BLACKASH
BUSHFIRE CONSULTING

Rothbury Battery Energy Storage System
Bushfire Risk Assessment

Prepared for

Ausgrid c/- AECOM Australia Pty Ltd

Version 1.5

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Project Name:	Rothbury Zone Substation BESS (J4108)		
Client Details:	AUSGRID C/- AECOM Australia Pty Ltd		
Project Address	1309 Wine Country Drive, Rothbury NSW 2325		
Name	**Position**	**Contact No**	**Email**
David Lemcke	Senior Planner & Bushfire Specialist	0439 220 464	David.lemcke@blackash.com.au
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David Lemcke | Senior Planner & Bushfire Specialist
Blackash Bushfire Consulting
Master of Environmental Planning; Grad. Dip. Bushfire Protection; Grad. Dip. Urban & Regional Planning; B.A.; Adv. Dip. Of Public Safety (Emergency Management); Dip. Management.
Fire Protection Association of Australia BPAD Level 3 - 68670

Lew Short | Principal
Blackash Bushfire Consulting
B.A., Grad. Dip. (Design for Bushfires), Grad. Cert. of Management (Macq), Grad. Cert. (Applied Management); Fire Protection Association of Australia BPAD Level 3 - 16373

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Glossary

This section defines those core terms and concepts which are adopted throughout the body of this report.

Term	Definition
Asset Protection Zone (APZ)	A fuel-reduced area surrounding a built asset or structure which provides a buffer zone between a bushfire hazard and an asset. The APZ includes a defendable space within which firefighting operations can be carried out. The size of the required APZ varies with slope, vegetation and weather conditions at site as expressed by the Forest Fire Danger Index (FFDI).
Battery Energy Storage System (BESS)	A large-scale rechargeable battery system made up of one or more individual units linked into the electricity system to perform a range of functions.
Bushfire	A general term used to describe fire in vegetation, includes grass fire.
Bushfire attack mechanisms	The various ways in which a bushfire can impact upon people and property and cause loss or damage. These mechanisms include flame contact, radiant heat exposure, ember attack, fire wind and smoke.
Bushfire Attack Level (BAL)	A means of measuring the severity of a building's potential exposure to ember attack, radiant heat, and direct flame contact. The BAL is used as the basis for establishing the requirements for construction to improve protection of building elements and to articulate bushfire risk.
Bush Fire Design Brief (BFDB)	A structured document required for performance-based solutions on bush fire prone land, outlining how a proposed development complies with *Planning for Bush Fire Protection 2019* (PBP). It defines the specific risks,

	including vegetation and slope, to justify alternative construction methods, ensuring safety, asset protection zones (APZ), and water supply.
Bushfire prone land (BPL)	An area of land that can support a bushfire or is likely to be subject to bushfire attack, as designated on a bushfire prone land map.
Bushfire Hazard	Any vegetation that has the potential to threaten lives, property, or the environment.
Bushfire Threat	Potential bushfire exposure of an asset due to the proximity and type of a hazard and the slope on which the hazard is situated.
Forest Fire Danger Index	A numerical rating to express how dangerous a fire is likely to be if started. It essentially summarises fire weather conditions using temperature, relative humidity, wind speed and drought factor. The higher the rating the more dangerous the fire weather conditions. This is used to set the design fire used in *Planning for Bushfire Protection 2019* for various local government areas.
Managed land	Land that has vegetation removed or maintained to a level that limits the spread and impact of bushfire. This may include developed land (residential, commercial, or industrial), roads, golf course fairways, playgrounds, sports fields, vineyards, orchards, cultivated ornamental gardens and commercial nurseries. Most common will be gardens and lawns within curtilage of buildings. These areas are managed to meet the requirements of an APZ.
Mitigation	The lessening or minimising of the adverse impacts of a bushfire event. The adverse impacts of bushfire cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures include engineering techniques, retrofitting and hazard-resistant construction as well as on ground works to manage fuel and separate assets from bushland.

Planning for Bushfire Protection 2019 (PBP)	NSW Rural Fire Service publication effective from 1 March 2020 which is applicable to all new development on bushfire prone land in NSW.
Project	The final completed BESS proposed for the site, including permanent access, ancillary buildings and plant, and Asset Protection Zones.
Project area	The area being impacted by the BESS construction and operation including construction area.
Resilience	The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management. UNDRR 2017
Risk	The degree of risk presented by that interaction will depend on the likelihood and consequence of the bushfire occurring. Risk may be defined as the chance of something happening, in a specified period of time that will have an impact on objectives. It is measured in terms of consequences and likelihood.
Site	The Lot/s on which the project is located.

1. Introduction

Blackash Bushfire Consulting has been engaged by AECOM Australia Pty Ltd on behalf of AUSGRID, to provide a bushfire assessment report (BAR) to support the construction, operation and maintenance of the Rothbury Battery Energy Storage System (BESS) (the Project). The site is located approximately 7km south of Branxton and 14km north of Cessnock within the Cessnock City Council local government area, in the Hunter region of NSW. The site is located at 1309 Wine Country Drive, Rothbury NSW on part of Lots 1 and 2 DP 1318566 (approximately 11.8 ha).

The Project is a utility scale energy development proposed to have a power capacity of up to 135 megawatts (MW) and a storage capacity of up to 540 megawatt hours (MWh).

The Project Area (development footprint) is 4.56 ha. The majority of the Project Area including the proposed Asset Protection Zone is located on Lot 2, with a small area of the Project on Lot 1. The site is located to the west of the existing Rothbury Zone Substation and excludes an area that is flood prone (associated with Black Creek) located west of the Project Area). The site is bounded by Old North Road to the south; Black Creek to the west; the existing Rothbury Zone Substation on Lot 1 and Wine Country Drive to the east; and private agricultural land to the north. The site is in single ownership of Ausgrid, has moderate slopes to the west generally and is largely cleared for agriculture, with the exception of trees along Black Creek, along Old North Road and screening around the existing substation. 132 kV transmission lines cross the site generally east-west within a 45m wide easement. Figures 1-4 put the indicative Project Area in context.

The Project is a state significant development (SSD) pursuant to schedule 1 of the *State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP)*. Approval for the Project is required under Part 4, Division 4.7 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project Area is located on designated Bushfire Prone Land (BPL). As SSD, Section 4.41 (f) of the EP&A Act does not require a Bushfire Safety Authority to be obtained from the NSW Rural Fire Service (RFS) however requires compliance with the Secretary's Environmental Assessment Requirements (SEARs).

This report demonstrates compliance with the RFS document *Planning for Bush Fire Protection 2019* (PBP). This assessment has been prepared by David Lemcke, Senior Planner & Bushfire Specialist (FPAA BPAD Level 3 Certified Practitioner No.68670) and Lew Short, Principal Bushfire & Resilience (FPAA BPAD Level 3 Certified Practitioner No.34603), both of whom who are recognised by the NSW RFS as qualified in bushfire risk assessment and have been accredited by the Fire Protection Association of Australia as suitably qualified consultants to undertake alternative solution proposals. David and Lew's curriculum vitae are presented in Appendix 2.

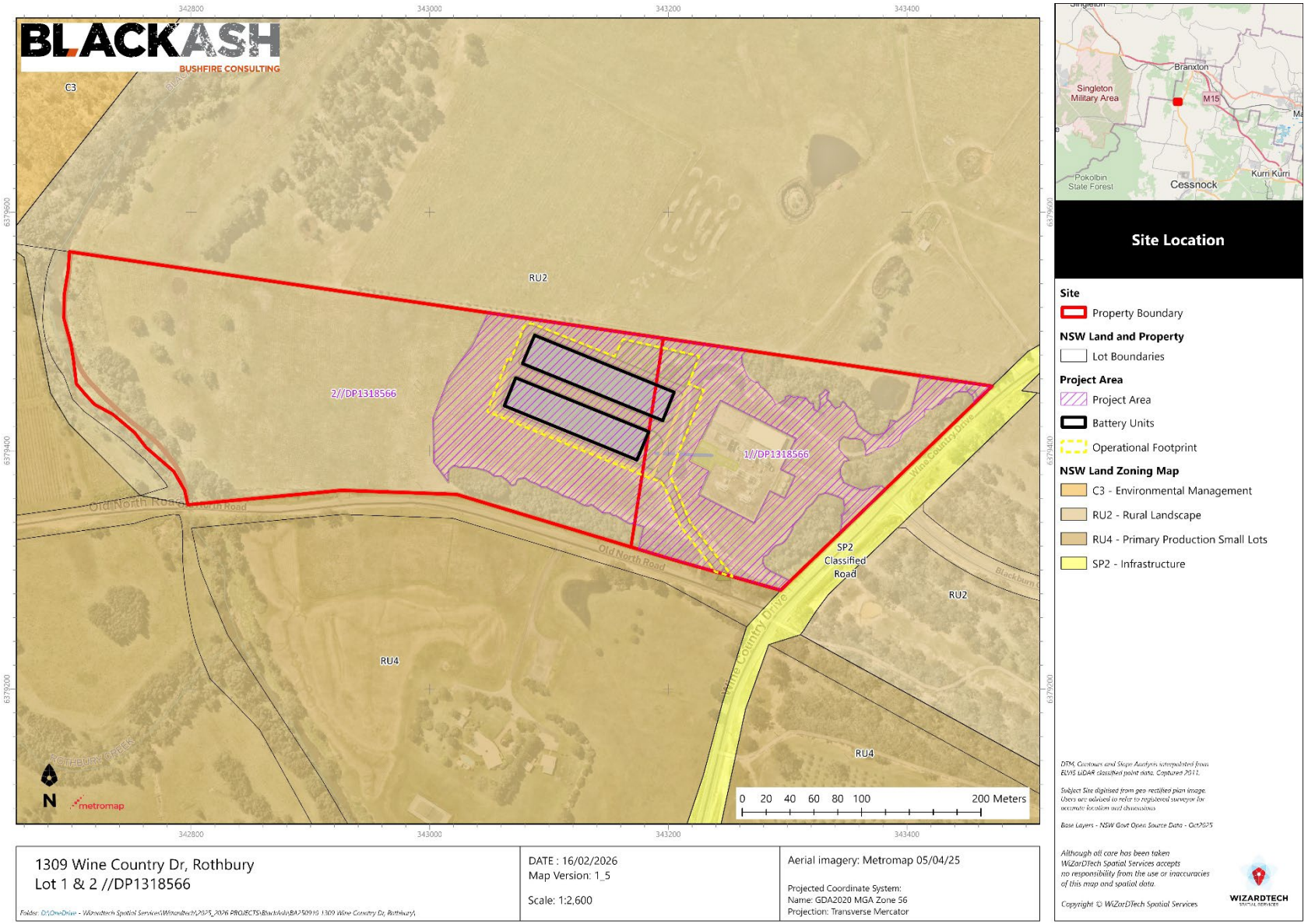


Figure 1: Site and current zoning

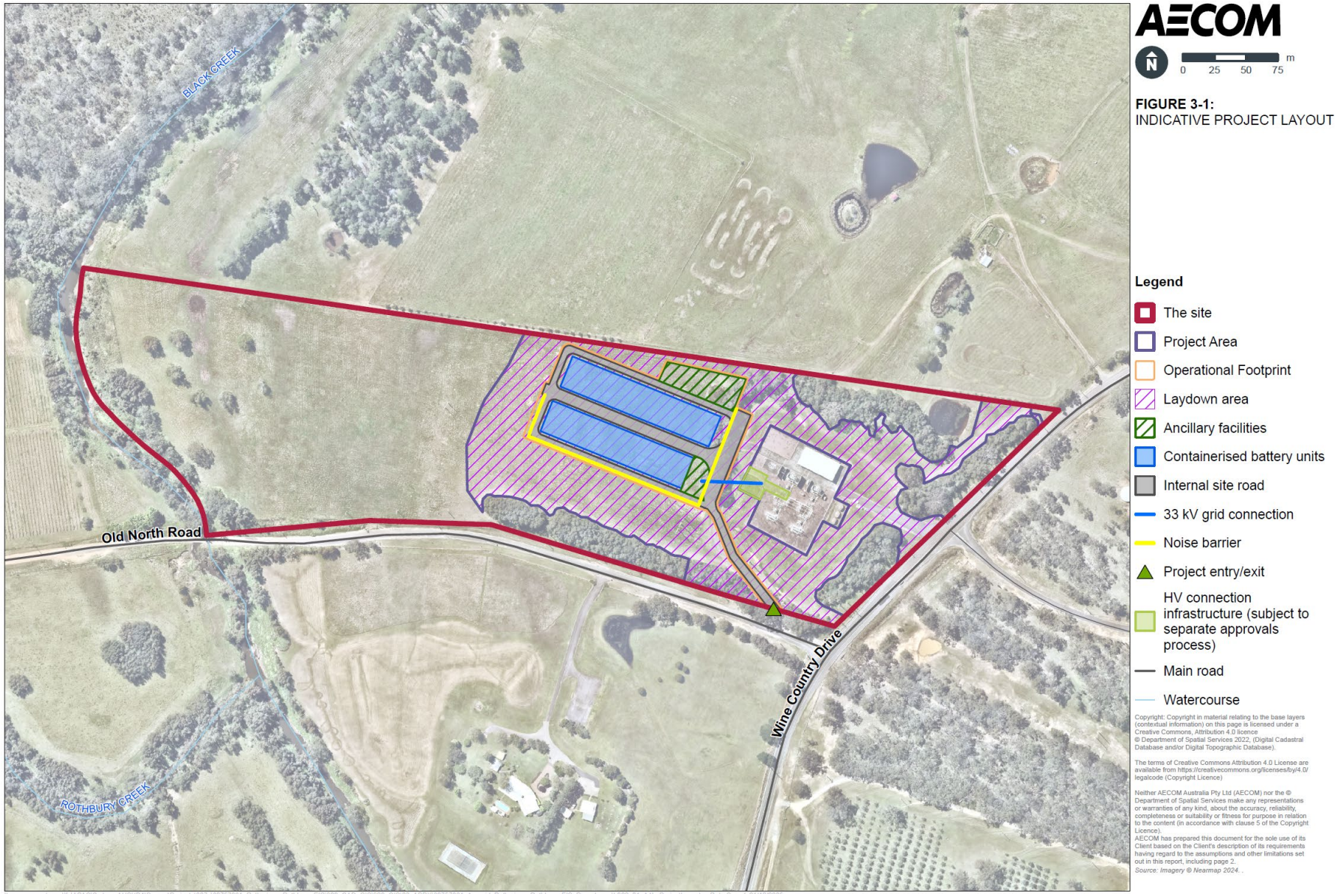


Figure 2: Project Area and relationship to existing Rothbury Zone Substation (AECOM)

Figure 3: Looking west from site entry road, existing vegetation screen along Old North Road (left)

Figure 4: Looking north along access, existing vegetation screen (centre) and existing substation (right)

1.1. Purpose of this report

This bushfire risk assessment report forms part of the environmental impact statement (EIS) for the Project and has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) (application number: SSD-85939708) issued for the Project on 3 July 2025 by the NSW Department of Planning, Housing and Infrastructure (DPHI). The SEARs specify the following:

> *Bushfire – a bush fire hazard assessment completed by a suitably qualified consultant and identify potential hazards and risks associated with bushfires / use of bushfire prone land including the risks that a BESS would cause a bush fire and demonstrate compliance with Planning for Bush Fire Protection 2019;*

No correspondence was received from the RFS for the SEARs. This assessment has been undertaken by a suitably qualified consultant and addresses the SEARs related to bushfire, the aims and objectives outlined in *Planning for Bush Fire Protection 2019* (PBP), and the provisions detailed in Section 8.3.5 of PBP – Wind and Solar Farms, ensuring that potential bushfire risks associated with the development are effectively identified and mitigated.

