AusNet Electricity Services Pty Ltd

Electricity Distribution Price Review 2016–20

Appendix 2A: Strategic Bushfire Management Plan – East Central Bushfire Risk Landscape
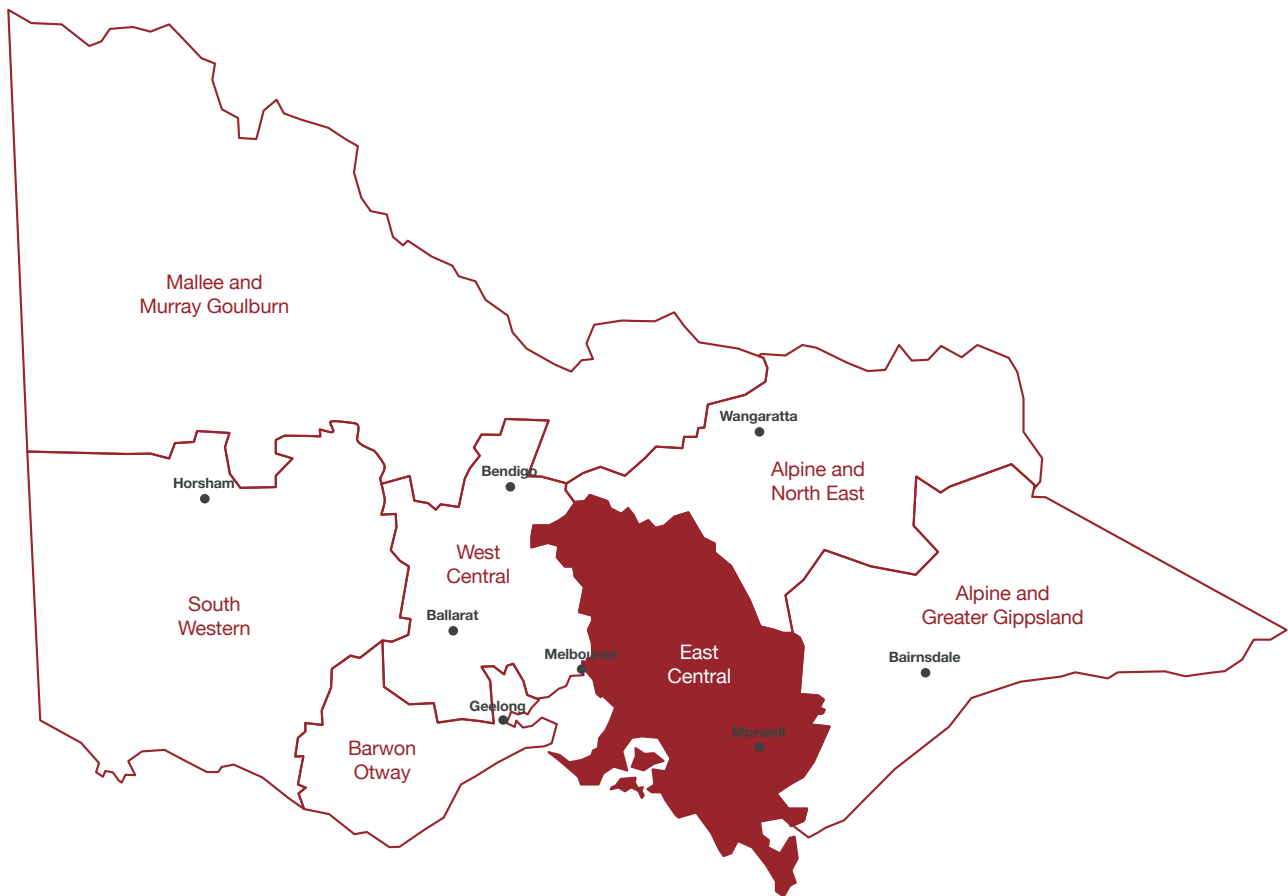
Submitted: 30 April 2015

mission **ZER**

Strategic bushfire management plan

East Central bushfire risk landscape

Map of Victoria showing regions: Mallee and Murray Goulburn, South Western (Horsham), West Central (Bendigo, Ballarat), Barwon Otway (Geelong), Alpine and North East (Wangaratta), Alpine and Greater Gippsland (Bairnsdale), East Central (Melbourne, Morwell).

Disclaimer

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Cover photo: Planned burning in the Dandenongs © DEPI

Contents

Discussing bushfire risk at Wilsons Promontory ©Joanna Wand

Foreword

This plan is the first strategic bushfire management plan for the East Central bushfire risk landscape. It marks the beginning of the new, strategic, risk-based approach to bushfire management on public land that was recommended by the Victorian Bushfires Royal Commission after the 2009 Black Saturday bushfires.

The Royal Commission was the catalyst for the Victorian Government to improve how emergency management systems work for communities. This plan—and the strategic bushfire management planning process through which it was developed—improves how the Department of Environment and Primary Industries (DEPI) and Parks Victoria (PV) work together with the community, industries and other emergency services agencies to build a safer and more resilient Victoria.

The Victorian Government is committed to managing and reducing risks to life, property, infrastructure and local economies from the impact of major bushfires, and to enhancing the resilience of our natural ecosystems. To do this, we are bringing together for the first time the best available science, cutting-edge bushfire simulation software and the extensive expertise of Victorian bushfire management specialists.

We are supplementing this expertise with the wisdom of local communities, to draw on their knowledge and experience, understand what they value and how they see bushfire risk, and engage them in planning the best course of action. We thank all those who have given their time to contribute to the process of preparing this plan, including staff and representatives of our department, PV, Country Fire Authority (CFA), local governments, water corporations, utility services, private land managers, regional and municipal integrated fire management planning

committees, Dandenong Ranges Landscape Project and communities in the landscape. We particularly thank the community reference group—which includes representatives from Melbourne Water, local government, Victorian National Parks Association, Latrobe University, the University of Melbourne, CFA, and Department of Human Services, as well as community representatives from Kinglake, Marysville, Powelltown, Inverloch, Warburton, Olinda, Warrandyte and Upper Beaconsfield—for their commitment and contribution to developing this plan.

It is important to note that the international standards for risk management, with which our strategic planning approach complies, accept that risk can never be completely eliminated. Bushfires will still occur each summer and everyone needs to be prepared and ready to respond. Bushfire risk can be managed, and its impacts minimised, with a high-quality risk management approach.

Strategic planning is important; it builds a shared understanding of bushfire risk, and the options available to reduce the risk. This understanding empowers everyone in Victoria to work in partnership, to tackle the threat of future bushfires.

Implicit in a high-quality approach is a commitment to continuous improvement. The processes used to develop this plan are an improvement on what has gone before, and bushfire management will continue to evolve with advances in science, technology and how we engage with the community.

Through this plan we set clear directions that will guide our bushfire management operations. Our activities will focus on reducing bushfire risk — this is how we will know we've been successful.

Alan Goodwin
DEPI Chief Fire Officer

Travis Dowling
DEPI Regional Director
Port Phillip

Planned burn © DEPI

Noojee Trestle Bridge © Suriya Vij

Introduction

This plan is the strategic bushfire management plan for the East Central bushfire risk landscape. It explains the fuel management strategy and other actions that we—the Department of Environment and Primary Industries (DEPI) and Parks Victoria (PV)—will undertake to minimise the impact of major bushfires on people, property, infrastructure and economic activity, and maintain and improve the resilience of natural ecosystems. This plan replaces existing fire protection plans for this landscape.

Under the *Forests Act 1958*, DEPI is responsible for bushfire risk management on the land it and PV manage, and on protected public land as described in the Act. We manage more than seven million hectares of public land on behalf of all Victorians. Our bushfire risk management work ranges from strategic planning to reduce bushfire risk, through to on-ground operations (such as managing vegetation that could fuel a bushfire, coordinating emergency responses to bushfires, and helping communities recover from them).

The Victorian Government's *Emergency Management Reform White Paper* emphasises that emergency management, of which bushfire risk management is a component, is a shared responsibility of the whole community. DEPI and PV work with other public sector agencies (including CFA, Victoria Police and State Emergency Service), local governments, water corporations, utility services, private land managers and Victorian communities to reduce bushfire risk on public and private land, in one of the most bushfire-prone areas in the world.

Established under the *Conservation Forests and Lands Act 1987,* the *Code of Practice for Bushfire Management on Public Land 2012* spells out how we will manage bushfire risk on public land. The code's two primary objectives are 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

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

The code requires DEPI and PV to prepare landscape-level strategic bushfire management plans to achieve the objectives, using a transparent, risk-based process based on scientific evidence and local knowledge. The code also includes outcomes, strategies and actions for prevention, preparedness, fuel management (including planned burning), response, recovery and monitoring, evaluation and reporting.

We developed this plan in the context of Victoria's new emergency management arrangements. The Victorian Government's *Emergency Management Reform White Paper* and subsequent legislation aim to build community resilience through increased participation and shared responsibility. This plan helps achieve that aim by:

- pairing local knowledge with world-leading technology to simulate how bushfires behave

- working with communities, industries and other stakeholders to understand what they value and want to protect from bushfires

- identifying the most effective options to reduce bushfire risk

- monitoring, evaluating and reporting how bushfire risk has been reduced.

To find out about the large body of research and analysis that underlies this plan, or how to be involved in activities to review and update this plan in future, go to www.depi.vic.gov.au/bushfirerisk.

Our risk-based planning approach

WEATHER

FUEL HAZARD

LANDSCAPE

Modelling Bushfire Risk

Community Values and Engagement

Risk Assessment

SIMULATED BUSHFIRE

RESIDUAL RISK

ENGAGE WITH COMMUNITIES

IDENTIFY WHAT WE VALUE

LIKELIHOOD

CONSEQUENCE

PRIORITIES

Joint Action

Reduce Bushfire Risk

Safer Communities

Strong Economies

Resilient Ecosystems

Continuous Improvement
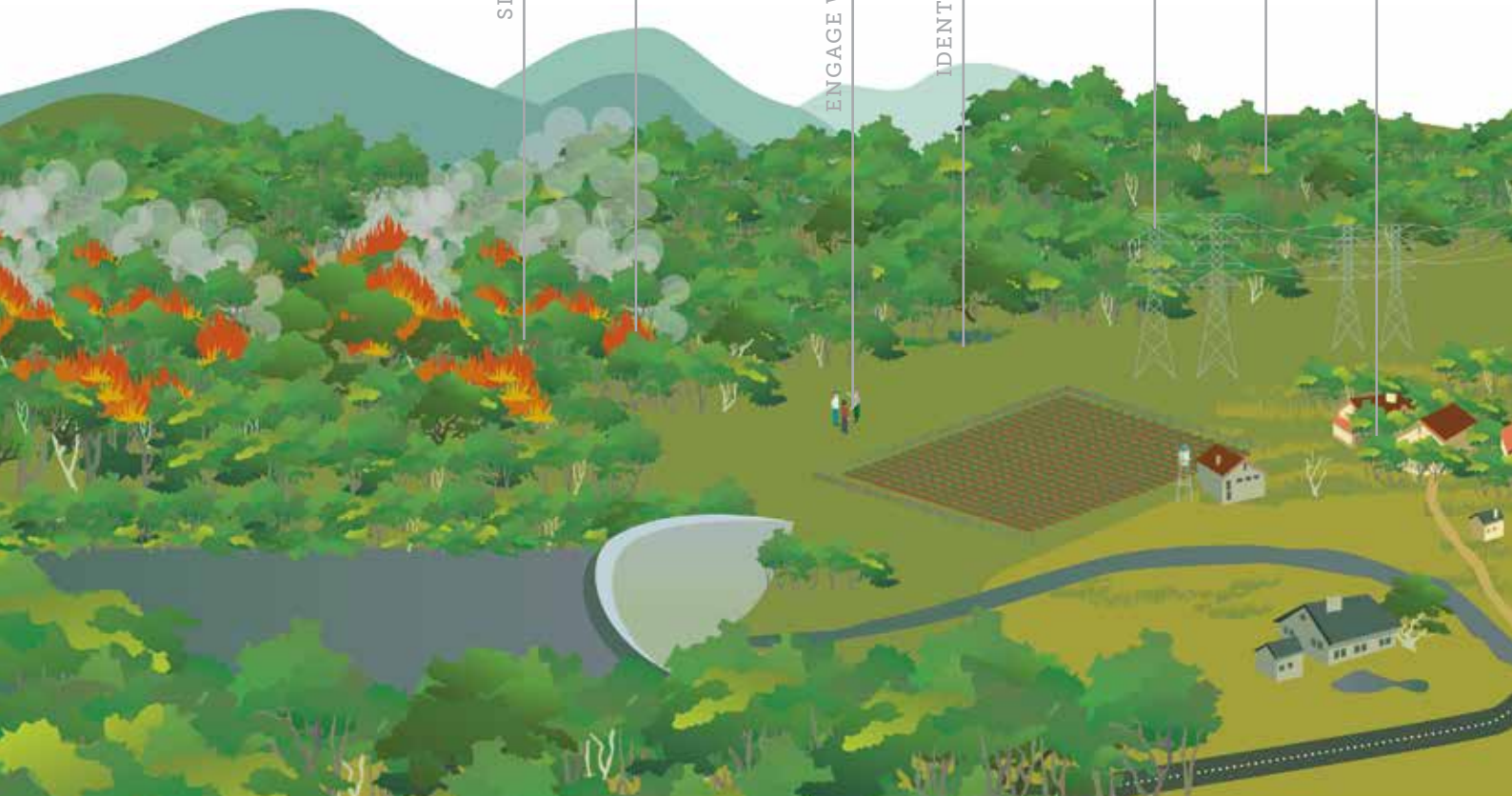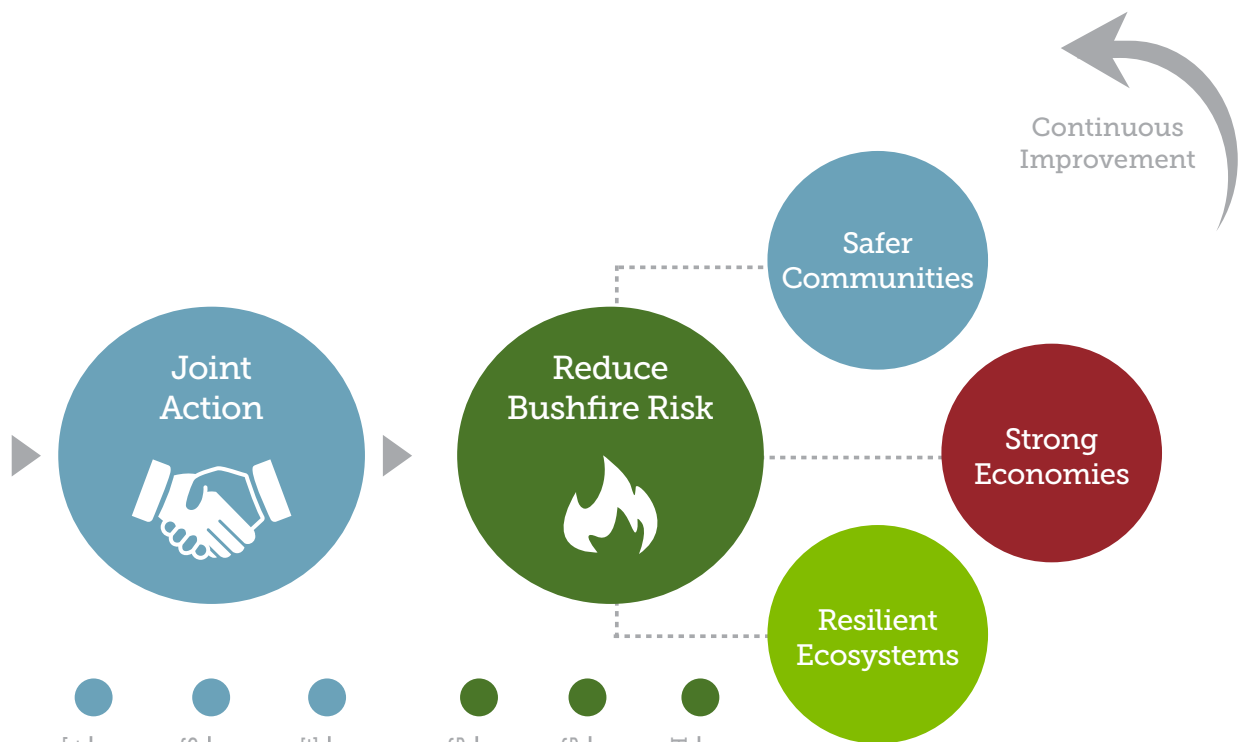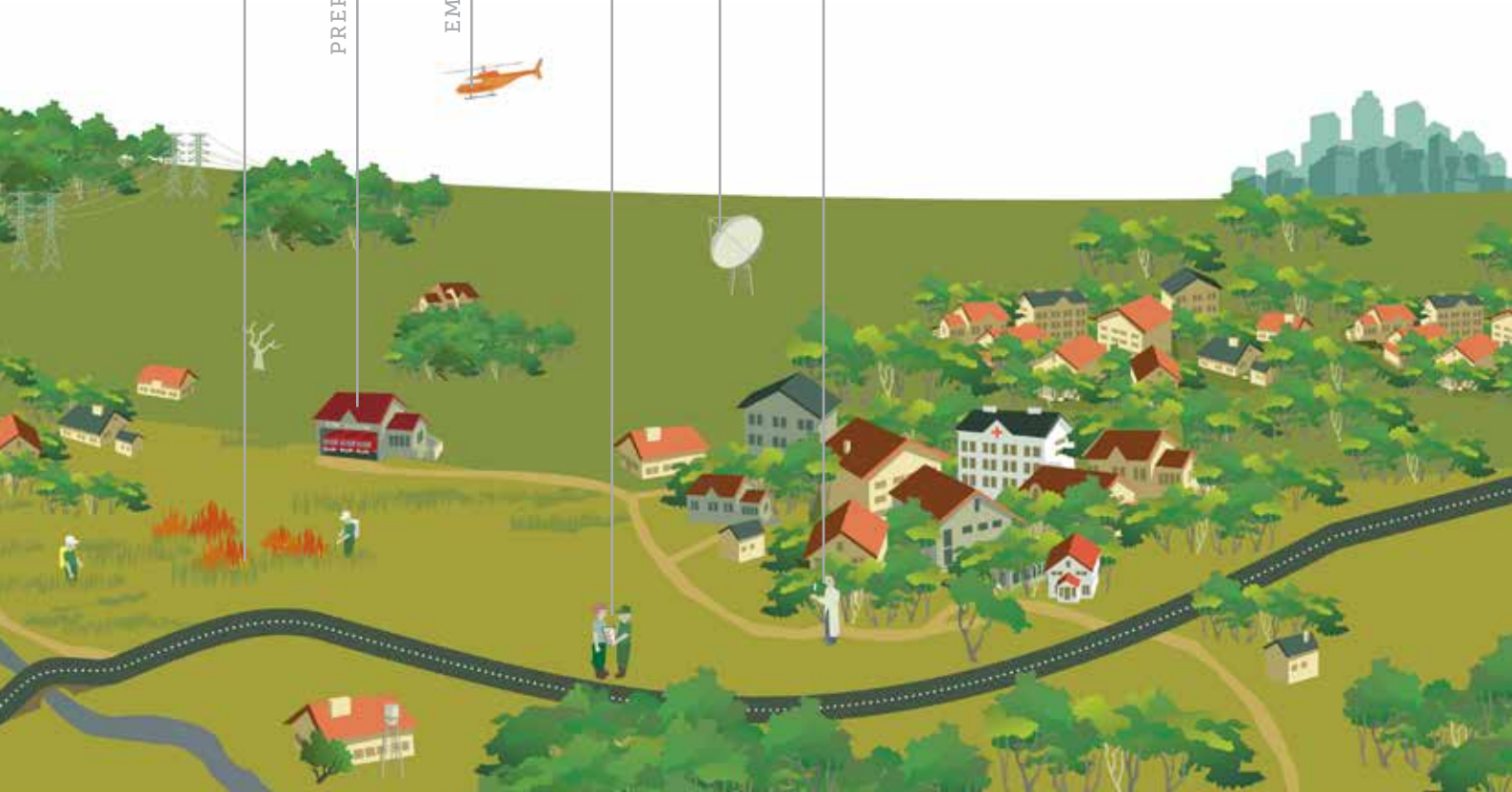
FUEL MANAGEMENT

