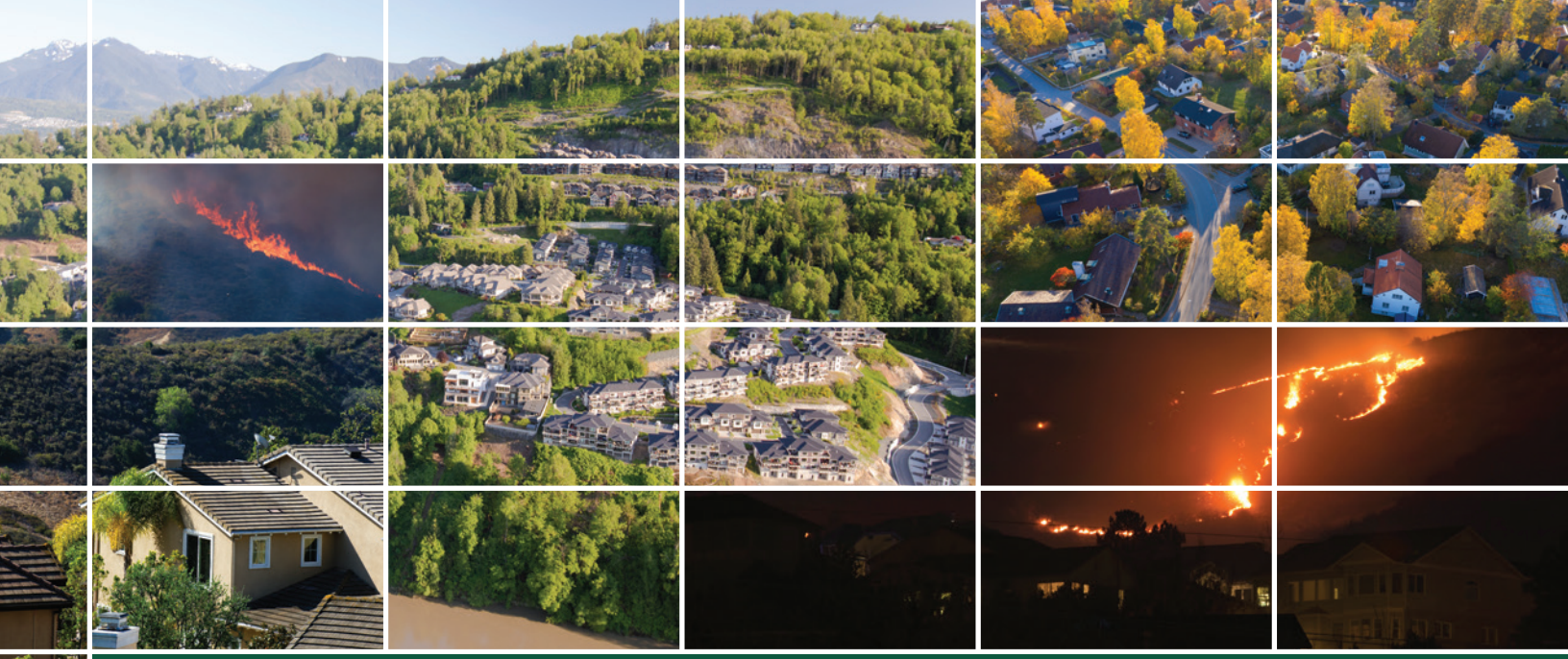

INTERNATIONAL CODE COUNCIL®

Building Confidence, Building Community.

Wildland-Urban Interface Codes Support Community Resilience

October 19, 2020

Wildfire Risk

Just as the nation is addressing the resilience challenges posed by COVID-19, several states in the Western United States are experiencing the most devastating wildfires on record. As of September 10, the 2020 wildfires in California resulted in a record 2.3 million acres burned, eight deaths and 3,700 destroyed structures.[1]

The U.S. Forest Service (USFS) determined that approximately 12 percent of the land in the contiguous U.S. is subject to high or very high wildfire hazard potential.[2] See Figure 1. While some of this land is in areas with little potential risk to human life and property, the number of people in the wildland-urban interface (WUI) is growing. The WUI in the United States grew rapidly from 1990 to 2010 in terms of both number of new houses (from 30.8 to 43.4 million; 41% growth) and land area (from 581,000 to 770,000 km^2; 33% growth), making it the fastest-growing land use type in the conterminous United States. The vast majority of new WUI areas were the result of new housing (97%), not related to an increase in wildland vegetation. Within the perimeter of wildfires from 1990 to 2015, there were 286,000 houses in 2010, compared with 177,000 in 1990.[3]

