energysafe VICTORIA

Creating a safer state with electricity and gas

End of Fire Season Summary

June 2018

VICTORIA State Government

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1. Introduction

1.1 Background to the report

ESV prepares weekly reports during the fire season that detail the cumulative and rolling fire incidents on Victoria's electricity networks, and the progress of the network operators in undertaking fire prevention activities across the networks.

This summary report provides a context for the 2017-2018 fire season (1 October 2017 to 30 April 2018) compared to previous years, and a more detailed and holistic view of the fires that occurred throughout the season.

1.2 Context to the fire danger period

Under Section 80 of the *Electricity Safety Act 1998*, the Country Fire Authority (CFA) is responsible for assigning fire hazard ratings for those areas where the CFA is the responsible fire control authority.

Rural areas are defined as hazardous bushfire risk area (HBRA) by default, unless otherwise defined as low bushfire risk area (LBRA) by the CFA. The CFA periodically reviews and assigns areas as being LBRA based on prevailing environmental conditions and land use.

The fire hazard ratings are used to prescribe LBRA and HBRA for the purpose of the:

- Electricity Safety (Electric Line Clearance) Regulations 2015
- Electricity Safety (Bushfire Mitigation) Regulations 2013.

These regulations place particular obligations on the MECs (and other regulated entities) to ensure they appropriately mitigate safety risks, including the risk of fire from trees growing too close to electric lines and poor maintenance of electricity assets.

Management of these risks is particularly important in HBRA, which is more prone to the threat of bushfire: even more so when the CFA has declared a fire danger period for the area.

The CFA declares the fire danger period for each shire or municipality in Victoria in the lead-up to the fire season. The timing of the declaration locally depends on the amount of rain, grassland curing rate and other local conditions.

The fire danger period may be declared as early as October in some municipalities, and typically remains in place until the fire danger lessens, which could be as late as May (see section 2).

The MECs manage their electricity safety risks during a declared fire danger period through their electric line clearance and bushfire mitigation management plans.

In preparation for the fire season and throughout the declared fire danger period, the MECs must meet and maintain specific targets as described in their electric line clearance and bushfire mitigation management plans. ESV requires that the MECs provide data weekly on their progress against these targets; the weekly fire start report is informed by this data.

2. CFA declarations

Given that the CFA issues fire declarations for municipalities when ground conditions are curing to a level that they can support grassfires and bushfires, we can use the declarations as an indicator of fire risk. This allows us to compare interannual risks and place the 2017-2018 fire season within a historic context.

Figure 1 shows the percentage of municipalities declared for the current year (bold orange line) against the historical average of fire seasons from 1995-1996 to 2016-2017 (bold blue dotted line).

While this year's season started slightly behind the average, all municipalities were declared five weeks earlier than the average. This season the first week when 90 per cent of municipalities were declared was also five weeks earlier than the average.

Where this season differed from previous years was in the extension of the fire season, with all municipalities still declared eight weeks after removal of declarations had commenced under the average case. The first week when declarations had been removed from 90 per cent of municipalities was three weeks after the average; however, the rate at which municipalities were declared was slower than in previous years. At week 30, the number of declarations still in force was greater than all fire seasons between 1995 and 2017.

In comparison to the previous two fire seasons (2015-2016 and 2016-2017), this year's season ramped up earlier than last year, but much later than the 2015-2016 season. The end of the season is also later than the previous two years; all declarations had been removed by week 30 in both years whereas 77 per cent of municipalities were still under declaration in week 30 this season.

Table 1 provides a statistical profile of declarations for the last three years. Comparing the differences in the profiles, the 2017-2018 fire season has a similar profile to the 2015-2016 season: last year's season shows a much lower relative risk as reflected in the lower levels of declarations. The profile for the 2008-2009 fire season, which resulted in the 2009 bushfires, shows a much higher level of declarations, and hence risk. The declarations for the 2008-2009 fire season (shown as the purple line in Figure 1) ramped up earlier than the current fire season and, similar to this year, ramped down late in the season.

In comparison to historical data from 1995 to 2017, Table 1 also identifies that only four of the 22 years had profiles where the risk (in terms of numbers of declared municipalities) was similar to, or worse than, the current fire season. The 2017-2018 season cannot, therefore, be regarded as an outlier, but it was certainly a higher risk bushfire season than much of the last quarter century.

The 2017-2018 fire season, while it started typically, was extended significantly and reflected a risk that ground conditions remained susceptible to fire events longer than previous years. Of the recent years, it was closer in profile to the 2015-2016 fire season and, as a result, this is the season that should be used for comparative purposes.

Note The 2009 bushfires also occurred after more than 10 years of drought that created extremely dry ground conditions conducive to the spread of fires.

