a).

All these statistics alone beg us — force us — to ask why. Why is there a significant increase in the severity, frequency and impact of wildfire in America's WUI? Perhaps more importantly, what actions are we going to take to better plan and prepare for, respond to, and protect America from this unavoidable threat?

Previous page photo: Ellijay, a fire-adapted community in the north Georgia mountains. (iStock)

Background

In 2002, the U.S. secretaries of Agriculture, Defense, Homeland Security and the Interior established the WFLC to provide strategic recommendations and ensure accountability and effective implementation and coordination of the Federal Wildland Fire Management Policy (DOI, 2001; DOI, 1995). WFLC is an intergovernmental committee comprised of federal, state, tribal, county and municipal officials. In addition to leadership representation from the 4 departments and their corresponding agencies and bureaus, nonfederal members include 2 state governors, representatives of the National Governors' Association, the NASF, the Intertribal Timber Council, the NACo, the NLC and the IAFC.

In 2009, WFLC began to develop the National Cohesive Wildland Fire Management Strategy (Cohesive Strategy) and released the final report in 2014, which identified 3 goals: Resilient Landscapes, Fire Adapted Communities, and Safe and Effective Wildfire Response. 2 years later, the White House convened a roundtable and issued the Wildland-Urban Interface Federal Risk Mitigation Executive Order 13728 (The White House, 2016).

Wildfire:
A wildland fire originating from an unplanned ignition, such as lightning, volcanoes, unauthorized and accidental human-caused fires, and prescribed fires that are declared wildfires (NWCG, 2022).

Despite progress made because of these initiatives and measurable gains from programs such as Firewise USA® and Ready, Set, Go!™, as well as efforts of Fire Adapted Communities Learning Network and Fire Safe Councils, the loss of life to civilians, firefighters and other first responders, and socioeconomic devastation, continues to rise due to wildfire in the WUI.

There are underlying and comprehensive factors contributing to this rising wildfire threat placing millions of Americans at risk. Specifically, these factors are a growing population, reduced land management practices, a dangerous increase of fuel buildup and climate change. These factors are increasing the vulnerability of our nation's citizens and first responders to further loss. Action must be taken to minimize their impact.

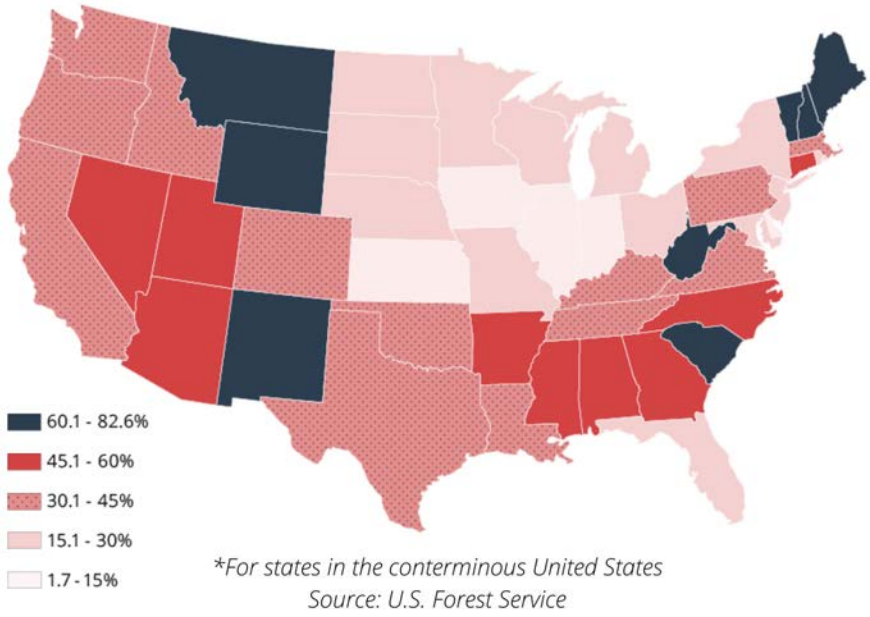
Increased population in the WUI

As the United States population continues to grow, the development in the WUI expands. From 1990 to 2010, the size of the WUI grew by 33% to over 190 million acres, and the number of homes on these lands expanded by more than 41%. The latest data show that close to 99 million people, or one-third of our population, now live in the WUI (Radeloff et al., 2018). In addition, more than 46 million homes, with an estimated value of $1.3 trillion, in 70,000 communities are now at risk from the impacts of wildfire (USFA, 2022). As wildfire impacts more residents in the WUI, it will escalate harm to health and property, businesses, infrastructure and communities.

Dixie Fire, 2021. Photo courtesy of CAL FIRE.

States with the greatest number of houses in the WUI:
1. California 2. Texas 3. Florida 4. North Carolina 5. Pennsylvania

Number of houses in the WUI relative to the total houses in the state*



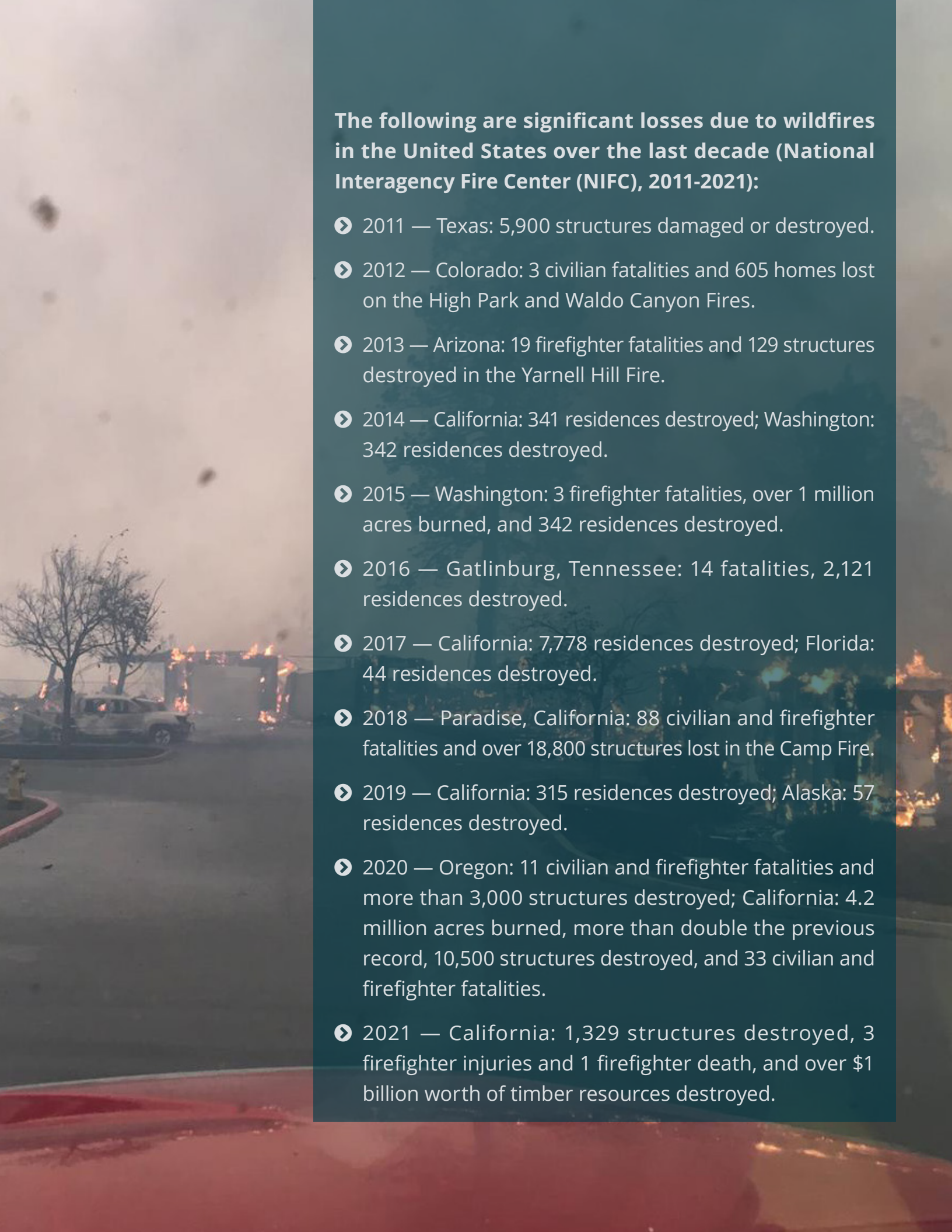
*For states in the conterminous United States
Source: U.S. Forest Service

Reduced land management practices and dangerous increase of fuel buildup

For many decades, fire-dependent landscapes or ecosystems like prairies and coniferous forest that depend on fire for germination and reproduction, especially in the West, have not been maintained. This lack of maintenance is due to various factors, including a lack of workforce capacity, funding, restricted prescribed burn opportunities, air quality impact and public perception. Fire suppression over the last century and past land management decisions, including reduced use of mechanical methods and prescribed fire as land management tools, have resulted in over 100 million acres of federal land at high or severe risk to wildfire, and many more acres of state, tribal and private land are also likely at risk (Government Accountability Office (GAO), 2019).

The long-time exclusion of fire and mechanical thinning in these areas has contributed to unhealthy forest, grassland and brush (e.g., chaparral and palmetto) conditions, including increased ground fuels and "overstocking" (when too many trees occupy the same growing space and compete against each other for limited resources). These overgrown and dense natural areas are vulnerable to damaging effects of drought, disease and wildfire. Changes in America's grass and rangelands have also increased the impacts of wildfire. The proliferation of invasive species, such as cheatgrass, has altered fire regimes and places these important habitats at risk.

Following page photo: Camp Fire, 2018. Photo courtesy of CAL Fire.



