Rising risk of wildfire

February 2019

Willis Re

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Abstract

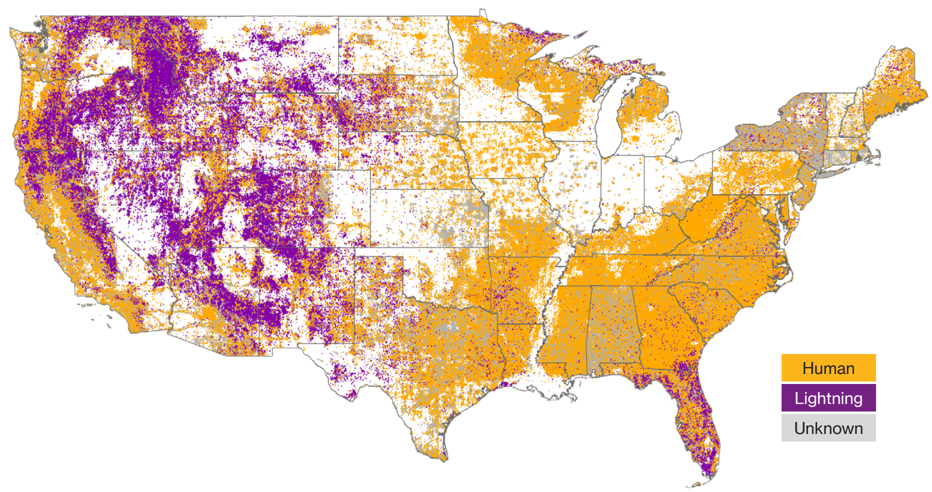
Property risk from wildfire is destined to increase over the coming several decades. The increase is due to a combination of climate and urban development in fire-prone environments. Climate change is expected to cause an increase in temperatures and drier conditions, which will increase the risk of wildfires. The number of houses in the wildland-urban interface (WUI), where structures blend with wildland, increased dramatically in recent decades. Losses from wildfires have increased exponentially, and sophisticated analytic solutions became necessary to price wildfire risk. Willis Re offers a wildfire assessment approach utilizing a robust simulation of 50 thousand years of stochastic wildfires developed by the U.S. Forest Service (USFS). This score will allow underwriters to make informed decisions about accumulations and portfolio management, underwriting and risk selection.

In 2018, several areas of the western U.S. were burned by historic wildfires for the second year in a row. We witnessed the Camp Fire, the deadliest and most destructive wildfire in U.S. history. The Camp Fire started on November 8, 2018, in Butte County, California, and it took more than two weeks to contain it completely. The estimated insured loss from the Camp Fire could be between $7.5 billion and $10 billion according to RMS,[1] a global catastrophe risk modeling company. *Table 1* shows the key damage and casualty statistics from the Camp Fire.

Table 1. Camp Fire[2]

Size (acres)	153,336
Civilian fatalities	86
Residential structures (destroyed)	13,696
Residential structures (damaged)	462
Commercial structures (destroyed)	528
Commercial structures (damaged)	102
Other structures (destroyed)	4,293
Estimated insured loss ($ billion)	7.5 – 10

Figure 1. Location and ignition type of all the wildfires reported in FPA FOD in the U.S. between 1992 and 2015 (adapted from Brey et al., 2018)[3, 5]



In the wake of the devastating Camp Fire, it is a fair question to ask what started it. The cause of the Camp Fire is still under investigation, but some are speculating that a utility company's failure to maintain its infrastructures could be the cause,[4] which can be categorized as human ignition. *Figure 1* (on the previous page) shows the location and ignition type of all the wildfires reported in the Fire Program Analysis Fire Occurrence Data (FPA FOD) in the U.S. between 1992 and 2015. The ignition causes other than lightning are grouped into a single category of human ignition that includes campfire, debris burning, arson, equipment use, smoking, railroad, fireworks and power line (following Brey et al., 2018).