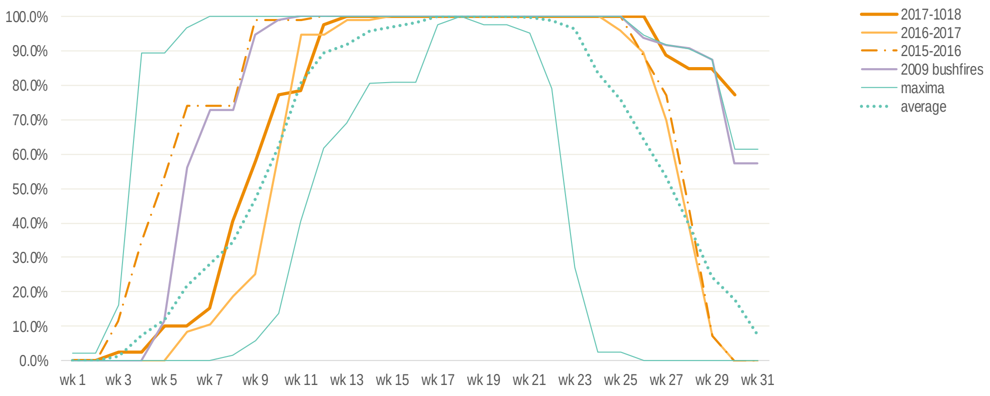

Figure 1 Summary of CFA fire declarations from 1995 to 2018

Blue lines indicate the minimum and maximum percentage of municipalities declared each week (maxima)

Table 1 Comparison of the statistical profile of current fire season and historical records

Threshold	Weeks where declarations equalled or exceeded threshold								Total years where declarations exceeded that of current season
	2008-2009		2015-2016		2016-2017		2017-2018		
100%	15	+1	14	0	10	-4	14		4
90%	20	+5	17	+2	15	0	15		6
80%	21	+3	18	0	16	-2	18		4
70%	23	+2	22	+1	16	-5	21		4
60%	23	+2	22	+1	17	-4	21		6
50%	26	+4	23	+1	18	-4	22		7

The number in orange is the difference from 2017-2018

3. Pre-season preparedness

Nine major electricity companies (MECs) operate in Victoria to meet the electricity needs of industry and the community. They are:

- AusNet Services (Distribution)
- AusNet Services (Transmission)
- Basslink
- CitiPower
- Jemena
- Powercor
- Transmission Operations Australia (TOA)
- Transmission Operations Australia 2 (TOA 2)
- United Energy

Failure to operate their electricity networks to acceptably safe standards exposes the community to safety risks such as electrocution, bushfire and loss of electricity supply.

The extreme conditions over the summer fire danger period elevate these risks — they increase the occurrence of electrical incidents and escalate the severity of impacts of such incidents.

In the lead up to and throughout the summer, ESV undertakes a range of activities to test the effectiveness of the systems and measures used by the MECs to manage their networks. This allows ESV to ensure that the MECs are best prepared to safely operate their networks over the fire danger period and not expose the community to unnecessary risk.

The activities that ESV performs include, but are not limited to, system and outcomes audits, asset and electric line clearance inspections, and review and analysis of incident and performance data.

4. Analysis of fire events

4.1 Fire statistics

4.1.1 Overall performance

There were 256 fires between 1 October 2017 and 31 April 2018. This was 75 more fires than the 2016-2017 fire season and 15 more fires than the 2015-2016 season (Table 2). As noted in section 2, the 2015-2016 season was similar to this year's season and should be used for comparative purposes.

There were 44 fires between 17 March 2018 and 22 March 2018 due to severe winds across the state, primarily in the southwest. In Figure 2, these fires are spread over a two-week peak — 19 fires in the first week of the peak (16 fires on 17 March alone) and 31 fires in the second week. This severe weather event is discussed in more detail in section 5.2.

For our analysis here, we have provided statistics showing the performance with and without the severe event. In the case of the statistics without the severe event, we have replaced the records for that week with records representative of the adjacent weeks (accounting for network owner, fire size and cause).

If you exclude the effects of the severe weather event, there were 23 fewer fires this season than two years ago.

The primary difference between the two seasons was that there were more fires in the first half of the fire season in 2015-2016, whereas 2017-2018 experienced more fires in the second half of the season (Figure 2).

This is also reflected in Figure 3, which shows the cumulative growth in fire numbers across the fire season: the 2015-2016 curve ramps up faster than the 2017-2018 curve, which closes the gap later in the season. Two curves are shown for 2017-2018 — one with all fires and one excluding the severe weather event.

Table 2 Comparison of last three fire seasons

		2015-2016	2016-2017	2017-2018
all fires	number of fires	241	181	256
	variation from 2017-2018	-15 -6%	-75 -29%	
excluding severe wind period	number of fires	241	181	218
	variation from 2017-2018	+23 +11%	-37 -17%	