1.2. Aims of this assessment

This report seeks to provide bushfire risk assessment advice relating to the implications of the Project including the BESS and connection to the nearby Rothbury Zone Substation. The aim of this report is to:

- Assess the potential bushfire risks to the development mitigation measures to improve the feasibility of the Project;
- Provide measures that meet the SEARs and PBP requirements through bushfire hazard identification and assessment, including a bushfire hazard site and landscape assessment;
- Provide recommendations for the protection of human life and to minimise impacts on property from the threat of bushfire;
- Reduce the occurrence and consequences of bushfires through risk-based design; and
- Enable safe and effective emergency response through the provision of;
    - Safe access in and around the Project Footprint including firefighting infrastructure such as water supply,
    - Management of vegetation,
    - Implementation and maintenance of building construction standards,
    - Prevention of fire ignition on site and prevention of fire spread between site infrastructure.
    - Operational procedures to address the impact on aerial fighting of bushfires.

2. Legislative Framework

The following sections identify the statutory and regulatory requirements relevant to the assessment of bushfire risk for the Project.

2.1. Environmental Planning and Assessment Act 1979

The Project has been declared SSD under Part 4, section 4.12(8) of the *Environmental Planning and Assessment Act, 1979 (EP&A Act)*.

The Project is located on 'bushfire prone land' for the purposes of Section 10.3 of the EP&A Act, and as such requires consideration of the requirements of PBP. The Project provides consideration against the requirements of PBP to satisfy the SEARs.

2.2. Planning for Bush Fire Protection 2019

As required by their SEARs, SSD applications must demonstrate the proposal complies with the overall Aim and Objectives of PBP.

The **aim** of PBP (p. 10) is:

- *To provide for the protection of human life and minimise impacts on property from the threat of bushfire, while having due regard to development potential, site characteristics and protection of the environment*.

The **objectives** (PBP p. 10) are to:

- *Afford buildings and their occupants protection from exposure to a bushfire;*
- *Provide for a defendable space to be located around buildings;*
- *Provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent the likely fire spread to buildings;*
- *Ensure that appropriate operational access and egress for emergency service personnel and occupants is available;*
- *Provide for ongoing management and maintenance of Bushfire Protection Measures; and*
- *Ensure that utility services are adequate to meet the* needs of firefighters.

The current planning and building systems are primarily based around the protection of assets/buildings through a combination of bushfire protection measures (BPM) to achieve an acceptable risk mitigation outcome, remembering it is rarely possible to reduce risk entirely in the Australian landscape.

Combinations of BPM are used to achieve acceptable outcomes for different types of development at different sites and provide some flexibility to satisfy the aim and objectives of PBP. The various BPMs available are shown in Figure 5. Appropriate combinations of these for any particular project depend upon geographic location and other site circumstances.

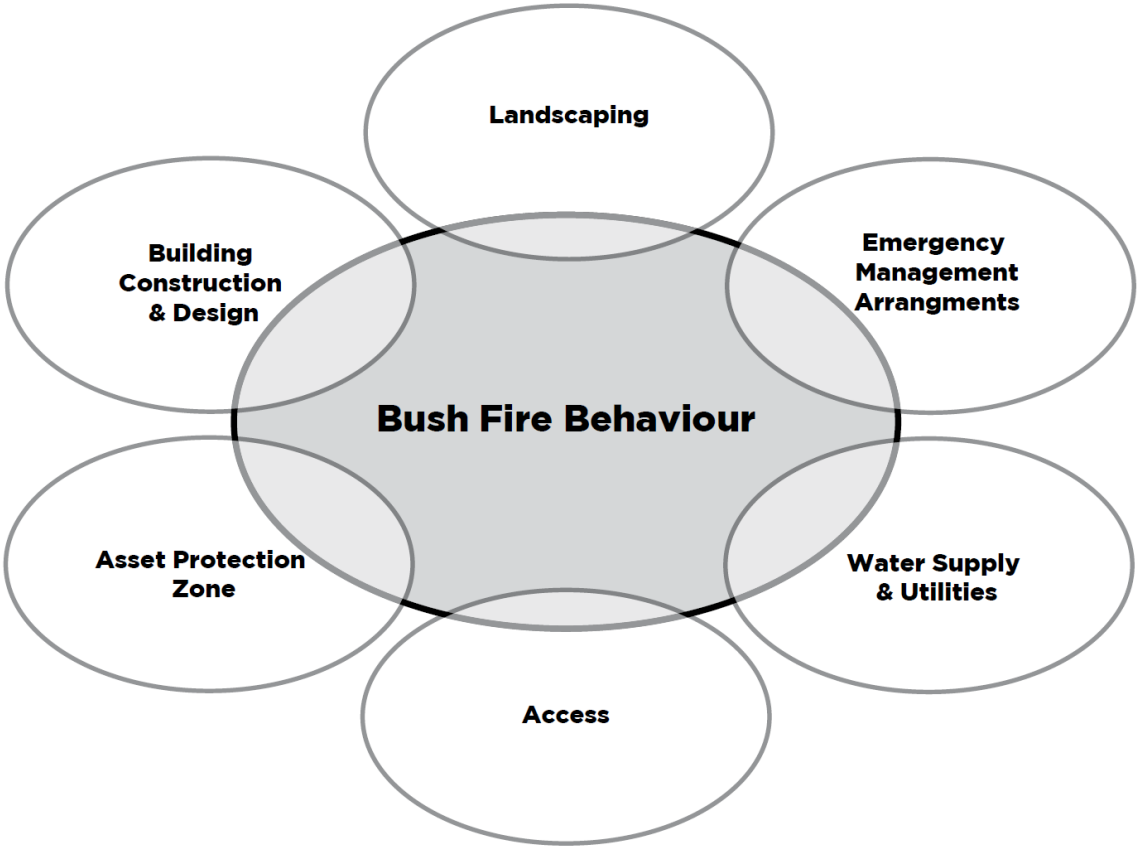


Figure 5: Bushfire Protection Measures in combination (PBP p. 26)

PBP addresses the specific considerations and requirements for wind and solar farms in Section 8.3.5. As BESS are often associated with these generation facilities and have some similar characteristics, compliance with these requirements is considered a suitable method of demonstrating performance compliance with the aim and objectives of PBP, particularly with respect to provision of Asset Protection Zones (APZ) (p. 77):

> *Wind and solar farms require special consideration and should be provided with **adequate clearances** to combustible vegetation as well as firefighting access and water. The following should be provided for wind and solar farms:*
>
> - *A minimum **10m APZ** for the structures and associated buildings/infrastructure; and*
> - *The APZ must be maintained to the standard of an Inner Protection Area (IPA) for the life of the development.*
>
> *Infrastructure, for the purposes of requiring APZ excludes:*
>
> - *road access to the site; and*
> - *power or other services to the site and associated fencing.*
>
> *Essential equipment should be designed and housed in such a way as to **minimise the impact of bushfires** on the capabilities of the infrastructure during bushfire emergencies. It should also be designed and maintained so that it will not serve as a bushfire risk to surrounding bush.*
>
> *A Bush Fire Emergency Management and Operations Plan (BEMOP) should be prepared for the development that identifies all relevant risks and mitigation measures associated with the construction, operation and decommissioning of the solar farm. This should include:*
>
> - *Detailed measures to prevent or mitigate fires igniting;*
> - *Work that should not be carried out during total fire bans;*
> - *Availability of fire-suppression equipment, access and water;*
> - *Storage and maintenance of fuels and other flammable materials;*
> - *Notification of the local NSW RFS Fire Control Centre for any works that have the potential to ignite surrounding vegetation, proposed to be carried out during a bush-fire fire danger period to ensure weather conditions are appropriate; and*
> - *Appropriate bushfire emergency management planning.*
>
> *It is important to be aware of operations that may be carried out on days of Total Fire Ban and any prohibited activities or exemptions that are notified by the Commissioner of the NSW RFS under the Rural Fires Act 1997 (s.99).*

These matters are discussed in more detail below, however the only numerical standard applicable to these analogous developments is the 10 metre APZ requirement. Consideration of the vulnerability of the BESS asset to fire, and the potential for a BESS ignition causing a wider fire, has been examined through the Project design process. The 10m APZ as prescribed by PBP for wind and solar generation assets is a general requirement and does not factor in the vulnerable nature of the infrastructure to bushfire attack (embers, radiant heat, flame contact and smoke) or the consequence of disruption or interruption to critical infrastructure as a result of bushfire, including, impacts to the asset (damage, loss and or disruption).

As such, the tolerable level of bushfire attack exposure to the critical infrastructure and assets will need to be further considered by Ausgrid during the detailed design phase. A larger APZ has been recommended for the Project, along with other mitigation strategies to address the heightened criticality of the asset, and to allay any community concerns that a BESS fire could spread to surrounding vegetation and cause a bushfire.

The specific mapping of the APZ and rationale underpinning the outcome is provided in Section 4 of this report. After consideration of design and site opportunities a higher standard of radiant heat flux reduction has been applied to the BESS, being <29kW/m^2. The rationale for applying this to the BESS is discussed in Appendix 1. The high voltage connection to the Rothbury Zone Substation will be an underground cable connection. The methodology used is consistent with PBP and *Australian Standard AS 3959:2018 Construction of buildings in bushfire-prone areas* (AS3959) and is detailed below.

Section 8.3.9 of PBP (p. 79) recognises the need for specific consideration of hazardous industry , which is defined in the PBP to include a range of development types that are particularly susceptible to bushfire risk. BESS have typically been included within this overall categorisation, with NSW Fire & Rescue requiring a Fire Safety Study (FSS) as a standard SSD consent condition for most renewable energy and storage systems being considered as power generating works. Section 8.3.9 – Hazardous Industry:

> *Some developments are considered by their very nature to be hazardous, as much for their ability to start bush fires as their susceptibility to bush fire impacts. New developments of this nature should be avoided on BFPL. However, where hazardous industries are proposed, prior consultation with the NSW RFS and preparation of a performance based solution, potentially including a BFDB, will be required.*
>
> *In preparation of a performance based solution or BFDB, the Fire Safety Study prepared under the DPIE Hazardous Industry Planning and Assessment Papers (HIPAPs) should be considered. This study provides details of all credible fire hazards and the associated fire prevention and mitigation measures for the development. The BFDB must address the appropriate protection*

measures to be provided commensurate with the bush fire hazards and associated risks. Care should also be taken to ensure that such facilities do not impact on existing developments.

Hazardous industries include but are not limited to:

- *power generating works;*
- *sawmills;*
- *junk yards;*
- *liquid fuel depots;*
- *hazardous industries/storage;*
- *chemical industries/storage;*
- *service stations;*
- *ammunition storage/manufacture; and*
- *fireworks manufacture/storage.*

2.3. Relevant standards for renewable energy and BESS facilities

The renewable energy and BESS industry is a rapidly changing development space. In some respects, the regulatory environment is running behind the pace of industry development. There is no consistent Australian position or suitable standard at this point in time that manages some elements of the development of large generation and energy storage facilities. This is common across the western world and at this stage there are a number of different approaches to determining what is the most effective standard bushfire management treatments.

It is not appropriate to rely on documentation developed in other jurisdictions to inform the NSW context, however information developed by fire agencies from across the country and by key industry participants can be used to inform the development of appropriate solutions. This is further discussed in Appendix 1 of this report. It is expected that as the industry matures in future years there will be a more comprehensive range of standards developed.

Appendix 5 provides a review of the likelihood of a BESS module fire causing a bushfire ignition.

3. Bushfire Landscape Scale Risk Assessment

A bushfire landscape scale risk assessment considers the likelihood of a bushfire approaching the site, its potential severity and intensity and the resultant impact on life and property in the context of the broader surrounding landscape. Detail of this assessment is provided in the following sections.

3.1. Bushfire Prone Land

The Project Area is identified as being within 'bushfire prone land' (BPL). Bushfire Prone Land Maps (BPLM) provide a trigger for the consideration of development on sites that are bushfire prone. BPL is land that has been identified by council, which can support a bushfire or is subject to bushfire attack. The BPLM are prepared by local councils and certified by the Commissioner of the NSW RFS.

The BPLM show vegetation hazards and provides a suitable buffer distance from that vegetation. They are an indication of potential bushfire attack only and are not a risk assessment of land.

The BPLM identifies most of the site as Category 3 vegetation, which is defined as:

> *Vegetation Category 3 is considered to be medium bush fire risk vegetation. It is higher in bush fire risk than category 2 (and the excluded areas) but lower than Category 1. It is represented as dark orange on a Bush Fire Prone Land map and will be given a 30 metre buffer. This category consists of:*
>
> *Grasslands, freshwater wetlands, semi-arid woodlands, alpine complex and arid shrublands.*

The existing Rothbury Zone Substation is defined as "managed land".

Managed land as defined within PBP (p. 112):

> *Managed land is land that has vegetation removed or maintained to limit the spread and impact of bush fire. It may include existing developed land (i.e. residential, commercial or industrial), roads, golf course fairways, playgrounds or sports fields, vineyards, orchards, cultivated ornamental gardens and commercial nurseries. Most common will be gardens and lawns within curtilage of buildings. These areas will be managed to meet the requirements of an Asset Protection Zone.*

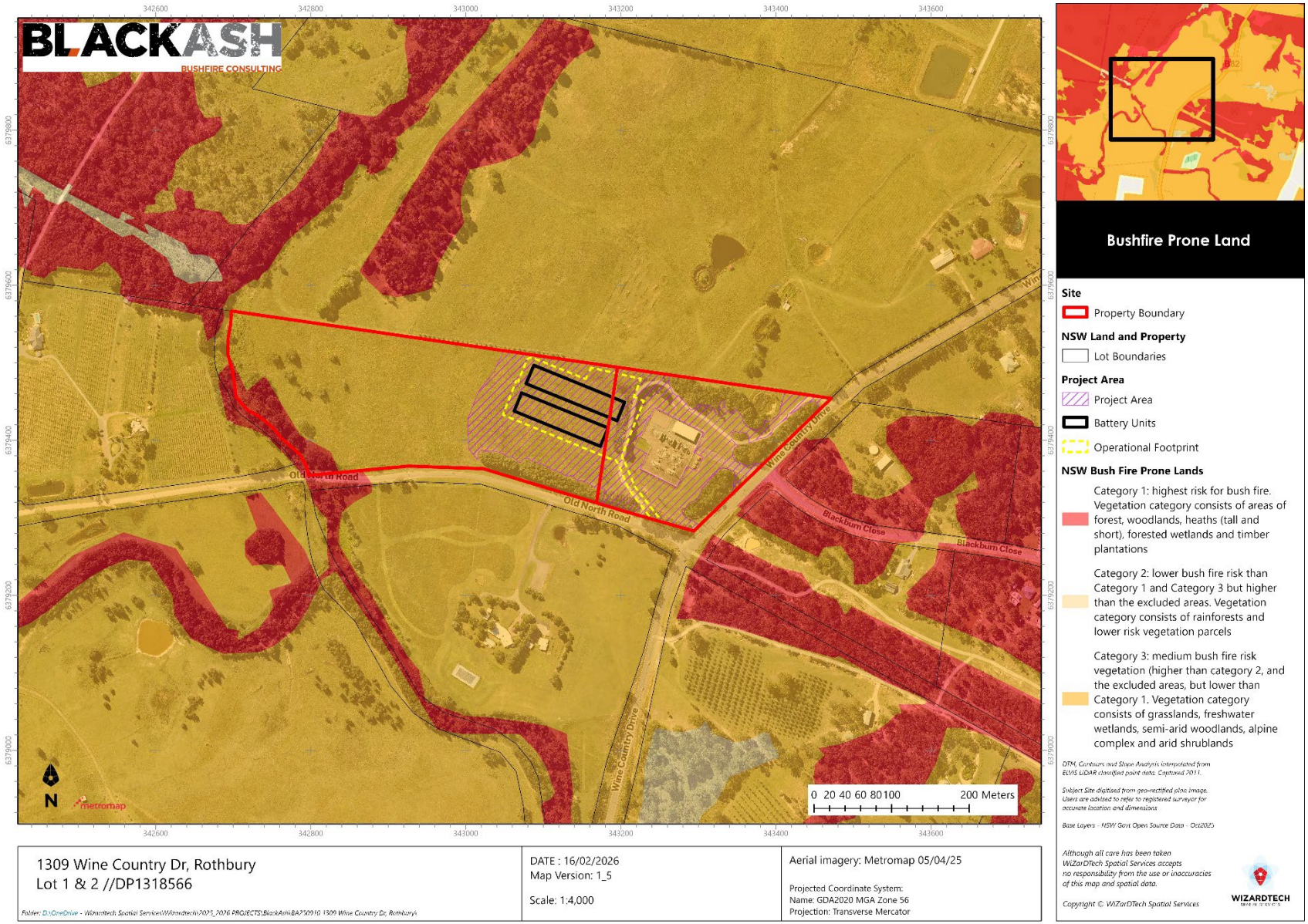


Figure 6: Bushfire Prone Land Map

3.2. Lower Hunter Bush Fire Risk Management Plan

The site and local area are identified within the *Lower Hunter Bush Fire Risk Management Plan 2023* (BRMP). As shown in Figure 7 the site sits within an area north of Old North Road identified as having Lowest to Moderate Risk to Economic Assets, using the BFRMP methodology that looks at likelihood of fire and vulnerability of asset class.