The following are significant losses due to wildfires in the United States over the last decade (National Interagency Fire Center (NIFC), 2011-2021):

- 2011 — Texas: 5,900 structures damaged or destroyed.
- 2012 — Colorado: 3 civilian fatalities and 605 homes lost on the High Park and Waldo Canyon Fires.
- 2013 — Arizona: 19 firefighter fatalities and 129 structures destroyed in the Yarnell Hill Fire.
- 2014 — California: 341 residences destroyed; Washington: 342 residences destroyed.
- 2015 — Washington: 3 firefighter fatalities, over 1 million acres burned, and 342 residences destroyed.
- 2016 — Gatlinburg, Tennessee: 14 fatalities, 2,121 residences destroyed.
- 2017 — California: 7,778 residences destroyed; Florida: 44 residences destroyed.
- 2018 — Paradise, California: 88 civilian and firefighter fatalities and over 18,800 structures lost in the Camp Fire.
- 2019 — California: 315 residences destroyed; Alaska: 57 residences destroyed.
- 2020 — Oregon: 11 civilian and firefighter fatalities and more than 3,000 structures destroyed; California: 4.2 million acres burned, more than double the previous record, 10,500 structures destroyed, and 33 civilian and firefighter fatalities.
- 2021 — California: 1,329 structures destroyed, 3 firefighter injuries and 1 firefighter death, and over $1 billion worth of timber resources destroyed.

Without changes to past fire suppression policies and land management practices in conjunction with new initiatives to reduce fuel buildup and manage resilient landscapes (WFLC, 2014), America's communities will continue to experience catastrophic wildfire events.

Climate change

Combining the above land stewardship challenges with an increase in prolonged droughts and warmer conditions associated with changing climate creates a recipe for fire disaster in the WUI, resulting in the loss of human lives and the cascading effects of environmental and socioeconomic devastation to communities for years to come (EPA, 2020).

Climate change (long-term change in climate conditions) includes increased or decreased precipitation, flooding and droughts. These conditions, along with warmer and drier climates, can be associated with an increase in the frequency, intensity and duration of wildfires, which can make them more difficult to control.

"Wildfire can threaten people and homes, particularly as building expands in fire-prone areas. Wildfires around Los Angeles from 1990 to 2009 caused $3.1 billion in damages (unadjusted for inflation). Respiratory illnesses and life disruptions from the Station Fire north of Los Angeles in 2009 cost an estimated $84 per person per day (in 2009 dollars)" (U.S. Global Change Research Program (USGCRP), 2017). While the increase in acres burning is alarming, the intensity and severity in which these wildfires are burning and the way they are impacting communities is even more disturbing.

Dixie Fire, 2021. Photo courtesy of CAL Fire.

Methodology

In 2018, the WFLC discussed the need for a report that presents a path forward in making risk reduction improvements related to the losses caused by wildfire in the WUI. Based on this discussion, the USFA, in collaboration with the DOI and the USFS, and through a contract with the IAFC which also collaborated with the WFLC, conducted this project to identify opportunities for federal organizations to work with partners at all levels to address the challenges of wildfire in the WUI.

In 2019, the 3 federal agencies collaborating on and funding this project (USFA, DOI and USFS) initially created a steering committee. The USFA as overall project manager contracted with the IAFC as the contract administrator. The steering committee and IAFC established objectives and timelines for the project. The steering committee, in collaboration with the contractor, identified 13 major issues related to wildfire in the WUI on which stakeholders and SMEs would be surveyed. These 13 issues were firefighter health and safety, public health and safety, evacuations, forest and rangeland health and resiliency, climate change, community planning and resiliency, infrastructure and utilities, communication strategy and engagement operations, socioeconomic impacts, recovery, emerging technology, data use and modeling, and risk management in wildland fire.

The IAFC presented the identified issues in an online survey format that was shared with all interested stakeholders. The stakeholders and SMEs surveyed during this project were from the federal, state, local, territorial and tribal (SLTT) governments, and other NGOs. More specifically, these stakeholders and SMEs included wildland fire leaders, community planners and developers, law enforcement and emergency service organizations, and wildland fire and climate change academia. Each stakeholder and SME received this online survey, developed by IAFC, that asked for input on the current challenges within the 13 major issues and were asked to make recommendations to address each challenge.

With the onset of the COVID-19 pandemic and in place of in-person meetings, the IAFC hosted virtual meetings and conference calls throughout the project to conduct additional discussion, research and review. Once all surveys were submitted, the IAFC systematically reviewed and qualitatively analyzed the survey input to identify consistent themes and interconnections emerging from the data and then organized the findings. This resulted in the identification of 33 major WUI challenges and led to 112 recommendations that are equitable and scalable at a national, regional or local level. Each recommendation is detailed and specific to the organization(s) with the capability and responsibility to carry it out.

A lead writer, who was contracted in 2020, then compiled the 33 challenges and 112 recommendations into this report, "Wildland Urban Interface (WUI): A Look at Issues and Resolutions," which can be used to guide all levels of leadership, including Congress, to address the threat of wildfire in the WUI and help residents learn and adapt to living safely within these regions.

In 2002, the WFLC was established by the U.S. secretaries of the Interior, Agriculture, Defense and Homeland Security to provide strategic recommendations and ensure accountability and effective implementation and coordination of the Federal Wildland Fire Management Policy (DOI, 2001; DOI, 1995). The council, or WFLC, is an intergovernmental committee comprised of federal, SLTT, county and municipal officials.

Issues and Recommendations

Issue 1: Firefighter health and safety

Overview

From 1990 to 2020, 534 firefighters were killed during wildland fire operations in the U.S. — an average of 18 fatalities per year (NWCG, 1990–2020). Firefighters responding to WUI fires face increasing physical and mental health risks due to both short- and long-term smoke and toxic exposures associated with the burning of vegetation and manufactured products. There is also substantial traumatic event exposure from the overwhelming size of the events and the immeasurable catastrophic losses they endure while protecting their neighborhoods, friends and families.

Challenge 1

Increased risk to firefighter health and safety from their exposure to hazardous smoke and toxic materials associated with fire suppression efforts in the WUI. Additionally, there is insufficient access to mental health resources for firefighters following wildfire response in the WUI.

Recommendations

1. WFLC should support efforts to secure funding for a longitudinal health study on the long-term impact of smoke and materials exposure to firefighters in the WUI.
   - Enlist National Institute for Occupational Health and Safety (NIOSH) as one of the lead agencies for the study.
   - The study should incorporate lifestyle data, all genders and ethnicities.
   - Prioritize the utilization of the Firefighter Cancer Registry Act of 2018 as a first step at the national and SLTT levels to begin understanding the problem of cancer in firefighters.
   - Ensure USFA can provide incident-level data for exposure tracking.

2. Federal and SLTT agencies should improve coordination with the Centers for Disease Control and Prevention (CDC), NVFC and NWCG in developing and disseminating information and resources for wildland firefighters and first responder mental and behavioral health, including identifying opportunities for collaborative research, support services, education and training.
   - Efforts should also be made to identify potential barriers to accessing resources and services, including institutional resistance, insurance coverage, training and peer support programs.
   - Consider utilizing the following:
     - Wildland Firefighter Foundation's "One Foot in the Black" suicide prevention and resilience program.
     - National Fallen Firefighters Foundation's (NFFF's) "Fire Service Behavioral Health Management Guide" reference.
     - NWCG's Mental Health Subcommittee.
     - NVFC's Share the Load™ resources.

Previous page photo: Portland, Oregon skyline during wildfire. (iStock)

3. USFS, in collaboration with the Department of Homeland Security (DHS) Science and Technology Directorate (S&T), should support research and development of improved personal protective equipment (PPE) for dermal and respiratory protection, e.g., reduced skin exposures and respiratory systems specifically for WUI incidents. See also Challenge 4.
   - USFS should expand current cooperation with the NIOSH National Personal Protective Technology Laboratory, DHS's First Responders Resource Group, and DHS S&T and manufacturers to develop and test improved PPE.
   - SLTT fire agencies should be included in the findings and PPE development.
   - Increase the presence of women and minorities as subjects in this fire research (USFA, 2019).

Photo courtesy of BIA.

Challenge 2

Insufficient access to training, proper PPE and funding to better equip, train and provide for a growing, inclusive firefighter workforce (builds capacity) that is prepared, well-equipped and trained for suppression tactics in the WUI.

Recommendations

1. USFS, DOI and DHS/FEMA should further invest in the firefighting workforce at all levels by increasing support and funding for the rural and volunteer fire programs, e.g., Volunteer Fire Assistance (VFA) and State Fire Assistance (SFA).
   - DHS/FEMA should review and adjust its programs to provide additional equitable support and funding to assist SLTT career and volunteer fire agencies in higher-risk WUI areas and underserved communities.
   - Bureau of Land Management's (BLM's) equipment transfer program to local firefighting organizations is an excellent example of what should be utilized by other DOI bureaus.
   - USFS/NASF should assign a task group to review increasing the VFA population cap (currently 10,000 or less) and consider underserved communities.
   - DHS/FEMA, U.S. Department of Agriculture (USDA) and DOI should prioritize and increase additional funding to support SLTT career and volunteer fire service agencies specifically for WUI training, cross-training of structural firefighters, PPE and response capabilities.

2. Expand or develop a national initiative, e.g., USFS's "Life First," to further protect firefighters responding to WUI incidents from unnecessary risk while protecting communities from wildland fire.
   - NWCG should support a national interagency effort with representation and participation from SLTT and federal fire organizations in developing the firefighter safety and decision-making initiative.
   - Utilize the NFFF's "Everyone Goes Home in the Wildland" program (NFFF, 2018).

3. NWCG should develop training.
   - Develop suppression strategies and tactics training within the "Incident Response Pocket Guide."
   - Develop additional firefighter and mitigation training courses specific to the WUI.

- All training resources should be made available nationwide, including the local level, for wildland and structural firefighters. Utilize the National Fire Academy and state fire academies to reach broader audiences of firefighters.

4. DOI, USFS and USFA should complete the research on gender-specific risks and solutions to prevent injuries on the job, focusing on adapting tasks, gear and training to the specific needs of women firefighters (USFA, 2019).