Variations are the difference from 2017-2018

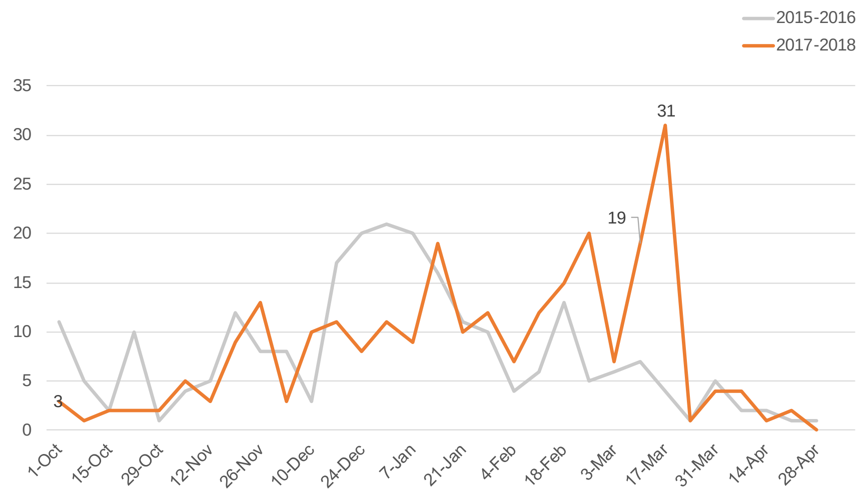

Figure 2 Fire incidents per week

4.1.2 Fires by distribution business

Figure 4 provides a breakdown of the incidents for each of the distribution businesses over the last three fire seasons (with and without the period of severe winds).

This indicates that:

- AusNet Services experienced more fires than in 2015-2016 regardless of whether or not the period of severe winds is excluded
- Powercor experienced more fires than in 2015-2016 (considering all fires) or fewer fires (excluding the period of severe winds)
- All other distribution businesses experienced fewer fires than in 2015-2016.

Note The size of operating area and number of assets differ significantly between distribution businesses.

The length of powerlines operated by AusNet Services is about 60 per cent of that of Powercor, United Energy's is about 15 per cent of Powercor's, and CitiPower's and Jemena's are 5-10% of Powercor's.

As such, absolute numbers of incidents are not directly comparable between distribution businesses.

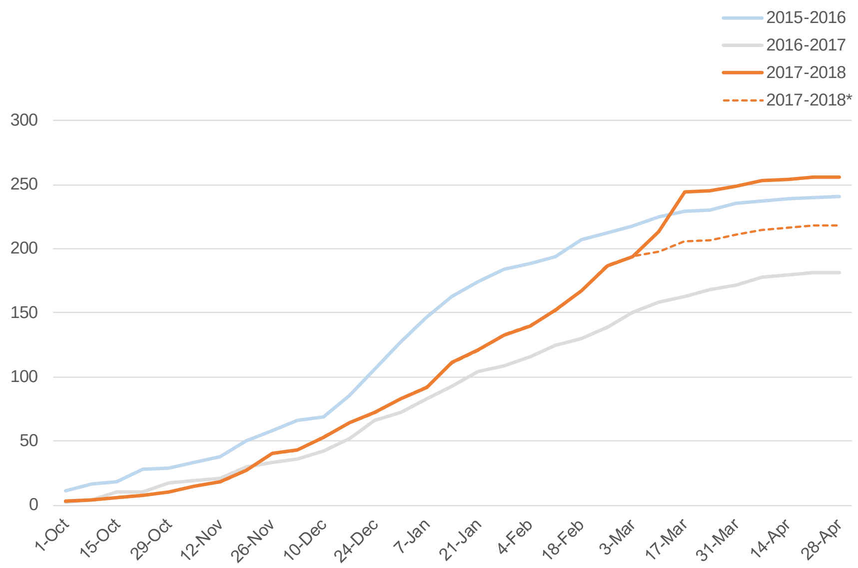

Figure 3 Cumulative fires across the fire season

Dotted line removes the effect of the 17-22 March severe winds

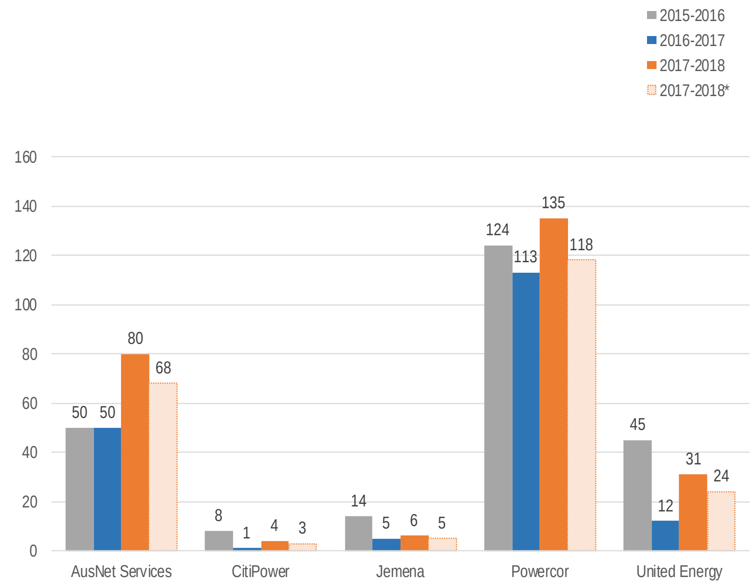

Figure 4 Total fires for each distribution business

The pale orange column removes the effect of the 17-22 March severe winds

4.1.3 Fires by size

When the distribution businesses report fires to ESV by through OSIRIS, the businesses are required to classify the size of the fire into the following categories:

- Large more than 10 ha
- Medium 1000 m^2 - 10 ha
- Small 10 - 1000 m^2
- Localised less than 10 m^2

Figure 5 shows the total fires in each size category for the last three fire seasons and the relative occurrence of fires in each category to the total number of fires.