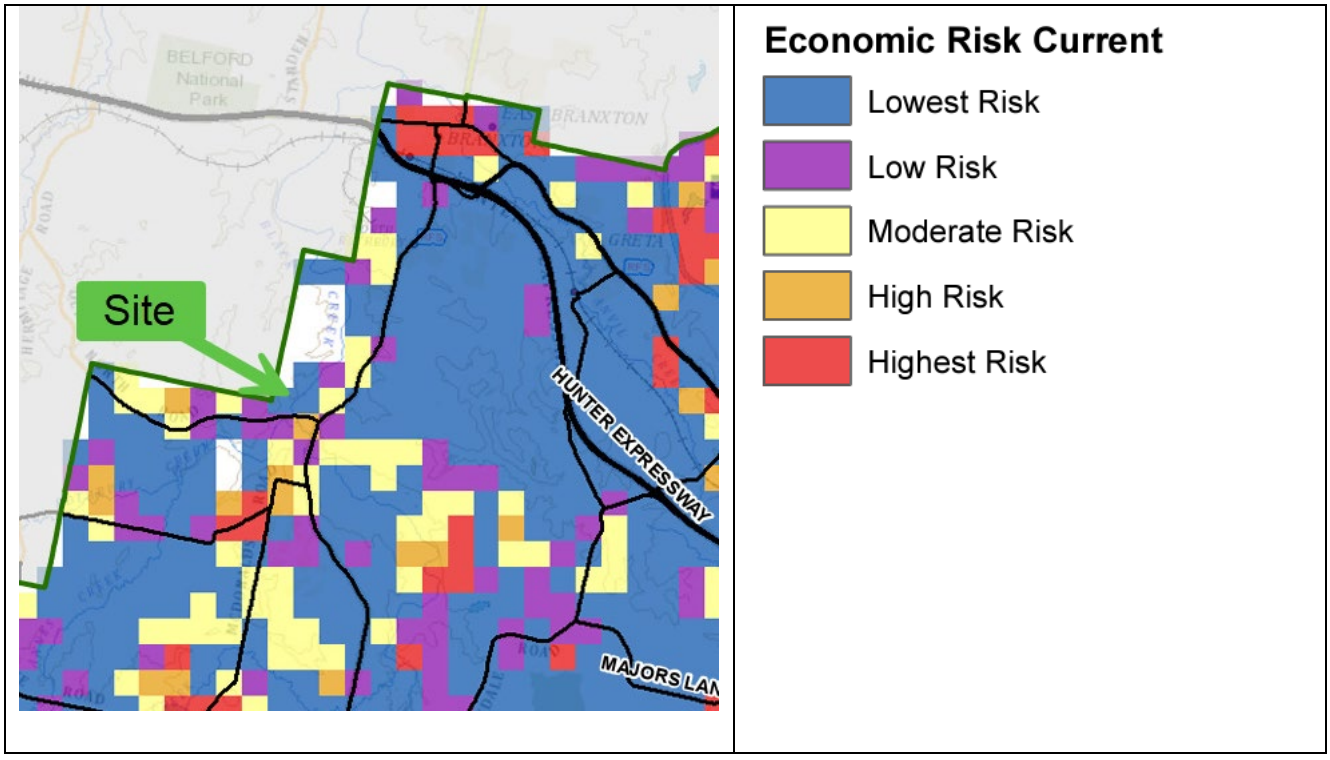


Figure 7: Extract from Lower Hunter BRMP - site shown as within Lowest to Moderate Risk area

3.3. Fire History

As shown in Figure 8, there is little mapped history of bushfires in the local area of the site. The date and accuracy of records vary across the state, however these typically reach back four decades. Figure 8 shows no bushfire impact recorded at the site and limited history within the local area with an indicative 10km radius from the site. Data is taken from NSW National Parks & Wildlife Service (NPWS) and Australian and New Zealand National Council for Fire and Emergency Services (AFAC).

The fire history mapping supports the site being considered as **Low Risk**.

The site presents a low bushfire risk to the Project due to the highly modified and fragmented agricultural landscape surrounding it. The predominant land use for cropping and grazing in the vicinity of the site has significantly reduced fuel continuity, limiting the capacity for a sustained fire run or high-intensity fire

behaviour. While this modified environment provides an effective buffer under normal conditions, there remains a residual risk during periods of extreme weather, when fast-moving grassfires could traverse open paddocks and impact the site. Such events would likely be of short duration and low to moderate intensity, allowing for appropriate design and operational mitigation measures to maintain asset protection and operational resilience. The project area itself is managed on an ongoing basis by Ausgrid for a variety of operational reasons.

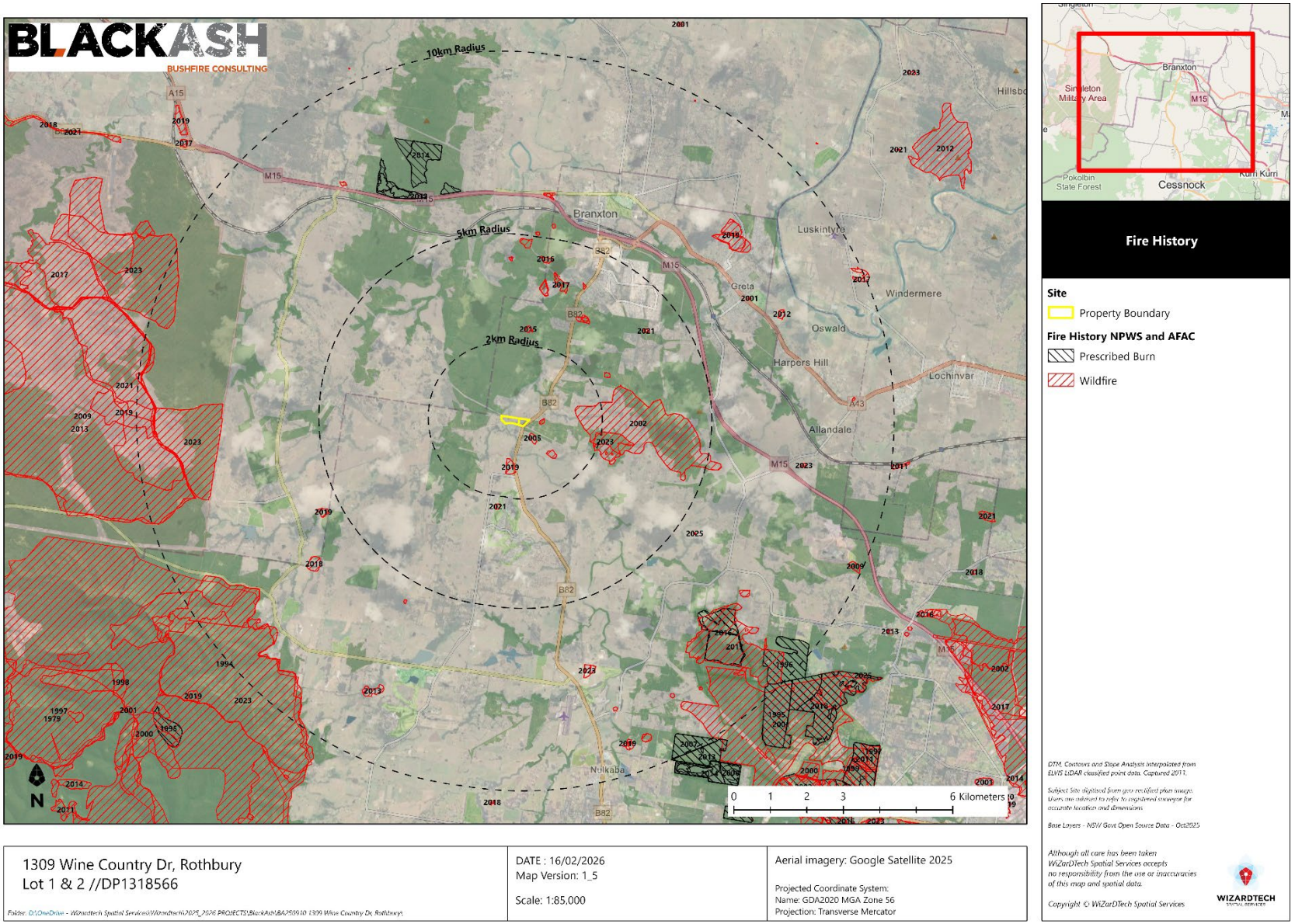


Figure 8: Fire history (NSW National Parks and Wildlife Service & AFAC data)

3.4. Blackash Landscape Scale Assessment Tool

The bushfire landscape assessment considers the likelihood of a bushfire, its potential severity and intensity and the potential impact on life and property in the context of the broader surrounding landscape. The likelihood of a bushfire, its severity and intensity, and the potential impact on life and property varies depending on where a site is located in the landscape. Landscape scale fires are those that can span many kilometres or tens of kilometres, and burn for days or weeks at a time. Typically, these fires can be many thousands of hectares in size with fire fronts many kilometres in length.

The scale of hazard vegetation and topography are key in terms of assessing the bushfire hazard and can be separated generally into one of two categories:

- Landscape-scale hazard – where large expanses of vegetation over tens to thousands of hectares are located in immediate proximity to, and may traverse, urban periphery suburbs/townships
- localised hazard – which is most commonly presented by fragmented areas of vegetation less than 20 hectares in size

The Blackash Landscape Scale Assessment Tool (LSAT) combines quantitative and qualitative techniques, supported by the *Planning Permit Applications Bushfire Management Overlay Technical Guide* (Victorian Department of Environment, Land, Water and Planning, 2017) and associated documentation. The LSAT is shown in Table 2 and uses elements of the Bayesian decision making model and expert judgment techniques (NSW *Land & Environment Court Uniform Civil Procedure Rules*, Part 31, 2005) backed by site data. Bayesian decision making has been used where there is both objective and subjective data to analyse, and decisions need to be made on the probability of successful outcomes where there are high levels of uncertainty. Expert judgement has been used in the assessment and determination of the overall landscape scale risk.

Key considerations in our assessment have included:

- extent and continuity of vegetation
- topography
- prevailing winds
- potential fire run and area that is likely to be impacted by the fire
- impact on evacuation routes to safer places considering road networks, distances, and landscape factors

- location and exposure of the development to bushfire
- ability to seek bushfire shelter on site or at alternative locations
- extent of neighbourhood-scale damage the bushfire may produce.

The Project Area is surrounded by grazing and cropping areas, with rural residential areas to the east and an extended area of bushland approximately 450m to the northwest of the Project, on the other side of Black Creek. The area to the south has extensive tourist and recreational activity including wineries and golf course development. The wider area is flat to gently undulating and is fragmented by roads and creeks.

There is no potential for a landscape scale fire to affect the site. The LSAT is heavily weighted to life safety and places significant emphasis on the ability for the future workers on site (during the construction, operational or decommissioning phases) to be able to shelter in place or evacuate safely, whilst emergency services can access the site at the same time.

When the individual factors are scored, after consideration of the landscape context, the site design complying with PBP, the overall Landscape Scale Threat for the site is assessed as **Low Risk**. The summary and weighted scores are presented in Table 1 below.

The total prevention of bushfires is not possible, and neither is the protection of all assets. What is common when considering risk management for relevant scenarios are the overarching common goals to prevent bushfire ignitions, design and prepare assets to facilitate effective bushfire suppression, and where possible, to incorporate protection of valuable assets and business continuity into Project planning. This also relates to the likelihood of a battery unit ignition spreading from the site and causing a bushfire to start.

The bushfire risk for the Project site is considered overall to be **Low Risk**.

