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STRATEGIC BUSHFIRE RISK ASSESSMENT

MIRBOO NORTH

REPORT PREPARED FOR SOUTH GIPPSLAND SHIRE COUNCIL

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Contributions to this report

Deanne Smith: Lead author, planning policy analysis and response lead

Helen Bull: Bushfire risk and resilience assessment lead, vegetation management, GIS analysis and mapping, review

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EXECUTIVE SUMMARY

This report provides bushfire advice to inform the revision of South Gippsland Shire Council's Mirboo North Structure Plan Refresh (2017, 2020). The Plan identifies areas for potential residential growth including one greenfield growth front and two key infill areas. This report is required to address State Government bushfire requirements for settlement planning which have changed since the Plan was prepared. Additionally, this report considers the broader risk of bushfire to the settlement of Mirboo North within a planning lens.

This report assesses the bushfire risk associated with residential use in these areas by:

- Identifying the type and levels of bushfire risk for each of the areas
- Characterising and evaluating key bushfire risks
- Identifying mitigation strategies to address the risk to existing, as well as the progressive expansion of the future urban interface, and
- Providing land use and urban design directions for consideration within future structure planning for proposed residential growth areas.

Planning Practice Note 64 – Local Planning for Bushfire Protection was used as a guide when assessing the bushfire risk. This included four main steps:

- Establish the context;
- Identify the risks from bushfire;
- Analyse and evaluate the risks; and
- Translate risk mitigation into planning scheme provisions (DTPLI, 2013)

The report has found that residential growth for Mirboo North should be directed to the south-east where the existing township provides protection and further development can improve the interface of the town. Landscape fire presents a higher risk of bushfire impact to settlement in the north and the west.

DEFINITIONS AND ABBREVIATIONS

Resilience and risk							
Resilience	'Resilience is the capacity of communities to prepare for, absorb and recover from natural hazard events (coping) and to learn, adapt and transform in ways that enhance these capacities in the face of future events (adaptation)' (Parsons & Morley 2016).						
Vulnerability	Susceptibility to hazards (the problem) and resilience						
Bushfire risk	The chance (likelihood) of a bushfire igniting, spreading and causing damage to the community or the assets they value (consequences)'. Consequences are influenced by threat from hazards (fuel, topography and weather) and vulnerability of the affected community (CFA 2012c)						
Bushfire							
AS 3959-2018	The Australian Standard *Construction of buildings in bushfire prone areas* (Standards Australia 2018) provides guidance on risk assessment and construction to assist buildings to survive the passage of a fire front and is used as the basis for bushfire-related planning and building requirements in Victoria						
Bushfire Attack Level (BAL)	The Bushfire Attack Level (BAL) rating describes the severity of the threat to buildings from burning vegetation based on the Australian Standard for *Construction of buildings in bushfire prone areas (Standards Australia 2018)*. The BAL is based on the amount of radiant heat buildings may be exposed to and is used to define construction requirements for protecting buildings from bushfire. The BAL rating is calculated in kW/m2 (1 kW equals the amount of heat from a single bar radiator) and is measured from the amount of fuel (hazard) and the slope under it, separation from the hazard and the expected fire behaviour under specified weather conditions.						
Bushfire Prone Area (BPA)	All land designated by the Minister for Planning under regulation 810(1) of the Building Regulations 2018. An area that is subject to, or likely to be subject to, bushfire attack. It applies to areas of moderate to high bushfire hazard, including land in the BMO.						
Bushfire Management Overlay (BMO)	Planning Scheme Clauses 44.06 and 53.02						
Construction standard	The BAL (threat) rating that is required to provide protection against radiant heat						
Defendable space	An area around a building (or other important asset) where vegetation is managed to reduce fuel available to be burnt by a fire, and its continuity						
Forest Fire Danger Index (FFDI)	The chance of a fire starting, its rate of spread, its intensity and the difficulty of its suppression, based on air temperature, relative humidity, wind speed and long and short-term drought effects.						
Fire intensity	Rate of heat output per length of fireline						
Landscape risk	The risk arising from the wider landscape, which may include land several km away						
NCC	*National Construction Code*						
VFRR-B	*Victorian Fire Risk Register – Bushfire*: a risk assessment and treatment planning register maintained by CFA (CFA undated)						
Environment, native vegetation and fire ecology							
Native vegetation	Plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses (Government of Victoria 2016)						
Ecological Vegetation Class (EVC)/Division (EVD)	EVCs are groupings of vegetation communities based on floristic, structural, and ecological features. AN EVD is a grouping of EVCs with a similar ecological response to fire (Cheal 2010).						
Location risk	The risk that removing a small amount of native vegetation in a particular location will have an impact on the persistence of a rare or threatened species (DEPI 2013)						
Tolerable fire interval (TFI)	The recommended intervals between successive disturbances by fire (or other causes) of a vegetation community based upon the critical characteristics (vital attributes) of its plants and animals (Cheal 2010)						
Planning scheme							
BMO/WMO	Bushfire/Wildfire Management Overlay	VPO	Vegetation Protection Overlay	LDRZ	Low Density Residential Zone	RLZ	Rural Living Zone
EMO	Erosion Management Overlay	FZ	Farming Zone	MUZ	Mixed Use Zone	SUZ	Special Use Zone
ESO	Environmental Significance Overlay	GRZ	General Residential Zone	RCZ	Rural Conservation Zone	TZ	Township Zone
SLO	Significant Landscape Overlay						
Organisations							
CFA	Country Fire Authority						
DELWP	Department of Environment, Land, Water and Planning						
FFMV	Forest Fire Management Victoria						
FRV	Fire and Rescue Victoria						

SECTION 1 INTRODUCTION

PURPOSE OF THIS REPORT

The purpose of this report is to identify and assess bushfire risk and provide recommendations regarding future land use and development planning within the context and requirements of Clause 13.02. This report specifically provides a detailed assessment of Mirboo North.

The project has these objectives:

1. To classify the risk of bushfire in the urban area of Mirboo North and the surrounds of the township using a robust landscape scale bushfire assessment.
2. To identify land at varying threshold of fire risk in Mirboo North and the immediate surrounds using risk contours, or similar approach, informing a 'go, go-slow, no' approach to development.
3. To identify land in Mirboo North that experiences a radiant heat flux of less than 12.5kW/m^2 (or a Bushfire Attack Level of BAL-LOW) and refine this further to identify land that could be further entertained for development in relation to Clause 13.02 of the Scheme, noting the criterion for land to have a BAL-12.5 rating or less under *AS3959 Construction of Buildings in Bushfire-prone Areas* is only one of the criteria that needs to be met. Conversely, identify land where development should be constrained.
4. To consider the vegetation hazard in Mirboo North, the risks associated with the hazard, and identify areas where existing vegetation poses a threat, and areas where potential revegetation could occur as part of future development. Utilize the South Gippsland VFRR and other municipal fire management material to inform this assessment.
5. To provide a succinct report encapsulating points 1-4 (above) in a form that can be used for a Planning Scheme Amendment. The report should use spatial and textual representation to provide background, summary of opinion and recommendations.

BACKGROUND

In 2017, South Gippsland Shire Council adopted the Mirboo North Structure Plan Refresh which updated the Mirboo North Structure Plan (2004). The 2017 Plan sought to provide strategic direction for future development and growth in the township of Mirboo North. Full implementation of the 2017 Plan requires additional work in relation to bushfire, particularly to update the town's Framework Plan. Part implementation of the Plan was undertaken via Amendment C115 to the South Gippsland Planning Scheme in 2020 which updated design guidelines for the town centre area.

Mirboo North is located in the northern area of South Gippsland Shire with close proximity to the neighbouring municipalities of Baw Baw Shire and Latrobe City. Mirboo North provide a 'green' rural township alternative and residents associate with communities located to the north and south of the range. The township has many constraints that restrict its expansion, with the existence of a bushfire hazard being just one. The 2017 Plan sought to recognise the existing Rural Living Zone land to the north as part of the settlement, remove some Farming Zone land, and expand the potential greenfield residential area to the south-east.

Figure 1 Regional context plan (extract from Gippsland regional growth plan, 2014)

SECTION 2 METHODOLOGY

STUDY APPROACH

Risk assessment involves consideration of the credible consequences of a hazard and the likelihood of those consequences being realised. *Planning Practice Note 64 – Local Planning for Bushfire Protection (DTPLI, 2013)* provides some guidance about assessing the bushfire risk in relation to land use planning decisions and incorporating risk mitigation measures in future development. The general approach described in Appendix 1 of Planning Practice Note 64 has been used to structure this bushfire risk assessment for Mirboo North. This includes four main steps, being:

- establish the context
- identify the risk from bushfire
- analysis and evaluate the risks
- translate risk mitigation into planning scheme provisions

It needs to be highlighted that the Royal Commission(*Royal Commission* 2010) and Clause 13.02-1S of the Planning Policy Framework advocate the need to apply the precautionary principle to the assessment of bushfire risk. This philosophy has guided this study. Chapter 3 of this report 'The context' provides factual information about the study sites and the surrounding landscape. This includes descriptions of the sites, future and current development, land use planning controls and bushfire mitigation plans relevant to the management of growth.

Chapter 4 of this report 'The risk from bushfire', gives details of the factors that influence fire behaviour and how they contribute to bushfire impact on the community. In the context of describing the risk of bushfire to the identified growth areas and the existing Mirboo North urban area, the consequence can be defined as loss of life and houses during a bushfire. The likelihood of this consequence can be assessed by considering:

- The probability of weather conditions occurring that could result in a fire of sufficient intensity to destroy homes and claim lives
- The probability of an ignition on that day
- The potential for a fire to develop to a level of severity at the study site such that homes are destroyed and lives could be lost
- The vulnerability of assets to the level of bushfire attack to which they are exposed
- The presence and efficacy of risk controls where information is available.

The description of the bushfire characteristics and potential bushfire scenarios at the study sites was based on:

- Analysis of spatial and other data provided by South Gippsland Shire Council
- Field inspection and assessment of the study area
- Professional judgement of the consultant team
- Review by the fire service (Fire Services Victoria and CFA)

Chapter 5 of this report ' Analysis and evaluation of the bushfire risk' provides a summary of the bushfire risk facing the settlement and provides directions for limited growth. The ability of the development to achieve no more than 12.5kW/m^2 radiant heat flux, calculated in accordance with *AS3959-2018 Construction of Buildings in Bushfire Prone Areas (Standards Australia, 2018)* is one of the inputs.

The response explains how bushfire mitigation measures can be included in the consolidation of Mirboo North. The following design principles were uses as foundations:

- Avoid residential development in risks deemed too high
- Avoid residential development where vegetation is highly valued

- Provide appropriate setbacks from classified vegetation in areas of lower risk
- Reduce the impact of bushfire on new subdivisions and adjacent existing urban areas by fundamentally good design
- Facilitate improvement of the existing township interface
- Ensure multiple opportunities for vehicle and pedestrian movement away from the bushfire hazard and to areas of lower risk (BAL-LOW).

The precautionary principle is applied throughout this report supporting the directions of the Royal Commission (*The 2009 Victorian Bushfires Royal Commission final report* 2010) and Clause 13.02-1S of the Planning Policy Framework. In the context of this report, the principle refers to:

- Vegetation classification where the presence of disturbance by bushfire or past use does not of itself warrant any reduction in the classification of the vegetation and the potential of re-vegetation should be considered; and
- Human behaviour being unpredictable and allowing for limited property preparation and late egress in the event of fire.

DOCUMENT REVIEW (BUSHFIRE RELATED)

REGIONAL BUSHFIRE PLANNING ASSESSMENT

As part of the response to the 2009 Victorian Bushfires Royal Commission, Regional Bushfire Planning Assessment (RBPAs) were undertaken across six regions that covered the whole of Victoria. The RBPAs provide information about 'identified areas' where a range of land use planning matters intersect with a bushfire hazard to influence the level of risk to life and property from bushfire. The RBPAs state that 'This information should be addressed as part of strategic land use and settlement planning at the regional, municipal, and local levels' (*Regional Bushfire Planning Assessment*" *Gippsland Region* 2012).

The Regional Bushfire Planning Assessment for Gippsland Region (*Regional Bushfire Planning Assessment*" *Gippsland Region* 2012) identifies the settlements of Mirboo North and Baromi as having an:

> "*interface with bushfire hazard and include a combination of small and medium size lots containing vegetation of high and very high conservation significance; the interface occurs in and around the existing golf course and south of Railway Road*".

This is of direct relevance to the northern and eastern aspects of Mirboo North. Of relevance to the western aspect of Mirboo North is the:

> *"mixture of landscapes and subdivision patterns including small and medium size lots interspersed with vegetated reserves and rural living land"*.
>
> Additionally, "*the area forms the western periphery of the township with a combination of living environments susceptible to the impact of bushfire''.*

VICTORIA FIRE RISK REGISTER

The Victorian Fire Risk Register (VFRR) identifies the Mirboo North township as being at high risk of bushfire. The VFRR process utilises a standardised set of questions put to subject experts including CFA and Council to determine the appropriate risk rating. It provides a likely scenario based on the McArthur Forest Fire Danger Index (FFDI) rating of 100 (the same FFDI used for Clause 53.02 of the Planning Scheme) which is 'direct fire attack from forest to the north-west and north-east, including ember attack'. Applicable risk reduction treatments are considered, as is the likelihood and consequence which combine to give a residual risk rating of 'High' for Mirboo North.

DELWP FIRE OPERATIONS PLAN

The Mirboo North area falls under the South Gippsland District Fire Management area within the East Central Region of Forest Fire Management Victoria (FFMVic). Planned burns and works within the district are determined through the Strategic Bushfire Management Planning process and Joint Fuel Management Program and carried out by FFMVic staff. Where CFA resources are needed to assist with planned burns, local resources are requested by DELWP.

Significant bushland reserves under DELWP/PV management exist in the Mirboo North area. Of note, the forest vegetation contained in the Strzelecki State Forest's Darlimurla block that is located either side of the Thorpdale Road and north of Mirboo North. This block is identified as a fire management zone where works will provide bushfire moderation and landscape management delivering biodiversity requirements yet providing some protection to the township of Mirboo North from a northerly fire run. The Strzelecki State Forest's Baromi block is located in the east of the town and contributes to one of the leafier areas of the township. This area is subject to planned burns and is targeted for bushfire moderation to reduce the bushfire hazard.

Municipal Fire Management Plan

The South Gippsland Municipal Fire Management Plan 2018-2021 (*South Gippsland Municipal FIre Management Plan 2018-2021* 2018) identifies the Mirboo North township at being at high risk of direct fire attack from forest to the north-west and north-east, including ember attack. The Municipal Fire Management Plan's 2018-2021 Work Plan provides a list of treatments aimed at reducing the risk to the community. Several agencies have responsibility for implementing treatments. Private landholders also have a responsibility to prepare for fire.

Council responsibilities

- Fire prevention notice program
- Fire plug installation and maintenance
- Roadside and Reserve slashing program
- Fire access tracks program
- Planning scheme fire prevention requirements
- Building permit fire prevention requirements
- Municipal Fire Management Plan

Vicroads responsibilities

- Roadside slashing program

CFA responsibilities

- Brigade operational preparedness
- Community Information Guides
- Planned Burning program
- Community safety programs

Department for Environment, Land, Water and Planning responsibilities

- Planned burning program
- Reserve track maintenance
- Fuel reduction works program

Community Information Guide – Bushfire

CFA have developed a Community Information Guide for Mirboo North. The Guide identifies Mirboo North as being at very high risk of bushfire. It advises residents to have a plan for fire danger days of Severe, Extreme or Code Red.

https://www.cfa.vic.gov.au/plan-prepare/community-information-guides

Document Review (Planning related)

Mirboo North Structure Plan Refresh (South Gippsland Shire Council, April 2017)

The draft Mirboo North Structure Plan Refresh 2017 nominates three potential growth areas as General Residential Zone and Low Density Residential Zone. A number of other areas are identified for infill residential development. Three of the areas identified for residential rezoning are proposed as Development Plan Overlay areas. Change in the Darlimurla Rural Living Zone is limited and to be restricted by the zone.

The role of the town as the 'principal township in the north of the shire, servicing the surrounding agricultural activities and rural population' is retained by the Refresh and there is identification that 'tourism is an increasingly important economic contributor'(*MIrboo North Structure Plan Refresh* April 2017).

The area in the north of the township (potential growth area 1), which is not yet developed, is utilised for farming and dissected by the Strzelecki Highway and retained vegetation. Grassy paddocks with scattered trees along drainage lines are typical, with the length of grass depending on the extent of grazing. The connection between this land and the existing township is identified for further consideration.

The draft Mirboo North Structure Plan Refresh 2017 indicates that these areas are planned for limited greenfield residential development. Road upgrades and provision of open space, particularly around the waterways would also be expected within the new sites as part of development. Infill development is also considered.

An area to the south-east of the established township which is currently used for farming has been identified for growth. It is bounded by Boolarra-Mirboo North Road to the north and Boolarra South- Mirboo North Road to the west. Murray Street dissects the land. This area connects north to the existing township through an area that is developed with scattered dwellings and gardens, similar to a rural living area. The Plan proposes expansion to this area.

In the south-west of the township, an area of undeveloped farmland, large residential lots and conventional residential lots is identified for development consideration. The area is bounded by Strzelecki Highway to the north and Balook Street to the west and dissected by Berry's Creek Road. This land abuts existing educational facilities and the township to the north-east.

PLANNING POLICY FRAMEWORK

Clause 71.02-3 of the Planning Scheme (integrated decision making) was amended in late 2017. It states that:

> *Planning authorities and responsible authorities should endeavour to integrate the range of policies relevant to the issues to be determined and balance conflicting objectives in favour of net community benefit and sustainable development for the benefit of present and future generations.* ***However in bushfire affected areas, planning authorities and responsible authorities must prioritise the protection of human life over all other policy considerations.*** **[Emphasis added]**

Clause 13.02 (Bushfire) of the Planning Scheme applies to all decision making and seeks to:

> *To strengthen the resilience of settlements and communities to bushfire through* ***risk-based planning*** *that prioritises the protection of human life.* **[Emphasis added]**

Clause 13.02-1 includes a number of strategies to achieve that objective. Broadly these strategies include:

- prioritising the protection of human life;
- requiring a robust assessment of the bushfire hazard and risk assessment before any strategic or statutory decision is made; and
- directing population growth and new settlements to low risk locations.

Importantly in relation to settlement planning, clause 13.02-1 includes the following requirements:

- ***Directing population growth and development to low risk locations, being those locations assessed as having a radiant heat flux of less than 12.5 kilowatts/square metre under AS 3959-2009 Construction of Buildings in Bushfire-prone Areas (Standards Australia, 2009)***
- ***Ensuring the bushfire risk to existing and future residents, property and community infrastructure will not increase as a result of future land use and development.***
- ***Achieving no net increase in risk to existing and future residents, property and community infrastructure, through the implementation of bushfire protection measures and where possible reduce bushfire risk overall.***
- *Assessing and addressing* ***the bushfire hazard posed to the settlement*** *and the likely bushfire behaviour it will produce at a landscape, settlement, local, neighbourhood and site scale, including the potential for neighbourhood-scale destruction.*
- ***Assessing alternative low risk locations for settlement growth on a regional, municipal, settlement, local and neighbourhood basis.***
- *Not approving any strategic planning document, local planning policy, or planning scheme amendment that will result in the introduction or intensification of development in an area that has, or will on completion have, more than a BAL-12.5 rating under AS 3959-2009.* **[Emphasis added]**

When these strategies are read together it is clear that before any planning scheme amendment is approved there needs to be a considered assessment of the bushfire risk on existing and future communities. The purpose of this report is to undertake such an assessment for Mirboo North, including an assessment of the likely fire behaviour and the risk to current and future residents, including future residents of infill areas. It is our view that in the context of strategic planning decisions, these strategies need to be read as on balance and consider the '*net increase in risk to existing and future residents'*. In order to do this it is necessary to assess the risk at the township scale.

SECTION 3 THE CONTEXT

This section provides factual information about the study sites and the surrounding landscape. This includes descriptions of the sites, future and current development, land use planning controls and bushfire mitigation plans relevant to the management of growth.

VICTORIAN CONTEXT

Victoria is one of the most fire-prone areas in the world, with a history of catastrophic bushfires such as Black Friday (1939), Ash Wednesday (1983) Alpine Fire (2003), Great Divide Fire (2006), Black Saturday (2009) and most recently, Black Summer (2019). Victoria's highest bushfire risk is the result of factors that increase the likelihood and consequences of fire.

These factors include large areas of the state comprised of highly flammable dry eucalypt forest, protracted droughts and an increasing population density in bushfire prone areas. While bushfire is a significant risk facing Victoria, it is also a natural part of the environment and most natural ecosystems are dependent upon fire for their health and regeneration.

A variety of causes can ignite a bushfire. Some bushfires result from events that are natural, such as lightning, while others result from human activity. Following ignition, the direction and speed of the fire's travel, and the height and intensity of the flames are determined by climatic and weather conditions, topography and fuel in the area. The climate in Victoria is characterised by mild, moist winters followed by dry hot summers. The Victorian fire season typically occurs between the end of October and the start of May. Days of higher fire risk are often typified by the passage of a cold front, which causes fire to spread rapidly and then change direction due to the wind change. Most of Victoria's catastrophic fires have been subject to this type of effect with many fatalities resulting from people being trapped after the fire changed direction.

Topography affects fire behaviour. Fires travel upslope much faster than they travel on flat land and more slowly downslope. North facing slopes are drier and fuels on north facing slopes will ignite and burn more easily than those on south facing slopes. Areas upslope of an approaching fire are considered highly dangerous.

Victoria has two main vegetation types affecting the spread of bushfires: grass and forest. Grass fires are predominantly wind driven and spread rapidly under the influence of strong winds, but burn out quickly and can often be quickly extinguished with water. In contrast, forests have more vegetation to fuel a fire. Wind speeds are lower in the forest and forest fires take some time to reach their full potential. Once fully developed, forest fires usually have a greater flame height and intensity than grass fires, especially where the flames are burning in the tree canopy. Large logs continue burning after the initial fire front has passed. The high flames and intensity of forest fire make them difficult to control. While the weather and topography in an area cannot be modified to reduce the fire hazard, a reduction in the flammable fuels in an area can reduce the flame height and intensity of a forest fire. Reduced flame height and intensity makes it safer and easier for firefighters to suppress a forest fire.

Infrastructure such as roads can also increase the speed of a fire response, allowing firefighters to safely and effectively suppress a fire before it reaches maximum intensity and flame height. Reduced fuel and improved access infrastructure can reduce the impact of the fire on communities and the environment. Victoria currently has several agencies with differing responsibilities for fire prevention and suppression: Fire Rescue Victoria (FRV), Country Fire Authority (CFA), and Forest Fire Management Victoria (FFMV) which includes the Department of Environment, Land, Water and Planning (DELWP) and Parks Victoria. The objective of all bushfire management activities in Victoria is to reduce the impact and consequences of bushfire on human life, communities, essential and community infrastructure, the economy and the environment(*State Bushfire Plan* 2014).

In Victoria, bushfire safety is considered a shared responsibility between the fires services, the Victorian Government and local Government, communities and individuals. All parties are responsible for preparing prior to the fire season in order to protect themselves and their interests from the impact of bushfires.

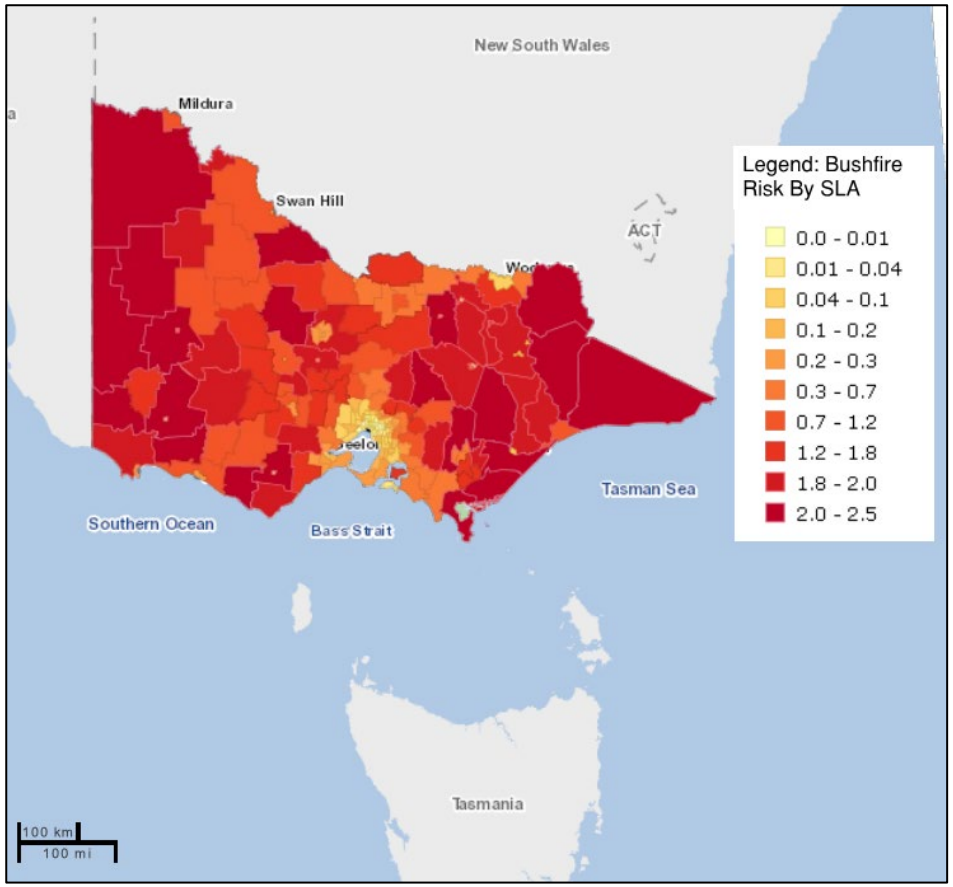


Figure 2: Bushfire Risk by SLA (Source: Victoria University)

Regional Context

Gippsland's population is growing. It is anticipated that the region's total population will reach 386,000 by 2041(*Gippsland Regional Growth Plan* 2014). The Gippsland region has areas of significant bushfire hazard and many of the landscapes most attractive to residents and tourists are also areas of high bushfire hazard. Regional bushfire planning assessments provide extra information about areas, referred to as 'identified areas', where a range of land use planning matters intersect with a bushfire hazard to influence the level of risk to life and property from bushfire. The regional bushfire planning assessments map where a significant bushfire hazard may and features such as settlements, urban interfaces and single access roads affect land use planning. This information should be considered as part of strategic land use and settlement planning at the regional, municipal and local levels.

