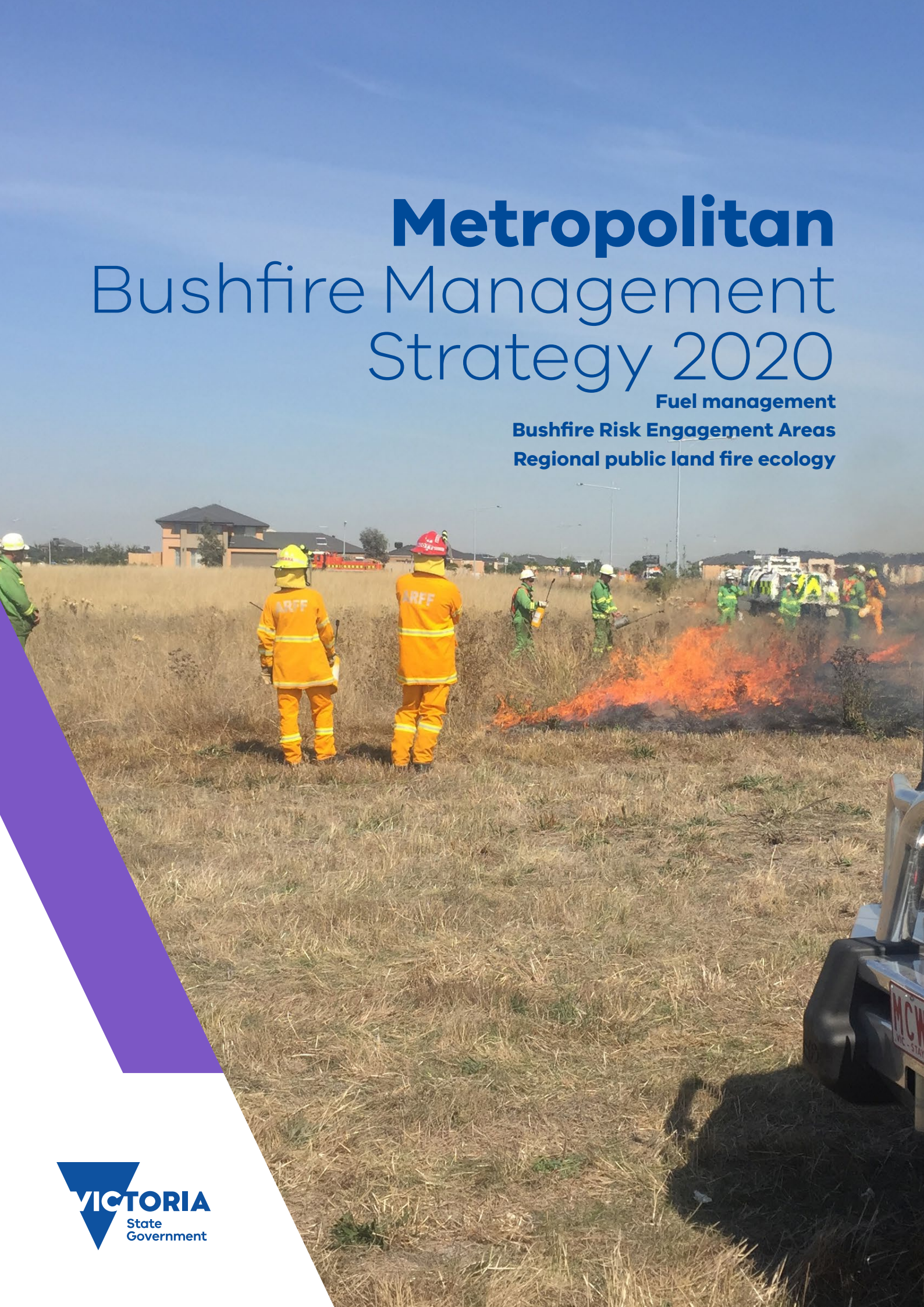
Metropolitan Bushfire Management Strategy 2020

Fuel management
Bushfire Risk Engagement Areas
Regional public land fire ecology



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Acknowledgements

We acknowledge and respect Victoria's Traditional Owners as the original custodians of the state's land and waters, their unique ability to care for Country and deep spiritual connection to it. We honour Elders past and present, whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

We are committed to genuinely partner and meaningfully engage with Victoria's Traditional Owners and Aboriginal communities to support the protection of Country, the maintenance of spiritual and cultural practices and their broader aspirations in the 21st century and beyond.

Aboriginal people should be aware that this publication may contain images or names of deceased persons in photographs or printed material.

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Abbreviations and Definitions

Abbreviation	Term
APZ	Asset Protection Zone an area around properties and infrastructure where we intensively manage fuel to provide localised protection to reduce radiant heat and ember attack on life and property in the event of a bushfire
BMZ	Bushfire Moderation Zone an area around properties and infrastructure where we manage fuel to reduce the speed and intensity of bushfires and to protect nearby assets, particularly from ember attack in the event of a bushfire
BREA	Bushfire Risk Engagement Area parts of the landscape, on public and private land, where managing bushfire fuels is most effective in reducing risk. It guides agencies and communities working together to determine the best actions in their local area
CAR	Comprehensive, Adequate and Representative reserve system
CFA	Country Fire Authority
DELWP	Department of Environment, Land, Water and Planning
EMV	Emergency Management Victoria
FDI	Fire Danger Index
FFMVic	Forest Fire Management Victoria comprised of staff from DELWP, PV, Melbourne Water and VicForests when working in bushfire management on public land
FMZ	Fire Management Zone for fuel management purposes, public land in Victoria is classified into four fire management zones: asset protection zone, bushfire moderation zone, landscape management zone, and planned burning exclusion zone
GMA	Geometric Mean Abundance an index of the relative abundance of species within a community. As the relative abundance of species changes, so too does the GMA, and this can be used as a measure of resilience
GSS	Growth Stage Structures the vegetation GSS of an area is its mix of vegetation of different ages, from juvenile to old. Vegetation's GSS depends on when it was last burnt or otherwise disturbed. We assume that a diversity of GSSs and habitats across a landscape ensures a diversity of species, which helps maintain and improve ecosystem resilience
Ha	Hectares
HVEA	High Value Ecological Area
JFMP	Joint Fuel Management Program

Abbreviation	Term
LMZ	Landscape Management Zone an area where we manage fuel to minimise the impact of major bushfires, to improve ecosystem resilience and for other purposes (such as to regenerate forests and protect water catchments)
MER	Monitoring, Evaluation and Reporting
M10	Metropolitan Region Strategic Bushfire Planning Coordination Committee
NCR	Nature Conservation Reserve
PBEZ	Planned Burning Exclusion Zone an area where we try to avoid planned burning, mainly because ecological assets in this zone are primarily intolerant to fire
PV	Parks Victoria
RAP	Registered Aboriginal Party
Residual risk	the amount of risk that remains after bushfires and fuel management activities reduce fuel. Residual risk is used by DELWP as a performance measure
RSFMPC	Regional Strategic Fire Management Planning Committee
SDM	Structured Decision Making
TFI	Tolerable Fire Interval a term which expresses the minimum or maximum recommended time intervals between successive fire disturbance events at a site or defined area for a particular vegetation community. The time interval is derived from the vital attributes of plant species that occupy the vegetation community. The TFIs guide how frequent fires should be in the future to allow the persistence of all species at the site or defined area
VFRR-B	Victorian Fire Risk Register – Bushfire

Introduction

Victoria is one of the most bushfire-prone areas in the world. Victorians are accustomed to living with bushfire risk, which is the likelihood and consequence of bushfires. It includes the likelihood of a fire starting and spreading across the landscape, and the consequences of it impacting the things we value: people, communities, houses and farms, infrastructure, our economy and the natural environment.

Bushfires are driven by three key factors – fuel, weather and topography – which together make up the 'fire behaviour triangle'. These three factors combine to affect how a bushfire behaves: how fast it travels, where it spreads, and how intensely it burns. Fuel management is important, because it is the only element of the fire behaviour triangle that we can influence.

Bushfire fuels are the leaves, bark, twigs and shrubs that are burnt by fire. The fuel type, dryness, size, moisture content and arrangement can all affect the speed, size and intensity of a bushfire. Fuel management includes planned burning — lighting and managing planned fires in the landscape — and mechanical treatment — mowing, slashing, mulching and using herbicides. Fuel management activities reduce the amount of fuel across our landscape, decreasing the fire behaviour of bushfires, helping limit their spread and intensity when they occur, and making it easier for our firefighters to control them and lessen their impacts.

Bushfire risk is influenced not only by how a bushfire behaves, but also by how fire impacts the different things that we value. For example, population growth in and near forested areas increases the bushfire risk, as more people enter areas where major bushfires are more likely to impact. The Victorian community is changing in other ways, with an aging population and decreases in volunteering in some areas, leading to an increase in vulnerability to bushfire. For plants and animals, drought, invasive species incursion, as well as habitat loss and fragmentation increase the susceptibility to negative bushfire impacts.

Our changing climate – bringing rising average temperatures, more hot days and less rainfall – means bushfire risk is constantly increasing as fuels dry out and extreme fire weather events increase. Bushfires with the worst consequences typically occur during extreme weather conditions (such as during very hot, dry and windy periods). The disastrous 2019–20 bushfire season, followed periods where parts of Eastern Australia – extending from Tasmania through Victoria, New South Wales and into Queensland – had experienced their driest conditions on record. Over 1.5 million hectares (ha) in Victoria were burnt and large areas of eastern Australia impacted.

Photo credit: Jacquie Quaine

In Victoria, climate change is forecast to:

- extend the bushfire season
- make bushfires larger, more severe, and more frequent
- make days with an elevated fire danger rating more frequent
- extend the area that experiences extreme weather conditions, increasing the frequency of these for communities that may have never or have only infrequently experienced such conditions
- start the bushfire season earlier, with more bushfires starting in spring (which may also change fire weather conditions that are experienced, such as wind speed and direction)
- further strain available resources and capacity as the bushfire season increasingly overlaps with suitable weather periods for planned burning.

The impacts of climate change on fire-sensitive habitats and refugia for plants and animals will become increasingly important to manage.

With climate change making many extreme weather events more frequent and more extreme, the impacts on communities are also likely to increase. Of 15,700 disasters between 1980 to 2015, 91% were weather related, and 51% of fatalities and 79% of economic losses were caused by weather related extremes[1].

Our shared responsibility to mitigate bushfire risk

While bushfires will always be a threat, Victorians have demonstrated their ability to work together to plan and deliver activities on public and private land to mitigate bushfire risk. As with all areas of emergency management, supporting communities to be safer and more resilient is the shared responsibility of all Victorians, not just of government agencies. To best manage bushfires, it is important that communities and government organisations come together to understand bushfire risk, agree on strategies, and then work both individually and collaboratively to fulfil their individual and shared responsibilities.

Actions that agencies are responsible for include issuing fire danger warnings and advice, reducing fuel through planned burning and mechanical treatments, commissioning bushfire science research, and recruiting and training firefighters. Actions that community members are responsible for include developing and practising a bushfire plan, fully extinguishing campfires, preparing their property, and participating in community bushfire preparedness activities and events. Actions we do together include building an understanding of risk in our area, sharing information through community and social channels, and developing, practicing and implementing plans to protect what is valued most by the local community.

Resilient communities prepare better for bushfires. They provide the volunteer workforce essential in the response phase, and they are better able to face the acute shocks and stresses of a bushfire and to recover after it.

1 Department of Home Affairs, 2018

Victoria's 'shared responsibility' approach recognises that communities:

- are best-placed to understand and mitigate their risks and drive preparedness and recovery, including through their fundamentally important volunteer contribution
- have knowledge, expertise, capability and diverse perspectives to work with agencies to mitigate bushfire risk
- have networks and relationships that help agencies identify and protect the things communities value, improve their capacity and create meaningful, sustainable solutions.

The shared responsibility approach seeks to ensure:

- the interests, values and expectations of stakeholders in, or members of, communities are understood and considered in the planning process
- ownership of the planning process and responsibility for implementing strategies are broadly shared.

Shared responsibility does not mean equal responsibility: there are some areas where land and fire management agencies are better-placed and have more resources and information to make decisions and act on them. Equally, while agencies develop plans and implement programs for mitigation, planning, preparedness, response and recovery, governments or agencies cannot guarantee that bushfires will be consequence-free for the community. Communities and individuals have the responsibility to prepare their own plans, properties and assets to reduce the impact of bushfires. During major bushfires with far-reaching consequences, land and fire agencies may not always be able to coordinate and deliver the support the community may expect.

Recognising the role of Victoria's Traditional Owners

The Metropolitan region recognises the **Victorian Traditional Owner Cultural Fire Strategy**, which aims to re-establish cultural fire with Traditional Owner led practices across Victoria, so Traditional Owners can heal Country and fulfil their rights and obligations to care for Country. The *Victorian Traditional Owner Cultural Fire Strategy* provides a set of principles and strategic priorities to facilitate greater self-determination for Traditional Owners and a framework for effective Traditional Owner-led cultural fire management in Victoria. The strategy has an important role in informing the Joint Fuel Management Program (JFMP) in consultation with individual Traditional Owner groups. Traditional Owners emphasise that cultural fire is applied to achieve culturally meaningful objectives, but that risk reduction is often a complementary outcome.

Photo credit: Jacquie Quaine

Bushfire management planning

Figure 1. Bushfire management strategic, operational and tactical planning for fuel management

Bushfire management planning occurs at different levels, with varying time frames, focuses and outputs. **Figure 1** shows fuel management planning at strategic, operational and tactical levels.

Strategic planning

The strategic planning process identifies where important values and assets are located across the landscape. It considers the current extent and quality of these values and where possible considers future trends including population, industry and environmental change. Strategic planning identifies objectives for the important values and assets, and develops an approach to manage the risks posed to them. The resulting bushfire management strategies describe landscape zones that focus fuel management activities to deliver bushfire risk reduction and ecological outcomes.

Strategic bushfire management planning takes place within a legislative and policy context which includes:

- the *Emergency Management Act 2013*, which requires from 1 December 2020 the Emergency Management Commissioner to prepare a state emergency management plan and to approve eight regional emergency management plans. In combination with the municipal emergency management plans, these provide for an integrated, coordinated and comprehensive approach to emergency management. The Act also requires emergency management plans to contain provisions providing for the mitigation of, response to and recovery from emergencies and to specify the emergency management roles and responsibilities of agencies
- the *Conservation Forests and Lands Act 1987*, which requires the Department of Environment, Land, Water and Planning (DELWP), through the *Code of Practice for Bushfire Management on Public Land* (2012), to develop a risk-based approach to bushfire management on public land. This document meets the requirements set out in the Code of Practice to prepare a strategic bushfire management plan.
- *Safer Together: A new approach to reducing the risk of bushfire in Victoria* (2015), a Victorian Government policy, focuses on how effective our actions are in reducing risk and not just the amount of activity we undertake.

Operational and tactical planning

This bushfire management strategy informs the development of operational plans, primarily the Joint Fuel Management Program (JFMP). The JFMP is the three-year rolling statewide program of fuel management works on public and private lands carried out by Forest Fire Management Victoria (FFMVic) and Country Fire Authority (CFA) to reduce bushfire risk and to maintain the health of native plants and animals that rely on fire to survive. Works include planned burning, slashing, mowing and clearing works, creating and maintaining fuel breaks, and carrying out maintenance on fire infrastructure (like fire dams and lookout towers).

This strategy does not directly address tactical (burn) planning, which is done for individual burns. Tactical planning can include individual burn objectives, community engagement plans and how the burn will be delivered safely.

Other bushfire management actions

This bushfire management strategy outlines our risk-based approach to fuel and ecological fire management. However, fuel management is not the only bushfire management action that reduces bushfire risk and is not always the most effective action to reduce that risk. Fuel management needs to be supported with other actions for a number of reasons:

- Some parts of the landscape have inherently high levels of bushfire risk which requires more actions to reduce that risk
- The ability to reduce risk through fuel management may be limited in some landscapes and there will always be fuel re-accumulation
- The effectiveness of fuel management may be reduced under extreme weather conditions
- Fuel management reduces fire behaviour, it does not eliminate bushfire. Suppression activities are always required to control bushfires.

Table 1 lists some key actions that agencies and communities undertake together to manage bushfire risk and complement our fuel management approach.

As with fuel management, these actions are guided by bushfire risk analysis combined with other information to ensure they are most effective. Strategies and plans for these actions are developed through emergency management planning processes by agencies at the state, regional and municipal levels.

Table 1. Bushfire management approaches beyond fuel management

Approach	Key actions
Reduce bushfire ignitions through prevention activities	• Education and advertising campaigns (e.g. campfire safety, reporting ignitions) • Coordinated, risk-based patrolling • Deterrence for deliberate or negligent ignition – laws/prosecution • Monitoring arsonists • Restrictions – fire danger period and total fire ban triggers, duration and restrictions (including legislative change) • Reducing ignitions from powerlines
Increase the effectiveness of fire suppression	• Fire detection (towers, aerial surveillance) • Resourcing, capacity and capability of fire-fighting resources (fire crews, contractors, incident management teams) • Aircraft fleet management: type, distribution, availability and pre-determined dispatch • Road infrastructure including maintenance of the strategic fire access road network and network of fuel reduced areas • Other fire response infrastructure maintenance including remote water access and helipads • Fire readiness including rostered and pre-formed Incident Management Teams and fire crews
Reduce bushfire spread and severity	• Planned burning based on tenure-blind risk • Strategic breaks and burn unit boundary standards • Flexible delivery of burning (e.g. managed bushfire, unbounded burns) • Other forms of fuel management (e.g. slashing, spraying, mulching) particularly in high-risk areas where planned burning is not suitable • Identify and effectively manage fuel hazard reduction on private bush
Reduce the physical effects of bushfires in inhabited areas	• Domestic property preparedness in towns, including fire prevention notices, penalties and cost recovery • Vegetation management on public and private land within or immediately bordering towns including implementation of fire prevention notices • Identification, prioritisation and treatment of risk to critical infrastructure • Access and egress (roadside vegetation/tree maintenance) pre- and post-fire • Asset protection (on-ground)
Reduce the social effects of bushfires on communities	• Bushfire education programs targeting vulnerable communities including those with identified at-risk or changing demographics, and/or where bushfire risk cannot be effectively reduced through planned burning. • Recovery planning and relationship building pre-bushfire (e.g. via community groups, scenario events and activities) • Municipal bushfire plans • Warnings and advice messaging • Personal and neighbourhood bushfire plans
Reduce impacts from fire management actions	• Community engagement about fire management and smoke impacts • Planning to minimise impacts on biodiversity, cultural heritage and other values • Connections between planning and delivery (e.g. on-ground staff aware of biodiversity/cultural sites and mitigation actions) • Cross-tenure planning and consultation • Monitoring effectiveness of mitigations (and subsequent improvement)

About this bushfire management strategy

Victorian landscapes, environments and communities are diverse and multifaceted, and Victorian communities have diverse values, preferences and priorities. This regional bushfire management strategy reflects our region's unique environments and communities. To develop this strategy, we undertook a regional planning process that was guided by the knowledge and priorities of experts, stakeholders and community members from Metropolitan region.