Table 1 Landscape Scale Assessment for the Project

Landscape Scale Assessment Tool					
Parameter	**Low landscape scale threat**	**Moderate landscape scale threat**	**High landscape scale threat**	**Extreme landscape scape threat**	**Rating**
1. Surrounding Vegetation	Bushfire cannot directly approach the site as it is surrounded by urban development and non-mapped vegetation or managed land.	Bushfire can only approach from one aspect and the site is within a suburban, township or urban area considered managed land. Typically an island of bushfire vegetation within a wider urban development area; site with highly fragmented vegetation nearby; or interface site impacted only by linear vegetation corridors of 100m width or less.	Bushfire can approach from more than one aspect and site is on the bushland-urban interface with the developed area considered as managed land. Typically contiguous bushfire vegetation with a typical fire run in any direction of 0.1-2.0 km distance.	Bushfire can approach from more than one aspect and/or fires have many hours or days to grow and develop before impacting and/or site is surrounded by significant unmanaged vegetation. Typically large areas of contigous bushland with fire runs of more than 2 km possible.	**High**
2. Bushfire Behaviour	Extreme bushfire behaviour at the site is not possible given the broader landscape.	Extreme bushfire behaviour at the site is unlikely in this broader landscape due to combination of factors of vegetation type, vegetation fragmentation, aspect and topography.	Extreme bushfire behaviour at the site is likely in this broader landscape due to combination of factors of vegetation type, vegetation fragmentation, aspect and topography.	Extreme bushfire behaviour is very likely in this broader landscape due to combination of factors of vegetation type, vegetation fragmentation, aspect and topography.	**Low**
3. Impact of severe fire behaviour (FFDI 80 or 100 as relevant) coming onto site from wider fire catchment	There is little vegetation beyond 150 metres of the site (except grasslands and low-threat vegetation) and will not result in neighbourhood scale destruction of the site.	The type and extent of vegetation beyond 150m from the site may result in neighbourhood-scale destruction as it interacts with the bushfire hazard on and close to the site.	The type and extent of vegetation beyond 150m is likely to result in neighbourhood-scale destruction as it interacts with the bushfire hazard on and close to the site.	The type and extent of vegetation beyond 150m will result in neighbourhood-scale destruction as it interacts with the bushfire hazard on and close to the site.	**Low**
4. Vegetation Corridors	Vegetation within the site cannot enable fire to enter and move through the site by a continuous fire path from the primary fire source.	Vegetation within the site is unlikely to enable fire to enter and move through the site by a continuous fire path from the primary fire source.	Vegetation within the site may enable fire to enter and move through the site by a continuous fire path from the primary fire source.	Vegetation corridors on site provide for passage of fire to enter and move through the site from the primary fire source.	**Low**
5. Separation	Hazard separation between extreme bushfire hazard and buildings of greater than 100m. Extreme bushfire hazard does not include vegetated corridors of less than 100m width or grasslands.	Hazard separation between extreme bushfire hazard and buildings of 50-100m. Extreme bushfire hazard does not include vegetated corridors of less than 100m width or grasslands.	Hazard separation between extreme bushfire hazard and buildings of 20-50m. Extreme bushfire hazard does not include vegetated corridors of less than 100m width or grasslands.	Hazard separation between extreme bushfire hazard and buildings of <20m. Extreme bushfire hazard does not include vegetated corridors of less than 100m width or grasslands.	**Low**
6. Shelter	Immediate access is available to a place that provides shelter from bushfire. This includes existing or proposed buildings on site constructed in accordance with PBP.	Access is readily available to a place that provides shelter from bushfire. This will often be the surrounding developed area.	Access to a place that provides shelter from bushfire is not certain during a wildfire and existing buildings are not built to PBP standards.	Access to a place that provides shelter from bushfire is not possible during a wildfire.	**Low**
7. Evacuation	Multiple evacuation routes are available and unlikely to be impacted by fire.	Evacuation to alternate location that provides life safety refuge is <1km and can be completed by foot or vehicle.	Evacuation to alternate location that provides life safety refuge is 1km-10km.	Evacuation to alternate location that provides life safety refuge is > 10km.	**Moderate**
8. Isolation and emergency services	Seamless integration with existing settlement - no impact on evacuation or access for emergency services.	Short bushland pinch points that may carry fire across roads and restrict access briefly during passage of fire. Unlikely impact on evacuation or access for emergency services.	Short bushland pinch points that are likely to carry fire across roads and restrict access temporarily. Likely impact on evacuation or access for emergency services.	Large areas of bushland or multiple pinch points that are likely to carry fire across roads in forest areas and will block evacuation or emergency service access routes for extended time.	**Moderate**
9. Firefighting water supplies	Site is within urban area and has access to reticulated water supply OR site has dedicated firefighting water supply in accordance with PBP requirements.	Site is on the periphery of urban area and has access to reticulated water supply that may be more susceptible to interuption.	Site is outside urban area and relies on an on site water supply not in accordance with PBP.	Site is in an isolated area and relies on an on site water supply not in accordance with PBP.	**Low**
		Overall Threat Rating	**Low Risk**	**Total**	130
	Assessed at Forest Fire Danger Index of 100 as the design fire, using Method 1 in accordance with PBP 2019				
	The scoring system uses a multiplier for each Threat level based on a conservative life safety approach.				
	The scaled scores for each Threat assessment are totalled and final scores are placed within a range to produce the final Risk Rating				

4. Project Area Bushfire Hazard Assessment

A range of elements are required to be considered as part of the bushfire hazard assessment for a project, and these are outlined within this section.

4.1. Bushfire Hazard Assessment Methodology

An assessment of the BPL is necessary to determine the application of Bush Fire Protection measures such as APZ locations and future building construction levels.

PBP provides a methodology to determine the bushfire threat and commensurate size of any APZ that may be required to offset possible bushfire attack. These elements include the potential hazardous landscape that may affect the site and the effective slope within that hazardous vegetation.

The following assessment is prepared in accordance with PBP. This assessment is based on the following resources:

- Planning for Bush Fire Protection (NSW RFS, 2019);
- Council Bushfire Prone Land Map;
- Aerial mapping;
- Detailed GIS and Site analysis; and
- Site inspection by David Lemcke 10 October 2025.

The following methodology is from PBP (p. 80) which has been used to determine the Bushfire Attack Level (BAL) at the Site. The process to determine BAL is outlined below:

To determine BAL:

- Step 1: Determine vegetation formation in all directions around the building to 140 metres
- Step 2: Determine the effective slope of the land from the building for 100 metres
- Step 3: Determine the relevant Forest Fire Danger Index (FFDI) for the council area where development is to be undertaken
- Step 4: Determine the separation distance by measuring from the edge of the unmanaged vegetation to the closest external wall of an asset
- Step 5: Match the relevant FFDI, appropriate vegetation, distance, and effective slope to determine the appropriate BAL using the relevant tables in PBP.

The FFDI, vegetation formations (bushfire fuels) and the topography (effective slope) combine to create the bushfire threat that may affect bushfire behaviour at the Site, and which determine the planning and building response of PBP. A detailed assessment has been undertaken to determine the bushfire hazard and likely radiant heat at the Site

4.2. Fire Weather

The design fire weather is dictated by PBP and RFS *NSW Local Government Areas FDI* (2017) and assumes a credible worst-case scenario and an absence of any other mitigating factors relating to aspect or prevailing winds. The Cessnock LGA is within the Greater Hunter Weather District and has an FFDI of 100.

4.3. Vegetation Assessment

PBP requires a classification of the vegetation on and surrounding the property (out to 140 metres from the boundaries of the property).

Predominant vegetation is classified by structure or formation using the system adopted by Keith (2004) and by the general description using PBP. Vegetation types give rise to radiant heat and fire behavior characteristics. There are seven vegetation formations (with sub-formations) identified in PBP. Where a mix of vegetation types exist, the type providing the greater hazard is said to predominate. The vegetation directly impacting the site (Grassland) is shown in Figure 9. It is further noted that the screening trees along parts of the perimeter and around the Rothbury Zone Substation are Low threat vegetation exclusions as detailed in PBP Appendix 1 A1.10 (p. 88).

4.4. Topography and Slope Influencing Bushfire Behaviour

PBP requires an assessment of the slope of the land on and surrounding the property (out to 100 metres from the boundaries of the property or from the proposed development footprint).

The effective slope influencing fire behaviour approaching the sites has been assessed in accordance with the methodology specified within PBP. The effective slope is the slope of the ground under the hazard (vegetation). It is not the slope between the vegetation and the building (the slope located between the asset and vegetation is the site slope).

The effective slope for the site is shown in Figure 9. The site and surrounding area is characterised by relatively flat country with gentle topography. The moderate slopes in this floodplain area results in minimal influence of slope on fire behaviour and spread.

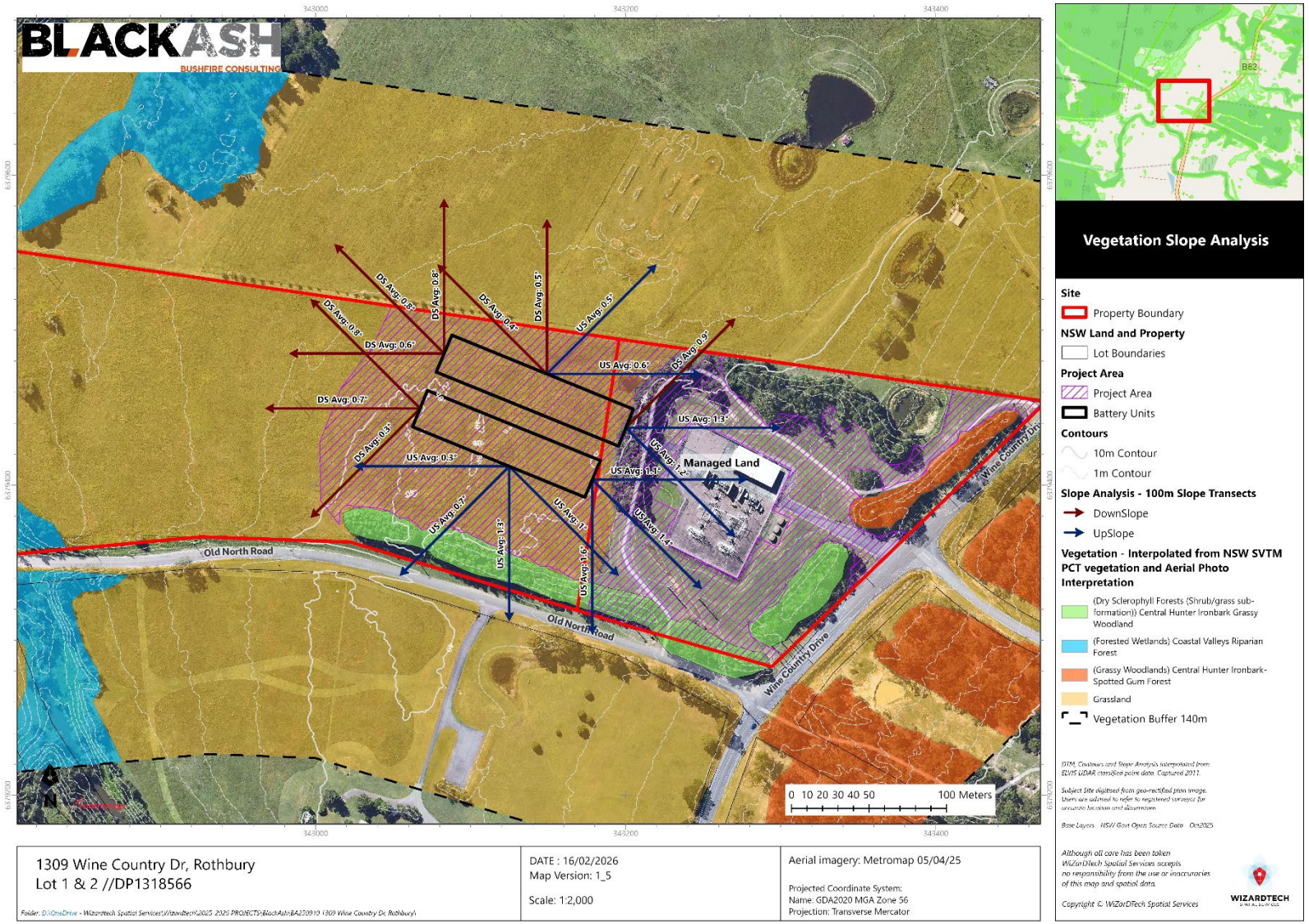


Figure 9: Vegetation and slope map

4.5. Bushfire Attack Assessment – APZ and Bushfire Attack Levels

As discussed in detail in Appendix 1, achieving the radiant heat flux standard of BAL-29 or <29 kW/m^2 is likely to provide a suitable risk management standard for the BESS components. The combination of fire weather (FFDI 100), moderate slope and grassland vegetation factors are used within the PBP methodology to analyse what APZ is required to provide the acceptable BAL-29 standard. As shown in Figure 11 the APZ provided **(12m)** exceeds the minimum 10m APZ required by PBP (p. 77) for "*structures and associated buildings/infrastructure*" for wind and solar farms.

Table A1.12.2

Minimum distances for APZs – residential development, FFDI 100 areas (≤29kW/m², 1090K)

KEITH VEGETATION FORMATION	EFFECTIVE SLOPE				
	Up slopes and flat	>0°-5°	>5°-10°	>10°-15°	>15°-20°
	Distance (m) from the asset to the predominant vegetation formation				
Rainforest	11	14	18	23	30
Forest (wet and dry sclerophyll) including Coastal Swamp Forest, Pine Plantations and Sub-Alpine Woodland	24	29	36	45	56
Grassy and Semi-Arid Woodland (including Mallee)	12	16	20	25	32
Forested Wetland (excluding Coastal Swamp Forest)	10	12	16	20	26
Tall Heath	16	18	20	22	25
Short Heath	9	10	12	13	15
Arid-Shrublands (acacia and chenopod)	6	7	8	9	10
Freshwater Wetlands	5	6	6	7	8
Grassland	10	12	13	15	17

Figure 10: Extract from PBP showing minimum APZ width for <29kW/m^2

The final Project Area will meet and/or exceed the minimum APZ required to provide a radiant heat load of <29kW/m^2 at the battery units and associated infrastructure. The ancillary infrastructure will be managed land and Class 7, 8 or 10 buildings which do not have specific requirements in PBP and will benefit from location within the overall APZ and boundary setbacks. The APZ is generally larger than the recommended <29kW/m^2, and it is noted that the south side of the Project footprint also benefits from the easement for the transmission lines.

Figure 11 shows the APZ of minimum 12m (and variable) width for the Project Area, and the indicative BAL ratings available are shown in Figure 12. Appendix 4 details establishment and maintenance requirements for an APZ per PBP.

Figure 11: APZ provided to BESS – meets and/or exceeds the minimum to achieve <29kW/m²

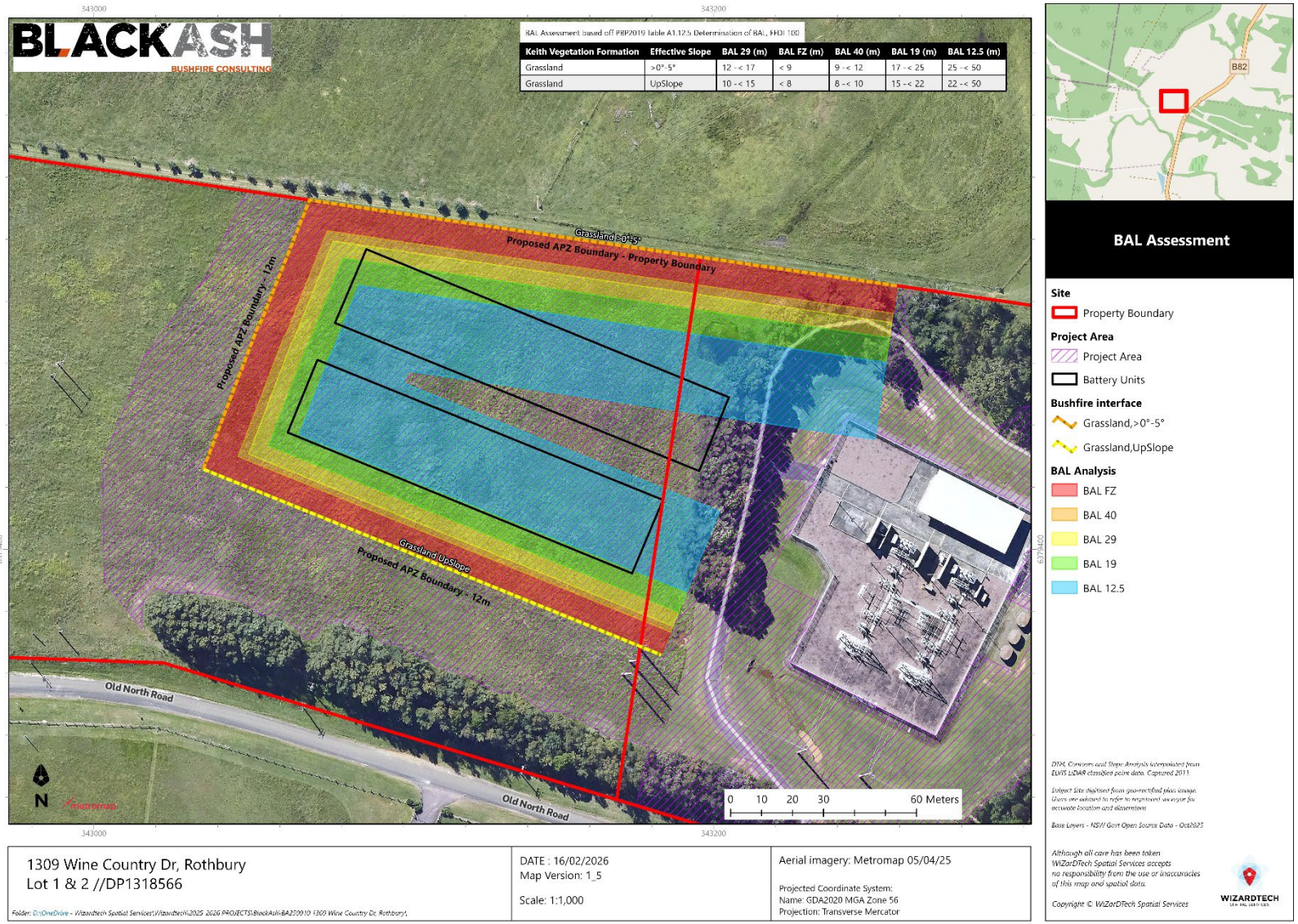


Figure 12: Indicative Bushfire Attack Levels onsite (from PBP Table A1.12.5)

The Project Area has been determined using a variety of influences including flood impacts and the need to accommodate the existing 132kV transmission line. This transmission line has an existing 45m wide easement that may be used to form the southern boundary of the final Project Area. The Project is required to mitigate multiple environmental impacts resulting from the development and one of these is to minimise acoustic impacts to surrounding properties. This will be achieved in part through the erection of an acoustic wall of 8.0m height. Ausgrid advises that the acoustic walls will meet the relevant AS/NZS standards for bushfire resistance and provide an additional fire separation measure.