Figure 6 shows the same but excluding the 17-22 March severe wind event.

Together they show that:

- large fires have increased significantly due to the wind event
- medium fires have decreased due to more large fires
- small fires are stable only due to the wind event, but have decreased otherwise
- local fires have increased due to the wind event, but have decreased otherwise
- small and localised fires account for 85-89 per cent of all fires
- fires smaller than 10 hectares account for 95-100 per cent of all fires (or 98-100 per cent if the severe event is excluded).

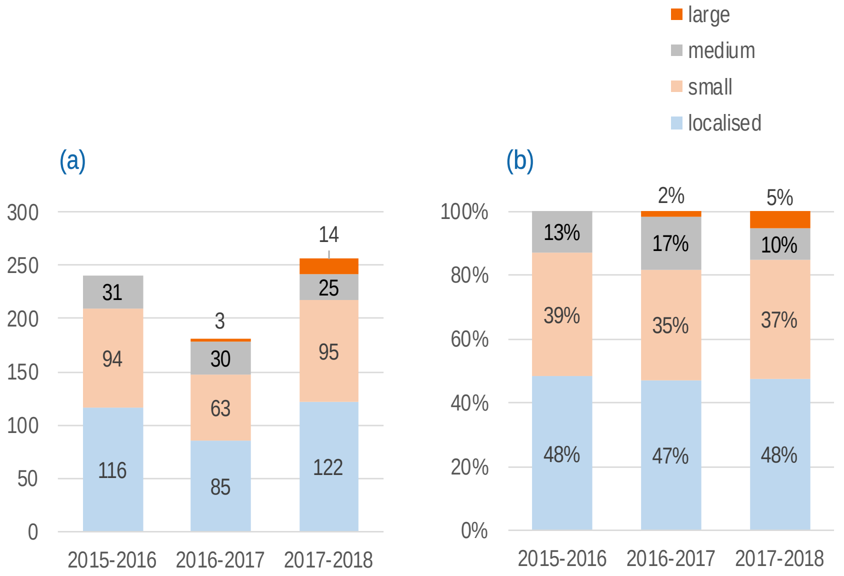

Figure 5 All fires by size
(a) absolute numbers; (b) percentage breakdown

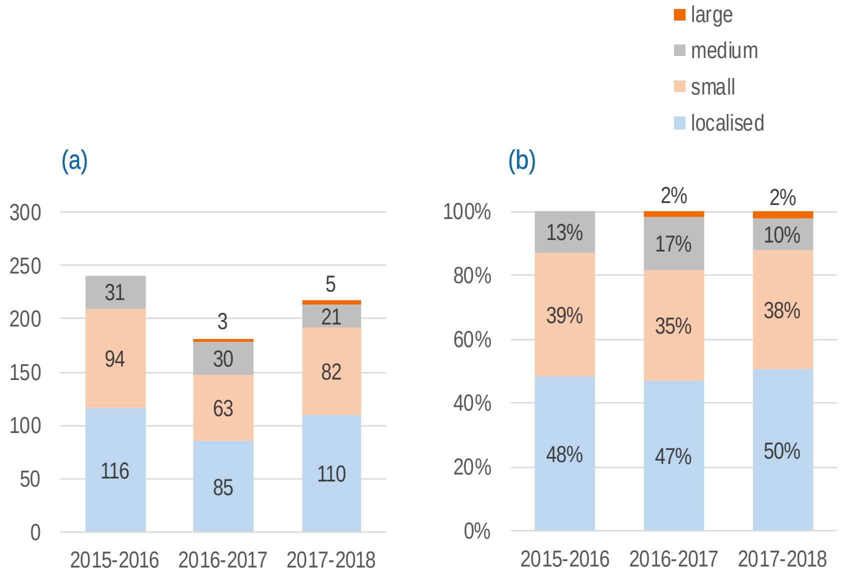

Figure 6 Fires by size excluding severe wind event
(a) absolute numbers; (b) percentage breakdown

4.1.4 Fires by cause

We have analysed the fires by three broad causal categories — technical, environmental and community.

The technical causes are wholly within the control of the distribution businesses to manage; the environmental causes are largely outside of their control (except for vegetation clearance and some animal contact), and the community causes are entirely outside of their control.

Figure 7 shows the total fires attributed to each cause for the last three fire seasons and the relative contribution of each cause to the total number of fires. This shows that fires from technical and community causes have reduced in absolute and relative terms since 2015-2016, whereas fires from environmental causes have increased in absolute and relative terms.

A breakdown of this season's fires by size and cause (Table 3) shows that:

- large and small fires were almost equally shared between technical and environmental causes
- two-thirds of medium fires are due to environmental causes
- 60 per cent of local fires are due to technical causes.

