Quantifying Wildfire Risk to Municipal Debt in California[1]

MMA's *interest and commitment to quantifying the risks of climate change to municipal securities has taken a significant step through its relationship with* **risQ**. **risQ**, *a National Science Foundation-funded company, is the leader in modeling and translating climate risk to the bottom line for municipal debt participants.*

The recent California wildfires motivate exploring the probability and severity of risk to other municipal obligors.

KEY TAKEAWAYS

- Wildfires, flooding, hurricanes, and heat stress are expected to inflict greater and more frequent destruction under climate change. These hazards can exacerbate traditional municipal credit risks, particularly among fiscally strained obligors.
- The probability and severity of these risks are quantifiable and can be translated into comparable estimates of risk across bond investments.
- The California Camp Fire destruction was unprecedented and threaten the rebuilding of the Paradise, CA tax-base and its ability to service its obligations. There are approximately 400 California cities with comparable or larger relative building footprint exposure to Camp Fire-equivalent wildfire risks.

CAMP FIRE HIGHLIGHTS WILDFIRE AS A MUNICIPAL RISK FACTOR

Wildfires have grown in scale and duration in recent decades,[2] owing in part to climate change.[3] Building footprint adjacent to forests has increased in tandem. The devastating human and economic impacts of California's recent Camp Fire are unprecedented, leaving at least 88 fatalities, 153,000 acres burned, and 18,800 structures destroyed. The town of Paradise was devastated, with more than 6,700 of its structures destroyed, its rebuilding prospects uncertain, and its ability to service its debt obligations unlikely.

Broader impacts are beginning to flow through to the municipal market ecosystem. The highest profile player is PG&E, which filed for bankruptcy protection this January, recorded a $10.5 billion charge in anticipation of damage claims, and in late February acknowledged their culpability in sparking the fire.[4] Its revenue bonds, issued through the California Infrastructure and Economic Development Bank, tumbled by 11% from mid-December 2018 to mid-January 2019. Moody's underlying rating of the California Statewide Communities Development

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Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

[2]https://www.willistowerswatson.com/en-US/insights/2019/03/rising-risk-of-wildfire

[3]https://www.pnas.org/content/pnas/113/42/11770.full.pdf

[4]https://www.msn.com/en-us/news/us/pgande-says-it-probably-caused-the-fire-that-destroyed-paradise-calif/ar-BBUcUp8?ocid=spartanntp

Authority's Taxable Pension Obligation Bonds 2007 Series A-2 Bonds fell to Caa3 from B1 because of Paradise's responsibility for 41.3% of the debt service.[5] AMBAC, already in runoff because of financial distress, will likely have its resources called upon to cover a large portion of the obligation. Paradise's uncertain future means that other regional obligors will face increased analytic scrutiny and potentially higher interest costs on their debt.

CLIMATE RISK CAN BE QUANTIFIED - WILDFIRE EXAMPLE

risQ's wildfire risk model was developed in collaboration with the US Forest Service.[6,7] One focus of the model is on risk to municipal obligor-level *building footprint*, a key component of economic value.

Under current climate, there is at least a ~7% annual chance of seeing an event in California as devastating as Camp Fire in terms of relative building footprint exposure. If California's long-standing drought continues, that probability is likely to grow. In terms of severity, the building footprint exposure in approximately 400 California cities is comparable to or larger than Camp Fire-equivalent wildfire risks. **Figure 1** maps relative building footprint exposed to severe risk across all counties, school districts, opportunity zones, and cities/CDPs in California.

By comparing the percentage of building footprint exposed to total building footprint (**Figure 2**), the scale of potential risk across the CDPs and cities becomes apparent. risQ's analysis identifies that Before Camp Fire, Paradise's heightened risk in terms of both probability and potential financial severity of a wildfire event was identifiable and actionable in an investment decision support context.

MEASURING TAX REVENUE AT RISK ENABLES COMPARABLE CLIMATE RISK ASSESSMENTS

Climate catastrophes can impact the key revenue streams and economic health indicators of a given issuer—property value, sales tax, job quality and quantity, infrastructure, demographics - and can play across relevant hazards—wildfires, floods, hurricanes, and heat stress. risQ's models allow municipal market participants to make informed investment decisions across obligors by comparably measuring the tax revenue at risk from a variety of climate risks at investment relevant timeframes.

As events grow in quantity and scale, key revenue streams associated with servicing bond obligations will be impacted. A substantial, sustained negative impact of wildfires on property values are amplified by spatial adjacency to wildland with flammable vegetation

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[5] https://www.moodys.com/research/Moodys-downgrades-California-Statewide-Communities-Development-Authority-Taxable-POBs-2007--PR_905682075

[6] Short, K. C., Finney, M. A., Scott, J. H., Gilbertson-Day, J. W., & Grenfell, I. C. (2016). Spatial dataset of probabilistic wildfire risk components for the conterminous United States.

