KBRA KROLL BOND RATING AGENCY

Burning Season: An Examination of U.S. Drought and Wildfire Risk

The Pacific Northwest is grappling with one of its worst wildfire seasons as fires—exacerbated by drought, extreme temperatures, and high winds—continue to rage across the region. California alone has seen over 8,136 fires ravage 3.75 million acres so far this year. This compares with 7,860 fires that destroyed 259,823 acres across the state in 2019.[1] The 2020 wildfire season is notable not only for its widespread devastation or its timing during a pandemic, but also because some events are occurring in habitats that are not typically affected, such as across Joshua tree and Redwood forests in California. Climate experts warn that as climate change worsens, drought seasons are likely to grow longer, and wildfires more frequent, across some regions of the United States.[2]

In this research report, Kroll Bond Rating Agency (KBRA) examines the relationship between drought and wildfire risk in the U.S., the cost of these types of natural disasters, and their implications (credit-related and otherwise) for state, local, and federal governments.

Key Takeaways

- Wildfire and drought risk are on the rise in certain regions, particularly in the western U.S., as the impact of climate change becomes more severe.
- KBRA believes the economic ramifications of rising climate change risks will become increasingly material to credit quality in high-risk areas.
- We believe wildfire and drought risk have the potential to significantly undermine economic activity over the longer term, affecting population migration patterns, hindering access to essential services such as power, and limiting insurance capacity, among other concerns. The fires in California alone this year are estimated to have reduced U.S. GDP by an annualized 0.7 percentage points in the third quarter.[3]
- As environmental risks increase due to climate change, states and local governments that incorporate environmental risks such as wildfire and drought into their strategies and management processes will be viewed positively by KBRA.

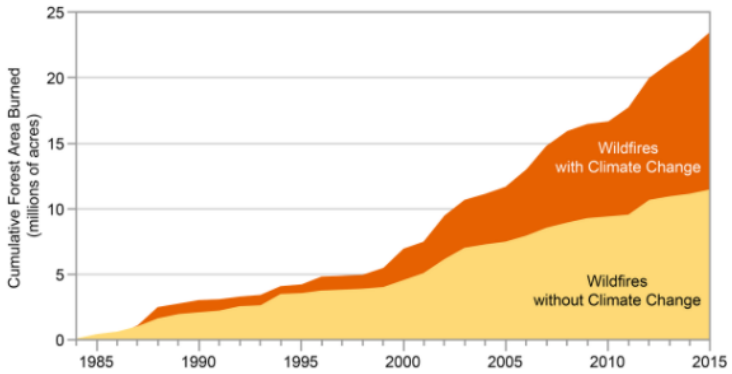
The Relationship Between Drought and Wildfire Risk

There are four types of drought which often occur in stages: meteorological, hydrological, agricultural, and socioeconomic. The first stage is meteorological drought, whereby abnormally dry weather persists in an area for a period of time. The second stage, hydrological drought, occurs when drought conditions begin to reduce a region's available water supply. The third stage in the drought transition cycle is agricultural drought, whereby the lack of water affects crops. The fourth stage is socioeconomic drought, in which supply and demand are affected by the water deficit. Unlike other extreme weather events like hurricanes or wildfires, the time horizon for droughts is less defined and often unfolds slowly, affecting many areas of the economy at once.[4]

[1] https://www.fire.ca.gov/incidents
[2] https://climate.nasa.gov/effects/
[3] https://www.bloomberg.com/news/articles/2020-10-01/counting-the-cost-of-wilfires-on-u-s-economics-growth-chart?sref=E8oVpDS3
[4] https://www.ncdc.noaa.gov/monitoring-references/dyk/drought-definition

Climate change's direct impact on the dynamics of drought is uncertain. It is unclear how increases in temperature will affect precipitation patterns and humidity levels, but as temperatures continue to increase globally, droughts are projected to become more frequent in certain regions. NASA estimates that the occurrence of extreme heat days—a period of high heat and humidity with temperatures above 90 degrees for at least two to three days—which historically take place once every 20 years in the U.S., will increase to about once every two to three years by the end of the 21st century. Increases in temperature and extreme heat days will likely reduce soil moisture, thereby increasing drought risk in some areas. The western U.S. is particularly at risk for increased intensity of drought and heat waves.[5]