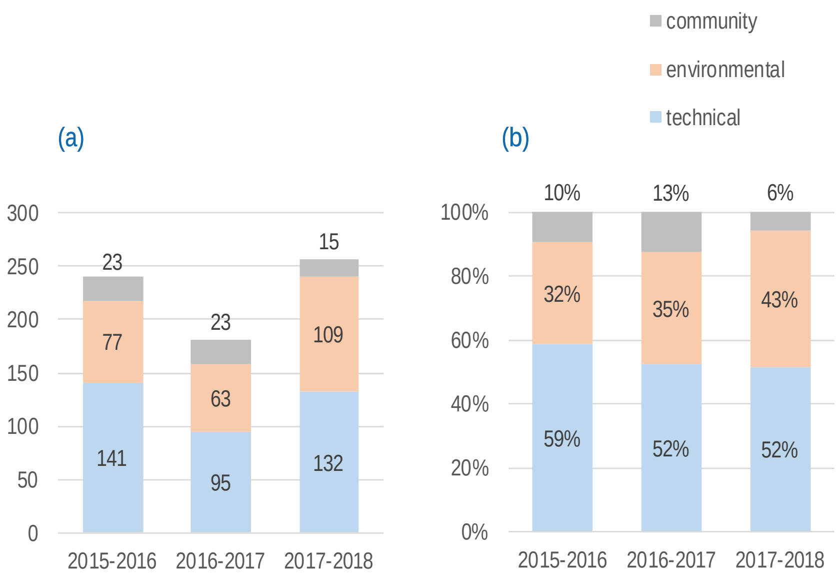

Figure 7 All fires by cause
(a) absolute numbers; (b) percentage breakdown

Table 3 Summary of 2017-2018 fire sizes by cause

Fire size	Cause			
	Technical	Environmental	Community	Total
Large	6	7	1	**14** 6%
Medium	8	16	1	**25** 10%
Small	44	46	5	**95** 37%
Localised	74	40	8	**122** 48%
Total	**132** 52%	**109** 43%	**15** 6%	**256** 100.0%

4.2 Spatial distribution

Figure 8 shows the locations of all fires during the 2017-2018 fire season: the circle sizes reflect the size of the fire.

A number of fires are evident along the Murray River. While this area is currently classified as LBRA, reduced irrigation is causing much of this land to revert to conditions similar to adjacent HBRA. This is increasing the risk of grass fires and bushfires in the region. ESV has been closely monitoring this situation over the course of the fire season: further details on addressing this situation are provided in section 5.1.

There was a spate of network-related fires between 17 March 2018 and 22 March 2018. These were associated with severe winds that came through Victoria, beginning with several large fires on 17-18 March. These fires form a cluster in the southwest of the state. Further analysis of these fires is provided in section 5.2.