Regional planning considerations related to bushfire include:

- Pressures to develop in highly attractive, bushfire prone areas in the region, such as near the foothills and in the valleys leading up to the Great Dividing Range, are likely to continue.
- Substantially restricting new development in the areas of highest bushfire risk, while giving due consideration to biodiversity conservation
- Applying the precautionary principle in decision-making and minimising risk to human life.

When considered in context to the broader Gippsland Region, South Gippsland Shire generally has less bushfire hazard than the other municipalities. A distinct difference between South Gippsland Shire and the rest of Gippsland Region is that there is limited forest bushfire hazard with the majority of the bushfire hazard in the Municipality being grassland and coastal vegetation. Wilson's Promontory National Park is a significant environmental asset in the south of the Municipality that regularly experiences planned and unplanned fire.

The northern area of the municipality forms part of the Strzelecki Range with the largest extent of forest being to the east, a direction that is unlikely to be associated with significant fire weather. Additionally the settled Latrobe Valley to the north forms a grass and urban break between the forested and rugged Great Dividing Range and the Strzelecki Range. Fires in South Gippsland are expected to be short duration of hours, at most a couple of days. Fires do not have sufficient rugged forested terrain to build and grow as they do in Baw Baw Shire, Latrobe City, Wellington Shire and East Gippsland. This distinct difference positions South Gippsland Shire as being at a lesser risk of bushfire than most of the Gippsland Region (Figure 2).

Municipal context

"While the overall likelihood of bushfire in the South Gippsland footprint is lower than most other Gippsland municipalities there are some pockets of community at high risk of bushfire that, without prudent mitigation works and education program, have the potential for loss of life and property."(South Gippsland Municipal FIre Management Plan 2018-2021 2018)

The South Gippsland Shire covers some 3,309 square kilometres and is located about 100 kilometres south-east of Melbourne. The municipality is bound by Cardinia and Baw Baw Shires in the north, Latrobe City and Wellington Shire to the east, Bass Strait in the south and Bass Coast Shire in the west. The municipality is a rural, residential and holiday area that consists of steep terrain in the Strzelecki Ranges in the north to the coast plains in the south. The predominant vegetation over the municipality is pasture. National Parks and conservation reserves are located in the southern reaches of the municipality. Isolated areas of natural vegetation remain scattered through the municipality ranging from wet forest, dry sclerophyll woodland, coast banksia woodland, heath and grasslands.

With a population of 29,124 (June 2017), the population is forecast to increase to 35,982 by 2036 representing an increase of approximately 24%. Much of this growth is directed to the main centres of Korumburra and Leongatha, however smaller urban centres will have some limited growth. Mirboo North is identified as a District Town and is the principal centre serving the surrounding agricultural activities and rural population in the north of the municipality.

Locality Context

Agriculture is a major land use in the area around Mirboo North. To the south farm land is used for grazing and dairying. To the north farm land is also used for horticulture particularly at the higher elevations between Thorpdale and Mirboo North. Forestry is an widespread land use to the north of Mirboo North, and separates the township of Mirboo North from the horticultural land. Other natural features of the town that influence landscape risk include the waterways and tracts of remnant vegetation that thread through the township. Heavily treed areas remain around the golf course and in a small number of nature reserves.

Township Context

Mirboo North is the third largest township in South Gippsland with 1,697 residents in 716 dwellings(*2016 Census* 2016). It is the principal town in the north of the municipality and is strategically located on the Strzelecki Highway between Morwell in Latrobe City Council and Leongatha in South Gippsland Shire Council. The South Gippsland Planning Scheme seeks future growth to respect the existing character and provide adequate protection from and management of bushfire hazards. The Structure Plan Refresh (*Mirboo North Structure Plan Refresh Appendix B - Background Report* 2017) expects the population to approach 2,000 residents in the next twenty years with an anticipated growth rate of seven dwellings per year.

Mirboo North is identified as a town where sustainable change in the form of small-scale residential, commercial and industrial development is to be encouraged (*Gippsland Regional Growth Plan* 2014). Mirboo North has a role as a district town (*Housing and Settlement Strategy* 2013) and provides a meeting place for residents located to the south and north of the range, as well as servicing the wider farming and resident communities. It serves as a satellite town for the Latrobe Valley and Leongatha. Mirboo North provides a low scale retail, service and community role to its residents and surrounding rural community, and offers a small town lifestyle alternative to the larger towns of Leongatha, Warragul and Morwell.

Mirboo North's desired future Character Statement is as follows:

The town's landscape and vegetation will continue to visually dominate over the built form. Waterways and natural drainage lines will be vegetated corridors. Residential development will be low rise and detached, generally responsive to the topography and set in established gardens. The town centre will be distinct from the surrounding built form by the buildings' commercial-style frontages, close spacing, construction to the front property boundary and cantilevered weather protection. The town centre will be a high quality pedestrian environment, particularly along the main streets (Ridgway, Peters Street, Brennan Street and Grand Ridge East) (Clause 21.14-5 South Gippsland Planning Scheme).

Low density residential growth has occurred predominantly to the west of the town centre. The town is surrounded by key farming and forestry land that should be protected as the location of food production for domestic and export markets (*MIrboo North Structure Plan Refresh* April 2017). The town is affected by a number of key restraints to development including bushfire risk, declared potable water supply catchment, steep slopes and erosion risk. The Structure Plan Refresh considered all these constraints, and identified a need to undertake further analysis of bushfire risk. The Mirboo North Structure Plan Refresh April 2017 is based largely on the previous Mirboo North Structure Plan 2004, which was prepared within a different policy context.

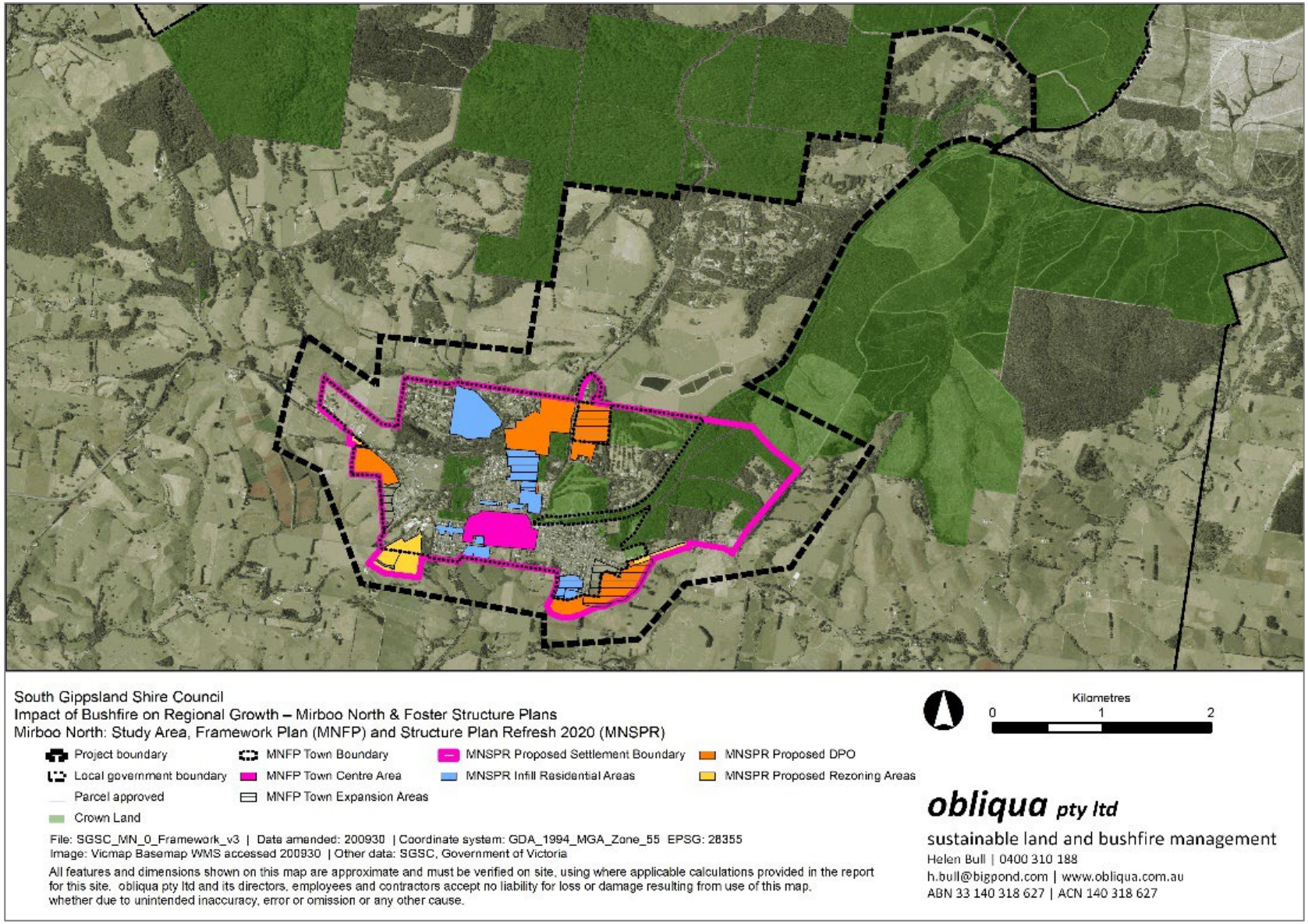


Figure 3: Township context

The core township area is located centrally on an east-west axis but is located to the south of the town when considering a north-south axis. This core contains strip shopping, commercial tenancies and services along both sides of Strzelecki Highway. Open space is located to the north of the 'main street' providing a separation from the northern residential area. Within the Refresh Plan, two area are proposed for rezoning as residential land; land to the south-west and to the south-east. The Development Plan Overlay has been identified as a planning tool that could be applied to the south-eastern growth area, the northern growth area and a small area in the west (see Figure 3). Some opportunities for infill of residential areas is also identified within the Refresh Plan.

PLANNING ZONES

RURAL ZONES

FARMING ZONE

The purpose of the Farming Zone is:

- To provide for the use of land for agriculture.
- To encourage the retention of productive agricultural land.
- To ensure that non-agricultural uses, including dwellings, do not adversely affect the use of land for agriculture.
- To encourage the retention of employment and population to support rural communities.
- To encourage use and development of land based on comprehensive and sustainable land management practices and infrastructure provision.

Except for the north-east, the Farming Zone applies to all the land surrounding the Mirboo North township reflecting the historic farming use of the land. Land adjacent to the south-eastern and south-western growth areas is predominantly in the Farming Zone; specifically, land to the west, south, and east of the township. Typically the land is used for grazing and a fast moving grassfire could spread through the Farming Zone and impact on the edges of the township. The most likely risk of a threatening grassfire would be from farmland on the south-western side of the township as this aligns to the south-westerly wind change that predominates on fire weather days, the topography, and coastal influences. This is discussed in more detail in later sections of this report.

RURAL LIVING ZONE

The purpose of the Rural Living Zone is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To provide for residential use in a rural environment.
- To provide for agricultural land uses which do not adversely affect the amenity of surrounding land uses.
- To protect and enhance the natural resources, biodiversity and landscape and heritage values of the area.
- To encourage use and development of land based on comprehensive and sustainable land management practices and infrastructure provision.

This zone surrounds most of the township. It has enabled significant native vegetation to feature in most estates; providing the semi-rural feel of Mirboo North. Typically this land is adjacent to forested areas and waterways. This zone provides a buffer to natural assets however development needs to adhere to bushfire mitigation measures. This can be challenging due to the smaller lot sizes. The development also constrains township development as the higher levels of vegetation can bring fire into the town interface. This constraint is particularly important to the north and east of the township. The Darlimurla settlement located 1.5km north of Mirboo North is totally within this zone and is at high risk of bushfire.

RURAL ACTIVITY ZONE

The purpose of the Rural Activity Zone is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To provide for the use of land for agriculture.
- To provide for other uses and development, in appropriate locations, which are compatible with agriculture and the environmental and landscape characteristics of the area.
- To ensure that use and development does not adversely affect surrounding land uses.
- To provide for the use and development of land for the specific purposes identified in a schedule to this zone.
- To protect and enhance natural resources and the biodiversity of the area.
- To encourage use and development of land based on comprehensive and sustainable land management practices and infrastructure provision.

The land connecting the Strzelecki State Forest's Darlimurla Block to the northern edge of the established Rural Living Zone is in the Rural Activity Zone. Currently, the land is mainly farmed grassland. All development needs to be undertaken in a way that it does not increase the fire risk to the main township. Two ways of facilitating appropriate development include restricting the development of continuous vegetation tracts, and retaining fire brigade access.

INDUSTRIAL ZONES

Mirboo North has two areas of Industrial Zone land. There is a small area of Industrial 3 Zone land near the centre of town located between low density residential and commercial development.

The purpose of the Industrial 3 Zone is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To provide for industries and associated uses in specific areas where special consideration of the nature and impacts of industrial uses is required or to avoid inter-industry conflict.
- To provide a buffer between the Industrial 1 Zone or Industrial 2 Zone and local communities, which allows for industries and associated uses compatible with the nearby community.
- To allow limited retail opportunities including convenience shops, small scale supermarkets and associated shops in appropriate locations.
- To ensure that uses do not affect the safety and amenity of adjacent, more sensitive land uses.

A larger area of Industrial 1 Zone land is located at the western entrance to the town. The purpose of the Industrial 1 Zone is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To provide for manufacturing industry, the storage and distribution of goods and associated uses in a manner which does not affect the safety and amenity of local communities.

This land interfaces with farmland to the north, west, and east and forest vegetation to the east. Some of the lots are vacant. The most likely bushfire risk would be from fire staring in nearby farmland either due to direct ignition or ember attack from a forest fire to the north. Industrial Zone land is appropriate for an interface with the hazard as these types of development usually have ease of access and large areas of hard surfaces, although external storage of large amounts of combustible materials may be problematic.

COMMERCIAL ZONE

The purpose of the Commercial Zone is:

- To create vibrant mixed use commercial centres for retail, office, business, entertainment and community uses.
- To provide for residential uses at densities complementary to the role and scale of the commercial centre.

Both sides of the Main Street, are in the Commercial 1 Zone. This is the area of shops, retail and office use. The police station is also located centrally in this zone. It is the area of Mirboo North where residents are likely to congregate in a bushfire emergency. Development in this zone has a reliance on reticulated water in the street hydrants for fire suppression as most lots generally have limited space for static water supplies.

RESIDENTIAL ZONES

LOW DENSITY RESIDENTIAL ZONE

The purpose of the Low Density Residential Zone is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To provide for low-density residential development on lots which, in the absence of reticulated sewerage, can treat and retain all wastewater.

In this zone, the minimum lot zone is 0.4 hectare where sewerage is not connected and 0.2 hectare where sewerage is connected. Two areas of Low Density Residential Zone exist in Mirboo North. One small area is directly south of the main street and is an area that interfaces to the grassland in the south. This area is well protected from bushfire by the settlement to the north. Development could be intensified which would remove the retained grassland risk within the zone and strengthen the town's interface with the southern grassland. The second area is developing to the west of the town. This development has lots backing onto the forested bushfire hazard and does not represent the current approach to subdivision in bushfire prone areas. This area is not suited to intensification of development.

GENERAL RESIDENTIAL ZONE

The purpose of the General Residential Zone is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To encourage development that respects the neighbourhood character of the area.
- To encourage a diversity of housing types and housing growth particularly in locations offering good access to services and transport.
- To allow educational, recreational, religious, community and a limited range of other non-residential uses to serve local community needs in appropriate locations.

The existing conventional residential areas of Mirboo North are in the General Residential Zone. All three potential growth areas identified in the Refresh Plan interface with land zoned and developed as General Residential Zone. This connection is positive as it allows new residents to egress to areas of lower risk and expands the area of the town that provides lower risk. The most likely risk to the General Residential Zone land is ember attack from fires in the landscape and radiant heat and some flame contact from local ignitions in retained vegetation.

MIXED USE ZONE

The purpose of the Mixed Use Zone is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To provide for a range of residential, commercial, industrial and other uses which complement the mixed-use function of the locality.
- To provide for housing at higher densities.
- To encourage development that responds to the existing or preferred neighbourhood character of the area.
- To facilitate the use, development and redevelopment of land in accordance with the objectives specified in a schedule to this zone.

A small Mixed Use Zone is located to the south of the main street between Commercial 1 Zone (north) and Low Density Residential Zone (south). This location is well protected from bushfire attack from all directions and will experience ember attack as the main mechanism. It is an area that could be readily developed.

PUBLIC LAND ZONES

PUBLIC USE ZONE

The purpose of the Public Use Zone is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To recognise public land use for public utility and community services and facilities.
- To provide for associated uses that are consistent with the intent of the public land reservation or purpose.

The central township has land zoned for public use including the primary school, the secondary college, aged care and local government facilities. This land is located in the core of the township. Two parcels to the east (the cemetery and the recycling station) are adjacent to forest bushfire hazard.

PUBLIC PARK AND RECREATION ZONE

The purpose of the Public Park and Recreation Zone is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To recognise areas for public recreation and open space. To protect and conserve areas of significance where appropriate.
- To provide for commercial uses where appropriate.

Mirboo North has significant areas in the northern part of the township that are Public Park and Recreation Zone that contribute to its character as a leafy township. The land use includes local reserves, sporting fields, the rail trail and the golf course. The management of this land has a key influence on the spread of fire within the township.

PUBLIC CONSERVATION AND RESOURCE ZONE

The purpose of the Public Conservation and Resource Zone is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To protect and conserve the natural environment and natural processes for their historic, scientific, landscape, habitat or cultural values.
- To provide facilities which assist in public education and interpretation of the natural environment with minimal degradation of the natural environment or natural processes.
- To provide for appropriate resource based uses.

Significant tracts of forest (the Strzelecki State Forest) are in this zone directly to the east and approximately 2 kilometres north of the township. This forest provides the potential for ember attack on the township. It's fire management, and particularly the ease of access to the forest and the grassland that interfaces with it is important in reducing the risk of fire runs into the township from the north.

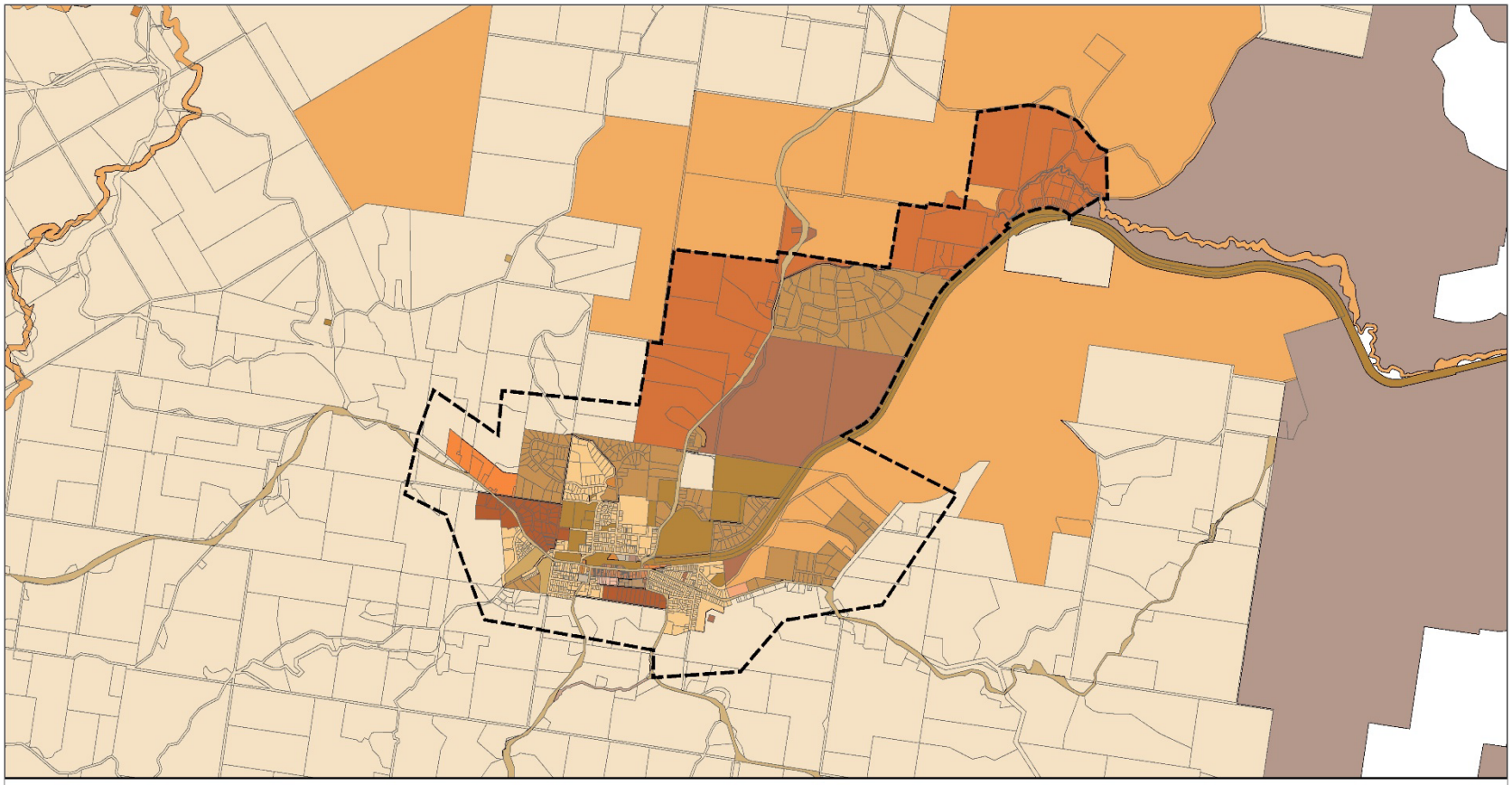


Figure 4: Planning scheme zones

PLANNING OVERLAYS

LAND MANAGEMENT OVERLAY

BUSHFIRE MANAGEMENT OVERLAY (BMO)

The purpose of this overlay is:

- To implement the Planning Policy Framework, including the Municipal Strategic Statement and local planning policies.
- To ensure that the development of land prioritises the protection of human life and strengthens community resilience to bushfire.
- To identify areas where the bushfire hazard warrants bushfire protection measures to be implemented.
- To ensure development is only permitted where the risk to life and property from bushfire can be reduced to an acceptable level.

As described in Planning Advisory Note 46 (2013), the BMO is a planning scheme provision used to guide the development of land in areas of high bushfire hazard. The location, design and construction of development and the implementation of bushfire protection measures must be considered under a BMO. The BMO applies to areas where there is potential for extreme bushfire behaviour, such as a crown fire and extreme ember attack and radiant heat and where the bushfire hazard warrants implementation of bushfire protection measures.

The BMO requires that development only be permitted where the risk to life and property from bushfire can be reduced to an acceptable level.

A planning permit is required to construct or carry out works associated with accommodation and a range of other community, commercial and other uses where occupants are at risk. Planning permit applications must be accompanied by a bushfire hazard site assessment; a bushfire hazard landscape assessment; a bushfire management statement and a bushfire management plan. Mandatory conditions are applied to permits issued for subdivision and buildings and works.

The extreme bushfire hazard that determines where the BMO should apply is where the head fire intensity of bushfire is modelled to be 30,000kW/m or more. Inputs to this calculation include physical characteristics such as vegetation and topography. Different fire behaviour models are used appropriate to the vegetation classification. While areas of contiguous vegetation of less than 4ha are excluded from the BMO, the BMO includes a buffer of 150 metres from larger areas of vegetation in recognition of research that indicates that 92% of house loss occurs within this distance(Blanchi et al. 2010b). Following a recommendation of the 2009 Victorian Bushfires Royal Commission, the BMO was mapped using hazard data developed by the Department of Environment and Primary Industries (DEPI). Revised mapping was verified by Councils during 2016 and 107 and then gazetted on October 3rd, 2017.

The Bushfire Management Overlay applies to the northern and eastern areas of the township reflecting the public forest and the reserves within settled areas. Of note, the southern area is not affected in the local or broader landscape indicting that the southern area of Mirboo North has less radiant heat exposure.