The WUI is also widespread outside of the US, including Argentina, Australia, France, and South Africa.[4]

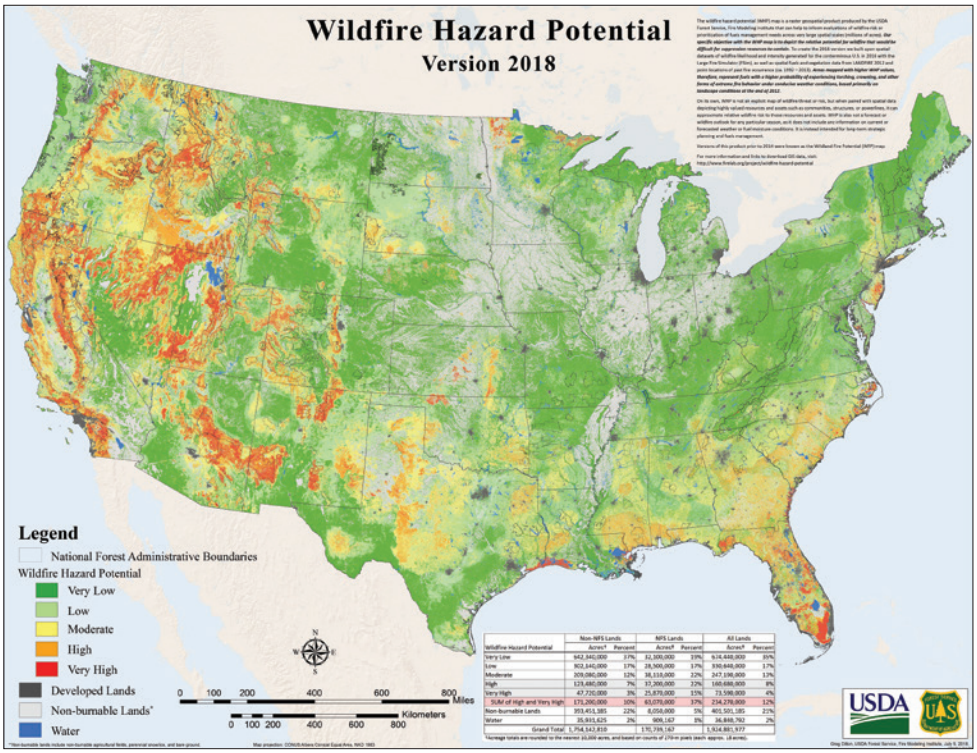

Figure 1. Wildfire Hazard Potential Map (USFS 2018)

CoreLogic found that 15 states (Alaska, Arizona, California, Colorado, Florida, Idaho, Montana, New Mexico, Nevada, Oklahoma, Oregon, Texas, Utah, Washington and Wyoming) represent the highest risk. In these states more than 1.9 million single family residences (SFRs) are at an elevated level of risk with a combined reconstruction cost value (RCV) of more than $638 billion. This comprises approximately 6.5% of the total number of SFRs in these states. Multifamily residential structures (MFRs) at elevated risk account for nearly 2.4% of all multifamily residences in these states.[5]

The Insurance Services Office (ISO) and Verisk identified 13 states with high to extreme wildfire risk for housing units built in the WUI. Table 1 highlights these states and the number and percentage of housing units at risk. Percentage numbers reflect the percent of total housing in each state for each category.[6]

Table 1. Housing Units at Risk of Wildland Fire (Verisk)

State	Total Housing	Housing Units At-Risk to Wildfire in the WUI					
	Units	High/Extreme	%	Moderate	%	Low	%
California	13,680,100	2,054,900	15	1,653,100	12	9,972,100	73
Texas	9,977,400	717,800	7	2,355,400	24	6,904,100	69
Colorado	2,212,900	373,900	17	301,700	14	1,537,300	69
Arizona	2,844,500	242,000	9	490,800	17	2,111,600	74
Idaho	667,800	175,000	26	125,100	19	367,700	55
Washington	2,885,700	160,500	6	444,200	15	2,281,000	79
Oklahoma	1,664,400	153,400	9	344,000	21	1,167,100	70
Oregon	1,675,600	151,400	9	356,400	21	1,167,800	70
Montana	482,800	137,800	29	119,200	25	225,900	47
Utah	979,700	136,000	14	137,100	14	706,500	72
New Mexico	901,400	131,600	15	220,500	24	549,200	61
Nevada	1,173,800	67,100	6	116,300	10	990,400	84
Wyoming	261,900	36,800	14	72,000	27	153,100	58

