

Understanding California wildfire risk

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California property owners are finding it increasingly difficult to obtain insurance coverage in the voluntary market in the wake of back-to-back years of devastating wildfires.

Figure 1 summarizes the acres burned and number of structures destroyed by wildfires (10 acres or more) managed by the California Department of Forestry and Fire Protection (CAL FIRE) and partner agencies.¹

FIGURE 1: CALIFORNIA WILDFIRE ACRES BURNED AND STRUCTURES DESTROYED BY CALENDAR YEAR

Year	Number of wildfires	1000 Acres burned	Structures damaged/ or destroyed	1000 Acres Burned Per Fire	Structures per 1000 acres
2013	9,907	602	456	0.06	0.05
2014	7,233	626	471	0.09	0.07
2015	8,283	881	3,159	0.11	0.38
2016	6,954	670	1,274	0.10	0.18
2017	9,270	1,548	10,280	0.17	1.11
2018	7,948	1,975	24,226	0.25	3.05

As illustrated in Figure 1, the number of acres burned per wildfire has increased since 2013, indicating that wildfires have become more severe. Also illustrated is the increase in structures damaged per acre burned, driven in part by construction closer to the wildland-urban interface (WUI).

The 2020 wildfire season so far has offered no relief, with CAL FIRE reporting over 4 million acres burned calendar year to date, more than the two prior calendar years combined.² Wildfires are having a devastating impact on both property owners and the homeowners property and casualty (P&C) industry, with losses of \$37 billion outstripping premiums of \$32 billion since 2016.³

Insurance companies are trying to manage their accumulation risk—that is, the risk of a single event like a wildfire destroying multiple properties. Unlike insuring typical claims that only impact one property at a time, such as a kitchen fire or a theft, accumulation risk is more costly for insurers to manage because it requires that sufficient liquid surplus be available in order to pay for multiple large losses resulting from a wildfire.

Managing accumulation risk is like diversifying an investment portfolio; insuring a portfolio of properties exposed to wildfire risk is like putting all investments into stocks subject to the same risk at once and letting it ride.

As a result, insurance companies often use reinsurance to help manage exposure to catastrophes. Catastrophe reinsurance allows insurance companies to spread the risk of a catastrophic event across multiple reinsurers with global portfolios of risks.

California insurance regulation does not allow the net cost of reinsurance to protect against wildfire catastrophes to be included in admitted insurance rates, so insurance companies have been absorbing this cost. Unfortunately, the recent wave of severe California wildfires has increased reinsurance costs. Faced with the inability to obtain adequate rates to cover all costs of insuring wildfire-exposed properties, many insurance companies have been implementing more restrictive underwriting eligibility guidelines with respect to wildfire exposure, and declining to insure wildfire-exposed properties. The recognition of accumulation risk and catastrophic wildfire exposure by insurance companies and reinsurers has pushed more policyholders into secondary markets, such as non-admitted (also called surplus lines) markets and the California Fair Access to Insurance Requirements (FAIR) Plan.

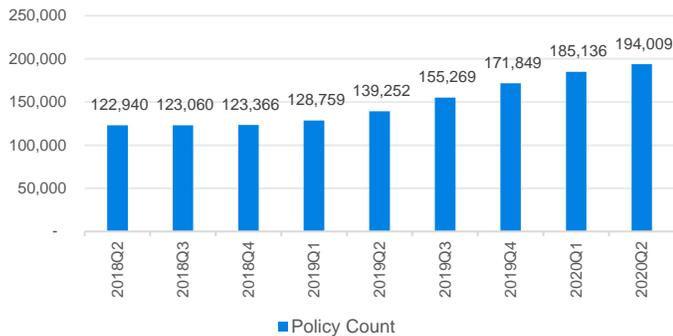
¹ Data pulled October 11, 2020, valued at October 7, 2020, and includes California fires of 10 or more acres from CAL FIRE. See <https://www.fire.ca.gov/incidents/>.

² See <https://www.fire.ca.gov/incidents/>.

³ NAIC Annual Statement, Statutory State Page, Line 4 Homeowners, Direct Incurred Losses and Direct Earned Premium, from S&P Global as of September 28, 2020, for calendar years 2015 to 2019.

According to the Surplus Line Association of California, the number of policies moving into surplus lines rose by 62% between 2014 and 2019,⁴ and the FAIR Plan's policy count has steadily increased since 2018, as depicted in Figure 2.