ENVIRONMENT AND LANDSCAPE OVERLAYS

ENVIRONMENTAL SIGNIFICANCE OVERLAY

The purpose of this overlay is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To identify areas where the development of land may be affected by environmental constraints.
- To ensure that development is compatible with identified environmental values.

Each schedule to the overlay contains a statement of environmental significance and specifies the environmental objectives to be achieved. In summary, the following apply to the study area:

- Schedule 1: Areas of Natural Significance
- Schedule 2: Special water supply catchment areas
- Schedule 4: Sewage treatment plant and environs
- Schedule 5: Areas susceptible to erosion

DESIGN AND DEVELOPMENT OVERLAY

The purpose of the overlay is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To identify areas which are affected by specific requirements relating to the design and built form of new development.

The DDO seeks to provide amenity for development and pedestrian improvement. Development applications require a landscaping plan that accords with the document CFA Landscaping for Bushfire November 2011 which is a background document to the South Gippsland Planning Scheme. This document provides a mechanism to maintain a leafy character yet not contribute to the risk of bushfire spread.

Two areas currently have a Design and Development Overlay. Design and Development Overlay – Schedule 13 applies to the Mirboo North Town Centre. It also incorporates the response to Landscaping for Bushfire. Design and Development Overlay – Schedule 2 applies to the Burchell Lane Industrial Precinct, and was recently updated in the scheme by Planning Scheme Amendment C115sgip.

Development Plan Overlay

The purpose of this overlay is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To identify areas which require the form and conditions of future use and development to be shown on a development plan before a permit can be granted to use or develop the land.
- To exempt an application from notice and review if a development plan has been prepared to the satisfaction of the responsible authority.

Currently, one growth area to the west of Mirboo North is contained in Development Plan Overlay – Schedule 11. This area is known as Berrys Creek Road Residential Development Area. Berrys Creek Road provides an effective interface with between the township and the farming land. Development of this area of land needs to achieve the same level of bushfire mitigation with an emphasis on a perimeter road. The DPO11 as currently written is not consistent with the bushfire planning provisions in that it emphasises a single point of access from the development to Berrys Creek Road, and appears not to have considered the impact of a perimeter road along the grassland interface in determining lot yield and preferred arrangement. The Development Plan Overlay can be an effective planning tool to achieve good subdivision design that is responsive to bushfire when the content of the overlay is considerate of bushfire.

Heritage Overlay

The purpose of this overlay is:

- To implement the Municipal Planning Strategy and the Planning Policy Framework.
- To conserve and enhance heritage places of natural or cultural significance.
- To conserve and enhance those elements which contribute to the significance of heritage places.
- To ensure that development does not adversely affect the significance of heritage places.
- To conserve specified heritage places by allowing a use that would otherwise be prohibited if this will demonstrably assist with the conservation of the significance of the heritage place.

The places in this overlay (95, 97, 98 and 152) are all located in or near the town centre. This is fortunate as this area is of lower bushfire risk than locations in the northern interface. This location allows a more flexible design response that can favour heritage outcomes over bushfire resilience.

Other Overlays

The Environmental Audit Overlay and the Public Acquisition Overlay also apply to parts of Mirboo North but have no influence in the consideration of the risk of bushfire.

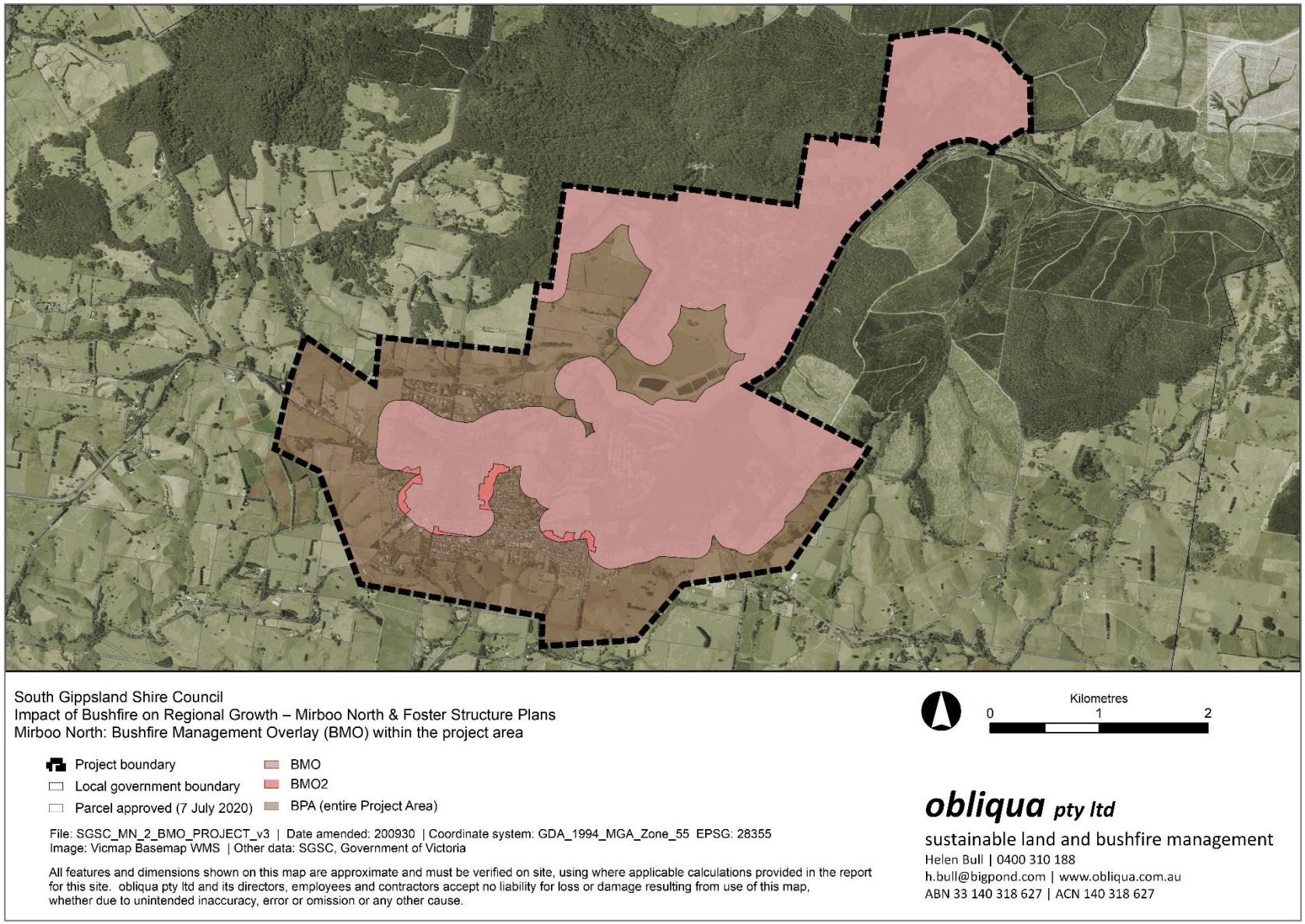


Figure 5: Extent of the Bushfire Management Overlay in the Study Area

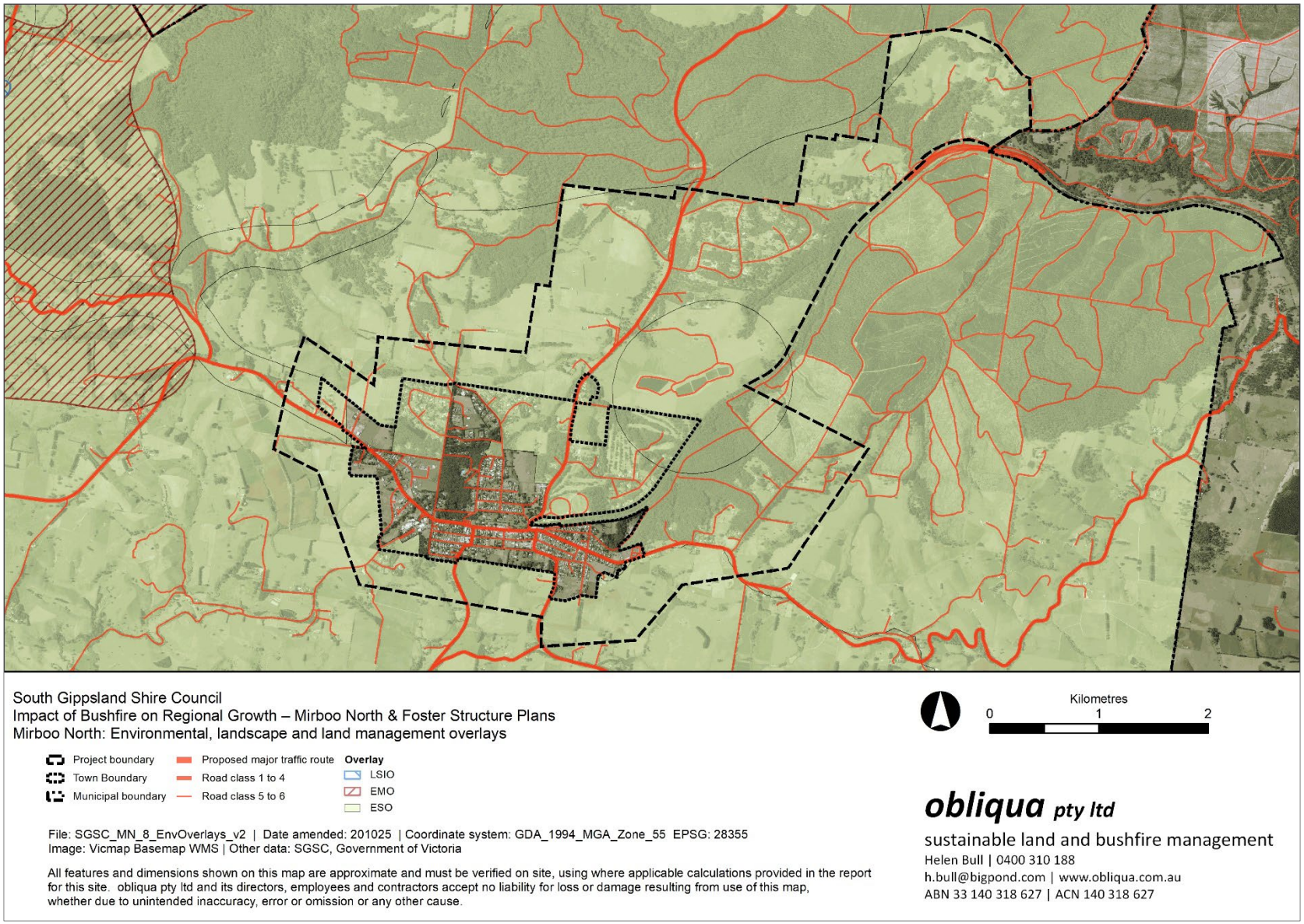


Figure 6: Environmental significance and erosion management overlays

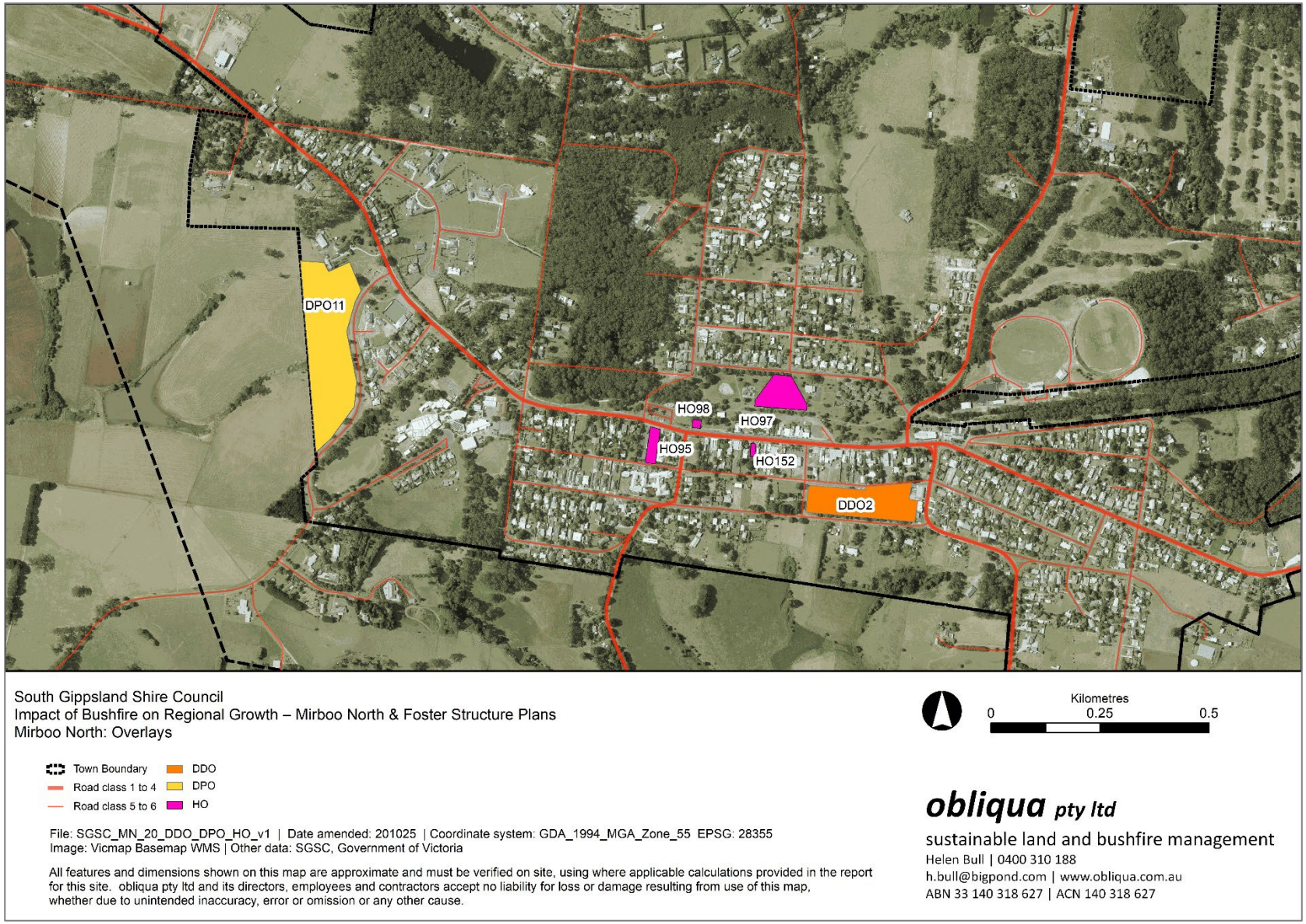


Figure 7: Design development, development plan and heritage overlays

SECTION 4 UNDERSTANDING THE BUSHFIRE THREAT TO THE SETTLEMENT

'Bushfire risk' can be defined as 'the chance (likelihood) of a bushfire igniting, spreading and causing damage to people or the assets they value (consequences)' (CFA 2012d). Key risk factors include the hazard or source of the risk, the exposure to the hazard, and the vulnerability of both the occupants and the buildings that they rely upon for shelter.

Consistent with planning scheme clause 13.02-S, this report considers bushfire risk in relation to a 'design fire' burning under conditions of extreme fire danger (a Forest Fire danger Index of 100).

This assessment briefly considers vulnerability, but primarily focuses on the hazard and exposure of township occupants. It is important to note that risk can be managed but not eliminated.

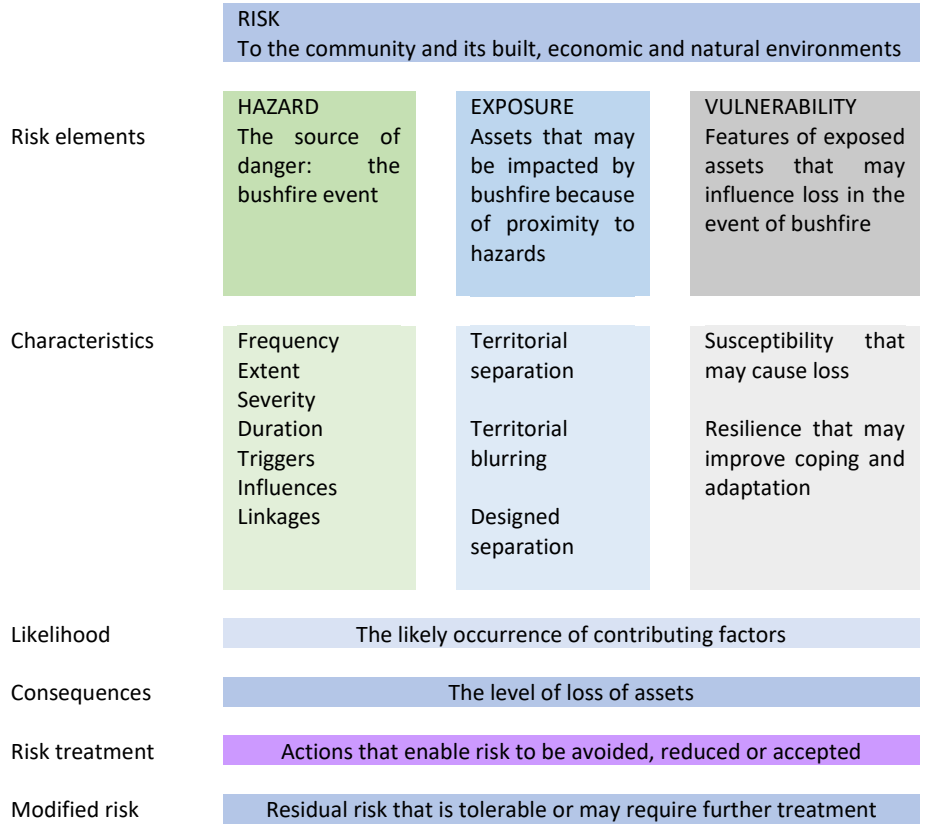


Figure 8: Bushfire risk elements and their characteristics
Adapted from Lein (2006)

EFFECT OF BUSHFIRE ON SETTLEMENTS

This section summarises some of the research relating to bushfire behaviour, and the impacts of bushfire that can help inform settlement planning.

Fire typically travels from the north-west, or south-west under a cool change. The peak rate of spread in forest fires under extreme conditions (generally less than 5km/hour (AFAC 2002)) may be achieved within minutes, although spotting may start new fires up to 2 to 3 km away and has been recorded up to 35 km a fire front (Gould et al. 2007). Intense grass fires burn quickly (generally less than 20 km/h) and may spot over 100m (AFAC 2002). While most fires are controlled at less than 5ha (DELWP 2015), they can grow quite quickly to be beyond the level of control, particularly on Severe, Extreme and Red Code days.

Fire control is likely to fail most of the time once Very High fire danger (Forest Fire Danger Index or FFDI = 25 to 49) conditions are reached (Hines, Tolhurst, Wilson, & McCarthy, 2010).

Under these conditions, the northern, western and southern boundaries of settlements are most exposed to flames and radiant heat from bushfire, and whole settlements can be affected by embers (burning leaves and bark that is carried ahead of the fire by wind or convection) and strong winds that damage buildings. Bushfire attack on a settlement located close to forest could involve:

- Ember and smoke impacts may be experienced for hours before a fire front arrives (Blanchi & Leonard, 2005). Spotfires ignited by embers grow under the influence of slope, fuel and wind to form a fire 'front' or 'tongues'. As the fire front approaches, wind may increase in speed and become more erratic due to convection and cause damage to houses, assisting entry of embers (He et al. 2013)
- Once in the urban area, fire may spread via vegetation, fences and other combustible material or from house to house as demonstrated by the 2003 Canberra fires (Blanchi & Leonard 2005). Embers, radiant heat (which can ignite burnable materials and crack window glass helping embers to enter a building) and flame contact increases (CFA 2012b). Even if buildings are not attacked by a flaming front, localised flame attack can be expected from ignition of debris that accumulates continuously during and immediately after the passage of the fire (Leonard, Blanchi & Bowditch 2004, p. 3).
- The fire 'front' may pass in seconds. Fine fuel may burn in minutes, but burning houses, caravans, cars, fences, water tanks, bins and other combustibles may make conditions unsafe for human exposure for over an hour (Leonard et al., undated). Ember attack may continue for hours after the fire passes (Blanchi & Leonard, 2005)

Over 85% of house loss from major fires in Australia has occurred within 100m of bushland (Chen & McAneney 2010) and most are lost from ember attack (Leonard, Blanchi & Bowditch undated). Embers can enter gaps in buildings as small as 1.8mm (Manzello et al. 2011), highlighting the importance of good construction and maintenance practices.

Design of settlement shape and depth is also important. The 2003 Canberra fires led to house loss for a distance of up to 674m from the neighbouring forest, in a highly urbanised area. Fire spread was observed to have been assisted by garden vegetation (such as hedges) and fences as well as house-to-house spread (Chen & McAneney 2010).

As well as directly threatening houses, bushfire also poses a threat to the tenability of properties and settlements by threatening the power and water supply, sewage treatment, access and telecommunications.

Figure 9 summarises the effect of bushfire on settlements, buildings and people based on Bushfire Attack Levels (or BALs, which are a measure of radiant heat).

Radiant heat decreases with distance from the hazard, but even low levels of radiant heat pose a significant threat to buildings that are not built to a construction standard that can withstand it. Most older houses are unlikely to meet requirements of the Australian Standard AS 3959:2018 for the lowest threat rating of Bushfire Attack Level (BAL) 12.5 (Standards Australia 2018).

BAL 12.5 LOW THREAT TO HOUSES	BAL 19 MODERATE THREAT TO HOUSES	BAL 29 HIGH THREAT TO HOUSES	BAL 40 VERY HIGH THREAT TO HOUSES	BAL-FZ EXTREME THREAT TO HOUSES
Low ember attack Low radiant heat (up to 12.5kW/m2)	Moderate ember attack Moderate radiant heat (up to 19kW/m2)	High ember attack High radiant heat (up to 29kW/m2)	Very high ember attack Very high radiant heat (up to 40kW/m2) Some flame contact from fire front	Extreme ember attack Extreme radiant heat (over 40kW/m2) Flame contact from fire front
Pain after 3 seconds (at 10kW/m2 or 2m from burning house) Pain after 10-20 secs (6kW/m2 or 6m from burning house) Critical conditions for firefighters Possible failure: float glass	Ignition of timber after a long time Possible failure: screened float glass Possible ignition: plastics (water tanks + rubbish bins)	Ignition of most timbers after 3 minutes	Ignition of cotton fabric after 5 seconds	Ignition of timber after 20 seconds

Figure 9: Bushfire threat and effects
Adapted from *AS3959-2009* (Standards Australia 2009) and Bowditch, PA (2006)

BUSHFIRE, HOUSE AND LIFE LOSS

Analysis of Australian data shows that:

- from 1901 to 2011, 825 people lost their lives in 260 bushfires (Leonard 2015)
- from 1965 to 2011, 168 houses were lost to bushfire each year (Blanchi et al. 2012).

While these numbers are significant, the chances of house loss from bushfire in SE Australia is estimated to be 1:6500 or 1/6th of the chance of loss from structure fire and half the risk of being killed in a traffic accident (McAneney, Chen & Pitman 2009).

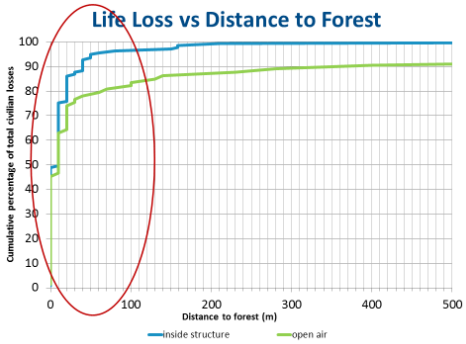
Research on major bushfires in Australia indicates that:

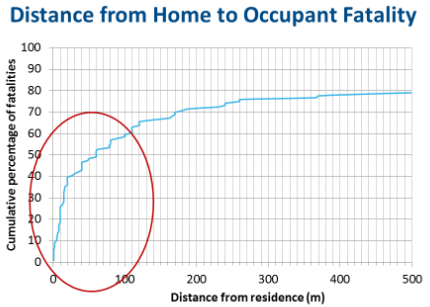
- House loss is a good predictor of life loss (Blanchi et al. 2012)
- The proportion of women killed by bushfire is increasing
- Approximately 40% of bushfire victims have died within 20m of their home (Leonard 2015)
- Life loss increases significantly once the fire danger rating exceeds Extreme (Forest Fire Danger Index = 100) (Leonard 2015).

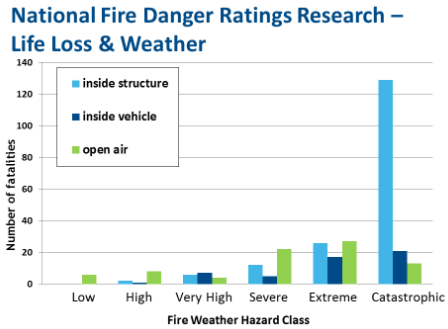
Research conducted after the 2009 Victorian bushfires indicates the circumstances in which the 173 victims died (Handmer, O'Neil & Killalea 2010):

- Sheltering either in the house or related buildings: 69%
- Sheltering in undefendable buildings: 32%
- Fleeing on foot or by car: 14%
- Taken by surprise by the fire: at least 30%
- Vulnerable' victims (aged/frail/children/disabilities): 44%

Figure 10: CSIRO Life loss statistics







(Leonard 2015)

BUSHFIRE HISTORY

There is a long history of small fires around Mirboo North, with the main causes being human. All of these fires have been quickly attacked and suppressed. Approximately 57% of all fires are contained to less than 1ha in size. With a dedicated fire brigade and local command facility in Mirboo North, it is expected that most ignitions can be suppressed.