Between November 2017 and September 2019, representatives of CFA, FFMVic, Emergency Management Victoria and local governments undertook a strategic bushfire risk management planning process. The process was guided by the Metropolitan Region Strategic Bushfire Planning Coordination Committee (colloquially referred to as "M10" due to the ten members), on behalf of the Northern and Western Metropolitan, Eastern Metropolitan and Southern Metropolitan Regional Strategic Fire Management Planning Committees (RSFMPCs). They offered opportunities to stakeholders and the broader regional community to be involved in the planning process through both in-person and online mechanisms.

The strategic planning process resulted in five strategies to reduce bushfire risk and maintain ecosystem health: together, they comprise this strategy — *the Metropolitan Bushfire Management Strategy 2020*.

The individual strategies are:

- our fuel management strategy, which focuses on reducing bushfire fuels through planned burning and mechanical works (mowing and slashing) on public land
- our Bushfire Risk Engagement Areas (BREAs), which focus on targeted community engagement to complement, inform and drive fuel management and other risk mitigation activities on public and private land
- our three public land fire ecology strategies – the Forests, French Island, and Grasslands fire ecology strategies – which set out optimal fire regimes for managing biodiversity values in Landscape Management Zone (LMZ), driven by ecological objectives.

Our bushfire management strategy focuses on:

- reducing the risk of bushfires threatening lives, homes, the environment and other important values and assets across the landscape
- maintaining or improving the resilience of ecosystems
- establishing a shared understanding of bushfire risk across the sector, based on the latest science and the extensive knowledge of agency personnel
- using a 40-year horizon, so long-term ecological changes and fuel accumulation rates can be considered in annual operational planning processes.

The strategy is a supplement to the ***Northern and Western Metropolitan Regional Strategic Fire Management Plan 2015–2025***, the ***Southern Metropolitan Region Fire Management Plan*** and the ***Eastern Metropolitan Region Strategic Fire Management Plan***, each developed by the RSFMPC for their region. These plans' agreed visions, strong leadership and greater cooperation between agencies promotes greater community resilience through effective engagement and best-practice integrated fire management planning. This strategy applies to the footprint of these three emergency management regions.

Regional emergency management plans and municipal emergency management plans are being prepared in line with the new amendments to the *Emergency Management Act 2013*. This strategy will help inform the bushfire components of these plans, now and into the future.

For the purpose of the *Code of Practice for Bushfire Management on Public Land (2012)*, the FFMVic Chief Fire Officer has approved the public land components of this strategy: specifically, where the strategy relates to state forests, parks administered under the *National Parks Act 1975* and protected public land. These components of the strategy will directly guide FFMVic's fuel management operations. This strategy replaces the former Strategic Bushfire Management Plans for public land, published by DELWP and PV in 2014 and 2015, which used bushfire risk landscape footprints.

Method overview

This document presents the outcomes of the strategic bushfire management planning process.

The planning process involved considerable community engagement — with individuals, private land managers, businesses, community organisations and other stakeholders — to tap into their knowledge, understand their priorities, discuss and evaluate options with them and prepare to involve them in implementing the strategy.

In the planning process, we:

- identified the values and assets that are most important to the residents of and visitors to the region: we grouped these into human life, communities and economy, cultural heritage and biodiversity and ecosystem resilience

- developed regional objectives: the things we want to achieve by implementing the strategy
- combined local knowledge, bushfire behaviour modelling, historical data and the best-available science to understand how bushfires behave in our region and to forecast bushfire and fuel management strategy impacts on our most important and at-risk values and assets
- developed and evaluated many potential strategies to select two — our fuel management strategy and the Bushfire Risk Engagement Areas (BREAs) — that will enable agencies and communities to best mitigate bushfire risk to the region's most important and at-risk values and assets.

The planning process was underpinned by the International Standard for Risk Management ISO 31000. The standard acknowledges that risk can never be completely eliminated. Bushfires will still occur, and we must all be prepared and ready to respond. However, bushfire risk can be reduced with a high-quality risk management approach.

The planning process followed the principles of structured decision making (SDM). SDM is a framework that helps people unpack complex decisions, navigate trade-offs and make logical and transparent choices. It provides a means of bringing together both scientific information and human values to make decisions, through analysis and inclusive deliberation. The principles of SDM are particularly useful in decision-making contexts characterised by uncertainty, multiple stakeholders and competing objectives. Broadly, the SDM steps included understanding the landscape context, setting objectives, identifying possible management strategies, and estimating and analysing the consequences and inherent trade-offs of these strategy options. We then selected the strategy that gives the greatest benefit to the things we care about, while balancing the impacts of fuel management actions on those same values.

Identifying and assessing risk to values and assets

The planning process identified values and assets across the region and modelled the impact bushfires and fuel management would have on them. Values are the ultimate durable reasons we care about managing bushfires, and assets are the physical sites that represent these values. For example, we value native species, and the locations of their populations and habitat are the assets we protect to ensure their continued existence.

To identify the region's most important values and assets, we consulted with our partners, stakeholders and communities, and we drew on specialised data sets including the Victorian Fire Risk Register – Bushfire (VFRR-B) and Victorian Biodiversity Atlas.

We used Phoenix RapidFire, which is world-leading bushfire simulation software developed in Victoria, to model the spread of a bushfire from an ignition point under specified weather conditions. This enables us to understand the impact bushfires could have on people, homes and other important values and assets in our landscape. We modelled ignitions and bushfire spread patterns at thousands of places throughout the region:

- using ignition likelihood models based on historical ignition characteristics and patterns
- using the bushfire characteristics information in the 'Bushfire history and patterns' section
- under a range of bushfire weather conditions, including Code Red conditions: a Forest Fire Danger Index (FFDI) rating of 130 or above. These were the conditions in many parts of the state on Black Saturday 2009, and conditions were similar at times during the 2019–20 fire season. Code Red conditions are also forecast to become more frequent and more extreme with climate change.

We also used a new 20-year historical weather dataset for Victoria to identify recent changes to the state's climate and so we could better model the average frequency with which various weather scenarios occur. This provided some indication of the likelihood of these scenarios occurring in future. We also partnered with climate scientists to forecast various climate conditions relevant to bushfires which will inform future strategic bushfire risk management planning and preparedness decisions.

Core measures we used in our planning process to predict ecological responses to fire included potential changes to the tolerable fire interval (TFI) and geometric mean abundance (GMA) of species in a community. As part of this planning process high value ecological areas (HVEAs) such as long unburnt areas and fire sensitive ecosystems were excluded from any fuel management activities.

Five distinct sub-landscapes were identified across the Metropolitan region with specific objectives, values, measures and, in turn, strategy options for each. The risk assessment for ecological values was based on information about fire-sensitive ecological vegetation classes, threatened species' habitat, long unburnt areas, growth stage structure (GSS) and TFI. This approach is described further in the 'Public land fire ecology strategies' section of the strategy.

Our landscape context

The Metropolitan region includes all Melbourne: its inner, middle and outer suburbs; its growth areas; and its surrounding peri-urban and rural areas including the Mornington Peninsula, Yarra Ranges, Dandenong Ranges and Western Grasslands. The region has a landmass of 901, 409 ha and is 3.96% of the state's area. Of this, 21% is public land and 79% is private land (**Figure 2**). The region is home to nearly 4.9 million Victorians. The Victorian Government defines three metropolitan emergency management regions: Southern, Eastern, and Northern and Western. The strategies in this document cover those three regions. The region comprises 32 local government areas. The region is home to a variety of essential infrastructure that is of regional, state and national significance including major water supply catchments, roads and railways, as well as iconic assets such as Puffing Billy and scenic old-growth forests that attract visitors from far and wide.

Photo credit: DELWP

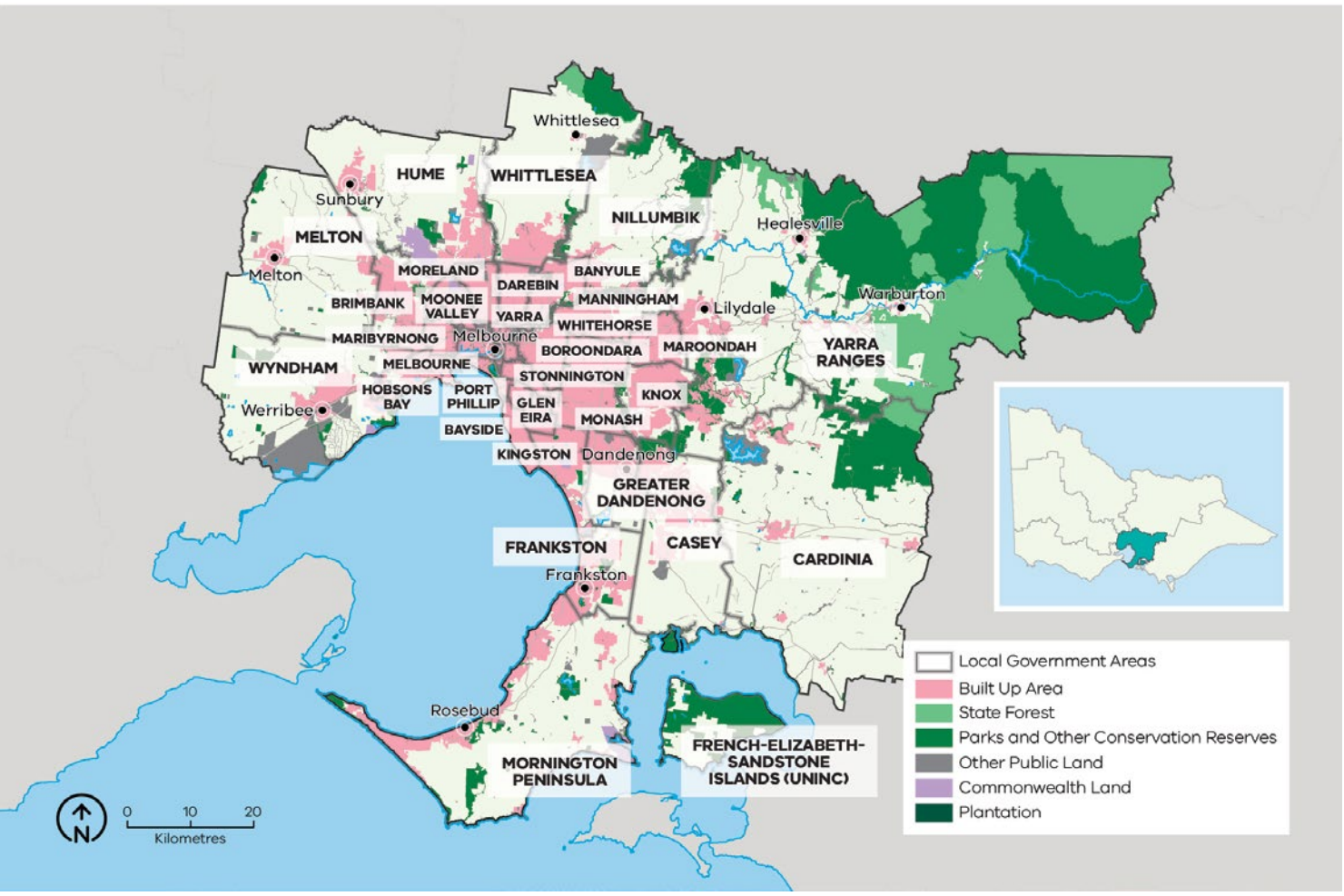


Figure 2. The Metropolitan region with local government boundaries and public land tenure

Metropolitan region profiles

Northern and Western Metropolitan Region

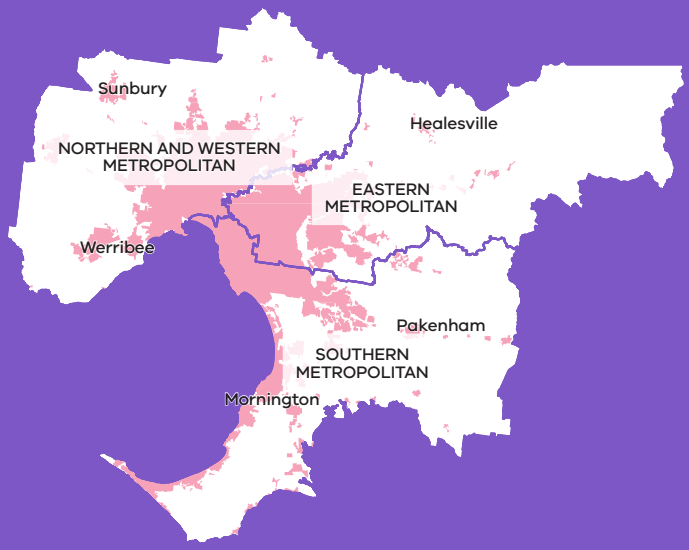
Spanning from the western suburb of Werribee to the inner-north-eastern suburb of Ivanhoe and outer-north-eastern suburb of South Morang, the Northern and Western Metropolitan Region is the most populous of the three metropolitan regions with an estimated resident population of over 2 million people. The region encompasses the southern and western grassy plains and hilly bushland to the north-east, along with significant features including Plenty Gorge Park and Sugarloaf and Yan Yean reservoirs. Major employment industries include health care and social assistance, manufacturing and retail trade, with land uses including farming land for dairy, beef, lamb and dry cropping, market gardens and industry including a range of manufacturing, heavy and light industrial businesses. The region is one of Victoria's highest-growth areas with the population projected to increase to about 2.8 million people by 2036.

Eastern Metropolitan Region

The Eastern Metropolitan Region encompasses the inner-eastern municipalities of Boroondara and Monash through to the Yarra Ranges, taking in the inner-city suburbs of Kew and Hawthorn, the outer-metropolitan suburbs of Ringwood and Boronia and the semi-rural townships of Healesville and Yarra Junction. With an estimated resident population of 1.1 million, the Eastern Metropolitan region's major employment industries match those of the Northern and Western Metropolitan region, with health care and social assistance, manufacturing and retail trade as the top three. The region is characterised by green wedge areas in the eastern peri-urban townships and municipalities, with significant areas including the Dandenong Ranges National Park, Yellingbo Nature Conservation Reserve (NCR), Yarra State Forest and Yarra Ranges National Park, and water catchments including the Upper Yarra, Maroondah and Silvan reservoirs.

Southern Metropolitan Region

Extending from the inner-city municipality of Port Phillip, south through Bayside and along the Mornington Peninsula and east through Casey and Cardinia, the Southern Metropolitan Region hosts an estimated resident population of nearly 1.6 million people. The region takes in the southern section of the Dandenong Ranges, Lysterfield Park, Bunyip State Park and Mornington Peninsula National Park, and numerous smaller peri-urban parks and conservation reserves. The region includes key elements of Victoria's transport, energy transmission and water supply infrastructure including the Cardinia Reservoir. Together with the Eastern Metropolitan Region, the Southern Metropolitan Region is characterised by areas with high tourist populations during the summer months – including the Dandenong Ranges and Mornington Peninsula – and with Casey being among the fastest-growing municipalities in Victoria, the interface between people and the bush and the subsequent risk of bushfire is ever-increasing.



Bushfire history and patterns

Bushfire is a major natural component of the Metropolitan region's landscape. Managing bushfire risk is especially challenging because of the fragmented nature of the landscape and the large areas of public-private land interface.

Bushfire risk is increasing as a result of climate change, population growth and urbanisation, especially in peri-urban and rural areas. Over the past two decades, the Metropolitan region has seen several large-scale bushfires and hundreds of smaller bushfires, with many impacts on people, communities and the environment.

Figure 3 shows areas in the Metropolitan region that have experienced bushfires since 1980. Some are ignited by lightning, but the region has a large population and most fires here have been caused by people. Fires in the region have burnt not just public land but also large areas of private land and numerous assets; including homes, businesses and other property. Fires are generally small, but the region has high population densities and fires can be very destructive with significant consequences.

The region has experienced large bushfires which have burnt through the east and north-east. These have often ignited outside the region and spread into it as northerly or north-westerly winds have blown hot, dry air from central Australia across Victoria. If a bushfire ignites or is already burning, such winds can push fires rapidly south-east, creating a relatively narrow fire front and long fire flanks on their western and eastern sides. Then, an approaching cold front with a strong south-westerly wind can expand a bushfire's eastern flank into a wide front, intensifying the fire. These weather conditions can create a fast-moving bushfire with a powerful convection column — a fast-rising column of smoke, gases, embers, particulates and other debris — which in turn causes extreme fire behaviour and ember storms. Typically, these were the conditions that resulted in large areas of the Metropolitan region being burnt (**Table 2**) in 1939, 1965 , 1983 and 2009 . Most recently, in the summer of 2018–19, the region had two significant bushfires: at Bunyip (15,500 ha) and Cambarville (2,600 ha).

Table 2. Major bushfires impacting Metropolitan region since 1939

Year	Location	Total Size (ha)	Size within Metropolitan region (ha)	Losses (for fires overall)
1939 Black Friday	Noojee, Warrandyte, Yarra Glen, Warburton, Erica	2,000,000	250,000	71 lives, 650 houses *
1962	Mount Dandenong, The Basin, Christmas Hills, Kinglake, St Andrews, Hurstbridge, Warrandyte, Mitcham	30,321	30,321	32 lives, 450 houses
1968	Plenty, The Basin, Upwey	881	881	53 houses, 10 other buildings
1983 Ash Wednesday	Belgrave South, Cockatoo, Beaconsfield Upper, Warburton, Powelltown	50,800	50,800	47 lives, 2,000 houses or other buildings
1997	Dandenong Ranges, Arthurs Seat	569	569	3 lives, 41 houses
2009 Black Saturday	Kilmore East, Kinglake, Marysville, Yarra Valley, Dandenong Ranges, Narre Warren, Upper Ferntree Gully, Wilsons Promontory, Bunyip State Park	232,300	73,000	173 lives, 2,007 houses *
2019	Bunyip, Cambarville	18,100	18,100	29 houses, 67 buildings

**Most losses occurred outside of the Metropolitan Region.*

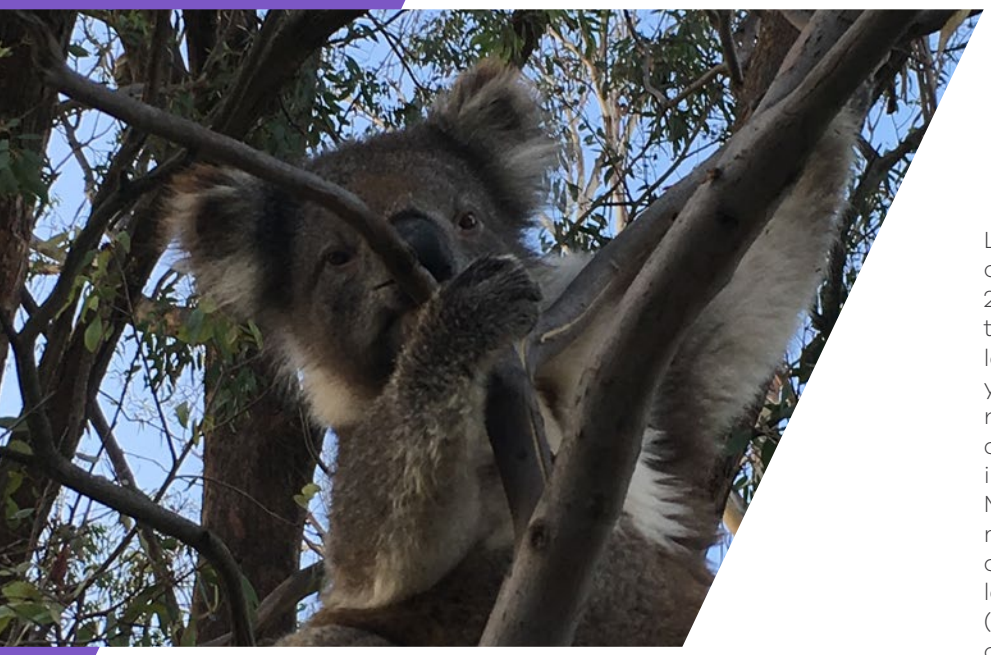


Photo credit: James Allen

Large areas on the northern edge of the region were impacted by the 2009 Black Saturday fires. While these fires reduced fuel over these large areas, fuel accumulation each year since 2009 means that bushfire risk has risen and is predicted to continue rising. This is also the case in Hume region, which borders the Metropolitan region to its north, where much of the bushfire risk to the region comes from: the Hume region includes large areas of wetter forest types (such as east of Healesville and north of Warburton) that stay too damp to treat with planned burning.