The ignition mechanism of wildfire is significantly different between the West and Southeast regions of the U.S. In the Southeast region, human ignition is the major cause for starting a fire; in the western part of the U.S., both human ignition and lightning are major causes of wildfire. However, lightning dominates for the large wildfires in the West. Using FPA FOD, Brey et al., (2018), showed that the seasonality of when these wildfires occur is also different. The wildfires in the Southeast occur more in the spring when the area experiences low fuel moisture and low relative humidity, and also in the fall when similar conditions occur. In contrast, the majority of wildfires in the West occur during July and August. Generally, wildfires in the West are larger than wildfires in the Southeast due to favorable climatological and ecological conditions. *Figure 2* shows a box and whisker plot of the size of wildfires (greater than 1,000 acres burned) each year from 1992 to 2015 in the West, using FPA FOD. The figure also shows the average and the 95th percentile of the fire size. Both the average and the 95th percentile show that the wildfires are getting larger. The fire size is a display of the fire severity as well.

As wildfires are growing in scale and duration, and consuming increasing areas of western U.S. forests, the economic costs of wildfires can be crippling. In addition to property damage, wildfires cost states and the federal government billions in fire-suppression management. The U.S. Forest Service's yearly only fire-suppression costs have exceeded $1 billion for 13 of the 18 years between 2000 and 2017. In 2015, these costs exceeded $2 billion, and in 2017 they totaled almost $3 billion (*Figure 3*).

Figure 2. Box and whisker plot of the size of wildfires each year from 1992 to 2015 in the West, using FPA FOD[5]

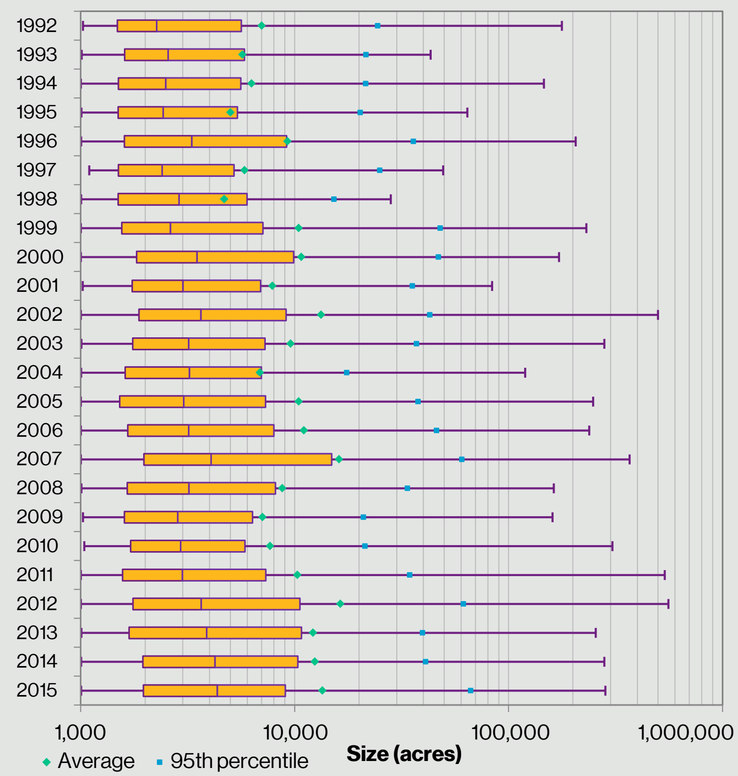
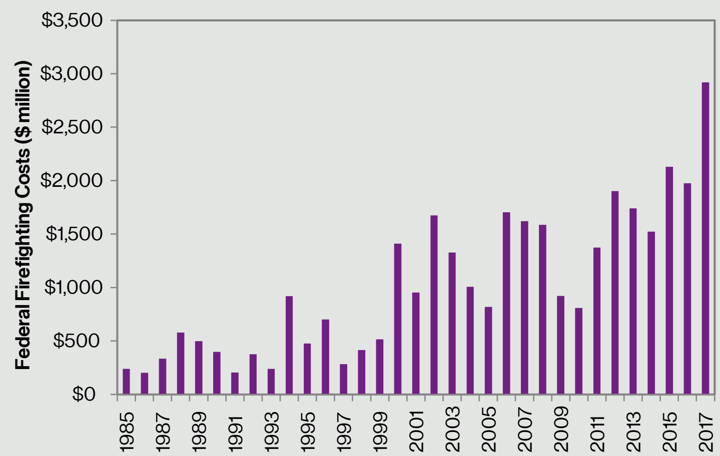


Figure 3. Federal firefighting (suppression only) cost from 1985 to 2017.[6]



Impact of climate change

Regardless of the ignition source, the annual burn area of wildfires is still linked to environmental conditions that allow fuels to ignite and wildfires to spread. Dry, warm conditions yield to low precipitation and high evapotranspiration, which deplete fuel moisture. These conditions increase the probability of ignition and potential for fire spread, which further increase with high winds that deliver more oxygen to wildfires. Climate change will be an important driver of future wildfire activity along with vegetation, land use and land management. Higher temperature and earlier snow melt generally cause soil to stay dry for longer periods of time, which increases the likelihood of drought and a longer wildfire season mostly in the western part of the U.S.