PREPARE FOR BUSHFIRES

EMERGENCY RESPONSE

MONITORING

REPORTING

RESEARCH

Simulating bushfire risk

We can simulate bushfires at many scales: state, landscape or local. For strategic bushfire management planning purposes, DEPI and PV divide Victoria into seven bushfire risk landscapes. These are areas where bushfire behaviour is sufficiently common to treat the area as a whole. Bushfire behaviour includes the types of places that bushfires start, the terrain and vegetation through which they spread, and the types of impact they have.

We use PHOENIX Rapidfire bushfire simulation software, that the University of Melbourne and the Bushfire Co-operative Research Centre developed in conjunction with DEPI, to simulate the spread and intensity of bushfires. The software predicts how bushfires spread from a range of ignition points, based on factors like vegetation, weather and terrain. It also helps us understand bushfire behaviour characteristics such as flame height, ember density, spotting distance and convection column strength and intensity. Comparisons between PHOENIX Rapidfire simulations and actual past bushfires show it accurately calculates their spread and intensity. This gives us confidence to simulate any weather scenario to measure future bushfire risk, to guide the development of bushfire management plans.

Map 1 compares the extent of the 1983 Belgrave South bushfire with the extent simulated by PHOENIX Rapidfire, using 1983 fuel hazard levels and worst-case bushfire weather. The simulation shows the extent after 24 hours: the actual extent is the bushfire's final perimeter. The map also shows simulated flame heights, which indicate the intensity of the bushfire.

The map shows the accuracy of PHOENIX Rapidfire's simulation of the location and extent of the bushfire. The differences between the actual and simulated bushfire extent are due to firefighters successfully controlling the actual bushfire by back burning in some areas, the actual bushfire burning longer than 24 hours in some areas, and on some local fire dynamics that the software does not account for.

The *Victorian Bushfire Risk Profiles* report describes how DEPI uses PHOENIX Rapidfire to simulate bushfires, and to measure the effectiveness of fuel management in reducing bushfire risk.

Bushfire scenarios

PHOENIX Rapidfire simulation is based on worst-case bushfire weather, measured using the Forest Fire Danger Index (FFDI) which accounts for dryness (based on rainfall and evaporation), wind speed, temperature and humidity. The higher the FFDI, the more extreme the bushfire weather. On Black Saturday 2009—a day of extreme bushfire weather—the FFDI was recorded at over 130, which is the value DEPI uses for PHOENIX Rapidfire simulation of bushfire scenarios. History tells us a handful of extreme bushfires occurring on days when the FFDI is higher than 100 have caused the greatest losses of human life, although any bushfire (including those when the FFDI is much lower than 100) can destroy properties and claim lives.

PHOENIX Rapidfire also lets us nominate the fuel hazard—the structure and amount of burnable vegetation—at any particular place. By altering the amount of vegetation in the

Map 1: Actual and simulated extent of 1983 Belgrave South bushfire
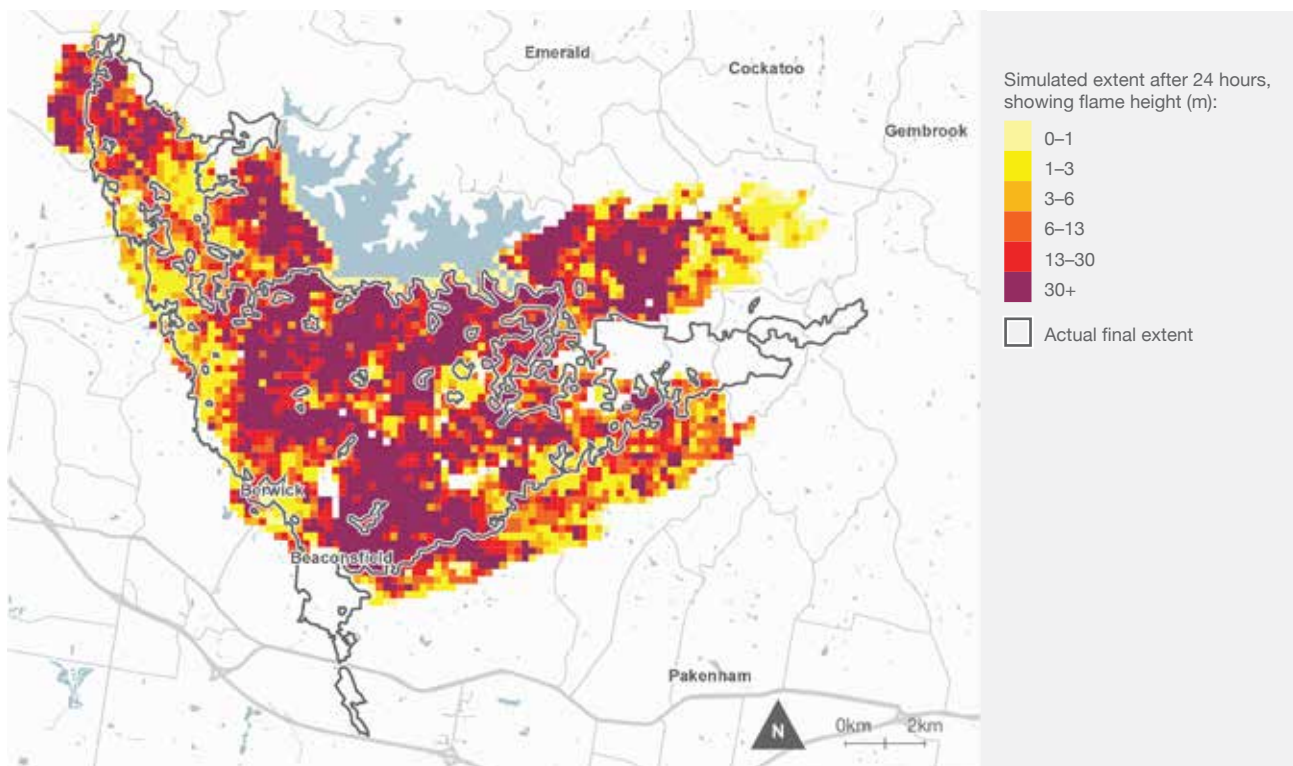
landscape, we can use PHOENIX Rapidfire to simulate how fuel management may alter the behaviour of bushfires on days with FFDI 130.

Residual risk

If there has been no fire—bushfire or planned burning—at a place, there is maximum fuel hazard. By reducing the amount of vegetation in places that bushfires are likely start, spread and impact, we can test the effectiveness of different fuel management strategies. The *Victorian Bushfire Risk Profiles* report has more information about how we use the PHOENIX Rapidfire bushfire simulation software to simulate bushfires and test fuel management strategies.

When there is maximum fuel hazard, there is maximum risk a bushfire will damage or destroy a property or piece of infrastructure. Bushfires, and our fuel management strategy, reduce fuel hazard and so reduce bushfire risk. The remaining risk is called the residual risk and PHOENIX Rapidfire can calculate it across Victoria, a whole landscape, or one or more locations.

Community values and engagement

To develop this plan, we consulted extensively with communities, stakeholders and experts. This helped us identify information, opinions and local factors (such as influxes of summer visitors) to paint a fuller picture about the importance of assets and bushfire risks. Community engagement also builds relationships and helps develop shared understanding of the risks we face, and how best to mitigate them.

An independent community reference group—with representatives of Melbourne Water, CFA, former Fire Services Commissioner, Department of Human Services, local governments, Victorian National Parks Association, the University of Melbourne, Latrobe University and community leaders helped develop this plan.

We will continue to work with communities and stakeholders as we update and improve this plan in future.

Using the best available information and technologies

We used the best available information to develop this plan. We used the Victorian Fire Risk Register, PHOENIX Rapidfire bushfire simulation software, past bushfire experience and local knowledge to identify our most at risk communities and most important infrastructure. The register identifies communities and places at particular risk of bushfire (such as schools, hospitals and aged cared facilities). We also drew on data from the *Victorian Biodiversity Atlas*, NaturePrint (which has information about biodiversity values, threatening processes and ecosystem function), and various databases of flora and fauna attributes, tolerable fire intervals and the growth stages of Victoria's native vegetation.

Our current technology is strongest for assessing risks to people, property, infrastructure and environment, and we are investing in research to develop better approaches to understanding intangible community values, such as cultural heritage.

Identifying what's most important

Based on our best available information we identify the most important property, infrastructure and economic assets in the landscape: major bushfires have resulted in

Field work in Kinglake National Park © Joanna Wand

millions of dollars damage to the agriculture, horticulture, viticulture, timber harvesting, tourism and retail industries, among others. We also identify our most important native vegetation and threatened species and how we can protect them from bushfire damage, and improve their resilience, through fuel management.

⚠ Risk assessment

Our methodology for developing this plan is based on the International Standard for Risk Management, ISO 31000. The risk assessment process aims to determine the likelihood and consequence of a major bushfire impacting on people and properties, on the landscape's key infrastructure, economic assets and high-value ecosystem areas.

Likelihood

Using PHOENIX Rapidfire, we develop maps of where bushfires might start, and how they might spread in worst-case bushfire weather, to estimate the likelihood of impacts occurring.

Consequence

We assess the consequences of a major bushfire by considering its intensity, speed, size and duration. We also assess how vulnerable a town, piece of infrastructure, economic asset or environmental asset is to fire, and whether it will recover quickly or slowly after a fire. Some factors may make particular communities or groups more vulnerable to bushfire (such as a lack of bushfire experience or high levels of disability).

Priorities

We prioritise for protection for a town, piece of infrastructure, economic asset or environmental asset if there is a strong likelihood that a major bushfire would impact on it, and there would be severe consequences if it did. We will protect those things at highest risk through the mitigation actions in this plan.

🤝 Joint action

Managing bushfire risk is a responsibility we share with other public sector agencies, land managers and the community.

The Victorian Government's *Emergency Management Reform White Paper* aims to build community resilience through increased participation and shared responsibility. It is reforming the emergency management sector over the next few years, starting with the *Emergency Management Act 2013*. The Act, among other things, establishes new institutions to ensure that Victoria is well-prepared to deal with emergencies when they occur.

The establishment of Emergency Management Victoria and other initiatives will improve how DEPI and PV work collaboratively with other agencies, stakeholders and the community to reduce the risk of bushfires and other emergencies and promote a safer and more resilient Victoria. This 'all hazards, all agencies' approach to emergency management improves our strategic bushfire management planning, and increases our sharing of information about bushfire behaviour and risk with our partners. This gives us all a common operating picture, improving our joint actions.