Figure 1: Relationship Between Climate Change and Wildfire



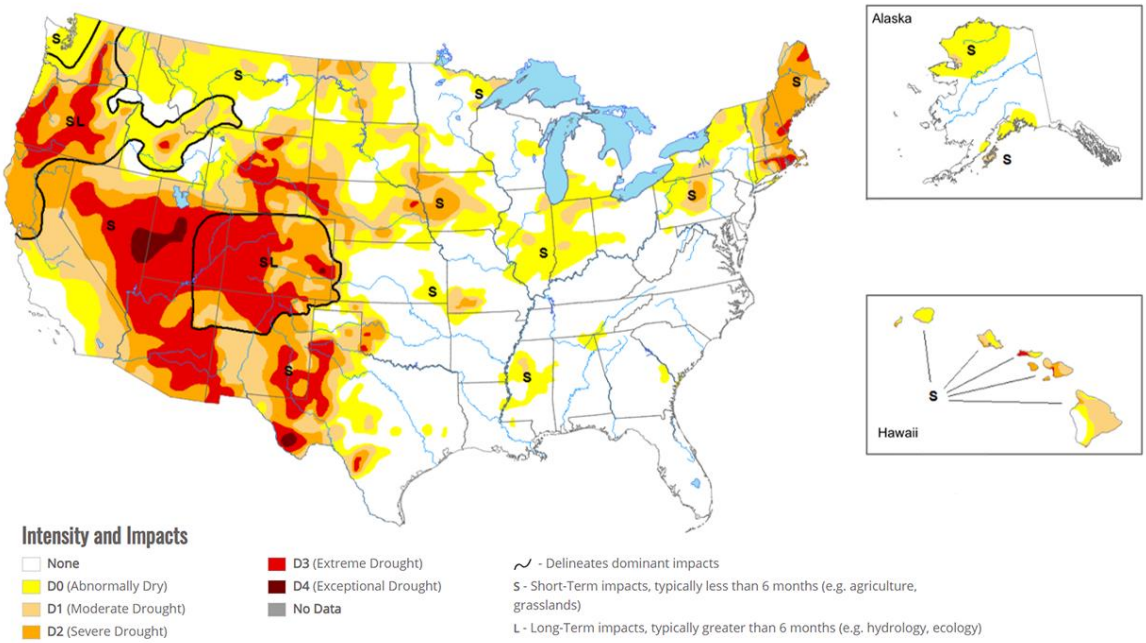
Source: U.S. Global Change Research Program

During a drought, both living and dead plant species (often referred to as "fuel") become drier and more flammable, which increases the risk of wildfire and its spread. Drought length does affect the risk of fire, but a period of about 30 days is usually sufficient time to dry out plant species, which does increase the risk. Climate change is not only increasing the probability of drought, it also increases the likelihood of other stressors like forest productivity and insects that also drive the risk of wildfire. For example, in the western U.S., increased outbreaks of the bark beetle species, which cause tree mortality, are being accelerated due to temperature rise and drought, providing increased fuel for wildfire spread.[6]

Figure 2 shows the U.S. regions that are experiencing abnormally dry or drought conditions, with darker colors denoting increased risk. Figure 3 shows the active large fires in the U.S. The maps clearly show that areas currently experiencing wildfires also face dry or drought conditions.