Australian Standard 1530.8.1:2018 *Methods for fire tests on building materials, components and structures, Part 8.1: Tests on elements of construction for buildings exposed to simulated bushfire attack - Radiant heat and small flaming sources* and Australian Standard 1530.8.2 *Methods for fire tests on building materials, components and structures, Part 8.2: Tests on elements of construction for buildings exposed to simulated bushfire attack - Large flaming sources* are the relevant standards for building materials and building systems.

Acoustic walls constructed to the appropriate standard will partially shield the BESS from the flame contact and radiant heat impacts of bushfire. This further reduces any chance of a battery unit fire spreading to vegetation. The acoustic walls may be located anywhere within the APZ (subject to compliance with relevant section of AS 1530.8.1 or AS 1530.8.2 as applicable and the BAL map at Figure 12) as long as maintenance of the entire APZ can be practically managed ongoing.

Any APZ on the outside of the acoustic wall will consist of a permanent service trail around the site and mown grass. In accordance with Ausgrid management of substations and similar equipment there will be a complete absence of vegetation from much of the site, and the remainder of the Project Area will be established and maintained to APZ standards as shown for a typical site in Figure 14.

Appendix 5 considers the guidance provided by *NFPA 855 Standard for the Installation of Stationary Energy Storage Systems 2023* and reproduces material from four recent publicly available Fire Safety Studies (FSS). Appendix 5 demonstrates that it is unlikely a BESS module fire will ignite a bushfire through radiant heat flux. In the event of a BESS module self-igniting due to damage or malfunction, the radiant heat generated by a burning module will produce radiant heat levels at 10m setback of typically 1-4kW/m^2, which is unlikely to ignite vegetation.

The provision of an APZ to the BESS infrastructure reduces radiant heat level from a bushfire at the assets to <29kW/m^2. The generation of radiant heat by a battery unit fire of typically 1-4kW/m^2, combined with a minimum APZ of 12m will not be likely to ignite nearby vegetation.

The setbacks to protect the Project from bushfire will therefore provide a secondary benefit of preventing bushfire ignition from any potential battery unit fire.

4.6. Access and Egress

The nature of the Project involves construction of internal site roads and upgraded connection to the public road system. These will be required to be built and maintained to heavy vehicle standard for Project operation (e.g. cranes, floats, concrete mixers, heavy vehicles). There are no specific standards detailed in PBP for access requirements for a BESS. Instead, the access standards in PBP that facilitate fire tanker operation will be sufficient to allow evacuation from the site to occur whilst firefighters are attending and firefighting are considered sufficient and relevant.

Access can be conditioned to comply with the aim and objectives of PBP.

4.7. Water supplies

The nature of the Project involves road building works, earthworks and concrete mixing, all of which require water supplies. The Fire Safety Study (FSS) that will be required by NSW Fire & Rescue following development approval, and prior to detailed design stage will include details such as firefighting water quantity, locations and access. The site is large and in single ownership with adequate room for future firefighting water supplies to be provided.

Water supplies can be conditioned to comply with the aim and objectives of PBP.

4.8. Landscaping

As discussed above, the site is in single ownership which simplifies ongoing APZ and landscaping management. Should there be a requirement for landscaping to manage site aesthetics or views, these can be established in accordance with APZ standards and/or at sufficient distance from the BESS to maintain the minimum 10m APZ. The Project will be managed consistent with existing Ausgrid practices for substations – that is excluding combustible material directly adjacent and maintenance of remaining vegetation (Figure 14).

Landscaping can be conditioned to comply with the aim and objectives of PBP.

4.9. Emergency management arrangements

Effective emergency planning provides for the safety of site personnel, emergency responders and the community.

An emergency management and planning process, informed by the RFS *Guide to Developing a Bushfire Emergency Management Plan* and AS 3745-2010: *Planning for emergencies in facilities*, and the NSW Hazardous Industry Planning Advisory Papers will be undertaken.

These documents provide the framework for the development of a Bushfire Emergency Management & Operations Plan (BEMOP) and a Bushfire Emergency Response Plan (BERP). These should be developed in consultation with the local Bush Fire Management Committee (BFMC) and include detailed information regarding ongoing maintenance of bushfire protection measures, relevant staff training, location and signage indicating firefighting infrastructure onsite, and a Pre Incident Plan (PIP) developed with local emergency services.

A Project BEMOP and BERP must include:

- Emergency procedures for fires within, and in the vicinity of, the BESS site.
- Details of any triggers or circumstances for modifying or ceasing BESS operation, such as approach of bushfire/grassfire to the facility.

Emergency management arrangements can be conditioned to comply with the aim and objectives of PBP

Figure 15 shows that there are 7 RFS brigades within approximately 20 minutes response time of the Project. North Rothbury RFS brigade and Branxton Fire & Rescue Brigade are located within less than 10 minutes drive of the Project. This indicates there are both significant nearby first attack firefighting resources in addition to any onsite capability, and the capability for a significant weight of attack response to be provided to any fire occurring on or impacting the site.

The nature of BESS infrastructure is that it is typically equipped with early warning and fire suppression systems linked to local emergency services. This will be considered further as part of the FSS.

Suitable emergency management arrangements can be developed during final design stages and prior to construction.

Figure 13: Landscaping management at existing Rothbury Zone Substation demonstrating BESS footprint treatment

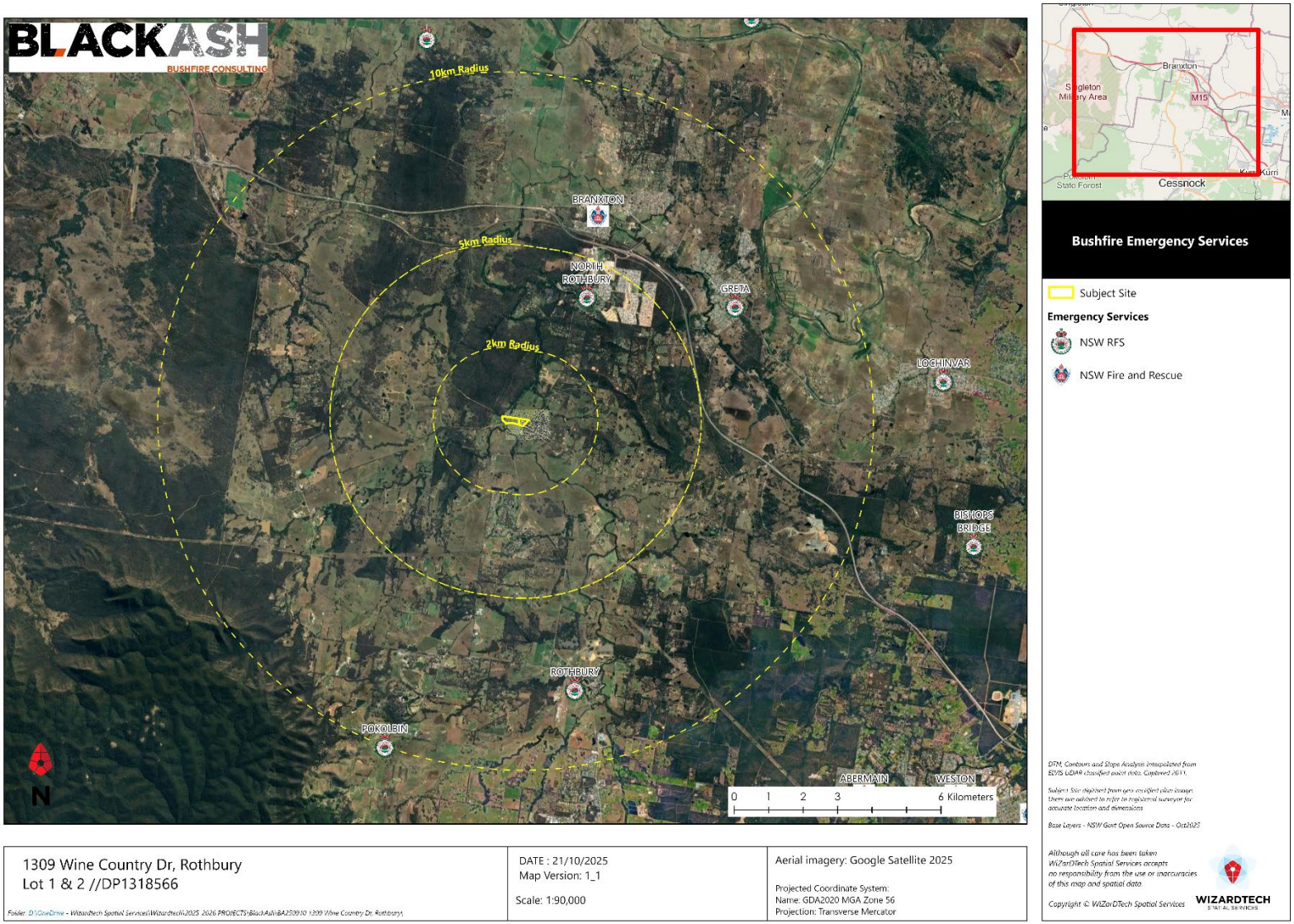


Figure 14: Local firefighting resources

5. Bushfire risk created by the Project

Fire risks have been identified and must be effectively managed during the construction, operation, and decommissioning of the Project.

5.1. Assessment of bushfire risk during construction and decommissioning

The potential sources of ignition of bushfires resulting from the construction of the Project and during decommissioning include:

- Construction equipment including bulldozers, excavators and vegetation removal machinery using slashers and mulching machines. These activities can produce sparks when steel blades encounter rock, with the potential to ignite surrounding vegetation.
- Motor vehicle exhaust systems and diesel-powered trucks with pollution control devices have the potential to emit burning diesel particles and ignite grassland and woodland ground fuels.
- Hot works such as welding and grinding can produce sparks resulting in an extreme level of risk of ignition for cured vegetation.
- Electrical equipment faults create a high level of risk of ignition of vegetation.
- Inappropriate storage of chemicals has the potential to cause a chemical fire or explosion. Failure to clean up a spill can also lead to fire; and
- Arson.

In general, the risk of bushfire impact during construction is dependent on factors such as fuel loads, weather and the scale (size) of fires which may occur. There is a very limited threat to construction personnel or firefighters from fast moving bushfire events which may impact the Project Area. Staff training, provision of firefighting water supplies and the availability of first attack firefighting equipment can be conditioned at the later stages of the Project.

5.2. Assessment of bushfire risk during operation

Section 3 of this report demonstrates the site is of Low Risk of impact by bushfire.

Section 4 of this report considers the provision of bushfire protection measures and demonstrates the Project will have bushfire risk which can be mitigated to an acceptable level. Similarly, there is little risk of a battery unit fire igniting a bushfire given the physical separation of the BESS from native vegetation.

Using the mitigation strategies recommended in this report, the risk of the BESS operation igniting a bushfire is an unlikely possibility due to the moderate slopes and very limited vegetation. The FSS will manage fire risk associated with BESS operation, with any fire spread to surrounding vegetation being managed via staff training, provision of firefighting water supplies and the availability of first attack firefighting equipment.

There is substantial area onsite to provide for necessary infrastructure such as firefighting water supplies and access, and these details can be finalised and conditioned through the FSS and BEMOP during later stages of the Project.

6. PBP Compliance Summary

Table 2 provides a compliance summary incorporating relevant and comparable elements of PBP, specifically the aim and objectives, Section 8.3.5 Wind and solar farms, and Section 8.3.9 Hazardous Industry.

Table 2: Summary of compliance with PBP

PBP requirements	Comment	Complies?
Comply with PBP Aim & Objectives (p.10)	The Project has been developed to incorporate a suite of bushfire risk mitigation measures that are incorporated into the layout and include consideration for ongoing maintenance of all bushfire protection measures and incorporation into local bushfire planning.	**Yes**
Section 8.3.5 - Wind and solar farms (p. 77)	APZs that meet and exceed the standard are provided; suitable access will be available; essential equipment is designed and housed to both minimise the impact of a bushfire, and to minimise risk to surrounding vegetation; and a BEMOP, including sub-plans, will be developed during later Project stages.	**Yes**
A minimum 10m APZ for the structures and associated buildings / infrastructure;	The Project is provided with a minimum 10m APZ around the BESS and its associated infrastructure. The Project area will be maintained to APZ standards during operation. The remainder of the site will be maintained to typical rural standards through slashing and grazing.	**Yes**
The APZ must be maintained to the standard of an Inner Protection Area (IPA) for the life of the development	The Project will be continually maintained to IPA standard as part of normal operations (refer to Appendix 3). This can be conditioned and will be part of the BEMOP.	**Yes**

PBP requirements	Comment	Complies?
Essential equipment designed and housed to minimise impact of bushfires, and to not serve as a bushfire risk.	All infrastructure is designed and sited to reduce the impact of bushfires, and to prevent bushfire risk. This uses a combination of APZ, hardstand areas around critical components, internal access roads, initial attack firefighting capability and water supplies will be provided on site. Further detail of the design will be outlined in the FSS and BEMOP.	**Yes**
Detailed BEMOP to be produced	This will be developed as part of next stage following the FSS and will be key part of ongoing operations. A BERP will be a sub-plan of the BEMOP.	**Yes**
Comply with Total Fire Ban Day (TOBAN) requirements under RF Act s.99	All construction and operations will be conditioned to comply with TOBAN requirements.	**Yes**
Section 8.3.9 – Hazardous industry (p. 79)	All construction, operations and decommissioning will be conditioned to be consistent with the relevant HIPAPs.	**Yes**
Development should be avoided on bushfire prone land	The Project site is of Low Risk of bushfire impact.	**Yes**
A Fire Safety Study should be prepared under the DPHI HIPAPs	An FSS is typically required by NSW Fire and Rescue and would be developed following the receipt of development consent. This can be conditioned.	**Yes**

7. Recommendations

The following recommendations have been made within this report to ensure the proposed development is compliant with *Planning for Bush Fire Protection 2019*:

Recommendation 1: APZ will be established in accordance with Figure 11 and maintained in accordance with PBP Appendix 4. The entire site is to be managed in accordance with standard Ausgrid substation procedures.

Recommendation 2: The acoustic walls (all components, materials and building system) are to be certified and installed in accordance with AS 1530.8.1 or AS 1530.8.2 as suitable for the Bushfire Attack Level (BAL) for their location in accordance with the BAL Map shown as Figure 12.

Recommendation 3: Access onsite to ensure a Medium Rigid firefighting vehicle can provide firefighting assistance to all Project components via an unobstructed path within 70m of truck access area using a maximum of two hose lengths in accordance with property access requirements of PBP.

Recommendation 3: This BAR should be used to inform a future FSS. The FSS will determine the quantum and location/s of bushfire fighting water supply.