5. WFLC, in conjunction with the National Institute of Standards and Technology (NIST), should convene a group to evaluate the current mutual aid process and better utilize the "closest emergency response resources concept."
   - Determine if the current process can be improved or if a new National Mutual Aid System needs to be developed.
   - Federal and SLTT representatives should be part of this evaluation and development process.

Dixie Fire, 2021. Photo courtesy of CAL FIRE.

Challenge 3

Lack of accountability for firefighting resources and insufficient real-time fire modeling in the WUI that can support, integrate and provide timely information that helps keep firefighters informed, accounted for and safe in the WUI.

Recommendations

1. Increase federal funding to develop the next-generation decision support tool (coupled fire-atmosphere interactions) for wildlands and WUI settings that replaces outdated empirical models (Rothermel-based).
   - Consider integrating existing fire decision-making support models (e.g., U.S. Department of Defense (DOD) FireGuard and NIST Wildland Ember Exposure Models) to update and replace the Rothermel model. This will be a more efficient and effective process and avoids developing a new model from scratch.
   - Build on current work being conducted with DHS S&T and the University of California San Diego WIFIRE Lab.

2. WFLC, in collaboration with NIST and DHS S&T should support a working group to adopt a standardized system for accountability and tracking of resources and develop an implementation schedule for integration into the interagency wildland/structural fire service.
   - The technology should use standardized geographic information systems (GISs) that integrate with local and state systems.

Challenge 4

Limited acceptance of new WUI fire respirator technologies by wildland fire agencies. Education and understanding of the illness and injuries associated with toxic respiratory exposure will drive the desire and the use of WUI fire respirators by responders. Growth in demand will push development and technological advancement in the private sector.

Recommendation

1. WFLC, in conjunction with federal research agencies (i.e., DHS S&T, NIST, USFS), should develop an interagency position to support new respirator technology for WUI firefighters.
   - All federal, state, tribal and local fire agencies should support the development of wildland respirators and increase the awareness of the need to protect firefighter airways.
   - Utilize existing NFPA standards developed for respirators (NFPA 1984, *Standard on Respirators for Wildland Fire-Fighting Operations and Wildland Urban Interface Operations*) as appropriate.
   - Consider powered air-purifying respirators and the Wildland Scarf Respirator (DHS S&T, 2022).

Issue 2: Public health and safety

Overview

More than 46 million residences in 70,000 WUI communities in the United States are currently at risk for wildfire (Manzello, 2014).

Wildfire events, such as the Gatlinburg, Tennessee, wildfire of 2016 where 14 lives were lost; the Camp Fire that destroyed Paradise, California, in 2018 and resulted in 88 fatalities; as well as the wildfires of 2020 in Oregon and California where 11 and 33 lives were lost, show the ever-increasing danger that wildfire inflicts in the WUI. In addition, short- and long-term smoke impacts on civilian populations need to be considered. Preplanning helps reduce the negative impact of wildfire smoke (CDC, 2021; EPA, 2021a; EPA, 2021b).

Carr Fire, 2018. Photo courtesy of CAL FIRE.

Challenge 1

Lack of research and solutions for the health hazards of smoke exposure during large and/or long-duration wildfires, especially when structures are involved.

Recommendations

1. WFLC should build upon existing public education campaigns to include the public health trade-offs of wildfire smoke exposure versus how we can manage smoke under controlled conditions with prescribed fire as a means of reducing fuels and preventing long-term exposures from wildfires.

2. The EPA, CDC and SLTT public health agencies, in partnership with FEMA, should develop guidelines for emergency breathing shelters to ensure communities can build them into their preplanning process.
   - Guidelines should also increase public communication on safety measures to reduce their exposure to smoke.
   - The guidelines should include the National Institute of Environmental Health Services Worker Training Program.

3. The EPA and WFLC should partner with the U.S. Department of Health and Human Services to learn more about the effects of wildfire on public health, including the consideration of underserved communities.

4. The EPA should develop an incentive program that allows more equitable access to low-cost air filtration systems for homes and personal use. The program should include developing best practices and code change proposals related to smoke intrusion in the built environment.

Issue 3: Evacuations

Overview

Evacuations from wildfire in the WUI are substantially different in comparison to organized evacuations before a hurricane. Wildfire evacuations tend to come with very short notice, limited information and unpredictable wildfire behavior weather pattern movement, resulting in rapidly changing and dangerous situations. The reality for many WUI communities is that residents may not have time or existing road infrastructure to evacuate safely from an area threatened by wildfire.

There is a need for first responders to engage residents in pre-evacuation planning and coordination. A whole of community approach that involves everyone, including underserved populations and residents with disabilities, must be incorporated in this process.

Burnt out cars during the Marshall Fire. Boulder, Colorado, 2021.

Challenge 1

There is a need for increased levels of communication and planning from SLTT leadership and the federal government to the public about wildfire safety measures, especially warnings and evacuations.

Recommendations

1. DHS/FEMA/USFA, and S&T in coordination with SLTT management response agencies, should research and develop enhanced community warning systems in high-risk areas with grant support from pre- and post-fire mitigation grants.

- Consider improving the FEMA Integrated Public Alert and Warning System (IPAWS) to include wildfires and develop an interface with social media platforms.
- Utilize geofence capability to notify all devices in a specific area, review opt-in systems versus opt-out systems, and emphasize hardening and redundancy of critical community communication infrastructure.
- Identify and include safety zones in the warning systems.

2. WFLC, FEMA/USFA and SLTT emergency management agencies should develop evacuation communications in multiple languages, including American Sign Language, for use at the local level.
   - Include picture-based communication tools.
   - Fund and facilitate access to high-quality, professional translation and interpretation services to assist with messaging.

3. USFS, DOI, NIST and DHS/FEMA should fund research to develop best practices for residents that cannot evacuate.

Challenge 2

Many established communities have poor emergency vehicle access and evacuee egress (1 way in/out; congested traffic flow; steep, narrow, overgrown roadways), inadequate water resources (hydrants), and dangerous wildfire design, such as buildings on steep slopes and hilltop development. These preexisting conditions make early evacuation warnings, temporary safe zones and evacuation signage, and training critical to public safety in WUI communities.

Wildfire evacuation. (iStock)

Recommendations

1. WFLC and SLTT law enforcement and emergency management agencies in collaboration with federal agencies should develop best practices for wildfire evacuations that include community safe zones along evacuation routes that can be used as a "last resort safety zone." These best practices should define how to design these safety zones, specifically what fuel setbacks will be needed, describe what capacity (persons and vehicles) they should have, as well as describe their recommended density, amount and location.
   - Best practices should include regional differences to be incorporated into local pre-wildfire planning and mitigation efforts utilizing Fire Safe Councils, Citizen's Emergency Response Team (CERT) groups and other local organizations including schools, hospitals, animal rescue groups, etc.
   - Best practices must also account for those with disabilities and limited English proficiency.
   - Best practices should be developed with stakeholders that have real-life experience and SMEs.

2. NOAA, NIST, DHS S&T, FEMA and emergency management agencies should examine how existing programs, such as the National Fire Danger Rating System and the National Predictive Services, can be expanded to inform the public better and create increased situational awareness regarding wildfire prevention, home preparedness and evacuation.
   - Assess how other countries, particularly Australia, have used fire warning systems and what they have learned about more effective practices.

3. USFS, DOD, NASA, NIST and DHS S&T should develop and fund real-time, next-generation wildfire and transportation modeling programs, e.g., WIFIRE, that help guide emergency responders on evacuation planning.
   - Ensure models and funding for training are available for disadvantaged, rural and at-risk communities.
   - Funding should be available to support planning, preparedness, training and drills at the community level.

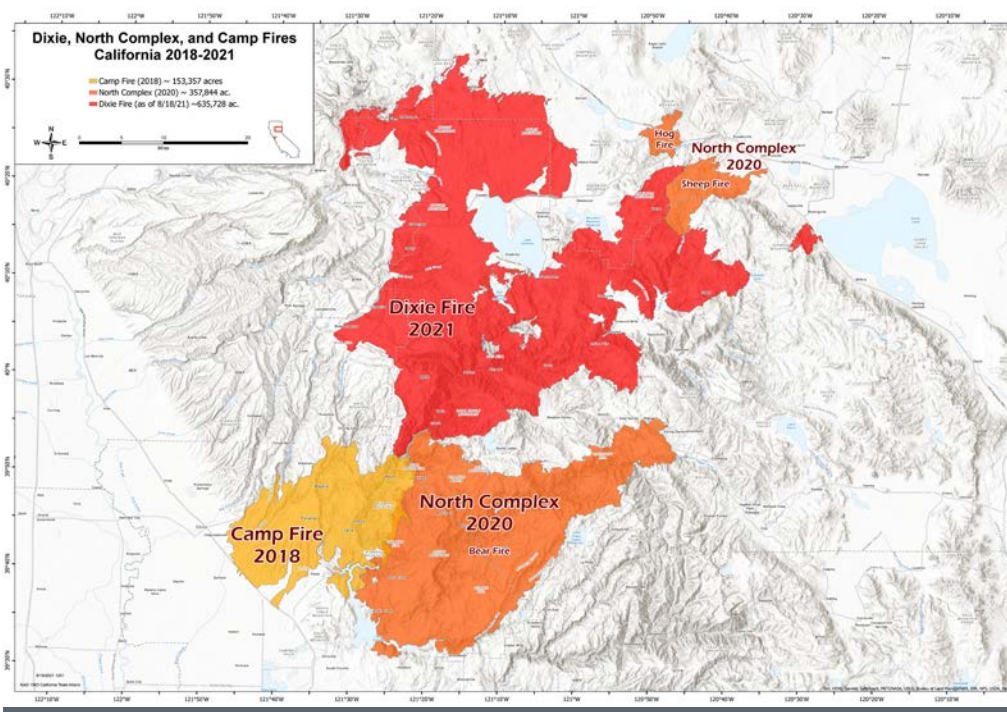
4. SLTT agencies and community leaders should spearhead efforts to plan and prepare for, fund, and implement community plans that incorporate wildfire evacuation best practices.
   - Implementation should include developing a partnership with FEMA regions and SLTT agencies to support community evacuation planning throughout the United States.
   - Best practices should include proper ingress/egress for both fire suppression response and evacuation.