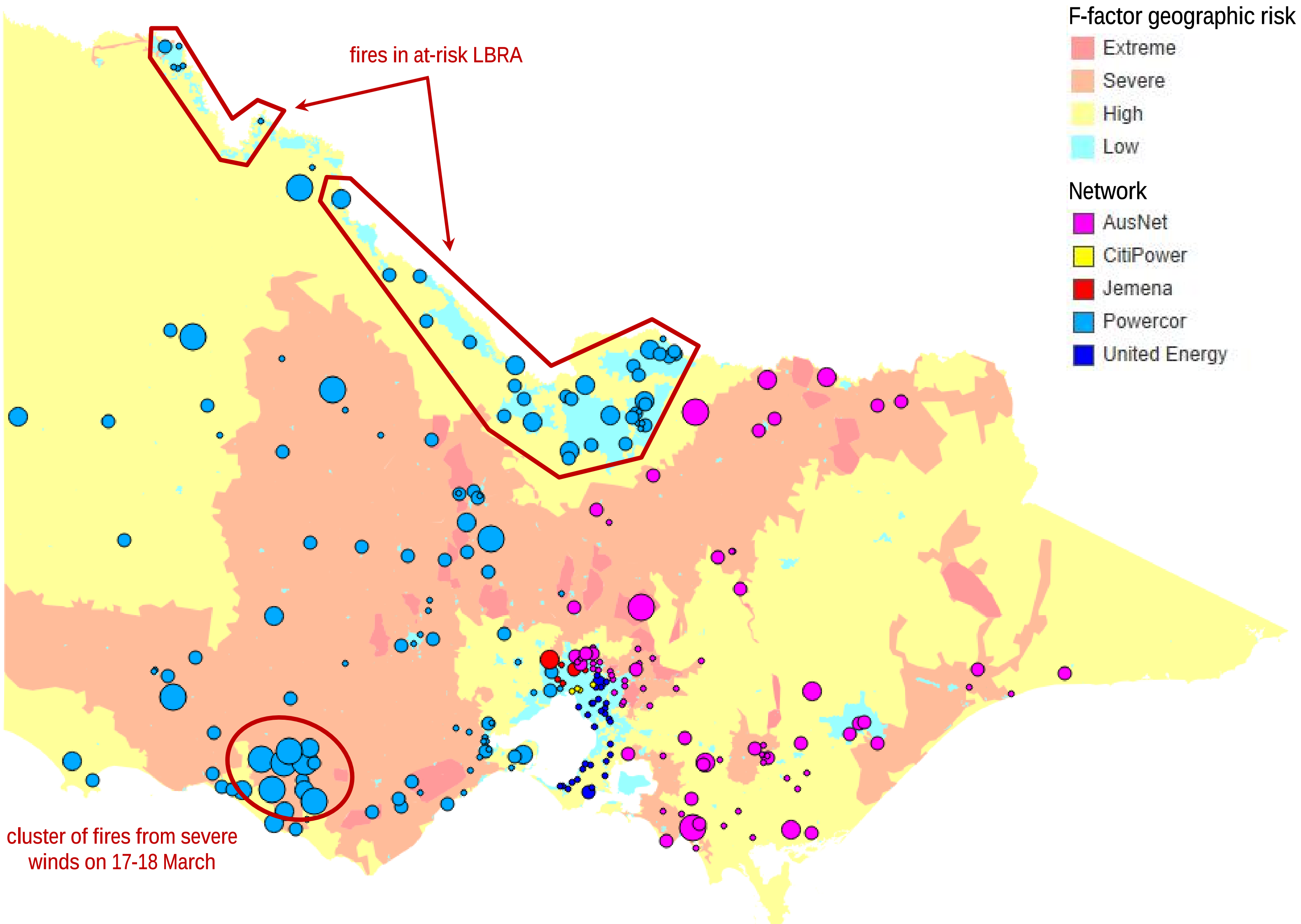

Figure 8 Locations of all fires during the 2017-2018 season

4.3 Influence of weather on fire events

Weather is one of the most powerful factors driving fire ignitions and behaviours; however, the manner and degree in which weather contributes to network-related fires is still not well understood.

As part of our analysis, we investigated the effect of different weather conditions on electrical fires.

Weather data (rainfall, temperature, wind speed, wind direction, maximum 3-second wind gust and relative humidity) was sourced from six Bureau of Meteorology stations across Victoria.[1] The weather data was then mapped against the location and time of fire incidents during the last three fire seasons, covering the period from 1 October 2015 to 30 April 2018.

We analysed the effects of 17 separate meteorological factors using machine learning and cluster analysis, and found the most influential factors that trigger and increase the number of incidents during the last three fire seasons. In order of importance, these were **temperature**, **maximum wind gust speed** and **the temperature differential over the preceding three days**. Based on these factors, days in the fire seasons can be partitioned into six clusters with different levels of fire risk. These clusters are shown in Table 4. For example, cluster 1 includes days of high maximum temperature and high maximum wind gust.

Figure 9 shows the likelihood of at least one incident occurring on a day when the weather conditions satisfied a cluster's criteria. On a day of high temperature (greater than 31°C) and high gust speed (above 85 km/h), there was greater than 91 per cent chance of a fire incident (cluster 1).

Table 4 Six clusters of fire incidents based on weather conditions

Cluster #	Weather conditions			
	Maximum temperature	Maximum gust speed	3-day temperature differential	Minimum temperature
1	High	High		
2	High	Low	High	
3	High	Low	Low	
4	Moderate			High
5	Moderate/Low			Low
6	Low			High

1 The stations used were Horsham aerodrome, Latrobe Valley airport, Melbourne Airport, Shepparton airport, Swan Hill aerodrome and Warrnambool airport. These stations were chosen to provide a broad coverage of the state where networks densities were highest.

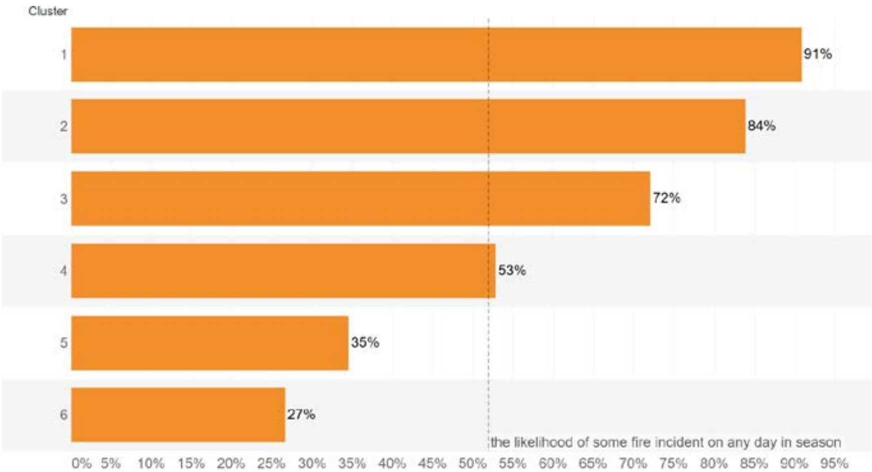

Figure 9 The likelihood of at least one incident a day for each cluster

As the gust speed reduced but the three-day temperature differential was still high (cluster 2), there was still a high likelihood (84%) of a fire occurring. As weather conditions improve (clusters 3-6), the likelihood of a fire reduces to where the chance of a fire drops to one every three days (cluster 5) and one every four days (cluster 6).