Wildland fire is not just an issue for rural areas. Urban communities can also be impacted. CoreLogic identified communities with significant wildfire exposure for SFR and MFR structures.[7] These vulnerable areas are captured in Tables 2 and 3.

Table 2. Top 10 Metro Areas with Single Family Residential Structures at Elevated Wildfire Risk (CoreLogic)

Rank	Metro Area	State	Number of SFRs at Elevated Risk	RCV of SFRs at Elevated Risk ($bn)
1	Los Angeles	CA	154,462	$90.31
2	Riverside	CA	126,628	$50.62
3	San Diego	CA	98,970	$47.45
4	Sacramento	CA	73,863	$30.55
5	Austin	TX	73,756	$22.67
6	San Francisco	CA	37,600	$18.76
7	Denver	CO	55,762	$17.73
8	Thousand Oaks	CA	27,331	$13.80
9	Truckee	CA	35,523	$12.27
10	San Antonio	TX	41,299	$11.66

Notes: SFR = single family residential; RCV = reconstruction cost value

Table 3. Top 10 Metro Areas with Multifamily Residential Structures with Elevated Wildfire Risk (CoreLogic)

Rank	Metro Area	State	Number of MFRs at Elevated Risk	RCV of MFRs at Elevated Risk ($bn)
1	Breckenridge	CO	4135	$1.06
2	Los Angeles	CA	1028	$0.77
3	Riverside	CA	946	$0.54
4	Sacramento	CA	847	$0.43
5	San Diego	CA	760	$0.43
6	San Francisco	CA	619	$0.41
7	Sonora	CA	759	$0.26
8	Redding	CA	495	$0.22
9	Salinas	CA	223	$0.17
10	Colorado Springs	CO	342	$0.12

Notes: MRF = multifamily residential structures; RCV = reconstruction cost value

The frequency and costs of wildfires is increasing. The National Oceanic and Atmospheric Administration (NOAA) tracks climate-related disasters that cause $1 billion or more damage.[8] The five-year average of wildfire costs has risen in the past few years, topping $10 billion. See Figure 2.