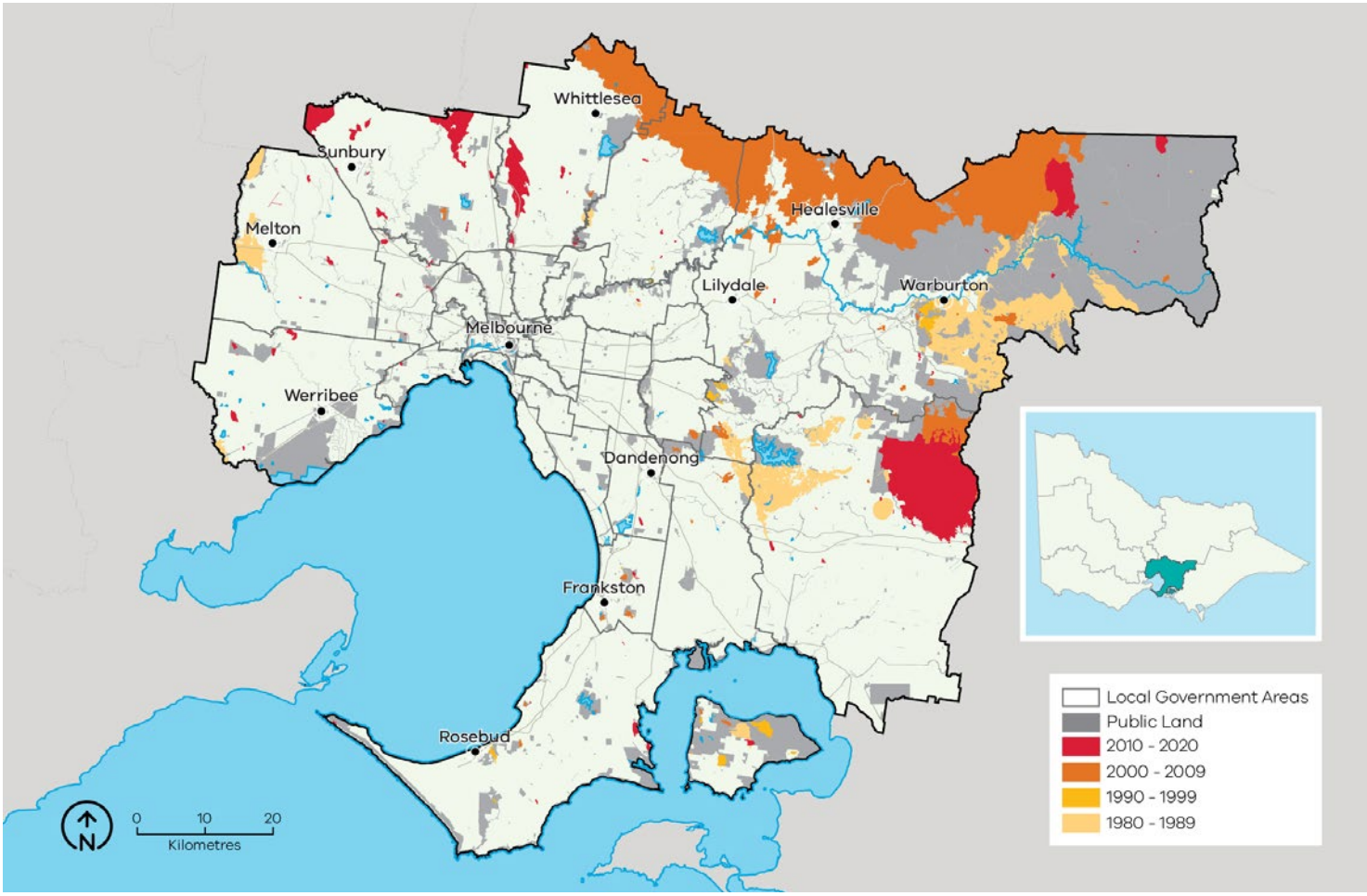


Figure 3. Map of bushfire history for the Metropolitan region, 1980–2020

Values and assets

Here we describe the most important features of our landscape that informed our strategy.

Human landscape

Life and property

The Metropolitan region is divided into three sub-regions: Southern, Eastern, and Northern and Western. Within these sub-regions, there are 32 local government areas. Over the next 40 years, the population of the Metropolitan region is forecast to increase from almost 5 million to 8 million people. The age profile is getting younger, and there is rapid socio-economic and demographic change, especially in peri-urban and rural communities. Melbourne is the fastest-growing city in Australia and will soon overtake Sydney as the largest city in Australia. By 2031, greater Melbourne is expected to add 790,000 dwellings, with a high proportion of these being located in the outer growth areas.

Future development within the Metropolitan region is led by Plan Melbourne, which sets out the framework for future land use.

Critical infrastructure

The region is home to infrastructure of regional, state and national significance (**Figure 4**). It contains the Cardinia, Silvan, Yan Yean, O'Shannassy, Maroondah, Sugarloaf, Greenvale and Upper Yarra reservoirs that are essential to Melbourne's water supply. There are several high-voltage power lines including from Melbourne to the Latrobe Valley and from Melbourne to Albury. Other critical infrastructure includes the communication towers on Mount Dandenong, which are used to broadcast television, radio and emergency services radio. Metropolitan, regional passenger and national freight railways from Adelaide and Sydney also pass through the region. There are three zoos in the region, which are home to captive populations of nationally and internationally threatened species.

Figure 4. Critical infrastructure, assets, systems and networks in the Metropolitan region

Economic values

Major industries in the Metropolitan region are tourism, agriculture, forestry, fishing, healthcare, social assistance, manufacturing, construction and retail trade (**Figure 5**). Many industries are important in the region, but not many are considered highly vulnerable to direct fire impacts. Industries such as tourism, agriculture and vineyards are vulnerable not only to large-scale bushfires, but also to smaller-bushfire impacts; including road closures, power failures, and in the case of vineyards the impacts of smoke.

Tourism is particularly important to the region, with part of the appeal for people either living in, or travelling to, the outer metropolitan area being the experience of nature that they can have. Many areas are of high natural scenic quality and are spiritually appealing (such as old-growth forest and areas where people can encounter wildlife). These can all be severely affected by bushfire. The region is home to many iconic assets important to its tourism industry including Puffing Billy and Arthurs Seat Eagle as well as picnic sites, walking tracks, waterfalls, zoos, wildlife sanctuaries and bike tracks (such as the Lilydale to Warburton Rail Trail).

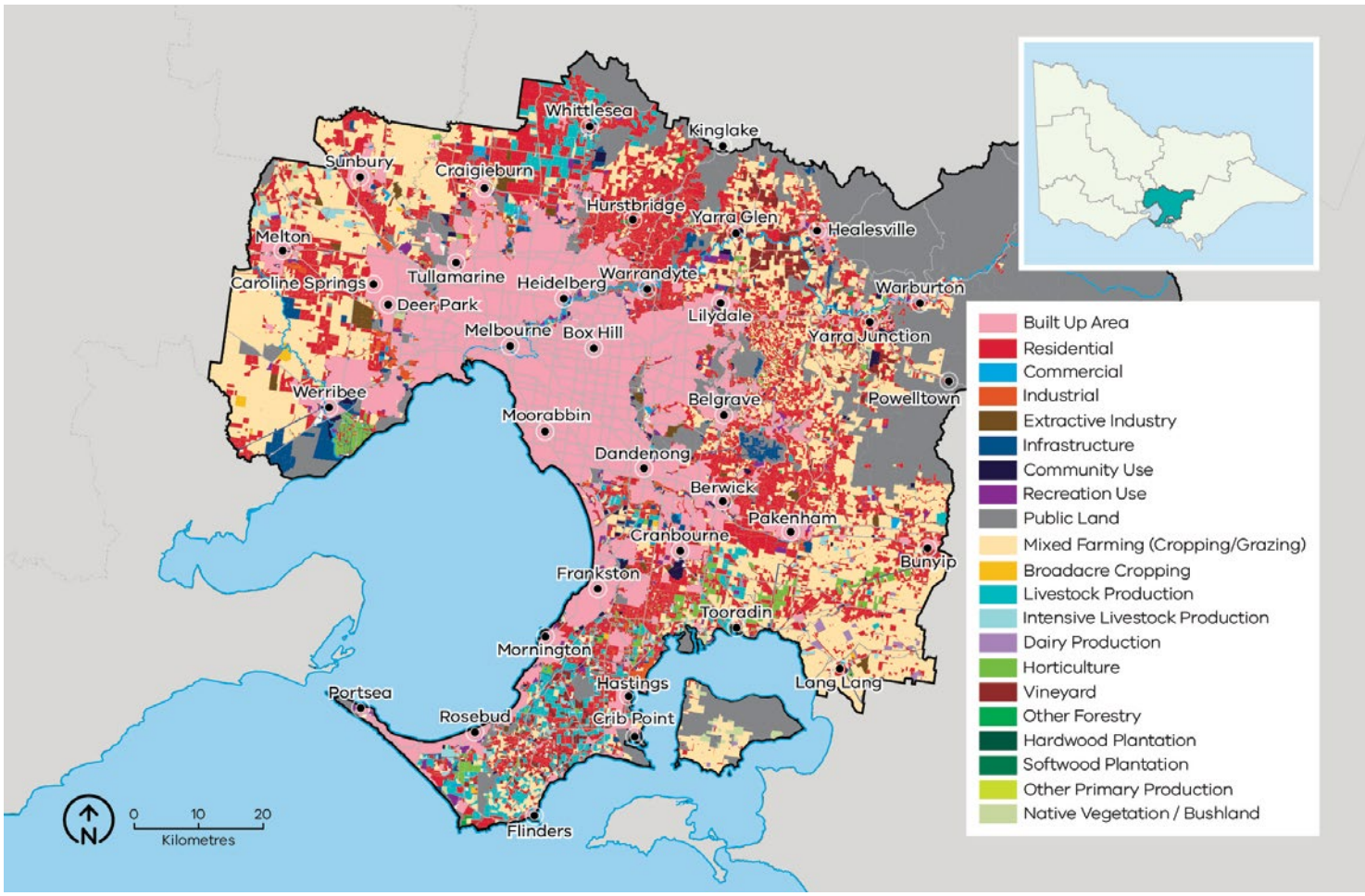


Figure 5. Generalised land use in the Metropolitan region

European cultural heritage values

There are many European heritage sites in the region that have a high level of importance to local communities. These sites include places of aesthetic, archaeological, cultural and scientific importance. There are over 15,000 sites in the region that have been registered with Heritage Victoria including historic buildings and building remains, avenues of honour, refuse dumps, structures and precincts, archaeological and artefact sites, mining and timber sites, railways, bridges, shrines, gardens, trees and cemeteries.

Aboriginal cultural heritage

The Metropolitan region includes tens of thousands of Aboriginal heritage sites, and more than 19,000 of these are listed on the Victorian Aboriginal Heritage Register. Sites include artefact scatters, object collections, earth features, scarred trees, shell middens, stone features and ancestral remains. There are also many known Aboriginal cultural and historic places. It is also acknowledged that cultural heritage management involves not only managing for known sites but includes an understanding of the intrinsic connection to the landscape that Traditional Owners in the Metropolitan region have.

Cultural heritage management practices implemented as part of strategic bushfire risk management planning include site identification, the development and implementation of protection measures, and contingency planning to avoid harm. Management practices also consider areas which are more likely to contain Aboriginal heritage or be of cultural significance; including natural landmarks and waterways. The planning process also actively supports and encourages the aspirations of Traditional Owner groups to re-engage in cultural fire practices.

The Traditional Owner groups that agencies in the Metropolitan region currently work in partnership with include Bunurong Land Council Aboriginal Corporation, Taungurung Land and Waters Council, Boon Wurrung Foundation, Wathaurong Aboriginal Co-Operative and Wurundjeri Woi-wurrung Cultural Heritage Aboriginal Corporation. **Figure 6** shows Registered Aboriginal Parties (RAP) in the region.

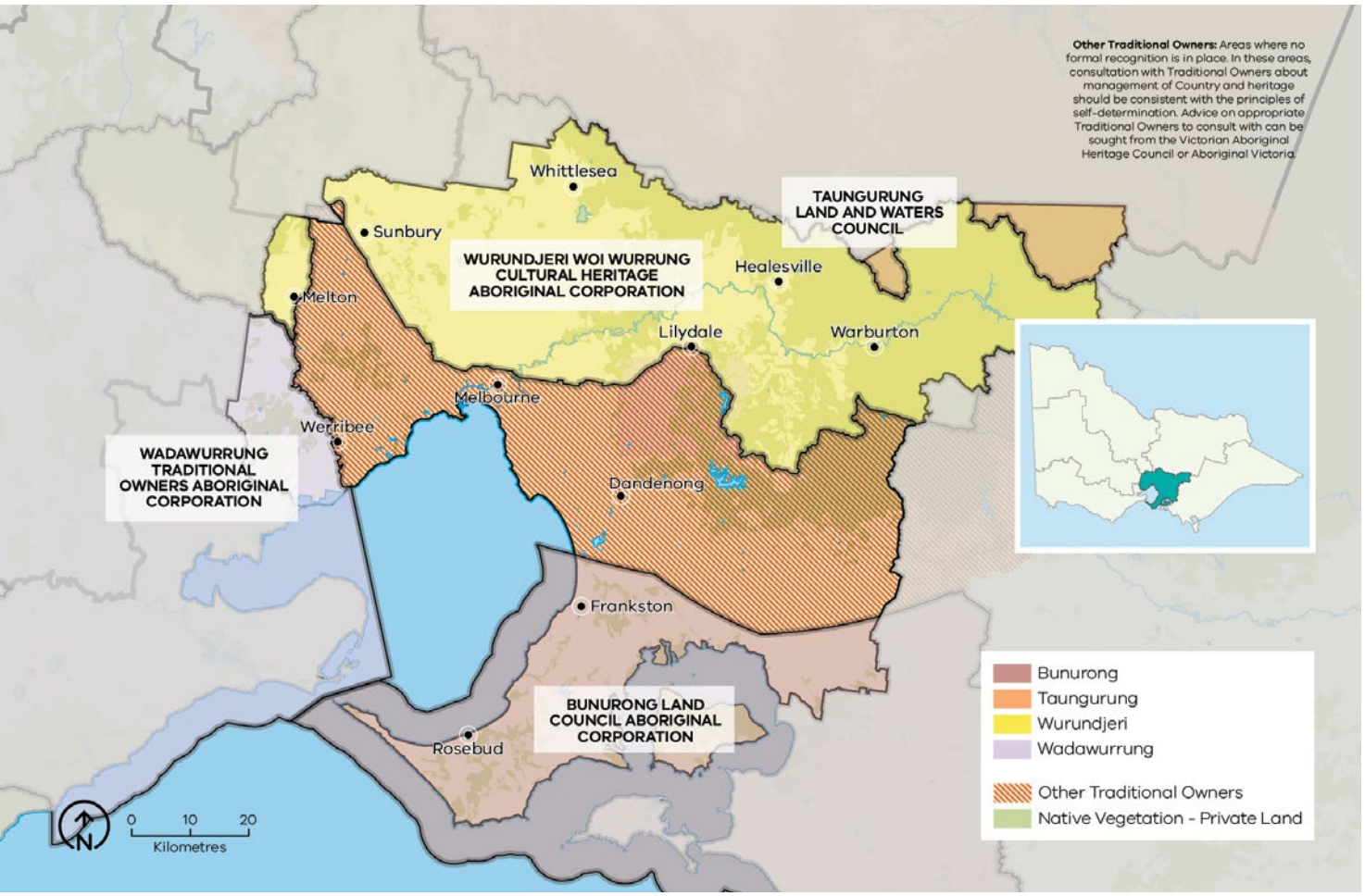


Figure 6. Traditional Owner groups in the Metropolitan region

Natural landscape

Natural landscape

The region's 236,600 ha public land estate is comprised of a network of parks and reserves and state forest including smaller parks and water frontages. The reserve network is built upon the national criteria for a comprehensive, adequate and representative (CAR) reserve system of Australia's forests (**Figure 7**). Parks and reserves are primarily managed for nature conservation, ecosystem services and recreation. State forest is managed for a greater diversity of purposes including biodiversity conservation, water catchment services, timber harvesting, firewood production, minor produce and apiary use. Recreation and tourism are also an important and increasingly popular use of state forest, with many active and passive pursuits commonplace across the Metropolitan region.

The Metropolitan region extends from the Western Grasslands across the inner-metropolitan area to the fragmented parks of the Dandenong Ranges and into the mixed and Ash forests in the east.

The region is one of the most biodiverse areas in Australia and home to many threatened species and communities. A large area of endangered grassland in the west is progressively being reserved, and it will eventually cover some 15,000 ha. The region's vegetation varies from tall, wet forests in the east to drier foothill forests and redgum woodlands and grasslands further west, and there are coastal vegetation communities around the bays.

The region is home to Victoria's faunal emblems — the Leadbeater's possum and the Helmeted honeyeater — as well as other threatened species and communities (**Table 3**). Many flora and fauna species have become rare or threatened as a result of land use changes due to human settlement. In some parts of the landscape, native vegetation has been highly fragmented as a result of clearing for agriculture or housing. Small fragments are less able to support plants and animals, and they are less resilient to disturbance. The remaining fragments have a high biodiversity value.