However, fire control is likely to fail most of the time once Very High fire danger (Forest Fire Danger Index or FFDI = 25 to 49) conditions are reached (Hines, Tolhurst, Wilson, & McCarthy, 2010), or even lower depending on other fires occurring in the greater region which may divert resources. A large fire is therefore a realistic scenario

Significant fires in the vicinity include:

The Delburn Complex (2009) was deliberately lit. It affected the townships of Darlimurla and Mirboo North directly impacting 128 properties.

Hallston 2013: A fire started from a DELWP planned burn in Hallston in 2013 burnt 562 hectares comprising public land (267 Ha), pine and blue gum plantations (151ha) private forest (95ha) and private pasture (49ha).

Seaview: A fire near McDonalds Track at Seaview burnt 254 hectares (*South Gippsland Municipal FIre Management Plan 2018-2021* 2018, p. 6).

The longer-term fire history of the region is shown in Table 1.

Table 1: Major bushfires in East Central region since 1851

Source: Strategic Bushfire Management Plan for East Central (DELWP 2014, p. 12)

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 Femtree 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.

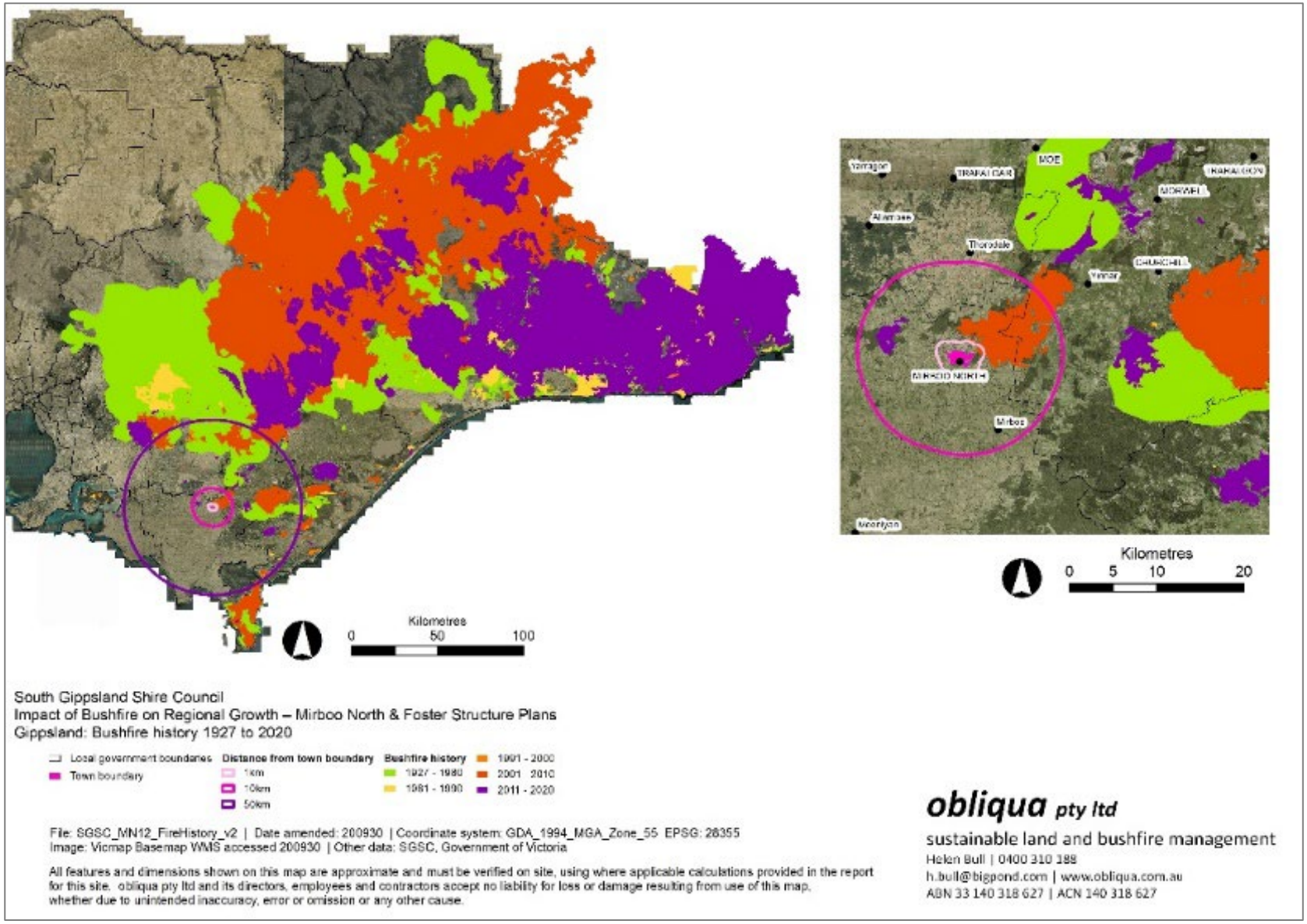


Figure 11: Fire history

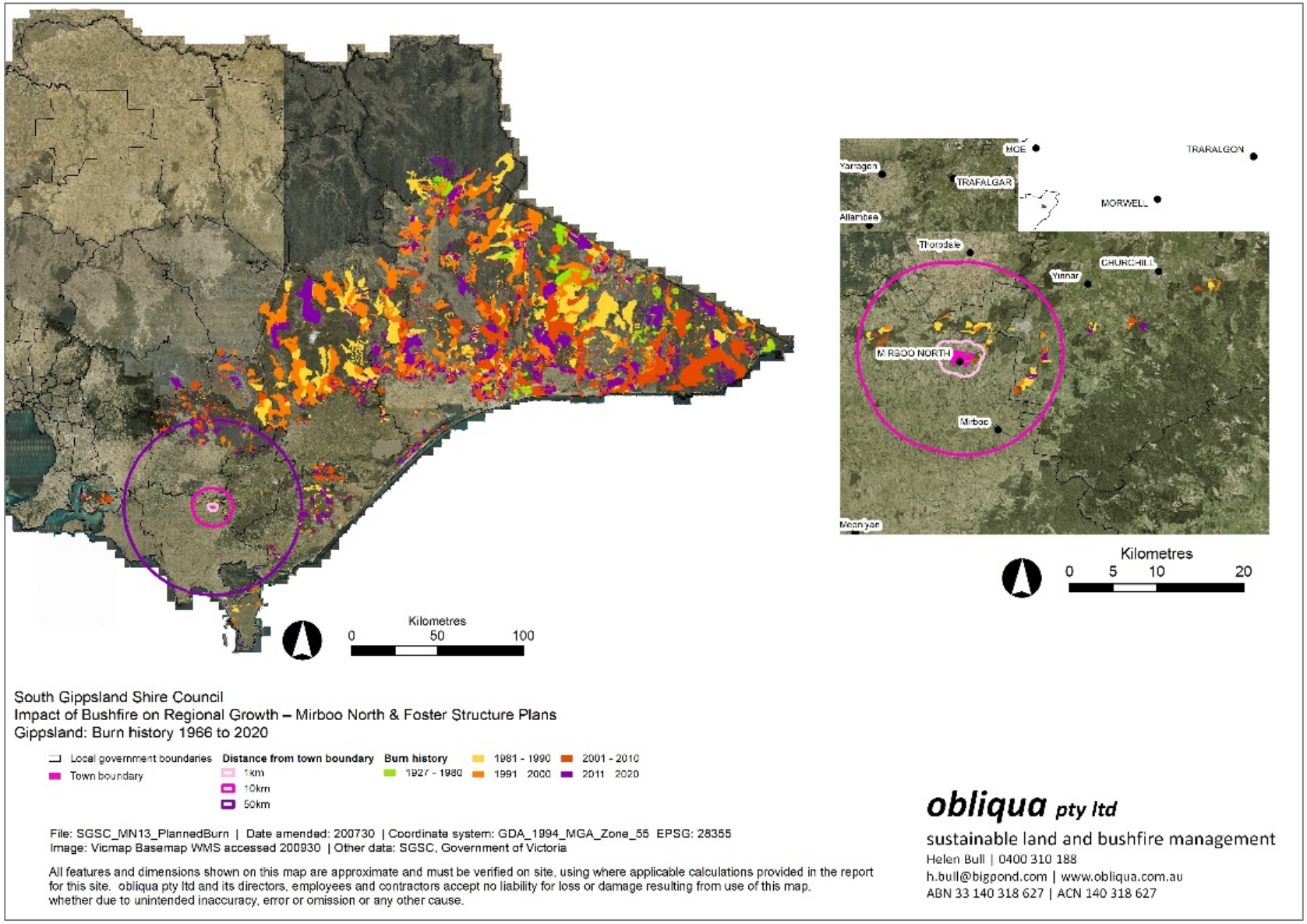


Figure 12: Planned burn history

BUSHFIRE HAZARD

This section provides information on local factors that contribute to the bushfire hazard: fuel, weather and topography.

FUEL - VEGETATION

This section describes the vegetation within and adjacent to Mirboo North and the contribution this fuel would make to fire behaviour.

The vegetation types around and within the Mirboo North township have been classified using the seven broad vegetation classes used within AS3959 (*AS3959 Building in a Bushfire Prone Area* 2018) to determine the relevant BAL and defendable space distances.

In accordance with AS3959, vegetation classifications have been determined for each of the potential growth areas within 150m. Determinations have been based on current landscape condition. As most asset impact occurs within 150m of vegetation, it is appropriate to the base the assessment on this buffer distance.

Primary fire fuel in the forests will be fine fuels (including leaves, twigs, bark, grass and other understorey vegetation). Primary fire fuels in the grasslands will be pasture grasses and crops. Where vegetation does not meet the AS3959 standard and are composed of modified landscapes (such as maintained household gardens), a classification of 'Modified Vegetation' has been applied. Given the predominant bark type in these areas, modified vegetation cannot be considered to be low threat.

The extent of vegetation within and surrounding Mirboo North and potential areas for revegetation of waterways is shown in Figure 17.

Vegetation Classification: Forest

AS3959:2018 Definition:

Open forest or Low open forest – Trees 10-30 m high; 30-70% foliage cover (may include understorey of sclerophyllous low trees and tall scrubs or grass). Typically dominated by eucalypts.

Mirboo North has forest located in the broader landscape to the north and east. Within the township there are reserves that are dominated by forest. The bark hazard for the types of trees in Mirboo North will produce massive member attack and fire spread. Combined with the bark hazard, the understorey is sufficient to carry a surface fire into the canopies of the trees under the design conditions.

Vegetation Classification: Grassland

AS3959:2018 Definition:

All forms, including situations with shrubs and trees, if the over storey foliage cover is less than 10%.

Mirboo North has grassland located in the broader landscape to the south and west. The grassland is used for farming and will have its highest fuel loads in early summer prior to hay-making. The presence of grassland on the south and west sides of the township provides for growth in those directions.

Vegetation Classification: Modified vegetation

Planning Scheme Definition:

Modified vegetation is vegetation that does not fit into the vegetation classifications in *AS3959:2018 Construction of buildings in bushfire prone areas* (the standard) because it:

- Has been modified, altered or is managed due to urban development, or gardening,
- Has different fuel loads from those assumed in the standard,
- Has limited or no understorey vegetation, or
- Is not low-threat or low-risk vegetation as defined in the standard.

In the rural living areas of Mirboo North, larger trees have been retained and additional plantings have occurred giving the township its bushland character. The Planning Scheme recognises this vegetation type as 'modified vegetation' noting that the bark hazard retained is the major mechanism for fire spread.

Vegetation Classification: Low threat vegetation

AS3959:2018 Definition:

2.2.3.2 Exclusions – Low threat vegetation and non-vegetated areas

The following vegetation shall be excluded from a BAL assessment:

(a) Vegetation of any type that is more than 100 m from the site

(b) Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified vegetation.

(c) Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site, or each other or of other areas of vegetation being classified vegetation.

(d) Strips of vegetation less than 20 m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified vegetation.

(e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops.

(f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, gold courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks.

NOTES:

1. *Minimal fuel condition means there is insufficient fuel available to significantly increase the severity of the bushfire attack (recognizable as short-cropped grass for example, to a nominal height of 100 mm).*

2. *A windbreak is considered a single row of trees used as a screen or to reduce the effect of wind on the leeward side of the trees.*

The town centre and smaller residential lots are considered to meet the definition of low threat vegetation. It is this area that can be considered a safer place for informal shelter. The guidance contained in Landscaping for Bushfire (*Landscaping for Bushfire* 2011) aims to provide a landscape that is generally consistent with this definition, and does not contribute significantly to the spread of fire.

WEATHER

The highest risk fire weather for Mirboo North is experienced on days of strong north to north-west winds, high temperatures and low humidity followed by a strong south-west cooler change late in the day. Dry storms with lighting strikes often accompany the south-west changes and provide an additional source of ignition. Fires can spread rapidly under cool change conditions.

Wind has a significant effect on the rate of spread of a fire; particularly for grassfire. Fire is most likely to travel towards the township with wind from the north to north-west; and the west to south-west following a cool change. Fire may travel to the town from other directions; but principally under lower fire danger ratings.

Fire control is likely to fail most of the time once Very High fire danger (Forest Fire Danger Index or FFDI = 25 to 49) conditions are reached (Hines, Tolhurst, Wilson, & McCarthy, 2010). Under those conditions, fire behaviour is dominated by weather rather than the fuel (Tolhurst, 2014), which indicates that measures other than vegetation management must be considered. Older weather data for East Sale indicates that extreme fire weather conditions may be experienced regionally on between 3 and 8 days each fire season (Long, 2006, p. 8). It is important to note however, that the number of significant fire weather days may be less as recorded peaks in fire danger may only occur for short periods of time, and the fire danger over an extended period (for example 3 hours) gives a better indication of fire behaviour. Fire danger is expected to increase as by 2050 Victoria is predicted with high confidence to have up to 70% more days rated at Severe, Extreme and Code Red fire danger. (Bureau of Meteorology 2018; DELWP 2014)

The weather recorded during the Black Saturday fires provides an indication of the weather conditions that can be expected on Very High, Severe, Very High or Code Red fire danger days. Weather records for 7 February 2009 from the Latrobe Valley Aerodrome in Traralgon (Bureau of Meteorology, 2009) showed that the FFDI peaked at 123 and exceeded 49 continuously for a period of approximately 7 hours. For most of this time, the wind was generally from the north west. Under the cool change, the wind direction changed from westerly to south westerly. Wind speeds peaked at 46km/h, with gusts were to 65km/h.

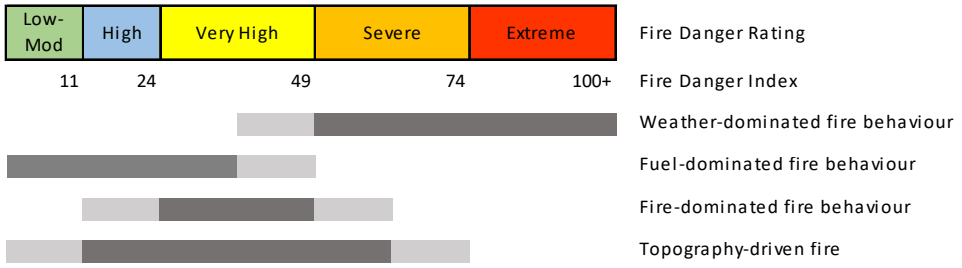


Figure 13: Fire Danger ratings and key influences on fire behaviour (Tolhurst 2014)

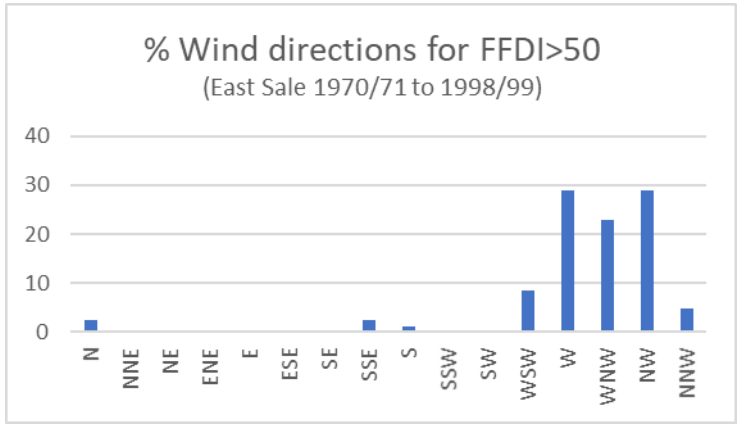


Figure 14: Fire Danger ratings and key influences on fire behaviour (Long 2006)

The Delburn fire was more complex. The maximum FFDI was 52 on 30 January 2009. Fire directions from the NW, S and W were reported (Teague, McLeod, & Pascoe, 2010, pp. 40-50).

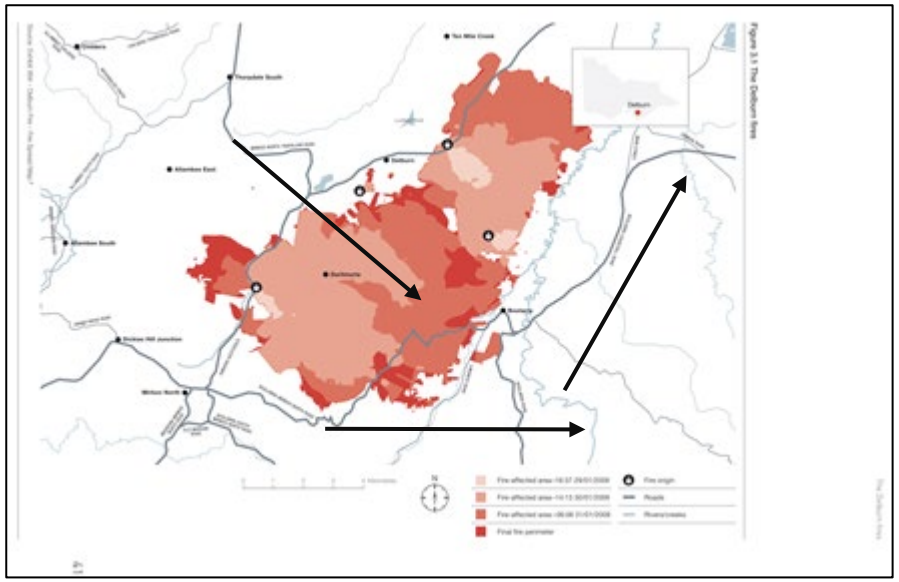


Figure 15: Map of Delburn fire showing variations in wind directions (Teague et al., 2010, p. 41)

TOPOGRAPHY

Slope and other topographical features can affect significantly fire behaviour. A fire will burn faster uphill. This is because the flames can easily reach more unburnt fuel in front of the fire. Radiant heat pre-heats the fuel in front of the fire, making the fuel even more flammable. For every 10˚ slope, the fire will double its speed and intensity, and its heat output will increase significantly. The opposite applies to a fire travelling downhill. For every 10˚ of downhill slope, the fire will halve its speed.

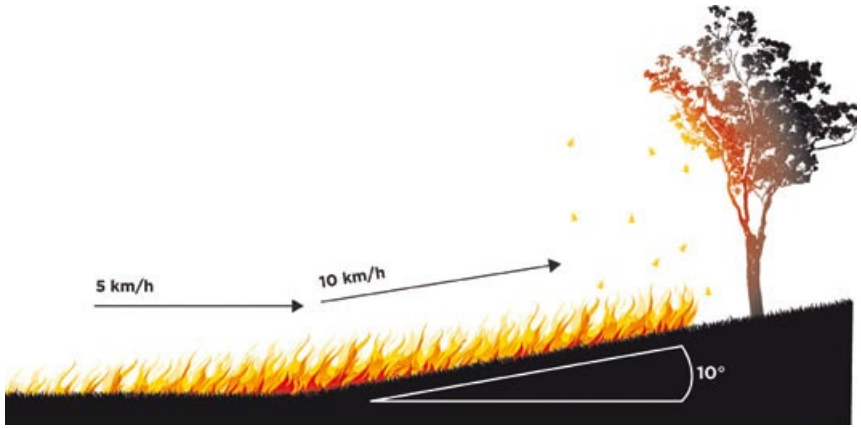


Figure 16: Effect of slope on fire behaviour (*How fire behaves* 2020)

Mirboo North is situated on a plateau. Most of the central part of the township is flat to gently sloping with slopes of less than 10 degrees. Land surrounding waterways is steeper, and while these slopes are short, they have the potential to significantly accelerate fire spread and intensity under the design conditions. Development is best suited to land with slopes of less than 5 degrees (Rowe, Howe & Alley 1981).

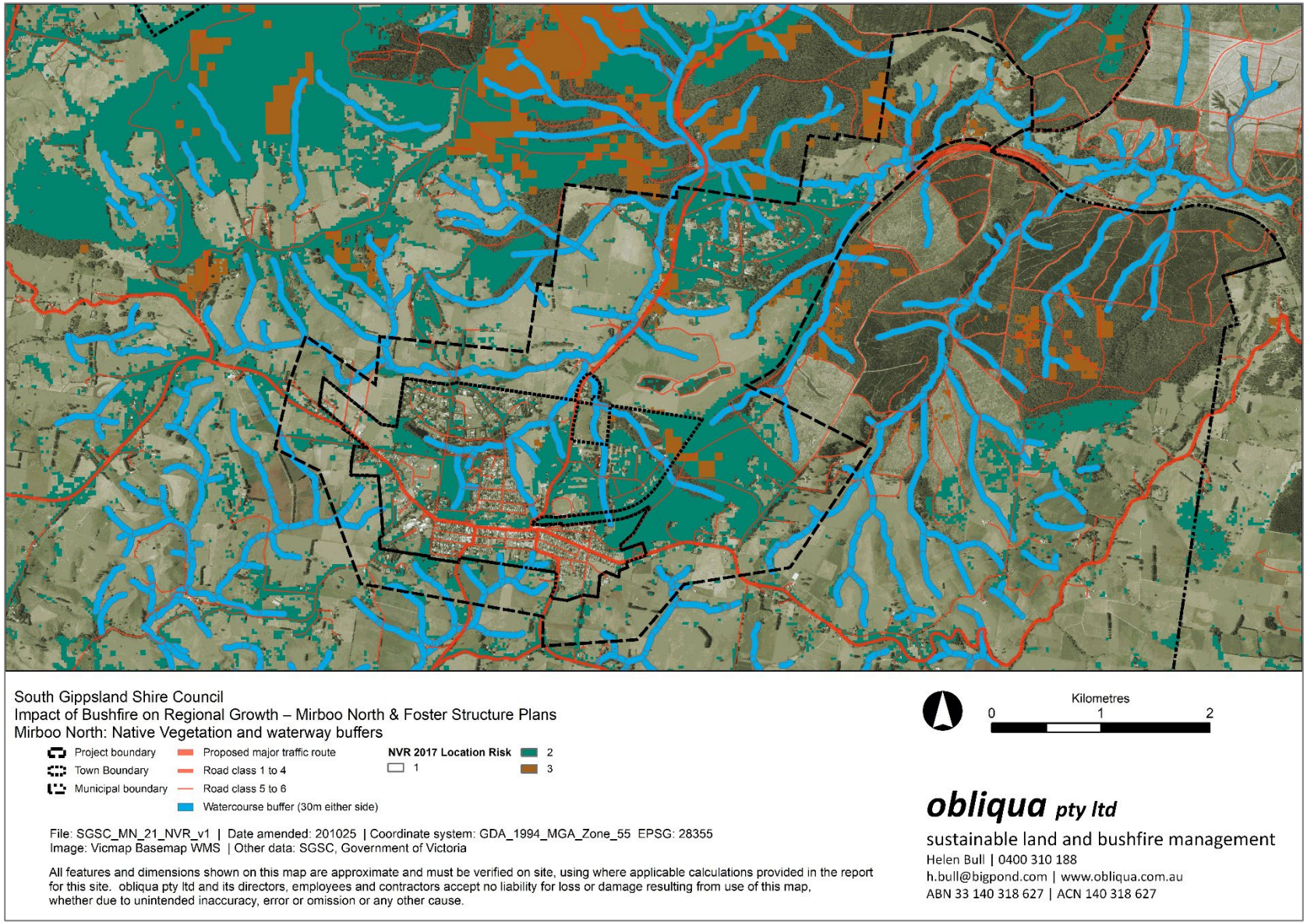


Figure 17: Native vegetation and waterway buffers

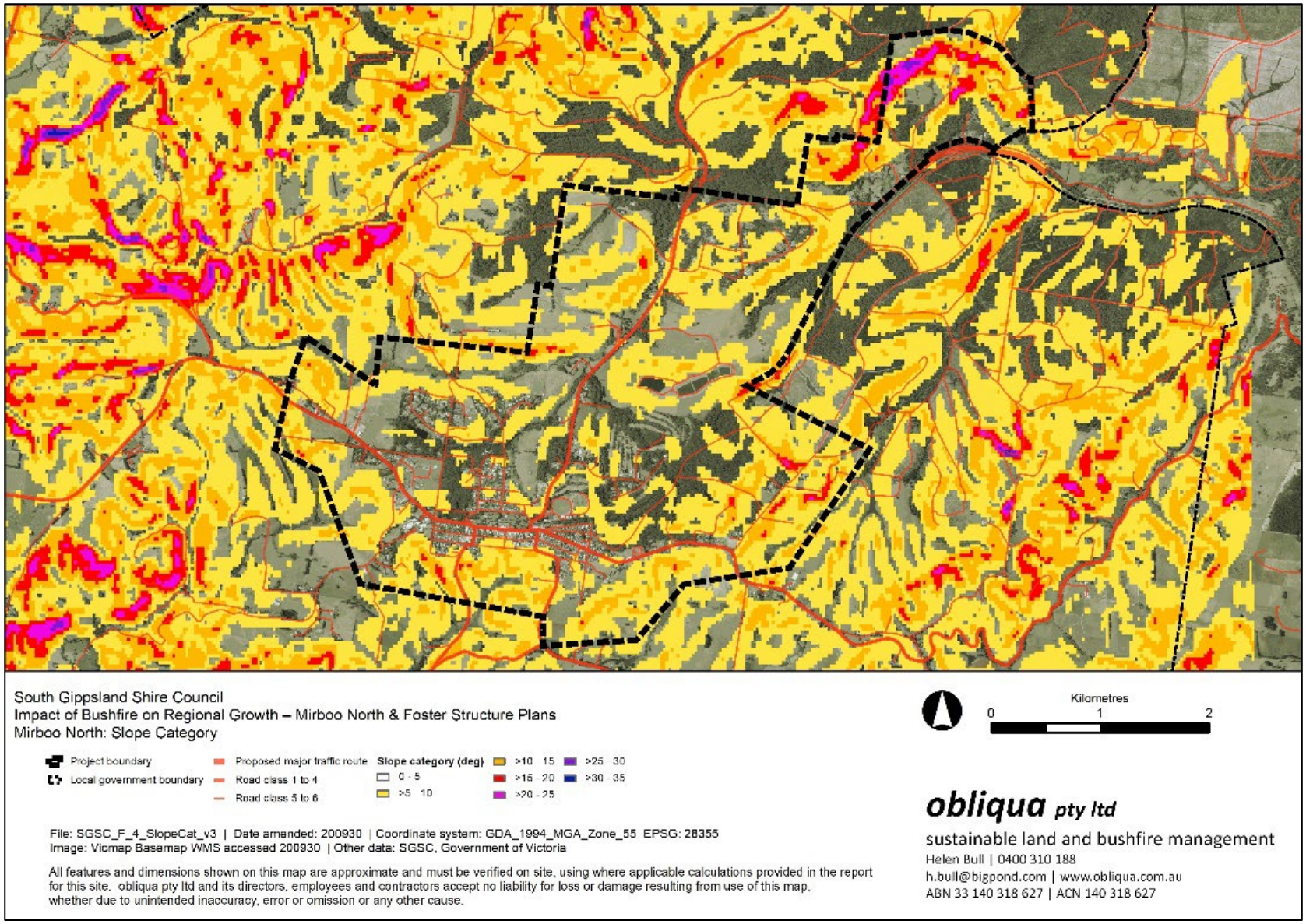


Figure 18: Slope categories

OTHER COMBUSTIBLES

As shown in Table 2, houses, sheds, cars, fences, logs and other combustibles may burn for an hour or more (Leonard, Blanchi & Bowditch 2004). These combustibles have the potential to hamper suppression and block egress routes including through smoke. They may also contribute to flying debris which can damage glazing and assist house loss through ember attack. They may also contribute to fire spread to buildings and vehicles through embers, radiant heat and flames.