Issue 4: Forest and rangeland health and resiliency

Overview

Wildfires have the most destructive and expensive impact in the WUI. However, comparatively more acreage is burned by wildfires in remote and less developed forest and rangeland areas. To reduce the number and intensity of wildfires impacting communities, resilient forests and rangelands are needed (USFA, 2022).

Like hurricanes, floods and other natural disasters, wildfires do not adhere to jurisdictional boundaries and burn both public and private lands. Isolated efforts to restore forest and rangeland resiliency to protect communities, watersheds and infrastructures are often not enough due to the size and frequency of megafires (a wildfire that burns more than 100,000 acres).



Source: NIFC, 2021.

Challenge 1

Currently, land management agencies, private landowners and SLTT governments lack the resources to treat and mitigate acres at the scale or rate necessary to reduce the impact of wildfire threats. While several authorities are available to facilitate cross-boundary coordination and execution, these are underutilized and underfunded.

Recommendations

1. WFLC should work with the Community Mitigation Assistance Team (CMAT) to expand trained resource ordering through the Interagency Resource Ordering Capability to increase wildfire mitigation efforts.
   - Consider SLTT and federal qualifications and crosswalks that utilize well-trained practitioners from all forms of government and NGOs, such as Fire Adapted Communities Learning network and others.
2. WFLC should continue to support expanding programs that help communities identify and address wildfire mitigation barriers; create local, sustainable mitigation partnerships; and increase risk reduction actions across land ownerships, e.g., CMAT.
3. USFS and DOI should expand their available workforce for wildfire mitigation efforts by increasing the use of private sector-qualified contractors and nonprofit organizations.
   - Efforts should include increasing educational opportunities for accomplishing wildfire mitigation efforts.
4. All agencies should collaborate together to expand the availability of wildfire mitigation training and recognition, including NFPA's Certified Mitigation Specialist, Coalitions and Collaboratives, Inc.'s Mitigation Best Practices and the NWCG Mitigation Specialist (currently in development).
5. WFLC should support developing and implementing a nationwide additional reporting matrix for community protection, such as homes and structures protected rather than only acres treated and cost per acre to treat.
   - Consider reviewing BIA's current mitigation reporting requirements.
6. DOI and USFS should develop and implement plans to shift seasonal firefighting positions to yearlong employees. This will provide more experienced firefighters and an increased workforce capacity that can train and specialize in wildfire, prescribed fire, fuel management and other mitigation efforts.
   - Plans should include salaries, benefits, training and experience required.
7. USFS and DOI should continue to expand the pace and scale of cross-boundary fuel reduction projects collaboratively with their partners on federal and nonfederal lands nationwide.
8. WFLC should continue to work with the EPA, Army Corps of Engineers, Council on Environmental Quality, USDA and DOI to explore internal agency processes that improve the efficiency and effectiveness in decision-making and public engagement under the National Environmental Policy Act and associated laws, regulations and executive orders which are critical to increasing the pace and scale of fuel reduction projects in and around the WUI.
   - Utilize existing categorical exemptions for mitigation and fuel reduction projects in the WUI.
   - Articulate roadblocks that reduce the pace and scale of wildfire mitigation and develop solutions to address them.

9. WFLC, USFS and DOI should expand opportunities for SLTT, federal and NGOs (such as TNC, Tall Timbers and others) to cooperate and share resources, reimburse expenses, and coordinate efforts across boundaries on prescribed fire, fuel management and other mitigation projects.

10. WFLC should support a task force to set standard policies for the use of wildland fire for resource benefits where appropriate.
    - Policies should include guidelines on when, where and how to utilize this tool to reduce threats to communities.
    - A task force should include DOI, USFS, NASF, national stakeholder organizations, SLTT fire agencies and other community stakeholders.

Challenge 2

Invasive species alter the natural forest and rangeland vegetative environments, increasing wildfire intensities and changing the return intervals of wildfire on the landscape.

Recommendations

1. WFLC should support the National Invasive Species Council initiative to address the impacts of fire on invasive species and the impacts of invasive species on wildfire activity.

2. DOI and USFS should support increased funding to expand the use of active management on both public and private lands and support incentives that reduce wildfire threats from overstocked forests, dense brush and rangelands infested with invasive species.

3. USDA should support, fund and prioritize fuel reduction practices for private landowners in high wildfire risk areas, including programs such as the Environmental Quality Incentives Program (EQIP), Emergency Forest Restoration Program (EFRP) and other USDA programs.

4. WFLC should establish a working group that includes federal, SLTT and private SMEs, such as the National Cattlemen's Beef Association, to develop policy that decreases barriers for grazing and supports fuel reduction around communities near federal lands.

Challenge 3

The loss of wood utilization infrastructure and markets has increased the cost and ability to accomplish fuel reduction projects. This is particularly acute in underserved communities. Additionally, existing cost-share programs typically exclude underserved communities.

Recommendations

1. USFS and states should enlist economic development authorities to improve markets for the wood and materials removed in hazardous fuel reduction projects.
    - Improvement should include developing programs that help train the workforce needed to accomplish this work.

2. USDA should provide additional funding through its programs with the Farm Service Agency (FSA), Natural Resources Conservation Service (NRCS) and USFS for nonindustrial private landowners for wildfire reduction projects adjacent to WUI communities.
    - USDA should consider removing or reducing cost-share assistance required in these programs where there is a direct benefit of reducing the wildfire threat adjacent to the WUI.

3. DOI and USFS, with support from NASF, should develop new grant programs and implement policies that research, build and invest in small-diameter wood products industries that utilize healthy forests and wildfire reduction project materials.

4. USFS and DOI should consider long-term wood utilization contracts for fuel reduction measures to support new wood using market development.

Challenge 4

Resource limitations, smoke and fire liability concerns, and landowner ownership complexities challenge agency and organizational abilities to significantly accomplish more prescribed fire and other fuel mitigation treatments.

Fuel management with prescribed fire on the Pompeys Pillar National Monument in Montana. Photo courtesy of BLM.

Recommendations

1. WFLC and the wildland fire community should support the passage and implementation of funding for a national prescribed fire act.
   - The national prescribed fire act should include increased liability protection; a national prescribed burner insurance program; increased public education, research, training and resource availability; and requirements for cooperation and collaboration between federal, state, tribal and local entities in support of more prescribed fire on the landscape.

2. The Coalition of Prescribed Fire Councils, NASF and Tall Timbers Research Station, and TNC should develop template liability protection language that can be used at the federal, state and local levels for prescribed fire burn bosses and certified burn managers.

3. DOI, USFS and all WFLC members should recognize, support and learn from indigenous and traditional burning practices for cultural purposes in support of wildfire mitigation efforts.
   - Identify opportunities to integrate beneficial practices within modern programs.

4. FEMA, with input from relevant NGOs, DOI and USFS, should update its pre- and post-wildfire mitigation grant programs to include prescribed fire as an acceptable mitigation practice.
   - Funding priorities should be focused on WUI-adjacent community fuel mitigation efforts.

5. USFS and DOI should increase priorities for smoke model development and decision support tools that are scalable and help inform decisions by SLTT health and public policymakers. Prioritize the development of operational smoke models that can be used in real-time by fire managers.

Issue 5: Climate change

Overview

Throughout much of the United States and worldwide, wildfires are growing in intensity, size and destructiveness. Climate scientists are beginning to correlate the increasingly destructive nature of wildfires with warming global temperatures.

In the western U.S., the annual acreage burned could increase 2 to 6 times from the current numbers by the middle of the century because of the effects of climate change. The southeastern U.S. has the potential for larger fires (greater than 12,000 acres) to increase by 300% to 400% by midcentury (USGCRP, 2017).

View of fire whirl created during Chaparrel Fire. Photo courtesy of CAL FIRE.

Challenge 1

Uncertainty regarding how climate change will impact future wildfires, including the length of wildfire seasons, and the ability to use prescribed fire. Additionally, other natural disasters, such as tornadoes and hurricanes, may complicate or exacerbate wildfire threat.

Recommendations

1. Federal and SLTT agencies, as well as nonprofit and local wildfire partners, should support a substantial increase to the pace and scale of prescribed fire through the passage of a national prescribed fire act.
2. WFLC should continue to support fire-adapted communities by implementing the Cohesive Strategy's 3 goals: resilient landscapes, fire-adapted communities, and safe and effective coordinated fire response.
3. USFS and DOI should review the need for better alignment of resources with changing fire regimes.

Storm surge damage caused by Hurricane Ike. Bolivar Peninsula, Texas, 2018. Photo courtesy of NOAA/Houston/Galveston National Weather Service Forecast Office; Houston Office of Emergency Management.

Tropical Storm Imelda causes closure of Interstate 10 in Houston, Texas due to high water. (iStock)

- The review should implement studies to determine if certain seasonal firefighting resources should be converted to full-time positions to support both wildfire response and wildfire mitigation programs.

4. BIA should consider increasing resiliency funding available to tribes as recommended by the National Congress of American Indians.