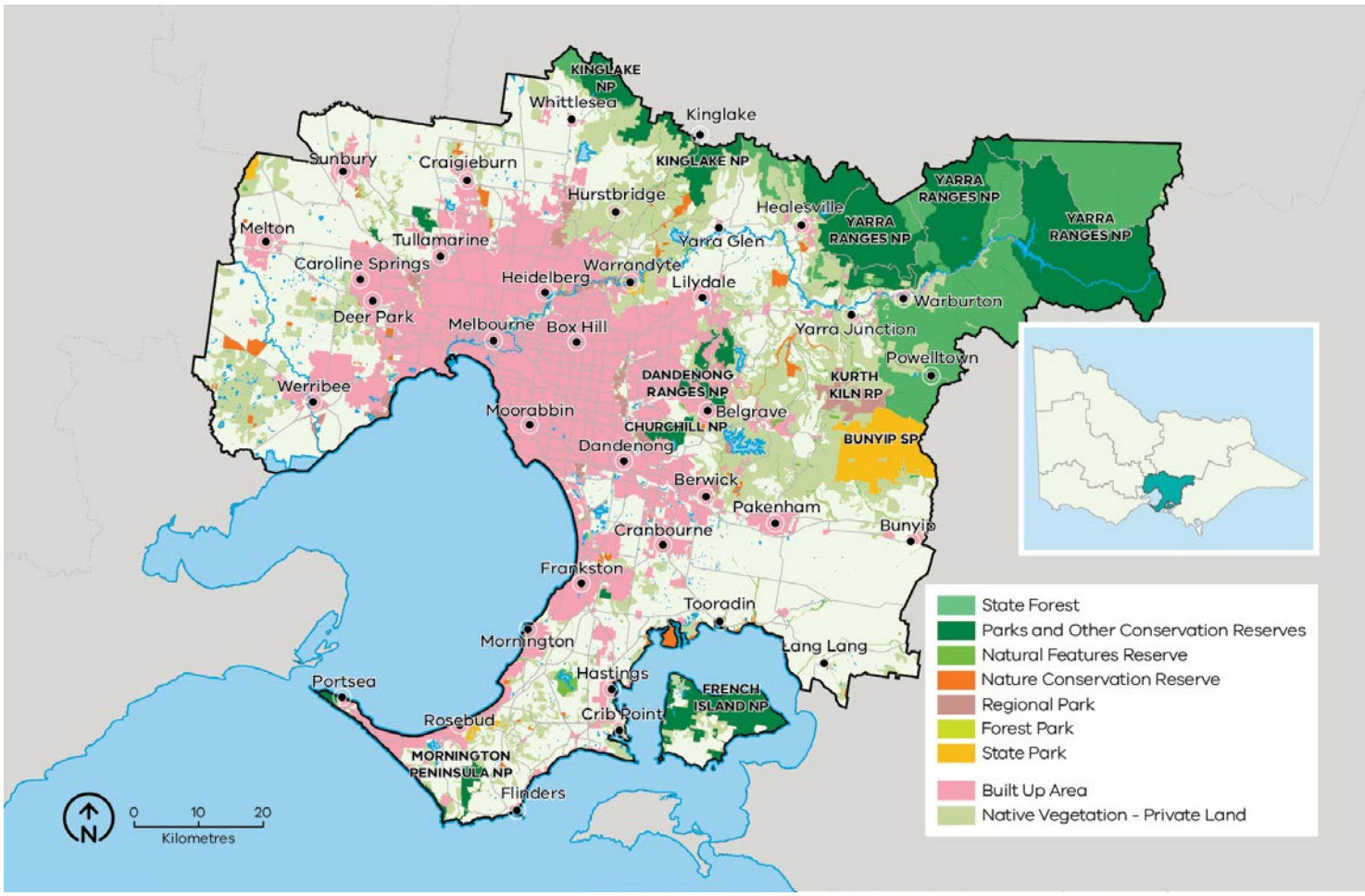


Figure 7. Public land in the Metropolitan region

Table 3. Ecological values in the Metropolitan region

Ecological values		
Longest-unburnt sites		
Fire-sensitive flora (threatened ecological vegetation classes)		
Fire-sensitive fauna (threatened species and species assemblages)		
Forests values • Leadbeater's Possum • Smoky Mouse • Helmeted Honeyeater • Greater Glider • Southern Brown Bandicoot • Longest-unburnt areas	**French Island values** • Eastern-barred Bandicoot release site at Bluegums • Long-nosed Potoroo • White-bellied Sea Eagle nesting and roosting sites • Koalas • King Quail • Various orchid species including French Island Spider Orchid • Heathland floristic diversity • Nesting bird habitat for various species	**Grasslands values** • Grassland and Grassy Woodland communities • Button Wrinklewort • Golden Sun Moth • Spiny Rice Flower • Sunshine Diuris • Striped Legless Lizard • Fat-Tailed Dunnart • Grassland Earless Dragon • Large-fruit Groundsel • Matted Flax-lily • Small Scurf-pea • Curly Sedge • Small Milkwort

Eastern Grey Kangaroo.
Photo credit: Jacque Quaine

Photo credit: Penny Orbell

Our objectives

What matters most in the Metropolitan region is discussed in the landscape context section and is summarised into the following fundamental values:

- human life, communities and economy
- cultural heritage
- biodiversity and ecosystem resilience.

These values are the ultimate, durable reasons why we care about managing bushfires, and they are what we want to protect and manage through bushfire management in the Metropolitan region.

The following regional objectives are derived from our values and articulate what we are aiming to achieve in the Metropolitan region (**Table 4**). These objectives contribute to the overall objectives for fire management articulated in the three regional strategic fire management plans for the Metropolitan region: prepared by the Northern and Western, Eastern, and Southern Metropolitan Regional Strategic Fire Management Planning Committees.

Table 4. Metropolitan region's values and objectives and how they align with the statewide vision, policy context and strategic objectives

Vision		
Safer and more resilient communities		
Policy context		
The Victorian Preparedness Goal is *A safer and more resilient community that has the capabilities to withstand, plan for, respond to and recover from emergencies that pose the greatest risk.* The Safer Together policy's four priorities for reducing the risk of bushfires in Victoria are *Community first, Land and fire agencies working together, Measuring success and Better knowledge = better decisions.*		
Strategic objectives (Code of Practice for Bushfire Management on Public Land)		
• To minimise the impact of major bushfires on human life, communities, essential and community infrastructure, industries, the economy and the environment. Human life will be afforded priority over all other considerations. • To maintain or improve the resilience of natural ecosystems and their ability to deliver services such as biodiversity, water, carbon storage and forest products.		
Metropolitan region values		
Human life, communities and economy	**Cultural heritage**	**Biodiversity and ecosystem resilience**
Metropolitan region objectives		
• To minimise the loss of human life, houses and properties • To minimise disruption to essential services and critical infrastructure • To minimise the social impacts of bushfires and fire management actions • To increase community understanding and ownership of bushfire risk management	• To minimise the impacts of bushfires and fire management actions on cultural heritage	• To maximise the persistence of ecological communities and species • To minimise declines in threatened species and communities • To minimise declines in plant and animal populations including threatened species and communities from bushfires and fire management actions • To avoid declines in carbon storage • To maximise water yield and quality

Our risk management approach

In hot, dry and windy conditions, a bushfire can travel quickly across a large area of our landscape. To effectively understand bushfire risk, we simulate many bushfires across the entire landscape to determine where bushfires are likely to start, spread and cause damage to values and assets, with a particular focus on people and communities. We can then reduce fuel hazard across the spread paths of these simulated bushfires with the intention of reducing the spread and intensity of these fires and ultimately limiting their impacts.

Risk in the Metropolitan region

Figure 8 shows the risk of house loss in the Metropolitan region. It compares where houses could be destroyed by bushfire across the region.

Different shades represent different levels of risk. As the shades progress from yellow through red to purple, more and more houses are potentially destroyed. The purple areas represent the top 5% of risk in the Metropolitan region. More houses could potentially be destroyed in these areas than in any other part of the Metropolitan region.

While bushfire risk exists across the entire landscape and house loss can and will occur in other areas, this map shows where the greatest 70% of house loss risk sits within our region.

Bushfire simulations generated by Phoenix RapidFire illustrate risk by showing where significant impacts on houses may occur. Simulations are undertaken using a range of different weather conditions, likelihood of an ignition, maximum fuel loads and limited bushfire suppression.

This helps us plan where, how often and how much fuel management we do to reduce risk to communities over years, or even decades.

This map does not reflect any recent bushfires or activities that could change the risk in the region. Importantly, this map shows where there is potential to destroy more houses compared to other parts of the region. It does not show risk to individual houses.

Photo credit: DELWP

Higher risk areas in the Metropolitan region

The Dandenong Ranges, Warburton Valley and the Warrandyte area are examples of high bushfire risk places in the Metropolitan region.

The Dandenong Ranges has highly populated residential areas among the forest, few escape routes and densely forested areas to the north and west of the area. Fire history and our fire modelling tell us many fires can impact the Dandenong Ranges and cause significant house loss.

Most towns within the Warburton Valley have large areas of forest to their north and east, with some completely surrounded by forest. Most of the forested areas are Ash forest which cannot be treated by fuel management. The risk is therefore present but cannot be treated. The Warburton Valley has limited access and egress as there is one primary route, the Warburton Hwy/Woods Point Rd, which is predominately a two-lane road. Our fire modelling indicates that bushfires which ignite north west of the Warburton Valley have a high likelihood of causing significant house loss.

The Warrandyte area (Nillumbik Shire and Manningham Council) is densely populated with towns interspersed within forested areas like St. Andrews, Wonga Park, Warrandyte and towns on the urban interface. The area is surrounded by a mixture of forested area and grasslands. The majority of the vegetation in the area is on private land which restricts the ability for public land managers to reduce risk through fuel management. Bushfires which ignite in this area and to the north/ north west in Hume region pose significant threat and are likely to cause significant impacts.

Lower risk areas in the Metropolitan region

In comparison, the Western grasslands within our region are lower risk, as they are dominated by grass not forest. While grassfires burn quickly, compared to forest fires, prediction modelling and fire history indicates they are less likely to result in house loss. Townships like Werribee, Sunbury, Melton and Craigieburn are at risk from grassfires.

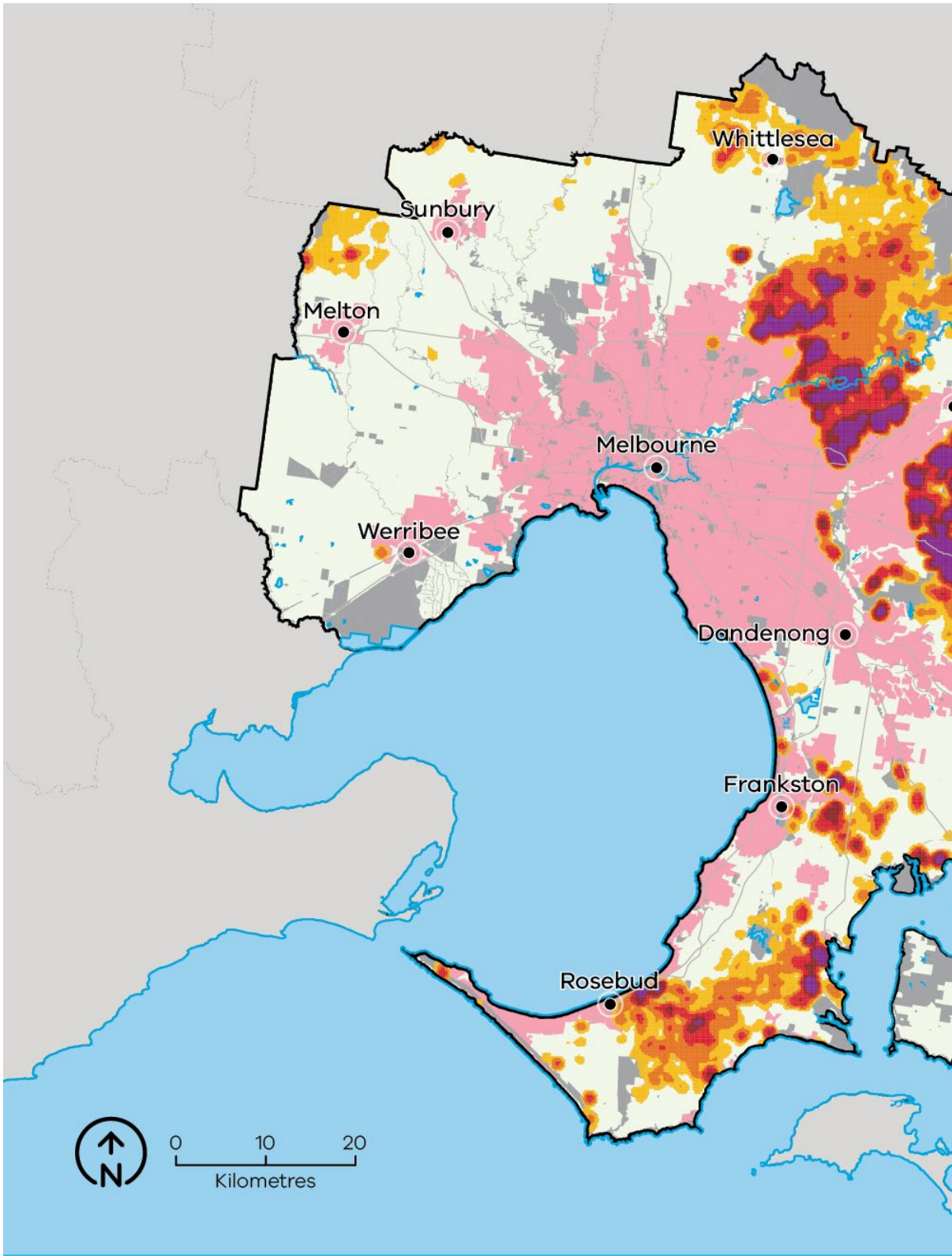
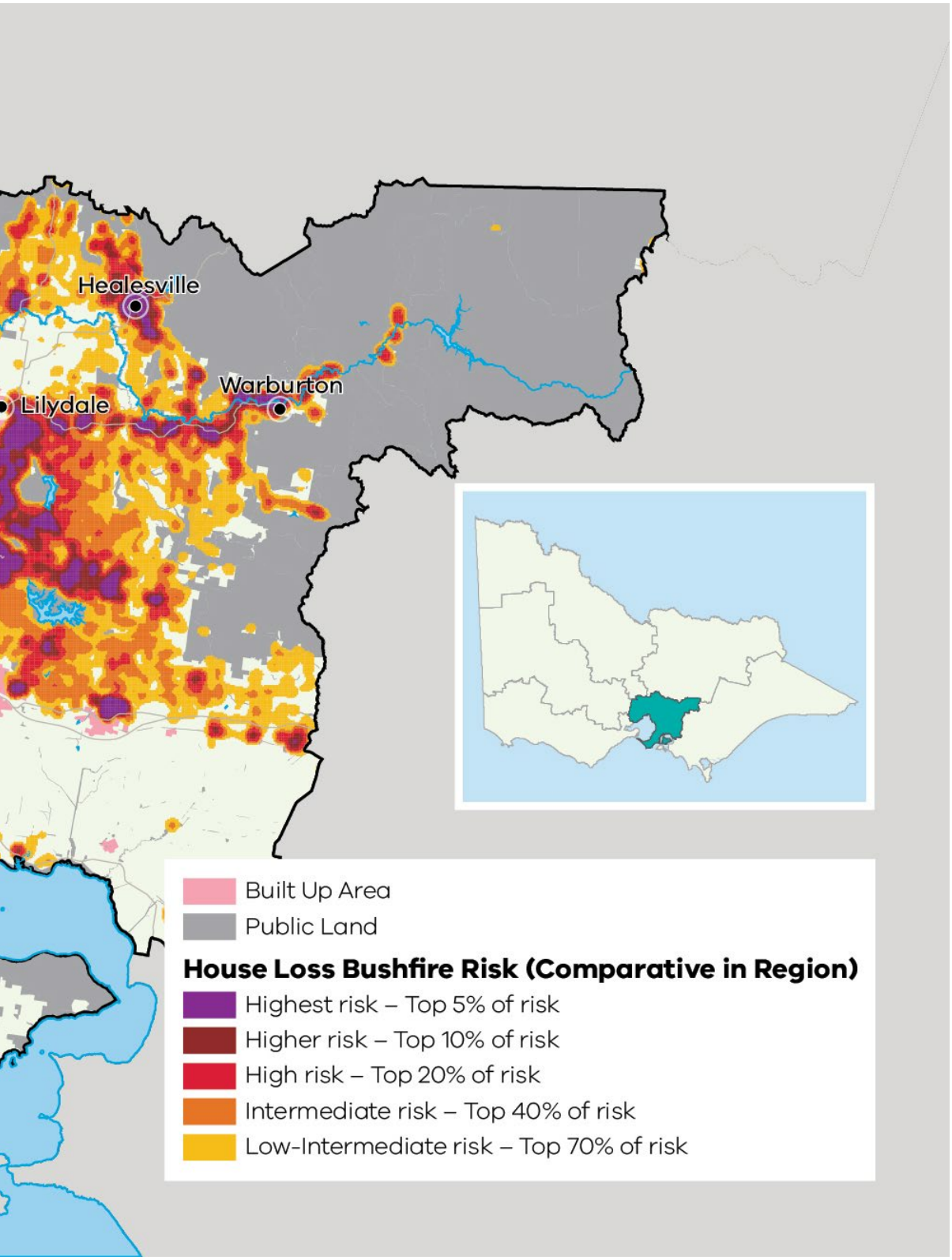


Figure 8. Bushfire risk within the Metropolitan region. This map only considers modelled house loss within the Metropolitan region, and so risk shown on this map can only be compared within this region.


Healesville
Warburton
Lilydale
Built Up Area
Public Land
House Loss Bushfire Risk (Comparative in Region)
Highest risk – Top 5% of risk
Higher risk – Top 10% of risk
High risk – Top 20% of risk
Intermediate risk – Top 40% of risk
Low-Intermediate risk – Top 70% of risk

Why model house loss?

Human lives are given priority over all other considerations, however we cannot know exactly where people will be in the event of a bushfire. Simulations of house loss help to identify areas across our landscape where bushfires could have the greatest potential impacts on lives, as well as on other things we value such as our homes themselves, livelihoods and communities. This also reflects the importance of homes as a primary place of shelter and residence. The simulated house loss shown in **Figure 8** indicates where these areas are and the possible scale of bushfire impacts relative to other parts of our region. We consider these impacts when developing fuel management strategies for the values and objectives in our region. We can model how our strategies improve the outcomes by reducing bushfire risk to people's homes, and the social values connected with them. House loss informs one of our key metrics — 'residual risk'— by which we assess the effectiveness of our fuel management strategies. The residual risk metric is explained in more detail under the section Our fuel management strategy.

How do we model house loss?

We compare the characteristics of bushfires that are simulated in Phoenix RapidFire with those that led to actual house loss in historic bushfires. Our model assumes houses (based on address points) are destroyed by a simulated bushfire if the modelled fire intensity exceeds 10,000 kilowatts per metre (generally a crown fire) or if ember density exceeds 2.5 embers per square metre. Research indicates that bushfire embers account for the majority of houses lost, with most occurring within 1 km of the edge of forested areas and native vegetation (although house loss still occurs beyond this distance). This is consistent with our modelling which shows similar patterns of house loss. Other fire behaviour factors can have a strong influence on house loss (such as convective strength of the fire), and they are being further researched to understand this risk.

We estimate the magnitude of property impacts by analysing how many houses are modelled as destroyed under all of our simulated bushfires. We can compare between communities to understand which are more likely to suffer large numbers of houses lost.

It is important to note that the modelled property impact is only a coarse estimate and should not be applied at the individual house level. The vulnerability of a house also depends on other factors: its building materials, design and maintenance, how close it is to combustible elements, the presence of human intervention (before, during and after a fire) and the environment in which a bushfire occurs. These factors cannot all be modelled in landscape scale simulations. However, over time they can be included in statistical models, to improve estimates of potential house loss.

Photo credit: Penny Orbell

Our fuel management strategy

Our fuel management strategy describes our approach to balancing the threats posed by bushfire to our most important values and assets, with managing fire to enhance the health and resilience of ecosystems. It responds to the Metropolitan region's unique bushfire risk profile, determined through our risk assessment process.