Recommendation 4: Prior to construction certificate stage a BEMOP and BERP (including a Pre Incident Plan) are to be developed for the Project in consultation with emergency services. These plans should be reviewed at least every five years and after any significant fire event in the immediate area. Copies of these plans are to be provided to local emergency services.

8. Conclusion

This Bushfire Risk Assessment has examined the proposed development of the Rothbury BESS, located adjacent to the existing Ausgrid Rothbury Zone substation.

The bushfire risk associated with the proposed Project has been considered and recommendations have been provided that will:

- Satisfies the SEARs (SSD-85939708)
- Meet and/or exceeds PBP requirements for wind and solar farm infrastructure,
- Significantly reduce the risk of a bushfire impacting the BESS,
- Significantly reduce the chance of the BESS igniting a bushfire,
- Provide comfort to the community that a BESS module fire is very unlikely to cause a bushfire,
- Provide sufficient space, firefighting equipment and water supplies for active firefighting, and
- Provide significant management assistance for a future FSS that is expected to be required as a condition of consent.

Whilst the bushfire risk is assessed as Low Risk, there is a possibility of bushfire occurring at the site over the asset life of up to 30 years. The risk to life and Project infrastructure can be mitigated relatively simply through good Project planning requirements, including a minimum 10m wide Asset Protection Zone, and good ongoing emergency management planning. Recommendations have been provided to provide passive protection and the future FSS will require additional measures to limit the potential for an uncontrolled fire starting at the site and spreading outwards.

The Project complies with *Planning for Bush Fire Protection 2019*. The location of the BESS is considered acceptable and practical provided appropriate bushfire protection measures are employed, including suitable and effective APZ setbacks, construction within tolerable radiant heat levels, adequate water supply, road and trail access arrangements and emergency management planning.

There is the potential for significant public benefits arising from the proposal and the Project overall provides a long-term contribution to the energy transition. The proposed Project can be supported with respect for managing the potential for bushfire risk.

David Lemcke | Senior Planner & Bushfire Specialist

Blackash Bushfire Consulting

Master of Environmental Planning; Grad. Dip. Bushfire Protection; Grad. Dip. Urban & Regional Planning; B.A.; Adv. Dip. Of Public Safety (Emergency Management); Dip. Management.

Fire Protection Association of Australia BPAD Level 3 - 68670

Lew Short | Principal

Blackash Bushfire Consulting

B.A., Grad. Dip. (Design for Bushfires), Grad. Cert. of Management (Macq), Grad. Cert. (Applied Management); Fire Protection Association of Australia BPAD Level 3 - 16373

Appendix 1 - Bushfire Attack Assessment – rationale and approach

An APZ is a fuel-reduced area surrounding a built asset or structure which provides a buffer zone between a bushfire hazard (fuel) and an asset. An APZ is land that has vegetation removed or maintained to a level that limits the spread and impact of bushfire. The APZ provides separation which reduces the potential for direct flame contact and reduces radiant heat. It provides a defendable space within which firefighting operations can be carried out. The RFS APZ management requirements are detailed in PBP Appendix 4.

Infrastructure associated with the Project should be designed in such a way so as to minimise the impact of bushfire on the infrastructure and ensure that the infrastructure does not cause a bushfire, and that minimises the risk that capabilities of the infrastructure are compromised during bushfire emergencies. Bushfire Protection Measures (BPM) should be commensurate with the bushfire risk and criticality of the infrastructure.

A BESS is considered as 'other development' in PBP. 'Other development' includes industrial, commercial and infrastructure development. Whilst PBP does not have specific requirements for BESSs, the methodology and standards used by PBP for building construction can be used in combination with power industry standards to provide a methodology to demonstrate compliance with the aim and objectives, and to consider appropriate levels of protection for the BESS. It is noted there are currently no minimum or maximum numerical standards for radiant heat flux impacting a BESS applied in any planning or other standards in Australia.

In the absence of standards and benchmarks that apply to bushfire risk reduction on 'other development' such as BESS, there is a need to consider a variety of guidelines, standards and references that have relevance. Figures 15-19, as described below, include various elements that can be applied to BESS developments. The focus is on demonstrating compliance with the intent of PBP Section 8.3.5 Wind and Solar Farms:

> *Wind and solar farms require special consideration and should be provided with adequate clearances to combustible vegetation as well as firefighting access and water.*

Figures 15 & 16 are taken from standard references long used in state planning and building frameworks in NSW and Victoria and referenced in Australian Standard *AS 3959:2018 Construction of buildings in bushfire-prone areas* (AS3959). These have been annotated and highlighted to emphasise the standards permissible for residential bushfire construction. This in turn relates to well established evidence regarding the impacts of radiant heat flux, which can also be applied to critical infrastructure. BAL-29 is the minimum standard for the creation of new residential lots in NSW, focusing on managing costs to a tolerable level for residential

homebuilders, related to the impact of that level of radiant heat flux on a range of building materials and components.

BAL-29 is a well-understood and practical standard, that has the advantage of having RFS "acceptable solution" modelling readily available in PBP. This also allows use of images and tables scaffolded by AS3959 and adopted by industry to simplify shared understanding between proponents and regulators about what impacts of radiant heat are being managed.

The BAL-29 standard aligns well to the industry standards that follow in Figures 17-19, with respect to components that are analogous to BESS components, and to the substation design for the site.

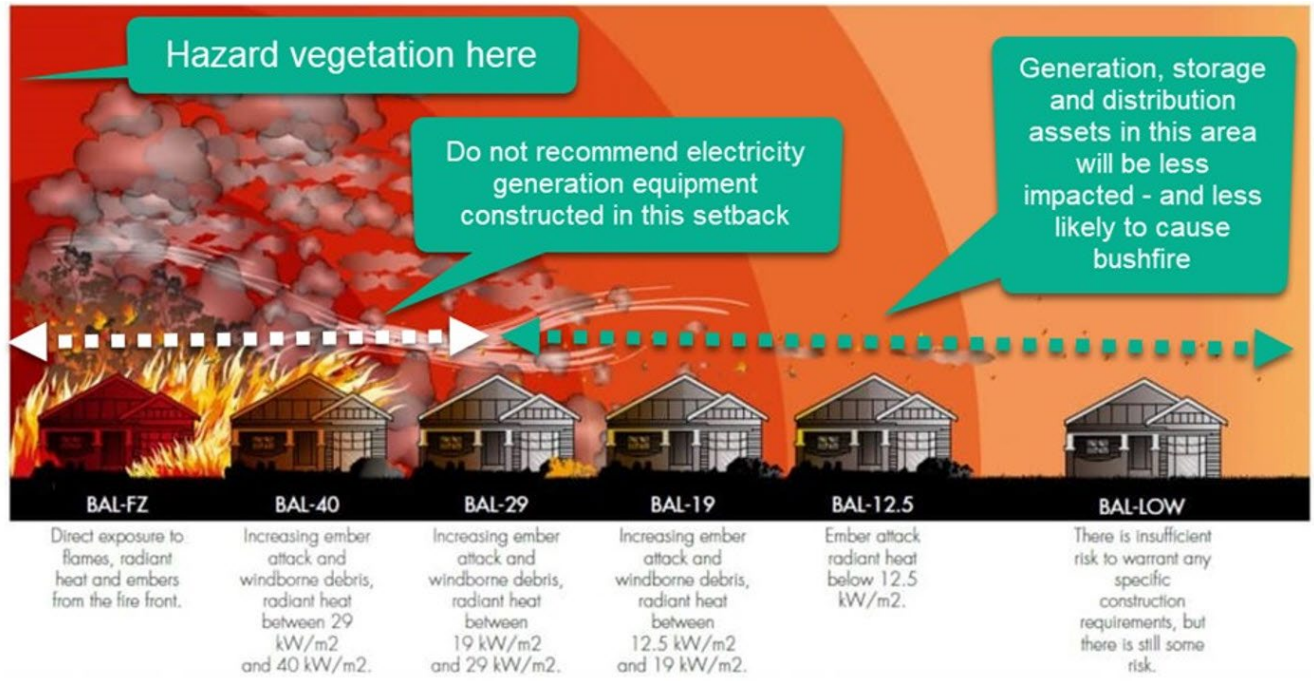


Figure 15: Bushfire attack mechanisms and relationship to radiant heat flux and building standards (CFA 2012; AS3959 2018)

Radiant heat flux kW/m²	Observed effect
1	Maximum for indefinite skin exposure
3	Hazardous conditions, firefighters expected to operate for a short period (10 minutes)
4.7	Extreme conditions, firefighters in protective clothing will feel pain after 60 seconds of exposure
6.4	Pain after 8 seconds of skin exposure
7	Likely to be fatal to unprotected person after exposure for several minutes
10	Critical conditions, firefighters not expected to operate in these conditions although they may be encountered. Considered to be life threatening in less than 60 seconds in protective equipment. Fabrics inside a building could ignite spontaneously with long exposure.
12.5 (BAL-12.5)	Volatiles from wood may be ignited by pilot after prolonged exposure. Standard float glass could fail during the passage of a bushfire.
16	Blistering of skin after 5 seconds
19 (BAL-19)	Screened float glass could fail during the passage of a bushfire.
29 (BAL-29)	Ignition of most timbers without piloted ignition (3 minutes of exposure) during the passage of a bushfire. Toughened glass could fail.
40+	Flame zone – exposure to direct flame contact from fire front

Figure 16: Observed effects of radiant heat flux (RFS, 2006; CFA, 2012)

Figure 17 is a highlighted extract from the Ausgrid Network Standard NS 187 Passive Fire Mitigation Design of Major Substations (amendment 2, 2020). This depicts the standards used in the development of major substations for this NSW network provider as it relates to bushfires. Each renewable energy generation facility or BESS is linked into the grid via a substation, and there are components and industry risk management approaches for substations that can be considered as a framework for a suitable standard for BESS until specific standards are developed.

The BAL-29 or <29kW/m^2 standard aligns with recognised protection of most key components of substations in this document.

A typical radiant heat / temperature duration curve applicable to bushfires would be as follows:

- Peak values are reached after 1 minute;
- Values remain at peak for up to 4 minutes; and
- Values recede to ambient linearly over a further 5 minutes.

Refer to Table 3 for limiting radiant heat flux levels for determining minimum safe separation distances. For bushfires, the NSW RFS PBP is the key reference document in establishing the maximum bushfire intensity at a given location. A flame front length equal to the approach boundary length is to be assumed and a flame height based on the PBP shall be used in calculations.

Table 3 – Radiant Heat Exposure Limits for Bushfires

Item	Maximum allowable radiant heat flux (kW/m^2)	Comment
Cable	12.5 20	PVC Cables begin to distort and may ignite. Ignition of XLPE cables between 85 and 550 seconds.
Steel support structure	35	To 60% of yield strength after a maximum duration of 5 minutes. Applies where elastic deflections due to elevated temperatures are not critical.
Porcelain bushing/Insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Polymeric bushing/insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 2.
Aluminium busbar	20	Based on 250°C after a maximum duration of 5 minutes. Comparable to withstand temperature under fault conditions.
Copper busbar	25	Busbars may undergo significant distortion and impose significant stresses on rigid insulators.
Transformer tank	>35 (see Note 1)	Refer to above regarding bushings and cables.
Combustibles	12.5	Piloted ignition may occur on timber.

Note 1. Transformers always have some more vulnerable components such as bushings and cables etc. Refer to Clause 7.2.

Note 2. Detailed information on radiant heat exposure limits is not available. However in-service applications exposed to bushfire indicate a high radiant heat limit and a low risk of damage or failure.

The radiant heat limits provided in Table 3 are applicable to identified critical substation structures and HV components. Critical elements are those deemed to be essential for return to service following a bushfire event.

The location of critical substation elements, their sensitivity to radiant heat and their ease of replacement will all impact upon the potential Asset Protection Zone (APZ) required at a given substation.

APZ widths may potentially reduce where critical exposed elements nearest the boundary are able to be locally protected and/or rapidly replaced following a bushfire event.

Substation design should aim for a high level of bushfire protection for critical assets and a rapid return to service following a bushfire event.

Figure 17: Extract from Ausgrid Network Standard 187 Passive Fire Mitigation Design of Major Substations

Figure 18 is taken from a similar Institute of Electrical & Electronics Engineers (IEEE) paper (*IEEE Guide for Substation Protection 2012 p.49*) which is in common usage in multiple countries including the United States where it was developed. This standard is currently under review; however, this is the current guideline. The BAL-29 or <29kW/m^2 standard aligns with recognised protection of most key components of substations in this document.

This industry standard specifically addresses major electricity Project infrastructure, and this may reasonably be related to a BESS. In particular, the damage to unprotected metal occurring at 30kw/m^2 is likely analogous to a BESS, and another indication that the BAL-29 standard is suitable.

Impact of radiant heat flux	Heat flux (kW/m^2)
Sufficient to cause damage to process equipment	37.5
Equipment failure	35
Damage to unprotected metal	30
Spontaneous ignition of wood	25
Cable insulation degrades	20
Pilot ignition of wood	12.5
Plastic melts	12.5
Pain threshold reached after 8 s Second-degree burns after 20 s	9.5
Possible failure of ceramic bushings	5
Skin burns	5

Reproduced from IEEE Std 979-2012: IEEE Guide for Substation Fire Protection

Figure 18: Extract from IEEE Guide for Substation Fire Protection (2012)

Figure 19 is an extract from Appendix 1 of *Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning* (Department of Planning 2011, p. 21) that also considers the consequences of radiant heat flux. This provides another indication that the BAL-29 standard is suitable when considering the appropriate standard to protect BESS components from a bushfire.

Table 6: Consequences of Heat Radiation

Heat Radiation (kW/m^2)	Effect
1 .2	Received from the sun at noon in summer
2.1	Minimum to cause pain after 1 minute
4.7	Will cause pain in 1 5-20 seconds and injury after 30 seconds' exposure (at least second degree burns will occur)
12.6	• Significant chance of fatality for extended exposure. High chance of injury • Causes the temperature of wood to rise to a point where it can be ignited by a naked flame after long exposure • Thin steel with insulation on the side away from the fire may reach a thermal stress level high enough to cause structural failure
23	• Likely fatality for extended exposure and chance of fatality for instantaneous exposure • Spontaneous ignition of wood after long exposure • Unprotected steel will reach thermal stress temperatures which can cause failure • Pressure vessel needs to be relieved or failure would occur
35	• Cellulosic material will pilot ignite within one minute's exposure • Significant chance of fatality for people exposed instantaneously

Figure 19: Appendix 1, Table 6 HIPAP No. 4 (NSW Department of Planning)

In summary, consideration of relevant analogous industry documents has been undertaken to work towards determining a suitable standard for radiant heat protection from a bushfire for typical BESS components. Review of these materials suggests that the BAL-29 or <29kW/m2 standard is likely to provide suitable risk mitigation. Such APZ distances associated with meeting the standard will also provide significant risk reduction of a BESS unit fire igniting vegetation that ultimately leads to a bushfire.

Appendix 2 - References

NSW Rural Fire Service (RFS). 2019. *Planning for Bushfire Protection: A Guide for Councils, Planners, Fire Authorities, Developers and Home Owners.* Australian Government Publishing Service, Canberra

Standards Australia. 2014. The storage and handling of LP Gas, AS/NZS 1596:2014, SAI Global, Sydney.

Standards Australia. 2018. Construction of buildings in bushfire-prone areas, AS 3959-2018. SAI Global, Sydney.

Australian Building Codes Board Building Code of Australia Volumes 1&2

Keith, David (2004) – Ocean Shores to Desert Dunes – The Native Vegetation of New South Wales and the ACT. The Department of Environment and Climate Change

NSW Rural Fire Service (2015) Guide for Bushfire Prone Land Mapping

NSW Government (1979) Environmental Planning and Assessment Act 1979.