FIGURE 2: CALIFORNIA FAIR PLAN POLICY COUNT GROWTH



The California FAIR Plan is designed to accept properties that have difficulty finding insurance in the market and does not decline risks due to wildfire exposure. As detailed in its recent dwelling fire rate filings, the FAIR Plan's number of insured properties in low wildfire risk areas has remained flat, whereas the number of wildfire-exposed properties has doubled in the past year. Not only has the count of properties in wildfire areas increased, but the average insured value of properties in wildfire-exposed areas also increased.⁵ In summary, the FAIR Plan footprint across the state has significantly shifted toward moderate to highly exposed wildfire areas.

Case study

This white paper explores the evolution of wildfire exposure measurement tools used by insurance companies and reinsurers to identify and price wildfire risk, the impact on insurance availability in the voluntary market, and how updating ratemaking regulations could improve availability.

TRADITIONAL TECHNIQUES

To calculate the overall rate needed to cover wildfire exposure, the California Department of Insurance (CDI) Rate Template uses 20 years of historical wildfire loss experience as a percentage of non-catastrophe loss experience. Using a historical ratio of catastrophe losses to non-catastrophe losses to calculate the rate needed for the future exposure is a traditional ratemaking technique. As explained in the background section of the Actuarial Standard of Practice (ASOP) 39, Treatment of Catastrophe Losses in Property and Casualty Insurance

Ratemaking, "in the late 1980s and early 1990s ... it became evident that adjustments to historical ratemaking procedures were necessary." These adjustments were needed to address "population shifts, non-adherence to building codes, and exposure concentration," and to include a rate load for infrequent large "catastrophes that had not been contemplated previously, such as the World Trade Center bombing and the Oakland Hills fires."⁶

If the ratio of wildfire to non-wildfire losses is decreasing, the traditional method can overstate the rate. For example, if an insurance company stops writing wildfire-exposed properties, its ratio of wildfire to non-wildfire losses may decrease. Applying the higher historical ratio to calculate future rates, without adjustment, may overstate the rate for next year's insurance. Conversely, if an insurance company's ratio of wildfire to non-wildfire exposure is increasing, as in the case of the FAIR Plan, using the CDI Rate Template methodology to calculate wildfire rate level, without adjusting for the increasing wildfire exposure, may understate the needed rate. Not only is the insurance company ratio of wildfire to non-catastrophe changing, but the ratio for the industry as a whole has also been increasing due to climate change and property construction closer to the WUI.

Further compounding the issue, the traditional method ignores the impact of individual property characteristics changing over time, including surrounding vegetation, property hardening, and other initiatives impacting property exposure. The evolution of wildfire exposure at the macro and micro levels makes it difficult for insurance companies and the CDI to evaluate wildfire exposure using the outdated CDI Rate Template methodology.

Because of these limitations, the insurance industry has shifted toward more advanced science to calculate insurance rates that forgo using insurance company historical loss experience.

Modern ratemaking techniques generally involve a catastrophe model that estimates average annual loss (AAL) or a wildfire risk score (WRS) for each property. Probabilistic catastrophe models calculate AAL by applying a catalog of simulated events, created from many years of historical data, to a portfolio of properties.

The insurance industry has adopted catastrophe models because they use modern science and the most up-to-date data about the exposure, overcoming the limitations of using the aggregated historical loss experience discussed above. In fact, ASOP 39 suggests using a catastrophe model if "the available historical insurance data do not sufficiently represent the exposure to catastrophe losses." Consistent with ASOP and industry practice, this study uses AAL as expected wildfire loss.⁷

⁴ Ted Bunker (March 4, 2019). Surplus lines biz booms in California as insurers think twice after wildfires. S&P Global. Surplus lines is synonymous with involuntary.

⁵ FAIR Plan California rate filings 19-4339 and 20-2965.

⁶ Actuarial Standards of Practice (ASOP) No. 39. "Treatment of Catastrophe Losses in Property/Casualty Insurance Ratemaking." Adopted June 2000. Retrieved November 4, 2020, from http://www.actuarialstandardsboard.org/wp-content/uploads/2014/02/asop039_156.pdf.

⁷ AAL from a leading industry catastrophe model unrelated to HazardHub.

WILDFIRE EXPOSURE MEASUREMENT TOOLS

With the growing recognition of wildfire exposure and the need to manage it, there has been a rapid evolution in the tools used to measure wildfire exposure. Many companies have started using property-level WRS tools for underwriting eligibility and rating. A WRS considers characteristics about a property and its surrounding area to provide a risk score for each property. Initial WRSs considered the following characteristics about the property.

1. Fuel: Grass, trees, dense brush, and vegetation feed wildfires.
2. Slope: Steeper slopes increase the speed of wildfire and affect reconstruction costs.
3. Access: Dead-end roads impede firefighting equipment.