Fire Management Zones

The fuel management strategy is presented as an arrangement of different Fire Management Zones (FMZ) on public land, as described in the Code of Practice for Bushfire Management on Public Land (2012). There are four zones – Asset Protection Zone (APZ), Bushfire Moderation Zone (BMZ), Landscape Management Zone (LMZ) and Planned Burning Exclusion Zone (PBEZ). Although the name of the zone indicates the primary purpose of that zone, it is recognised that multiple goals can be achieved when undertaking activities in each zone. For example, a burn undertaken primarily for land management purposes may also have asset protection outcomes.

Bushfire risk mitigation outcomes are the primary purpose of Asset Protection Zones. Ecological outcomes are still considered, but the protection of life and property is the priority for the management of these zones. This emphasis gradually shifts through the Bushfire Moderation Zone and the Landscape Management Zone, such that the primary focus of the Planned Burning Exclusion Zone's is ecological outcomes. It is important to note that although the Bushfire Moderation Zone has a stronger bushfire risk mitigation focus than the Landscape Management Zone, there is still a focus on risk mitigation in the LMZ. Fuel management is often scheduled in the LMZ to complement that which has been undertaken in BMZ and APZ and enhance the risk reduction that can be achieved across the whole landscape. In Metropolitan region, most risk reduction to life and property is achieved through fuel management in APZ and BMZ, enabling a stronger focus on ecological outcomes in the LMZ. Where there is a demonstrated outcome for risk reduction, fuel management can happen in the LMZ to support risk reduction objectives of the surrounding BMZ and APZ, including the protection of water catchments and high value ecological areas. In some areas, communities may see fuel management works occurring in nearby forest most years. This may be because we are delivering a multi-year planned burn, where some fuel types or areas of the burn are targeted in one year, and a different fuel type or area targeted the next year. It may be because we are burning in adjacent blocks to those previously treated, to ensure the highest level of protection to a town or other assets. If we undertake mechanical treatments such as slashing in an area, fuels often re-accumulate quickly and treatments need to be repeated.

Photo credit: Jo Wand

The aims of each zone, how they have been placed and how they will be implemented in the Metropolitan region is described further in **Table 5**.

The Metropolitan region's FMZs were reviewed and updated through an earlier strategic planning process in 2016-17, using a risk-based approach and internal and external expertise. The outcomes of that previous process are still being implemented, so the region's FMZs were not changed as part of the 2017–19 strategic planning process.

The FMZ configuration for public land in the Metropolitan region is shown in **Figure 9**.

Photo credit: Michael Jones

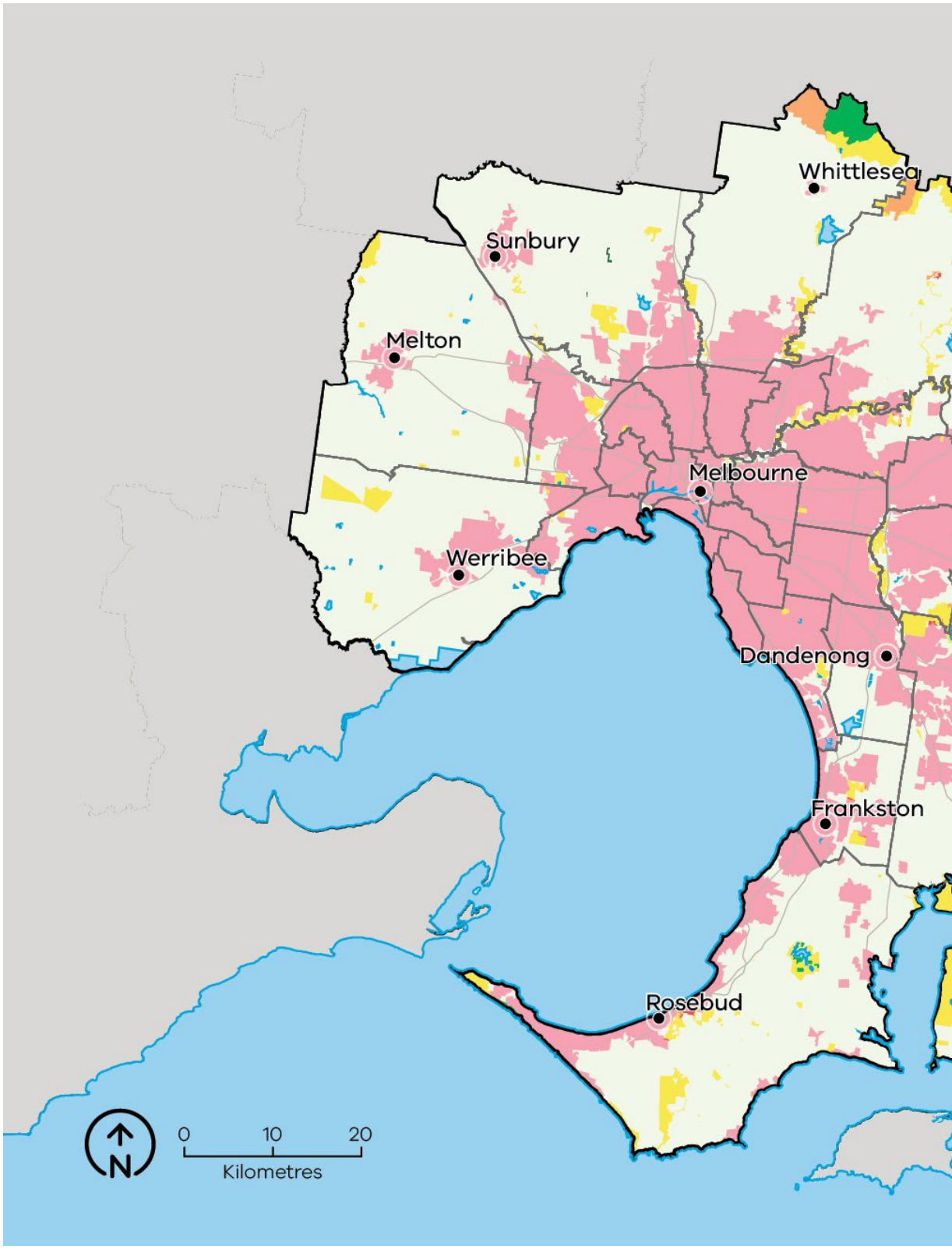


Figure 9. Fire Management Zones for public land in the Metropolitan region. This zoning configuration was developed through risk assessment processes and in consultation with key delivery partners.

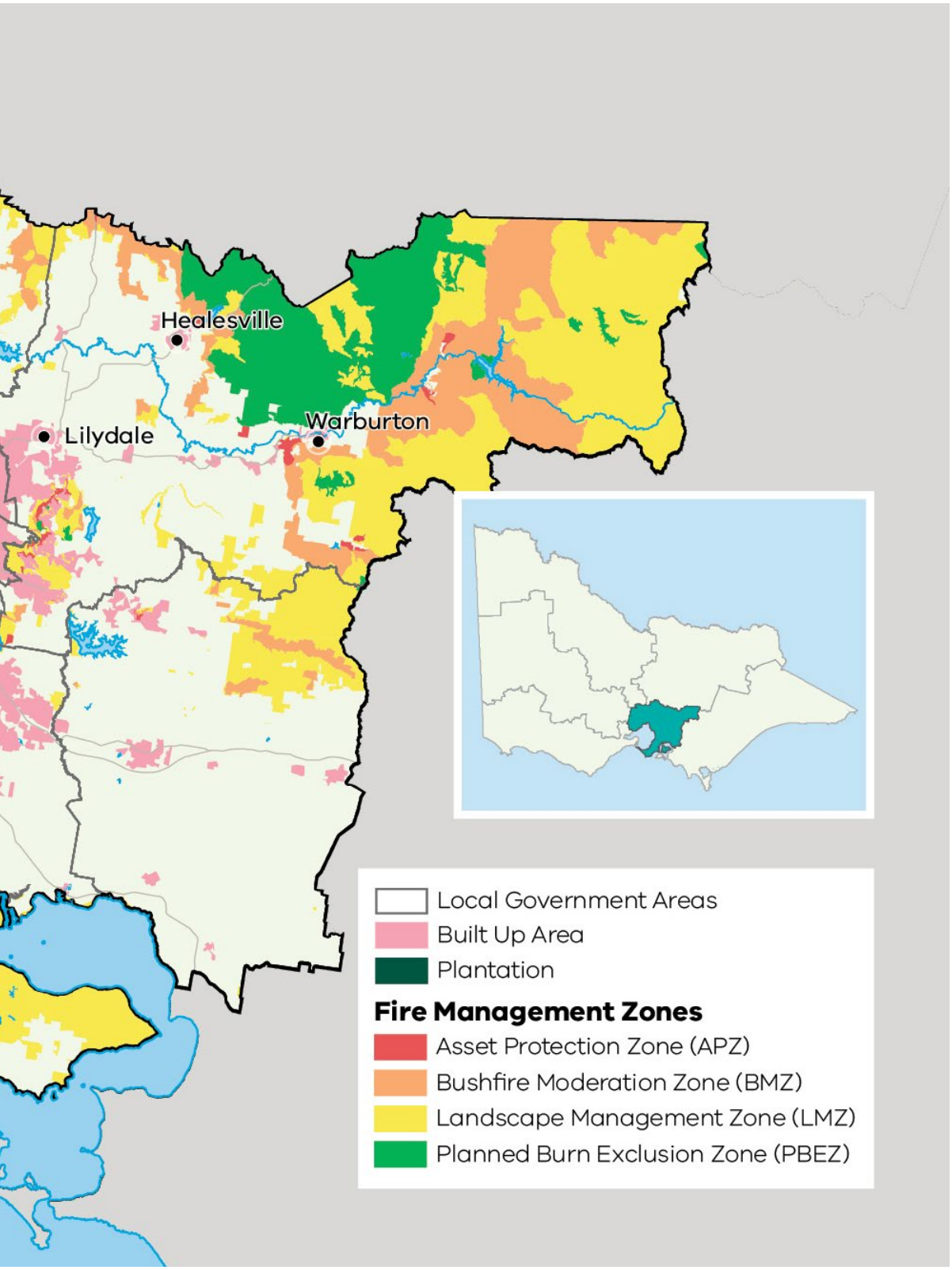

Healesville
Lilydale
Warburton
Local Government Areas
Built Up Area
Plantation
Fire Management Zones
Asset Protection Zone (APZ)
Bushfire Moderation Zone (BMZ)
Landscape Management Zone (LMZ)
Planned Burn Exclusion Zone (PBEZ)

Table 5. Description of the aims, placement, planned fire intervals and typical outcomes of fire management zones for public land in Metropolitan region. This is a description of typical features of these four zones, consistent with the aims of the zones in the *Code of Practice for Bushfire Management on Public Land (2012)*.

	Asset Protection Zone (APZ)	Bushfire Moderation Zone (BMZ)	Landscape Management Zone (LMZ)	Planned Burning Exclusion Zone (PBEZ)
Aim	Provide localised protection to human life, property and key assets.	Reduce the speed and intensity of bushfires. Achieve ecologically-desirable outcomes where possible.	Reduce overall bushfire hazard at landscape-scale; support ecological resilience and land-management objectives.	Exclusion of planned burning from areas primarily intolerant to fire.
Typical placement	Where most effective to reduce overall bushfire risk; typically, smaller burn units on the public/private interface.	Near public/private interface or key assets, or strategic placement to inhibit spread of large fires.	Rest of landscape not covered by APZ, BMZ or PBEZ. Largely covered by fire-intolerant vegetation communities.	Burn units wholly or largely covered by vegetation communities less tolerant of fire.
Typical planned fire interval	5 to 8 years.	8 to 15 years.	Varies depending on land-management and fire-management objectives.	Not applicable.
	These intervals are indicative only to help provide an understanding of time between planned fire in each zone. Planned fire intervals for each zone are determined by fuel hazard (type, size, arrangement and quantity) triggers to achieve fuel treatment outcomes in each zone. Actual planned fire intervals may be more or less frequent depending on previous fire severity and coverage, vegetation type, climatic and seasonal conditions and actual rate of fuel re-accumulation. It is also important to note that some burns are conducted in multiple stages and sequenced with other burns in the landscape to form a landscape mosaic, meaning that planned burning operations can occur in the same area over successive years. Some areas, especially in APZ, are treated with mechanical treatments which may occur more frequently.			
Fuel treatment goal	Reduce radiant heat and ember attack.	Complement APZ goals and reduce bushfire spotting.	Reduce treatable fuels and achieve ecologically beneficial fire intervals.	Not applicable.
Typical fuel treatment outcomes	Intensive treatment; 80–100% burn cover, with reduction of bark fuel hazard a priority. In some cases, mechanical treatment as alternative or complementary.	Moderately intense treatment, seeking a significant reduction of fuel hazard over a majority of treatable fuels within the burn unit. Coverage targets typically 50–70%.	Varies depending on land-management and fire-management objectives. Generally, involves burning at low intensity, with less than 50% burn cover.	No planned fire.

Ecosystem resilience

An ecosystem's resilience is its capacity to withstand and recover from a range of disturbances, including fire. We cannot measure ecosystem resilience by looking at a single species or fire event: we must look at the whole landscape, and at multiple fires with various frequencies, intensities, scales and seasons of burning. Tolerable fire intervals (TFIs) are the minimum and maximum recommended times between fire events for a particular ecological fire group. Burning regularly outside these intervals increases the risk that there will be fundamental changes in the abundance and composition of species, and the type of vegetation. Growth stage structures (GSS) describe the mix of habitats available across a particular landscape or vegetation type.

In our fuel management strategy, TFI has been used as a tool to guide where burning can occur that has the least amount of impact on a vegetation community. The strategy aims to minimise the total area burnt below minimum TFI because fire can affect overall ecosystem resilience if it occurs too frequently. However, planned burning may be conducted in some areas below minimum TFI to reduce bushfire risk to life, property and important ecosystems.

Larger and more intensive bushfires have a significant impact on ecosystem resilience. Planned burning may also be conducted below minimum TFI to reduce the size, severity and frequency of large bushfires. There will be instances in the footprints of past large bushfires where fuels re-accumulate and become flammable before ecological maturity is reached. Fire is also reintroduced in these areas below minimum TFI to prevent large bushfires reoccurring, which can be more likely due to fuels loads being the same across a broad scale area. Burning below minimum TFI will have shorter term or localised impacts on vegetation communities, however we also need to compare this with how they would be impacted should a major bushfire occur.

We recognise that TFI is a broad measure of ecosystem resilience and there are finer-scale vegetation responses to differing severity of planned burning and bushfires, however it can help us with regional-scale planning.

We are continuing to improve our understanding of TFIs by monitoring the responses of different species of vegetation to differing fire severity, and by investing in research that improves our ability to predict these responses. We are also improving the TFI mapping by using species distribution models for key flora species on which minimum TFIs are based. This enables TFIs to be mapped more accurately.

About our fuel management strategy

Our fuel management strategy meets the Metropolitan region's objectives by:

- focusing on fuel treatments where they will be most effective in reducing the impacts of bushfire on people and communities. This is done by (i) configuring the distribution of the APZ and BMZ using a combination of computer risk modelling and local knowledge, and (ii) reviewing bushfire risk levels across the landscape annually to inform the nomination and prioritisation of planned burns via the JFMP. In other words, there is a 'broad plan' for the landscape reflected in the FMZ system (**Figure 9** and **Table 5**), but also regular updating (following bushfires and planned burning) to ensure we are targeting planned burning where it is most effective for reducing risk.
- minimising the area burnt below minimum TFI, where this does not prevent us from delivering other objectives (including reducing overall fuel and bushfire hazard in the landscape or for protection of water catchments, for example). In the APZ and BMZ, our focus on reducing risk to people and assets will involve repeatedly burning below minimum TFI. In the LMZ we will seek to minimise the area burnt below minimum TFI, especially in locations where there is no record of previous fire below minimum TFI. However, there will be instances such as in large fire footprints where fuels become flammable before ecological maturity is reached where fire will need to be applied to prevent larger areas being burnt by more intense bushfires.
- providing flexibility to apply or exclude planned burning to meet ecological objectives. When deciding where and how to burn in the LMZ, we will seek to avoid the abundance of individual species declining below an acceptable threshold, at the regional scale.

Victoria's residual risk

When predicting possible changes to bushfire risk over time, we use a measurement called *residual risk*. Residual risk is expressed as a percentage, and it represents the level of risk that remains in a landscape after planned burning and bushfires have reduced fuel levels. The maximum residual risk value you can possibly have is 100%: this means that there has been no fire in the landscape and no fuel reduced; in other words, no risk reduction.

A residual risk value of 70% — our statewide target set in the *Safer Together* policy — means that risk in the landscape has been reduced by 30%, due to planned burning and bushfires. In other words, on average there would be 30% fewer houses lost by fire if worst case bushfires were to occur anywhere in the landscape. In practice however, the residual risk is different in different parts of the landscape, due to differences in vegetation, topography and where houses are located. Our fuel management strategy, together with the strategies of all the other regions in Victoria, contributes to achieving the statewide target.

To obtain a residual risk estimate, we first use the Phoenix RapidFire bushfire simulation software to simulate thousands of bushfires across Victoria under conditions of highest fuel in the landscape and worst-case bushfire weather conditions. We calculate the impacts on houses, based on these simulations, and this is the maximum residual risk. We then simulate a second set of bushfires where we have changed the fuels in the landscape, to allow us to compare the two scenarios and estimate the reduced impact. When we are calculating the current or past residual risk, we include bushfires and planned burns that have occurred to reduce the fuels in the landscape. When we are testing strategies, we model different arrangements of planned burning that might occur in accordance with our strategy, for 40 years into the future.

Using Phoenix, we have forecast the performance of our preferred fuel management strategy together with other regions in Victoria. **Figure 10** shows changes in residual risk from 1980 to 2060, with the residual risk values beyond 2020 representing the forecasted measurement.

As yet, we are unable to model the impacts of our other bushfire management actions beyond planned burning in our residual risk metric, including mechanical treatments. We are working to be able to include these and other improvements to the metric in the future.