A study by Abatzoglou and Williams (2016)[7] showed that the impact of climate change is already evident. *Figure 4* was adapted from Abatzoglou and Williams (2016), which shows that the area burned by wildfire had grown twice from 1984 to 2015 due to climate change. This estimation was based on the strong correlation between fuel aridity and the western U.S. area burned by wildfire, and the detectable impact of anthropogenic climate change on fuel aridity.

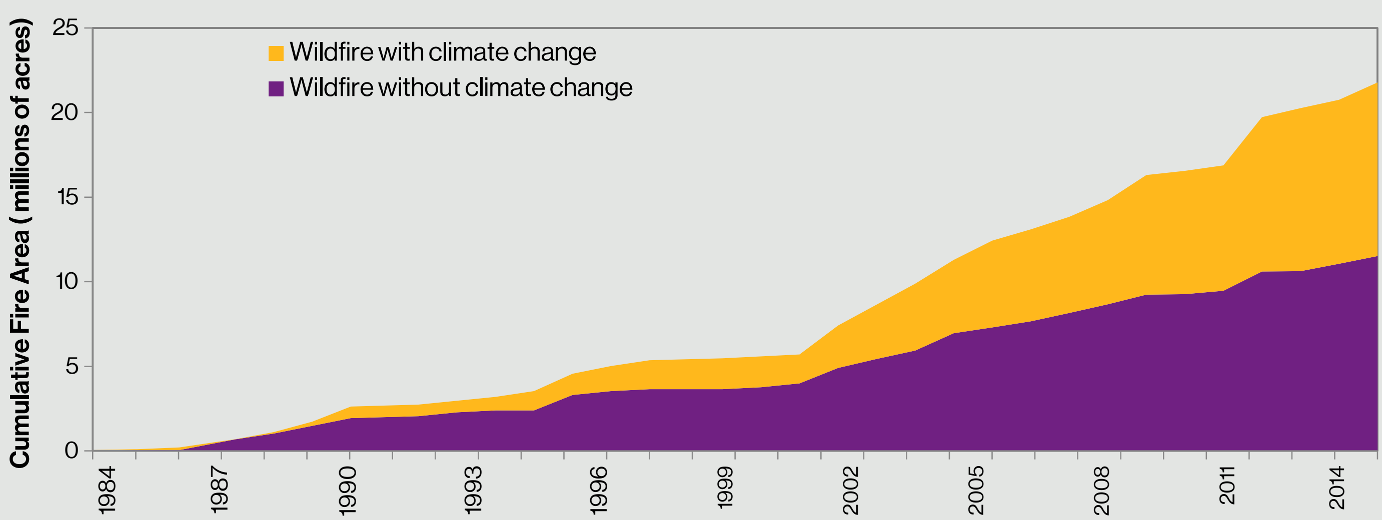
Impact of urban development

Climate change is not the only factor aggravating wildfire risk. Recent development patterns have also played a role in increasing risk. The developments in the WUI, areas where structures blend with wildland, have increased dramatically in recent years. Just in California, there was a 34% increase in housing units in the WUI from 1990 to 2010.

Generally, more than 50% of structure ignitions are caused by windblown firebrands and embers. Other ignitions are from burning trees and brush near buildings, fire transmission from neighboring houses and the wildfire flame front itself. While forest fires themselves produce flying embers, a house on fire actually produces far more, and for a longer period of time.

The first step in reducing wildfire loss is to raise awareness of the responsibilities of living in a fire-prone environment. Individual and community action can ensure that homes and neighborhoods are prepared for wildfire. WUI Code,[8] Firewise[9] and Community Wildfire Protection Plans[10] encourage land conservation in the WUI and more development in areas with less risk. Zoning and building code policies suggest leaving defensible space around homes to create barriers to stop wildfire from spreading and encourage the use of fire-resistant building materials.