Research into house loss during the 2015 Wye River fire found that ignition of heavy fuel elements adjacent to or under buildings including adjacent houses (house-to-house ignition), combustible retaining walls, combustible decking, combustible stairways, vehicles, stored equipment, plastic water tanks and firewood were a significant factor in the loss of houses built to regulatory standards (Leonard et al. 2016, p. 1). Building to building fire spread was also identified as a significant factor in the 2003 Canberra fires (Chen & McAneney 2010; Lambert 2010).

Direct flame contact from a passing fire front or adjacent involved fuels (including burning fuels underneath the vehicle) have the potential to result in rapid vehicle fire involvement in as little as 90 seconds (Penney, G., Habibi & Cattani 2019, p. 41). Vehicle-to-vehicle spread can be achieved in urban settings within 12 minutes (Collier 2011b). As shown in Figure 20, the heat load from burning vehicles is expected to be significant and supports the need to provide adequate space for parking away from vulnerable buildings and access routes.

Based on extrapolation from the more conservative measures of radiant heat from buildings used in verification method V2.3.1.4 of the *National Construction Code Volume 2* as shown in Figure 19, radiant heat impacts from buildings can be significant This view is supported by a study of a house burn by CSIRO (Bowditch, P 2006) that as shown in Figure 21, indicates that radiant heat level quickly declines with separation and may be negligible with a separation of 6m or more. These separation distances indicate that impacts of other combustibles can be effectively dealt with through separation.

Table 2: Fuel sources and estimates of duration and flame length

Source: Leonard, Blanchi and Bowditch (2004)

Fuel sources	Approx. duration (minutes)	Approx. maximum flame length (m)
Stored material	5–120	Various
Forest fuels – fine	0.25–0.55	50
Forest fuels – heavy	30–120	2
Garden sheds	30–60	2
Pergolas and decks	15–60	2
Detached garages	30–120	4
Adjacent houses	60–180	4
Around mulch	5–20	0.4
Cultured gardens	5–20	0.6
Motor vehicles	30–60	3
Gas bottles	5–60	6
Combustible fences	10–30	2
Wind-borne combustible debris	10–300 not continuous	0.4

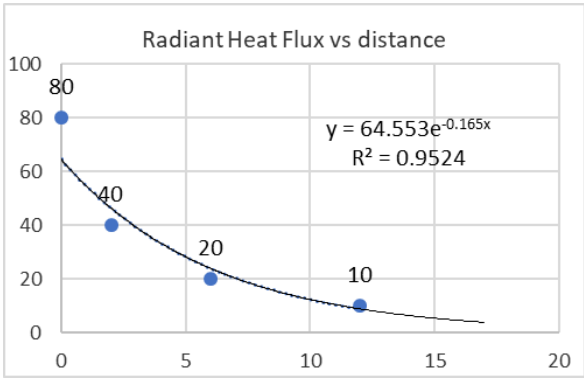


Figure 19: Indicative relationship between radiant heat flux from a burning building and separation derived from verification method V2.3.1.4 of the *National Construction Code*

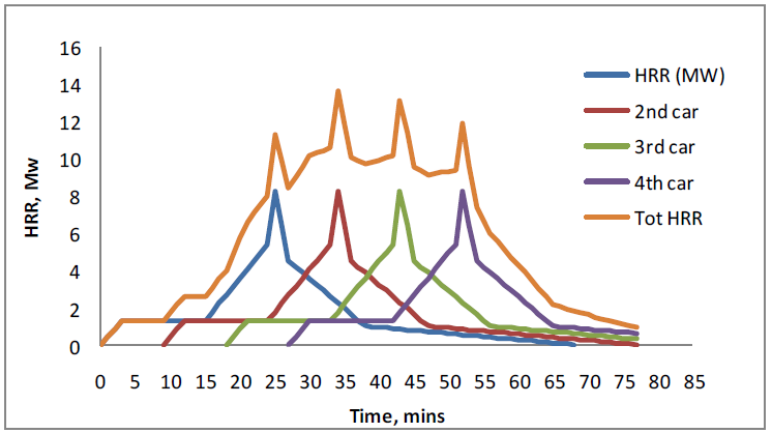


Figure 20: Heat release rate (HRR) for 4 cars ignited at 12min intervals from car to car ignition
Source: Collier (2011b)

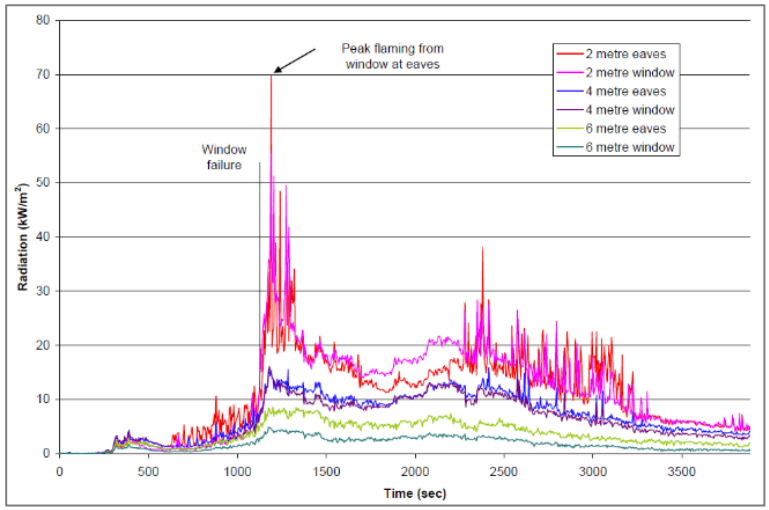


Figure 21: Radiation over time from a burning building
Source: Bowditch, P (2006)

Figure 22: Example of the contribution of fencing to bushfire risk at a site level

EXPOSURE TO THE HAZARD

Australian bushfire research indicates that most buildings that are lost to bushfire are located within 100m of bushland (Chen & McAneney 2010).

As the number of bushfire-related deaths correlates well with loss of houses (Blanchi et al. 2012), this distance of 100m also indicates where people are most exposed. However, people and structures located up to 1km away (Leonard, Blanchi & Bowditch undated; Wang 2006) from extensive areas of bushland will also be significantly exposed to ember attack. Houses within 10m of houses, cars, or other structures or within 50m of significant areas of vegetation are also at significant risk of ignition due to flames (Bowditch, PA 2006; Collier 2011a; Leonard, Blanchi & Bowditch undated).

Based on this research, this report uses the following distances to indicate the areas of highest exposure to bushfire hazard that may endanger life and property.

Table 3: Distance from hazards that contributes to highest exposure

Distance	Hazard	Attack mechanism/rationale
0-10m	Structures Vehicles	House-house or structure-house spread due to flames and radiant heat (Bowditch, PA 2006; Collier 2011a; Leonard, Blanchi & Bowditch undated).
0-50m	Significant areas of vegetation (>4ha (DTPLI 2013))	Flame contact (Leonard, Blanchi & Bowditch undated; Standards Australia 2009)
0-100m		Most houses lost (Chen & McAneney 2010) Most lives lost (Blanchi et al. 2012)
0-400m		Significant ember attack (Leonard, Blanchi & Bowditch undated; Wang 2006) which can form new spotfires in advance of the main fire front
0-700m		Penetration of urban area by the 2003 Canberra bushfires (Blanchi & Leonard, 2005; Chen & McAneney, 2010)

SUSCEPTIBILITY TO THE HAZARD

This section outlines factors that reduce the ability of the built, economic, social and natural environments to be resilient (cope with and adapt to) bushfire.

ACCESS TO SHELTER

Well-sited, constructed and maintained buildings in safer precincts provide the best shelter from bushfire, although building and vegetation management is likely to become more difficult with age and infirmity and be impacted by personal and economic circumstances. In the absence of safe housing, the best option is to leave on days of significant fire weather. Safe evacuation requires planning for safe egress, and locations to retreat to. There is no designated Neighbourhood Safer Place (open air refuge) in Mirboo North but there are established areas of lower risk within the town centre that can function as an area to retreat to. Late evacuation will take considerable time (Leon & March 2013) and planning needs to consider provision of alternate routes in case roads are blocked or obscured by traffic, smoke or fire.

COMMUNITY AND BUSINESS FUNCTION

Vulnerable groups include occupants of the aged care facilities, schools and kindergartens, but these facilities are required to have emergency plans to help them manage their risks (CFA 2014b). The summer population is increased by visitors, who may be more vulnerable due to lack of knowledge on how to prepare for and respond to fire, be isolated from their normal support networks and may have limited understanding of English. Business premises are vulnerable to direct fire attack and to indirect fire effects including road closures, smoke and effects on visitation which based on the experience of the 2009 fires may last for weeks, months or years (Walters & Clulow 2010). Census data indicates that Mirboo North is in the 2nd lowest quintile for disadvantage which could indicate higher vulnerability to bushfire risk (Australian Bureau of Statistics 2020).

INFRASTRUCTURE

Infrastructure including roads, powerlines, telecommunications, water and sewerage are critical to preparedness, response and recovery of normal community function. All of these facilities are vulnerable to direct damage by fire.

NATURAL ENVIRONMENT

Environmental and amenity values are important to community resilience through their contribution to a 'sense of place' (Beilin, R. & Reid, K. 2015; Paton, Kelly & Doherty 2006) and Mirboo North's tourism and economic well-being. Vegetation in the town is vulnerable to modification for reduction of both actual and perceived risks.

CLIMATE CHANGE

The community is vulnerable to climate change through its potential effects on personal circumstances including health (Hughes, Hanna & Fenwick 2016) and disposable income (ACOSS 2016), and the expected increase in bushfire likelihood and consequences (Hughes 2014; Lucas et al. 2007).

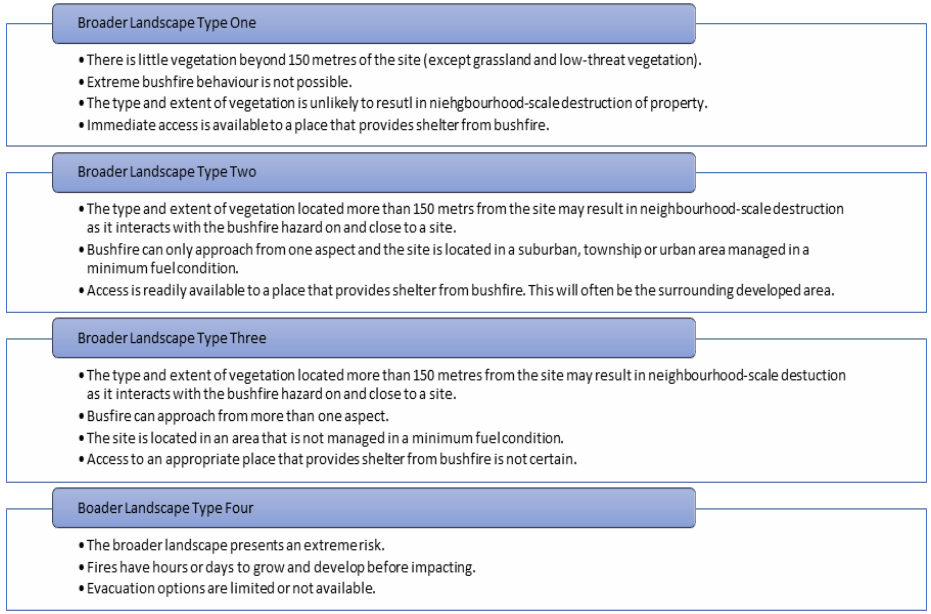


Figure 23: Broader landscape typologies as detailed in DELWP guidance (DELWP, 2017)

LANDSCAPE RISK

Landscape-scale fire hazards are responsible for Australia's most catastrophic fire events including Ash Wednesday (1983), Black Saturday (2009) and East Gippsland (2020). Landscape risk is influenced by several elements in the surrounding landscape, including the hazard (vegetation, topography and weather conditions), exposure to the hazard and susceptibility (including accessibility to low threat areas and/or shelter and the quality of the road networks surrounding the site).

Dynamic simulation of bushfires at a landscape level is increasingly used to study such complex interactions(Tolhurst, K. 2018). However, this report takes a more strategic approach, using two methods.

Firstly, this report uses the four 'broader landscape types' contained in the DELWP Technical Guide Planning Applications Bushfire Management Overlay(*Planning Permit Applications Bushfire Management Overlay* 2017) to describe the landscape risk. These types are intended to streamline decision-making and support more consistent decisions based on the landscape risk. At a strategic planning level, the landscape scenarios provide a sufficient framework for assessment.

The landscape typology for Mirboo North sits between 'Broader Landscape Type Two' and 'Broader Landscape Type Three'. The northern and eastern areas of Mirboo North have a higher bushfire landscape risk as the bushfire can approach from more than one aspect. However in the southern side of the township, bushfire can only approach from one aspect and as a grassfire.

Secondly, as required by Clause 13.02-1S of the Planning Policy Framework, the broader landscape around Mirboo North has also been considered at a 1km, 10km, and 60 km scale using a template and indicative mapping produced by Tolhurst (2014) as a guide.

The broader landscape is intrinsically fire prone. The overall landscape threat from the hazard is assessed as shown in Table 4 as Moderate to High, but with extreme ember risk. Key contributors to the assessment are described as follows.

Sources of fire impact

The Strategic Bushfire Management Plan for East Central (DELWP 2014, p. 20) identifies Mirboo North as being at risk from fire originating in a 'catchment' that extends from the Central Highlands (near Woods Point) to Leongatha. However Mirboo North may more exposed to bushfire that originates locally due to the wide break provided by the Latrobe Valley and the northern escarpment of the Strzelecki Range.

Proximity to extensive areas of vegetation

Mirboo North is exposed to potentially long fire runs through forest located to the north and north east and runs through grassland in other directions.

Ruggedness

Ruggedness of terrain is also indicative of the potential for convection and fire damage. Fire runs up steep hills dramatically increases the energy and rate of spread of bushfire including through the production and transport of embers. Threat from terrain around Mirboo North is assessed as Low to Moderate.

Convection

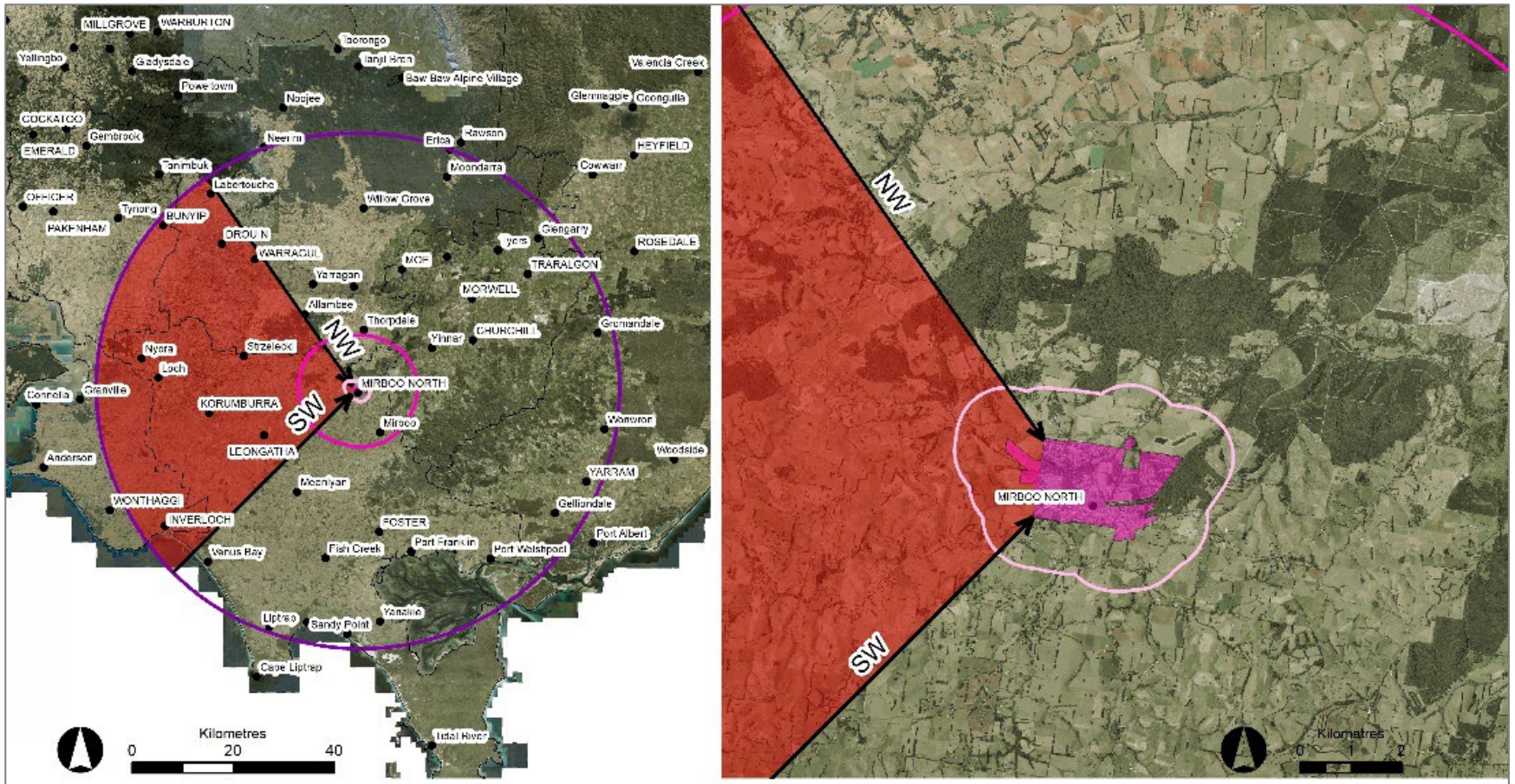
Intense fire creates and is driven by convection columns which draw in air from the surrounding area. This air movement (convective wind) can enhance or override local winds. Wind can be strong and/or erratic in direction due to convection. For example, severe tree damage at the 2009 Bunyip Ridge fire was assessed as requiring wind speeds of 120km/h (Tolhurst, KG 2009, p. 11), which corresponds to wind speeds for a Category 1 tropical cyclone (BOM n.d). Consideration should be given to requiring design that addresses convective winds that may reach this level. Convection is also a key spread mechanism for embers. The heat associated with convection may be in the order of one BAL rating (Quintiere 2006, p. 167).

Embers

There is a significant risk from embers in this locality due to the dominance of stringybark eucalypts in the township and locality. Even areas of perceived safety can be exposed to mass ignitions that lead to firestorm development. This effect is caused by being in a 'drop zone'. Boolarra was involved in a drop zone event in 2009. The drop zone is an area that receives substantial amounts of embers that cause multiple ignitions within a short timeframe. Steep and rugged topography, and extensive areas of forest with extreme bark hazard are typical environments that can result in a drop zone event.

House loss probability

The Strategic Bushfire Management Plan for East Central (DELWP 2014, p. 20) identifies Mirboo North as having a moderate level of simulated property risk.



South Gippsland Shire Council
Impact of Bushfire on Regional Growth – Mirboo North & Foster Structure Plans
Mirboo North: Indicative fire directions (landscape and local scales) for higher fire danger ratings

Local government boundaries
Town boundary

Distance from town boundary
1km
10km
50km

Direction of threat (higher fire danger ratings)
Key fire runs (indicative)
Key fire directions

File: SGSC_MN14_FireDirection | Date amended: 200730 | Coordinate system: GDA_1994_MGA_Zone_55 EPSG: 28355
Image: Vicmap Basemap WMS accessed 200930 | Other data: SGSC, Government of Victoria

All features and dimensions shown on this map are approximate and must be verified on site, using where applicable calculations provided in the report for this site. obliqua pty ltd and its directors, employees and contractors accept no liability for loss or damage resulting from use of this map, whether due to unintended inaccuracy, error or omission or any other cause.