Issue 6: Community planning and resiliency

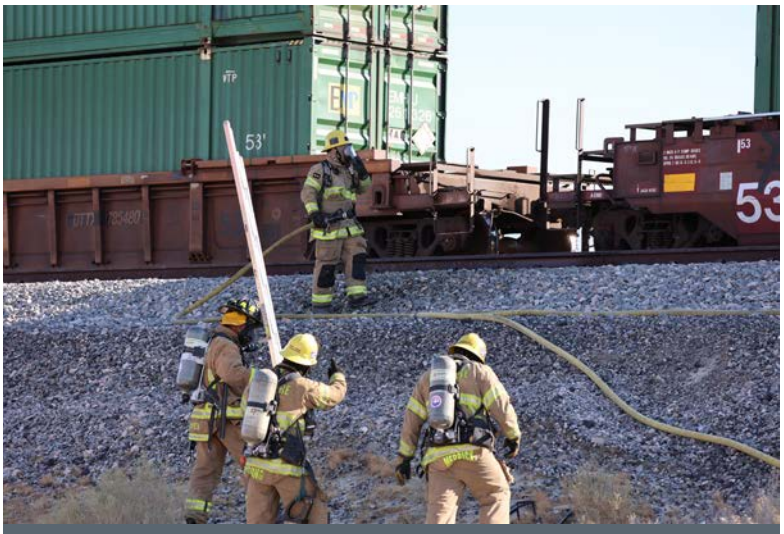
Overview

More than 46 million residences in 70,000 communities in the United States are at risk for wildfire because of the increase in suburban development in the WUI (USFA, 2022). Preparedness efforts and risk reduction are shared responsibilities; they call for the involvement of everyone, not just the government. Joining forces will help reduce the impact on our nation (FEMA, 2020).

Wildfire community meeting. Photo courtesy of FEMA.

Challenge 1

Many SLTT agencies cannot access FEMA Hazard Mitigation funding for wildland fuel mitigation projects. Many states have a disconnect between wildfire mitigation planning and funding and other disaster mitigation planning and funding. While federal wildland fire agencies work directly with state forestry agencies, FEMA works directly with state emergency management agencies. There is often minimal coordination and collaboration at federal or state levels regarding mitigation project planning and funding.



Preplanning with railroad crews in the event of a wildfire. Photo courtesy of CAL FIRE.

Recommendations

1. WFLC and its SLTT partners working with FEMA should develop a list of programmatic, regulatory or statutory changes needed to allow additional FEMA funding for hazardous fuel reduction projects.
   - Allow each state to have 2 Governor's Authorized Representatives (GARs), 1 which would specifically address wildland fire mitigation projects.

2. DOI should develop a suite of programs in their bureaus that allow greater engagement with communities such as USFS's SFA or VFA programs.

Challenge 2

Developing climate-adapted, fire-resistant and resilient homes and infrastructure in the WUI is difficult due to associated costs, homeowner desires for aesthetics and the lack of knowledge regarding resilient building practices. Defensible space standards and codes are widely misunderstood and not widely embraced by homeowners in the WUI.

Aerial view of defensible space. Photo courtesy of NIFC.

Recommendation

1. WFLC should form a working group, including NGOs that are already developing codes and standards for wildfire-resilient construction, such as NIST, NFPA, ICC and IBHS.
   - The working group should identify immediate, short-term and long-term gaps in the availability and enforceability of wildfire-resilient building practices; identify viable solutions for filling the gaps and addressing equity concerns.
   - The working group should address how to ensure the community is built back for wildfire resiliency.
   - The working group should evaluate and develop strategies for local communities and state governments to adopt model building codes for wildfire resiliency, such as the International Wildland Urban Interface Code, and develop best practices based on research.
   - The working group should include the opportunity for voluntary or beyond-code standards to be recognized and adopted by local jurisdictions.

Challenge 3

There is a major disconnect in most places between land use planning and wildfire planning. Fire-resilient land planning and building codes are not widely adopted in WUI communities.

Recommendations

1. SLTT policymakers should support the WFLC working group (Challenge 2a) on the topic of developing climate-adapted, fire-resistant and resilient homes and infrastructure.
   - NGOs, such as IAFC, NLC and NACo, should support the implementation of these recommendations.

2. NIST and the Joint Fire Sciences Program, with support from USFS, DOI, DHS S&T and USFA, should increase fire research opportunities to develop and implement next-generation code standards that address modern wildfires utilizing the best available science and review of past wildfire losses.
   - Efforts should include national codes and standards-making organizations.

3. USFS and DOI should integrate Community Wildfire Protection Plans (CWPPs) with other land management plans, including all-hazard mitigation plans, and/or fire management plans to facilitate fuels treatments across multiple jurisdictions.

4. SLTT agencies should consider CWPPs the most useful at the county and fire district level while utilizing the Ready, Set, Go! program; Fire Safe Councils; Fire Adapted Communities Learning network; and Firewise USA at the community level to allow for better community engagement and ease of development and implementation.

Challenge 4

Community planning often occurs without sufficient collaboration.

Recommendations

1. DHS/FEMA/USFA, DOI and USDA should include the WFLC with the Mitigation Framework Leadership Group to coordinate mitigation efforts across federal and SLTT agencies.

2. WFLC should develop a leader's intent that promotes agency participation in community planning along with SLTT members of communities.
   - Review successful state programs that employ wildfire mitigation specialists who support collaboration with the community planning processes.

3. WFLC should support wildfire hazard assessments that include projections of future wildfire risk as well as projected changes in population and land use.
   - Future fire assessments should jointly prioritize mitigation projects around communities across federal, SLTT and private lands.

Issue 7: Infrastructure and utilities

Overview

Wildfires impact multiple sectors of our nation's economy, including the infrastructure and utility sectors. Infrastructure and utilities can include human elements of the environment such as communication towers, power grids, water utilities, transportation corridors and community watersheds (DHS et al., 2019).

Challenge 1

There is a need for greater collaboration between communities, land management agencies and utilities to increase fire resiliency, investments and cross-boundary project coordination and expansion.

Wildfire burning under a high-voltage electrical transmission line. (iStock)

Recommendations

1. WFLC should develop a working group that includes the U.S. Department of Energy's (DOE's) Office of Electricity, the Federal Energy Regulatory Commission, NIST and utility partners to design and implement regional pilot projects and workshops with utility providers intended to coordinate and integrate utility wildfire mitigation efforts with SLTT fire and emergency services.
   - The pilot project should set standards for coordination and communication between utility providers and local fire service agencies.
   - The pilot project should also develop a standard template that encourages and reflects wildfire risk coordination and prioritization concerning key infrastructure components for local communities.
   - Consider facilitating workshops for utility partners to share wildfire mitigation best practices and experiences.

2. WFLC, in conjunction with the Federal Energy Regulatory Commission, Energy Sector Government Coordination Council and the Electricity Subsector Coordinating Council, should convene a working group of utility providers, utility regulators and wildland fire research entities to determine immediate research necessary to help prevent and reduce the impacts of wildfire associated on utilities.

3. WFLC should establish a working group that includes utility organizations, public utility commissions and utility associations to develop wildfire safe standards for all utility infrastructure in the WUI and forest and range environments based on research.
   - These standards can then be incorporated into CWPPs and other wildfire mitigation plans and programs.
   - Consider including required utility participation in CWPP development, recognizing utility watershed, water distribution, gas, electric and communication infrastructure.

Challenge 2

The cost to create resilient utility infrastructures can be beyond the ability of many communities and utility companies. Grant funding is complicated, arduous and time-consuming to receive and utilize.

Recommendation

1. FEMA should convene a working group with NASF, USFA, DOI, EPA and DOE to review and update grant programs, such as Building Resilient Infrastructure and Communities (BRIC), to better utilize funding at the ground level for wildfire mitigation projects.
   - Consider processes that would facilitate wildfire mitigation to include utilities and infrastructure in underserved, rural and tribal communities.
   - Consider including nonprofit organizations and SLTT entities in the federal funding review process to ensure the equitable distribution of resources.

Issue 8: Communications strategy and engagement operations

Overview

Communication in the digital age has evolved dramatically in the last few decades and continues to transform daily. The worldwide COVID-19 pandemic has severely limited in-person communication and further highlights the public's dependency on digital communication, especially social media.

Since its inception in 1996, social media has reached half of the 7.7 billion people in the world. Social network platforms almost tripled their total user base in the last decade, from 970

million in 2010 to the number passing 3.81 billion worldwide users in 2020. 70% of the total U.S. population have social network accounts, regardless of age. As of 2021, the average user has 8.6 accounts on different networking sites, and popular platforms have over 66% of their monthly users logging in to use social media daily (Dean, 2021).

Effectively reaching various audiences is complex and requires traditional (television, radio, print) and digital (social media, video, audio/visual graphics) communication tactics. Expertise within all the mediums and specialties as well as wildland fire knowledge is critical for communication professionals responsible for reaching, educating and engaging the various audiences, especially residents living in WUI communities. Research shows that increasing funding for wildfire prevention education and communication can significantly reduce wildfire-related losses and suppression costs (Hermansen-Baez et al., 2011).

2021 Wildfire Preparedness Week Kick-Off Press Conference, Orinda, California. Photo courtesy of CAL FIRE.

Challenge 1

Unified messages from the wildland fire community. Clear messages on wildfire risks, challenges and opportunities to prevent and prepare for wildfire in the WUI are needed. Inconsistent messaging confuses the public and policymakers.

Recommendations

1. WFLC, collaborating with the USFS; DOI; FEMA/USFA; and the NWCG Communication, Education, and Prevention Committee (CEPC), should create a strategic communication coordinating group to provide consistent wildfire messaging and help align wildfire prevention and mitigation outreach across the federal and SLTT spectrum.
   - Ensure messaging promotes the Cohesive Strategy vision, guiding principles and goals as a national priority in all relevant policy, budget justification and other strategic communication opportunities.
   - Encourage WFLC member agencies and organizations to communicate consistent messaging about "living with wildland fire" or "how to live with fire" within the context of everyday life and utilize significant events as opportunities to promote Cohesive Strategy goals.
   - Build partnerships, e.g., EPA, CDC, DHS/FEMA/USFA and Department of Transportation, and develop communication channels to help disseminate wildfire messaging to new audiences, expanding a focus on WUI and wildland fire and implementing the Cohesive Strategy.
2. All federal and SLTT agencies should integrate social science in the planning, engagement and communications strategies that tie outreach to a specific local call to action (McCool et al., 2002).