[7] Riley, K. L., Williams, A. P., Urbanski, S. P., Calkin, D. E., Short, K. C., & O'Connor, C. D. Will Landscape Fire Increase in the Future? A Systems Approach to Climate, Fire, Fuel, and Human Drivers. *Current Pollution Reports*, 1-16.

(referred to as the Wildland Urban Interface, or WUI),[8] temporal proximity to a prior wildfire,[9] and increasing insurance costs.[10]

The potential for large relative destruction within a given obligor's boundaries inherently increases as size decreases. By the same token, the potential for impairment and default grows as within-obligor economic affluence falls.

There is a potential confluence of factors that can amplify the impact of climate risks in an investment portfolio. For example, investment and insurer strategies that lead to higher exposures of lower-rated and/or smaller obligors with constrained resources can subject a portfolio to greater losses related to severe climate events. Correlation of risks will exist where multiple obligors are spatially proximate and hence exposed to the same hazards.

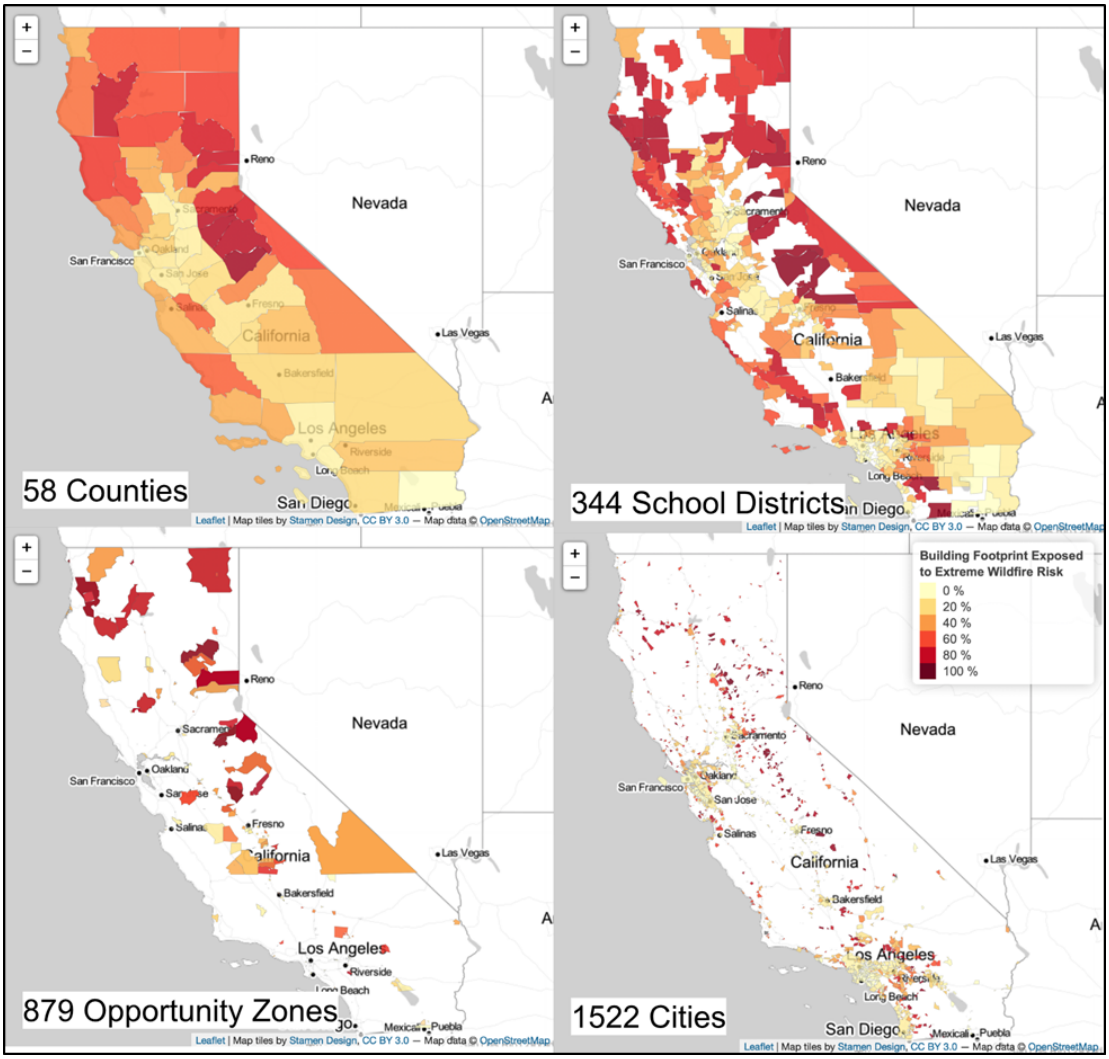

Figure 1- Building footprint exposed to extreme wildfire risk comprehensively for four different spatial jurisdiction types.