As WRSs evolved, they incorporated additional information about the property, like how close it is to fuel and the type of fuel. For example, a new entrant to the market discloses that its model considers the following characteristics:⁸

1. Base WRS: Based on the amount of fuel and distance to the WUI.
2. Fire season precipitation: Dry areas increase wildfires.
3. Distance to nearest high base WRS: Embers can travel great distances and start new fires.
4. Vegetation burn points: Satellite imagery identifies burn points, typically caused by lightning strikes.
5. Katabatic winds: Downward high-density winds, such as the Santa Ana winds, can exacerbate wildfires.
6. Historical wildfire perimeters: Areas that have experienced multiple wildfires are more prone to wildfires, because undergrowth grows back and is exposed to more sunlight in the absence of trees that were destroyed in past wildfires.

PORTFOLIO OF PROPERTIES

There are several WRS models, sold by vendors or internally developed by (re)insurance companies. The FAIR Plan's portfolio of properties is uniquely suitable for evaluating a wildfire model and wildfire exposure because it:

- Is both diverse in high and low value properties
- Has both residential homes and commercial properties
- Has properties with varying levels of wildfire exposure from the recent influx of properties from the voluntary market

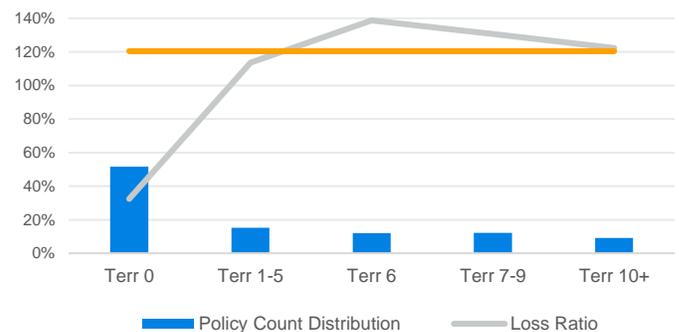
The remainder of this paper examines how FAIR Plan properties were used to evaluate a WRS model and how WRS models are being used to enhance current risk stratification methods.

RESIDENTIAL PROPERTIES

FAIR Plan residential properties were sorted in order of FAIR Plan wildfire territory, and then grouped into five groups of increasing wildfire exposure territory.⁹ Group 1 contains the lowest wildfire exposure territory that couldn't be further segmented, while Group 5 represents properties in territories currently defined as having the highest wildfire risk.

Figure 3 summarizes the distribution of properties and loss ratio for each territory group. The loss ratio for a territory group was calculated as the sum of each property AAL in the territory group, divided by the on-level in-force premium for each property in the territory group. The orange line is the average loss ratio across all territory groups combined, which is 120%. This means that on average, over many years, for every \$100 in premium collected, \$120 will be paid out in losses.

FIGURE 3: WILDFIRE LOSS RATIO



As illustrated in Figure 3, properties in the first two territory groups have a loss ratio that is better than all groups combined. Territories 6 and above have loss ratios between 120% and 140%. The area between the orange line and the gray line represents the cross-subsidization that is occurring. For territories 0 to 5, the area below the orange line, down to the gray line, represents the subsidization that properties in these territories are providing to properties in territories 6+. The amount that each of the territories 6+ are obtaining in subsidy is the area above the orange line to the gray line.

⁸ As per model documentation material received from HazardHub's CEO Bob Frady.

⁹ Dwelling fire policies in force on June 30, 2019, and commercial policies in force on December 31, 2019, were rerated using current on-level rates. Dwelling fire premium included application of the FAIR Plan wildfire territory factor. FAIR Plan commercial rates do not have wildfire territories or factors.

FAIR Plan could reduce cross-subsidization by reducing rates in territories 0 to 5 and increasing rates in territories 6+. However, because of the large number of policies in territory 0, a small decrease to territory 0 rates requires a larger increase to territories 6+ to avoid increasing the overall program loss ratio, which is already above 120%.

USING A WRS MODEL TO FURTHER STRATIFY RISK

To see whether the FAIR Plan could use a WRS model and additional characteristics about each individual property to segment wildfire exposure with more granularity, we used a new entrant into the market, HazardHub, to calculate the WRS on each FAIR Plan property. HazardHub was chosen for this analysis because of the additional geospatial and property-level characteristics available in its WRS model. However, the work was performed independently, and not commissioned by HazardHub or any other company. Further, we intend to complete additional analyses using other WRS models in the future.

To perform the analysis, FAIR Plan properties were sorted into five groups of increasing WRSs. Figure 4 illustrates the distribution of properties across current FAIR Plan territory and WRS groups.

