The Fire Rescue Victoria Fire District Review

Finalisation of Proposed Risk Assessment Methodology

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Contents

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List of Acronyms

ABS	Australian Bureau of Statistics
AS	Australian Standard
AUS/NZ	Australian/New Zealand
CFA	Country Fire Authority
DEWLP	Department of Environment, Land, Water and Planning
DSA	Decision Support Analysis
ESTA	Emergency Services Telecommunications Authority
EMR	Emergency Medical Response
FFMVic	Forest Fire Management Victoria
FRV	Fire Rescue Victoria
GWR	Geographically Weighted Regression
IRSAD	Index of Relative Socio-economic Advantage and Disadvantage
ISO	International Standards Organization
NERAG	National Emergency Risk Assessment Guidelines
NEXIS	National Exposure Information System
OLS	Ordinary Least Squares
SA1	Statistical Area Level 1
SA2	Statistical Level Level 2
SDS	Service Delivery Standard
VicGov	Victorian Government

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1. Background

In September 2021, the Fire District Review Panel (the Panel) published a discussion paper as part of its consultation on the review of the Fire Rescue Victoria (FRV) fire district boundaries. The discussion paper outlined the proposed methodology for the risk assessment and sought to gather feedback from key stakeholders and anyone with an interest in the work of the Panel.

The Panel wrote to 100 stakeholders inviting formal written submissions. Feedback was also sought from the general public via a structured survey made available on vic.gov.au/fire-district-review-panel.

Formal written submissions and feedback via the structured survey closed on 19 November 2021.

The Panel received 13 formal written submissions from key stakeholders and 68 responses from the general public via a structured survey. These are available on the Panel's website.

Subsequently, the Panel has considered the feedback received and the availability of data, and the methodology has evolved accordingly.

The methodology is now finalised for the inaugural four-year review cycle which commenced 1 July 2020 and will be completed 30 June 2024.

2. Legislation

The Panel was established and is bound by the obligations under section 4 of the *Fire Rescue Victoria Act 1958* (the Act) to provide independent and informed advice to the Minister for Emergency Services (the Minister) on:

- whether it is necessary or desirable for the FRV fire district to be changed;

- whether a change in fire risk, or something that may result in a change in fire risk, may warrant a review of the FRV fire district.

The object of a review of the FRV fire district is to conduct a risk-based assessment of the assignment of responsibility necessary for the provision of fire services by fire agencies throughout Victoria. The overarching objective is to prevent, and protect against, loss of life and damage to property, infrastructure or the environment.

3. Addressing stakeholder feedback

All formal submissions were acknowledged in writing by the Chair of the Panel upon receipt. The Panel have addressed stakeholder feedback below.

3.1 Legislative remit

The Panel understands that fire agencies provide many services beyond fire, however its legislative remit is focused on the review of fire risk across Victoria, and the provision of fire services by fire agencies.

Section 4 of the Act is specific to the Panel's limited remit:

- Section 4F(b) – change in fire risk;

- Section 4H(a) and (b) – change in fire risk;

- Section 4J(1) – provision of fire services by fire service agencies;

- Section 4J(2) – change in fire risk;

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- Section 4J(4) – change in fire risk; and

- Section 4K – change in fire risk.

Further, section 32A of the Act references 'alarm of fire' which covers assistance related to a fire, accident, explosion or other emergency. Fire, explosions and accidents where fire is a risk will be incorporated into the Panel's methodology.

Although non-fire considerations are outside the Panel's formal recommendations, its final report will comment qualitatively on broader responsibilities that are beyond a 'change in fire risk'. These responsibilities include Emergency Medical Response (EMR) and other fire agency services, which the Minister may need to consider.

In making a determination on the Panel's review, section 4M(2) of the Act requires the Minister having regard to the following before instigating any legislated changes to the FRV fire district:

- the capacity of the fire services agencies to perform its statutory functions and duties;

- the implications for the budget and resources of the fire services agencies;

- the implications for the budget and resources of the emergency management sector; and

- other implications for the emergency management sector.

3.2   General

By examining historic fire incidents, existing resources and whether the relevant Service Delivery Standards (SDS) are being met, the Panel will ascertain the areas around Victoria that are experiencing an unacceptably high level of fire risk.