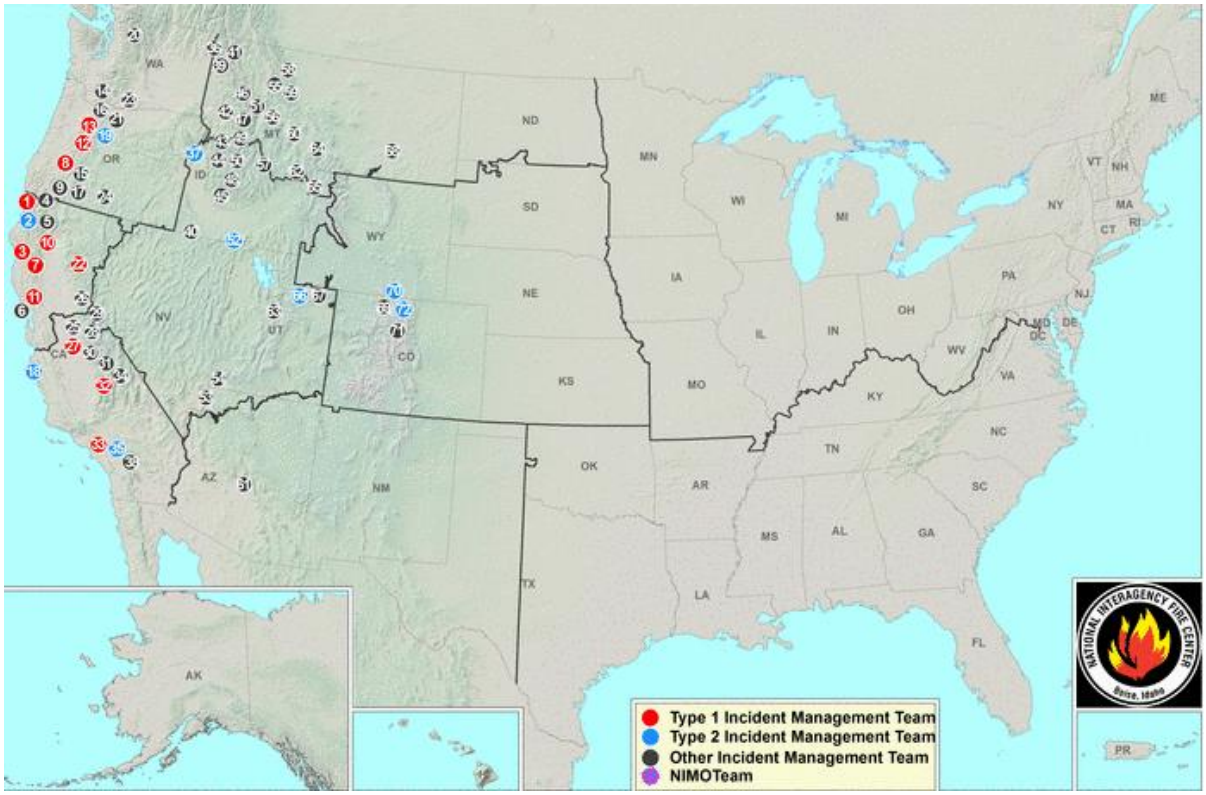
[5] https://climate.nasa.gov/effects/
[6] https://www.fs.fed.us/rm/pubs_journals/2016/rmrs_2016_littell_j001.pdf

Figure 2: U.S. Drought Monitor Map



Source: The National Drought Mitigation Center, University of Nebraska Lincoln

Figure 3: U.S. Large Active Wildfires Map[7]



Source: National Interagency Fire Center

[7] This map shows current large fire incidents in the U.S. The color denotes the type of incident management team assigned to suppression efforts. Type 1 management teams have the most training and expertise and are generally sent to more extreme fire outbreaks.

The dynamics of wildfires vary across the country. In the western U.S., fire incidents typically occur on federal land, in contrast to wildfires in the eastern U.S. State governments are responsible for wildfires that start on nonfederal land, while the federal government is responsible for funding wildfire suppression and other efforts on federal lands. While there are more wildfire incidents in the East, wildfires in the West are generally more widespread and severe, with more acreage destroyed. In 2019, 29,600 fires destroyed approximately 600,000 acres in the East, while 21,000 wildfires ravaged about 4.1 million acres in the West.[8]

Costs and Impacts of Drought and Wildfire

On their own, droughts do not often directly damage physical assets such as homes, businesses, or infrastructure, which differentiates them from other disaster events like wildfires. However, similar to wildfires, droughts can cause significant economic damage. Droughts directly impact industries that rely on water as a key input, especially the agricultural sector.[9] Drought-induced crop damage often negatively affects crop yields, thereby impacting agriculture revenues and potentially increasing food prices. The key factors impacting the extent of drought-induced economic damage are the length and severity of the specific event.