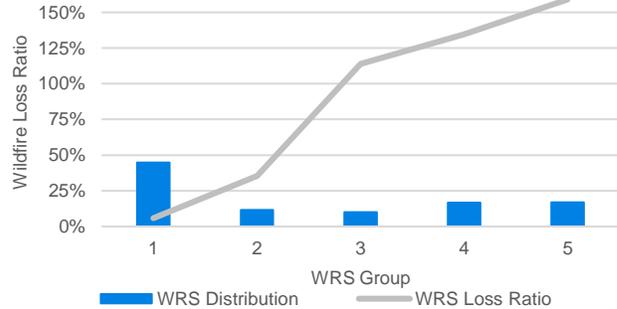
FIGURE 4: DISTRIBUTION BY WILDFIRE RISK SCORE GROUP

		HazardHub WRS Group					Total
		1	2	3	4	5	
Current Wildfire Territory Group	Terr 0	43.7%	5.5%	1.5%	0.6%	0.3%	51.5%
	Terr 1-5	0.8%	2.7%	3.4%	3.9%	4.3%	15.1%
	Terr 6	0.1%	1.2%	2.3%	4.8%	3.5%	12.0%
	Terr 7-9	0.1%	1.3%	1.8%	4.7%	4.3%	12.1%
	Terr 10+	0.1%	0.9%	1.0%	2.8%	4.4%	9.2%
	Total	44.8%	11.5%	10.0%	16.8%	16.9%	100.0%

As illustrated in Figure 4, FAIR Plan’s current rate plan assigned 51.5% of properties to its lowest-risk territory. The HazardHub WRS assigned 44.8% of properties to its lowest-risk territory group 1. The diagonal of the above matrix represents 57.9% of properties, where both the current rate plan and HazardHub WRS classified the wildfire risk similarly. Above the diagonal represents 32.0% of properties, where the WRS classified them as higher-risk than the current rate plan. Below the diagonal represents 10.1% of properties, where the WRS classified them as lower-risk than the current rate plan.

The loss ratio in each of the WRS groups was then calculated, illustrated in Figure 5.

FIGURE 5: WILDFIRE LOSS RATIO

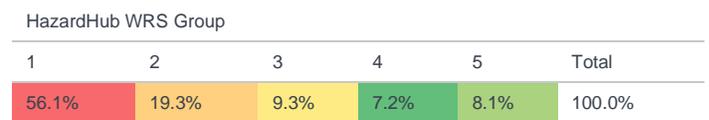


The chart in Figure 5 is called a lift chart, where the upward slope of the loss ratio line measures how well the model is identifying relative risk above and beyond the current rate plan.

COMMERCIAL PROPERTIES

The same process as described above was applied to the FAIR Plan’s commercial properties. Figure 6 illustrates the distribution of commercial properties into WRS groups. Because the FAIR Plan does not currently use wildfire territories to rate commercial properties, the distribution can only be provided by WRS group.

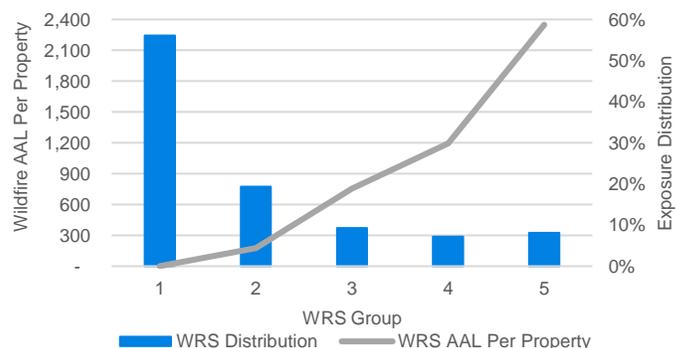
FIGURE 6: DISTRIBUTION BY WILDFIRE RISK SCORE GROUP



Similar to dwelling fire properties, commercial properties are heavily concentrated in the lowest WRS group 1, which cannot be further segmented.

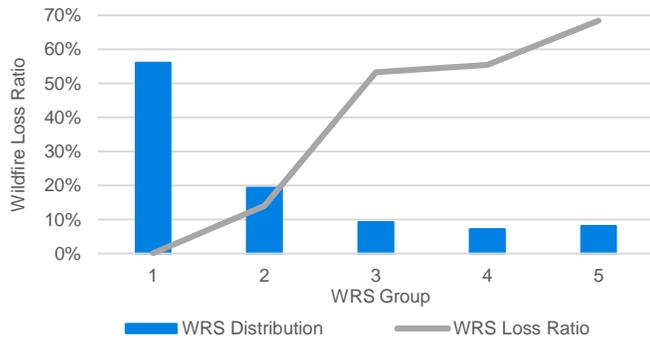
Figure 7 summarizes AAL per property by WRS group.