The inaugural review undertaken by the Panel will establish a fire risk baseline for Victorian communities.

Where boundaries are changed, fire agencies remain responsible for determining appropriate fire station capacity and capability responses (such as personnel training or adjustments to fire-fighting equipment). Planning for the viability of new stations falls within the remit of the Department of Justice and Community Safety.

3.3   Data

Feedback from stakeholders regarding data was varied, ranging from suggestions of what to include, who to consult, how to calibrate and manage the data.

Fire and explosion data is being used by the Panel to undertake the assessment of risk. A complete description of fire and explosion and an outline of all incidents encompassed will be available in the final recommendation report.

The Panel has access to all fire service incident data, including EMR, high angle rescue, urban search and rescue and trench rescue. Broader consideration of these incidents and the risk they pose may be commented on in the Panel's final recommendation for further consideration by the Minister.

Similarly, false alarms and hoax calls are being considered by the Panel but will not be used to calculate risk. The Panel are investigating this data to understand the overall workload of each fire agency and their subsequent ability to respond to risk.

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The outcome of each fire incident (or impact) will be explored in terms of casualties (injury + fatalities) of fire brigade personnel and members of the public. Only casualties recorded at the time of the fire[1] will be examined, due to difficulties in obtaining coronial data. Property losses and/or economic losses as a result of fire will not be considered by the Panel.

Australian Bureau of Statistics (ABS) datasets have been used to explore fire risk patterns in communities. These include 2016 Census data relating to population and households and derived indices, such as Index of Relative Socio-economic Advantage and Disadvantage (IRSAD). Relevant data from the 2021 Census isn't currently available for use in this analysis.

Population projection data is also being used in the analysis. Planned future residential, commercial and industrial precinct spatial data have also been incorporated into the methodology.

Consideration of climate change is limited to bushfire risk. The Panel relies on risk outputs from the Department of Environment, Land, Water and Planning's (DELWP) Forest, Fire and Regions group, which considers fuel reduction activities and encompasses both public and private land. Bushfire risk will be integrated into the Panel's methodology. Other bushfire related datasets being considered, include the Bushfire Risk Register, bushfire management overlay and bushfire prone areas. Additional climate change data such as changes in building construction are not considered due to the difficulty in obtaining the related datasets.

With respect to qualitative data, the Panel is considering its integration into the methodology. A range of qualitative data was suggested, with reference to prevention, preparedness and recovery information.

Any perceived shortcomings in data availability, consistency or quality will be noted by the Panel in the final report for fire agency and Minister consideration.

3.4   Capacity and capability

The Panel recognises that standards of fire cover[2], represented by capacity and capability data vary between organisations. These differences in standards of cover are not examined to determine if they manifest risk, rather, the Panel seeks to gain an overall view of state-wide risk with the current settings in place.

The Panel understands that fire incident response times are calculated differently by the fire agencies. Suggestions to use Emergency Services Telecommunications Authority (ESTA) data to calibrate the response time were considered. However, the Panel is assessing risk based on the individual agencies' ability to service the risk. The Panel is not normalising the calculation of response time in order to do this.

Surge capacity during bushfires is the responsibility of the fire agencies. In particular this will be a consideration for the Country Fire Authority (CFA) to advise the Panel further over the course of the review.

3.5   Guidelines and standards

The National Emergency Risk Assessment Guidelines (NERAG) are focussed primarily on emergency risks and provide general guidance on management frameworks and approaches.

These guidelines have been adapted from the Australian risk management standard AS ISO 31000:2018 Risk management - Guidelines (ISO 31000:2018).

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[1] Fire incident data includes attribute information such as location of fire incident, response time, standard response time, casualty, property loss. This information is recorded at the time of the incident.

[2] Response capability in terms of time and on-scene performance for personnel and equipment

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The Panel have developed a risk assessment methodology that aligns with these guidelines and is considered a 'best practice' approach. ISO:31000 and NERAG define risk as **"the effect of uncertainty on objectives"**.

Our risk nomenclature, outlined in Appendix A: Theoretical risk overview, may vary from the guidelines, but it has been adopted to align datasets and make the quantitative process more understandable across a broader range of stakeholders.