Analysis from the National Integrated Drought Information System (NIDIS) found that the U.S. experienced 25 droughts between 1980 and 2019, accounting for $9.5 billion, on average, in damages per event (see Figure 4). Over the nearly 40-year period, drought damage was valued at over $236 billion, mainly throughout the Southern and Great Plains, where agriculture and livestock assets are concentrated. Although the U.S. experienced 219 billion-dollar disaster events during this period, 69 (31.5%) of those events occurred between 2015 and 2019 and accounted for 34.6% ($531.7 billion) of total losses. This is a troublesome trend and suggests that the frequency and severity of these large disasters is accelerating.

Figure 4: Total Cost of Billion-Dollar Disaster Events in the U.S., 1980-2019

Disaster Type	Number of Events	CPI-Adjusted Losses (Billions)	Percent of Total Losses	Average Event Cost
All Disasters	219	$1,537.40	100%	$7.00
Tropical Cyclone	38	$850.50	55.30%	$22.40
Drought	25	$236.60	15.40%	$9.50
Severe Storm	91	$206.10	13.40%	$2.30
Flooding	28	$119.90	7.80%	$4.30
Wildfire	15	$53.60	3.50%	$3.60
Winter Storm	14	$43.10	2.80%	$3.10
Freeze	8	$27.60	1.80%	$3.50

Source: NIDIS

In contrast, wildfires do not typically cause direct damage to physical assets. Further, wildfires' direct costs are generally easy to quantify and typically occur during or immediately following the fire event. This includes suppression costs incurred by local, state, and federal governments; private and public property damage, including damage to utility lines; evacuation efforts; and aid to residents. There can also be certain rehabilitation costs associated with the event that are usually borne by governments. Among these are damage from flooding and erosion, as well as increased invasive species activity. Wildfires also include indirect and intangible costs, which are much harder to quantify and can extend long after the initial event. This category includes lost tax revenue, costs to public health including decreases in air quality, ecosystem loss, and loss of civilian life. Additional costs may

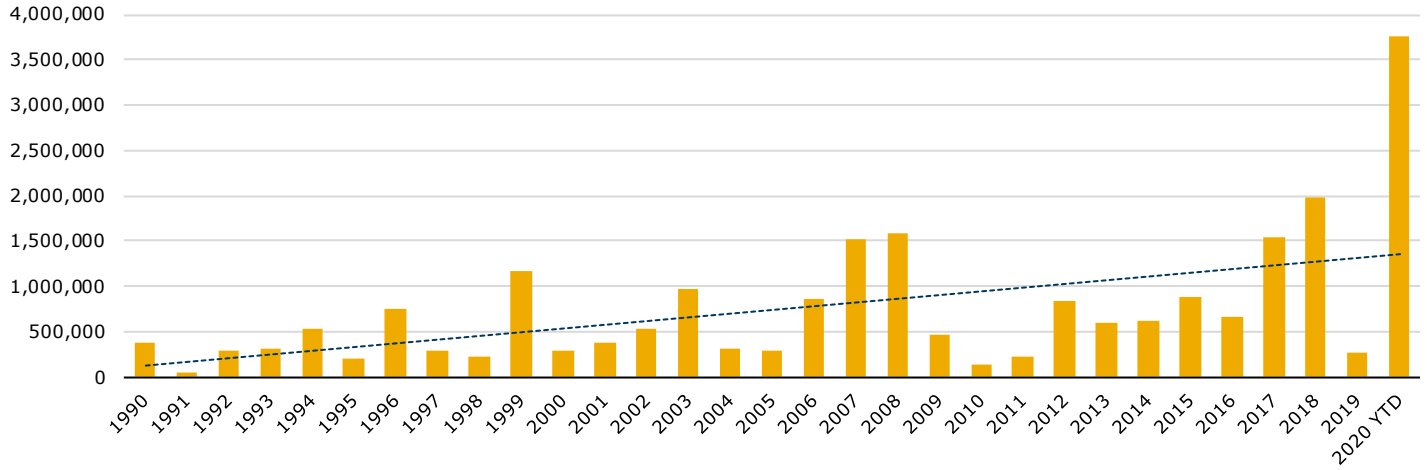
[8] https://www.blm.gov/or/districts/roseburg/plans/collab_forestry/files/TrueCostOfWilfire.pdf
[9] https://ora.ox.ac.uk/objects/uuid:b9a0431d-7069-422e-a4de-e3b8a7cbcdb1/download_file?safe_filename=ECOLEC_2016_884.pdf&file_format=application%2Fpdf&type_of_work=Journal+article

include population migration away from risk-prone areas, resulting in falling property values. Wildfires can also drive up insurance costs, with some homes in wildfire-prone areas becoming commercially uninsurable.