Planned burn Woori Yallock © DEPI

Monitoring near Marysville © DEPI

We will continue to work in partnership with the Emergency Management Commissioner, CFA, local governments and water corporations to reduce bushfire risks on public land. We also work with other agencies, and with private land managers, to reduce risks on private land and to encourage residents and land owners to find out about bushfire risks on their property and have an up-to-date fire ready plan.

Managing fuel hazard

Our fuel management strategy for this landscape involves reducing the quantity of leaf litter, twigs, bark and undergrowth by planned burning and mechanical methods. The strategy identifies locations where fuel management will help to keep fires small where they start, or reduce the spread of bushfires, to minimise their impact on life and property, and maintains or improves the resilience of natural ecosystems.

Through fuel management, DEPI has already significantly reduced bushfire risk in our landscape.

Prevention, preparedness, response and recovery

The code of practice emphasises the importance of using a range of prevention, preparedness, fuel management, response and recovery strategies and actions to reduce bushfire risk.

Prevention actions minimise the occurrence of bushfires, particularly those started by people, when weather conditions are extreme. We must be adequately prepared for bushfires, to improve our response to them when they occur. DEPI is responsible for suppressing bushfires in state forests, national parks and protected public land, and for the recovery of public land after a bushfire.

Continuous improvement

DEPI is soon to release the *Monitoring, Evaluation and Reporting Framework for Bushfire Management on Public Land*, which will guide how we assess the effectiveness of our management strategies and activities across Victoria in achieving the two code of practice objectives.

Monitoring and evaluation

This plan outlines broad monitoring and evaluation priorities we will use to measure how effectively our fuel management strategy and other actions minimise the impact of major bushfires on life and property, and maintain or improve the resilience of natural ecosystems. We will develop a monitoring and evaluation plan for our landscape to guide the implementation of this plan.

Reporting

We will make regular public reports of monitoring and evaluation findings, to promote transparency and accountability and to ensure the community has current information about bushfire risk.

Research

Under DEPI's *Bushfire Science Strategy 2013–17*, we will invest in research to improve the information available for future planning.

Review

We will regularly review and revise the strategies and actions in this plan, as bushfire technology and science advance, to respond to changes in bushfire risk, the things communities value, and community and stakeholder needs. We emphasise our commitment to engaging stakeholders and communities in reviews and revisions of this plan.

Bushfires and East Central

About our bushfire risk landscape

The East Central bushfire risk landscape, shown in Map 2, extends north and east of Melbourne, from the High Country around Lake Eildon, south-east to the Latrobe Valley and south to Wilsons Promontory. It includes the Yarra Valley, Dandenong Ranges, Thomson and Upper Yarra Catchments, Mount Baw Baw and the Mornington Peninsula.

The landscape is 2,344,000 ha, which is 8% of the state's area. Of the East Central landscape, 35% is public land and 65% is private land.

The East Central landscape has 31% of Victoria's total bushfire risk. Of Victoria's seven bushfire risk landscapes, our landscape has the most risk. This reflects the landscape's high population density close to forests. Over half the bushfire fatalities in Victoria since European settlement have occurred in our landscape. These fatalities are a reminder of the devastating impact that bushfires can have on communities, and the real impacts bushfires can have in areas with high bushfire risk. The *Victorian Bushfire Risk Profiles* report describes how bushfire risk to properties is calculated and distributed across the state.

In 2011, 44% of East Central's population of 3.2 million people—which was over 59% of Victoria's population—lived in the peri-urban municipalities. Peri-urban municipalities commonly have houses and other properties close to, or bordering, bushland, so face bushfire risks that Melbourne's inner and middle suburbs do not.

East Central is one of the most biologically diverse landscapes in Victoria. This diversity is evident in the 10 bioregions represented in the landscape, each comprising a unique set of landscape properties and associated flora and fauna assemblages. From the tall mountain ash forests of the Great Dividing Range, to the dry foothill forests and grasslands, this landscape has some of the most flammable types of vegetation on earth.

How our worst bushfires behave

In worst-case bushfire weather, north-westerly winds bring hot, dry air from central Australia to raise Victoria's temperature above 40°. Then, cold fronts, often with little rain, swing the wind to the south-west, initially at strong to gale force. These conditions can create bushfires with powerful convection columns. Ember storms, wind-blown debris, downbursts, fire tornadoes and explosive flares of igniting eucalyptus vapour are common. This was the weather on 16 February 1983 (Ash Wednesday) and 7 February 2009 (Black Saturday).

Bushfires in our landscape vary considerably depending where they are, from short one-day fires in the Dandenongs to long and protracted fires in the forests in the east of our landscape. Major bushfires in our landscape include spotting that can travel many kilometres and be very destructive.

Many communities in the landscape are surrounded by forest and over 300,000 people live close to public land. Communities such as Kinglake, Marysville, Warburton, Warrandyte, Woori Yallock, Neerim and Erica all have large areas of forest to their immediate north and south-east, as do many communities in the Dandenongs and the Latrobe Valley.

In the last 10 years, 10% of the land in East Central has been burnt. Three-quarters of this was public land.

Our major bushfires

There have been many destructive bushfires in the East Central landscape. Table 1 shows major bushfires in our landscape since 1851. The potential for similar bushfires exists, and will continue to exist into the future.

October–April is bushfire season

Bushfires can start any time of the year, but most occur between October and April. The largest and most damaging bushfires generally occur from December through February, with about 60% occurring in the summer months.

In the 20 bushfire seasons to 2013–14, DEPI responded to an average of 104 bushfires a year in our landscape, although the actual number each season varied substantially according to the dryness of the season. For example, 2010–11 had a relatively wet summer, and only 34 bushfires: 2006–07 had a hot, dry summer, and 249 bushfires.

Since 1972, DEPI and the CFA have suppressed 87% of the bushfires we attended in our landscape before they grew to 5 ha. Our capability to quickly suppress bushfires before they grow to a size and intensity that makes them difficult to control is a core part of our approach to reducing bushfire risk.

How bushfires start

In the decade to 2014, the biggest cause of bushfires in our landscape that DEPI responded to (34%) was accidents by people. These bushfires were started by causes including machinery, trains and escapes from campfires and burn offs. Deliberate action by people accounted for 17% of bushfires, lightning 27% and the remainder (22%) had other or unknown causes.

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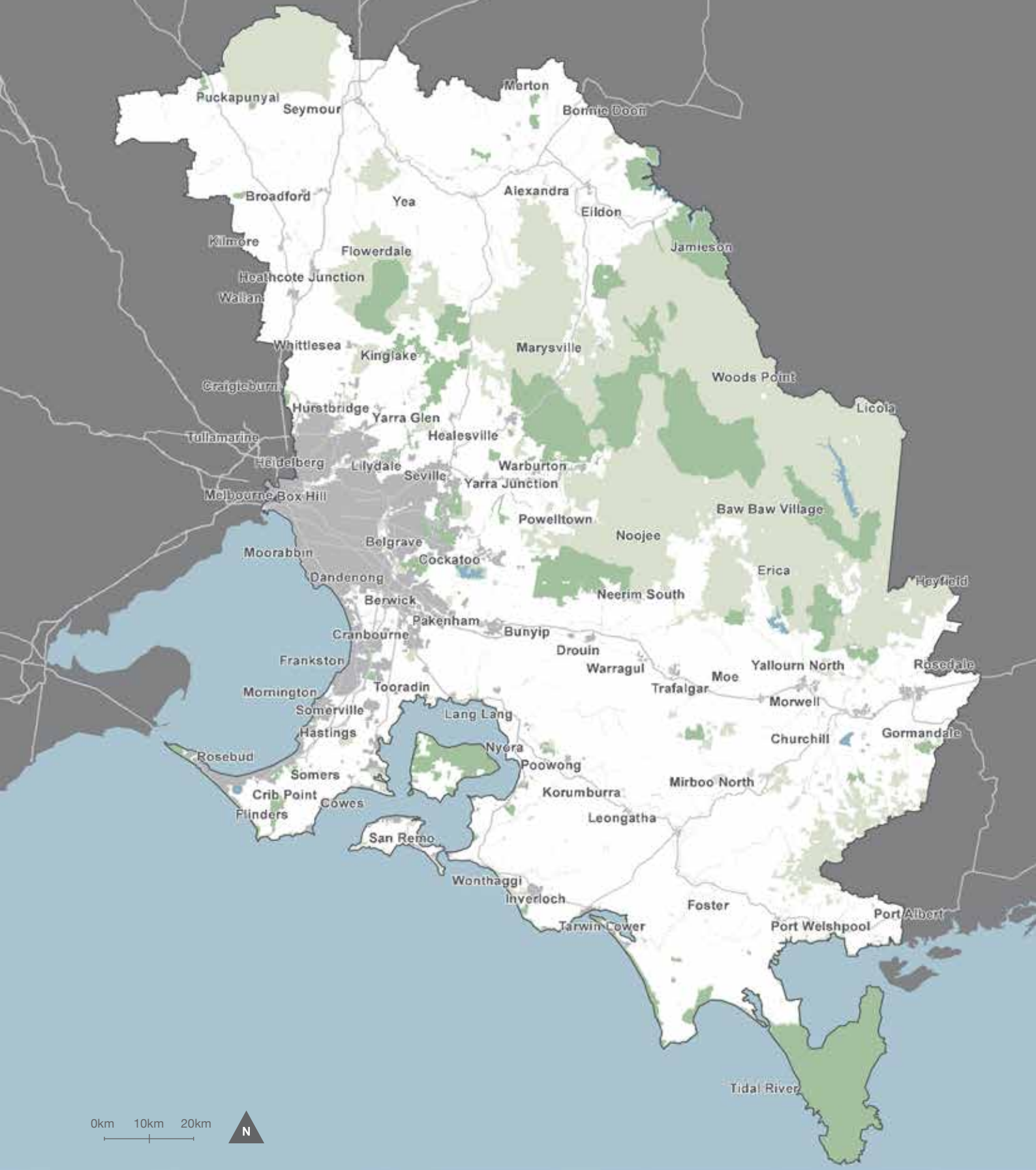
Public land (State forests and other Crown land)

Public land (national parks)

Private land

Built-up areas

Main roads

Table 1: Major bushfires in East Central since 1851

Year	Location	Size (ha)	Losses
1851	Dandenong Ranges (Black Thursday)	Unknown	12 people
1898	South Gippsland	260,000	12 people, 2000 buildings
1926	Warburton, Noojee, Kinglake, Erica, Dandenong Ranges	Unknown	31 people
1939	Noojee, Warrandyte, Yarra Glen, Warburton, Erica (Black Friday)	2,000,000	71 people, 650 houses
1942	South Gippsland	Unknown	1 person, 20 houses
1944	Beaumaris	Unknown	63 houses
1944	Yallourn, Morwell, Traralgon	Unknown	9 people, 136 houses
1962	The Basin, Christmas Hills, Kinglake, St Andrews, Hurstbridge, Warrandyte, Mitcham	30,321	32 people, 450 houses
1968	The Basin, Upwey	1920	53 houses, 10 other buildings
1983	Belgrave South, Cockatoo, Beaconsfield Upper (Ash Wednesday)	93,500	47 people, 2000 houses or other buildings
1997	Dandenong Ranges, Arthurs Seat	569	3 people, 41 houses
2005-06	Yea, Moondarra, Kinglake	25,000	4 people
2006-07*	Walhalla (Great Divide bushfire)	1,048,238	1 person, 51 houses
2009	Kilmore East, Churchill, Kinglake, Marysville, Yarra Valley, Dandenong Ranges, Narre Warren, Upper Ferntree Gully, Wilsons Promontory, Bunyip State Park, Delburn (Black Saturday)	232,300	173 people, 2007 houses
2014	Warrandyte, Darraweit Guim, Hernes Oak	41,000 +	40+ houses

*Most losses occurred outside the East Central landscape.

Using residual risk to measure our success

DEPI uses the idea of 'residual risk' to assess whether activities such as fuel management are reducing bushfire risk.

Residual risk is the risk, on average and across the whole landscape, that bushfires will impact on properties or other assets. It is the percentage of risk remaining after bushfire history and fuel management (mainly planned burning) activities are taken into account. For example, 80% residual risk means that the risk of property and infrastructure being impacted by a bushfire—on average, throughout the landscape—is 80% of what it would have been if we had never had bushfires and planned burning to reduce the fuel hazard.

DEPI measures residual risk using PHOENIX Rapidfire bushfire simulation software. This software calculates the reduction in a location's residual risk if we reduce fuel hazard at the ignition points, and along the spread paths, of bushfires that could impact the location. This gives us the information to manage fuel where it offers the greatest reduction in residual risk. It also helps us minimise the environmental impacts of our planned burning activities because we can better choose where to burn, and at what intensity.

DEPI reports the residual risk of bushfires in its annual fuel management report. The trend in this number, over time, indicates whether our activities are helping reduce bushfire risk.

Figure 1 shows how bushfires and our planned burning have affected residual risk in the East Central landscape since 1980. It shows that residual risk increased in the 15–20 years after the 1983 Ash Wednesday bushfires, as vegetation slowly grew back, from just under 80% to almost 100% (100% risk is the maximum residual risk possible if the fuel hazard had never been reduced through bushfires or planned burning). The 2009 Black Saturday bushfires reduced residual risk to about 45% but it has steadily increased since then to 73% in mid-2014. While our planned burning will reduce the rate of increase, residual risk will continue to rise in our landscape as fuels reaccumulate in the ash forest burnt in 2009. The figure also shows the

hectares burnt by bushfires, and by planned burning, in each year.

Residual risk comprises risk on both public and private land. Safe and efficient burning of some areas of public land needs to be done in conjunction with private landholders, if there is continuous forest across the public–private land boundary.

Projections for our future climate

Long-term records show an increase in bushfire danger and the length of the bushfire season for Victoria in recent decades. Projections for Victoria's future climate indicate that the frequency and intensity of bushfires in south-east Australia will continue to increase. Projections also include:

- reduced average rainfall and streamflows
- fewer and heavier rainfall days and more consecutive dry days
- an increase in the extent and frequency of droughts

- more days over 35° and a higher annual mean temperature
- an increase in the number of extreme fire danger days (with FFDI greater than 75), by between 15% and 70% by 2050.

The precise impacts of climate change on the landscape's flora and fauna are not known, but are likely to include the arrival of species to new areas in the landscape, altered fire regimes and altered hydrology. Climate change is likely to change the attributes and availability of habitat, which will pose a particular threat to species that are isolated in the landscape, or have little ability to relocate to more suitable habitat.

PHOENIX Rapidfire simulations can be done for any weather scenario, including extreme weather conditions. We can therefore use it to assess bushfire risk resulting from changes in our climate over time.