Figure 4. Cumulative forest area burned by wildfires between 1984 and 2015 with and without climate change (adapted from Abatzoglou and Williams [2016])



Fire-resistant construction and retrofits

Choosing proper building material and design along with proper landscaping around a structure is the key to make a property less susceptible to fire loss. The Insurance Institute for Business & Home Safety (IBHS) provides a series of regional wildfire retrofit guides, which include a risk assessment checklist and cost estimator to help home and business owners choose retrofit projects.[11] Below are some highlights, by key building components, on how to reduce wildfire vulnerability for residential structures:

Roof: The roof is the most vulnerable component of a home. Roofs that are made of wood or shingle are prone to catch fire from flying embers. Building the roof or retrofitting it with fire-resistant material such as metal or tiles can greatly reduce the chance of catching fire. Since embers can also enter through vents, it is important to cover all vents with metal mesh.

Exterior walls: Many commonly used siding materials are combustible and not suitable for areas with high wildfire potential. Using wildfire-resistant sidings (e.g., stucco, fiber cement, treated wood), doors and windows, and installing weather stripping can reduce the vulnerability of flying embers.

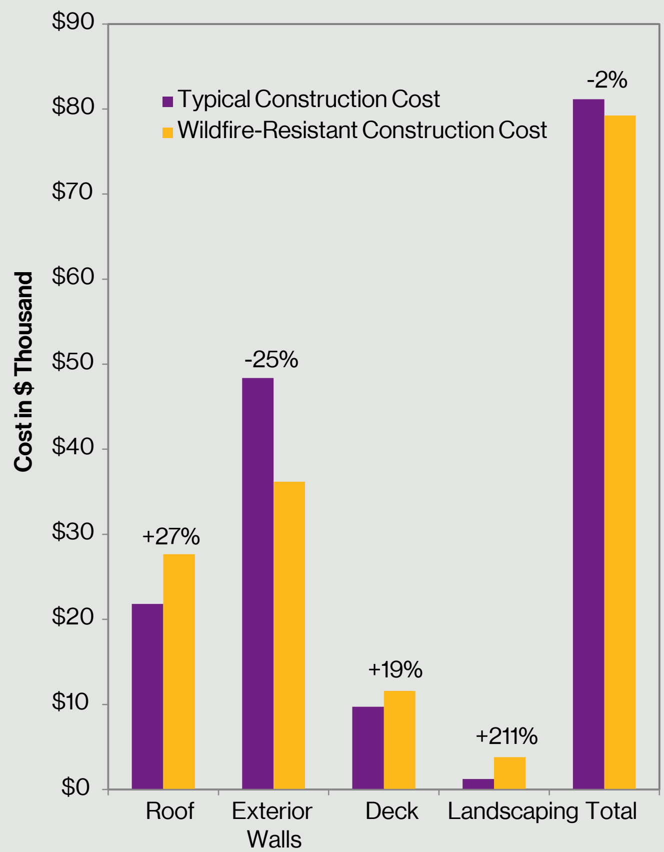
Deck: Any accumulation of combustible materials such as dried debris around a house is hazardous. Decks create places where combustible materials can accumulate easily, either on or under the deck. Once these combustible materials are ignited, decking materials that are combustible will catch fire easily. Wood and wood-plastic composite with a fire retardant incorporated in the material can improve the performance against fire.

Near-home landscaping: IBHS recommends maintaining a noncombustible zone of five feet around the entire perimeter of the house and outer edges of the deck. Mitigations include using rock, mulch, flower beds and gardens as ground cover for bare spaces and as effective firebreaks.

Cost of a wildfire-resistant home

A recent study conducted by Headwaters Economics in partnership with IBHS[12] compared the relative costs of new construction of a typical home versus one with wildfire-resistant standards for a three-bedroom, 2,500-square-foot, single-story, single-family home. *Figure 5* shows cost differences between typical and wildfire-resistant construction. The study suggests that a new home built to wildfire-resistant codes can be constructed for roughly the same cost as a typical home. However, costs could vary for retrofitting an existing home to be wildfire-resistant, as some components, such as the roof and walls, add significant expense.