Appendix 3 - Curriculum Vitae

BLACKASH
BUSHFIRE CONSULTING

Curriculum Vitae

David Lemcke
Senior Planner & Bushfire Specialist
BlackAsh Bushfire Consulting
T: 0439 220 464 E: david.lemcke@blackash.com.au

Summary

David is an experienced bushfire, planning and land management professional with over 20 years in local government and 4 years as a private sector bushfire consultant. He has undertaken a wide range of development assessments and strategic planning projects in both regulatory and proponent roles. He was Central Coast Council's bushfire subject matter expert for over 15 years, including representation in the Land & Environment Court and numerous working groups. He has a deep understanding of contemporary, practical bushfire management from a range of perspectives due to decades of experience as a public land manager and a Rural Fire Service (RFS) volunteer, and now applies this expertise with a range of clients across the private and public sectors.

David has served as Council's staff representative on the Wyong and Central Coast Bushfire Management Committees since 2007 and was instrumental in developing and contributing to emergency management planning including preparation of Bush Fire Risk Management Plans, Fire Access & Fire Trail Plan, developing local policy and pre-incident planning, and delivering community engagement.

From 2010 he was the program manager for the Wyong Shire Council and then Central Coast Council (CCC) bushfire program. These programs won several awards, sponsored research and were renowned for innovation and improvement of local government bushfire management. The CCC program included management of over 220 fire trails, management of 275 mechanical Asset Protection Zones, Hazard Reduction burning, access management, environmental protection and community engagement using both contractors and internal staff teams.

David has been active in policy development at State level, being the Local Government NSW representative on numerous RFS policy committees including the Review of the Bushfire Environmental Assessment Code and delivering numerous conference presentations.

David is an active senior RFS volunteer, with 23 years in the service, having been a field officer for 18 years.

Areas of Expertise

- Rezoning and strategic bushfire studies
- Residential, commercial and industrial development assessment
- Infrastructure vulnerability and consequence management
- Bushfire planning, design & construction requirements in accordance with National Standards
- Bushfire Management Plans for large and small scale holdings
- Evacuation planning and implementation
- Technical and strategic advice
- Innovative policy development

Qualifications

BPAD Level 3
Accredited Practitioner
Fire Protection Association of Australia - 68670

Graduate Diploma of Bushfire Protection
Western Sydney University, 2025.

Advanced Diploma of Public Safety (Emergency Management)
Australian Emergency Management Institute, 2015

Diploma of Management
Management Consultancy International, 2012

Master of Environmental Planning
Macquarie University, 2005

Graduate Diploma Urban & Regional Planning
University of New England, 2000

Certificate 2 Bush Regeneration
Blue Mountains TAFE, 2000

Bachelor of Arts (Geography)
University of New England, 1998

Rural Fire Service
Various foundational, technical, specialist and incident management qualifications
2002 - current

BLACKASH
BUSHFIRE CONSULTING

Curriculum Vitae

Lew Short
Director BlackAsh Bushfire Consulting
T: 0419 203 853 E: lew.short@blackash.com.au

Summary
Lew is an experienced leader in the government and emergency sector. He has an intimate knowledge of the workings of government and how emergency service organisations operate. He is not only a technical expert but a practitioner who has deep industry knowledge.

Lew has extensive experience providing national leadership in building community resilience representing AFAC and the FPAA. Lew's technical expertise is in bushfire consequence management, risk assessment and mitigation, specifically the planning and design of new developments in high bushfire risk areas to comply with legislative and planning requirements.

Lew has worked with some of Australia's leading organisations including NSW Rural Fire Service, Country Fire Authority, Emergency Management Victoria, Lend Lease, Mirvac, Victorian State and Local Governments, Sydney Water Corporation, Great Lakes and Warringah Councils.
Lew has a deep operational understanding of how fire works in the Australian landscape. He has multifaceted insight into how governments respond to this threat. Lew provides unique strategies to comply with regulatory requirements and safety outcomes.

Lew established and led the Community Resilience Group for the New South Wales Rural Fire Service (RFS). His areas of responsibility included land use planning, community engagement, education, vulnerable communities, bunkers, Neighbourhood Safer Places, business systems and projects, social media, integrated risk management and environmental management. He was responsible for the establishment, management and leadership of the development assessment function for the RFS at a State level where he was responsible for the assessment of over 80,000 development applications in Bush Fire Prone Areas.

Areas of Expertise

- Landuse planning & consequence management
- Legal strategy, Land & Environment Court and Expert Witness
- Bushfire planning, design & construction requirements in accordance with National Standards
- Insurance threat, vulnerability and constraints assessments
- Bushfire Prone Mapping, hazard mapping and risk assessments
- Australian Standard AS3959 Construction of Buildings in Bushfire Prone Areas
- Bushfire Management Plans
- Alternative & performance based solutions
- Evacuation planning and implementation
- Technical and Strategic advice

Qualifications / Accreditation

BPAD Level 3 Accredited Practitioner
Fire Protection Association of Australia

Graduate Diploma of Bush Fire Design
University of Western Sydney, 2006

Graduate Certificate of Applied Management
Australian Institute of Police Management, 2005

Graduate Certificate of Management Macquarie
Graduate School of Management Macquarie University, 2001

Bachelor of Arts, Resource and Environmental Management
Macquarie University, 1994

Appendix 4 - Asset Protection Zone Requirements

Source PBP 2019. P. 106-108

APPENDIX 4

ASSET PROTECTION ZONE REQUIREMENTS

In combination with other BPMs, a bush fire hazard can be reduced by implementing simple steps to reduce vegetation levels. This can be done by designing and managing landscaping to implement an APZ around the property.

Careful attention should be paid to species selection, their location relative to their flammability, minimising continuity of vegetation (horizontally and vertically), and ongoing maintenance to remove flammable fuels (leaf litter, twigs and debris).

This Appendix sets the standards which need to be met within an APZ.

A4.1 Asset Protection Zones

An APZ is a fuel-reduced area surrounding a building or structure. It is located between the building or structure and the bush fire hazard.

For a complete guide to APZs and landscaping, download the NSW RFS document *Standards for Asset Protection Zones* at the NSW RFS Website www.rfs.nsw.gov.au.

An APZ provides:

- a buffer zone between a bush fire hazard and an asset;
- an area of reduced bush fire fuel that allows for suppression of fire;
- an area from which backburning or hazard reduction can be conducted; and
- an area which allows emergency services access and provides a relatively safe area for firefighters and home owners to defend their property.

Bush fire fuels should be minimised within an APZ. This is so that the vegetation within the zone does not provide a path for the spread of fire to the building, either from the ground level or through the tree canopy.

An APZ, if designed correctly and maintained regularly, will reduce the risk of:

- direct flame contact on the building;
- damage to the building asset from intense radiant heat; and
- ember attack.

The methodology for calculating the required APZ distance is contained within Appendix 1. The width of the APZ required will depend upon the development type and bush fire threat. APZs for new development are set out within Chapters 5, 6 and 7 of this document.

In forest vegetation, the APZ can be made up of an Inner Protection Area (IPA) and an Outer Protection Area (OPA).

A4.1.1 Inner Protection Areas (IPAs)

The IPA is the area closest to the building and creates a fuel-managed area which can minimise the impact of direct flame contact and radiant heat on the development and act as a defendable space. Vegetation within the IPA should be kept to a minimum level. Litter fuels within the IPA should be kept below 1cm in height and be discontinuous.

In practical terms the IPA is typically the curtilage around the building, consisting of a mown lawn and well maintained gardens.

When establishing and maintaining an IPA the following requirements apply:

Trees

- tree canopy cover should be less than 15% at maturity;
- trees at maturity should not touch or overhang the building;
- lower limbs should be removed up to a height of 2m above the ground;
- tree canopies should be separated by 2 to 5m; and
- preference should be given to smooth barked and evergreen trees.

Shrubs

- create large discontinuities or gaps in the vegetation to slow down or break the progress of fire towards buildings should be provided;
- shrubs should not be located under trees;
- shrubs should not form more than 10% ground cover; and
- clumps of shrubs should be separated from exposed windows and doors by a distance of at least twice the height of the vegetation.

Grass

- grass should be kept mown (as a guide grass should be kept to no more than 100mm in height); and
- leaves and vegetation debris should be removed.

A4.1.2 Outer Protection Areas (OPAs)

An OPA is located between the IPA and the unmanaged vegetation. It is an area where there is maintenance of the understorey and some separation in the canopy. The reduction of fuel in this area aims to decrease the intensity of an approaching fire and restricts the potential for fire spread from crowns; reducing the level of direct flame, radiant heat and ember attack on the IPA.

Because of the nature of an OPA, they are only applicable in forest vegetation.

When establishing and maintaining an OPA the following requirements apply:

Trees

- tree canopy cover should be less than 30%; and
- canopies should be separated by 2 to 5m.

Shrubs

- shrubs should not form a continuous canopy; and
- shrubs should form no more than 20% of ground cover.

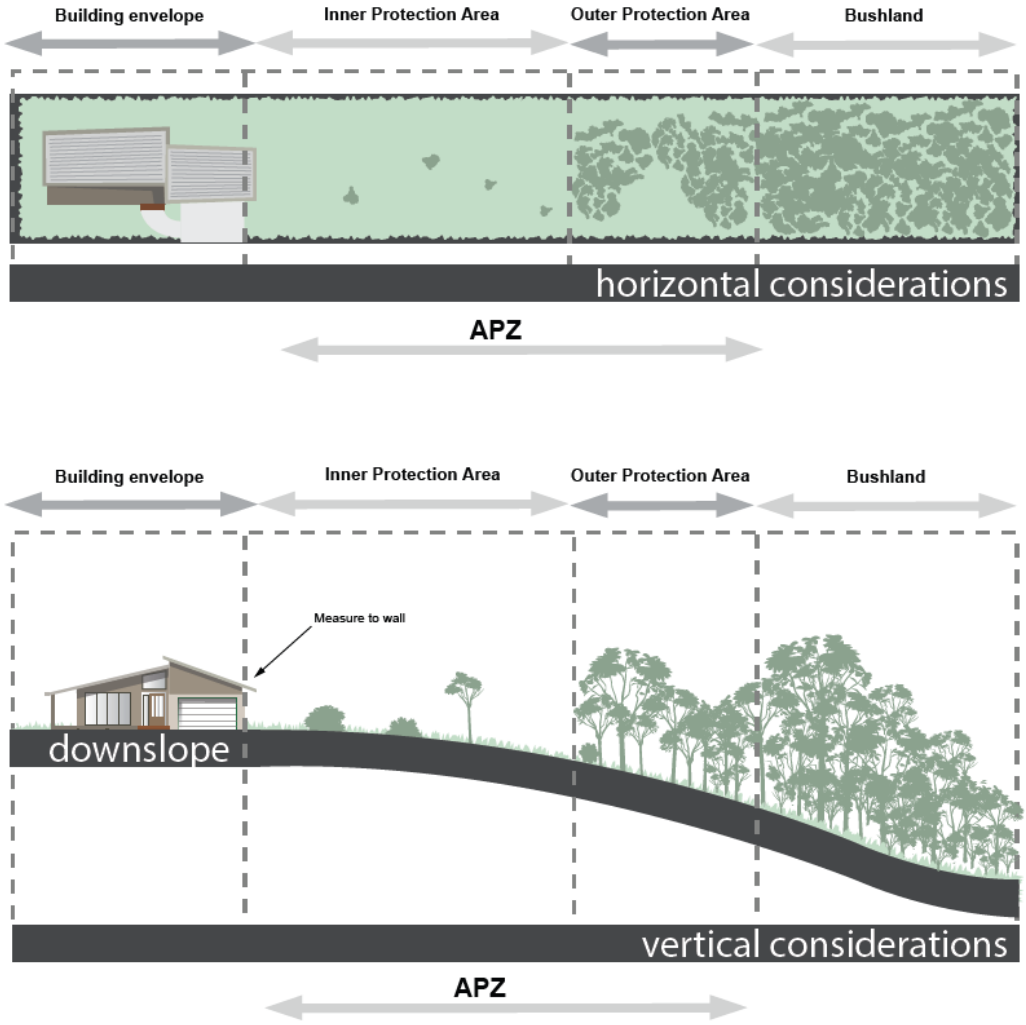
Grass

- grass should be kept mown to a height of less than 100mm; and
- leaf and other debris should be removed.

An APZ should be maintained in perpetuity to ensure ongoing protection from the impact of bush fires. Maintenance of the IPA and OPA as described above should be undertaken regularly, particularly in advance of the bush fire season.

Figure A4.1

Typical Inner and Outer Protection Areas.



Appendix 5 - BESS Fire Safety Study examples

BESS Fire Safety Study examples – generation of radiant heat by battery module under thermal runaway

This appendix considers the guidance provided by NFPA 855 Standard for the Installation of Stationary Energy Storage Systems 2023 and reproduces material from four recent publicly available Fire Safety Studies (FSS). The purpose is to demonstrate that it is unlikely a BESS module fire will ignite a bushfire through radiant heat flux.

There are many different models and configurations and this range appears representative through material presented. Different batteries tested will have variations however Original Equipment Manufacturers (OEMs) use a range of fire engineering methods and have standard separation distances between modules, typically 2.44m-3.5m, as suitable to prevent module to module fire propagation.

The provision of an APZ to the BESS infrastructure to reduce radiant heat level from a bushfire at the assets to <29kW/m^2, will in turn provide a setback to reduce the radiant heat from a BESS module fire at nearby vegetation and prevent bushfire ignition.

Analysis of 4 recent publicly available Fire Safety Studies shows the radiant heat flux out from a burning battery module is typically 1-4kW/m2 at a distance of 10m from module.

In the event of a BESS module self-igniting due to damage or malfunction, the radiant heat generated by a burning module will produce radiant heat levels at the 10m setback that are very unlikely to ignite vegetation.

Appendix G – Flame tilt calculations

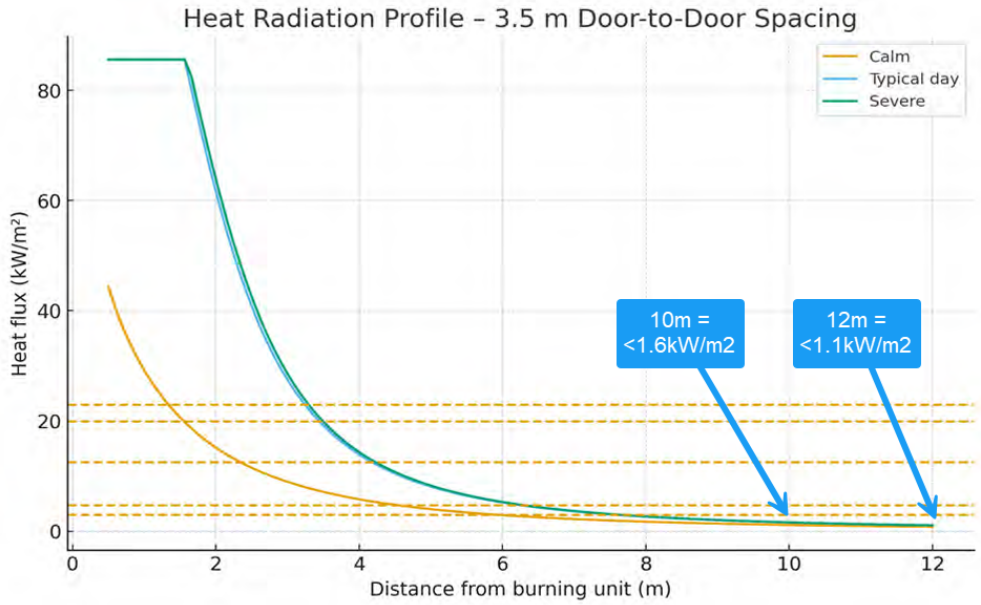


Figure 9 - Heat radiation profile.