[8] http://web.holycross.edu/RePEc/hcx/HC1503-Kiel-Matheson_Wildfires.pdf
[9] https://pdfs.semanticscholar.org/e604/2430d468e5d5fa6367b2be54cf32ff39ae03.pdf#page=116
[10] https://www.wsj.com/articles/california-homeowners-face-higher-prices-for-a-scarce-commodity-wildfire-insurance-11549803600?mod=hp_lead_pos5

CLIMATE RISK AS AN IMPAIRMENT AMPLIFIER

Using **MMA**'s impairment database, vulnerable issuers and corresponding CUSIPs can be identified and assessed for wildfire risk. Two anecdotal examples can be highlighted:

- Rancho Murieta CSD 2014-1 (CUSIP: 752135BR3): East of Sacramento and fairly rural, Rancho Murieta does not have as much forested area as Paradise. The majority of its real estate lies in the WUI. For higher probability events, it is actually *more* at risk than Paradise: approximately 65% of Rancho Murieta's building footprint is exposed to severe fire with a likelihood estimated to be significantly higher than Paradise's (itself an estimated ~0.02-0.1% annual probability event).
- Western Hills Water District CFD 1 (CUSIP: 958324EE1): This is an ~8 square mile water district east of San José where almost all (>99%) of the built environment is exposed to a relatively high likelihood (~1% annual probability) wildfire risk.

These examples represent the worst of both worlds: impaired securities along with outsized exposure to wildfire risk. There are other issuers in California lying close enough to impairment thresholds that a climate event would be material to an ongoing ability to service debt.

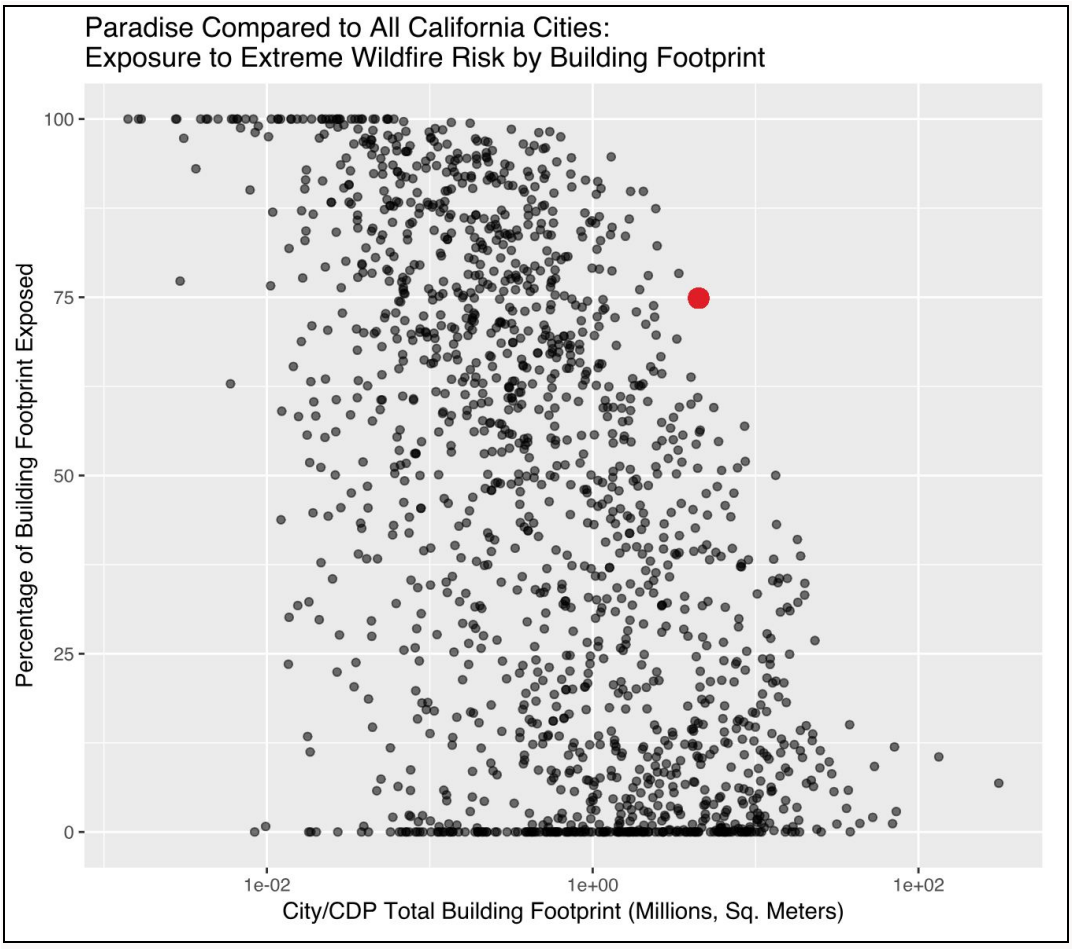

Figure 2 -- Total building footprint shown against percentage at risk. For wildfire hazards, there is a relatively strong inverse correlation (rank correlation = -0.54 in Figure 2) between total building footprint and risk. This largely reflects the tendency of larger cities to be further removed from the WUI. Paradise is demarcated in red.