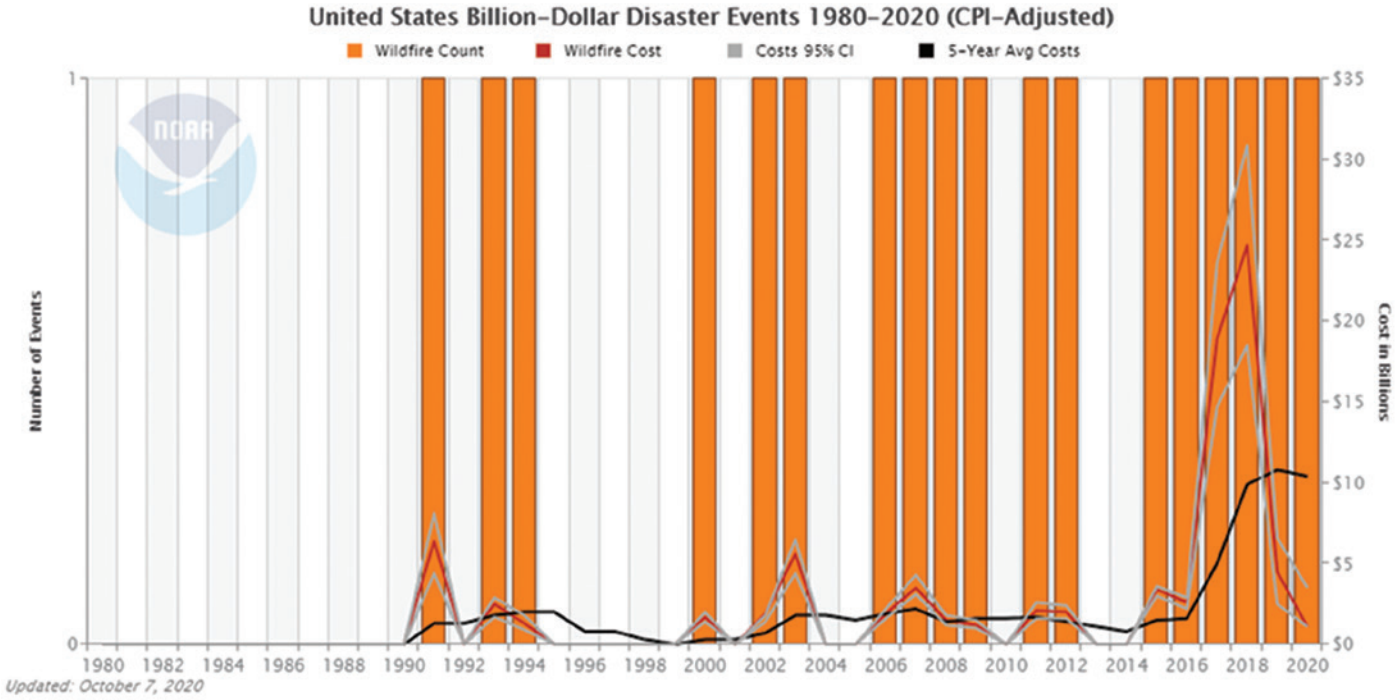

Figure 2. Billion-Dollar Wildfire Events 1980 - 2020 as of July 8, 2020(NOAA)

Wildfire disasters place significant burdens on communities. Properties are damaged or destroyed, lives are lost, significant resources are expended to contain the fire, and destroyed communities struggle to recover. These burdens coupled with other hazards faced by communities reveal the need for a holistic strategy to reduce the impacts—a strategy focused on enhancing resilience.

REDUCING RISKS AND IMPACTS THROUGH RESILIENCE

There is a growing effort to reduce the risks communities face and mitigate the impacts of hazard events. This effort is often characterized as resilience. The National Academies have defined resilience as "the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events."[9] The building industry, including organizations representing planning, design, construction, ownership, operation, regulation and insurance have embraced the definition established by the National Academies. Over 50 building industry organizations signed on to an Industry Statement on Resilience, recognizing the need for coordinated action through research, advocacy, education, planning and response.[10]

Achieving resilience requires a recognition of the shocks and stresses that increase vulnerabilities. While catastrophic shocks like wildfires, earthquakes, hurricanes and tornadoes capture public attention, many communities also face chronic stresses that cause harm to communities and amplify the impacts of shocks. Examples of shocks and stresses are captured in Figure 3.[11]

Shocks	Stresses
Infrastructure failure	Affordability
Hurricanes	Aging population
Earthquakes	Environmental degradation
Wildfires	Sea level rise
Heat waves	Growing wealth gap
Blizzards	Drought
Epidemics	Species extinction
Flooding	Aging infrastructure
Tornadoes	Population growth
Acts of terrorism	Unemployement
Civil unrest	Melting polar ice
Dam failure	Global warming
Subsidence	Food scarcity
	Increasing population

Figure 3. Community Shocks and Stresses (AIA)

Achieving resilience also requires a focus on the interconnected functions that form communities. The Alliance for National & Community Resilience (ANCR) has identified 19 functions that make communities great places to live and work but also contribute to their ability to withstand and bounce back from adverse events. These functions include social, organizational and infrastructural aspects of communities. See Figure 4. To be resilient, communities must address the resilience of each of these functions. ANCR is in the process of developing benchmarks for each of these functional areas to allow communities to assess and improve their resilience. An adverse event like wildfire reveals the importance of both a coordinated approach to resilience across multiple community functions and the impacts that can occur across the local economy.

Figure 4. Community Functions Contributing to Resilience

MITIGATING WILDFIRE RISK

While there are many factors that lead to wildland fire, there are methods to reduce the impacts these fire events have on people and structures within the WUI. The Forest Service and its other federal, tribal, state, and local partners have developed and are implementing the *National Cohesive Wildland Fire Management Strategy*[13] (*the National Cohesive Strategy*). The *National Cohesive Strategy* outlines wildfire management opportunities including general guidance on homes, communities, and values at risk:

- Promote community and homeowner involvement in planning and implementing actions to mitigate the risk posed by wildfire.
- Emphasize proactive wildfire risk mitigation actions.
- Pursue municipal, county, and state building and zoning codes and ordinances that mitigate fire risk to protect life and property from wildfire.