Figure 1: Residual risk, 1980–2013

Legend: Residual risk · Bushfires · Planned burning
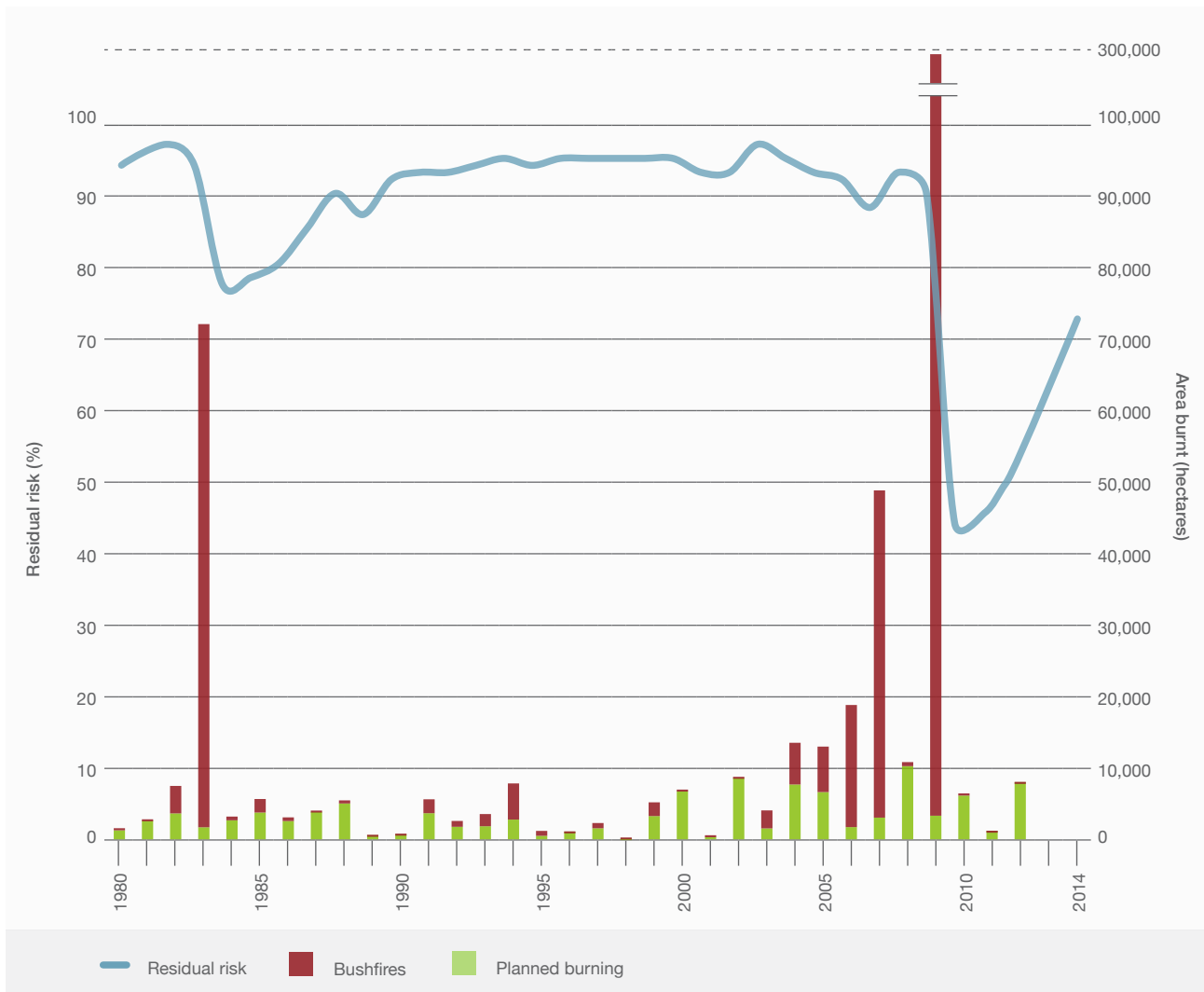
Identifying what's most at risk in East Central

The fuel management strategy and other actions in this plan aim to reduce bushfire risk to our landscape's priority communities and infrastructure, high-value native forest timber and high-value ecosystem areas.

People

Protecting human life and property is the highest priority in strategic bushfire management planning. 3.2 million people live in our landscape, and 300,000 of them are neighbours of public land.

We are moving into bushland

By 2031, the peri-urban population of our landscape is expected to grow by 39%, much of it in the urban growth corridors. Many regional cities and small towns are also growing as commuters to Melbourne, 'sea changers' and 'tree changers' move to the landscape. This expands established communities and increases demand for more isolated properties.

All these factors increase the amount of housing in, or close to, bushland and at risk from bushfires. People and communities in these areas will need to take action, with the support of emergency management organisations, to address bushfire risks.

Larger populations also result in more private and public infrastructure, especially at the forest interface which is at risk of being damaged or destroyed in a major bushfire and increase the number of deliberate and accidental bushfire ignitions.

New or temporary populations are at risk

Recently established communities, newly established residents, day trippers, short-stay visitors and holiday-home owners can be much less likely than communities that have experienced bushfire to have adequate awareness and response planning.

Large influxes of people, particularly at weekends and holiday periods, also congests main roads and roads in towns. This can severely compromise evacuation and firefighting efforts.

Disability, illness, age and a non-English-speaking background may reduce people's bushfire risk awareness and limit their ability to respond safely to bushfires, including by evacuating quickly if necessary. As the population ages, people, social services and health networks will need greater support to prepare for, respond to and recover from bushfires.

Infrastructure

Map 3 shows the location of East Central's priority infrastructure: its key power infrastructure (power stations and coal mines) and water infrastructure (the Upper Yarra and Thomson catchments and their infrastructure).

The cost of repairing or replacing infrastructure after a major bushfire can be enormous and in some cases can take years. Rebuilding roads and associated infrastructure (such as signposts, guardrails and bridges, which are easily damaged or destroyed by a major bushfire) is an essential step for economic and community recovery.

Power infrastructure

The Latrobe Valley has the largest amount of power generation infrastructure in Victoria. Infrastructure at risk includes the Yallourn, Hazelwood and Loy Yang power stations, which rely on onsite coal mines. Coal ignites easily and coal fires are hard to suppress.

The 2006–07 Great Divide bushfires illustrate the consequences of a loss of power. The bushfires cut Victoria's main electricity link to the New South Wales power grid. This resulted in widespread power outages to homes, loss of mobile phone coverage over a 750 km2 area and 1100 metropolitan street lights going out. Power was lost during peak hour in Melbourne: 160 trains were cancelled and 616 trains delayed, affecting an estimated 175,000 passengers.

Water supply infrastructure

Most of Melbourne's water comes from protected catchments. These are forested areas to the north and east of the city that stretch along the Great Dividing Range, from Wallaby Creek in the west to the Thomson Reservoir in the east.

The catchments cover 156,700 ha, made up of 56,000 ha of state forest managed by DEPI and 90,800 ha of national park managed by PV. Melbourne Water supports DEPI and PV to manage the catchments and actively engages in fire protection. Melbourne Water also owns and manages 7,500 ha of land.

Planned burn ©DEPI

Map 3: Priority communities and infrastructure, high-value native forest timber and high-value ecosystem areas

Legend:
- Priority communities
- Priority infrastructure
- High-value native forest timber
- High-value ecosystem areas

0km 10km 20km

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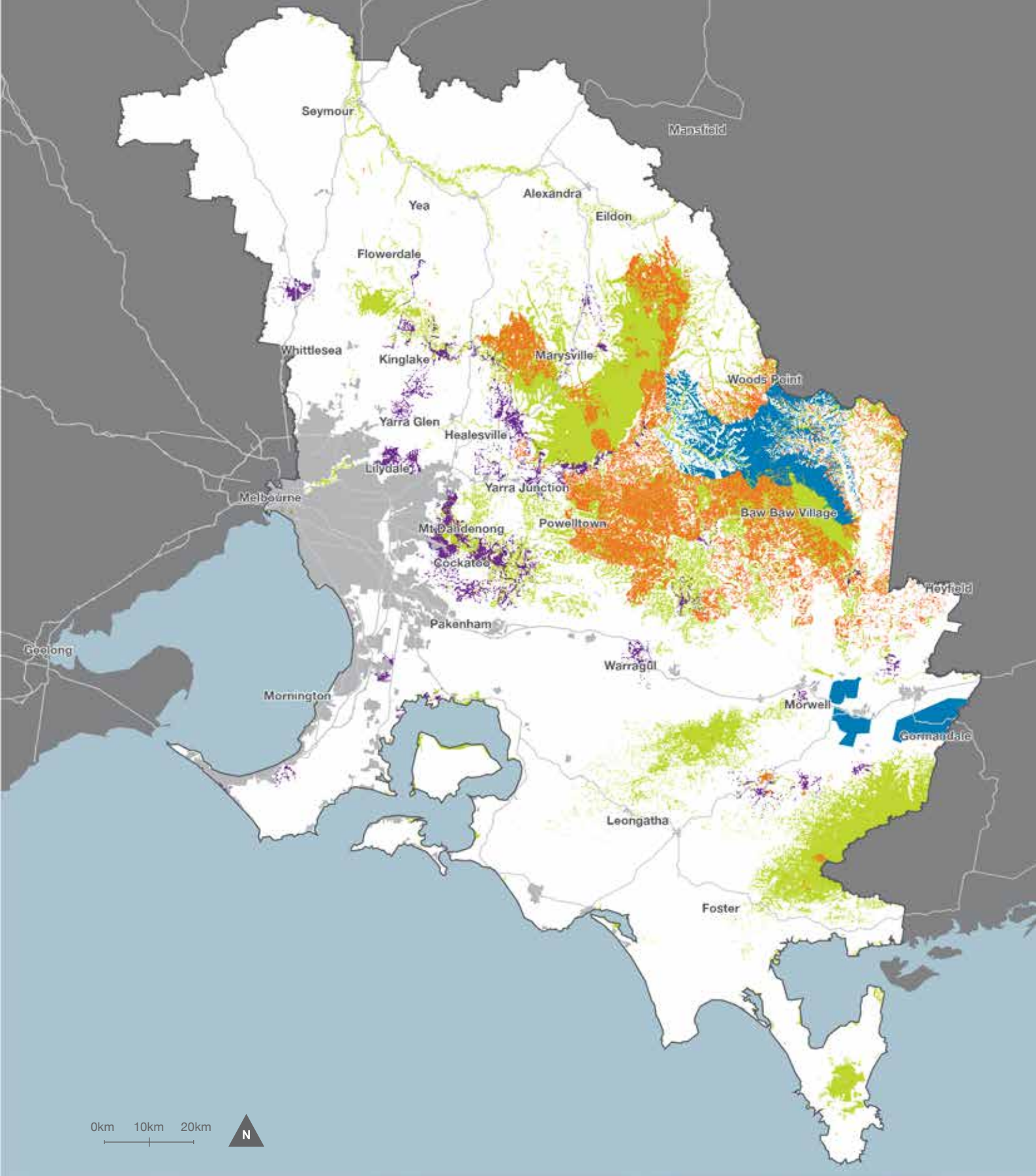
Toolangi State Forest © DEPI

The Upper Yarra and Thomson catchments are the priority water supply catchments in East Central. The Thomson Reservoir comprises 60% of Melbourne's reservoir storage capacity, and the Upper Yarra Reservoir a further 10%. Most of this water is produced from mountain ash forests in these catchments, and these forests are at extreme risk from major bushfires.

Bushfires can disrupt drinking water supplies by damaging water supply infrastructure, contaminating water with bushfire ash and other debris, and reducing water yield into dams and reservoirs. A major bushfire in the ash forests of Melbourne's water catchments could reduce water yield for up to 150 years as the ash forests regenerate and grow again to maturity.

Environment

About our native vegetation

The East Central landscape is geologically diverse and complex, with variations in climate and topography from sea level through foothill forests to alpine environments. Sixty-four percent of our native vegetation is on public land and ranges from the tall mountain ash forests of the Great Dividing Range, to grasslands, to the coastal mangroves of Port Phillip Bay. Major bushfires since 2002 have resulted in a massive shift from older to younger native vegetation, reducing its growth stage and habitat diversity.

In some parts of our landscape, native vegetation has been highly fragmented due to clearing. Fragmentation increases the risk of biodiversity loss. Small fragments are less able to support plants and animals, and are less resilient to disturbance. This is of most concern for species with limited abilities to disperse, with large home ranges or with no nearby habitat to move to. The landscape's remaining fragments therefore have a high biodiversity value.

Fragmentation also increases the area of interface between public and private land close to towns. This means that planning for fuel management activities can be complex, and the activities resource-intensive to implement.

Ecological fire groups

The landscape has 23 ecological fire groups (EFGs). EFGs are groupings of the more commonly known ecological vegetation classes that have common ecological requirements for fire, and common fire behaviour characteristics. EFGs are a useful way of classifying native vegetation when developing a fuel management strategy.

The EFGs in our landscape are:

- moist forest, tall mist forest, closed forest, riparian forest and high altitude shrubland/woodland, covering 120,000 ha of wetter and higher-altitude areas

- tall mixed forest, forby forest, ironbark/box, foothills forest, grassy/heathy dry forest and heathland, covering 337,000 ha of drier and lower-altitude areas

- basalt grassland, damp scrub, coastal grassland, western plains woodland, riverine woodland, inland plans woodland, granitic hillslopes eucalypt canopy and rocky knoll, covering 67,000 ha of lowland and coastal areas

- saline wetland, freshwater wetlands (permanent and ephemeral) and treed swampy wetlands, covering 31,000 ha of wetland areas.

Ecosystem resilience, tolerable fire intervals and vegetation growth stages

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 EFG. 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.

We use TFIs as an initial surrogate measure of risk to ecosystem resilience across the landscape, and as an input to decisions about how often, when and where to conduct planned burning.

The growth stage of vegetation depends on when it was last burnt, or subject to other disturbance. Each vegetation type passes through distinct stages following disturbance, each stage differing in the quality of the habitat it provides for plants and animals. Lack of diversity of growth stages in a landscape may reduce the ecosystem's capacity to resist damage and maintain its basic structure and type, after being disturbed by fire. DEPI is working toward using vegetation growth stages to help measure ecosystem resilience.

Threatened species

East Central is home to 3346 native flora species and 842 native fauna species. These include Victoria's faunal emblems, the Leadbeater's possum and helmeted honeyeater. Significant land use changes have occurred in this landscape causing many species to become rare or threatened, and many are listed as threatened under the *Flora and Fauna Guarantee Act 1988* and the *Environment Protection and Biodiversity Conservation Act 1999*. Both Acts require DEPI and PV to ensure our activities (including fuel management activities) do not have a significant impact on threatened species and communities.

While many species have adapted so they can survive fire, intense bushfires can put some vulnerable species and ecosystems at risk. Individuals may perish in bushfires. Less directly, bushfires can increase rates of predation, and reduce the habitat provided by hollows and logs. Soil erosion can also damage stream habitats.

High-value ecosystem areas

Map 3 shows the high-value ecosystem areas in the landscape we identified as vulnerable to bushfire or repeated burning. To do this, we considered the cumulative impacts of bushfires and planned burning on vegetation over time, vegetation growth stages, sites that are long unburnt, and sites with a rich diversity of species. High-value ecosystem areas provide habitat for key species at most risk from a major bushfire. Many of these species have similar habitat requirements to a wider range of similar species, giving us confidence that protecting these high-value ecosystem areas accounts for the habitat that a broad range of species need.

Our high-value ecosystem areas include fire-sensitive wet forests, which do not need fire for ecosystem resilience and which take a very long time to recover from fire. Fire-sensitive wet forests include cool temperate rainforest, warm temperate rainforest, wet forest, montane wet forest and montane riparian thicket.

While we prioritise high-value ecosystem areas for bushfire risk management planning purposes, we also consider the requirements of threatened species and include measures to reduce the impacts of our fuel management activities on them, through fire operations planning and planned burning processes.

Other forest types (such as forby forest, foothills forest and grassy/heathy dry forests) are more resilient to one-off fires, but are vulnerable to too-frequent fires; repeated fires in short periods may reduce their diversity and habitat. These forests are more likely to burn in moderate weather conditions associated with planned burning and are therefore more likely to be targeted for planned burning.