Challenge 2

Lack of understanding about the concepts and differences of prescribed fire and wildfire, including the acceptance of prescribed fire. Additionally, there is a lack of education on both types of fire for new residents moving into the WUI areas.

Recommendations

1. EPA and WFLC, in partnership with NASF, the Coalition of Prescribed Fire Councils, TNC, Tall Timbers Research Station and Land Conservancy, and public health agencies should collaboratively develop consistent and improved messages.
   - Messaging should focus on the benefits of prescribed fire, wildfire risk reduction and ecological benefits.
   - Messages should include how prescribed fire is planned, including permitting, smoke management, desired objectives, environmental conditions, and required personnel, equipment and training.

2. USFS, DOI, NASF, TNC, Tall Timbers Research Station and Land Conservancy, and others should develop improved messaging and public engagement through a national education campaign on the short-term, low-impact risks and smoke production from prescribed fire versus the long-term, high-impact risks and impacts from wildfires.

3. SLTT fire agencies should establish and foster relationships with local meteorologists to support prescribed fire and wildfire messages. These partnerships will reach greater audiences and are viewed as reliable, science-based resources.

4. SLTT fire agencies should meet new residents on traditional and digital media platforms.
   - Most people utilize smartphone apps to find their new home and community. Include these mediums in outreach efforts as well as real estate and apartment associations.
   - Notify residents that the neighborhood, community and/or region is subject to wildfire mitigation efforts such as prescribed burning.

Prescribed fire as part of a fuel reduction project. Photo courtesy of CAL FIRE.

Successful prescribed fire. Photo courtesy of CAL FIRE.

Challenge 3

Limited funding for local wildfire coordination and communication. Without adequate support, community outreach and education are inadequate.

Community engagement with Afghan refugees. Photo courtesy of CAL FIRE.

Recommendations

1. Federal and SLTT agencies should invest in wildfire prevention and mitigation programs and hire wildfire mitigation specialists whose jobs are to help communities become fire resilient.

2. State and local agencies should stay consistently connected with the public to understand what they value and address key local concerns and barriers to empower them to prepare for and prevent wildfire.
   - Ensure resources are easy to access, relatable, based on research and in layperson's terms.
   - Utilize recent and relevant stories that connect on a local level.

3. SLTT and federal agencies should develop a communications infrastructure that supports and meets the needs of diverse audiences through digital resources.

4. SLTT and federal agencies should invest in specialized communications personnel with hard skill sets that can merge both social science and forest/fire science to develop skill sets needed to encourage residents to take wildfire mitigation actions. Specialized communication personnel will decrease net costs long term and lag time when working with non-forest/fire professionals who struggle with understanding messaging.

5. WFLC, working collaboratively with the NWCG CEPC, USFA, DOI and FEMA/USFA, should convene a working group focused on language access to ensure timely and accurate wildfire information availability before, during and after a wildfire.

Issue 9: Socioeconomic impacts

Overview

When wildfire enters the WUI, communities are impacted in many ways. Typically, fire agencies only track the cost to suppress wildfires as well as structures lost. These agencies usually do not evaluate the cascading economic and environmental impacts associated with wildfire and related smoke in the WUI. Examples include municipal watershed loss, transportation and utility disruption, business and job loss, loss of community tax base, the hidden cost of health-related issues from wildfire smoke, and the psychological stress associated with these very traumatic events.

Wildfires in the United States inflict an economic loss of $63 billion to $285 billion each year. This includes everything from fire suppression to evacuations to property loss and recovery efforts (Thomas et al., 2017).

San Francisco, California, Sept. 9, 2020: The sky across California darkened and stayed orange during day as smoke from many wildfires across the state created a massive smoke cloud changing the sunlight to a perpetual orange glow. (iStock/Jason Doly)

A community's ability to respond to a wildfire and protect itself can be a socioeconomic indicator of its ability to recover fully from the impacts of wildfire. Research indicates that low-income households are more likely to have lower to no fire response capabilities than higher-income households (Lynn & Gerlitz, 2005).

Challenge 1

There is a lack of understanding about wildfire's true financial and personal cost; there is not always equitable treatment of underserved groups.

Recommendations

1. WFLC should support the Council of Western State Foresters in their efforts to update the true cost of wildfire.
2. WFLC should develop a report of the true cost of wildfire for the entire United States by 2023.
3. WFLC should convene a working group focused on diversity, equity and inclusion to examine the existing inequities of the impact of wildfire in underserved communities.
   - The working group should make recommendations for federal wildfire programs to better meet the needs of all residents.
   - The working group should be composed of diverse stakeholders, including those traditionally underrepresented in wildfire planning.

A burnt down business building after the Camp Fire in Paradise, California, in 2018. (iStock)

Challenge 2

Underinsured and uninsurable households residing in the WUI. This situation makes it more difficult to rebuild and return to normal while mitigating and rebuilding in a resilient manner following a wildfire.

Recommendation

1. WFLC, working with NGOs (such as Headwaters Economics, NFPA and IBHS), should form a working group with a representative sample of insurance providers and/or insurance trade groups and insurance regulators from wildfire-prone states to identify and develop solutions for assessing, evaluating and incentivizing climate-adapted, fire-resistant and resilient homes and businesses in the communities with WUI risk.

Challenge 3

Wildfires can have significant economic impacts on communities including but not limited to evacuations and sheltering costs, fire damage repairs, repairs from suppression damage, debris removal and the interruption to tourism affecting commerce.

Recommendation

1. FEMA should expand on their Preliminary Damage Assessment Teams to include wildfire-related issues such as burned area restoration on nonfederal lands that can support efforts in and around wildfire-impacted communities.
   - Expansion should include deployable resources, such as Burned Area Emergency Response (BAER) teams, that come in after a wildfire impacts a community.
   - These teams should provide additional expertise on the recovery assistance programs related to wildfires and available to impacted homeowners and businesses.
   - States should also develop post-wildfire recovery teams.
   - Army Corps of Engineer's Silver Jackets Program, the U.S. Geological Services (USGS), NRCS and FSA programs should integrate with these post-wildfire efforts.
   - CMATs serve under the authority of the USFS and are designed to help communities build sustainable local capacity for community wildfire mitigation during high-risk times before, during and after a wildfire when awareness for risk reduction and the likelihood of action is highest.

Challenge 4

Vulnerable homeowners, renters and communities with limited resources will require more focused mitigation efforts.

Recommendations

1. WFLC, working collaboratively with FEMA and the U.S. Census Bureau, USFA and DOI, and in conjunction with federal and SLTT agencies, should develop and implement a process to map high wildfire risk in underserved communities and additional research measures to concentrate mitigation support in these areas.
   - Expand the Wildfire Risk to Communities Project to ensure it fully captures underserved communities.

2. FEMA, DOI and USDA should support at-risk and lower-income residents through multiparty, leveraged funding initiatives with less burdensome match and reporting requirements.
   - Agencies should acknowledge that home-hardening activities are an allowable grant match. Allow "soft-match" to come in the form of home-hardening activities.
   - Support additional funding to areas where residents need additional support, such as rural, tribal and low-income communities, where the requirements for the match are reduced.
   - Consider making funding available based on income demographics, e.g., below poverty level.
   - Reduce environmental compliance requirements for activities such as home hardening that have no potential to impact the environment adversely.

After the Camp Fire in Paradise, California, in 2018. (iStock)

Issue 10: Recovery

Overview

Wildfires can have a traumatic effect on communities. Minimizing displacement and expediting rebuilding is critical to reducing the social and economic impacts of wildfire on communities. Recovery plans and procedures for these potential impacts should be developed and community staff trained well in advance of the actual event. Rebuilding with fire-resilient structures is critical to long-term resilience.

Burned neighborhood from Marshall wildfire, Louisville, Colorado, in 2021. (iStock)

Challenge 1

BAER teams are currently limited to federal lands, including tribal lands, and do not provide critical rehabilitation efforts on state, local or private lands.

Recommendation

1. USFS, DOI and DHS/FEMA should support congressional approval to develop a new federal policy that allows BAER teams to conduct rehabilitation work across jurisdictional boundaries, including private lands that are deemed at high risk to local communities.
   - FEMA funding should be incorporated into this cross-jurisdictional process for private lands work completed by BAER teams or state resources if available.
   - USDA should prioritize and streamline programs such as NRCS's EQIP to assist farmers and ranchers with recovery following a wildfire.
   - States should develop state BAER teams.

Challenge 2

Wildfire recovery programs are not timely and effective to help the victims recover and build a fire-resilient future.

Recommendation

1. NASF, IAFC, NACo, NLC, TNC, International Association of Fire Fighters, the Army Corps of Engineer's Silver Jackets Program, USGS, NASF, the American Forest Foundation (AFF) and the greater wildland fire community should pursue congressional direction to revise federal programs and increase funding for post-wildfire recovery efforts that streamline and provide for better utilization of current programs.
   - FEMA should increase the BRIC noncompetitive allocations, specifically for post-wildfire-related projects in the WUI.
   - FSA should streamline and improve the effectiveness of the EFRP that has been designed to help with forest recovery and resiliency efforts.
   - SLTT SMEs should be involved in the program improvement process.
   - SLTT agencies should be trained to utilize recovery grant programs.

Challenge 3

The recovery process for homeowners and landowners is confusing, with no guidebook to help direct citizens after a wildfire. Impacted citizens are left with confusing processes, inconsistent tools and complicated funding mechanisms that slow recovery. Agencies must develop processes for a coordinated response to improve recovery efforts. Educational materials are needed that direct and support residents on their road to recovery after a wildfire has impacted them.

Recommendations

1. FEMA/USFA, working with wildfire SMEs from SLTT agencies and insurance industry experts, should develop and share a best practices document for communities to follow during the pre-wildfire planning process and post-wildfire recovery efforts. Best practices should:
   - Connect homeowners/landowners directly to agencies with recovery programs that can provide support.
   - Contain templates and checklists that can be distributed after the wildfire.
   - Contain pre-fire training templates that can help communities prepare and mitigate before a wildfire.
2. Agencies must develop processes for a coordinated response to improve recovery efforts. Educational materials are needed that direct and support residents on their road to recovery after a wildfire has impacted them.