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Figure 24: Indicative fire directions

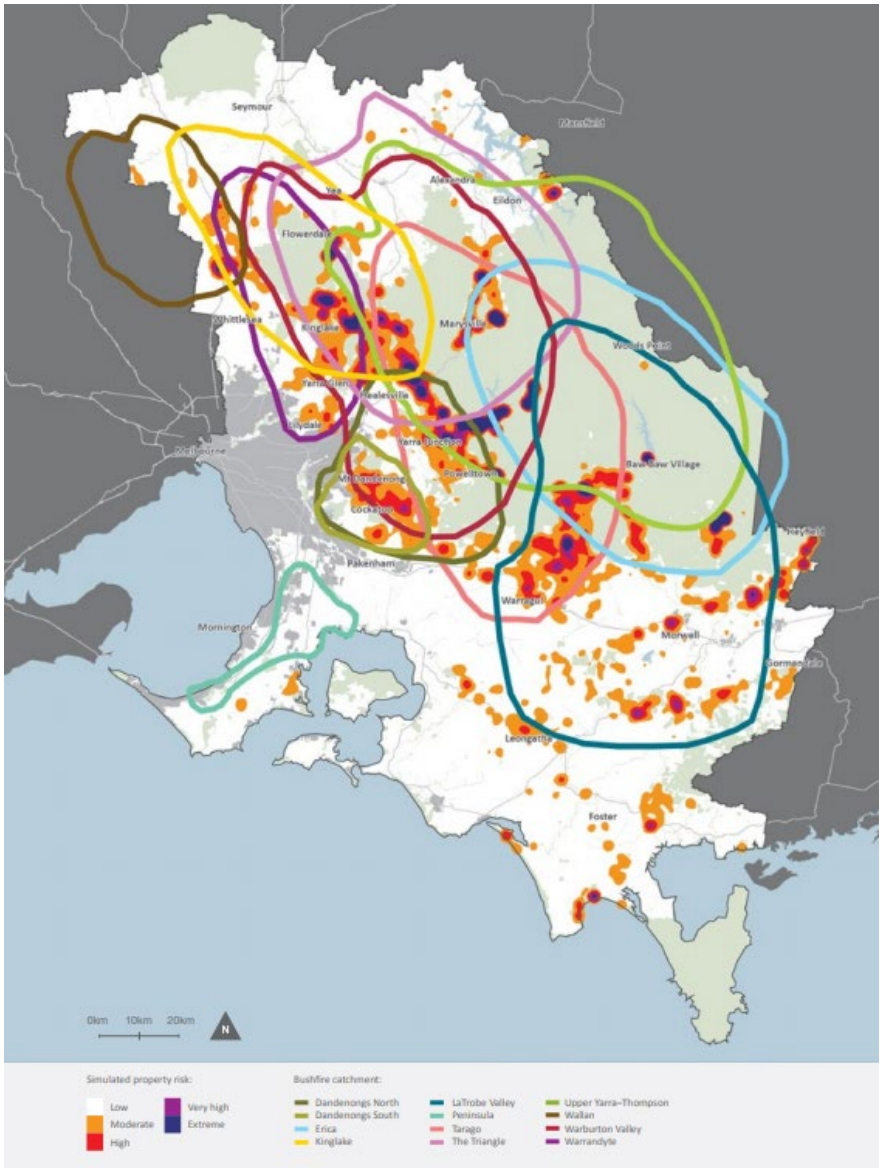


Figure 25: East Central bushfire catchments and simulated property risk

Table 4: Indicative landscape threat at FFDI=100

Adapted from Tolhurst (2014) and data from Figure 26

Threat level	Ruggedness	Convection	Ember potential	House loss probability
	Elevation range (m) in 1.5km radius	Size of forest within 2km radius (ha)	Distance to forest > 0.4 ha (m)	(DELWP, Tolhurst)
Low	0 to 150	<1000	>700	Low
Moderate	151 to 300	1000 to 3000	200 to 700	Moderate
High	301 to 500	3000 to 10000	50 to 200	High
Extreme	>500	>10000	<50	Extreme

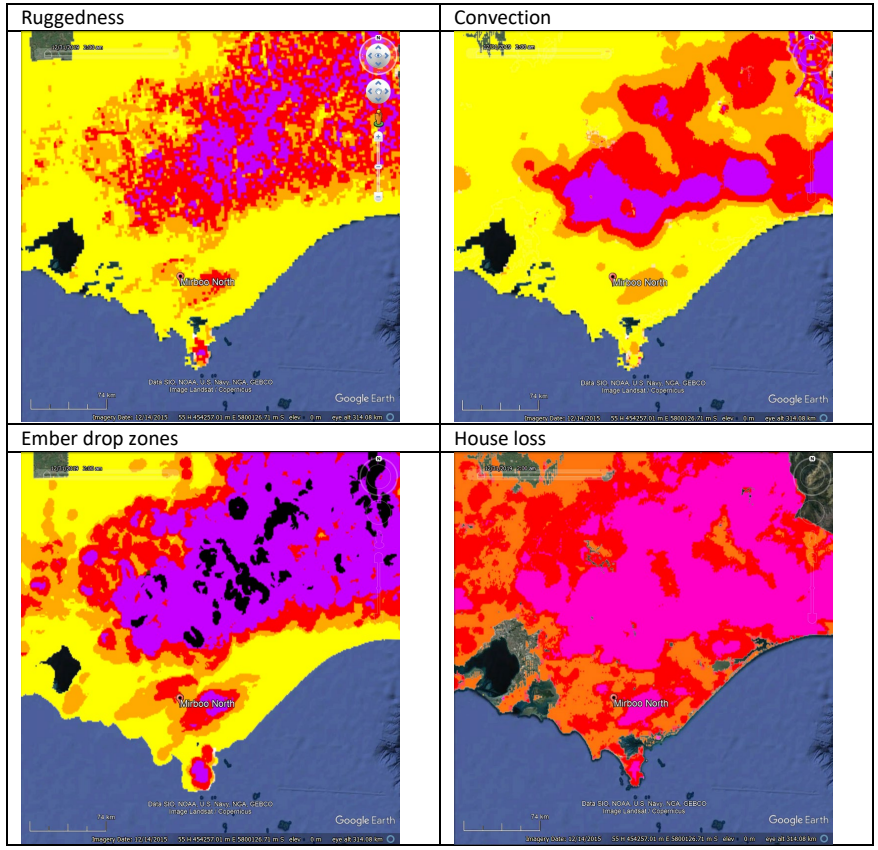


Figure 26: Indicative landscape threat maps (Tolhurst, KG 2014)

Note: These are intended to be general representations of threat and are not location-specific

LANDSCAPE RISK TREATMENT

State and local government programs are in place to reduce bushfire risk at a landscape and township level (CFA 2016). The Municipal Fire Management Plan (p72) lists the following treatments for Mirboo North:

100 Community Education

201 Burn Program, LGA

231 Planned Burn Program, DELWP

203 Slashing program, DELWP

404 FP & Hyd Install. & Maint, LGA

412 Emergency Water Supply, LGA

416 Fire Access Road/Track, DELWP

422 Reserve Mngt plan, LGA

501 Section 173 Agreements LGA

The following treatments are listed for the Darlimurla Estate. Planned burning has also been carried out:

100 Community Education, CFA

106 CFG, CFA

405 Emergency Water Supply, LGA/CFA

Treatments targeted at landscape risk include planned burning in fire management zones which are shown in Figure 27.

These treatments have been assessed reducing residual risk in Gippsland to 72% compared with no treatments; highlighting the fact that it is impossible to eliminate risk.

The Municipal Fire Management Plan identifies the residual risk based on landscape-scale and site-scale factors as High. This assessment is based upon a likelihood of 'possible' and consequences of 'Major' in the event of fire.

IMPLICATIONS FOR SETTLEMENT PLANNING

Several factors contribute to the severity and impact of bushfires. At a settlement scale, the planning scheme considers three factors: flame contact and radiant heat; ember attack; and the bushfire fuel that contribute to these impacts. Consideration also needs to be given to heat from other sources, such as buildings and vehicles. It also needs to consider wind and heat from convection where settlement is close to longer slopes of over 20 degrees (Quintiere 2006, p. 167).

Fuel management may only be effective in moderating fire behaviour or assisting control under milder conditions particularly due to spotting (Cheney, 1996; Cheney & Sullivan, 1997; Hines et al., 2010) and the amount of burning that can be achieved is limited by the narrow 'window of opportunity' of milder conditions. In addition as shown in Figure 27, only part of the nearby forest is included in FFMV's fire management zones. Consequently, mitigation of landscape risk is very reliant upon treatments that reduce the vulnerability of buildings and their occupants.

AS 3959-2018 provides only limited measures for protecting buildings against landscape risk. It provides only limited requirements for minimizing impacts of ember attack and none for wind. Additional measures will be required to both reduce the exposure and increase the resistance of the proposed building to bushfire attack. Further detail is provided in section 5.

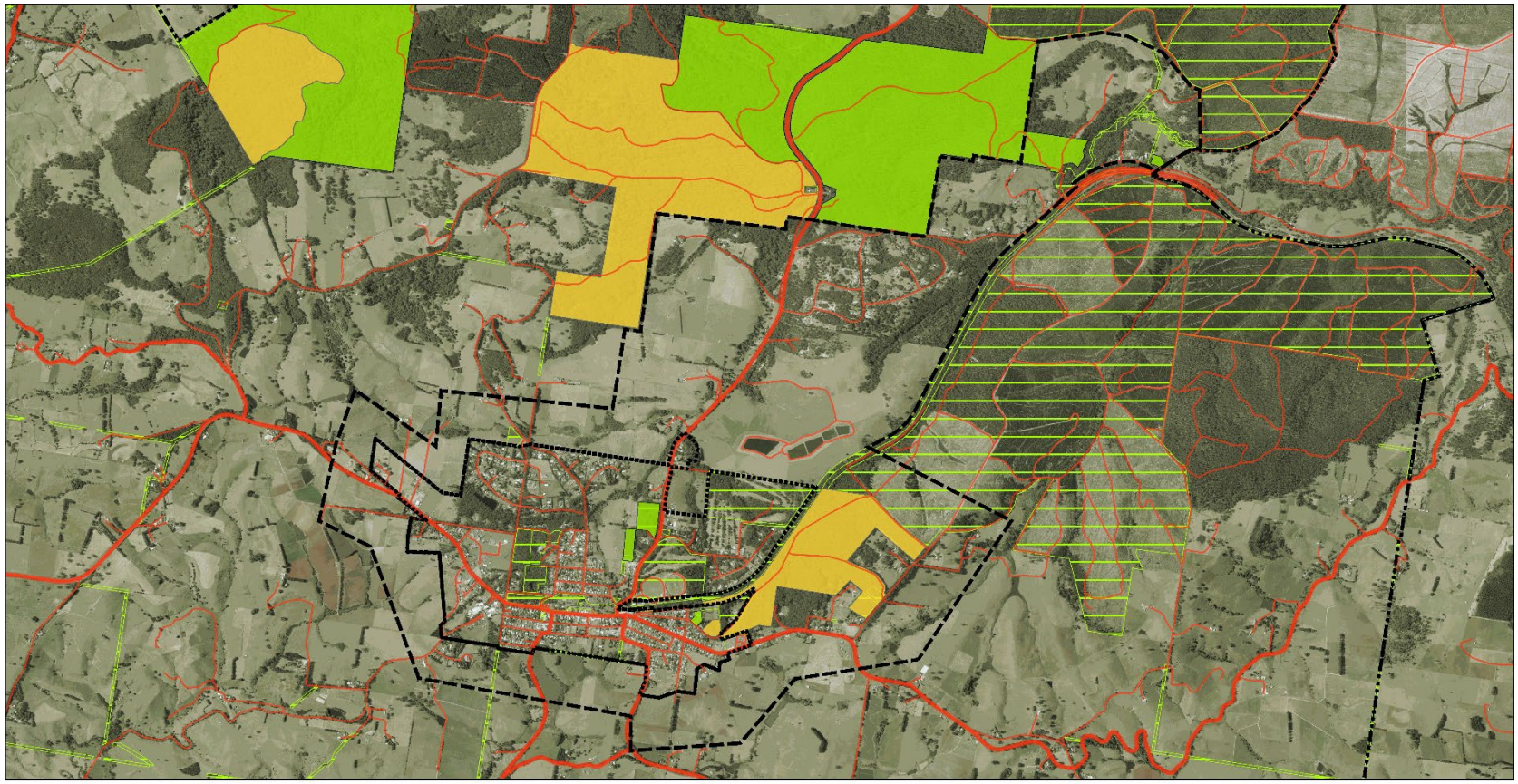


Figure 27: Map of public land fire management zones and primary access routes

SECTION 5 ANALYSIS AND EVALUATION

This section considers the summary of the bushfire risk provided in the previous sections and provides directions for limited growth. The ability of the development to achieve no more than 12.5kW/m^2 radiant heat flux, calculated in accordance with *AS3959-2018 Construction of Buildings in Bushfire Prone Areas (Standards Australia, 2018)* is one of the inputs.

The response explains how bushfire mitigation measures can be included in the consolidation of Mirboo North. The following design principles were uses as foundations:

FORM AND STRUCTURE OF SETTLEMENT

In the broader planning of a settlement, bushfire is an important consideration. Mirboo North is an established town and future growth should be optimised to strengthen the bushfire resilience of the existing settlement. General recommendations on building bushfire-resilient settlements are provided in Attachment 1.

Bushfire-resilient settlements maximise passive design features including separation from hazards, structure density, construction standards, access, water supply and provision for evacuation (Gonzalez-Mathiesen, Constanza & March, Alan 2014). Passive design features are most useful as they do not rely upon human intervention to achieve their objectives, and may therefore be more reliable. They can help minimise environmental impacts as they are supplemented, only to the extent needed, by more active measures including management of fuel, which can be unreliable due to weather and other constraints. In addition, planners can strengthen community resilience and recovery following a bushfire or other disaster through good land use planning to create 'liveable communities, a sense of place and a sense of community' (Paton & Johnston 2006). This includes provision and protection of facilities and services which assist the community to function and to interconnect.

A summary of these general features of bushfire-resilient settlements is provided in Attachment 1 for consideration.

Important passive design needs for Mirboo North include creation of an effective interface between Mirboo North and the broadacre land, and the identification, retention and maintenance of an area of lower risk in the commercial centre that provides retreat for residents. By incorporating bushfire mitigation considerations, land use planning has the capacity to guide the design of settlements to reduce the risk of bushfire, while still allowing some growth in medium risk areas (Burby 1998).

THE BUSHFIRE HAZARD IN DIRECTING SETTLEMENT GROWTH

Settlement planning should direct growth to locations that are less exposed to bushfire. Consideration of the context and landscape impact on exposure are a critical foundation to informing design responses to the nature of fire threats (Gonzalez-Mathiesen, C. & March, A. 2014). As discussed in preceding chapters of this report, the municipality has less bushfire hazard and less risk of bushfire than the majority of the Gippsland region. Within a municipality context, Mirboo North has a higher risk of bushfire and presence of bushfire hazard than the central area around Korumburra and Leongatha.

As such, nominating Mirboo North for limited growth is appropriate as:

- Forest fire is generally from the north west to north-east
- Grassfire is generally from the south and west
- There are established areas of lower risk within the town centre that can function as an area to retreat to
- Fires do not have days to develop.

Figure 28 (a) Main Street looking east (b) Service station in the Main street (c) Industrial area in western town entry

THE DISTRIBUTION OF LAND USES IN THE SETTLEMENT

The protection of infrastructure and land uses of greater vulnerability is another important land use planning concern for Mirboo North. Social vulnerability can be managed by regulating land use to reflect the risks associated with a given site (Gonzalez-Mathiesen, C. & March, A. 2014). For some buildings, an increased level of building standards can also enhance design performance. Emergency management plans complementary to the type and capability of the occupants are a valuable addition.

Vulnerable development includes the following uses: residential aged care facility, residential building, retirement village, child care centre, education centre, hospital, leisure and recreation facility and a place of assembly (*Settlement Planning at the Bushfire Interface* 2020). In Mirboo North, vulnerable uses are located near the town centre. Consolidation in these areas is appropriate as they have the greatest protection from the bushfire being located to the south of the main street.

Hazardous uses, such as a petrol station, can present a significant risk during a bushfire. In Mirboo North, the petrol station is located at the eastern end of town close to the forest hazard. While not ideal, this is an existing situation. Notably, vulnerable development is located at the other end of the main street approximately 500 metres further west. Given the size of Mirboo North, this is the best separation of land use that can occur.

LOT SIZES IN SETTLEMENT LAYOUT

At the subdivision scale, planning and design has real capacity to achieve separation in contrast to small individual sites where possibilities may be constrained by existing lot patterns (Gonzalez-Mathiesen, C. & March, A. 2014). Management of lot size is an effective mitigation measure for ember attack. Ember attack may ignite fuel sources and create many smaller fires throughout the settlement and the different lot sizes contribute to different bushfire outcomes (*Settlement Planning at the Bushfire Interface* 2020).

Urban lots of less than 800 square metres are less likely to provide vegetation for ignition by ember attack. These smaller lots contribute to an area of lower-fuel in settlements but can contribute to structure-to-structure fire spread.

Larger lots found in the older settlement areas in Mirboo North in, for example 0.2ha to 4ha size range, allow sufficient space to provide for separation of buildings from localised fuel sources including vegetation and vehicles, and facilitate retention of modified vegetation. These larger lots in modified vegetation are not necessarily suited to infill development as they do not have appropriate settlement edges and are difficult to retrofit. In addition as while development will achieve a greater level of vegetation management on the site, the adjacent hazard will continue to exist on the larger lots. Infill development is appropriate in the areas are at least 150 metres from modified vegetation and are separated from the modified vegetation by a road.

Railway Road, Mirboo North

VEGETATED AREAS WITHIN A SETTLEMENT

The Project Area is located in the Strzelecki Ranges bioregion and supports the Ecological Vegetation Classes (EVCs) listed in Table 5. Most of the vegetation in the Project Area is classified as either Wet or Damp Forest. A very small proportion is Lowland Forest. All classes have Messmate Stringybark in the overstorey and a shrubby understorey. Damp and Wet Forest have the longest tolerable fire intervals (TFIs) indicating that they are the least receptive to disturbance, including by fire. All three EVCs have a high conservation status in the bioregion (BCS). Vegetation is a mixture of smaller fragmented blocks with modified understory, and larger areas with relatively intact understory. As shown in Figure 30, most vegetation is rated Location Risk Level 2 (mid-range importance) on the Native Vegetation Regulation (NVR) Location Risk data layer (Government of Victoria 2020).

As shown by several recent fires in Delburn (2009), Canberra (2003) and several other locations, fire can penetrate settlements by at least several hundred metres (Chen & McAneney 2004). This penetration is assisted by continuous vegetation, but also by other combustibles including buildings, fences and garden vegetation. The threat posed by vegetation is lower where the understory and bark fuels have been modified or for fragmented, smaller, or narrower patches of vegetation including riparian corridors (CFA 2017).

Vegetation management should be informed by an assessment of risk that considers potential fire paths, realistic estimates of fire behaviour taking into account fragmentation by roads and other low-fuel surfaces and realistic estimates of impacts from flame, radiant heat and embers. Assessment of these factors will require skill and experience and may require the use of science-based tools in addition to, or instead of, *AS 3959* (Penney, Greg, Habibi & Cattani 2020). The assessment and treatment of risk should also include consideration of options including improving bushfire resistance of buildings and infrastructure.

Best practice in fuel management requires elimination of weeds that contribute to fuel loads, limiting native vegetation removal to the extent necessary, particularly in areas of high biodiversity or amenity significance and on steep slopes and around waterways, and where practical aligning fuel treatments with ecological requirements (CFA 2011a).

Best practice also requires consideration of community views about vegetation and fuel management. Even with careful design, management has the potential to significantly affect aspects of the environment that are valued by people (CFA 2011a). The importance of nature to some people is illustrated by a study by Beilin, Ruth and Reid, Karen (2015) who suggest that people are connected to the landscape through the simple or daily practices that connect them, such as going for walks, gardening, taking in the view from their home and interaction with wildlife. This connection may be very deep, and contribute to the feelings of security provided by 'home' (Beilin, Ruth & Reid, Karen 2015; Harries 2008; Lohm & Davis 2015). Fuel management aimed at increasing bushfire security may reduce these feelings of security.

However, other research highlights opportunities for minimising impacts on people's 'sense of place'. One study showed that understorey modification may be viewed favourably by the community as it may align preferences for bushfire safety, recreational use and amenity (Gill et al. 2015, p. 749). Another found community support for various fuel management treatments where there was trust in fire management agencies, previous exposure to fire, previous knowledge of fuel management and feeling vulnerable to fire (Mylek & Schirmer 2016).

Laura Rise, Mirboo North

Table 5: EVC descriptions and response to fire

EVC descriptors (DELWP n.d.)					Response to fire (Cheal 2010)				
EVC	EVC name	BCS	Dominant tree species	Description	EVD	EVD name	Max TFI	Min TFI (High severity fire)	Min TFI (Low severity, patchy fire)
16	Lowland Forest	Vulnerable	Eucalyptus obliqua (Messmate Stringybark) Eucalyptus croajingolensis (Gippsland peppermint) Eucalyptus sieberi (Silvertop Ash) Eucalyptus radiata s.l. (Narrow-leaf peppermint)	Open forest to 25 m tall. It grows on a wide variety of geology and soils mostly on north and north westerly aspects. Characterised by an often heathy understorey with a variety of other life forms including shrubs, grasses and herbs.	7	Tall Mixed Forest (eastern)	60	25	8
29	Damp Forest	Endangered	Eucalyptus obliqua (Messmate Stringybark) Eucalyptus globulus ssp. bicostata (Eurabbie) Eucalyptus cypellocarpa (Mountain Grey Gum)	Grows on a wide range of geologies on well-developed generally colluvial soils on a variety of aspects, from sea level to montane elevations. Dominated by a tall eucalypt tree layer to 30 m tall over a medium to tall dense shrub layer of broad-leaved species typical of wet forest mixed with elements from dry forest types. The ground layer includes herbs and grasses as well as a variety of moisture-dependent ferns.	10	Moist Forest	150	25	25
30	Wet Forest	Depleted	Eucalyptus regnans (Mountain Ash) Eucalyptus globulus s.l. (Blue Gum) Eucalyptus obliqua (Messmate Stringybark)	Grows on fertile, well-drained loamy soils on a range of geologies and elevation levels. It is largely restricted to protected sites in gullies and on southern aspects of hills and mountains where rainfall is high and cloud cover at ground level is frequent. Characterised by a tall eucalypt overstorey to 30 m tall with scattered understorey trees over a tall broad-leaved shrubby understorey and a moist, shaded, fern-rich ground layer that is usually dominated by tree-ferns.	12	Tall Mist Forest	300	80	80

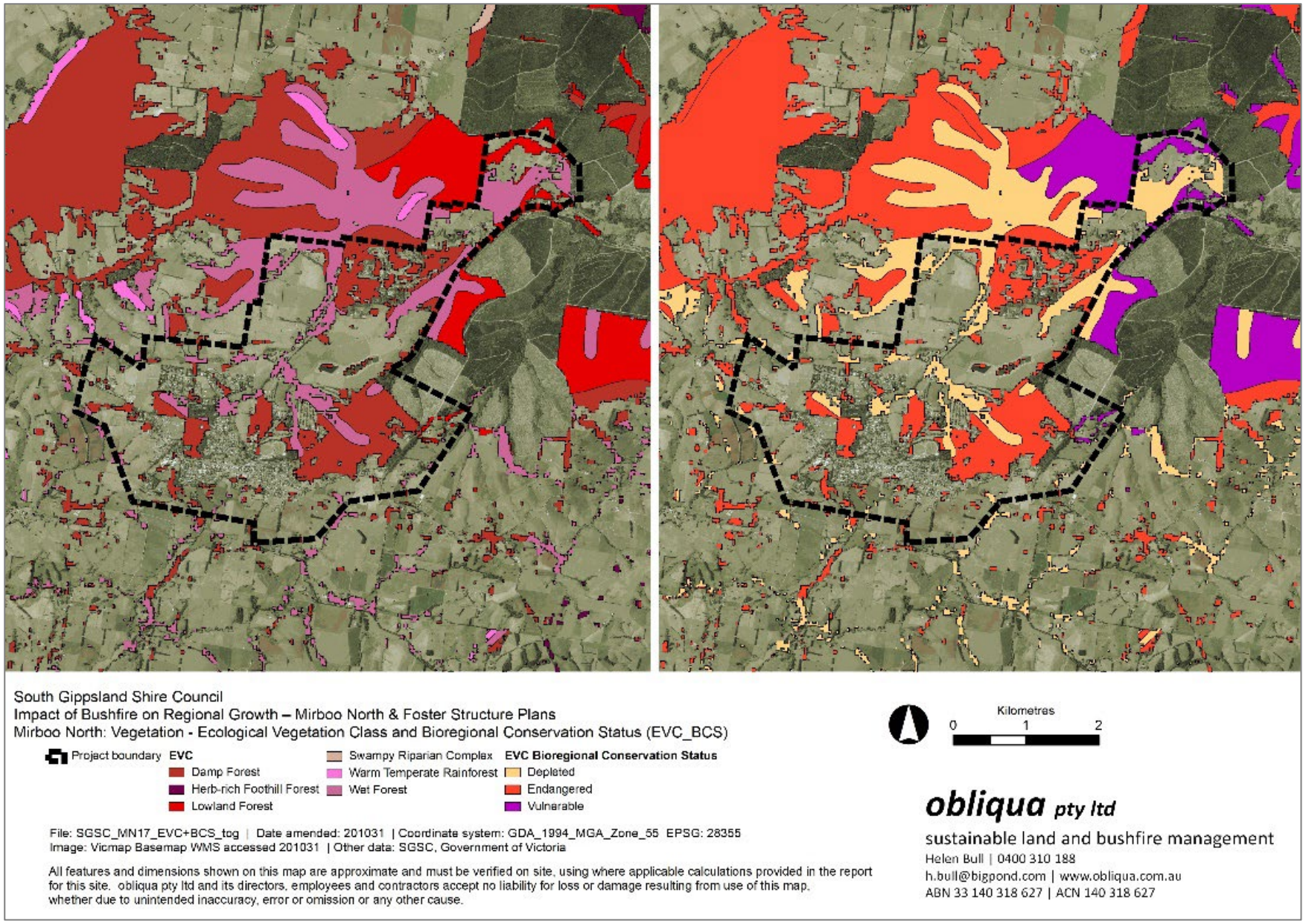


Figure 29: Ecological Vegetation Classes and Bioregional Conservation Significance