Photo credit: Ange Wright

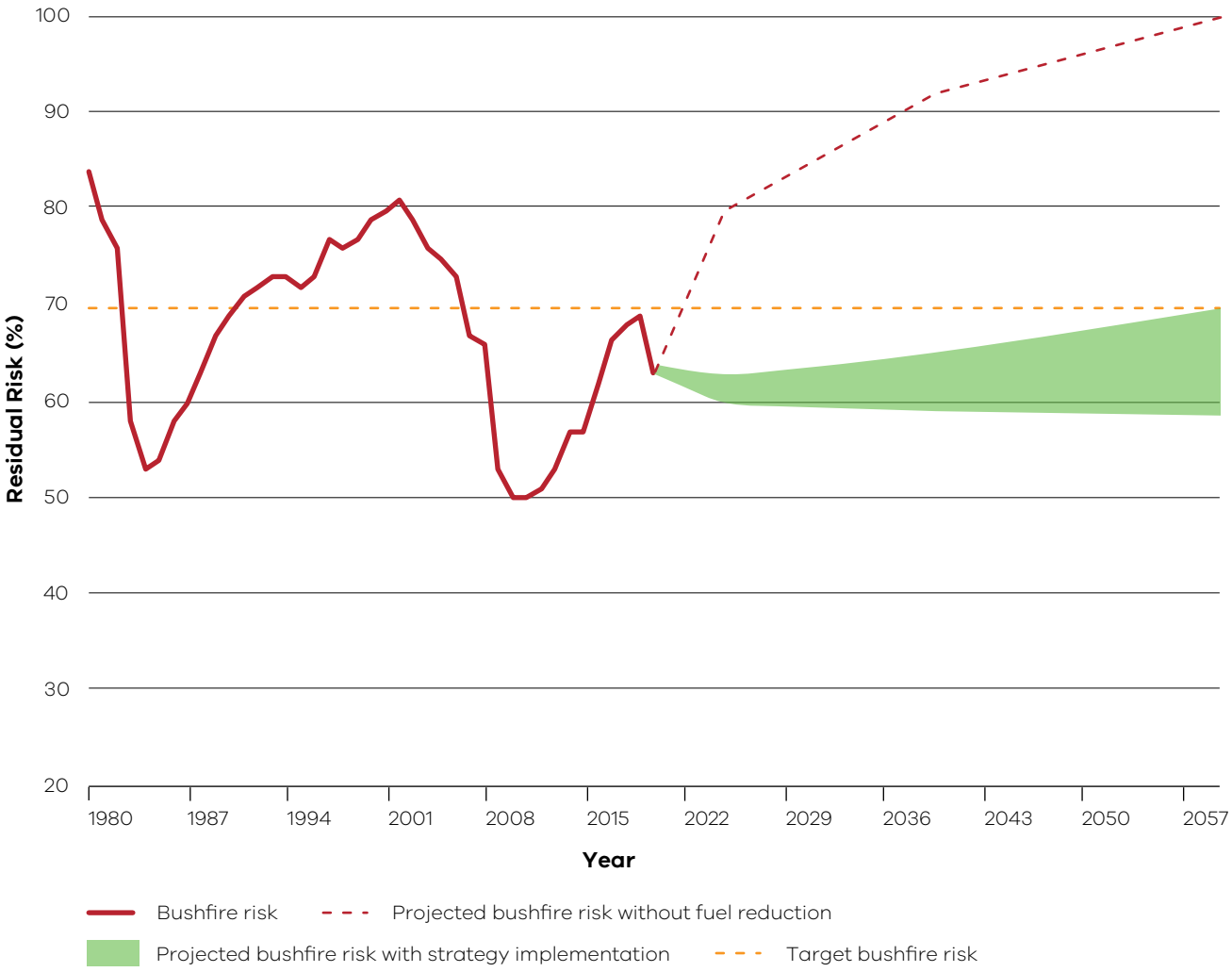


Figure 10. Statewide residual risk

Historic and projected future bushfire risk for Victoria. The orange dotted line is the statewide bushfire risk target (70%). The red line represents historical bushfire risk due to past bushfires and planned burning. The green shaded area is the projected bushfire risk for the fuel management strategies of all Victorian regions collectively, measured from 2021 to 2060. This represents that there is a range of possible future residual risk values which is dependent on the amount of fuel reduction achieved each year in our region and across Victoria. The red dotted line represents projected increase in bushfire risk without fuel reduction.

Bushfire Risk Engagement Areas

As part of the 2017-2019 strategic bushfire management planning process, land and fire management agencies have undertaken an analysis to define Bushfire Risk Engagement Areas (BREAs)[2]. BREAs identify parts of the landscape where managing bushfire fuels is most effective in reducing risk. This helps to indicate the priority areas in our region where we can work with communities to reduce bushfire fuels.

BREAs also help land and fire management agencies, local government and stakeholders to focus conversations about the range of treatment options available to reduce bushfire risk. This may include other actions where reducing fuels may not be possible. Over time, on-ground discussions and assessments between agencies and the community will determine the treatments that best suit a particular place.

Managing fuels on private and public land begins with a conversation about the benefits, limitations and viability of fuel reduction in a BREA. Complementary or alternative treatments will arise from these discussions. We will work with the community to explore risk treatment options for private land and, where suitable, apply them to complement public land fuel management described in our fuel management strategy. By working together in this way, we will maximise the impact of our collective risk-reduction effort.

It is important to note that BREAs are not legislated planning zones and do not obligate landowners or land and fire agencies to take any action. They cover large areas of public and private land, their boundaries do not align to administrative or cadastral boundaries, and are not linked to individual parcels of freehold land.

The Metropolitan region's BREAs are shown in **Figure 11**.

2 During the consultation phases of this strategic planning process, these areas were called 'Priority Fuel Management Areas' (PFMAs). They have since been renamed to provide greater clarity as to their intended use. Feedback and comments received during the planning process from stakeholders and community members relating to PFMAs have been incorporated into designing the BREA strategy.

Photo credit: Penny Orbell

Photo credit: Daniel Selzmann

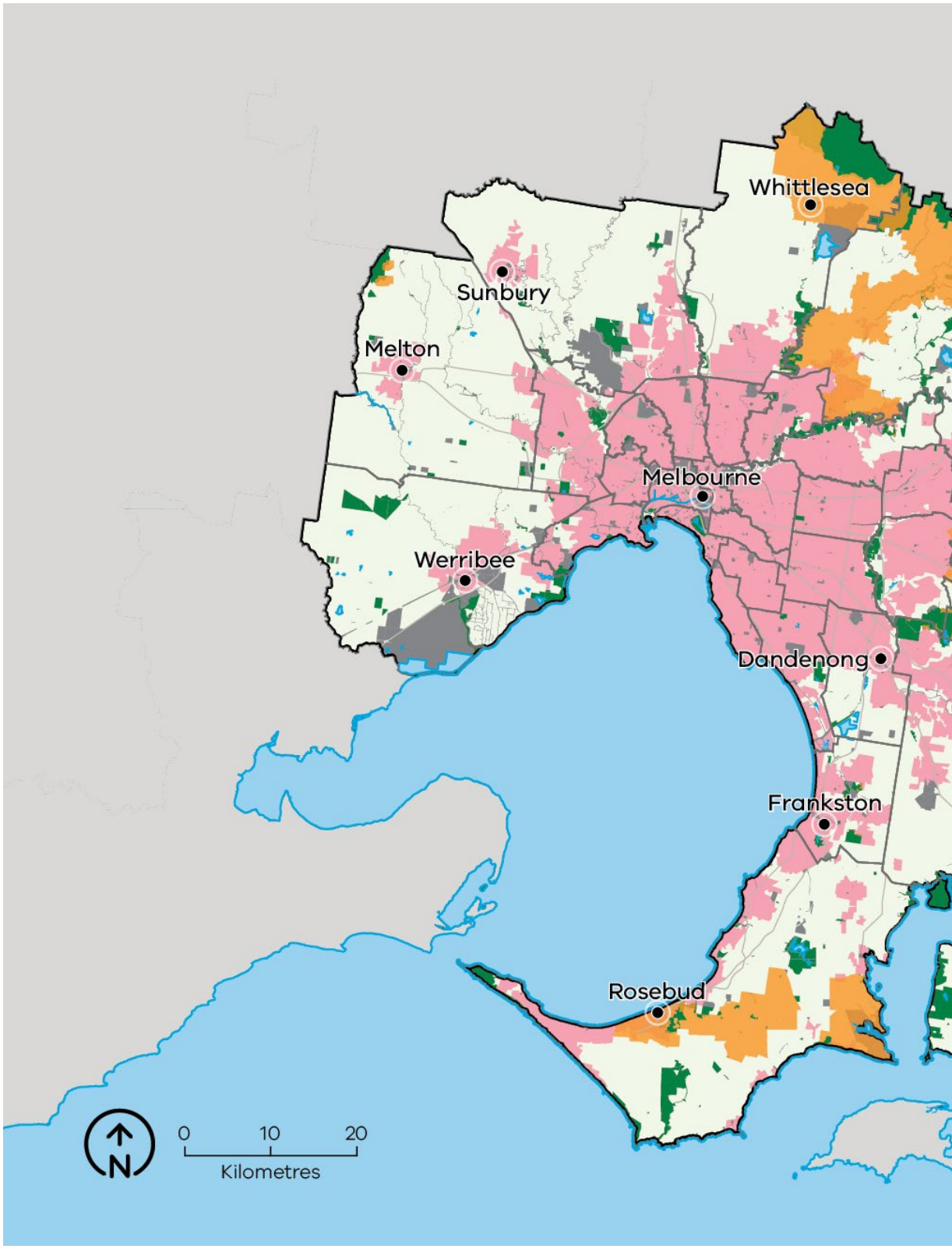
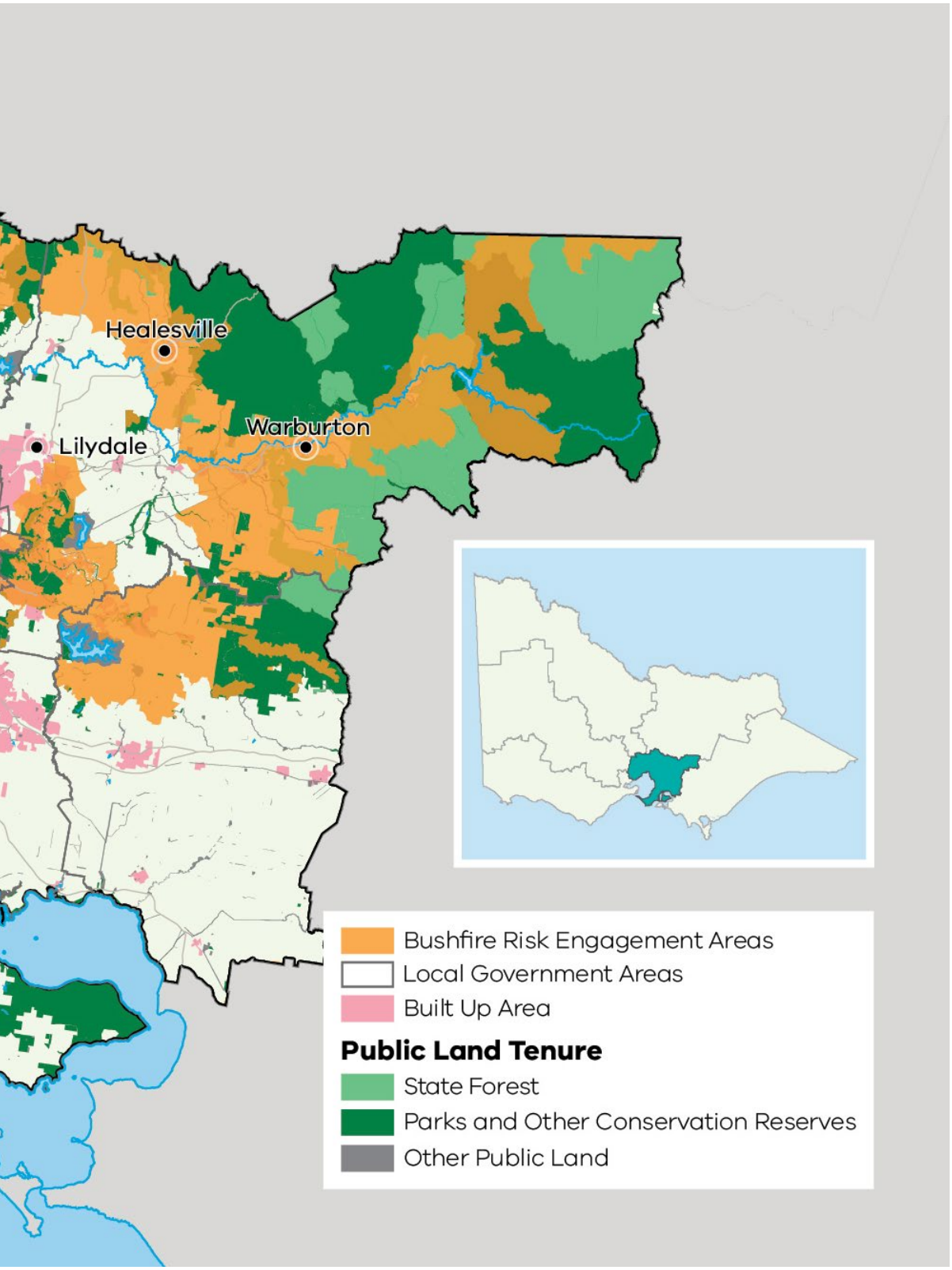


Figure 11. Bushfire Risk Engagement Areas in the Metropolitan region


Healesville
Warburton
Lilydale
Bushfire Risk Engagement Areas
Local Government Areas
Built Up Area
Public Land Tenure
State Forest
Parks and Other Conservation Reserves
Other Public Land

Private land fuel management in the Metropolitan region

Figure 12 shows that including both private and public land in the fuel management strategy results in a greater reduction in modelled risk than just including public land. The figure shows modelled residual risk in the region:

- in 2020 (the left-side blue bar)
- in 2059 if only (public land) FMZs were fuel-managed on regular rotation (the middle blue bar), noting that bushfires, which are not included in the modelling, also reduce fuel and therefore risk (the middle blue bar)
- in 2059 if — as well as FMZs being fuel-managed on regular rotation, as above — 100% of treatable private land in BREAs was fuel-managed on a 12-year rotation (the right-side blue bar).

The modelling shows that with fuel management only on public land, bushfire risk will remain under the regional target over the period, but with fuel management on public and private land, it drops significantly.

In practice, it is seldom possible to implement the entire fuel management program on public land, and it is operationally not possible to manage fuel on 100% of treatable private land. The figure does, however, illustrate the substantial risk reduction potential of managing fuel on private land.

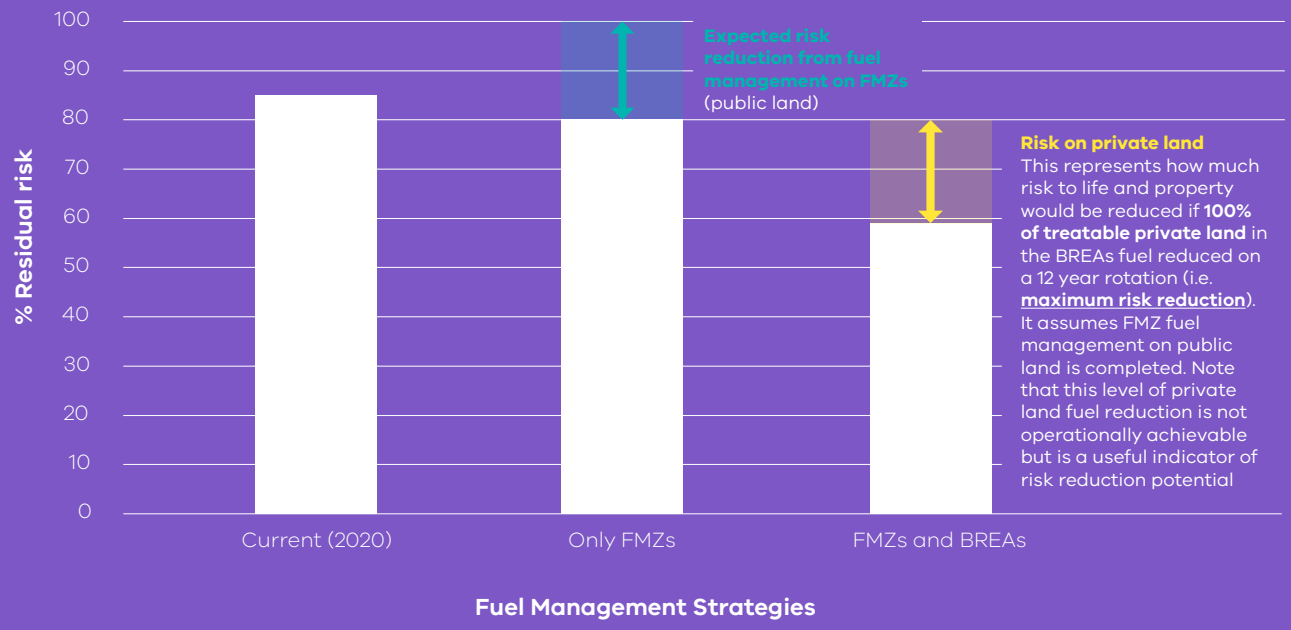


Figure 12. Modelled current residual risk, 2059 risk with fuel management on public and private land

Table 6 indicates, for fuel management treatments in BREAs on private land, how this approach performs against our bushfire management strategy objectives. The more coloured icons for a value, the more effective the strategy is for that value. For example, fuel management in BREAs on private land is very effective for minimising risk to life and property but less effective for native biodiversity conversation.

Table 6. Performance ratings of the fuel management strategy

Value protected	Performance rating (1–5)
Minimise loss of life and property	
Reduce the risk to critical infrastructure	
Native biodiversity conservation (flora)	
Native biodiversity conservation (fauna)	

Photo credit: Jo Wand

Regional strategies

Regional public land fire ecology strategies

The second objective of the Code of Practice is 'to maintain or improve the resilience of natural ecosystems and their ability to deliver services such as biodiversity, water, carbon storage and forest products'. We assessed where we could practically undertake fuel management to meet ecological objectives, what values are important in relation to fire and how frequently fuel management should be undertaken to maximise ecosystem health.

The Metropolitan region's risk reduction targets for life and property are currently met through fuel management in the Asset Protection Zone (APZ) and the Bushfire Moderation Zone (BMZ), so fuel management in the Landscape Management Zone (LMZ) and Planned Burning Exclusion Zone (PBEZ) can predominantly focus on meeting ecological objectives. In these areas, ecological objectives generally don't compete with life and property objectives due to our ability to achieve risk reduction outcomes for life and property within the APZ and BMZ. Furthermore, some areas within the LMZ can't be treated with planned burning, including wet forests. It should also be noted that when managing fuel in the APZ and BMZ, we aim to mitigate any potential impacts on ecological values where practicable, and any fuel management activity in the LMZ may provide localised protection from bushfire to ecological assets.

The public land fire ecology strategies identify management regimes to promote ecosystem health in areas planned for burning. They do this by modelling the impacts of burning; analysing previous fire history, vegetation types and their TFIs and ideal Growth Stage Structure (GSS) to support biodiversity; and by identifying fire-sensitive areas for protection. The strategies do not cover private land as agencies could not do the required analysis within the planning period, but the planning process may incorporate private land at some time in the future.

FFMVic categorised public land in the region into five sub-landscapes — also referred to as landscape management units — based on their vegetation and species profiles and landscape connectivity. **Figure 13** shows these sub-landscapes: Grasslands, French Island, Warrandyte, Yarra Ranges and Dandenong Ranges.

We used the forest modelling tool Woodstock to simulate planned burning over a 40-year timeframe. Woodstock shows vegetation changes in the landscape so that fuel management activities such as planned burning can be optimised to achieve different management objectives such as desired GSS.

We then prepared a 40-year burning schedule that incorporated the 2018–19 to 2020–21 JFMP, and then set a burning schedule for the APZ and BMZ on fixed cycles of eight and 12 years respectively. Having set the burning schedule for the APZ and BMZ, we then used Woodstock to determine an appropriate burning regime for the LMZ.

Mt Little Joe planned burn.
Photo credit: Russell Clarke

We calculated optimal GSS targets for the French Island, Dandenong Ranges, Warrandyte and Yarra Ranges sub-landscapes. These targets are the optimal proportion of ages that will be most suitable for the most fauna species of each ecological fire group.