4.   The fire risk assessment methodology

4.1   What is risk?

Risk is the likelihood of a **hazard** occurring, where a hazard is something that has the potential to cause harm, based on *exposure* and *vulnerability* to that hazard. Further information regarding risk and its components are provided in Appendix A.

4.2   Risk and fire data

In assessing fire risk, the fire represents the hazard, while the *likelihood* of fire is examined as a function of past fire history (using incident data from FRV and the CFA). Response time affects the level of *exposure* to the hazard, while casualties result from both exposure and vulnerability to the fire and may be viewed as an *impact or consequence* of the fire. Our analysis is dependent on the availability of data and its effectiveness in representing risk (Table 1).

Table 1 Risk components and their relationship to available datasets

Risk component	Available dataset
Likelihood of fire	• Fire and explosion data 2010–2019
Impact of fire	

Exposure	• Residential
	   ○ Residential dwelling density (NEXIS)
	   ○ Residential structural characteristics (NEXIS)
	• Industrial (VicGov)
	• Commercial (VicGov)
	• Recreational areas (VicGov)
	• Wildland-Urban Interface (VicGov)
	• Infrastructure (VicGov)

Hazard	• Casualties 2010–2019
	   ○ Deaths by fire (fire personnel)
	   ○ Deaths by fire (public)
	   ○ Injuries by fire (fire personnel)
	   ○ Injuries by fire (public)

Vulnerability	• Disability data (ABS – Census 2016) • People requiring care (children and elderly) (ABS – Census 2016) • Families with no vehicle (ABS – Census 2016) • Families with single parent, elderly and children (ABS – Census 2016)

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4.3   Methodology

The Panel have explored many techniques to assess the distribution of fire risk across Victoria. The core methodology is presented in Figure 1B (Appendix B). This methodology explores the temporal and spatial distribution of the incidences of fire, the casualties and associated response times.

Probabilistic and deterministic modelling have also been undertaken to understand the drivers behind fire.

The **unit of analysis** is the Statistical Areas Level 1 (SA1), which is an ABS geographical unit. It has been designed as the smallest unit for the release of Census data and typically have a population between 200 and 800 people with an average of 400.

Additional analysis to the core methodology includes:

- False alarms and hoax calls

- Capacity and capability mapping for each fire station

The assumptions and limitations associated with the methodology will be provided in the final risk assessment methodology report. It is anticipated that the methodology will be refined and (if necessary) modified in response to learnings from the inaugural review.

4.3.1   Temporal risk pattern

Temporal analysis investigates data over a **time** period. The Panel's analysis uses a decade of data from 2010–2019. Fire and explosion data, the casualties that result from these incidents and response time by the fire agencies to these incidents, will be analysed over time. This analysis will identify patterns over a year, month, week, and for each hour of the day. The total number of incidents for each time period, as well as the number of incidents, casualties and responses for each fire agency (FRV and CFA) will be explored.

4.3.2   Spatial risk pattern

Spatial analysis investigates data over an **area**. Fire and explosion data, casualties resulting from them and response time by the fire agencies to these incidents will be analysed over the spatial extent of Victoria. The Panel has used of the following methods to explore data spatially:

- Fire rate

- Hot spot

- Kernel density estimation

4.3.3   Markov chain estimation

The utility of Markov chain estimation is in its capacity to **estimate the future fire risk using the fire events history**. The Markov chain process is a probabilistic approach to risk estimation, resulting in a time-based estimate of the likelihood of fire. However, it is developed to estimate the likelihood of fire across a spatial extent.

The probability of having a fire at time (t) in a certain location given there was no fire within the neighbourhood in past (t-1) is used to inform the work of the Panel. The probability is categorised into five groups. Of all categories, the areas having more than 50 per cent of probability of fire risk is of greater concern.

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4.3.4 Regression modelling

Regression modelling **reveals the underlying drivers for the variations in fire risk** across an area. Independent variables from the ABS 2016 Census[3], include population, household structure and socioeconomic indices, land use and landcover. These independent variables, which represent the various drivers of fire, are inputs to regression modelling techniques; Ordinary Least Squares (OLS) and Geographically Weighted Regression (GWR).

4.3.5 Decision Support Analysis

The outputs described in sections 4.3.2 to 4.3.4 of this document, produced at the SA1 scale are subsequently input into the Decision Support Analysis (DSA).