Helmeted honeyeater © Peter Menkhorst

Diuris orchid © DEPI

Thomson Reservoir © DEPI

Reference areas

Reference areas are relatively undisturbed tracts of public land proclaimed under the *Reference Areas Act 1978*. They serve as a reference for research to investigate the impacts and potential solutions to issues arising from land use and management activities. There are 20 reference areas in our landscape, totalling 12,000 ha. This plan aims to maintain these areas in as natural a state as possible by reducing bushfire risk—provided it doesn't compromise our ability to mitigate risk to life and property—and by using planned burning in an ecologically sensitive way.

Economy

There are about 1.5 million employed people in the East Central landscape. Melbourne's south-east generates one-third of Victoria's manufacturing economic output and 23% of Victoria's total economic output.

Across Victoria, bushfires have caused huge economic losses: $925 million for Black Saturday (2009), $2.2 billion for the Great Divide bushfires (2006–07) and $2.7 billion for the alpine fires (2003). In our landscape, the tourism, agriculture and timber harvesting industries have been particularly affected by bushfires.

High-value native forest timber

Map 3 shows the landscape's high-value native forest, of key importance to the native forest timber industry.

Bushfires can destroy softwood and native hardwood plantations and devastate the native forest timber industry. The loss can continue for decades, as new trees grow to harvestable age. Plantations are generally fragmented and are often adjacent, or close to, native forest. They can increase the bushfire risk across the landscape by providing continuity of fuel for spreading bushfires.

Ash forests in the landscape planned to be harvested in the next 20 years are at highest risk because they are the highest value timber asset in East Central, and because they take a long time to regenerate.

Agriculture, horticulture and viticulture

Agriculture employs about 14,400 people (or 1%) of the employed population in East Central. Bushfires destroy agricultural, horticultural and viticultural assets, such as buildings, fencing, machinery and equipment. They also kill and injure livestock and destroy productive plants, such as fruit trees and grape vines.

Smoke from fires can permeate through the skin of fruits. The viticulture industry is particularly vulnerable to smoke taint during the summer bushfire season and autumn planned burning periods, which are when fruit ripens. We aim to manage the risk of smoke taint by reducing the frequency and severity of bushfires, simulating the movement of smoke before starting planned burning in critical areas and at critical times, by consulting with grape growers about the timing of planned burning, and by continuing research into smoke taint.

Wilsons Promontory © Janet Pakan

Tourism

Bushfires damage or destroy the natural environments and infrastructure on which tourism industries rely. Bushfires, occurring as they usually do in the summer holiday months, can result in a dramatic drop in tourist numbers, with consequent economic losses. During and immediately after a severe bushfire, would-be visitors generally stay away from burnt and nearby areas.

In the East Central landscape, three months after the 2003 bushfires, 1100 fewer businesses were trading than before the bushfires, and 15 had closed. This resulted in an estimated loss to the economy of $200 million. The 2009 Black Saturday bushfires severely impacted Marysville, damaged almost all the buildings at the Lake Mountain Alpine Resort, and burnt much of the forest. Tourism, retail and related business in the area were severely affected.

Retail, commercial and industrial

During and after a bushfire, retail trade drops as local people evacuate their property, and they may not be able to return quickly. The number of tourists also drops. For example, businesses in bushfire-affected areas after the 2003 alpine bushfires reported a 50–70% downturn, and some reported no business at all. However, some businesses did well by providing goods and services (such as food, water and equipment) for firefighters and support personnel.

Cultural heritage

People value our landscape for many reasons. We have initiated a research project with the University of Melbourne to explore how these values can inform future bushfire planning.

There are three registered Aboriginal parties in East Central: Wurundjeri Tribe Land and Compensation Cultural Heritage Council Inc., Taungurung Clans Aboriginal Corporation and Gunaikurnai Land and Waters Aboriginal Corporation. Bunurong and Boonurong are also applicants for registered Aboriginal parties.

There are many Aboriginal cultural heritage sites in the landscape, arising from a history of thousands of generations of Aboriginal people. They include ceremonial gathering places, shell middens, burial sites, scar trees and artefact scatters.

Bushfire risk management must draw on the wisdom and experience of the landscape's Aboriginal cultural heritage, and support the landscape's Aboriginal people to rebuild and maintain connections to Country. Aboriginal cultural heritage in this landscape is an important heritage of all Australians, and is of global significance.

Over the last 200 years, European cultural heritage has also played an important role in shaping the East Central landscape. Important heritage assets include historical mining, timber, railway and military sites (such as Fort Nepean and the Quarantine Station in Port Nepean National Park), and the Puffing Billy steam railway between Belgrave and Gembrook.

Planned burn near an orchard © DEPI

Scar tree (Noojee) © Rebecca Rose

Point Nepean, Mornington Peninsula © Suriya Vij

East Central's bushfire catchments

In worst-case bushfire weather, a bushfire can travel quickly across a large area of our landscape. To effectively manage bushfire risk, we simulate where the highest-impact bushfires are likely to start, spread and cause maximum damage to life and property. We can then reduce fuel hazard at the potential ignition points and along the spread paths of these highest-impact simulated bushfires, which will support last-line defence around priority assets. Knowledge of the most consequential ignition points also helps us decide where to preposition firefighting equipment and conduct patrols in worst-case bushfire weather.

Map 4 shows where PHOENIX Rapidfire predicts bushfires would start that would destroy the greatest number of properties in East Central, given maximum fuel hazard (which is with no fuel reduction in the landscape, from bushfires, planned burning and other fuel management). Maximum fuel hazard is the benchmark against which we can measure the effectiveness of various fuel management scenarios in reducing bushfire risk. Red and orange show the starting points—not where properties would actually be impacted—for the greatest-impact bushfires; white the least.

Map 5 shows where PHOENIX Rapidfire predicts bushfires would start that would destroy the greatest number of properties in East Central, based on the fuel hazard as it was in 2013. Comparing maps 5 and 4, we see that fuel reduction (through bushfires and fuel management) has reduced the potential impact of simulated bushfires that might start at the most consequential ignition points. For example, with maximum fuel hazard (Map 4), bushfires igniting in a broad area around Kinglake–Marysville could potentially impact over 4000 properties. With 2013 fuel hazard, this reduces to around 900 properties for almost all bushfires that might start anywhere in that area.

Map 6 shows where in our landscape PHOENIX Rapidfire simulations indicate bushfires would cause maximum damage to life and property. Extreme property impact risk is where a location has lots of properties, and is in the path of lots of simulated bushfires (that is, impact by a potentially high-consequence bushfire at some time is almost certain).

The map shows that the simulated property risk is highest around Kinglake, Marysville, Healesville and the Warburton Valley, around Noojee and south to Drouin, and in the Erica-Rawson area. Most of these communities are close to large areas of forest (particularly with forest to their north-west), which can drive large convection columns and extreme bushfire behaviour.

Drawing on our understanding of where the highest-impact bushfires start and spread, and our landscape's highest priorities for risk management, we defined 12 bushfire catchments for the East Central landscape. Map 6 shows these catchments, which are areas in which the worst bushfires are likely to start, spread and cause maximum damage to priority communities, under worst-case bushfire weather.

Upper Yarra catchment © DEPI

Map 4: Bushfire ignition locations,
in terms of their impact, maximum fuel hazard

Map 5: Bushfire ignition locations,
in terms of their impact, 2013 fuel hazard
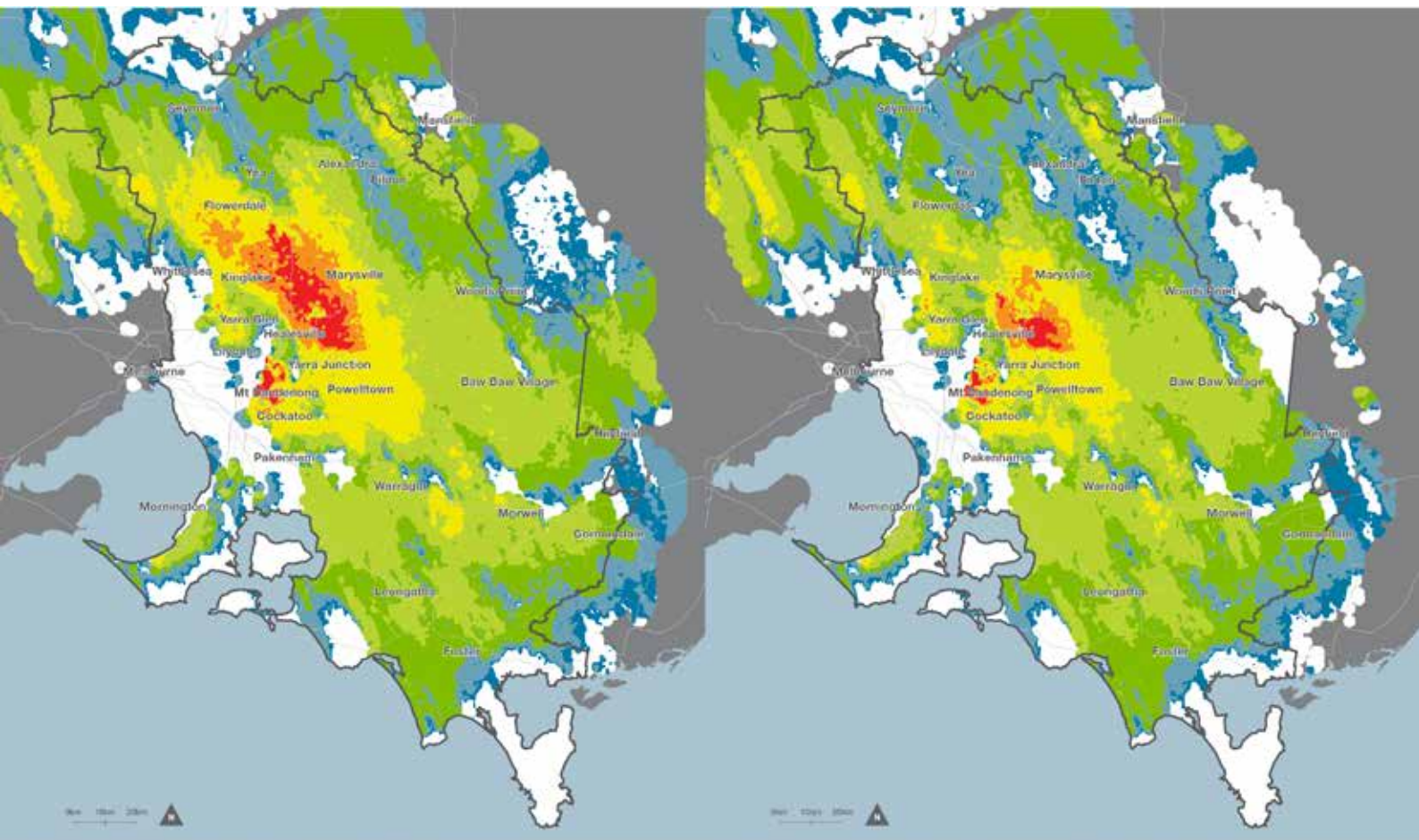
Simulated number of properties impacted by bushfire starting at this point:

0–10	101–300	2701–4000
11–30	301–900	4000+
31–100	901-2700	
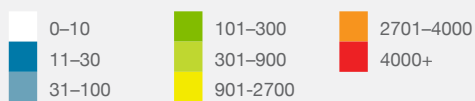
Map 6: East central bushfire catchments and simulated property risk

Simulated property risk:

- Low
- Moderate
- High
- Very high
- Extreme

Bushfire catchment:

- Dandenongs North
- Dandenongs South
- Erica
- Kinglake
- LaTrobe Valley
- Peninsula
- Tarago
- The Triangle
- Upper Yarra–Thompson
- Wallan
- Warburton Valley
- Warrandyte

0km   10km   20km   N
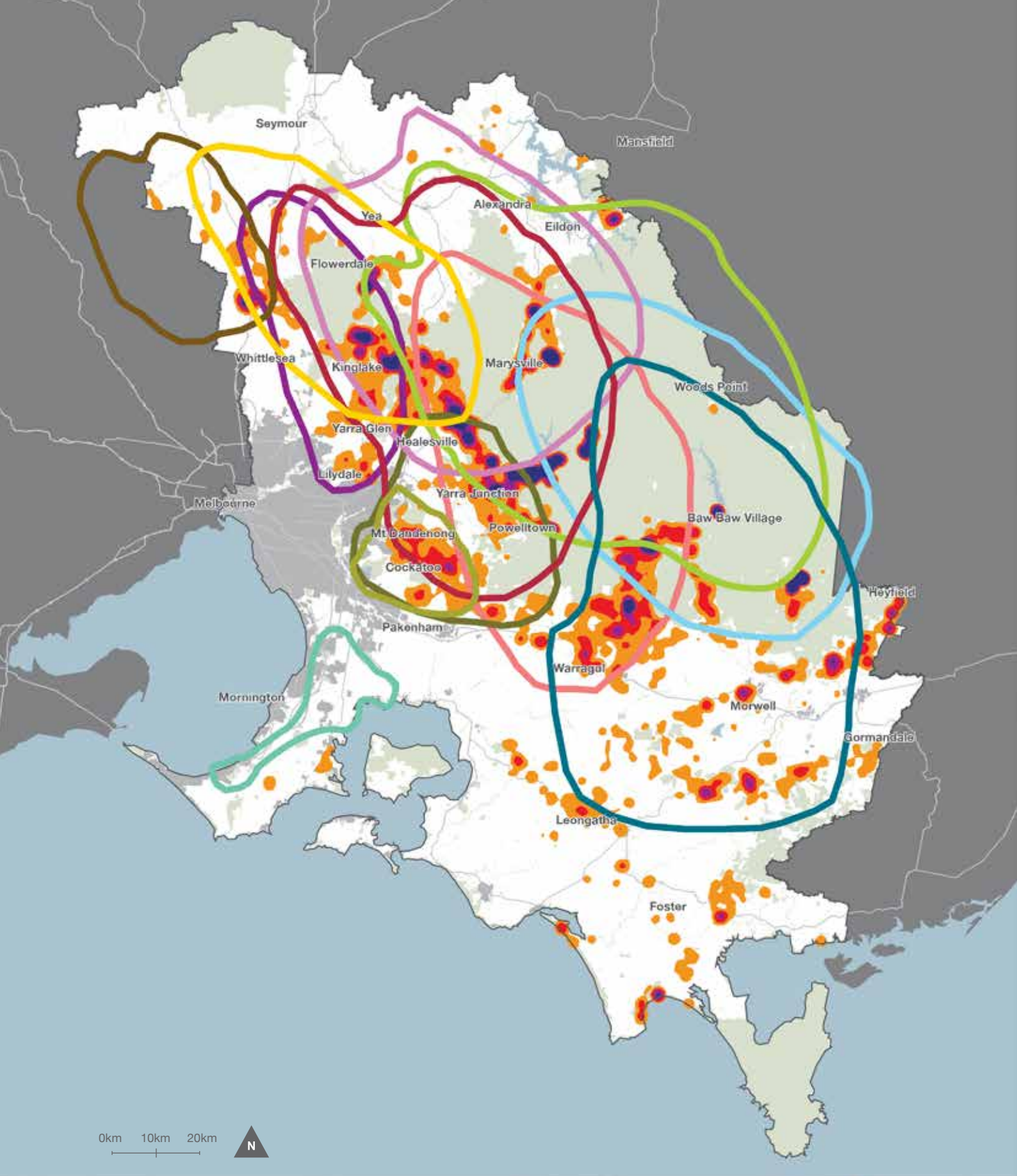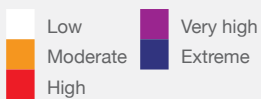
Bushfire catchments cover both public and private land. There is bushfire risk across the whole of each catchment. Indeed, there is bushfire risk right across the landscape, but the risk in bushfire catchments is higher.