Challenge 4

Communities that need the most assistance before and after a wildfire are often underserved with few resources to recover.

Recommendations

1. Congress should fund the conceptual navigator and road map proposals that have been developed by WFLC and the Western Governors' Association (WGA) (After the Flames, n.d.) to further assist states and communities with mitigating post-wildfire impacts year-round.
   - The road map must address the needs of underserved communities.
   - Training for SLTT agencies must be included in the program delivery.
2. Congress should make funding available to develop a comparable "road map" for the Northeast and Southeast regions.

Issue 11: Emerging technology

Overview

New and emerging technology that can be applied to wildland fire mitigation projects, wildfire incident response and wildfire recovery efforts have tremendous potential to guide agencies and local officials in planning and implementing safe and effective programs.

SLTT entities need wildfire technology that provides real-time, accurate information, which is critical to increasing civilian and firefighter safety and interoperability between first responders.

Challenge 1

There is a lack of new and improved tools and associated training for local and state professionals that can help assist communities, e.g., evacuation models, real-time wildfire prediction models, wildfire assessment models and prescribed fire forecast models.

Big Hollow Fire, 2020. Photo courtesy of USFS Pacific Northwest.

Photo courtesy of CAL FIRE.

Recommendations

1. Expand on the successfully collaborated efforts of NWCG, DHS/FEMA/USFA, WFLC and NASF Fire Committee to develop interagency fire databases, fire assessments and modeling programs. These tools should serve SLTT and federal needs and are interoperable and accessible to all.

2. DHS S&T and NIST, with support from DHS/FEMA/USFA, should evaluate the use of augmented reality technologies to seamlessly integrate real-world imagery and provide near-instant feedback on wildfire safety and preventative measures.

3. WFLC and its partners should support a business analysis to ensure that states have baseline systems necessary to capture and analyze data. This analysis should include any state deficiencies and solutions to improve state data collection systems.

4. NWCG should increase emphasis on adequate firefighter training for new technologies at the SLTT and federal levels.

5. USFS, NIST, DOI and DHS/FEMA/USFA should fund or otherwise support programs to utilize simulation software, such as QUIC-Fire, that provides 3D modeling of fire progression and incorporates critical influences in real-time on laptops, offering mobility and rapid information for fire managers (Linn et al., 2020).

6. WFLC should develop an interagency committee to establish a standard database for reporting and mapping SLTT and federal wildfires and prescribed fires.
   - The database should include the ability to pull information and show the outcome of current mitigation efforts and investments.

Challenge 2

There is a lack of regulations, policies and guidance for use of unmanned aircraft systems (UASs) by responders during wildfires.

Recommendations

1. NWCG and its interagency wildland aviation community should collaborate with NFPA 2400, *Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations,* and the Federal Aviation Administration to disseminate a lessons-learned data site where new technology development can be posted and accessed by all agencies of UASs during wildfires.
   - Ensure dissemination to SLTT fire agencies.
2. DOI should resume its role in using and developing UASs for wildfire suppression and mitigation and ensure technology transfer of this vital information to all fire service agencies.

Challenge 3

Limited personnel trained to operate emerging technology in the SLTT.

Recommendations

1. USDA Rural Development, USFS, DHS S&T and DOI should partner with the Federal Communications Commission and develop measurable outcomes for increased broadband coverage in rural, tribal and underserved communities.
2. USFS, FEMA and DOI should develop or expand current grants that provide technical support and training to rural, tribal and underserved communities to utilize emerging technology.

Issue 12: Data use and modeling

Overview

Data collection, analysis, management and use has become overwhelming for local communities and federal and SLTT agencies. To capture, manage and use the volume of new data available, agencies must develop interoperability practices that require compatibility for data exchange to allow all agencies access and equitable use.

Current systems are not frequent or accurate enough to relay real-time fire perimeters (DHS et al., 2019). In most cases, current wildfire models fail to adequately predict fire behavior under extreme conditions and within the built environment of the WUI.

An Incident Remote Automatic Weather Station used on the Boulder 2700 Fire in Montana helped to provide real-time weather data for wildfire managers. Photo courtesy of Flathead Agency, BIA.

Challenge 1

Current wildfire behavior models are outdated, fail to predict fire behavior under extreme conditions in the built WUI, and require supercomputing requirements instead of desktop applications for fire managers.

Recommendation

1. USFS, DOI, DOD, FEMA, DHS S&T, NASA, NOAA, NIST, USGS and SLTT agencies should increase funding for ensembled approaches to wildfire behavior modeling that is near real-time and accessible to all communities.
   - These models can also be utilized for prescribed fire in the WUI and wildlands.
   - Support the development of fire simulation models that can incorporate the built environment as a fuel so that more realistic models can better determine future WUI community threats.

Challenge 2

Lack of investment in data collection, including on-the-ground compilation and validation, resulting in the use of inferior data that produces inadequate fire behavior modeling.

Recommendation

1. WFLC should request the Wildland Fire Information Technology Group to identify the key challenges and recommendations in developing accurate, consistent and streamlined wildland fire and prescribed fire occurrence reporting by all fire agencies.
   - Federal and SLTT representatives should be included in the group.
   - WFLC's data nuances group should include in their report datasets and modeling efforts that better incorporate data and reporting efforts reflected by fire regimes of all regions.

Challenge 3

Wildfire smoke can have a significant impact on responders and communities, including contributing to health and socioeconomic issues.

Recommendation

1. USFS, DOI, DHS S&T and EPA should increase priorities for smoke model development.
   - Prioritize the development of operational smoke models that can be used in real-time by fire managers.
   - Priorities should also include decision support tools for local and regional health and public policymakers.
   - Prioritize exposure tracking for firefighters.

Issue 13: Risk management in wildland fire

Overview

Risk management in wildland fire is a continuous process that provides a systematic method for identifying and managing the risks associated with wildland fire operations. It entails adopting and applying best practices, many of which have evolved out of real wildland fire issues for which documented justifications are necessary (Thompson et al., 2016).

Recommendations in this section are organized by FEMA's 4 phases of emergency management: mitigation, preparedness, response and recovery.

National Cohesive Wildland Fire Management Strategy Vision: “To safely and effectively extinguish fire when needed; use fire where allowable; manage our natural resources; and as a nation, to live with wildland fire.” (WFLC, 2014)

Mitigation recommendations

1. WFLC should collaborate with FEMA to streamline the FEMA Hazard Mitigation Grant Program and redevelop this program into a proactive tool to help reduce wildland fire threats in the WUI.
   - Include SLTT partners in the redevelopment process.

2. USFS, DOI and DHS should work with Congress to develop or expand a program like the Civilian Conservation Corps that conducts wildfire mitigation work in high-risk, underserved communities across the nation.
   - Expansion of AmeriCorps and veterans work programs could be part of this effort.
   - The additional workforce should also be part of wildfire suppression efforts.

3. WFLC, along with nonprofits and wildfire mitigation partners, should work with Congress to develop tax incentives for private lands fuel reduction efforts and private home fire-resilient retrofits, e.g., allowing structure hardening to be used as in-kind match to federally funded mitigation programs or as tax credits.

4. Federal and SLTT agencies should support and enhance programs to overcome local resource barriers to increased wildfire mitigation efforts and develop a mitigation workforce.
   - Programs should consider funding for positions, fuels treatment crews and equipment.

Preparedness recommendations

1. USFS, in partnership with NASF and in collaboration with the greater wildland fire community, should increase funding to develop a process to allow greater access to the NWCG Incident Qualifications and Certification Systems for all fire responding partners.
   - Formalize process from resource access and deployment through normalized and efficient reimbursement.
   - Prior learning and crosswalks for equivalent training should be considered.

2. DOI, USFS and NWCG, in coordination with USFA, should develop a proposal to train and equip urban/structural responders in local, tribal and state organizations to backfill federal response agencies when resource shortages occur due to regional or national deployment or other causes.

Response recommendations

1. WFLC, working with NWCG, USFA and the NFPA Technical Committee, should develop a concise, multipronged approach to increasing cross-training opportunities and reassess differing or mutual training standards for structural and wildland firefighters in the WUI.

Caldor Fire, 2021. Photo courtesy of CAL FIRE.

Previous page photo: The Craig Hotshots, Mullen Fire, 2020. Photo courtesy of BLM.

2. WFLC partners should prioritize implementing compatible fire suppression strategies and tactics across SLTT and federal responding agencies.

3. WFLC partners should collaborate and establish an agreeable suppression doctrine. This will address the concern among some members who feel the current doctrine is not aggressive enough during initial attack, particularly among federal land management agencies.

4. WFLC, NASF, IAFC, NVFC and FEMA/USFA should develop a working group to streamline the process and time to receive Fire Management Assistance Grants and reimbursements for costs incurred. Include state and local fire agencies in the redevelopment process.

5. USFS and DOI should review the federal policy on hours for seasonal employees and pursue policy changes to increase seasonal employee hours for wildfire response and mitigation.

6. WFLC should support Congressional funding for wildland fire training and response for the National Guard across the nation.

Recovery recommendation

1. FEMA/USFA, in collaboration with CMAT, USGS, the Army Corps of Engineers Silver Jackets Program and insurance industry leaders, should establish a working group to develop a "Where to Start" guide to assist homeowners and renters who have lost everything during a wildfire.
   - The guides should include programs, potential assistance, etc.

Summary of Key Recommendations

The following recommendations have been identified by the Steering Committee as those most likely to have the greatest impact. If implemented, these actions can most quickly and significantly improve the health and safety of firefighters and the public and provide resilient landscapes and fire-resilient communities across our nation.

Mitigation recommendations

1. WFLC should build upon existing public education campaigns to include the public health trade-offs of wildfire smoke exposure versus how we can manage smoke under controlled conditions with prescribed fire as a means of reducing fuels and preventing long-term exposures from wildfires (Issue 2, Challenge 1, Recommendation 1).