Among management options offered to help mitigate the U.S. wildfire problem, the *National Cohesive Strategy* suggests that focusing on building codes supports the goal of making homes and other buildings more resistant to ignition.[14]

The adoption and enforcement of building codes—particularly the International Wildland Urban Interface Code or IWUIC is one such method. As of August 2020, state or local jurisdictions in 20 states adoption varies. See figure 5.

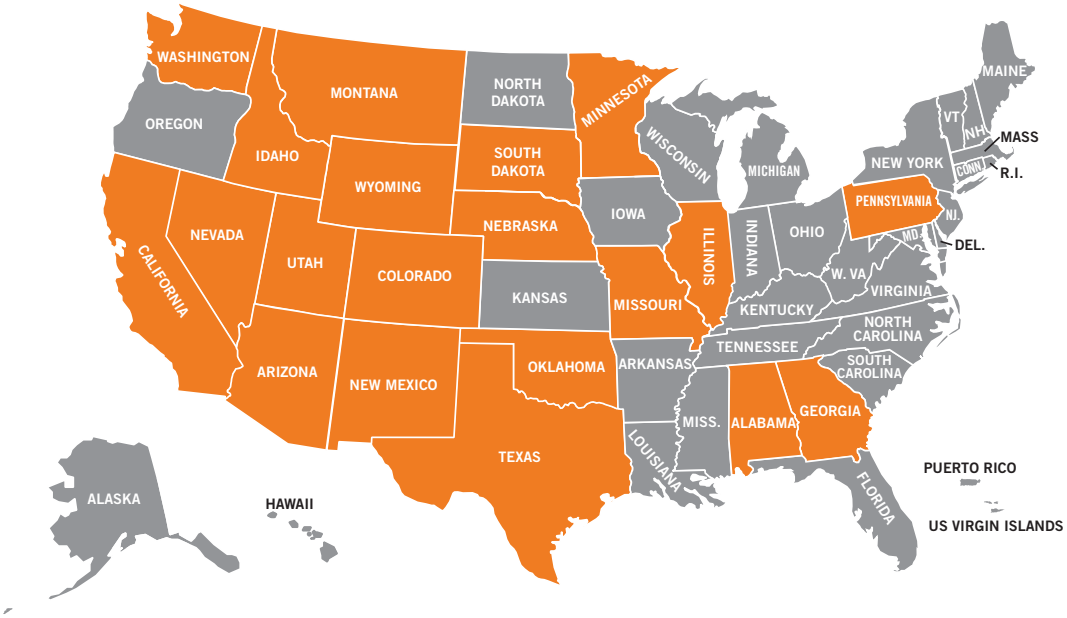

Figure 5. States with state-wide or local adoption of the IWUIC

Building codes are an essential strategy in achieving resilience. Code-based strategies to enhance community resilience must be coordinated across all building codes including energy, plumbing, mechanical, electrical and fire codes. As examined in greater depth in the section that follows, the IWUIC addresses the specific risks to people and structures in the WUI.

The Congressionally established National Institute of Building Sciences (NIBS), found that compliance with the 2015 IWUIC provides $4 of benefit for every $1 invested at the national level with some counties seeing benefits exceeding $6.[15] See Figure 6. NIBS also found that retrofitting structures in the WUI to provisions of the 2018 IWUIC provides a conservative benefit of $2 for every $1 invested but it could yield as much as an $8 benefit.

