

EXECUTIVE SUMMARY

While the Wildland-Urban Interface (WUI) is not a new concept, fires in WUI communities have rapidly expanded in frequency and severity over the past few decades. The number of structures lost per year has increased significantly, from around 900 per year in the 1990's to almost 3000 per year in the 2000's (Bailey, 2013; NIFC, 2014). This trend is the result of many factors, including increased development in rural areas, fuel management policies, and climate change, all of which are projected to increase in the future (Krawchuk et al., 2009).

Responsibility for the protection of these buildings falls between both wildland and urban fire authorities, with mixed guidance available for homeowners, code officials, etc. (IBHS, 2014; ICC, 2012; CBC, 2009; Fire Adapted Communities, 2015). The NFPA has begun to address this problem by instituting several standards, including NFPA 1141, 1142, 1143 and 1144, which aim to reduce structural ignitions and provide adequate firefighting infrastructure in WUI communities. A necessity for improvement of these standards and others is technical knowledge which can be used to understand pathways for fire spread and their statistical and/or quantitative contribution to fire risk. While the general pathways for fire spread in the WUI (flame, radiative and ember exposure) are known, the exposure conditions generated by surrounding wildland fuels, nearby structures or other system-wide factors and the subsequent response of WUI structures and communities are not well known or well understood. Several key pathways into structures, such as eaves, vents, windows, roofs and decking have received attention and limited study, but no effort has been made to compile all available data quantitatively for use in an applied, risk-informed framework.

A thorough literature review of multiple pathways to ignition and their requisite exposure conditions in WUI communities has been performed, along with a gap analysis to identify data needed to inform prevention and protection strategies. Information has been compiled from a wide array of resources, including archival publications, conference papers, research reports from academia and federal agencies, case studies and investigative reports from WUI fire incidents, existing codes and standards, and interviews with leading incident commanders and fire researchers. These studies have been compiled from local (US) resources, as well as Pathways to Fire Spread in the WUI

international sources in North America, Europe, Asia and Australia who have amassed a wide variety of experience on these topics.

After reviewing the available literature, many areas related to pathways for fire spread in the WUI were found to still be in need of additional research. As part of a gap analysis, these areas were broken down into those related to quantification of risk and hazard and more practical and specific issues. Areas necessary to inform quantification of risk and hazard included pre- and post-fire data collection, improved testing of firebrands, understanding of ember and wildland fire fundamentals, and improved understanding of structural ignition mechanisms. There are also many other practical issues, which relate to specific areas of code and standard development and WUI community protection or firefighting that are in need of rapid research and development. These included understanding fuel management, defensible space, community planning, development of test standards, design of ignition-resistant materials, assessing the effectiveness of mitigation strategies, understanding the impact of wildland fires on health and the environment, improving firefighting techniques and identification of educational needs.

These categories represent a wide spectrum of subjects within possible WUI research. One of the most important gaps identified through this review is that most work to date has not *quantified* effects in a repeatable manner. While it is useful to identify vulnerabilities and best practices, protection of WUI communities cannot evolve without more quantitative analyses to optimize protection schemes, standards and risk and hazard analyses. Improved dissemination of literature, especially through more peer-reviewed studies will also enhance the technical credibility and wide dissemination of work on the field.