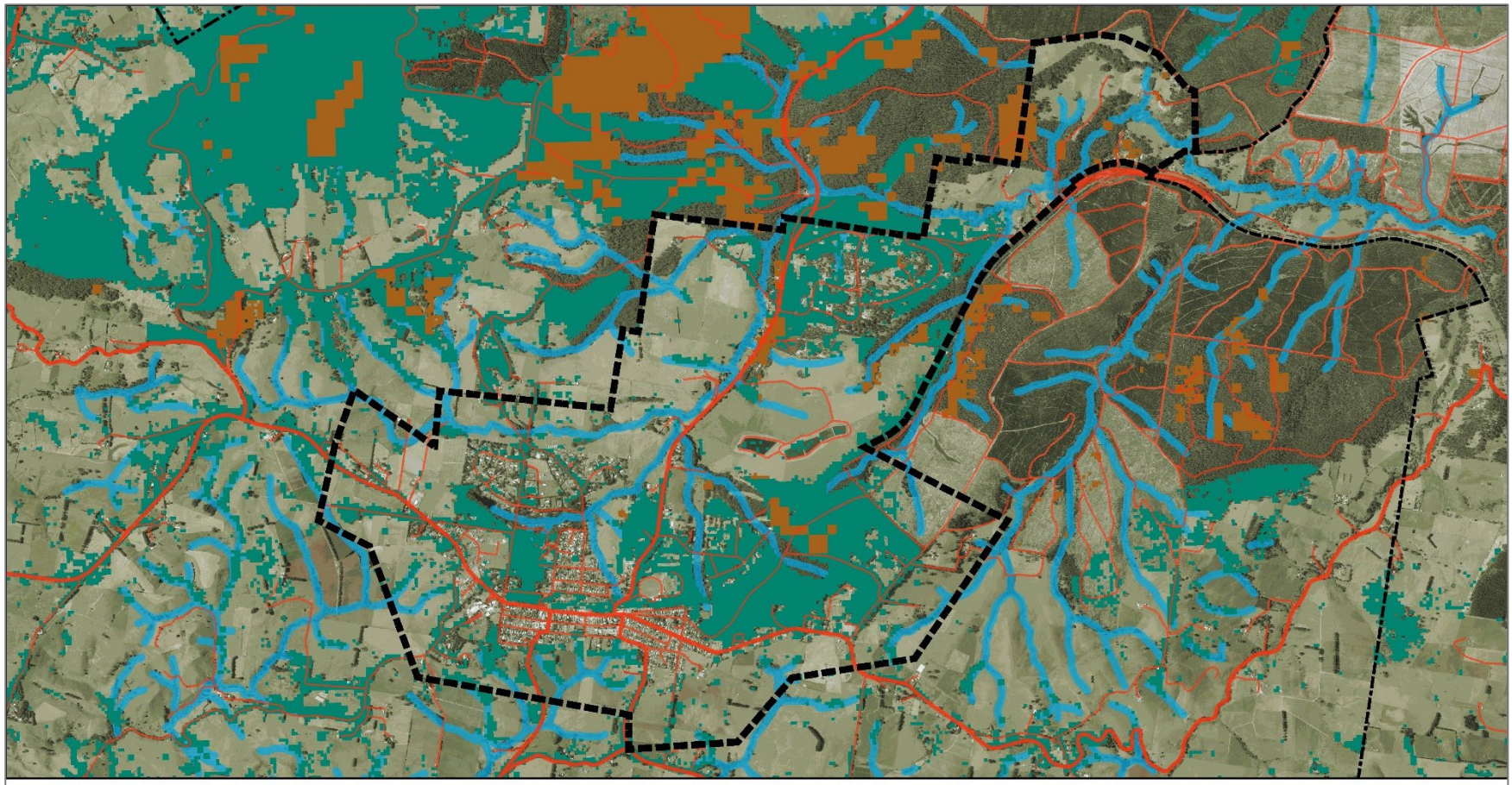


Figure 30: Native Vegetation Regulation (NVR) Location Risk and watercourse buffers

THE SETTLEMENT INTERFACE

APPLY THE REQUIRED DEVELOPMENT SETBACK

Separation from the hazard has primacy in decision-making. New development must be set back from the bushfire hazard. The setback is determined based on the type of vegetation and the slope under the vegetation, requiring assessment at the site scale. The policy settings differ within the Planning Policy Framework depending on the proposal and mechanism of approval. Where the proposal is part of a planning scheme amendment or development plan, then the setback much be sufficient to ensure that no future dwelling is exposed to a radiant heat flux of greater than 12.5kW/m2. For larger residential subdivisions that is also the case. For small subdivisions, usually infill subdivisions, it can be acceptable to for a future dwelling to experience a radiant heat flux of up to 29kW/m2. The type of use influences the required setback as well. If the future occupants are potentially vulnerable then the setback required will be greater. Landscape bushfire considerations where the settlement is subject to the Clause 44.06 Bushfire Management Overly in planning schemes may prescribe a greater setback as a means of being more precautionary.

DESIGN THE SETTLEMENT INTERFACE

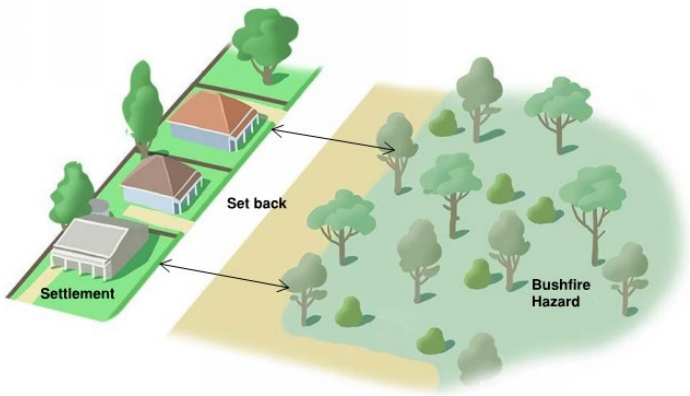


Figure 31: Design of the setback from the hazard

Once the setback of development from the bushfire hazard has been determined then the interface can be designed in a manner that reduces bushfire risk. It should be noted that AS3959 considers there is no hazard within the setback (or that the hazard within the setback is taken into account) , and the interface needs to be designed to ensure it does not increase the risk or bring the hazard closer to the development. As a guide the interface should be consistent with the Clause 2.2.3.2 of AS 3959 (exemptions) and Table 6 in Clause 53.02 Bushfire Planning (deemed-to-satisfy conditions for defendable space.

In designing the settlement interface, Clause 13.02-1S makes it clear that development should proceed only if the impacts on biodiversity are acceptable. Protection of amenity, particularly on township entries and other prominent places is also important and vegetation is an important contributor to this. This important not only to maintain ‘scenery’ but also feelings of security provided by ‘home’ (Beilin, Ruth & Reid, Karen 2015; Harries 2008; Lohm & Davis 2015).

Existing vegetation may need management including removal, lopping or trimming. Where possible, the setback should be based upon the outer edge of vegetation that is to be retained as this removes the need for ongoing management of the vegetation and provides a quality vegetation edge. However, based on one author’s experience in community-based fuel management planning in East Gippsland, understorey removal through mulching is increasingly used on shallower slopes and is gaining recognition in communities as acceptable from an amenity point of view. Where practical, vegetation edges should be designed to fit the landform and be visually attractive. Any risk introduced through retaining small patches of vegetation in the interface should be offset by providing an appropriate buffer around them.

Where public land will be incorporated into the proposal, it is advisable that the land has an everyday use that reduces bushfire risk, such as a shared path. Where reserves are incorporated into developments to be transferred to public land, the ongoing management and level of management of these reserves needs to identified and accepted by Council prior to the development being approved. This is essential as the level of maintenance of a reserve will be different whether or not it forms part of the setback or not. It would be wise for Council to request that any reserve that introduces a bushfire hazard into the setback should have a management plan developed either

prior to transfer to Council, or by Council to guide its development. These reserves should also be highlighted as part of Municipal Fire Management Planning. The Landscape Masterplan should highlight the importance of the setback from the bushfire hazard and both the Masterplan and the Detailed Landscape Plan should provide fire-responsive landscaping that meets the benchmark of 'defendable space' as reflected by Table 6 of Clause 53.02 as a minimum, or an acceptable alternative.

Poor settlement interface design

Good settlement interface design

Figure 32: Settlement interface design examples

Table 6 in Clause 53.02 Bushfire Planning in planning schemes specifies the vegetation management requirements for bushfire that are acceptable by the Planning Scheme. They are:

- Grass must be short cropped and maintained during the declared fire danger period
- All leaves and vegetation debris must be removed at regular intervals during the declared fire danger period
- Flammable objects must not be located close to the vulnerable parts of the building (within 10 metres)
- Plants greater than 10 centimetres in height must not be placed within three metres of a window or glass feature of the building
- Shrubs must not be located under the canopy of trees
- Individual and clumps of shrubs must not exceed five square metres in area and must be separated by at least 5 metres
- Trees must not overhang or touch any elements of the building
- The canopy of trees must be separated by at least five metres
- There must be a clearance of at least two metres between the lowest tree branches and ground level.

Clause 2.2.3.2 of AS3959-2018 referenced in the planning scheme and used for the bushfire hazard site assessment defines the following as exclusions :

- Vegetation of any type that is more than 100 m from the site
- Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified vegetation.
- Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site, or each other or of other areas of vegetation being classified vegetation.
- Strips of vegetation less than 20 m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified vegetation.
- Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops.

Clause 2.2.3.2 of AS3959-2018 defines the following as low threat vegetation :

- Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, gold courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks.

NOTES:

- Minimal fuel condition means there is insufficient fuel available to significantly increase the severity of the bushfire attack (recognizable as short-cropped grass for example, to a nominal height of 100 mm).
- A windbreak is considered a single row of trees used as a screen or to reduce the effect of wind on the leeward side of the trees.

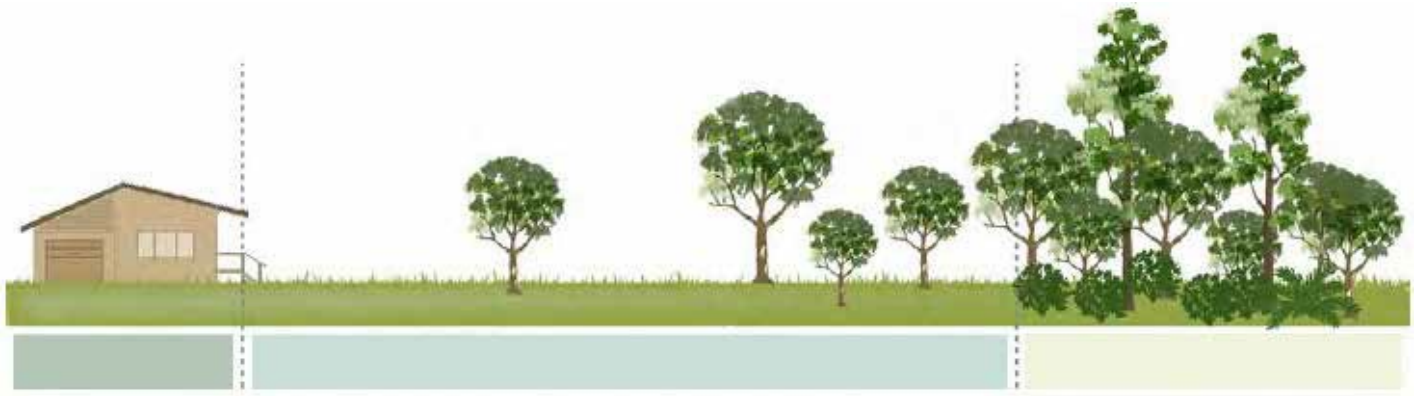


Figure 33: Defendable space (DELWP 2017)

Where the settlement abuts a bushfire hazard, a perimeter road is the preferred design outcome as a perimeter road enables a 'no fuel' area to form the interface, provide an effective location for fire authorities to attack a bushfire and a enable land managers to undertake fuel management activities. The BMO requires a perimeter road where a proposal is to subdivide the land to create 10 or more lots. Regardless of whether that provision applies or not to an application, the application of a perimeter road is the most effective way of managing the settlement interface. Where subdivision proposes lots larger than 800 square metres, for example, in the Low Density Residential Zone and Rural Living Zone, a perimeter road should be considered and applied. Non-residential development also benefits from the inclusion of perimeter roads, however have these land uses may already require features that can be sited and designed to strengthen the interface including sports fields and parking areas.

A common approach taken is to integrate open space into the settlement interface. Where this approach is undertaken, the vegetation in the open space and all the landscaping must be managed in a low-threat manner with no permanently-occupied buildings in the setback. Water bodies, sports fields, hard surface sports fields and parking areas provide acceptable design outcomes in open space. For the open space to be considered part of the setback, the management of the vegetation needs to be the responsibility of public land managers and be secured in perpetuity.

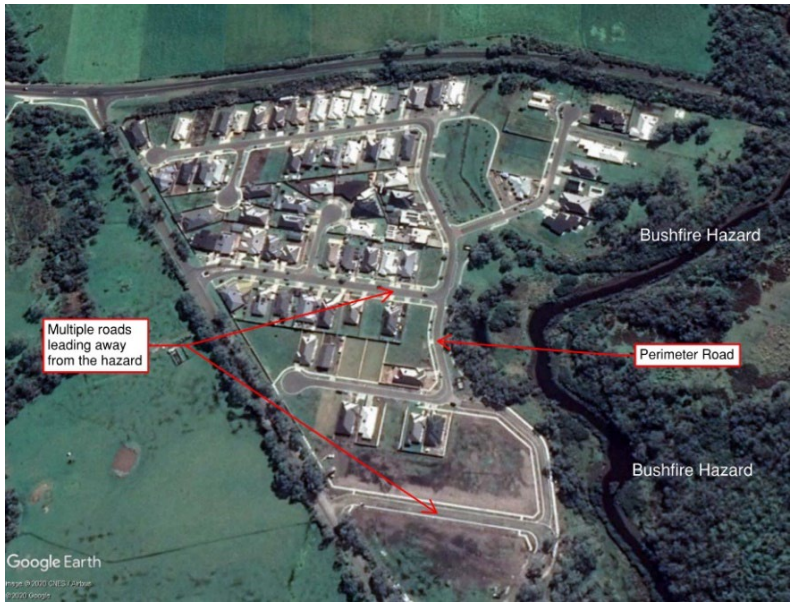
Access and egress

Access and egress are important strategic considerations in settlement planning and at the local scale of subdivisions. Access is vital to ensure emergency services can rapidly and safely gain access an area to undertake suppression operations. Egress is equally important, if not more, to ensure that residents can leave early or if unprepared and panicked leave at the last moment in as safe as conditions as possible. Multiple egress options, minimal choke points and well planned and built roads facilitate these movements. At the local scale, roads can contribute to the separation between the dwellings and the bushfire hazard while enabling ready access and egress to occur.

Construction of roads should be to the approved standard for CFA vehicles with sufficient width, capacity and turnaround provision as outlined in CFA guidelines. It is expected that a few different types of egress in the event of a fire will occur. Some residents will leave Mirboo North, others will gather at areas they consider safe and some will remain at home until fleeing in the last moments. Egress routes needs to be considered with these behaviours in mind.

An effective road network ensure that roads leading away from the hazard are no more than 120 metres apart (on average), provides road widths designed to meet the planning scheme requirements and provides multiple roads or directions of egress away from the hazard edge. Perimeter roads should be available for access of firefighting vehicles so other connecting roads within the developed areas should be provided to facilitate resident egress. Where it is not feasible to provide two trafficable alternatives to all lots, access points for pedestrian or emergency vehicle use can be considered. The actual network will depend on the scale of the development and the scale of the bushfire hazard.

Figure 34: Access and egress on the settlement interface



PLANNING AND DESIGN RESPONSE

As pointed out by the 2009 Victorian Bushfires Royal Commission and other authors (Buxton et al. 2011; Council of Australian Governments 2011; Teague, McLeod & Pascoe 2010), good land use planning is critical to the creation of resilient, safer and sustainable communities throughout all stages of an emergency (prevention, preparedness, response and recovery).

'Resilience is the capacity of communities to prepare for, absorb and recover from natural hazard events (coping) and to learn, adapt and transform in ways that enhance these capacities in the face of future events (adaptation)' (Parsons & Morley 2016).

Land use planning is an important contributor to resilience, as:

- bushfire control is less likely to succeed once the fire danger rating reaches Very High (Blanchi et al. 2010a; Hines et al. 2010)
- although planned burning can reduce risk significantly (DELWP, 2015), fuel can recover quickly, and there is only limited time in which to conduct burns safely
- while community safety policy (CFA 2014a) emphasises leaving undefendable buildings or untenable situations early, in reality, many people will leave decision-making until the last moment and are reliant on being able to shelter in their homes or other local places.

While state bushfire policy prioritises human life over other policy (including environmental/amenity) considerations, the challenge for South Gippsland Shire is how to maximize all policy objectives, including bushfire safety and those relating to biodiversity, land protection and amenity values of vegetation that contribute to the character of the municipality.

Planning Practice Note 64 (Government of Victoria 2015) provides some guidance on how this can be achieved. It states that '*Directing development to the lowest risk locations is the most effective way to prioritise the protection of human life. This should be the key strategy to enhance resilience to bushfire. Alongside this is the need to avoid future development in extreme risk locations. Due to the devastating impacts of bushfire there are some locations where the bushfire risk cannot be reduced to an acceptable level*'. The recently released Design guidelines for settlement planning at the bushfire interface (DELWP, 2020) provides further advice that illustrates this point. Areas of high bushfire hazard are often vegetated and coincide with high environmental values. It is also important to address features of the community that influence its vulnerability and ability to cope.

CONSIDER VEGETATION MANAGEMENT

New settlement presents the opportunity to establish a vegetation management standard that limits bushfire risk and exposure to ember attack. Mirboo North is an existing settlement with some room for expansion into greenfield development and other areas that will can provide infill development. Proper vegetation management and maintenance helps to reduce the potential for localised fires from ember ignition.

Where development is within the Bushfire Management Overlay, vegetation is required to be managed. In other locations, the extent of vegetation management needs to be individually determined. The forest to the north and east places Mirboo North township at risk of ember attack and the conclusion can be drawn that there is a need to control vegetation planting across the township particularly the planting of new vegetation tracts. Planning Scheme Amendment C115sgipp placed the CFA publication *Landscaping for Bushfire* into the South Gippsland Planning Scheme as a background document. This is one method of achieving fire-responsive landscaping across development proposals. *Landscaping for Bushfire* was developed by the Country Fire Authority in response to Recommendation 44 of the Victoria Bushfires Royal Commission. It provides a valuable resource to assist settlement planning. When creating or reviewing planning tools such as Development Plan Overlays, the referencing of this document will guide the landscaping design response. It is equally important when considering the development of open space, trails and recreation reserves.

The work undertaken in the public forests and in Council's forest reserves to manage the bushfire hazard is equally important. This work is recognised as a whole of settlement approach to bushfire mitigation. New development should not require work to be undertaken on public land.

CONSIDER BUILDING CONSTRUCTION STANDARDS

The resilience of buildings to withstand a level of bushfire attack is important in settlement planning. Bushfire attack levels (building standards) seek to mitigate the impact of flame contact, radiant heat and ember attack on a structure. Bushfire attack levels do not seek to mitigate the impact of convection or wind.

In areas subject to the Bushfire Management Overlay and the Bushfire Prone Area, building construction standards apply.

While Clause 13.02-1S seeks minimum radiant heat benchmarks, this alone may not be sufficient to derive a building construction standard. In Mirboo North, areas to the north of the town centre are more likely to be affected by a high degree of ember attack from the forest and have retained localised vegetation. In these cases, a higher building construction standard should be applied. Consideration should also be given to requiring design that addresses convective winds that may reach lower cyclonic levels.

In areas such as the southern aspect where the predominant fire risk is grassland and an extensive area of residential development with controlled vegetation (either by lot size, section 173 agreement or other means) exists the minimum building standard is appropriate.

CONSIDER FENCES AND OTHER LOCALISED FUEL SOURCES

The area of land around buildings provides opportunities for additional fuel sources to be introduced. Many of these sources cannot be influenced by planning, however fencing is one element that can be controlled in new development. Metal sheet fencing is effective at slowing the spread of bushfire through a settlement and can also reduce some radiant heat. Post and wire fencing provides easy firefighting access but does not impede fire spread. Timber panel fences and brush fences add fuel load through a settlement and when involved in fire can fail in ways that penetrate the home, e.g. window breakages. Throughout Mirboo North, timber panel and brush fencing should be discouraged.

Planning can also specify management of other combustibles around new development including furniture, rubbish bins and firewood. A common response is to require separation from buildings by the same distances applied to outbuildings. Requirements for relocating vehicles on days of higher fire risk can also be applied to larger or more vulnerable developments through bushfire emergency plan requirements.

SECTION 6 PLANNING POLICY ASSESSMENT

Section 2 of this report identifies the planning scheme policies in clause 13.02-1S Bushfire. This section of the report uses these policies to assess the bushfire risk in Mirboo North having regard to the analysis and evaluation. For each consideration, extracts from Clause 13.02-1S are shown.

It is pertinent to be reminded that the objective of Clause 13.02-1S is '*to strengthen the resilience of settlements and communities to bushfire through risk-based planning that prioritises the protection of human life*'.

LANDSCAPE BUSHFIRE CONSIDERATION

Clause 13.02-1S requires a tiered approach to assessing the hazard:

- *Considering and assessing the bushfire hazard on the basis of [..] landscape conditions - meaning the conditions in the landscape within 20 kilometres and potentially up to 75 kilometres from a site.*
- *Assessing and addressing the bushfire hazard posed to the settlement and the likely bushfire behaviour it will produce at a landscape, settlement, local, neighbourhood and site scale, including the potential for neighbourhood-scale destruction.*

Section 4 of this report provided an assessment of the bushfire hazard landscape in the greater landscape. This has considered the bushfire hazard at the strategic and landscape scales as required by the above policies.

The primary bushfire risk to the study area is from forest fire from the north and north-east. There is potential for extreme fire behaviour due to the large tracts of forest and the terrain. Strzelecki State Forest is a larger scale risk and impacts from north-west to north-east. There is potential for a bushfire to spread and grow large over a few days, however not the few weeks experienced in other areas of Gippsland.

The secondary bushfire risk to the study area is from grassfire from the south-west. There is no potential for extreme fire behaviour due to the lack of larger, non-grassland areas of vegetation.

The landscape in the north does not provide good access to locations where human life can be better protected from the harmful effects of bushfire. Travel south into the township takes time and for the Darlimurla settlement is by a single main road.

The landscape to the west and south provides good access to locations where human life can be better protected, including good access to areas of BAL:LOW in the developed area around and south of the town centre. Further development along the southern side of Mirboo North will increase the area considered BAL:LOW.

The landscape typology for Mirboo North sits between 'Broader Landscape Type Two' and 'Broader Landscape Type Three'. The northern and eastern areas of Mirboo North have a higher bushfire landscape risk as the bushfire can approach from more than one direction and access to shelter is not certain. However on the southern side of the township, bushfire can only approach from one direction and as a grassfire.

Landscape type 2 is at the lower end of bushfire risk arising under Victoria's planning system, however Landscape Type 3 is a determinant in approaching with caution.

The landscape and strategic bushfire risk to the study area is moderate to high. Landscape risk constrains the growth of Mirboo North. Areas of elevated landscape risk in the north should be subject to risk avoidance strategies and interface treatments.

ALTERNATIVE LOCATIONS FOR DEVELOPMENT

Clause 13.02-1S includes two strategies that seek to direct new development:

- *Give priority to the protection of human life by [..] directing population growth and development to low risk locations[.]*
- *Assessing alternative low risk locations for settlement growth on a regional, municipal, settlement, local and neighbourhood basis.*

The landscape risk is moderate to high, positioning the study area at the median of bushfire risk in Victoria, and the lower scale of bushfire risk in the Gippsland Region. The township scale risk is also mostly moderate with slightly lower scale along the southern and western interface with grassland. There is scope within detailed subdivision planning to provide separation within the study area for development to be separated from permanent bushfire hazards including riparian vegetation, forest reserves and grassland.

If evacuation is required, there is currently good access from the south to locations where human life can be better protected from a bushfire currently. Areas immediately north of the town centre such as around Laura Rise and south of the Little Morwell River also have good access to safer locations. Good access can be incorporated in future development.

The moderate to high landscape risk, the ability to effectively treat site-based risks, and good access to safer locations make the southern part of study area a preferred location to direct development through planning.

This report recommends further analysis at the neighbourhood and site scale during subdivision planning to consider the best means of achieving separation from the hazard, lower radiant heats and proximity to safer locations.

AVAILABILITY OF SAFE AREAS

Clause 13.02-1S requires a location in easy reach that provides absolute protection for life from the harmful effects of bushfire:

- *Ensuring the availability of, and safe access to, areas assessed as a BAL-LOW rating under AS 3959-2009 Construction of Buildings in Bushfire-prone Areas (Standards Australia, 2009) where human life can be better protected from the effects of bushfire.*
- *Directing population growth and development to low risk locations and ensuring the availability of, and safe access to, areas where human life can be better protected from the effects of bushfire.*

While the location of Mirboo North on the high plains near the Strzelecki State Forest forms a strong barrier to movement to the north and east, the road network does connect the study area to urban areas that are capable of being assessed as BAL:LOW. For example, Leongatha can be accessed through a 25km journey through grassland areas. Traralgon can be accessed, but the route traverses forest.

The study area itself provides small amounts of area that constitute BAL-LOW but will be affected by ember attack. Once further land is developed to the south and west, the area of BAL:LOW will increase. However, the existing forest reserves in the northern and eastern parts of the town will always limit the extent of land that constitutes BAL:LOW and development should be discouraged where access to the town centre is jeopardised by retained bushfire hazard (e.g. Baths Road Reserve, Little Morwell River riparian corridor). The existing urban area provides people with limited but immediate access to safer areas in the event of a bushfire if they have not left the township earlier.