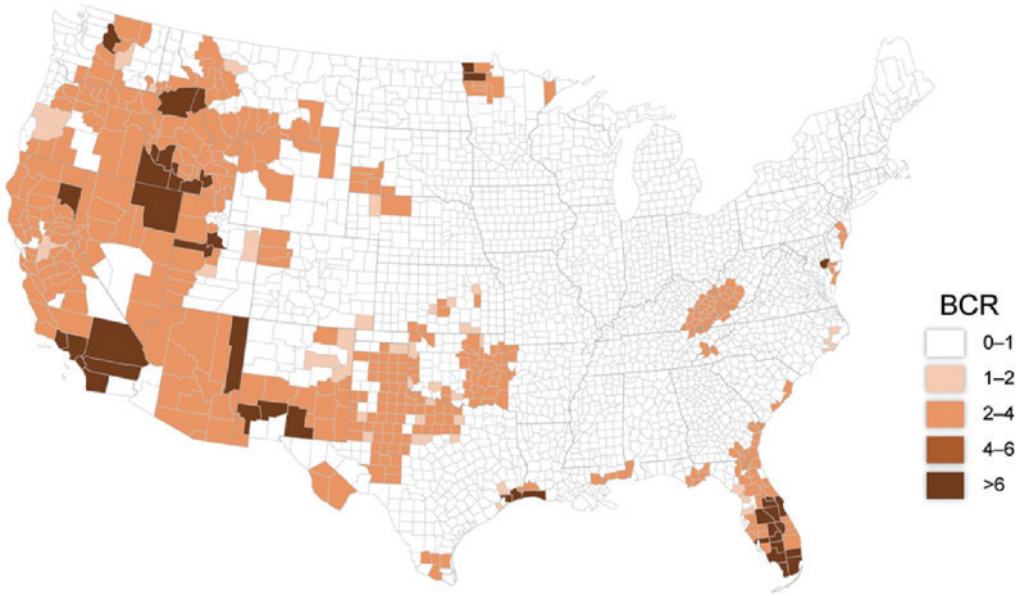

Figure 6. Benefit Cost Ratio of adoptiong the 2015 IWUIC (by county) (NIBS)

A McClatchy analysis following the California Camp Fire in October 2018 found that 51% of the structures built after a WUI code was implemented escaped damage compared to 18% of the 12,100 structures built prior.[16] The IWUIC generally meets or exceeds the California structural wildfire code studied.

The federal government supports the application of the IWUIC for its own buildings and within the disaster mitigation programs it funds. Executive Order 13728 established that all federal buildings over 5,000 square feet in the WUI comply with the IWUIC.[17] In its first round of Community Development Block Grant (CDBG) mitigation funding (CDBG-MIT) issued in 2019, the Department of Housing and Urban Development (HUD) recognized the importance of up-to-date codes including those that address WUI-related risks. The U.S. Federal Emergency Management Agency (FEMA) requires the IWUIC for federal funded post-disaster reconstruction of building and energy and water infrastructure in the WUI.[19] Pending legislation in the U.S. House of Representatives would provide tax credits towards rebuilding to the IWUIC.[20]

This white paper, the third[21] in a series examining how different International Codes contribute to resilience, explores the contributions provided by the IWUIC.

RESILIENCE AND THE INTERNATIONAL WILDLAND URBAN INTERFACE CODE

The IWUIC recognizes the benefits of a holistic approach to addressing risks and enhancing community resilience. Protection from wildfires relies on a community-wide approach that engages multiple actors. Reliance on building-level measures alone will not provide the level of protection necessary.

As provided in the preface to the 2021 IWUIC, "The IWUIC is a model code that is intended to be adopted and used supplemental to the adopted building and fire codes of a jurisdiction. The unrestricted use of property in wildland-urban interface areas is a potential threat to life and property from fire and resulting erosion. The IWUIC has as its objective the establishment of minimum special regulations for the safeguarding of life and property from the intrusion of fire from wildland fire exposures and fire exposures from adjacent structures and to prevent structure fires from spreading to wildland fuels, even in the absence of fire department intervention.

Safeguards to prevent the occurrence of fires and to provide adequate fire protection facilities to control the spread of fire in wildland-urban interface areas are provided in a tiered manner commensurate with the relative level of hazard present."[22]

Unlike other model codes produced by the Code Council, the IWUIC focuses on protecting life and property from a very specific threat.[23] It works in conjunction with other codes including the International Building Code (IBC), International Residential Code (IRC), International Fire Code (IFC) and International Property Maintenance Code (IPMC) to provide requirements in areas vulnerable to wildfire. These requirements directly influence the resilience of buildings and communities in the WUI.

Like all the I-Codes, the IWUIC is updated every three years through the code development process. For the first time a code commentary has been developed for the 2018 IWUIC. Provisions for the 2024 edition will be considered in 2021 with code change proposals due January 11, 2021.[24] As communities use the IWUIC and recover from recent wildfire events, they are encouraged to share their lessons learned through the submission of code change proposals.