2. DOI and USFS should develop and implement plans to shift seasonal firefighting positions to year-long employees. This will provide more experienced firefighters and an increased workforce that can train and specialize in wildfire, prescribed fire, fuel management and other mitigation efforts (Issue 4, Challenge 1, Recommendation 6).
   - Plans should include salaries, benefits, training and diversifications.

3. USFS and DOI, collaborating with the Small Business Association, should consider long-term wood utilization contracts for fuel reduction measures to support new wood using market development (Issue 4, Challenge 3, Recommendation 4).

4. WFLC and the wildland fire community should support the passage and implementation of funding for a national prescribed fire act (Issue 4, Challenge 4, Recommendation 1).
   - The national prescribed fire act should include increased liability protection; a national prescribed burner insurance program; increased public education, research, training and resource availability; and requirements for cooperation and collaboration between federal, state, tribal and local entities in support of more prescribed fire on the landscape.

5. WFLC and its SLTT partners, working with FEMA, should develop a list of programmatic, regulatory or statutory changes needed to allow additional FEMA funding for hazardous fuel reduction projects (Issue 6, Challenge 1, Recommendation 1).
   - Allow each state to have 2 GARs, 1 who would specifically address wildland fire mitigation projects.

6. WFLC should form a working group, including NGOs that are already developing codes and standards for wildfire-resilient construction, such as NIST, NFPA, ICC and IBHS (Issue 6, Challenge 2, Recommendation 1).
   - The working group should identify immediate, short-term and long-term gaps in the availability and enforceability of wildfire-resilient building practices; identify viable solutions for filling the gaps.
   - The working group should address how to ensure the community is built back for wildfire resiliency.
   - The working group should evaluate and develop strategies for local communities and state governments to adopt model building codes for wildfire resiliency, such as the International Wildland Urban Interface Code.
   - The working group should include the opportunity for voluntary or beyond-code standards to be recognized and adopted by local jurisdictions.

7. FEMA should convene a working group with NASF, USFA, DOI, EPA and DOE to review and update grant programs, such as BRIC, to better utilize funding at the ground level for wildfire mitigation projects (Issue 7, Challenge 2, Recommendation 1).
   - Consider processes that would facilitate wildfire mitigation to include utilities and infrastructure in underserved, rural and tribal communities.
   - Consider including nonprofit organizations and state and local entities in the FEMA funding process.

8. WFLC should collaborate with FEMA to provide updated guidance for the Hazard Mitigation Grant Program to leverage it as a proactive tool to help reduce wildland fire threats in the WUI (Issue 13, Mitigation Challenge, Recommendation 1).
   - Include SLTT partners in the redevelopment process.

Preparedness recommendations

1. DHS/FEMA/USFA and S&T, in coordination with SLTT emergency management response agencies, should develop enhanced community warning systems in high-risk areas with grant support from FEMA pre- and post-fire mitigation grants (Issue 3, Challenge 1, Recommendation 1).
   - Consider improving the FEMA IPAWS to include wildfires and develop an interface with social media platforms.
   - Utilize geofence capability to notify all devices in a specific area, review opt-in systems versus opt-out systems, and emphasize hardening and redundancy of critical community communication infrastructure.
   - Identify and include safety zones in the warning systems.

2. WFLC and law enforcement agencies and emergency management agencies in collaboration with federal agencies should collaboratively develop best practices for wildfire evacuations that include community safe zones along evacuation routes that can be used as a "last resort safety zone." These best practices should define how to design these safety zones, specifically what fuel setbacks will be needed, describe what capacity (persons and vehicles) they should have, as well as describe their recommended density, amount and location (Issue 3, Challenge 2, Recommendation 1).
   - Best practices should include regional differences to be incorporated into local pre-wildfire planning and mitigation efforts utilizing CERT, Fire Safe Councils and other local organizations.
   - Best practices must also account for those with functional needs and limited English proficiency.
   - Best practices should be developed together with stakeholders that have real-life experience and SMEs.

3. USFS, DOI, DOD, FEMA, DHS S&T, NASA, NOAA, NIST, USGS and SLTT agencies should examine how existing programs, such as the National Fire Danger Rating System and the National Predictive Services, can be expanded to inform the public better and create increased situational awareness regarding wildfire prevention, home preparedness and evacuation (Issue 3, Challenge 2, Recommendation 2).
   - Assess how other countries, particularly Australia, have used fire warning systems and what they have learned about more effective practices.

4. USFS, DOI, DOD, FEMA, DHS S&T, NASA, NOAA, NIST, USGS and SLTT agencies should increase funding and research for ensembled approaches to wildfire behavior modeling that is near real-time and accessible to all communities (Issue 12, Challenge 1, Recommendation 1).
   - These models can also be utilized for prescribed fire in the WUI and wildlands.
   - Support the development of fire simulation models that can incorporate the built environment as a fuel so that more realistic models can better determine future WUI community threats.

Response recommendations

1. USFS, DOI and DHS/FEMA collaborating with NASF should further invest in the firefighting workforce at all levels by increasing support and funding for the rural and volunteer fire programs, e.g., VFA and SFA (Issue 1, Challenge 2, Recommendation 1).
   - FEMA should review and adjust its programs to provide additional support and funding to assist state and local fire agencies in higher-risk WUI areas and underserved communities.
   - BLM's equipment transfer program to local firefighting organizations is an excellent example of what should be utilized by other DOI bureaus.
   - USFS/NASF should assign a task group to review increasing the VFA population cap (currently 10,000 or less) and consider underserved communities.
   - FEMA, USDA and DOI, collaborating with NASF, should prioritize and increase additional funding to support state and local fire service agencies specifically for WUI training, cross-training of structural firefighters, PPE and response capabilities.

2. WFLC, in conjunction with NIST and DHS S&T, should support a working group to adopt a standardized system for accountability and tracking of resources and develop an implementation schedule for integration into the interagency wildland/structural fire service (Issue 1, Challenge 3, Recommendation 1).
   - The technology should use standardized GISs that integrate with local and state systems.

Recovery recommendations

1. WFLC should support congressional approval to develop a new federal policy that allows BAER teams to conduct rehabilitation work across jurisdictional boundaries, including private lands that are deemed as high risk to local communities (Issue 10, Challenge 1, Recommendation 1).
   - FEMA funding should be incorporated into this cross-jurisdictional process for private lands work completed by BAER teams or state resources if available.
   - USDA should prioritize and streamline programs such as NRCS EQIP to assist farmers and ranchers with recovery following a wildfire.
   - States should develop state BAER teams.

2. Congress should fund the conceptual navigator and road map proposals that have been developed by WFLC and the WGA (After the Flames, n.d.) to further assist states and communities with mitigating post-wildfire impacts year-round (Issue 10, Challenge 4, Recommendation 1).
   - The road map must address the needs of underserved communities.
   - Training for state and local agencies must be included in the program delivery.

Conclusion

The threat of catastrophic wildfire in America's WUI demands national attention and a unified, multifaceted approach to prevention, mitigation, response, recovery and overall community risk reduction. This report not only assists in heightening attention on the WUI wildfire threat but also provides recommendations for a unified approach to decision-making regarding the future direction to address the WUI wildfire problem.

Fire tornado, the Pine Bulch Fire, Colorado, 2020.
Photo courtesy of Eric Coulter, BLM.

WFLC, identified as a critical convener, is well-positioned to coordinate partners and move many of the report's recommendations forward. With additional resources, WFLC has the capacity to lead the implementation and track the status of all actions. Additionally, elected and other government leaders can allocate resources and garner support to build the much-needed capability to carry out these recommendations.

Unless America builds a coalition of support that can assist all levels of authority to implement these recommendations and help residents learn and adapt to living safely in the WUI, the wildfire devastation will likely continue. With a clear and common vision across all levels of leadership, these recommendations and related actions will be a catalyst to reducing the threat of devastating wildfire in the WUI while improving public health and safety and decreasing socioeconomic and environmental impacts.

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Appendix C: Acronyms

AFF	American Forest Foundation
BAER	Burned Area Emergency Response
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BRIC	Building Resilient Infrastructure and Communities
CDC	Centers for Disease Control and Prevention
CEPC	Communication, Education, and Prevention Committee
CERT	Citizen's Emergency Response Team
CMAT	Community Mitigation Assistance Team
CWPP	Community Wildfire Protection Plan
DHS	U.S. Department of Homeland Security
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
EFRP	Emergency Forest Restoration Program
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FEMA	Federal Emergency Management Agency
FSA	Farm Service Agency
GAO	Government Accountability Office
GAR	Governor's Authorized Representative
GIS	geographic information system
IAFC	International Association of Fire Chiefs
IBHS	Insurance Institute for Business & Home Safety
ICC	International Code Council
IPAWS	Integrated Public Alert and Warning System
ITC	Intertribal Timber Council
NACo	National Association of Counties
NASA	National Aeronautics and Space Administration

NASF	National Association of State Foresters
NFFF	National Fallen Firefighters Foundation
NFPA	National Fire Protection Association
NGA	National Governors' Association
NGO	nongovernmental organization
NIFC	National Interagency Fire Center
NIOSH	National Institute for Occupational Health and Safety
NIST	National Institute of Standards and Technology
NLC	National League of Cities
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NVFC	National Volunteer Fire Council
NWCG	National Wildfire Coordinating Group
PPE	personal protective equipment
S&T	Science and Technology Directorate
SFA	State Fire Assistance
SLTT	state, local, territorial and tribal
SME	subject matter expert
TNC	The Nature Conservancy
UAS	unmanned aircraft system
USDA	U.S. Department of Agriculture
USFA	U.S. Fire Administration
USFS	U.S. Forest Service
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Service
VFA	Volunteer Fire Assistance
WFLC	Wildland Fire Leadership Council
WGA	Western Governors' Association
WUI	wildland urban interface

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