The DSA supports the development of a single, state-wide, fire risk map. Those areas identified by the DSA at high risk of fire will be published in the Victorian Government Gazette.

4.3.6 Overlay

The final part of the methodology involves the spatial overlay of supplementary data that will assist in determining an optimal fire boundary configuration. They have been explained in detail below.

A bushfire risk spatial layer will be obtained from the DELWP Forest Fire and Regions Group. It will provide an up-to-date, state-wide representation of the bushfire risk posed to address points, derived using their bushfire simulation software.

The location (coordinates) of operable hydrants has been provided by the water companies. Firefighters use water as a prime tool of attack for fire. Reticulated water pipes have hydrants (above ground or below) that enable firefighters to tap into the reticulated system and control the flow. The water is pressurised by pumps in the fire truck and delivered via hoses to the fire. If this infrastructure is not in place, firefighters are reliant on static water supplies and/or the water on board tanker trucks.

Population and land use projections

Victoria in Future[4] is the official Victorian Government projection of population and households. Projections are based on trends and assumptions for births, life expectancy, migration, and living arrangements across all of Victoria. These projections are available at the SA2 scale and cover the period to 2036. Additional land use planning datasets for Melbourne metro and regional Victoria relating to future residential, commercial and industry zones will be explored.

Prevention and preparedness

Prevention is aimed at stopping the fire from occurring. It involves building codes, AUS/NZ Standards, building materials, certification and compliance systems, statutory land-use planning, active and passive fire safety systems, fire safety inspections. Many of these preventions by CFA are represented by spatial data (for example, land use planning and bushfire overlays) that can be integrated into the Panel's methodology:

- Bushfire Management Overlay
- Bushfire Attack Level
- Water supply requirements
- Road access requirements
- Integrated Bushfire Management Planning

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[3] Datasets from the 2021 Census are currently not available

[4] https://www.planning.vic.gov.au/land-use-and-population-research/victoria-in-future

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- Fuel Management Activities
- Electric Line Vegetation Clearance
- Declared Fire danger period and total fire bans

Preparedness is readying people for a fire event and mitigating its likelihood/consequence. For example, installation of smoke alarms and sprinkler systems, advice and education programs and workshops. Fuel management by CFA is also considered under preparedness.

Lastly, the FRV and CFA district boundaries will be viewed in relation to these supplementary layers and in consideration of CFA's advice on capacity and capability for high risk areas. Any requirement for changes to the FRV boundaries will then be determined.

4.4   Phasing

Due to changes in the methodology, phasing has also changed. The final phasing of the review is outlined below.

- Phase 1 – Data collection and preparation
- Phase 2 – Data analysis
- Phase 3 – Decision Support Analysis
- Phase 4 – Overlay and recommendations for boundary adjustment

Following completion of Phase 3, the output will be published in the Victorian Government Gazette.

5.   Next steps

The review of the FRV fire district for the current four-year cycle is underway.

As required under legislation, where there is a change in fire risk, or for the purpose of this inaugural review where there is a high risk of fire, the Panel will publish its initial determination in the Victorian Government Gazette by April 2023.

Following publication, the Panel will suspend the review for a period to be determined of up to 12 months for CFA to advise on support arrangements to volunteer brigades to ensure that they have the capacity to respond effectively to address identified fire risk.

The review will be completed, and final report containing the Panel's recommendations will be submitted to the Minister, by 30 June 2024.

The final determination on any changes to the FRV fire district boundaries will be made by the Minister.

The Panel will continue to engage with key stakeholders throughout the life of the current review.

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6. Useful links

- Fire District Review Panel – vic.gov.au/fire-district-review-panel
- Fire Services Reform – vic.gov.au/fire-services-reform
- Fire Rescue Victoria Act – *Fire Rescue Victoria Act 1958*
- Safer Together – safertogether.vic.gov.au/
- EMV – emv.vic.gov.au/
- CFA Plan and Prepare – cfa.vic.gov.au/plan-prepare

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Appendix A: Theoretical risk overview

Risk is the likelihood of damage/loss from the hazard, integrated across the entire spectrum of possible events:

$$Risk = f(\,likelihood, impact)$$

Impact is based on the interaction of the fire characteristics and the vulnerability of the asset to fire.

$$Impact = f(hazard, exposure, vulnerability)$$

The direct impact of the event is calculated from the costs modelled across all exposures during the event. If we examine the elements of impact:

- **Hazard** is a physical situation with a potential for undesirable consequences to people, property or the environment. It refers to the fire, accident or incident that the fire service is responding to.