As outlined in Table 4, provisions in the IWUIC provide resilience through requirements that address building-level and community-level measures. The Code provides communities and property owners with flexibility to identify and deploy the most practical or cost-effective solution for their particular situation. Chapter 5 of the IWUIC provides flexibility across mitigation measures such as ignition resistant materials, water supply and defensible space.

Table 4. Select IWUIC Provisions Contributing to Resilience

Selected Code Topic	Relevant Sections (2021 IWUIC)	Supported Resilience Strategy
Identification of vulnerability	302	▪ Risk assessment ▪ Communication of risk ▪ Community planning
Emergency vehicle access to dwellings	403	▪ Emergency response ▪ Property protection
Availability of water for fire fighting	404	▪ Community planning ▪ Fire protection
Testing of water sources and fire protection equipment	404.9	▪ Emergency preparedness
Reliability of fire protection equipment	404.10, A107	▪ Defensible space/safe access to equipment ▪ Redundancy in power supply
Fire protection plan	405	▪ Community planning ▪ Emergency preparedness ▪ Risk assessment
Hazard severity determination	502	▪ Risk assessment ▪ Fire protection ▪ Robustness
Ignition-resistant construction	503	▪ Risk reduction ▪ Fire protection ▪ Mitigate fire spread
Building specific measures/strategies	504, 505, 506	▪ Fire protection ▪ Risk reduction
Automatic sprinkler systems	602	▪ Fire protection ▪ Property protection ▪ Occupant egress
Defensible space	603, 604, A107	▪ Fuel reduction ▪ Mitigate fire spread ▪ Risk reduction
Spark arrestors	605	▪ Risk reduction
Vegetation clearance/management	A102, B101	▪ Risk reduction ▪ Fuel reduction ▪ Mitigate fire spread ▪ Maintain energy service
Access restrictions	A103	▪ Emergency response Evacuation
Ignition source control/material storage	A104, A105	▪ Risk reduction ▪ Fuel control ▪ Limiting hazardous conditions
Fuel models	D101	▪ Risk assessment ▪ Emergency planning
Understanding and communicating local conditions	**Appendix E**	▪ Community planning ▪ Risk assessment ▪ Risk communication ▪ Emergency planning

CONCLUSION

Building codes are instrumental to protecting life and property against a variety of risks. They are foundational elements of a community's resilience. The International Wildland Urban Interface Code builds off the general resilience measures contained in other codes to provide targeted requirements that address the specific risks faced in the wildland urban interface.

As the wildland urban interface grows and the risk of fire in these areas increases, communities must be prepared to implement strategies that enhance their resilience. Including adoption of the IWUIC as part of this resilience strategy can help reduce the social and economic impacts these events have on residents and businesses.

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[1] California Department of Forestry and Fire Protection (CAL FIRE) Incidents Webpage, https://www.fire.ca.gov/incidents/2020/ (accessed September 10, 2020).

[2] U.S. Forest Service, Classified 2018 WHP: GIS Data and Maps, https://www.firelab.org/document/classified-2018-whp-gis-data-and-maps.

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[4] Ibid.

[5] CoreLogic, September 2020 Wildfire Report.

[6] ISO/Verisk Analytics FireLine State Risk Reports https://www.verisk.com/insurance/campaigns/location-fireline-state-risk-report/

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[20] https://pascrell.house.gov/news/documentsingle.aspx?DocumentID=4415#:~:text=(D%2DNJ%2D09),owners%20rebuild%20after%20natural%20disasters.

[21] Prior white papers in the series are *Resilience Contributions of the International Building Code* and *The Important Role of Energy Codes in Achieving Resilience*.

[22] International Code Council. *2021 International Wildland Urban Interface Code*. https://codes.iccsafe.org/content/IWUIC2021P1

[23] The Code Council does produce standards that focus on specific risks (ICC 600: Standard for Residential Construction in High-Wind Regions; ICC 500: Standard for the Design and Construction of Storm Shelters; and ICC 1300: Standard for the Vulnerability-Based Seismic Assessment and Retrofit of One- and Two-Family Dwellings (in development). However, these standards are generally incorporated into broader codes like the International Building Code and International Residential Code.

[24] https://www.iccsafe.org/products-and-services/i-codes/code-development

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