California Wildfires: A Case Study

California's rising population has led to more people living in and along the wildland-urban interface (WUI), the area between cities and undeveloped lands and forests, which is especially at risk for wildfire. Over 25% of California's population lives in the WUI, putting them and their homes at risk for wildfire.[10] Estimates from 2018 show that over 3.7 million homes (27% of total homes) in California were at either high/extreme risk (15%) or moderate risk of wildfire (12%).[11] The combination of increasingly dry conditions, extreme heat, and high winds has often led to deadly fire seasons in late summer and early fall. Climate change is increasing the likelihood of more extreme fire seasons in the state (see Figure 5).

Figure 5: Annual Total Acreage Burned in California



Source: California Department of Forestry and Fire Protection (CAL FIRE)

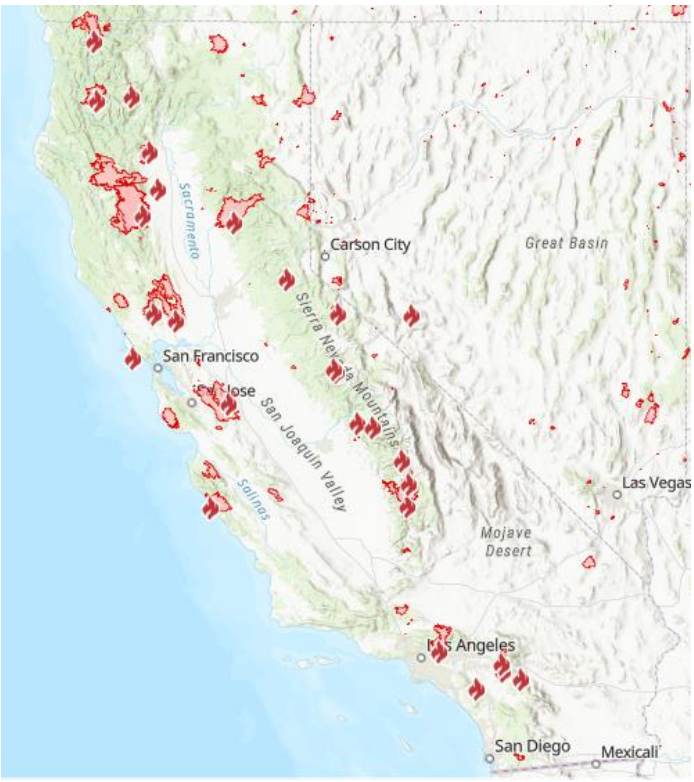
In 2018, California's Camp Fire was the deadliest and most damaging wildfire in the state's history, resulting in the destruction of 153,336 acres over 17 days.[12] The fire was caused by faulty electrical lines owned and operated by utility PG&E and exacerbated by dry conditions and high winds. Paradise, a town in Northern California, was hit especially hard, with much of the location destroyed. Investigations after the fire showed ignored warnings by officials and flaws in Paradise's evacuation plans.[13] A 2005 state fire management report warned that Paradise was especially at risk for wildfire and spread: "Heavy fuel loads, steep terrain, poor access, and light flashy fuels create severe fire hazards. The increased population in this area creates a high potential for catastrophic life and property loss."[14] One of the biggest issues with Paradise's evacuation plan was that it relied on text message warnings to alert residents and, during the Camp Fire, damage to cell towers eventually shut down cell service entirely throughout the town. Paradise officials set up 14 evacuation zones in the town and evacuations were to begin zone by zone so that traffic would allow people to leave quickly; they did not have a plan for citizens to evacuate the city all at once. During the Camp Fire evacuations, of the 14 total zones, three zones received only warnings instead of mandatory leave orders and three zones did not receive any warnings at all. Also, only 30% of residents were signed up for the