Figure 5. Cost differences between typical and wildfire-resistant construction for a three-bedroom, 2,500-square-foot, single-story, single-family home.[12]



Willis Re can help you manage wildfire risk

Until this year, the wildfire events of 2017 were generally assumed to be tail events – unlikely to be soon repeated. But now with very similar events having occurred in 2018, the insurance community is rethinking how to see wildfire risk. Historically, wildfire has typically either been ignored in underwriting or by considering proximity to burnable vegetation. Some insurers also use commercial wildfire hazard scores for risk selection, underwriting or pricing. More sophisticated second-generation wildfire probabilistic models are just beginning to emerge and have yet to gain wide acceptance. Over the past couple of decades, losses from wildfires have increased exponentially, making more sophisticated analytical solutions necessary to write and price wildfire risk confidently.

Willis Re has developed a wildfire risk assessment approach utilizing a robust simulation of 50 thousand years of stochastic wildfires developed by the USFS. The tool was built using the highest resolution data available and returns location-level hazard scores for the all contiguous states. The key components of the Willis Re wildfire hazard score includes crown fires (the most extreme type of wildfire risk), considers the regional efficiency of suppressing wildfire risk, and considers proximity to either the WUI or other vegetation.

Recent events have provided evidence that Willis Re wildfire hazard scores can be used by underwriters to confidently make informed decisions on risk selection, accumulation management and portfolio management. *Figure 6* shows average normalized hazard rankings, ranging from 0 to 4 with 4 representing extreme risk, by various models using claims captured in 2017. Willis Re's normalized risk assessments for 2017 wildfire claims are, on average, highest among all other industry tools and models that are available to compare. In addition, Willis Re scores show credible spatial differentiation.

The map in *Figure 7* on the following page shows Willis Re wildfire hazard scores for locations in Butte County, which contained the catastrophic 2018 Camp Fire, and includes the neighboring cities of Paradise and Chico. These cities are notable because Paradise was devastated by the fire while Chico was largely spared. Two sets of box and whisker plots are shown in the insets. The plot at upper left shows that the distribution of wildfire scores in Paradise are significantly higher than those in Chico; the plot at lower left shows that the distribution of the scores for locations inside the Camp Fire perimeter are significantly higher than those for locations outside (up to five miles) of the perimeter.

Figure 6. Average normalized wildfire score by various models using the claims captured in 2017.