- **Exposure** refers to what elements are at risk (people, buildings, infrastructure, agriculture etc.).

- **Vulnerability** refers to how each exposed element responds to the level of hazard. Vulnerability can be divided into four main areas: physical, social, economic and system.

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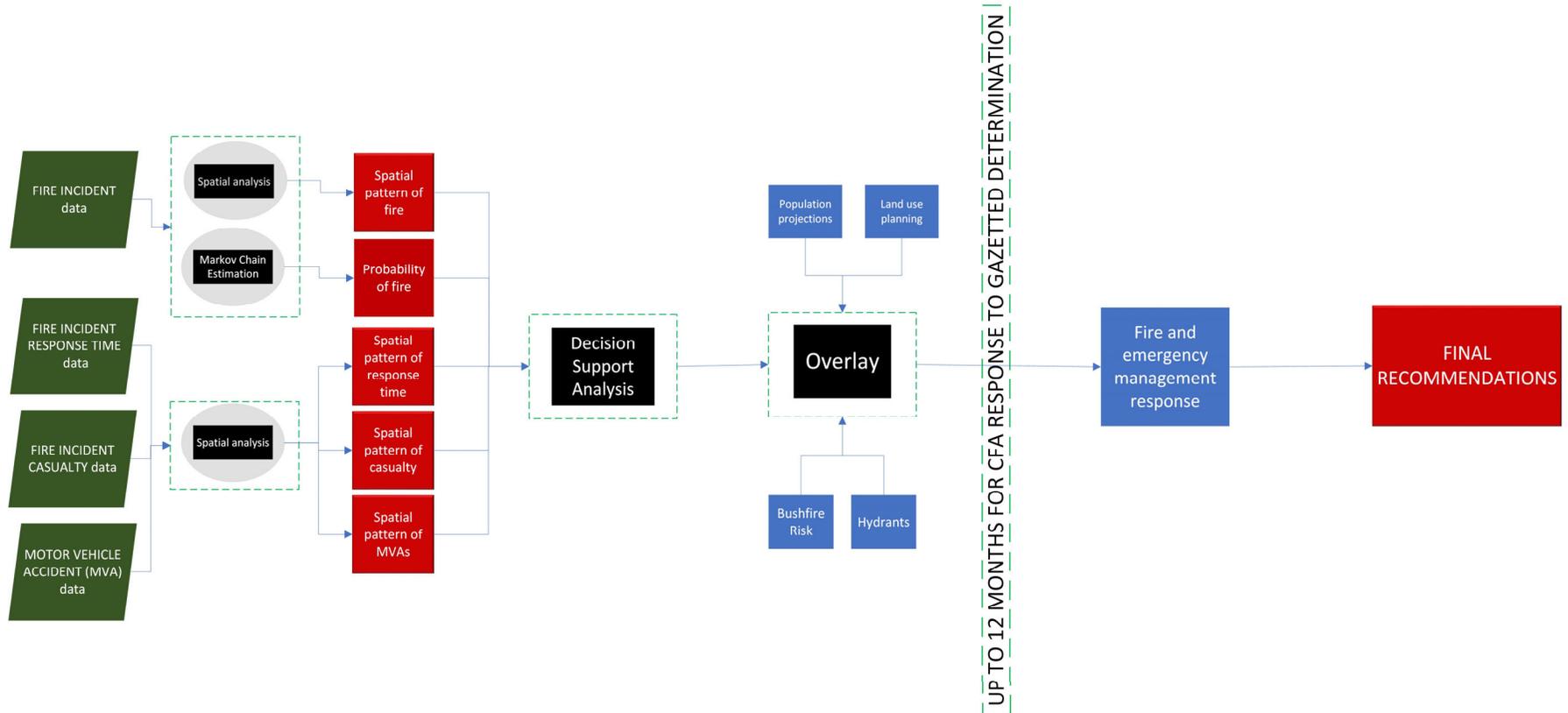REVIEW PANEL VICTORIA

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Appendix B: Methodology overview

Figure 1B Methodology overview