THE VIEWS OF THE RELEVANT FIRE AUTHORITY

Clause 13.02-1S identifies that a key element of a risk assessment is to:

- *Consult[…] with […] the relevant fire authority early in the process to receive their recommendations and implement appropriate bushfire protection measures.*

CFA were consulted in preparing this report through a meeting with the Council and the report authors. CFA were supportive of the approach being taken and expressed no concerns with the principle of urban development being limited in the study area consistent with a township direction of 'limited growth'.

CFA provided advice on additional matters to be considered in preparing the report including:

- the pending (now published) DEWLP publication *Design Guidelines Settlement Planning at the Bushfire Interface(Settlement Planning at the Bushfire Interface 2020); and*
- articulating the comparative bushfire risk of Mirboo North in the context of the Municipality and the greater region.

CFA also indicated that at the time the report was completed they would review it. This review culminated in a meeting in February 2023 where CFA indicated that in principle they agreed with the report. CFA supported a summary document as a communication medium to inform future planning control changes.

SITE BASED EXPOSURE

Clause 13.02-1S provides directions for planning authorities about the level of acceptable exposure for new development enabled by a planning scheme amendment:

- *Not approving any strategic planning document, local planning policy, or planning scheme amendment that will result in the introduction or intensification of development in an area that has, or will on completion have, more than a BAL-12.5 rating under AS 3959-2009.*
- *Directing population growth and development to low risk locations, being those locations assessed as having a radiant heat flux of less than 12.5 kilowatts/square metre under AS 3959-2009 Construction of Buildings in Bushfire-prone Areas (Standards Australia, 2009).*

Examples provided in Section 5 demonstrate that site based exposure benchmark can be achieved, particularly in the southern and western areas with the use of perimeter roads. Further analysis at site level needs to be undertaken when preparing development and subdivision plans. Vegetation should be re-assessed so the assessment is contemporary and reflects local slope assessments. There should be no continuity of fuel paths from grassland areas into the urban developed areas unless specific mitigation measures are put in place; for example, road interfaces to all vegetation reserves and riparian corridors.

Section 5 of report provides guidance on how subdivision plans can satisfy the site-based exposure elements of Clause 13.02-1S. To ensure the exposure of future development is no more than 12.5kW/m^2 of radiant heat, the setback from grassland will vary from 19 metres to 28 metres depending on the local topography.

As forest is a greater part of the hazard in the north, it is not expected that site based exposure can be sufficiently reduced to achieve this outcome without loss of native vegetation. Even if the site based exposure could be achieved, the inability to achieve other strategies suggests that development would not be supported.

AREAS OF HIGH BIODIVERSITY CONSERVATION VALUE

Clause 13.02-1S provides directions on situations where bushfire and high biodiversity conservation values correlate:

- *Ensure settlement growth and development approvals can implement bushfire protection measures without unacceptable biodiversity impacts by discouraging settlement growth and development in bushfire affected areas that are of high biodiversity conservation value.*

This report incorporates high-level environmental and ecological information (Section 5). It demonstrates that the bushland setting of Mirboo North's character is inextricably linked to the retention of native vegetation. Most of the vegetation is classified as either Wet or Damp Forest and a very small proportion is Lowland Forest. All classes have a shrubby understorey and Messmate Stringybark in the overstorey. All three EVCs have a high conservation status in the bioregion (BCS). Vegetation is a mixture of smaller fragmented blocks with modified understory, and larger areas with relatively intact understory. Most vegetation is rated Location Risk Level 2 under the NVR Location Risk.

It is beyond the scope of this report to assess the biodiversity conservation value of vegetation that may need to be removed or managed as a result of bushfire requirements. However, given the option to provide settlement on the southern and western aspects of the town centre, it is reasonable to assume that development can be avoided where vegetation would be lost.

At this stage, and recognising that more detailed work will occur at the development and subdivision plan stage, is it reasonable to conclude that development can implement bushfire protection measures more readily in the southern and western aspects of Mirboo North. Therefore where development cannot accommodate bushfire requirements due to biodiversity factors, then development should not proceed.

NO INCREASE IN RISK

Clause 13.02-1S provides an overall view of acceptable risk:

- *Ensuring the bushfire risk to existing and future residents, property and community infrastructure will not increase as a result of future land use and development.*
- *Achieving no net increase in risk to existing and future residents, property and community infrastructure, through the implementation of bushfire protection measures and where possible reduce bushfire risk overall.*

The development of the land to the south and west is not likely to increase the bushfire risk to existing residents. Both these locations provide opportunity to strengthen the settlement interface for access and reduce site-based exposure. The Development Plan Overlay that is in place for the Berry's Creek Residential Area seeks a subdivision design that does not meet Clause 13.02-1S and should be amended.

Infill development that creates lots less than 800m^2 can be pursued outside the Bushfire Management Overlay and can provide opportunities close to the town centre where occupants could easily move to an alternate location by foot or vehicle.

It is sensible to direct development towards areas where site-based exposure is readily reduced, and access to areas of lower risk are available without passing through forest hazard study area.

CLAUSE 44.06 BUSHFIRE MANAGEMENT OVERLAY

Land subject to the Bushfire Management Overlay will require a planning permit to develop, including for subdivision. Where located within 150 metres of forest the setback distances required will be greater than for grassland. Given the pattern of development within Mirboo North, development of land subject to the Bushfire Management Overlay should be limited to infill development that removes hazard (scattered vegetation) in existing settlement but where lot size is greater than 800m2 so that the buildings can be sufficiently set apart to limit fire spread. It is sensible to develop existing lots, but it is not sensible to establish new estates on land subject to the Bushfire Management Overlay that will be most at risk from the permanent and on-going bushfire hazard of vegetation retention in Mirboo North.

If development does proceed in any part of the Bushfire Management Overlay, the requirements of Clause 53.02 Bushfire need to be met as they relate to the following approved measures, including:

- AM2.2 - Siting of development within a proposed lot.
- AM2.3 – Building design.
- AM3.1 - Defendable space and construction standards.
- AM4.1 - Water supply and emergency vehicle access.
- AM5.3 - Perimeter road adjoining permanent hazards.

The planning scheme requirements for vegetation management for bushfire purposes in Clause 53.02 Bushfire Table 6 Vegetation management requirements (see Figure 33 in this report) will need to be applied to all developed areas subject to the Bushfire Management Overlay.

Approved measure AM2.1 requires that the risk from the landscape beyond a site be mitigated to an acceptable level. Given the elevated landscape risk to the north and east of Mirboo North, this approved measure will need appropriate consideration at the time any permit is sought for conventional or rural residential development. It is for this reason that the southern and western aspects of the township are better placed for residential subdivision.

CLAUSE 13.02-1S USE AND DEVELOPMENT CONTROL IN A BUSHFIRE PRONE AREA

The use and development control in a bushfire area will apply to future planning applications:

- To subdivide the land into more than 10 lots
- Accommodation
- Child care centre
- Education centre
- Emergency services facility
- Hospital
- Indoor recreation facility
- Major sports and recreation facility
- Place of assembly
- Any application for development that will result in people congregating in large numbers.

While the considerations are to be made at the time of a planning permit application, this report confirms that location of most of these vulnerable developments on the south side of the township is a positive aspect of the existing settlement. The report also demonstrates that consideration of bushfire is essential for proper design and planning for new developments or expansion of the existing developments.

SECTION 7 CONCLUSIONS AND RECOMMENDATIONS

The purpose of this report is to identify and assess bushfire risk for Mirboo North and to provide recommendations regarding future land use and development planning within the context and requirements of Clause 13.02.

This report has been prepared in response to the following project objectives:

1. To classify the risk of bushfire in the urban area of Mirboo North and the surrounds of the township using a robust landscape scale bushfire assessment.
2. To identify land at varying threshold of fire risk in Mirboo North and the immediate surrounds using risk contours, or similar approach, informing a 'go, go-slow, no' approach to development.
3. To identify land in Mirboo North that experiences a radiant heat flux of less than 12.5kW/m^2 (or a Bushfire Attack Level of BAL-LOW) and refine this further to identify land that could be further entertained for development in relation to Clause 13.02 of the Scheme, noting the criterion for land to have a BAL-12.5 rating or less under *AS3959 Construction of Buildings in Bushfire-prone Areas* is only one of the criteria that needs to be met. Conversely, identify land where development should be constrained.
4. To consider the vegetation hazard in Mirboo North, the risks associated with the hazard, and identify areas where existing vegetation poses a threat, and areas where potential revegetation could occur as part of future development. Utilize the South Gippsland VFRR and other municipal fire management material to inform this assessment.
5. To provide a succinct report encapsulating points 1-4 (above) in a form that can be used for a Planning Scheme Amendment. The report should use spatial and textual representation to provide background, summary of opinion and recommendations.

This report provides a detailed assessment of bushfire risk and contributing factors. The risk has been assessed at a landscape scale as moderate to high, and moderate at the site level.

This report also describes how risk can be addressed through good planning to create a more bushfire-resilient township.

Bushfire-resilient settlements maximise passive design features including separation from hazards, structure density, construction standards, access, water supply and provision for evacuation (Gonzalez-Mathiesen, Constanza & March, Alan 2014) and minimise impacts on features of the environment that are valued by the community. They also have features that support 'liveable communities, a sense of place and a sense of community' and assist the community to function and to interconnect and to prepare for and recover from disaster (Paton & Johnston 2006).

A summary of these general features of bushfire-resilient settlements is provided in Attachment 1 for consideration.

This report also identifies the potential for development using a 'go, go-slow, no' approach which is summarised in Table 6 and Figures 35 and 36.

ADDENDUM *– An addendum to the report is included as Attachment Two. The consultation process with CFA and South Gippsland Shire Council was lengthy due to priorities, pandemic and staff availability. At a meeting in February 2023 between CFA, Council and the consultants, CFA acknowledged that they accepted the draft report with no changes required. They did recommend that a summary document (the addendum) could be prepared by Council to draw from this report to provide a planning summary for the Mirboo North Structure Plan, particularly as some of the nomenclature (go, go-slow, no) is being referenced differently. This addendum should be taken as the document that informs a revision of the planning controls in Mirboo North and the Mirboo North Structure Plan.*

Table 6: Recommendations

Recommendation	Characteristics	Development considerations
Go	Single direction grassfire hazard Adjacent existing residential areas Existing settlement provides protection for fire spread from forest hazard Limited native vegetation	Perimeter road Landscaping for bushfire considerations Site based exposure no more than 12.5kW/m^2 Non-combustible fencing Pedestrian and vehicle links to place of greater protection to human life
Go – BAL12.5 infill	Developed area central to town High amenity Minimum risk from fire Pedestrian access to safer areas	Landscaping for bushfire considerations
Go – BAL29 infill	Retained mature trees and native vegetation generally present Adjacent riparian forest and forest reserves Difficult to redevelop due to existing lot pattern Compromised egress to a place of greater protection to human life Egress is through or adjacent forest hazard Not all land is in the Bushfire Management Overlay	Increased construction standard required (Minimum BAL29) Additional planning controls required to establish the balance between development and retention of a bushland setting, e.g. Design and Development Overlay, Vegetation Protection Overlay.
Go - Industrial	Provides an interface between grassland hazard and residential settlement Larger lots Non-vegetated areas on each site Non-residential Direct vehicle access to/from highway	Site based exposure no more than 12.5kW/m^2 Landscaping for bushfire considerations Encourage hard-paved and non-vegetated areas Integrate the firefighting water supply required by building and planning codes where possible Restrict open-air storage of flammable materials
Go Slow	Steeper slopes and/or retained mature trees and native vegetation generally present Grassland interface on one or more side Abuts established residential areas	Perimeter road where part of the interface with the grass hazard Multiple egress points Balance development with vegetation conservation Lot size - <800 can encourage structure to structure spread, 800-1200m^2 optimum. Non-combustible fencing Increased construction standard may be required
Go Slow – Non-Intensive	Dwellings not as of right Primarily grassland	Uses with lack of permanent occupancy encouraged, eg.tourism. Landscaping for bushfire considerations, particularly not bringing the forest hazard closer to the settlement or providing fire transmission links.
No go	Adjacent to large tracts of forest vegetation Direct attack from forest fire likely Place of shelter not certain Egress compromised	No new lots to be created Permit development on existing lots where deemed an acceptable outcome considering Clause 13.02-1S and the Bushfire Management Overlay

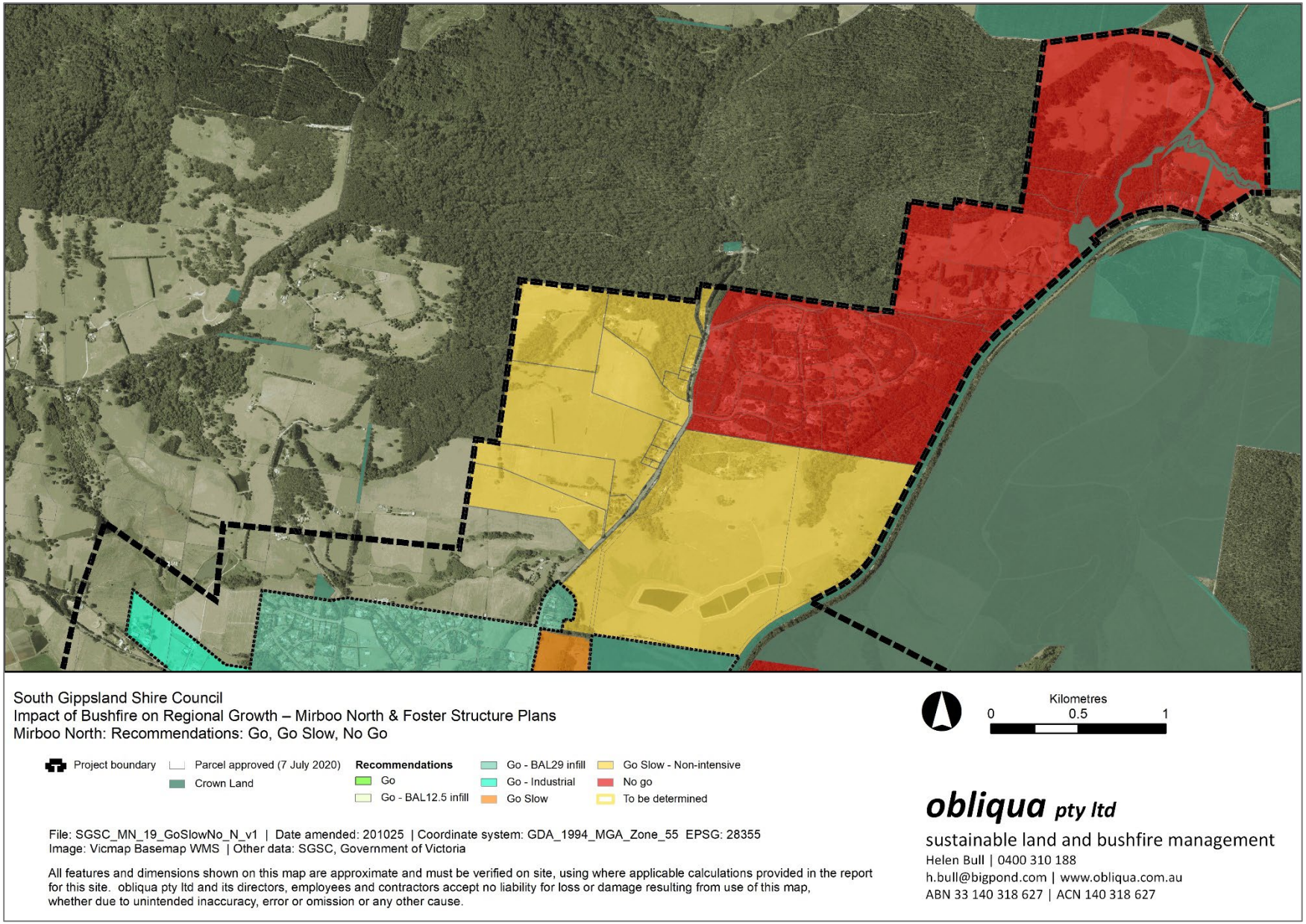


Figure 35: Recommendations – Mirboo North (north)

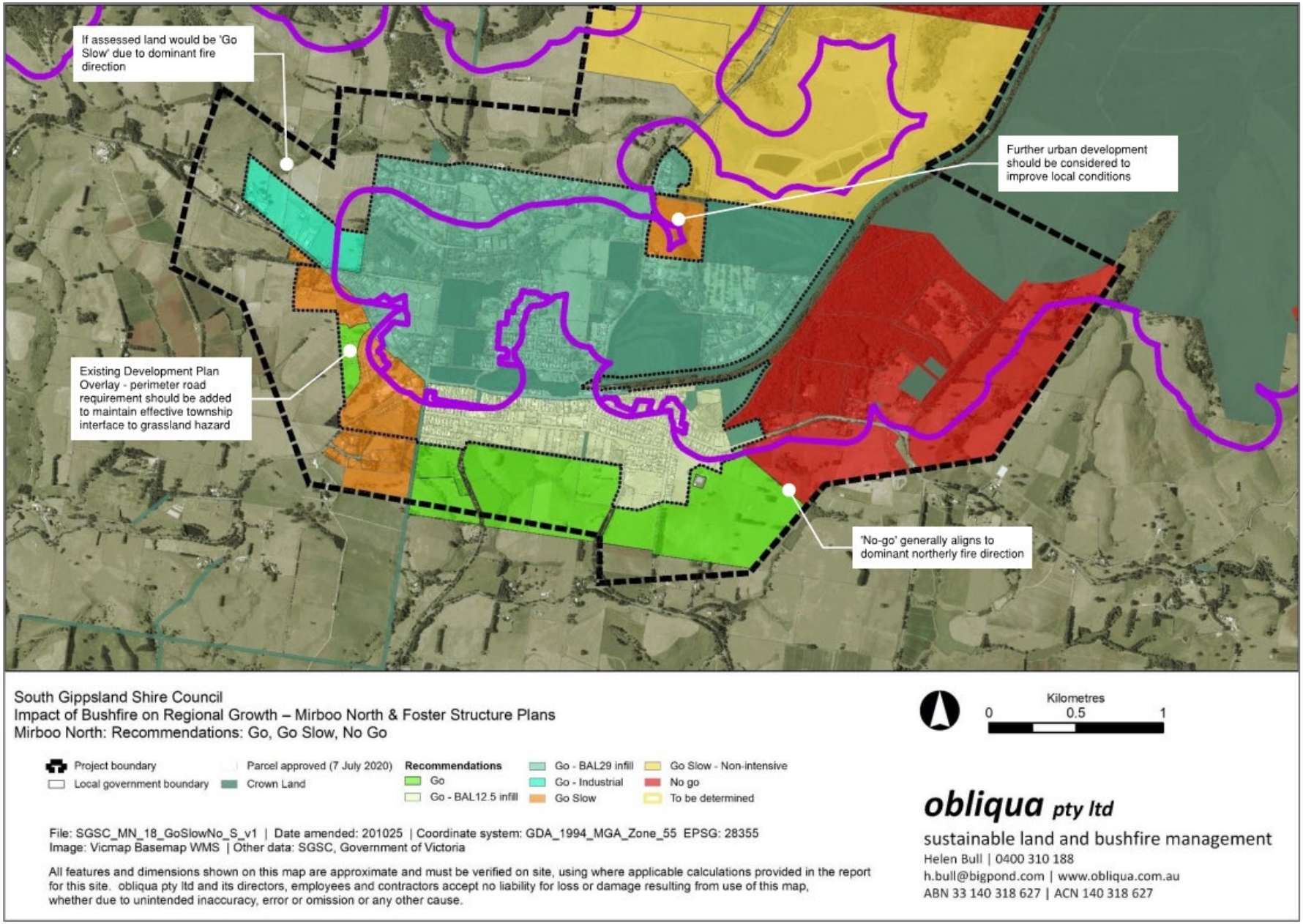


Figure 36: Recommendations – Mirboo North (south)

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ATTACHMENT 1: Some features of bushfire-resilient settlements that can be achieved through or influenced by land use planning

Settlement location	Development avoids areas exposed to 'unacceptable' risk, however this is not defined in planning controls. Based on AS/NZS ISO 31000:2009 (Australian Standards & New Zealand Standards 2009) risk may be tolerated, provided the risks are known and managed. While some risks can be tolerated, as long as they are 'as low as reasonably practicable (ALARP)', generally unacceptable or intolerable risks 'require risk treatment measures whatever their cost, or the elimination of the risk' (National Emergency Management Committee 2010).
Settlement size and shape	Larger, deeper and more compact settlement shapes reduce the number of houses located on the interface with hazards, and the separation of houses from hazards.
Settlement density	Based on evaluation of the 2009 fires at Bendigo, increasing housing density reduces risk of bushfire penetration (March, Holland & Harwood 2011). This finding is supported by other studies (R. Hughes & Mercer, 2009; Syphard, Bar Massada, Butsic, & Keeley, 2013; Syphard, Keeley, Massada, Brennan, & Radeloff, 2012), although this appears to contradict findings from the 2003 Canberra fires, where bushfire penetration appears to have been assisted by housing density (Blanchi & Leonard, 2005).
Separation from hazards	Based on past losses from extreme fire (Chen & McAneney 2010; Leonard 2015), it is desirable that settlements are located at least 100m and preferably over 700m from extensive areas of dense forest. At a minimum, new houses should be separated from areas of extensive vegetation by the distances set out in AS 3959 (while correcting for flame temperature as set out in Wotton et al (2012) and noting that AS 3959 has been criticised for 'serious flaws' (Leonard 2009)). These distances may be reduced for smaller, narrower and isolated areas of vegetation where fire is less likely to reach peak behaviour. Development should also be well away from steep slopes, and areas with long fire runs that can lead to extreme fire behaviour, particularly convection and related strong fire-induced winds. This can help address impacts from flame contact and radiant heat, but not spotting, which may occur over several kilometres. Houses should be separated from other structures including houses and sheds which if burning can emit radiant heat sufficient to ignite structures within 6-10m (Bowditch 2006). Buildings should also be well-separated from vehicles
Construction standards and property management	All houses meet minimum standards as set out in AS 3959 (while correcting for flame temperature (Wotton et al. 2012)) and wind loading where intense convection and fire-induced winds are expected (He et al. 2013). Research conducted after the 2009 fires showed the benefits of meeting the standards set out in earlier bushfire controls (WMO). No fatalities were associated with houses built under the WMO controls in the areas affected by the 2009 fires. In addition, there were lower rates of house loss (although other factors, notably small samples and timing of fire reaching settlements may have influenced the outcomes) (Holland et al. 2013). For example, within the five fire areas studied (Kilmore East-Murrindindi, Churchill-Jeeralang, Delburn, Beechworth and Bunyip fires), only 12% of WMO dwellings were destroyed, compared with 38% house loss overall.
'Vulnerable uses'	Vulnerable uses including schools and aged care facilities are located in areas of lowest risk to protect occupants. Emergency services and medical facilities are located in areas of lowest risk to ensure they remain functional during emergencies.
Access	Access allows for rapid egress for residents to places of safety and access for emergency services in the event of fire, and proposed road layouts are tested against evacuation and fire travel times. While the 2011 changes to the bushfire controls and planning guidance introduced additional measures to improve the design and layout of roads in subdivisions, small-scale simulations carried out for settlement fringes around Bendigo showed that 'that a complete evacuation takes considerable time (between 30 minutes and 1 hour), despite … different sizes and urban patterns, and that it is possible for bushfires to overrun or surround settlements before people leave following a warning' (Leon & March 2013).
Hazard management around and within settlements	Fuel management supplements good settlement and site design, construction standards and property management which are the primary mechanisms for reducing exposure. Fuel is managed to levels that can be maintained on an on-going basis without causing increases in fuel through species change, or environmental impacts (including threats to biodiversity, visual amenity, soil stability and air and water quality). Manual fuel management methods are used where amenity values are high (such as along roadsides), where annual treatment is required and to minimise impacts of frequent burning. Fuel management is based on an expert assessment of risk rather than perceived risk that accounts for the contribution of tree canopies to reducing wind speeds, filtering embers and moderating fire behaviour, while removing overhanging trees that deposit debris, contributing to loss from ember attack (Newnham et al. 2014). Garden vegetation is managed in accordance with *Landscaping for bushfire* (CFA 2011b)
Emergency shelter	To supplement the provision of warnings and advice on 'leaving early', settlements in areas of higher risk have equitable access to last-resort options for shelter, including open space that meets requirements for Neighbourhood Safer Places (CFA 2012a) and/or community bushfire refuges installed in accordance with *Information Handbook: Design and Construction of Community Bushfire Refuges* (ABCB 2014). Reliance on shelters should be avoided by people with significant health concerns particularly for the elderly or people with heart conditions
Infrastructure	Settlements are serviced by adequate levels of water, power and telecommunications, which is protected from fire, wind and failure due to overload, and/or has backup
Facilities in settlements	Settlements contain design features including community facilities (such as halls, schools, parks, sporting and other facilities) that assist interaction and cohesion (and contribute to separation from hazards or emergency shelter or recovery)
Services in settlements	Settlements provide services that address possible socio-economic disadvantage and assist preparation, response and recovery including employment, health, food, shops, transport, emergency services and warning systems
Shared understanding	Land use planners, emergency planners and the community have a shared understanding of the risk associated with bushfire and other hazards and work collaboratively to support settlement planning
'Future-proofing'	Settlements are designed to take climate change and its impact on bushfire risk into account

ATTACHMENT 2: ADDENDUM – Prepared by South Gippsland Shire Council, with review by Deanne Smith (co-author of this bushfire assessment report).