Not only did the probability of an incident occurring change across different clusters, Table 5 indicates that the incident rate per day also did.

The last column in Table 5 shows that the average number of incidents increased when the temperature rose and/or high wind gusts occurred. There are noticeably greater incident rates linked to clusters 1 and 2 when compared to the average incident rate. More specifically, on days of cluster 1 conditions (high temperature, high wind gust), the number of incidents are three times greater than that on an average day in the fire season.

Considering the size of fires, fires in all size classes were consistently more likely to happen on the days of cluster 1 conditions than when other conditions prevailed. Interestingly, the most prevalent fire size under cluster 1 conditions is the small fire (10-1,000 m^2) whereas localised fires (less than 10 m^2) are the most likely fires for all other clusters.

For incidents resulting in large fires (greater than 10ha), the analysis shows that it is more likely to happen on the day with high wind and high wind gusts (cluster 1).

Note While this analysis provides a correlation between weather conditions and network-related fires in the last three years, further work and data collection is required to develop this into a predictive model.

If models are to predict the size of fires (not just their occurrence as considered here), measures of landscape conditions may also need to be included in the models. These measures may include long-term rainfall and curing rates.

Table 5 Incident rate per day of each cluster by size of fire

Cluster	Localised ($<10m^2$)	Small ($10-1000m^2$)	Medium ($1000m^2$-10ha)	Large (>10ha)	All
1	1.09	1.45	0.36	0.55	3.45
2	0.93	0.41	0.30	0.02	1.66
3	0.31	0.22	0.09	0.02	0.64
4	0.28	0.25	0.07	0.01	0.61
5	0.03	0.04	0.01	0.00	0.09
6	0.09	0.02	0.01	0.00	0.11
Avg. rate	0.51	0.39	0.14	0.03	1.06

5. Major themes for fire season

5.1 Electric line clearance

The Electricity Safety (Electric Line Clearance) Regulations seek to mitigate the risk of electrocution, fire (including bushfire) and loss of electricity supply by excluding vegetation from a predetermined clearance space around electric lines. The required clearance space is prescribed within the Code of Practice for Electric Line Clearance (the code), a schedule to the regulations.

The code makes a distinction between the clearance spaces required in HBRA and LBRA, with required clearances being greater in HBRA due to the greater threat of bushfire. That said, the bushfire risk also exists in certain areas of LBRA throughout Victoria.

As noted in section 1.2, the CFA is responsible for assigning LBRA and HBRA across the areas where it is the designated fire control authority. Historically, the CFA performed regular cyclic review of these boundaries in consultation with the MECs and municipal councils, with funding from the MECs. This program lapsed in 2013 and boundaries have not been reviewed since then. As a result, there are areas where the assigned fire hazard rating no longer represents the conditions that prevail.

Where at-risk vegetation has been cleared for urban development, areas defined as HBRA could now be classified LBRA by the CFA.

Conversely, in areas where irrigated pasture has reverted to drier ground farming, the LBRA classification no longer represents the fire risks that exist and these areas could be better defined and managed as HBRA.

The former may result in higher levels of management than are warranted. The latter can result in a greater exposure of the public to the risk of bushfire.

While the review of fire hazard boundaries is outside of the immediate remit of ESV, we have engaged with the CFA and MECs and reinstated the cyclic reviews by the CFA (funded by the distribution businesses).

Commencing in July 2018, the review will target in its first year the high risk areas along the Murray River identified in section 4.2. Future scheduling of areas will be based on risk profiling, geographical location and efficient use of resources.

5.2 Influence of severe events

As shown in Section 4.1.1, the fires that occurred between 17 March and 22 March 2018 were the main reason that there were more fires in the 2017-2018 season than in the 2015-2016 season. In this section, we explore the events of that week in more detail.

There were 44 network fires across Victoria during the 17-22 March period. As shown in Figure 10, most of the fires occurred on the weekend of 17-18 March when strong winds came through from the west and combined with temperatures close to 40°C. There were further incidents over the subsequent days as the winds reduced but the temperatures remained high.

The wind gusts experienced on 17-18 March reached 103.7 km/h at their peak (based on maximum gusts recorded at Warrnambool). At the two nearest stations considered in our analysis (Horsham and Warrnambool), wind gusts have met or exceeded 100 km/h on twelve occasions since 1 January 2010. While gusts of such speed are severe, they are not exceptional in that they occur at least[2] one to two times per year.

Table 6 provides a breakdown of the 44 fires that occurred in the week against network operator, fire size, cause and cause description. Common fire sizes and causes are shown with colour coding. Table 7 summarises the fires by size and cause.

Of the 44 fires, 21 were on the Powercor network, fourteen on the AusNet Services network, seven on the United Energy network, and one each on the Jemena and CitiPower networks. There were also nine large fires (greater than 10 ha), four medium fires (1,000 m^2 to 10 ha), sixteen small fires (10 m^2 to 1,000 m^2) and fifteen localised fires (less than 10 m^2).