Some catchments have hot spots—areas where intense convection creates severe flame and ember threats—and critical escalation zones earlier in a bushfire's path, where crown fire runs can create strong convection and spotting. In some catchments, these are close to population centres; in others, they are further back in the catchment. Hotspots and critical escalation zones can accelerate and expand bushfires and reducing fuel hazard in these places is important, to moderate major bushfires.

Some catchments may extend over 50 km, indicating how far some bushfires can travel from their points of ignition to impact.

The high-to-extreme risk areas in the 12 catchments comprise 63% of the total risk to life and property in our landscape. We must prioritise fuel management in these areas.

We will also manage fuels outside priority fuel management areas (as identified in fire operations plans) to reduce risk to other towns, infrastructure and economic activity, protect other things like water yield and water quality in the Upper Yarra and Thomson water catchments, and maintain and improve ecosystem resilience.

Dandenongs North bushfire catchment

The Dandenongs North bushfire catchment contains 3% of the risk to life and property in our landscape. High-risk towns in this catchment include many towns north of Cardinia Reservoir including Kalorama, Ferny Creek, Emerald and Cockatoo. The catchment's high population is interspersed with forest. Much of the public land is wet forest which cannot be treated through planned burning. The catchment also contains significant tourism assets and Cardinia and Silvan reservoirs, which supply much of Melbourne's water.

The worst bushfires in this catchment are on the west face of the Dandenongs and in forests east of Monbulk. This catchment is small, and bushfires that start in worst-case conditions can quickly destroy property and claim lives. Planned burning to reduce fuels and quick suppression to stop bushfires before they grow large is the key to reducing risks. The west face of Mt Dandenong is a major convection area, and bushfire intensity peaks at Mt Dandenong and Silvan. Planned burning there can reduce the spread and intensity of bushfires.

Dandenongs South bushfire catchment

The Dandenongs South bushfire catchment contains almost 2% of the risk to life and property in our landscape. High-risk areas in this catchment include areas around Upwey, Selby, Beaconsfield Upper and Pakenham Upper, and the area south of Cardinia Reservoir. The catchment's high population is interspersed with forested land, most of which is privately owned. Most of the catchment can be treated

by planned burning, except for the Sherbrooke Forest area north of Belgrave. The catchment's most important infrastructure is Cardinia Reservoir and the Metro and Puffing Billy railway lines.

The worst bushfires in this catchment start in areas of contiguous forest to the north and west of towns, often on public land. These areas include Sherbrooke Forest, Lysterfield Lake Park and Cardinia Reservoir. This catchment is small, so bushfires that start in worst-case bushfire weather can quickly become calamitous. Fuel reduction and quick suppression to stop bushfires growing large is the key to reducing risk to the towns in this catchment. Pakenham Upper has high convection levels and the area around Beaconsfield Upper and Pakenham Upper have high bushfire intensities, so fuel management can be effective in reducing the spread and intensity of bushfires.

Erica bushfire catchment

The Erica bushfire catchment contains almost 3% of the risk to life and property within the East Central bushfire risk landscape. High-risk towns in this catchment include Erica, Rawson and Walhalla, all of which are almost entirely surrounded by large forested areas. The Baw Baw plateau is immediately north-west of these towns, and is characterised by wet, alpine forest which is difficult to treat with planned burning. Important infrastructure to protect includes the Upper Yarra and Thomson water supply catchments, Mount Baw Baw Ski Resort and vast areas of valuable mountain ash forests that are used for timber production.

The worst bushfires in this catchment start near Lake Mountain and spread south all the way to Erica, Rawson and Walhalla. Each of these towns is in areas with a lot of potential for extreme convection. The entire catchment is in an area of extremely high convection, so broad-scale fuel management can help reduce the spread of bushfires.

Kinglake bushfire catchment

The Kinglake bushfire catchment contains almost 9% of the risk to life and property in our landscape. High-risk towns in this catchment include Kinglake, Kinglake West, Kinglake Central, Hazeldene, Toolangi and Castella. DEPI will continue planned burning in the Kinglake National Park and Toolangi State Forest, which surround most of these towns. The worst bushfires in this catchment start north-west of Kinglake West, travel through the grasslands then into forest and park, coming out into towns. Stopping bushfires in parks before they reach towns is the key to reducing risk. The ash forests around Toolangi create convective bushfire activity, so fuel management to prevent fire moving into this area is important for reducing the spread and intensity of bushfires.

Latrobe Valley bushfire catchment

The Latrobe Valley bushfire catchment contains almost 3% of the risk to life and property in our landscape. High-risk towns in this catchment include Tyers, Mirboo North, Jeeralang Junction, Moe South and Boolarra. Key infrastructure includes the Loy Yang, Hazelwood and Yallourn power stations and coal mines, and the APM

paper mill. The Tanjil State Forest and Moondarra National Park to the north of the catchment can be treated by planned burning, but much of the land south of the Princes Freeway—being either plantation forest or agricultural grassland—cannot.

The worst bushfires in this catchment start in the grasslands in and north of Mount Worth Park, and north of Yallourn North in the Tanjil State Forest, with bad bushfires starting many kilometres into the forest. Major areas of convection are the Mount Worth State Park and everything in the large forested area north of Yallourn North in the Tanjil State Forest, so fuel management there can effectively reduce the spread and intensity of bushfires. Planned burning to stop large bushfires spreading out of the large northern forested and Mt Worth areas is the key to reducing the risk to towns and infrastructure in this catchment.

Peninsula bushfire catchment

The Peninsula bushfire catchment contains less than 1% of the risk to life and property in our landscape. High-risk towns in this catchment are in two sections: a southern section with Arthurs Seat, McCrae and Rosebud and a northern section with Blind Bight, Cannons Creek, Langwarrin, Somerville and Warneet. The southern section is highly populated and surrounds a large, public-land forest area. The northern section also has a large population surrounded by alternating forest and grasslands, mostly privately owned. Important infrastructure to be protected includes the Hastings high-voltage power line and the Arthurs Seat tourist assets.

The worst bushfires start in varying locations in the catchment, some at the base of Arthurs Seat National Park, others near The Pines Reserve in Langwarrin and north of Warneet. This catchment is small, so bushfires that start in worst-case bushfire weather can quickly become calamitous. Fuel reduction to stop bushfires growing large is the key to reducing risk to the towns in this catchment. Arthurs Seat National Park is a major convection area, so fuel management is important there to reduce the spread and intensity of bushfires.

Tarago bushfire catchment

The Tarago bushfire catchment contains almost 6% of the risk to life and property in our landscape. High-risk towns in this catchment include Noojee, Neerim South and Drouin. Noojee is surrounded by forest, which cannot be planned burnt. Neerim South is surrounded by grassland but has forested areas close by. Drouin is a large suburban town surrounded by grass, with forest a few kilometres to the north. Infrastructure to be protected includes the Melbourne–Latrobe Valley high-voltage power line.

The worst bushfires start in a large band north of Bunyip in the Yarra State Forest and go many kilometres north, even as far as Warburton. Noojee is in an area of very high convection, while the forest surrounding Neerim also has high levels of convection. Drouin, being in a grasslands area, does not have high levels of convection. Fuel management is best done where bushfires start and spread, where conditions allow for planned burning. Interrupting the large

band of the worst bushfire starts also correlates with the simulated worst spread paths: managing the fuel hazard in these areas is the key to reducing the risk to towns.

The Triangle bushfire catchment

The Triangle bushfire catchment contains almost 6% of the risk to life and property in our landscape. High-risk towns in this catchment include Marysville, Buxton and Narbethong. These towns are almost entirely surrounded by large forested areas. Most of the forest on the south and east sides of the catchment is wet forest which cannot be treated by planned burning. Important infrastructure to be protected includes the Melbourne–Wodonga high-voltage power line and the Lake Mountain Ski Resort.

The worst bushfires in the catchment start north-west of Narbethong: some start quite close to the town and others much further away, even as far as Yea. Planned burning in the Toolangi State Forest between Glenburn and Marysville, to reduce bushfire intensity and help stop bushfires from starting, is the key to reducing risk in this catchment. The entire catchment is in an area of extremely high convection, so broad-scale fuel management can help reduce the spread of bushfires.

Upper Yarra and Thomson bushfire catchment

The Upper Yarra and Thomson bushfire catchment contains the reservoirs of the same names, which have 100% of the risk to high-risk water assets in our landscape. The catchment has very few people and consists mostly of large, public-land forested areas including Upper Yarra National Park, Baw Baw National Park and Thomson State Forest.

The reservoirs provide much of Melbourne and surrounding areas with water and are important infrastructure to protect. Bushfire damage can greatly reduce water yield and quality. Other significant infrastructure includes Lake Mountain recreational area and hydropower stations at the Thomson and Upper Yarra reservoirs. The worst bushfires start to the east of Marysville and extend to McMahons Creek and The Triangle. This catchment is large and bushfires starting in worst-case weather can run through large tracts of unbroken forest. Fuel reduction to stop bushfires growing large is the key to reducing risk to water yield and quantity in the catchments: 80% of the water that enters the reservoirs comes from the ash forest part of the catchment.

Wallan bushfire catchment

The Wallan bushfire catchment contains almost 1% of the risk to life and property within the East Central bushfire risk landscape. Wallan is a moderately sized, fast-developing town surrounded by grassland. There are some patchy private forested areas just out of town, to the west. DEPI does not do planned burning to protect Wallan because there is no nearby public land. Important infrastructure in the catchment includes the Melbourne–Sydney rail corridor and the Hume Freeway.

The worst bushfires in the catchment start between 10 km and 20 km north-west of Wallan in areas of scattered forest, then run into grasslands before hitting Wallan.

Marysville 2009 © DEPI

Wilsons Promontory 2009 © Stephen Platt

Upper Yarra Reservoir © DEPI

This catchment does not have significant hotspots or critical escalation zones. Fuel management on the private land to the immediate west of Wallan to reduce ember attack and bushfire intensities is the key to reducing risk to the town.

Warburton Valley bushfire catchment

The Warburton Valley bushfire catchment contains almost 28% of the risk to life and property in our landscape. High-risk towns in this catchment extend from Warburton east to Reefton, west to Seville East, north to Healesville and south to Powelltown. Most towns have large areas of forest to their north and east, with some completely surrounded by forest. Most forested areas are ash forest and cannot be treated by planned burning. The worst bushfires start in a large, wide band between Pheasant Creek and Yarra Junction. Most of the catchment (except towns to the west, such as Seville East) has extremely high levels of convection, and bushfire intensities are very high through the catchment.

Warrandyte bushfire catchment

The Warrandyte bushfire catchment contains almost 1% of the risk to life and property in our landscape. High-risk towns in this catchment include St Andrews, Panton Hill, Warrandyte, Wonga Park and North Warrandyte. Panton Hill and St Andrews, in the north of the catchment, are surrounded by a mix of forested area and grassland, with some public forest to the east of the towns. The other towns

(in the south) are densely populated and heavily forested. Almost all the forested area in the catchment can be treated by planned burning, but most is on private land. Important infrastructure to be protected includes the SP AusNet high-voltage power line that runs through Kangaroo Ground and passes tourism assets.

The worst bushfires in the catchment start north of Warrandyte (both very close and a few kilometres from it) or come through Eltham, Diamond Creek and Hurstbridge. Other bad bushfires start in the Kinglake National Park. Fuel reduction in Kinglake Park can help protect the St Andrews area. St Andrews and North Warrandyte are in a high-convection area so fuel reduction can help reduce the spread and intensity of bushfires. The key to reducing risk to towns in this catchment is to focus fuel management actions where bad bushfires are likely to start, as they can quickly spread into the towns. Around Warrandyte, bad bushfires often start on private land, so fuel management on private land is an important strategy for reducing bushfire risk.

Strategy and actions to reduce bushfire risk in East Central

DEPI's risk mitigation approach is to provide a higher level of protection to the priority communities and infrastructure, high-value native forest timber and high-value ecosystem areas (as described in the last chapter), while providing a level of protection to other important features of our landscape, consistent with the two code of practice objectives.

This strategic bushfire management plan marks the beginning of a new, strategic, risk-based approach to bushfire management on public land in the East Central landscape. It outlines the practical steps DEPI and PV will take to implement the code of practice objectives.

A new fuel management strategy for the landscape is central to our approach. It identifies priority fuel management areas on public and private land, to best reduce bushfire risk to communities while maintaining ecosystem resilience.

We will ensure that at least 40% of all planned burning each year on public land is undertaken in priority fuel management areas. We will also amend the fire management zones to ensure fuel management objectives across the landscape reflect our improved understanding of bushfire risk.

A large amount of the bushfire risk—and consequently priority fuel management areas—is on private land. We will continue to share information and work with CFA, local governments and other land managers to support action on private land that provides additional risk reduction to communities.

Bushfire risk cannot be eliminated with fuel management alone. This plan identifies prevention, preparedness, response and recovery actions to complement our fuel management strategy and further reduce bushfire risk. Over the next few years, we will work in partnership with communities, stakeholders and other agencies to further plan and implement comprehensive strategies for prevention, preparedness, fuel management, response and recovery.