FIGURE 7: WILDFIRE AAL PER PROPERTY



The continuously increasing AAL per property indicates that the WRS is segmenting the properties into increasing wildfire exposure, using AAL as the measurement of risk. Figure 8 illustrates how WRS segments the risk using expected loss ratio as the measurement of risk.

FIGURE 8: WILDFIRE LOSS RATIO



The increasing WRS loss ratio and steep slope measures how the model is segmenting risk above the current rate plan.

Summary

The WRS further segments both the FAIR Plan dwelling fire and commercial books of business beyond the current rate plan, as illustrated in the above distributional tables and lift charts. Insurance companies and reinsurance companies have been using WRS to better match rate to risk, manage escalating reinsurance costs, and control accumulation risk.

REGULATION OF MODELS

For an admitted insurance company to introduce a WRS, it must seek prior approval from the CDI. To validate a WRS model and support how an insurance company proposes to use it, an insurance company can use a lift chart, such as the ones presented above. There are other model validation techniques, such as a Lorenz curve or Mean Square Error approach. Each of these methods requires the use of a target variable, and in the above charts we used AAL or AAL as a percentage of premium (loss ratio). The CDI has approved the use of catastrophe AAL as we did above to support the use of a WRS to segment risk and calculate wildfire territory rating factors. However, to calculate the overall wildfire exposure and rate need, the CDI Rate Template requires the use of insurance company historical wildfire loss experience rather than the more broadly accepted method of using catastrophe model AAL. Updating the CDI Rate Template to facilitate the use of catastrophe models and other modern ratemaking techniques, in accordance with ASOP 39 and industry practice, could help insurance companies better reflect and regulators better assess wildfire risk. It would likely also reduce the indicated rate increase immediately after several years of large wildfire losses.

REGULATION OF INSURANCE RATES

Further compounding the issue, California insurance regulation does not allow the net cost of reinsurance to protect against wildfire catastrophes to be included in admitted insurance rates. California Insurance Code Section 2644.25, Reinsurance, allows insurance companies to include the net cost of reinsurance for earthquakes, but not for wildfires.

Although admitted insurance companies must seek approval to support their rates prior to implementing a WRS, reinsurers are not subject to the same requirements. As the number of WRS models available to reinsurance companies expands, their ability to reflect the risk of wildfire exposure in the reinsurance rates charged to insurance companies is improved. An alternative to reinsurance is to hold more capital to be available in the event of a catastrophic loss. However, the inability of insurance companies to recover the cost of reinsurance or the higher cost of capital required to protect against a catastrophic wildfire event is creating a market crisis.

Updating the Insurance Code to recognize that a wildfire is a catastrophe, and updating the CDI Rate Template to allow the net cost of reinsurance so insurance companies can recover the cost for concentrations of risk, or an additional cost of capital to recognize the riskier wildfire exposure, could improve availability in the admitted market.

MODEL CONFIDENTIALITY

Another hurdle when seeking approval of a WRS model from a regulator is the ability to retain confidentiality of intellectual property (IP). Because many WRS and catastrophe model vendors have spent years developing their models, and consider the inner workings of the models IP, it is necessary for California regulators to find a way to allow insurance companies and model vendors to submit IP confidentially in a way that restricts access to only the regulator and those that have a license to access this IP.

REGULATORY MODERNIZATION

It is not just an update to the California ratemaking regulations that could help regulators address wildfire risk. The National Association of Insurance Commissioners (NAIC) Risk Based Capital (RBC) model assigns a catastrophe risk charge for exposure to hurricanes and earthquakes, but not for exposure to wildfires. Incorporating a charge for wildfire exposure, and an offset for wildfire risk ceded via reinsurance, would improve the RBC model's ability to assess risk to capital for insurance companies with heavy wildfire exposure. This would also encourage insurance companies to maintain more capital and better position themselves to pay for a large wildfire. This would give regulators a more accurate tool for assessing insurance company solvency risk.

However, requiring insurance companies to retain higher capital, without the ability to obtain sufficient return on this exposed capital in California, will only worsen the trend of insurance companies declining to renew insurance on wildfire-exposed properties.

Modernizing insurance ratemaking and regulatory oversight tools would promote a more efficient and stable insurance market, increase availability in the voluntary market, and reduce the flow of wildfire-exposed properties to the surplus lines markets.



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