Based on incident reports submitted by the distribution businesses, fallen trees and blown vegetation caused six of the nine large fires and three of the four medium fires: conductor clashing accounted for a further two large fires and a broken pole accounted for one large fire. The remaining medium fire was due to lightning strike. All these events correlate with strong winds that occurred in the region during the period (Figure 10). This is consistent with the more generalised findings in section 4.3.

The dominance of environmentally-related network fires is shown by comparing the results of Table 3 and Table 7. Through the entire fire season, fires due to environmental causes made up 42.6% of all fires; they comprised 70.5% of all fires in the 17-22 March period. They also made up 50% of all large fires throughout the fire season, but two-thirds of all large fires in the 17-22 March period.

The environmentally-related network fires were largely due to vegetation outside the clearance space, vegetation managed by other parties, animal contact and lightning strike. Only one was explicitly reported as being due to contact with a tree growing into the clearance space.

ESV is investigating the causes of these fires, including forensic examination of the pole that failed and further analysis of incident and meteorological data to aid in predicting future incidents.

Note Further details on the Terang fire can be found in the ESV technical investigation report *P3 High Street Terang Electrical Incident – 17 March 2018*.

[2] The Bureau of Meteorology data used for the analysis only records the largest gust in the hour: strong gusts less than the maximum may occur but are not recorded.

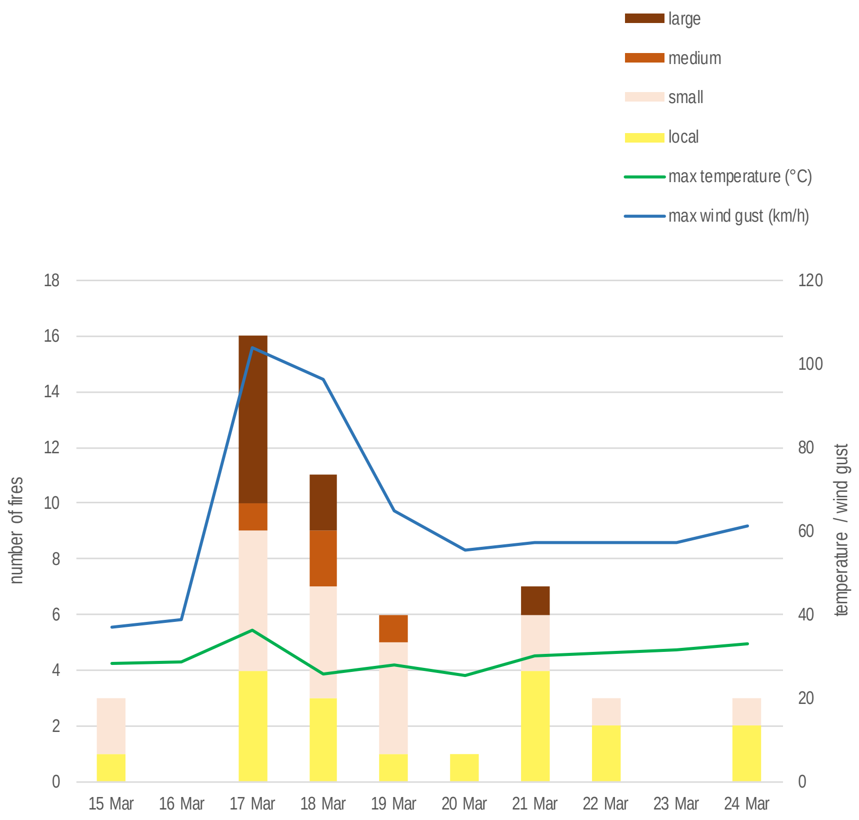

Figure 10 Effect of severe weather on incidents

The temperature and wind gust are the maximums recorded across the six stations identified in section 4.3

Table 6 Details of fires during the severe event of 17-22 March

fire size	cause	cause description
large (9)	technical (3)	conductor clashing (2)
		broken pole (1)
	environmental (6)	fallen tree (3)
		blown branch (2)
		fallen branch (1)
medium (4)	environmental (4)	fallen tree (1)
		fallen branch (1)
		blown branch (1)
		lightning strike (1)
small (16)	technical (6)	pole fire (4)
		isolator failure (1)
		burnt-out EDO fuse (1)
	environmental (9)	fallen tree (3)
		blown branch (2)
		fallen branch (1)
		tree contact (within clearance space) (1)
		bird contact (2)
	community (1)	tractor contact (1)
localised (15)	technical (3)	overheated connection (2)
		loose connection (1)
	environmental (12)	fallen tree (6)
		fallen branch (3)
		tree contact (private tree) (1)
		bird contact (1)
		bat contact (1)

Table 7 Summary of fire sizes by cause (17-22 March)

fire size	cause			
	technical	environmental	community	total
large	3	6	-	**9** 20.5%
medium	-	4	-	**4** 9.1%
small	6	9	1	**16** 36.4%
local	3	12	-	**15** 34.1%
total	**12** 27.3%	**31** 70.5%	**1** 2.3%	**44** 100.0%