[10] https://lcau.mit.edu/project/cataloguing-interface-wildfire-and-urban-development-california
[11] https://www.naic.org/cipr_newsletter_archive/vol24_wildfire.pdf
[12] https://www.fire.ca.gov/incidents/2018/11/8/camp-fire/
[13] https://www.latimes.com/local/california/la-me-camp-fire-deathtrap-20181230-story.html
[14] https://www.latimes.com/local/california/la-me-camp-fire-deathtrap-20181230-story.html

service.[15] The confusion caused huge traffic jams in the city as people tried to flee. Stand-still traffic began just an hour after the initial sightings of wildfire in the town. Although these investigations have the benefit of hindsight, their findings do provide a useful tool for outlining best practices for managing and mitigating wildfire risk.

In mid-August 2020, lightning strikes ignited fires across Northern California, exacerbated by dry conditions and high winds. The state would later declare a state of emergency. As climate change intensifies, fire seasons in California and other drought-prone areas of the west are likely to become more extreme and deadlier. Between January 2019 and August 2019, California experienced 3,673 fires that burned 29,960 acres. During the same period this year, 5,924 fires have burned 1,059,583 acres.[16] Figure 6 shows the current map of active fires at the time of publishing.

Figure 6: Current Active Fire Incidents in California



Source: CAL Fire

Policy and Credit Implications

As climate change continues to drive temperature rise and increased drought risk across much of the U.S., the risk of wildfire and increased wildfire severity will continue to grow. This heightened risk has vast implications for state and local governments as well as the federal government, who are largely responsible for the economic damage wrought by these natural disasters. KBRA expects that states and counties located in zones experiencing dry and drought conditions with increased wildfire risk have developed or are developing a framework to plan for wildfire outbreaks. States and localities in the northwest U.S. that have historically been vulnerable to wildfires should have adopted or be actively considering wildfire evacuation plans. KBRA positively views management teams who engage directly with their residents to ensure they understand the importance of evacuation orders and how to receive them, as well as the location of shelters and evacuation routes. Local planning is essential in jurisdictions

[15] https://www.latimes.com/local/california/la-me-camp-fire-deathtrap-20181230-story.html
[16] https://www.fire.ca.gov/stats-events/

with increased wildfire risk, while coordination with other localities, states, and the federal government is a key part of evacuation planning efforts.

Notably, while wildfire risks continue to increase, suppression costs are also on the rise as a proportion of the U.S. Forest Service (USFS) budget, which implies that less money is being invested on risk mitigation efforts. In 2000, 25% of the USFS budget was allocated toward wildfire suppression efforts,[17] and in 2017, this number was estimated to be about 55%.[18] The Bureau of Land Management emphasizes that government efforts, whether state, local, or federal, need to be refocused on risk mitigation efforts such as forest management with the specific goal of fire prevention.

As environmental risks increase due to climate change, states and local governments that are incorporating risks such as wildfire and drought into their strategies and management processes will be viewed positively by KBRA. Natural disasters such as drought and wildfire are likely to affect state and municipal resource bases, which in turn affects revenue. For example, after Hurricane Katrina in 2005, the labor force fell 20% in New Orleans and its current population rate is still 20% below the 2005 level.[19] Broadly speaking, states and municipalities that are not taking preventative measures to reduce the impact of climate change risks are more likely to experience knock-on credit pressures due to climate events.

Conclusion

Wildfire and drought risk are environmental factors that can be relevant to an issuer's credit profile, especially in areas that are highly exposed to these risks. In our view, many governments have become more focused on climate change and increased the level of awareness and constituent engagement on the subject. Risk management related to environmental factors is a consideration in any credit analysis. While multiple solutions will be needed, and efforts vary by state and locality, proactive risk mitigation efforts are generally constructive to an issuer's credit profile. Government administrations that address environmental risks and allocate resources with climate change in mind can preserve, and potentially enhance, their state or jurisdiction's long-term economic health.

[17] https://www.blm.gov/or/districts/roseburg/plans/collab_forestry/files/TrueCostOfWilfire.pdf
[18] https://www.usda.gov/media/press-releases/2017/09/14/forest-service-wildland-fire-suppression-costs-exceed-2-billion
[19] https://www.breckinridge.com/insights/details/municipal-implications-of-the-california-wildfires/

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