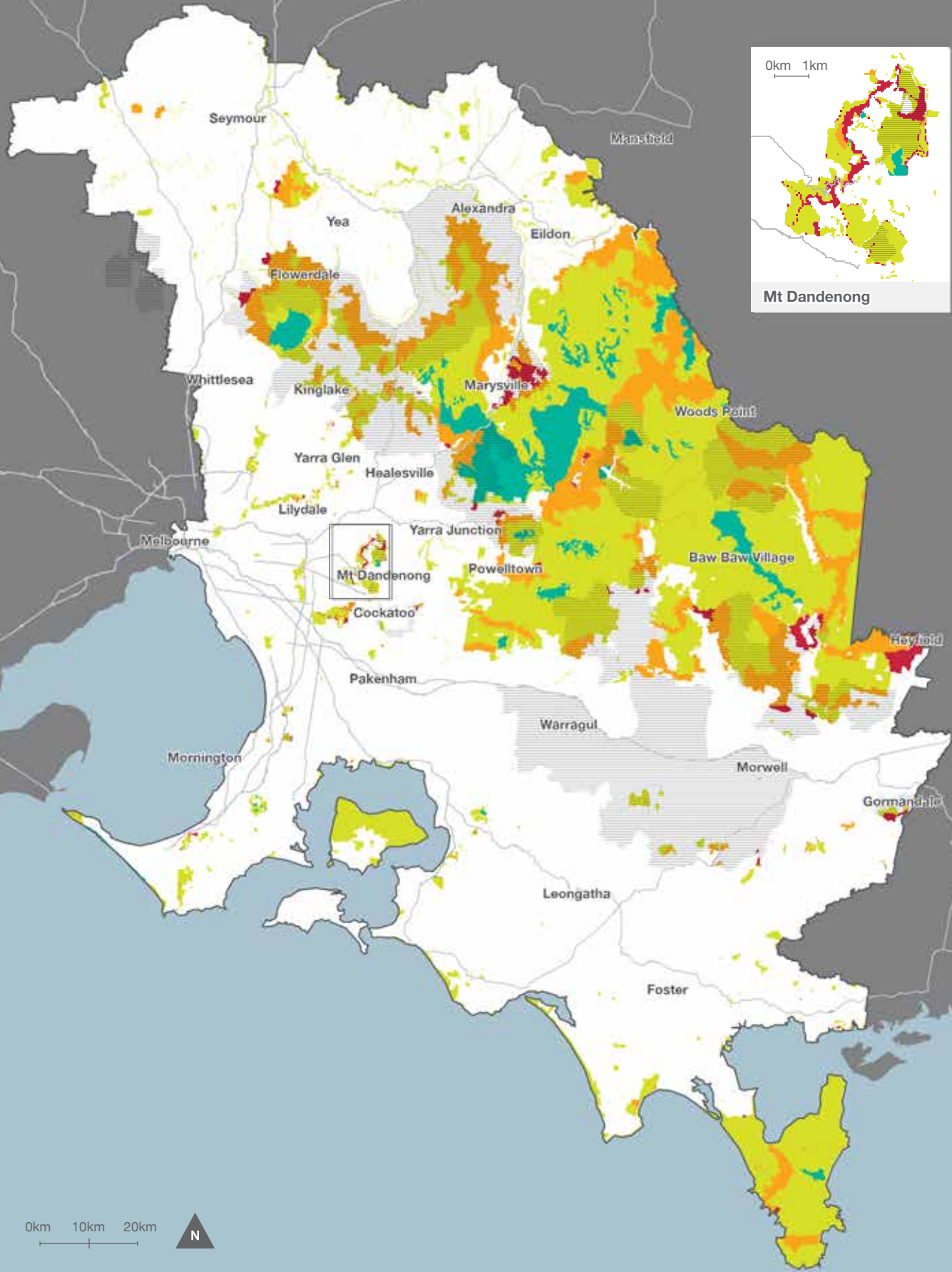## East Central fuel management strategy

About fuel management

Planned burning is the deliberate introduction of fire into the landscape to reduce the quantity of leaf litter, twigs, bark and undergrowth. It is the most effective method of fuel management on large areas of public land, and is the main way this plan reduces bushfire risk. We also manage fuel by ploughing, mulching, applying herbicide, chain rolling, grazing, mowing and slashing. Fuel management also serves ecosystem resilience purposes, such as regeneration of plant species and habitat.

We undertake fuel management activities where bushfires are likely to start and along the paths they are likely to travel, to reduce their rate of spread, intensity and long-distance spotting potential. We also manage fuels close to and adjacent to priority communities and infrastructure, high-value native forest timber and high-value ecosystem areas. This helps minimise flame contact, radiant heat, ember generation and short-distance spotting potential.

Residual risk to life and property in our landscape is at an historic low, due to large areas of ash forest having been burnt in the 2009 bushfires. These areas are rapidly accumulating fuel, and residual risk is rising. The sizeable areas of wet forest (particularly mountain ash forest) in our landscape are generally too wet for fuel management, but will burn, with serious consequences, in worst-case bushfire weather. In these areas, reducing fuel hazard in adjoining drier forests where bushfires are likely to start (before spreading to ash forest) helps reduce bushfire risk. Burning drier forests on the lower slopes also reduces risk for wet forest and rainforest, including in high-yielding areas in water catchments.

Map 7: East Central fuel management strategy

0km 1km

Mt Dandenong

Seymour

Mansfield

Yea

Alexandra

Eildon

Flowerdale

Whittlesea

Kinglake

Marysville

Woods Point

Yarra Glen

Healesville

Lilydale

Yarra Junction

Melbourne

Mt Dandenong

Powelltown

Baw Baw Village

Cockatoo

Heyfield

Pakenham

Warragul

Morwell

Mornington

Gormandale

Leongatha

Foster

0km 10km 20km

N

Legend

Priority fuel management area

Asset protection zone

Landscape management zone

Private land

Bushfire moderation zone

Planned burning exclusion zone

Planned burn © DEPI

DEPI also uses planned burning for ecosystem resilience reasons (such as to regenerate plant species and habitat), and VicForests uses planned burning to promote regeneration of harvested areas.

Our landscape has many small, isolated parcels of public land with a high fuel hazard but which are not practical to burn. Other fuel management activities, such as machine slashing, are more effective in these parcels.

Our strategy

Map 7 shows the fuel management strategy for the East Central landscape. It shows priority fuel management areas, where fuel management offers the greatest risk reduction to our priority communities and infrastructure, high-value native forest timber and high-value ecosystem areas, while minimising impacts on ecosystem resilience. Priority fuel management areas are on private and public land, as bushfire risk occurs across the whole landscape.

To identify priority fuel management areas, we considered the landscape as blocks of 1000–5000 ha each. We assessed each block to determine how effectively managing fuel on it would reduce risk to life and property, and what the ecological consequences of frequent planned burning would be. The strategy identifies blocks that offer the greatest risk reduction and have low ecological vulnerability to fuel management. We will continue to undertake more detailed analysis of priority fuel management areas, to further refine and improve our understanding of the most important risk reduction areas in the landscape.

East Central's fuel management strategy aims to ensure that:

- through to 2019, as fuel reaccumulates in forests burnt in 2009, residual risk to life and property does not return to pre-2009 levels, but is kept below 90%

- through to 2050, residual risk to life and property continues to fall.

To achieve this, we will:

- ensure that at least 40% of all planned burning in East Central each year is in the priority fuel management areas shown in Map 7

- ensure that the fuel hazard in those parts of priority fuel management areas suitable for planned burning on public land does not exceed a high rating (as defined in DEPI's *Overall Fuel Hazard Assessment Guide - 4th edition*): depending on the particular vegetation and fuel accumulation, they are likely to need burning between every 7–12 years

- manage public land outside priority fuel management areas consistent with current zoning, ensuring the primary objective of planned burning in landscape management zones is ecological

- promote opportunities for planned burning in priority fuel management areas on private land, and in particular in areas next to public land which can be burnt in joint operations

- monitor residual risk annually to ensure the strategy is reducing risk, and adapt and change priority fuel management areas and scheduling as required.

Grassfire © CFA

Implementing our strategy

Map 7 shows the current fire management zoning of public land. This zoning establishes the primary objective for fuel management in different areas of the landscape. It categorises public land into four fire management zones:

- asset protection zone: where intensive fuel management provides the highest level of localised protection to human life and property by reducing radiant heat and ember attack

- bushfire moderation zone: where there is fuel management to reduce the speed and intensity of bushfires, either close to towns or as they spread through the landscape

- landscape management zone: where fuel management is done to reduce fuel hazard, improve ecosystem resilience and manage the land for particular uses (such as forest regeneration and water catchment protection)

- planned burning exclusion zone: where there is no planned burning, mainly to protect particular areas that can't tolerate fire.

We will review current fire management zoning in the landscape to reflect our improved understanding of bushfire risk.

Our fuel management strategy and the fire management zoning directly inform DEPI's fire operations planning, and detailed planning for each planned burn.

Each year, DEPI produces a fire operations plan that sets out our three-year fuel management program, including priorities for areas to be burnt in the next 12 months. Through the fire operations planning process, we will ensure that no less than 40% of the total annual area planned for burning is in priority fuel management areas.

To determine the optimal fuel management regime to implement our strategy, we will develop a 40-year burn schedule (where and when we should undertake fuel management activities) to inform the fire operations planning process.

We recognise that our planned burning and other fuel management activities can have a range of impacts on communities, infrastructure, economic activity and the environment, and we will continue to identify measures to mitigate these impacts though fire operations planning and burn planning, without compromising the strategic objectives of the burn.

Planned burn © DEPI

What we expect to achieve

Reduced bushfire risk

Figure 2 shows residual risk to life and property in our landscape from 1980 to the present, and forecast residual risk resulting from implementing our fuel management strategy on public land to 2050. It shows that residual risk (shown as a blue-shaded area, representing the range between the highest and lowest forecasts) is projected to increase due to factors such as mountain ash regrowth from bushfires in 2009, but will stabilise as we implement our fuel management strategy, reducing residual risk to pre-2009 levels.

Our computer modelling tells us that by implementing our fuel management strategy on public land, we could reduce residual risk to as low as 55%. Even if we were able to treat all fuel hazard on public land in the East Central landscape, residual risk would only be reduced to around 38%.

Fuel management in many areas of public land cannot be undertaken because the vegetation is too wet to do planned burning, it is not safe to do so, or for other operational reasons. We will determine the actual residual risk to be achieved when we develop our long-term burn schedule.

Fuel management on private land

To reduce risk across the landscape, effective treatment of fuel on both public and private land is needed. Our modelling shows that maximum treatment of fuel on private land could reduce risk by about another 30%. Approximately half of this risk falls within the priority areas identified in this strategy.

DEPI will support other agencies (mainly the CFA, local governments and Melbourne Water) and landowners to prioritise and focus their fuel management activities on the highest-priority areas. Local governments can also use the strategy when developing their own strategies for managing risk on private land.

Limitations of fuel management

Finally, figure 2 shows that modelled residual risk will never be reduced below 9%. This figure represents the risk which can't be treated through fuel management, and highlights the importance of complementary bushfire prevention, preparedness, response and recovery actions.
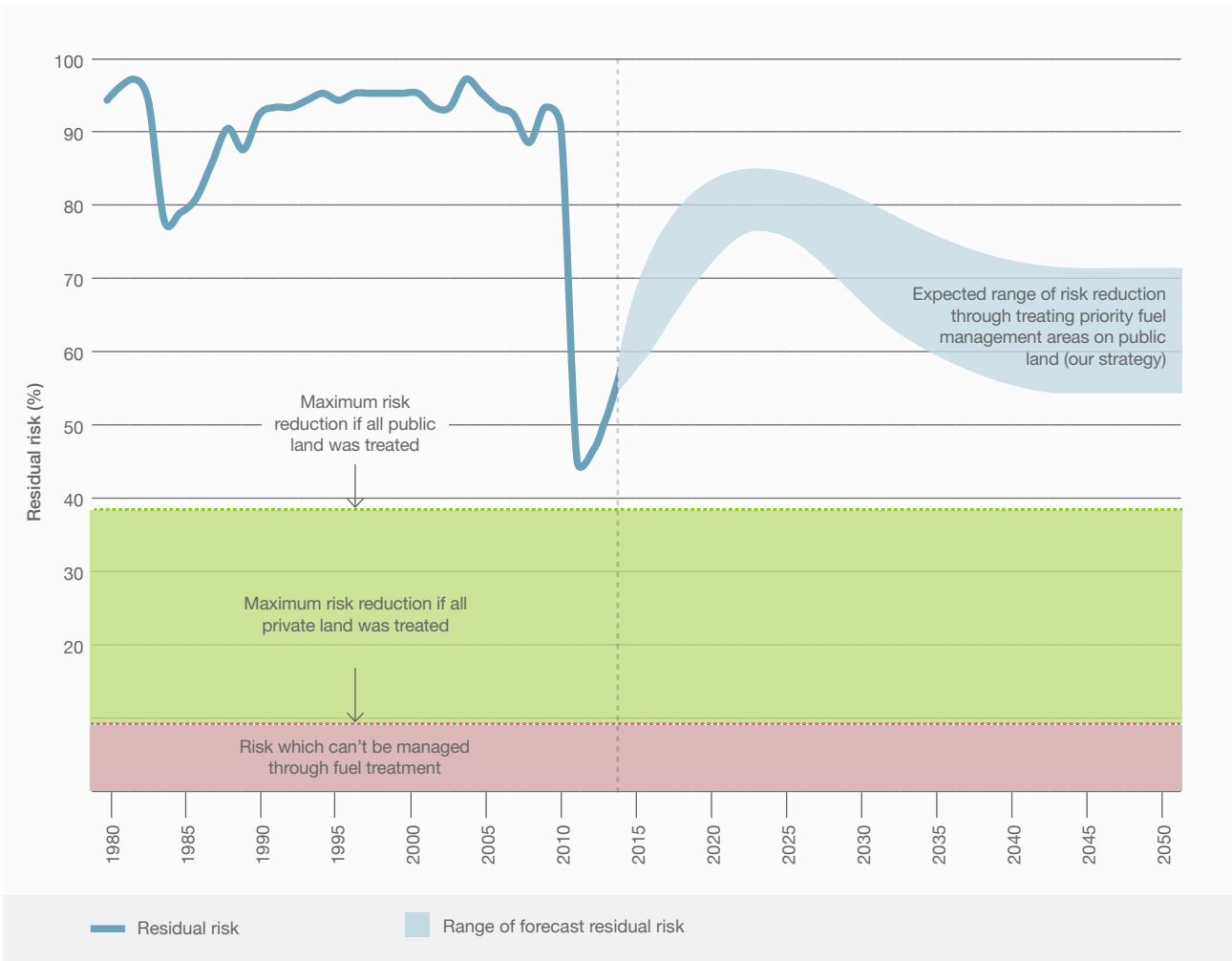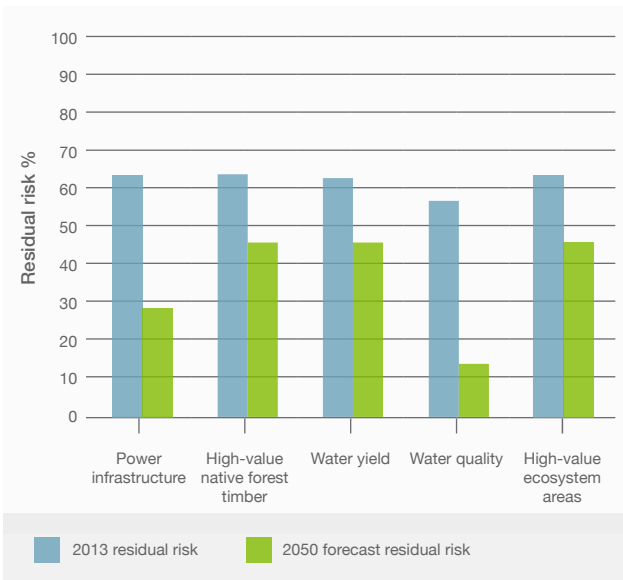
Figure 2: Residual risk, 1980–2050

Maximum risk reduction if all public land was treated

Maximum risk reduction if all private land was treated

Risk which can't be managed through fuel treatment

Expected range of risk reduction through treating priority fuel management areas on public land (our strategy)

Residual risk (%)

— Residual risk   Range of forecast residual risk

Figure 3: Risk reduction for priority infrastructure, high-value native forest timber and high-value ecosystem areas

Residual risk %

Power infrastructure | High-value native forest timber | Water yield | Water quality | High-value ecosystem areas

2013 residual risk   2050 forecast residual risk

Risk reduction for our priority assets

Figure 3 shows the current residual risk of our landscape's priority infrastructure, high-value native forest timber and high-value ecosystem areas, and the theoretical minimum risk which our fuel management strategy could reach to reduce this risk. It shows that for all assets, implementing the strategy will reduce residual risk.

Supporting the recovery of Victoria's faunal emblem—the Leadbeater's possum—and maintaining a sustainable timber harvesting industry

The endangered Leadbeater's possum—thought to be extinct until it was rediscovered in 1961—is found only in the East Central bushfire risk landscape. It inhabits snow gum woodland on Lake Mountain, the swamp gum forest in Yellingbo and areas of mountain ash and alpine ash forests across the Central Highlands. The Central Highlands forests are also important for Victoria's native forest timber harvesting industry, providing local employment and supporting regional economies.