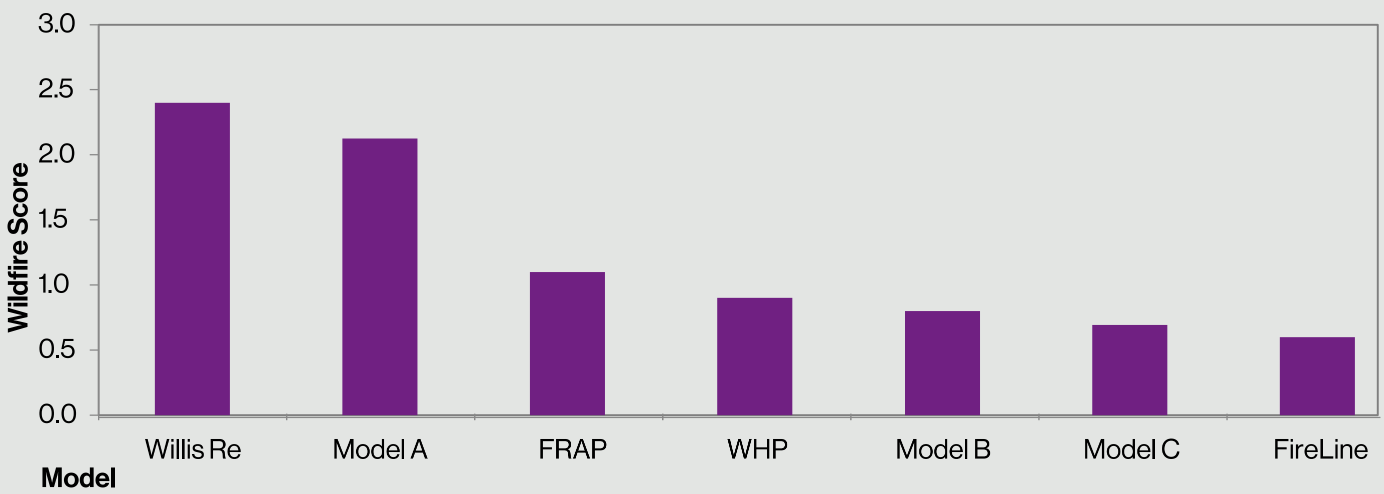
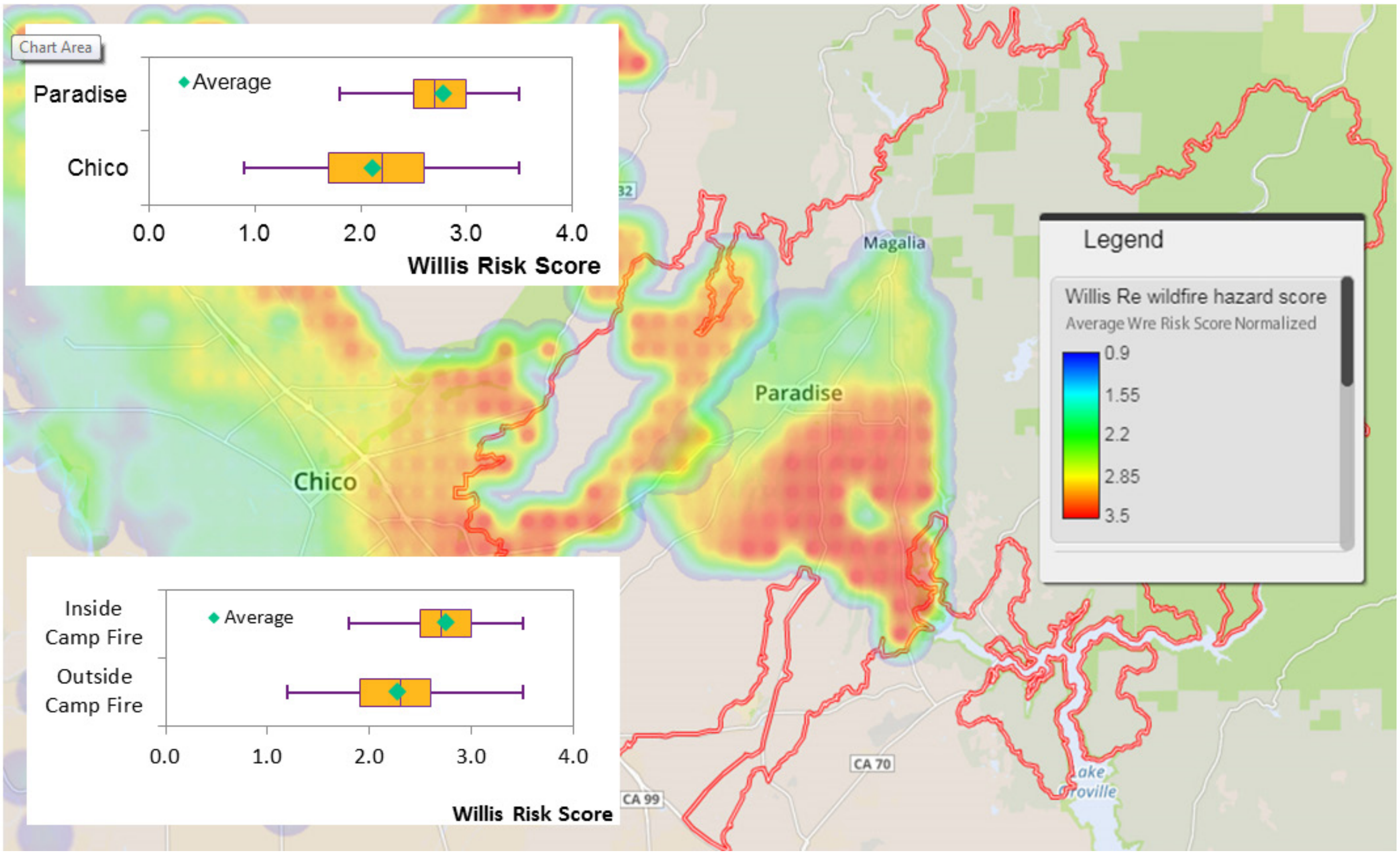


Figure 7. Willis Re wildfire hazard score (normalized) in Chico and Paradise. The Camp Fire perimeter is shown in red. The top inset shows a box and whisker plot of these scores for the two cities. The bottom inset shows a box and whisker plot of these scores for locations inside and outside (up to five miles) of the Camp Fire perimeter.



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[12] https://headwaterseconomics.org/wildfire/homes-risk/building-costs-codes/

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