We then used Woodstock to determine the best burning regime to achieve the targets, also considering the objectives in **Table 4** to create a set of management rules and constraints which the model attempts to meet when providing a solution. These included:

- minimise burning below TFI in the LMZ
- avoid burning the habitat of the fire-sensitive threatened species Leadbeater's Possum and Helmeted Honeyeater
- avoid burning long-unburnt sites.

Greater Glider.
Photo credit: Adam Whitchurch

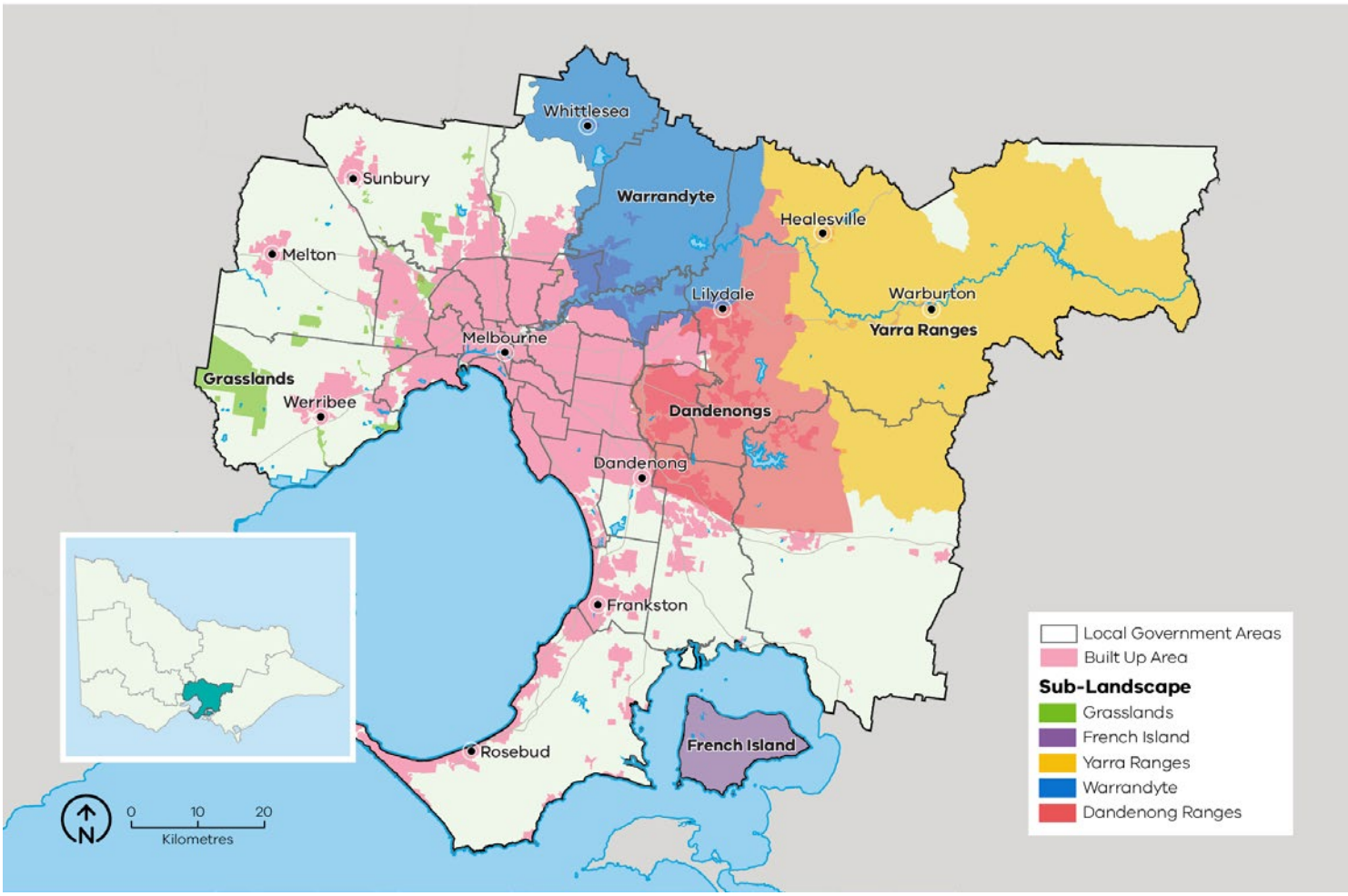


Figure 13. Public land fire ecology strategy sub-landscapes

Photo credit: Michael Jones

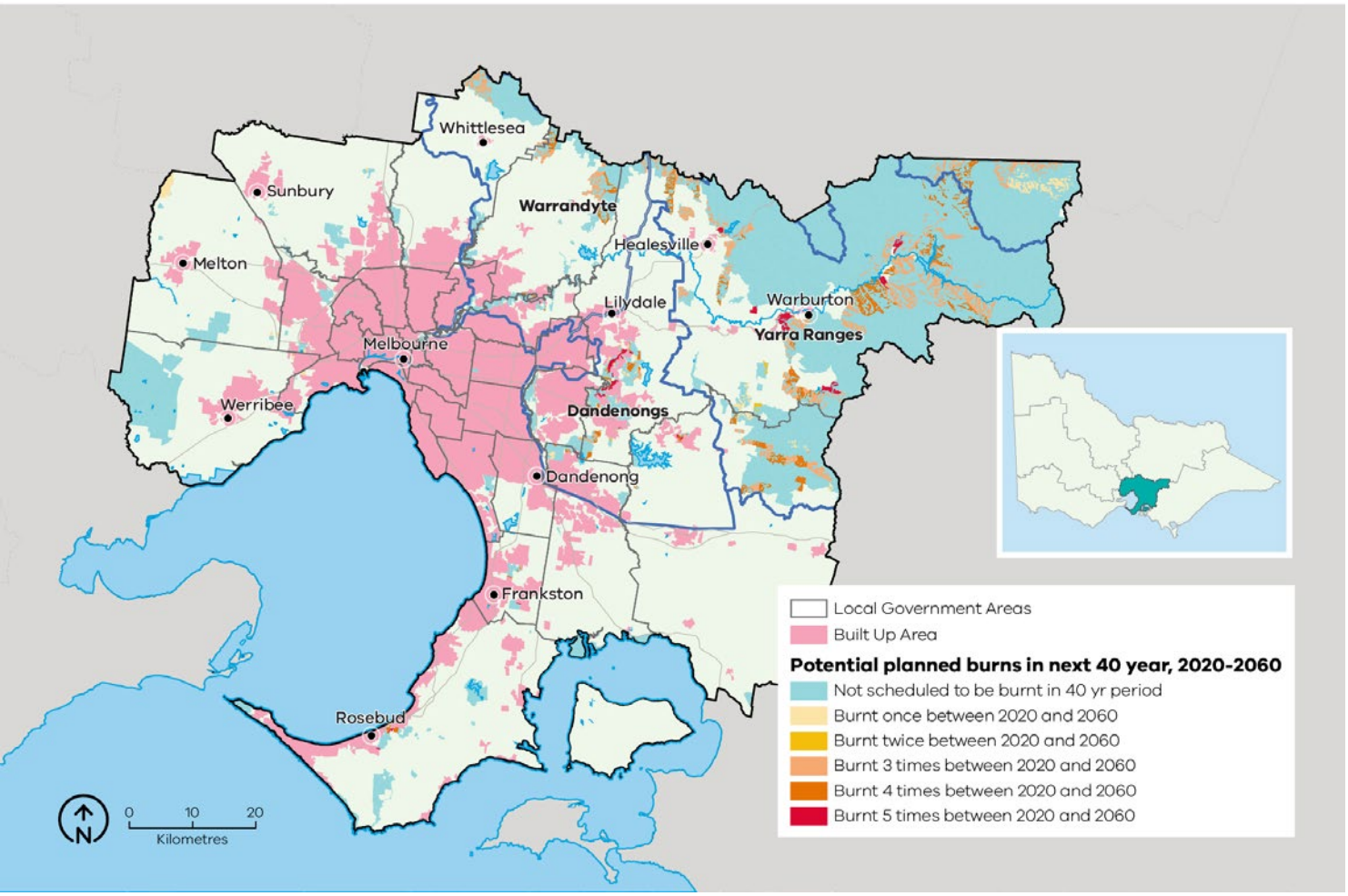


Figure 14. Forests Fire Ecology Strategy

Forests Fire Ecology Strategy

Figure 14 shows the Forests Fire Ecology Strategy, a strategy for planned burning in the Warrandyte, Yarra Ranges and Dandenong Ranges sub-landscapes. The strategy aims to meet GSS targets and recommended TFIs and to respect exclusion areas that support biodiversity objectives, while burning in the APZ and BMZ on a nominally fixed rotation of eight and 12 years respectively. The strategy prescribes minimal burning in the LMZ to meet the GSS targets. Fuel management (including planned burning) in the LMZ may be required at times to support broader landscape risk reduction, by reducing the overall fuel hazard, and to support fuel management objectives in the APZ and BMZ through targeted, complimentary fuel reduction.

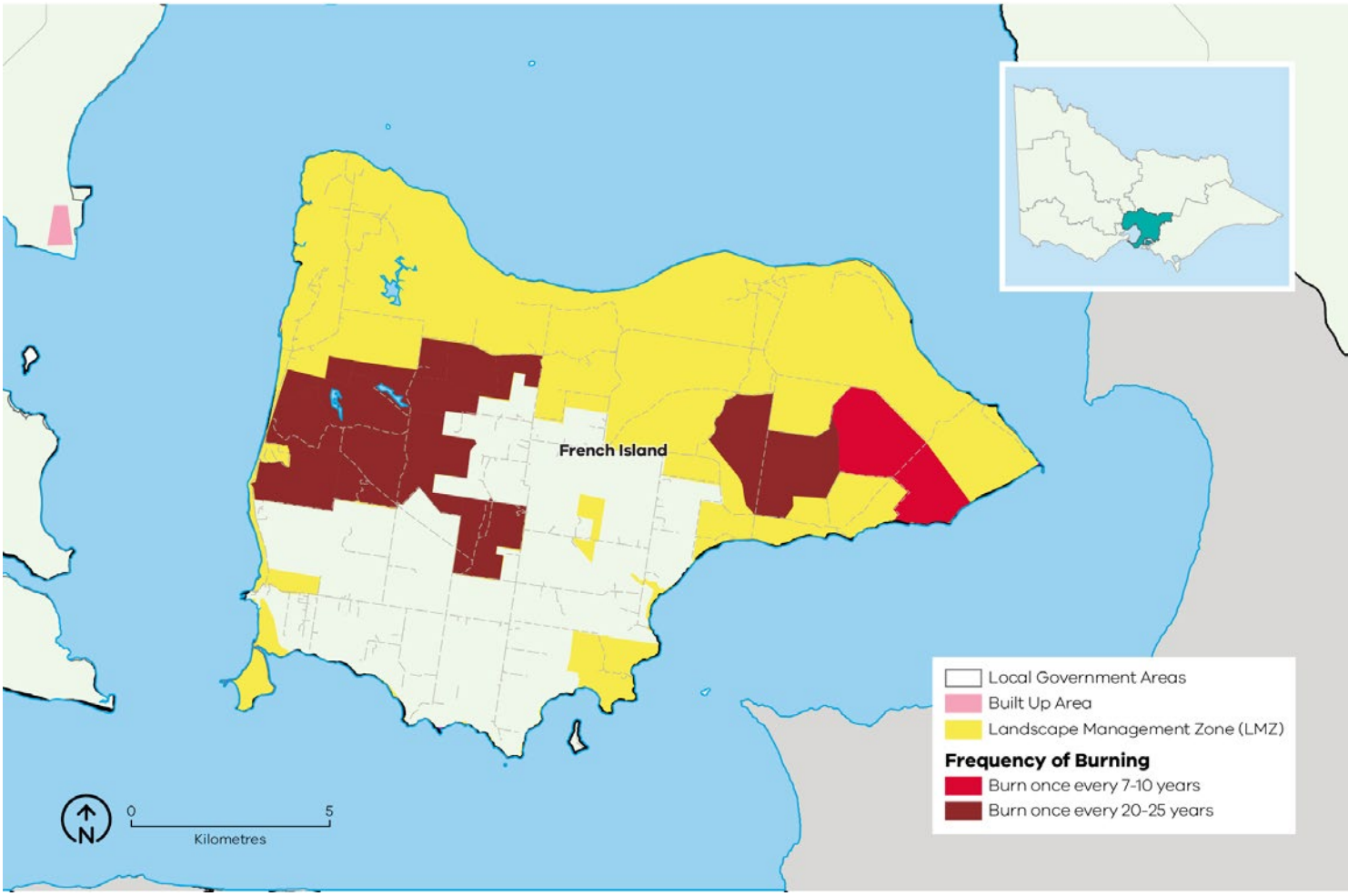


Figure 15. French Island Fire Ecology Strategy

French Island Fire Ecology Strategy

Figure 15 shows the French Island Fire Ecology Strategy, which is Parks Victoria's French Island Fire Ecology Assessment. The strategy specifies areas to be maintained as heathland and burnt every 20–25 years and to be burnt every 7–10 years to manage Pinus pinaster. Refer to **Table 3** for an overview of French Island values.

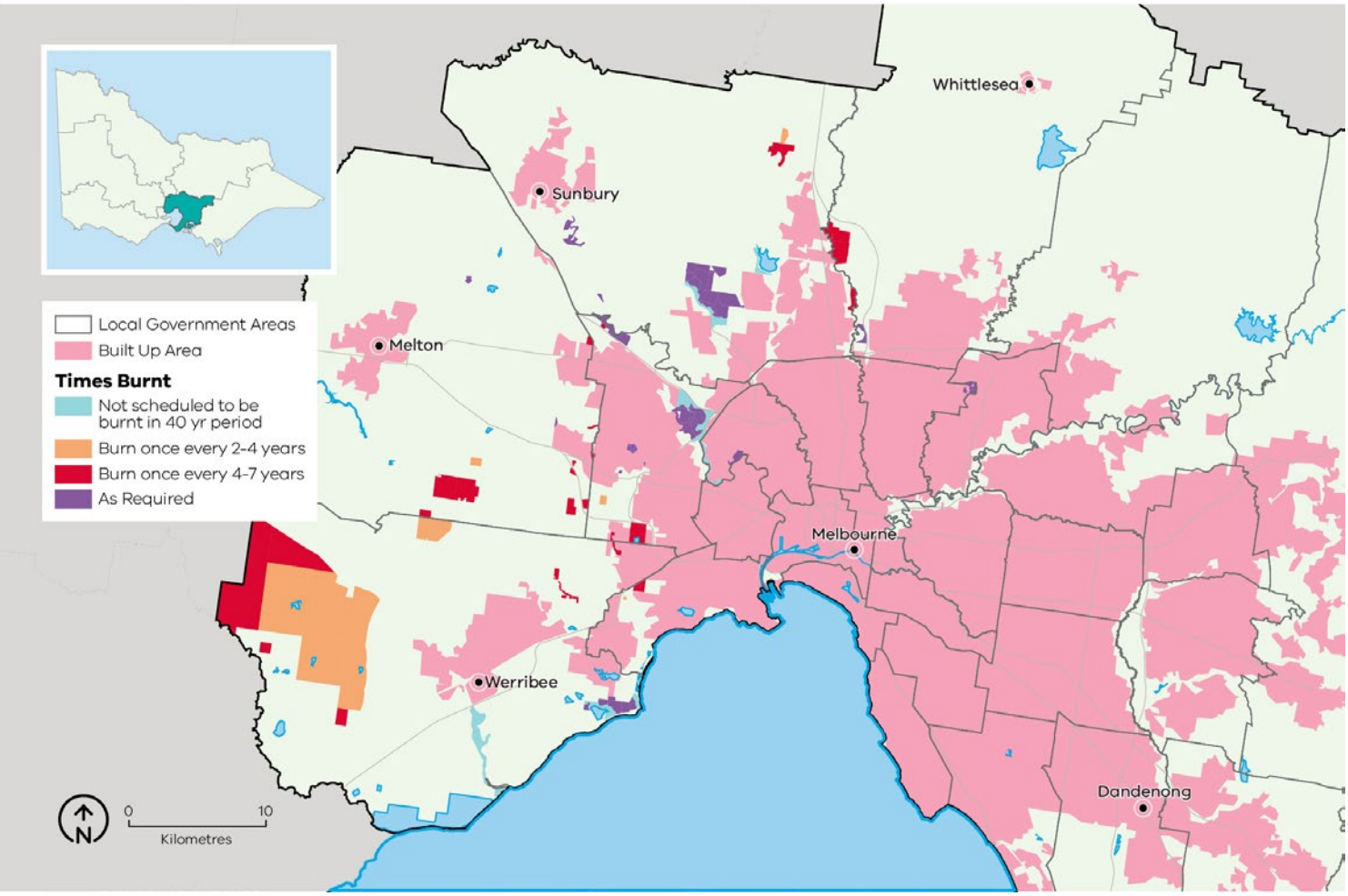


Figure 16. Grasslands Fire Ecology Strategy

Grasslands Fire Ecology Strategy

Figure 16 shows the Grasslands Fire Ecology Strategy, a strategy for planned burning of the grasslands in the north and west of the region, and **Figure 17** shows areas where grassfires could impact life and property. These 'risk catchments' were modelled using FDI 100 conditions. The strategic planning process drew on expert opinion and the experience of land managers to develop fire regimes suitable for the species and communities that occur in grassland and grassy woodland vegetation communities (refer to **Table 3**). These fire regimes were applied to individual burn units in each park and reserve, based on the values and preferred management objective of each park and reserve.