Bushfires are a major risk to both the survival of the Leadbeater's possum and to the timber industry. The 2009 Black Saturday bushfires burnt about 45% of the Leadbeater's possum reserve and 26% of the Central Highlands' harvestable ash forest.

The Minister for Environment and Climate Change and the Minister for Agriculture and Food Security established the Leadbeater's Possum Advisory Group in June 2013. The advisory group made recommendations to support the recovery of the Leadbeater's possum, while maintaining a sustainable timber industry. In April 2014, the Victorian Government announced its support for all 13 recommendations and 48 actions in the advisory group's report, including greater protection of Leadbeater's possum colonies and habitat through fire planning and operations. As part of developing our fuel management strategy, we assessed bushfire risk to known colonies and high-quality habitat of Leadbeater's possum, and chose areas for priority fuel management to reduce the risk.

Figure 4 shows the extent to which PHOENIX Rapidfire predicts the strategy will reduce residual risk to Leadbeater's possum, and to high-value native timber in the Central Highlands, benefiting the recovery of the possum and a sustainable timber industry.

© Zoos Victoria

Figure 4: Residual risk for high-value native forest timber, and for Leadbeater's possum
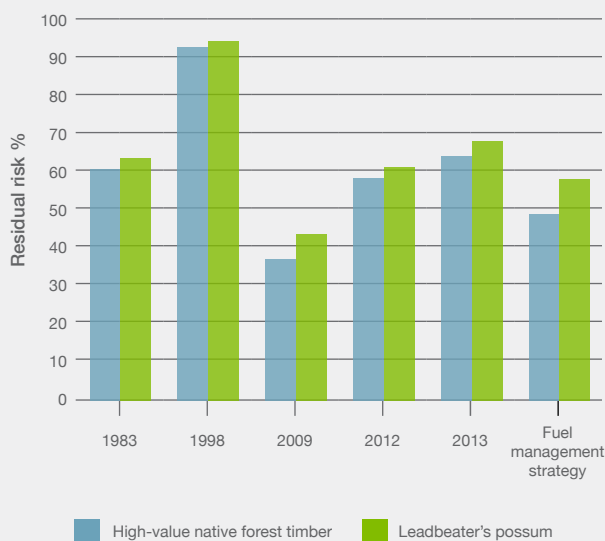
Resilient ecosystems

As part of preparing our fuel management strategy, we considered several alternative fuel management strategies to understand how they might affect the proportion of vegetation that could be burnt below minimum TFI.

Figure 5 looks at the eight EFGs in the landscape that are most affected by frequent—once every seven years—planned burning. For each EFG, it compares the total area of the EFG in the landscape to the area that could be planned

burnt under our fuel management strategy. It shows that up to 32% of forby forest may be planned burnt below its minimum TFI; up to 19% of grassy/heathy dry forest; up to 32% of moist forest; and up to 33% of tall mixed forest.

We are working to better understand the strategy's impacts on ecosystem resilience. Our 40-year burn schedule will balance residual risk reduction to life and property with the maintenance or improvement of ecosystem resilience across the landscape.

Figure 5: Potential maximum area of EFGs that could be burnt below minimum TFI under the strategy

Area in landscape

Maximum area that could be burnt below minimum TFI under the fuel management strategy
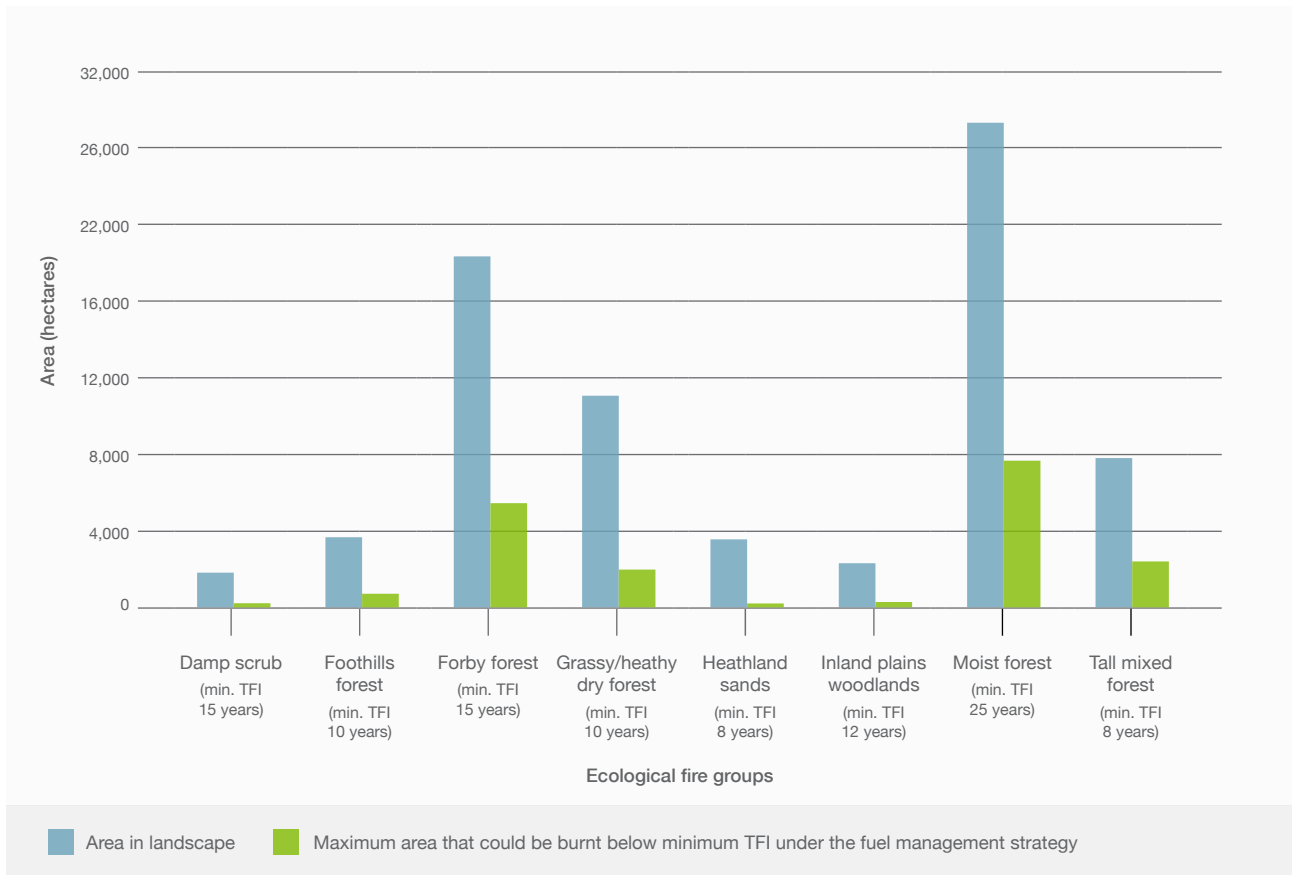
Fire recovery at Wilsons Promontory 2009 © Stephen Platt

Backburning in the Kilmore East - Murrindindi fire 2009 © DEPI

Chief Fire Officer Alan Goodwin discusses planning with senior DEPI staff © DEPI

Other bushfire management actions

As well as implementing our fuel management strategy, we will also undertake prevention, preparedness, fuel management, response and recovery actions on public land, to further reduce bushfire risk and promote ecosystem resilience.

DEPI will continue to share bushfire risk information and work in partnership with other agencies (including CFA, local government and Victoria Police) to strengthen bushfire management across the whole landscape.

Preventing bushfires

Prevention actions minimise the occurrence of bushfires, particularly those started by people, when weather conditions are extreme.

To improve bushfire prevention, DEPI will:

- close parks and forests on days of extreme bushfire weather, to ensure public safety and reduce the incidence of fires starting in forested areas

- prioritise compliance activities (including community education and enforcement patrols) on high-fire-danger days in worst-ignition areas, to reduce ignitions

- share bushfire risk analysis with local governments, other emergency services agencies, land managers and community-based planning forums to inform bushfire prevention activities on private land.

Being prepared for bushfires

We must be adequately prepared for bushfires, to improve our response to them when they occur.

Fire learning networks

Our fire learning network program helps communities build their knowledge and understanding of bushfires.

It brings together people with different levels of knowledge, particularly in communities at high risk of bushfires, to raise awareness of risk and examine their ability to prepare and respond.

To improve community awareness and preparedness for bushfires, DEPI will:

- provide information, including through fire learning networks, community fireguard groups, community forums and groups so people understand, and can make decisions based on knowledge of, their bushfire risk

- continue to increase and improve communication and engagement with Victorian communities, including through better use of online tools, and prioritise engagement activities in high-risk communities.

Fuel breaks

A fuel break is a strip of land where DEPI removes or modifies the vegetation to reduce the risk of bushfires starting, and to reduce their rate of spread and intensity if they do. Fuel breaks also reduce the threat to nearby houses, provide safe routes for firefighters into fire suppression zones and for people leaving them, give firefighters options (such as making a flank attack on a bushfire, or back burning) and provide safe and easy-to-manage control lines. There are almost 1000 km of fuel breaks in the landscape.

DEPI will:

- review the effectiveness of the existing fuel break network in the landscape for reducing bushfire risk

- investigate a consistent classification system for all existing fuel breaks within the landscape, to improve management effectiveness and maintenance efficiency.

Roads and tracks

Well-maintained roads and tracks are essential for quick response, and for community and firefighter safety. Of the 7500 km of roads DEPI manages, it has identified 1200 km of them as strategically important: they allow access for heavy firefighting machinery, safe access for bushfire response and a safe environment for planned burning.

Bushfire response at Lysterfield 2009 © DEPI

Hakea seed opened after fire © Stephen Platt

To improve the public land road and track network, DEPI will:

- review the effectiveness of the network in our landscape in reducing bushfire risk and supporting fuel management and response activities

- develop a renewal program for bridges and major crossings on roads classified as heavy and medium that DEPI manages in East Central which enable access for fuel management and fire response

- identify the light vehicle roads of strategic importance in the landscape which align with priority fuel management areas, and prioritise maintenance of these roads.

Emergency management planning

- DEPI and PV will maintain up-to-date emergency management plans for the planned closure and evacuation of high-risk areas of public land.

- DEPI will develop and maintain staff capability in bushfire management, including emergency response.

- DEPI will work in partnership with other agencies (including Emergency Management Victoria, CFA, local governments and Victoria Police) to include strategic risk analysis and PHOENIX Rapidfire simulation in municipal and regional fire and emergency management planning.

Improving our analysis

When developing our fuel management strategy, we identified areas in the landscape where more detailed analysis is needed to determine how to maintain or improve ecosystem resilience and further reduce residual risk.

We will do more detailed PHOENIX simulation for Cape Liptrap Coastal Park, Arthurs Seat State Park, The Pines Flora and Fauna Reserve and Plenty Gorge to identify opportunities to further reduce residual risk. These areas contain fire-sensitive threatened species and native

vegetation. We will improve our understanding of where best to manage fuel in these areas to reduce bushfire risk, and use this understanding to improve future plans.

We also identified areas of the landscape of particular ecosystem importance but which are not priority fuel management areas, including the Yellingbo Nature Conservation Reserve / State Emblems Conservation Area, Wilsons Promontory National Park, Point Nepean National Park and French Island National Park. We will improve our understanding of where best to manage fuel in these areas to maintain and improve ecosystem resilience.

Responding to bushfires

DEPI is responsible for suppressing fires in state forests, national parks and protected public land.

To improve bushfire response, DEPI will:

- share bushfire risk assessment data with other fire agencies and land managers (such as the CFA, Metropolitan Fire Brigade, VicForests and Melbourne Water) to support bushfire response

- continue to validate priority assets and pre-deploy resources on days of high fire danger

- investigate developing a bushfire response strategy, to prioritise bushfire response activities.

Recovering from bushfire

DEPI is responsible for the recovery of public land after a bushfire.

To improve bushfire recovery, DEPI will:

- work with other agencies and communities to identify recovery priorities

- address recovery priorities to re-establish access to public land in a timely manner, and support bushfire-impacted communities return to normal daily life.

Monitoring, evaluation and reporting

DEPI is soon to release the *Monitoring, Evaluation and Reporting Framework for Bushfire Management on Public Land*, which will guide how we assess the effectiveness of our management strategies and activities across Victoria in achieving the two code of practice objectives.

Monitoring, evaluation and reporting are essential tools for quantifying the effectiveness of our fuel management strategy, and for informing decisions to implement it. This adaptive management approach is important to how we improve bushfire management planning.

The framework includes statewide priorities for monitoring, evaluation and reporting, which are to:

- measure the effectiveness of fuel management activities in reducing risk to life and property and maintaining or improving ecosystem resilience

- measure the effectiveness of the strategic bushfire management planning process

- measure how well the framework supports and improves fuel management activities and effectiveness.

These priorities will inform our fire monitoring program across the state. We will aggregate the data collected in our landscape with other data to support reporting against both landscape and state objectives.

Monitoring and evaluation

Monitoring activities in East Central will be informed by the statewide monitoring, evaluation and reporting framework and will:

- measure changes to residual risk by assessing fire severity and fuel hazard in priority fuel management areas

- measure changes to ecosystem resilience by assessing key habitat attributes and key flora and fauna in high-value ecosystem areas.

We will use the information collected about fuels, fire severity, habitat and ecosystem resilience to:

- evaluate the extent to which the fuel management strategy has reduced the impact of bushfires on communities and ecosystem resilience

- refine and improve the models on which the simulations are based.

Evaluation enables more informed decisions, and learning and improvement over time.

In the next 12 months, DEPI will develop a monitoring, evaluation and reporting implementation plan for the landscape. It will:

- evaluate the effectiveness of our fuel management strategy in reducing bushfire risk to life and property

- evaluate how the fuel hazard changes and reaccumulates after burning the EFGs which will help us to better simulate bushfire risk (considering fuel accumulation in areas burnt by bushfires in 2009)

- evaluate the effectiveness of the fuel management strategy for maintaining vegetation and growth stage diversity in high-value ecosystem areas

- evaluate risk to ecosystem resilience in areas that may be burnt below their TFI (such as forby forest, grassy/heathy dry forest, moist forest and tall mixed forest).

Reporting

Reporting ensures transparency and shares knowledge about bushfire management. DEPI will report:

- annually, on fuel management activities (in its fuel management report)

- every five years, on the effectiveness of the fuel management strategy and other actions in this plan

- at least every ten years, on achievement of the code of practice objectives.

Under DEPI's *Bushfire Science Strategy 2013–17,* we will invest in research to improve the information available for this and future plans. We plan to improve our risk assessment methodology by incorporating weather patterns, ignition likelihood weightings, convection strength and better measures for ecosystem resilience and environmental values. We will work with water corporations to better understand the impact of bushfires and planned burning on water assets. We also plan to develop a methodology to identify and rate public administration assets and social (including cultural heritage) assets.

Review

DEPI and PV want bushfire management to evolve to a state where monitoring, evaluation and reporting is a continuous process that leads to improved versions of this plan. Improvement of the fuel management strategy and other actions in this plan will be driven by monitoring and evaluation of:

- their effectiveness in reducing bushfire risk and maintaining ecosystem resilience

- the impacts of major bushfires or other major events

- improved science, technology and community knowledge.

This plan — the first strategic bushfire management plan for East Central — focuses on fuel management. Over the next few years, we will work in partnership with communities, stakeholders and other agencies to develop a more comprehensive range of bushfire prevention, preparedness, fuel management, response and recovery actions on public land.

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