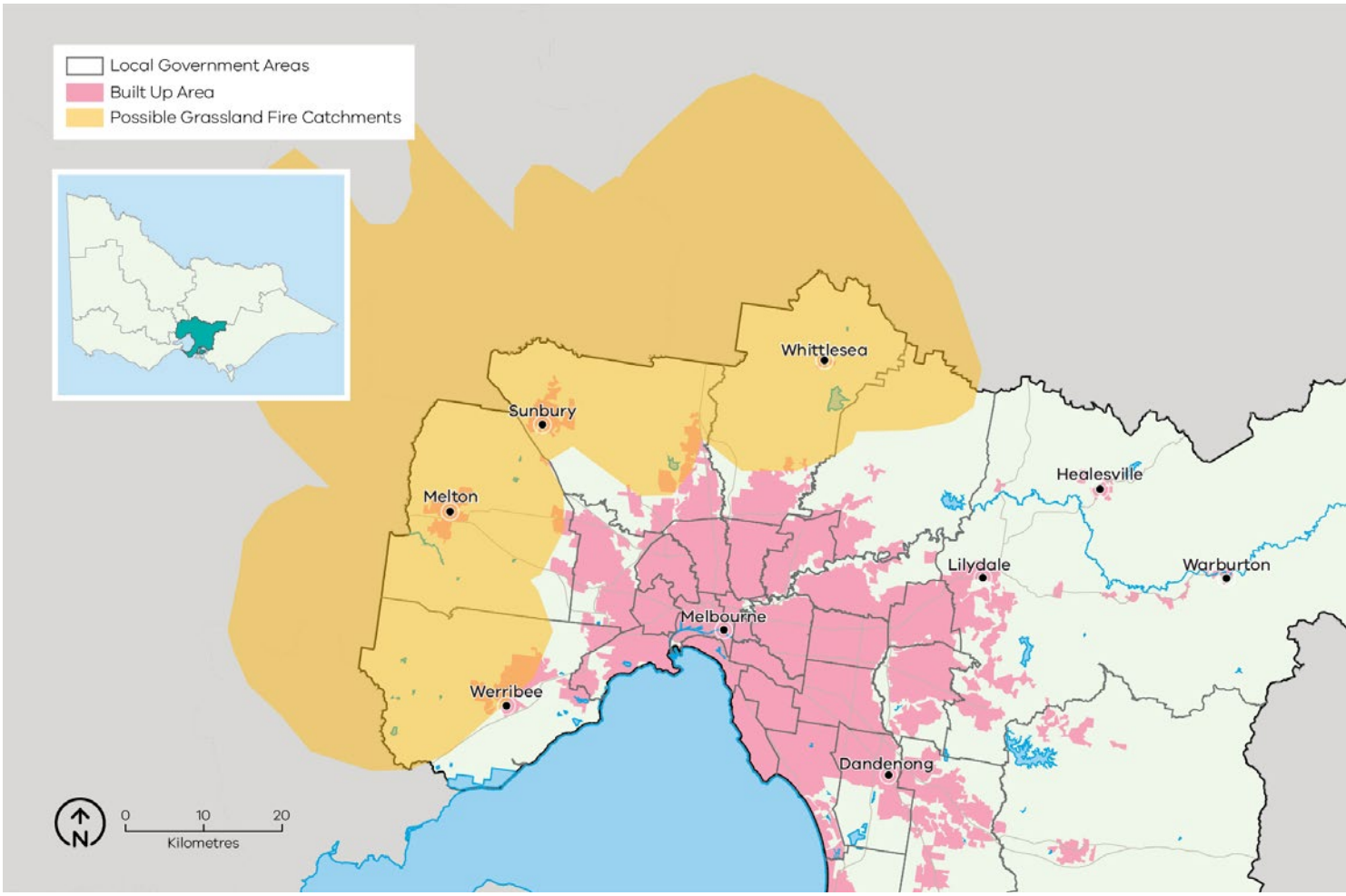


Figure 17. Grassfire risk catchments are shown which depict areas where grassfires could impact life and property. These 'risk catchments' were modelled using FDI 100 conditions.

Roadside fuel management implementation and coordination approach

After the Black Saturday fires, the Victorian Bushfires Royal Commission recommended a systematic, statewide program of bushfire risk assessment for all roads under section 43(1) of the *Country Fire Authority Act 1958* and under the Forests Act 1958. The agencies responsible for roadside management have approached this work in different ways over the years. In line with our multi-agency strategic planning process, we (FFMVic, local government, CFA) developed a roadside fuel management implementation and coordination approach to better align agencies' systems, operations and collaboration.

Roads are managed for two purposes in relation to bushfire management, these are:

1. to facilitate access and egress for public and emergency response vehicles in a safe manner, and
2. to act as strategic fuel breaks, by reducing the rate of spread of bushfires and enabling firefighters to more effectively access, suppress and contain bushfires.

A road can provide access and egress while also acting as a strategic fuel break.

Roadside fuel management involves modifying fuels alongside roads by mechanical treatments (such as slashing, mulching and mowing). Roadside fuel management is completed regularly to enhance the safety of access and egress and bolster strategic fuel breaks.

Work has been undertaken to consolidate spatial data provided by agencies on their roadside fuel management activities and to collate it in a single map to share between agencies.

As shown in **Figure 18**, the work includes a consolidated spatial dataset of roadside fuel management actions and agencies responsible for roadsides in the region outside the urban area. This will improve coordination of roadside fuel management across agencies, and has the potential to be used as an input to Phoenix RapidFire to make its models more accurate. Furthermore, this work will help to reduce duplication of roadside fuel management actions and make the use of resources across agencies more efficient.

The focus on roadside fuel management also resulted in a new definition for the region of 'fire access track':

'A fire access track facilitates travel for emergency response vehicles to areas inaccessible by existing public roads, enabling rapid first attack and suppression of ignitions.'

Fire access tracks have previously been ill-defined and inconsistently managed and coordinated across the region. The new definition comes with new track maintenance standards that combine established CFA and FFMVic standards and underpin access for the various classes of firefighting vehicles. The new definition and standards are tenure-blind and can be applied and understood consistently by different agencies, which will improve coordination across the region.

In future, agencies in the region plan to create a spatial dataset of the location of all fire access tracks.

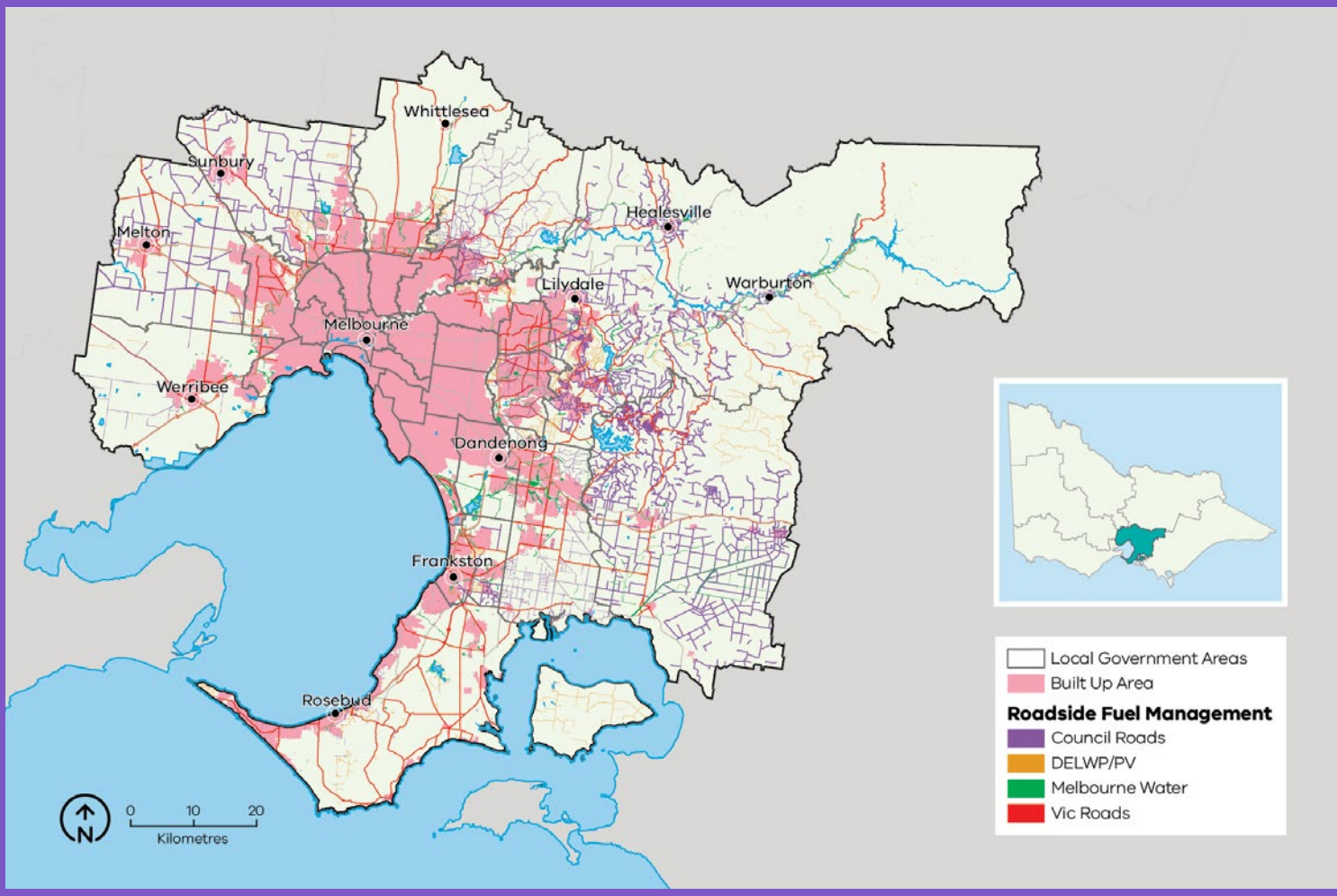


Figure 18. Multi-agency dataset of roadside fuel management areas in the Metropolitan region

Yellingbo Nature Conservation Reserve bushfire suppression approach

Yellingbo Nature Conservation Reserve (NCR) contains the threatened Sedge-rich *Eucalyptus camphora* swamp vegetation community, the last remaining wild population of the critically endangered Helmeted Honeyeater and the only known lowland population of the endangered Leadbeater's Possum. Bushfire is a significant risk to these values in Yellingbo NCR and typical fuel management — planned burning, slashing and mulching — is also not a viable bushfire risk management approach here.

The purpose of the Yellingbo NCR bushfire suppression approach is to provide guidelines for fire suppression actions and risk mitigation measures to reduce potential bushfire impacts on the reserve and its ecological values. The guidelines are based on local knowledge, agencies' knowledge and experience and Phoenix RapidFire modelling. The modelling used six fire response suppression scenarios and five local weather streams on a fine-scale grid to best understand where the highest-risk ignitions are likely to occur.

The operational guidelines provide essential information which incident management teams and on-ground crews can use if a bushfire threatens the reserve. The guidelines identify:

- high-risk ignition locations
- access and egress routes
- the most effective suppression methods
- priority suppression areas.

The guidelines also include information about:

- **preparedness**: accessibility, community and ecological values, the location of water points, priority suppression areas and machinery exclusion zones
- **response**: FFMVic operates at enhanced readiness on elevated fire danger days. The guidelines discuss' likely ignition locations and the impacts of different ignitions, appropriate first attack methods, aircraft advice, endangered species management and appropriate firefighting methods in sensitive ecosystems.
- **recovery**: the roles of agencies in recovery and issues to be addressed when creating a recovery plan.

The operational guidelines were informed through consultation with stakeholders including FFMVic, the CFA, threatened species experts and Friends of the Helmeted Honeyeater Incorporated.

The Yellingbo Nature Conservation Reserve provides essential habitat for species, including Victoria's faunal emblems: the Lowland Leadbeater's Possum and Helmeted Honeyeater. Photo credit: Michael Jones

Implementation

Implementation of this bushfire management strategy will occur through the Joint Fuel Management Program (JFMP) prepared by FFMVic and CFA, as well as a range of agency-specific operational plans.

The fuel management strategy described here directly informs the development of the JFMP, and it is through the implementation of this program that bushfire risk in the Metropolitan region will be maintained in line with the state residual risk target, in a manner which balances outcomes for multiple values.

Fuel management on private land, where appropriate and with landholder permission, will form part of the overall JFMP and will reduce bushfire risk in the Metropolitan region even further.

The JFMP prepared by FFMVic and CFA is also informed by the *Victorian Traditional Owner Cultural Fire Strategy*.

Our bushfire management strategy can also help inform actions in municipal fire management plans.

The implementation of Bushfire Risk Engagement Areas will be undertaken by all agencies working together with the community. BREAs assist agencies to plan where to engage with communities about fuel management where it is most effective to reduce bushfire risk or explore alternative options to reduce that risk.

The three public land fire ecology strategies will inform the JFMP and the region's MER plan.

The roadside fuel management implementation and coordination approach described below will inform the JFMP and activity plans at the municipal level as well as resource and budget planning.

The Yellingbo NCR bushfire suppression approach will inform response planning by incident management teams, as well as preparedness and recovery planning. It will also act as a case study for broader risk-based response planning undertaken by all fire agencies during emergencies.

Photo credit: Jo Wand

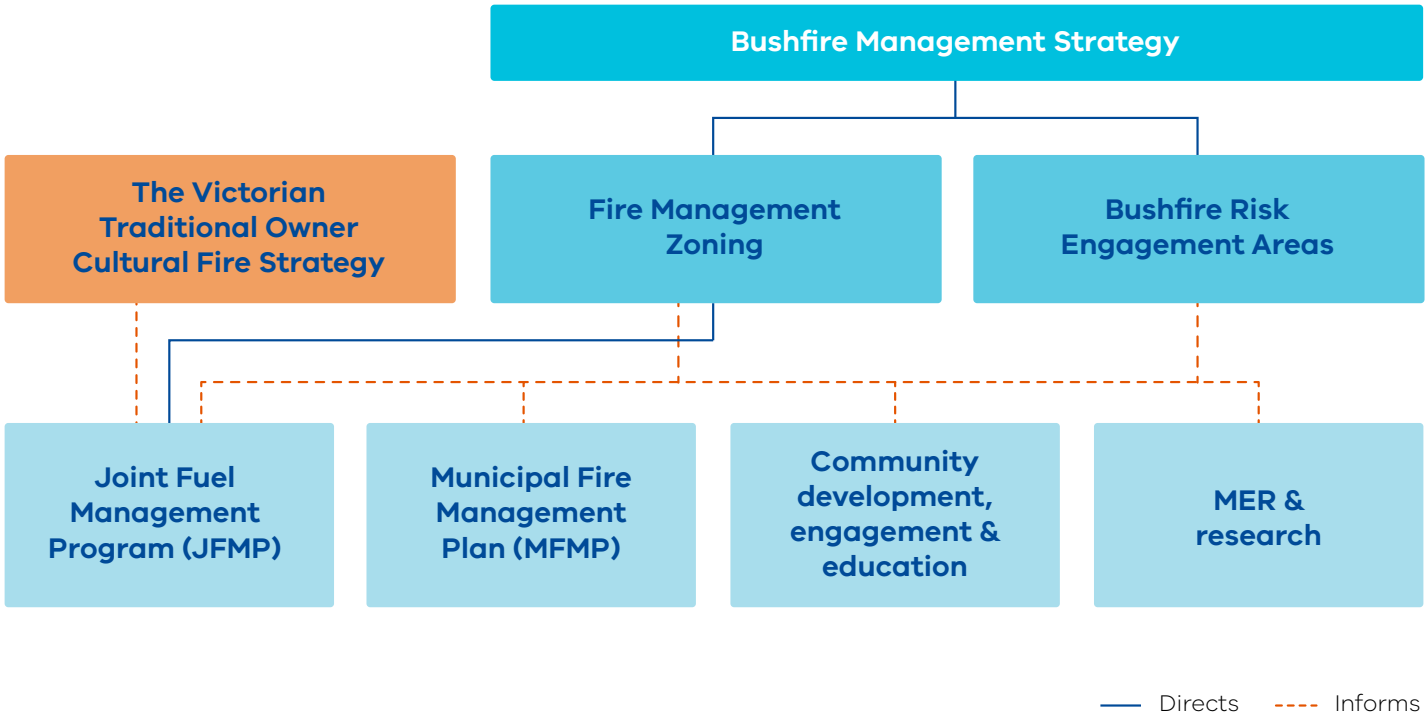


Figure 19. Schematic representation of the strategy's influence on implementation programs and plans

Monitoring, evaluation and reporting

Regional monitoring, evaluation and reporting (MER) enables us to measure how our strategies and actions are performing against the regional objectives set out in this bushfire management strategy. This is achieved by developing key evaluation questions that we will use to measure success against our objectives and enable reporting and improvements. The MER process ensures transparency and supports adaptation of management practices to achieve improved outcome from bushfire management to our important values. Key evaluation questions and the process for addressing them will be developed in MER plans by individual agencies.

A MER plan can also identify key knowledge gaps and prioritise research and monitoring activities to address them. MER plans ultimately improve risk-based planning and decision-making, helping to guide future resource and funding allocation.

Individual agencies will be responsible for the MER of their own work programs and the activities that they deliver. The spirit of collaboration will continue between agencies, such as identifying and addressing knowledge gaps that cross tenure boundaries.

FFMVic's MER program is guided by the *Monitoring, Evaluation and Reporting Framework for Bushfire Management on Public Land* (MER Framework), which aims to assess how well management activities across Victoria are achieving the two objectives of the Code of Practice. Information on FFMVic's annual fuel management monitoring and reporting can be found in Managing Victoria's Bushfire Risk: Fuel Management Report.

Photo credit: Mitch Watton

Hairpin Banksia.
Photo credit: Ange Wright

Appendix 1: Program logic

Table 7. Metropolitan region Bushfire Management Strategy 2020 program logic

Vision	**Safer and more resilient communities and resilient ecosystems**			
Program context	The Victorian Preparedness Goal is A safer and more resilient community that has the capabilities to withstand, plan for, respond to and recover from emergencies that pose the greatest risk.			
Strategic objectives	• To minimise the impact of major bushfires on human life, communities, essential and community infrastructure, industries, the economy and the environment. Human life will be afforded priority over all other considerations.			
Metropolitan region values	**Human life, communities and economy**			**Cultural heritage**
Metropolitan region objectives	• To minimise the loss of human life, houses and property	• To minimise disruption to essential services and critical infrastructure	• To minimise the social impacts of bushfires and fire management actions • To increase community understanding and ownership of bushfire risk management	• To minimise the impacts of bushfires and fire management actions on cultural heritage
Outcomes	• Less loss of human life, houses and property	• Less bushfire impact on critical infrastructure: major roads, power lines and communications networks	• Greater community understanding and ownership of bushfire risk management through community-based bushfire management	• Less loss of community and cultural assets from bushfires due to bushfire risk management actions

The Safer Together policy's four priorities for reducing the risk of bushfires in Victoria are Community first, Land and fire agencies working together, Measuring success and Better knowledge = better decisions.

- To maintain or improve the resilience of natural ecosystems and their ability to deliver services such as biodiversity, water, carbon storage and forest products.

Biodiversity and ecosystem resilience				
• To minimise declines in the condition and persistence of ecosystems in LMZ	• To minimise declines in plant and animal populations from bushfires and fire management actions	• To minimise declines in threatened species and communities	• To avoid declines in carbon storage	• To maximise water yield and quality
• GSSs that support biodiversity	• Areas planned for burning below minimum TFI do not exceed LMZ and PBEZ thresholds • The number of fauna species declining does not exceed the thresholds set for the strategy by 2050	• Protected habitat for populations of threatened species	• Old-growth forest protected from bushfire/ planned burns to retain carbon sinks • Less bushfire risk to reduce high- intensity fire contributing to large amounts of atmospheric carbon	• Less bushfire risk to water catchments to protect water quality and minimise debris • Maintained water yield by limiting fire in Ash forest

Assumptions	• Reducing bushfire risk minimises loss of human life, homes and property • Fuel management and objectives are achievable • Phoenix data assumes address points correlate to houses and life • The impact thresholds for different assets are correct • Fuel accumulation for different vegetation types is modelled accurately	• In the VFRR-B, each asset type is in the appropriate category • Bushfire risk management actions reduce the likelihood of bushfire impacts on critical infrastructure and essential services	• Engagement through Engage Victoria, the Community Based Bushfire Management Program and the Bushfire Strategy Advisory Group reaches and represents the whole community • There is a degree of community apathy to engage	• The Victorian Aboriginal Heritage Register includes all important sites, and the threshold impacts are appropriate

- Ecosystem resilience metrics relate to the condition and persistence of ecosystems
- The thresholds used to determine declines in fauna species are appropriate
- Factors currently out-of-scope (such as drought, climate change and introduced species) do not impede our ability to minimise declines in native plant and animal species
- Fire management mitigation measures for species minimise declines in plant and animal populations
- Modelled habitat represents where species inhabit
- No influence of unplanned bushfire (especially stand-replacing fire)

- Fire is the major driver of carbon cycles and atmospheric levels of carbon (and other potential drivers such as drought and climate change are not)

- The methodology to model the impacts of fuel management and bushfires on water yield and water quality is correct

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