Table 15 - Input assumptions

Item	Value
Project	Wellington BESS – Flame Tilt Appendix G (Simplified)
Unit height H (m)	2.6
Unit width/depth W (m)	2.6
Front separation (m)	3.5
Back/side clearance (m)	0.15
Flame length factor k (-)	1.2
Flame emissivity ε (-)	0.9
Flame temperature T (K)	973
Characteristic plume velocity Uc (m/s)	3
Observation height (m)	1.5
Wind bins (m/s)	0.0, 8.33, 11.11
Acceptance thresholds (kW/m²)	3, 4.7, 12.5, 20, 23
Notes	Back/side treated as shared-wall; governing case is front (aisle).

Wind (m/s)	Scenario	Tilt angle θ (deg)	Effective separation S_eff (m)	Peak flux at aisle (kW/m²)	Comment
0	Calm	0	3.5	7.1	Door-to-door
8.33	Typical day	70.2	2.03	19.2	Door-to-door
11.11	Severe	74.9	1.99	19.9	Door-to-door

Distance (m)	Flux Calm (kW/m²)	Flux Typical day (kW/m²)	Flux Severe (kW/m²)
10.06722689	1.113162701	1.550862555	1.566300694
11.03361345	0.933615832	1.260302969	1.271501479
12	0.793867066	1.043923044	1.052293152

Broken Hill BESS

(Planager Risk Management Consulting, ref. 02-B612, rev 05B, 6/4/23) p.53

Separation to prevent fire propagation: AS/NZS 5139:2019 (paragraph 3.2.6.1) specifies that the BESS shall be installed such that, in the event of a fire originating within the BESS, the spread of the fire *shall be kept to a minimum*. No detailed guidance as to the actual separation distance required for an outdoor major BESS is provided in AS/NZS 5139.

With the scope of AS/NZS 5139:2019 limited to a maximum energy capacity of 200 kWh and noting that a grid-scale NEM connected BESS comes under AS/NZS 5139 scope exclusion 1 pertaining to critical power requirements, it is common practice in Australia to refer to international codes for guidance in the development of large scale BESSs.

One such code is the NFPA 855:2020 *Standard for the Installation of Stationary Energy Storage Systems.* NFPA 855 has become internationally recognised in the area of fire safety for large scale energy storage systems, and, while the requirements do not cover all battery configurations and are not binding in Australia, reference to the guidance in the NFPA Code is made here to inform the present assessment, as follows:

- NFPA 855 (para 4.4.3.3) *Clearance to Exposures* sets the separation distance of 10 feet (about 3 metres) between battery enclosures and other *buildings*; *stored combustible materials*; *hazardous materials*; and *other exposure hazards not associated with the electrical grid* etc.
- NFPA 855 (para 4.4.3.3.4) allows the clearances to exposures *other than buildings* to be reduced to 3 ft (914 mm) where large-scale fire testing of the ESS in accordance with UL 9540A[22] demonstrates that a fire within the ESS enclosure will not generate radiant heat flux sufficient to ignite stored materials or otherwise threaten the exposure.

The Fluence Cubes at the Facility are installed in rows with a minimum separation distance of 3m between the rows. This is sufficient to:

- Exceed the clearance to exposures requirement of NFPA 855 for UL 9540A fire tested installations

Fire characteristics	Bespoke Burn test	Values as modelled by Effects® (low/no wind conditions)	
Height of flames	4 metres	5 metres	
Flame temperature	400-700°C sustained and 900°C short duration	700°C	900°C
Heat radiation at 1.1 metres	14 kW/m^2	14 kW/m^2	33 kW/m^2
Heat radiation at 2.1 metres	5 kW/m^2	7 kW/m^2	17 kW/m^2

Table 8: Bespoke Burn test values for wind-still conditions versus Effects® modelled values

The values modelled in the Effects® software for the 700°C flame follow closely those measured in the Bespoke Burn test (Ref 3), including:

- Effects® calculates the flame height as 5 metres versus 4 metres in the test.
- Effects® models the heat radiation at 1.1 metres as 14kW/m^2 (same as the Bespoke test) and at 2.1 metres as 7kW/m^2 (somewhat higher than the Bespoke test results of 5kW/m^2).
- For this fire, the Effects® software calculates the surface heat emission as 45 kW/m^2, the atmospheric transmissivity as 99%.

The values modelled for the 900°C flame are much more severe than those measured during the Bespoke Burn test (Ref 3) but included in the FSS for information.

The heat radiation profile for the burning Cube as modelled in Effects® during no wind conditions is presented in Figure 11 below, for the 700°C and the 900°C flames in the blue and orange curves respectively. The data points that were considered as accurate from the Bespoke Burn test are also included as the two grey dots, coinciding with the Effects® results for the 700°C flame.

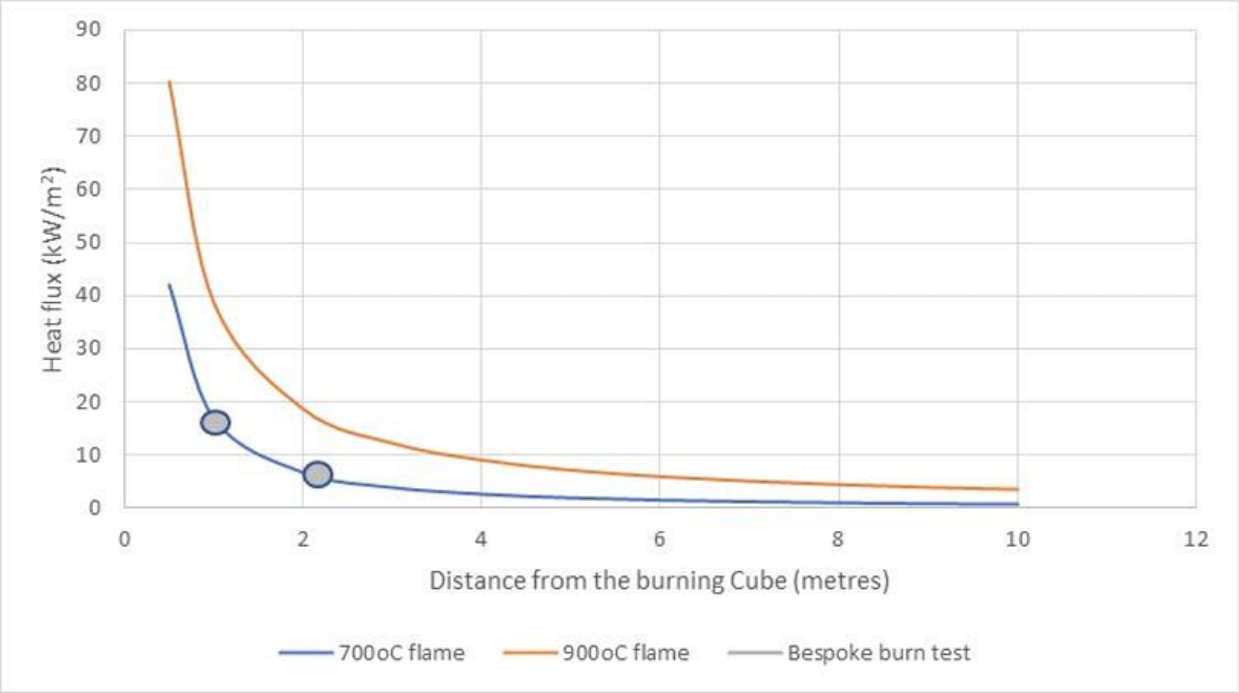


Figure 11: Heat radiation for the Fluence Gen 6 Cube assuming no shielding of fire in the front and roof of the enclosure (View Factor calculation method, no wind)

The heat radiation increases in the direction of the wind as the wind tilts and drags the flame towards the target.

The effect of the wind on the heat radiation profile is presented in Figure 12 and in Table 9, during no wind conditions and during 5 m/s and 10 m/s wind speeds. The results are for the 700°C fire, which represent the sustained fire conditions (refer to Figure 7). The distance to the 23 kW/m^2 heat radiation level, which is considered for potential propagation for non-combustible material, as per HIPAP 4, is calculated to be less than 2 metres in all cases.

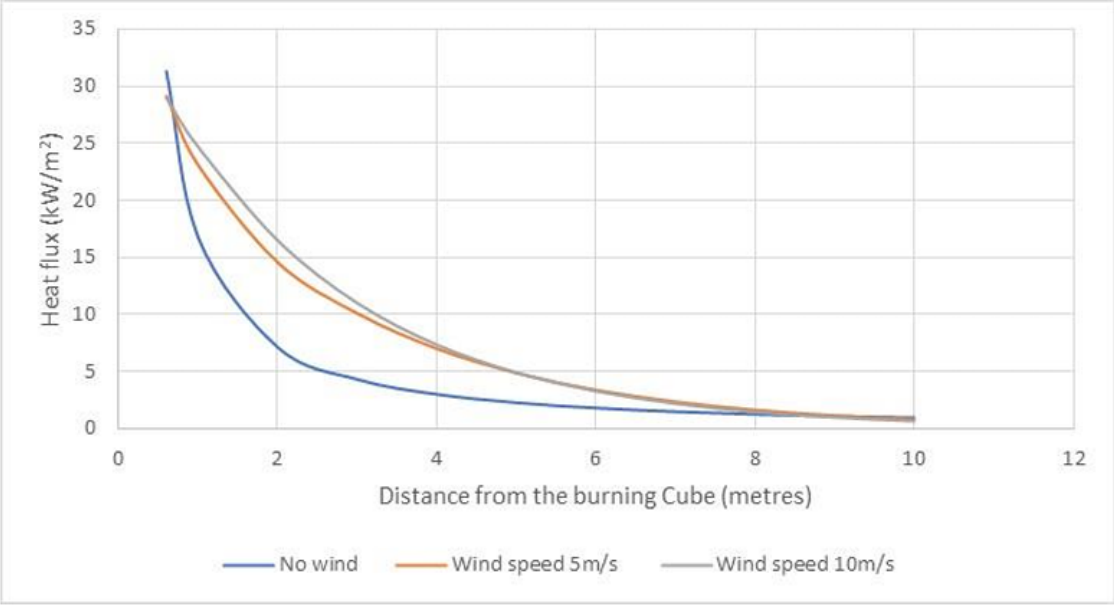


Figure 12: Effect of wind on heat radiation profiles for the Fluence Gen 6 Cube, 700°C sustained fire

Heat radiation (700°C flame)	Distance, as measured radially from the Cube			Potential effect (actual effect depends on duration of exposure)
	No wind	Wind 5m/s	Wind 10m/s	
23 kW/m^2	0.7 m	1.3 m	1.2 m	Potential propagation to non-combustibles; likely fatality
12.5 kW/m^2	1.3 m	2.9 m	3.0 m	Potential propagation to combustibles; significant chance of fatality
4.7 kW/m^2	2.8 m	5.6 m	5.6 m	Injury may occur if a person is exposed
3 kW/m^2	10.8 m	6.8 m	6.8 m	Unlikely to cause excessive discomfort

Table 9: Heat radiation for the Fluence Gen 6 Cube, View Factor calculation method), 700°C flame

For the 900°C (short duration) flame, the calculated distance to the 23 kW/m^2 heat radiation level is 2 metres (for 5 m/s wind speed) and 4.5 metres (for 10 m/s wind speed).

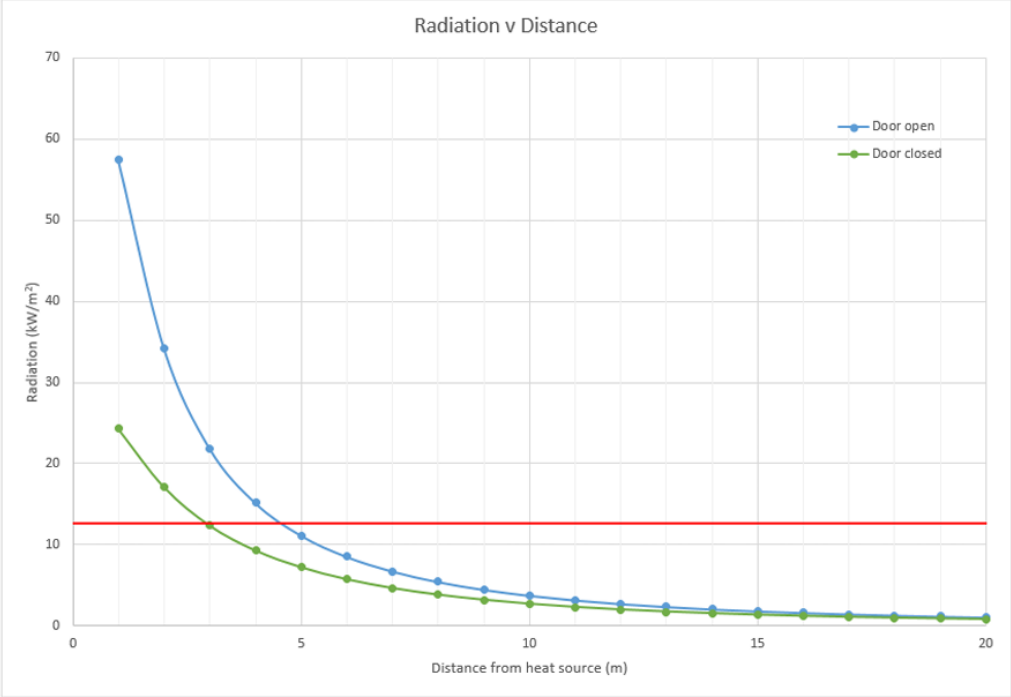


Figure 8: The results of the fire modelling, showing heat flux radiation plotted against distance. The red line is set at 12.6 kW/m^2

4.2.2 Fire Spread

In order to mitigate against the risk of fire spread from the BESS to the rest of the site and potentially off-site, a 20 m clear zone is to be installed around the BESS, with all vegetation cleared and gravel or a similar material placed on the ground.

The results of the analysis above suggest that in the event of an entire container catching fire, the 12.6 kW/m^2 radiation contour would extend approximately 3 m (door closed) to 4 m (door open) and at 20 m, the heat radiation would be below 1 kW/m^2, which is comparable to the effect of direct sunlight, and insufficient to cause ignition.

The fire modelling demonstrates that the 20 m separation zone is sufficient to prevent fire spread from the BESS to the remainder of the site and to off-site receptors.

6.2.3. BESS unit fire and propagation potential (PHA modelling) [HAZID Tag A & B]

Offsite impact

The heat radiation and toxic gas (hydrogen fluoride) modelling conducted in the PHA study (Ref [4]) was updated to cover the MP2XL battery unit. The calculations for a complete BESS unit on fire are show in APPENDIX C.

The PHA modelling is useful in terms of estimating the 'stand back' distance for emergency response and public. Of note:

- The distance to a heat flux level of 23 kW/m^2 (escalation) was 8 metres (module long side) and 3 metres (module end side). Based upon the BESS layout, the predicted heat radiation impact to the neighbouring sites from a BESS unit on fire is not expected.
- The distance to a heat flux level of 4.7 kW/m^2 (injury) was up to 7 metres. Based upon the BESS layout, radiation impact would slightly extend offsite into Kingspan yard. Update to the site Emergency Response Plan is discussed in Section 7.
- Depending on the weather condition and wind direction, toxic gas could potentially extend off-site into the Kingspan yard. However, the toxic gas (injury) is not expected to reach the occupied building at Kingspan. Update to the site Emergency Response Plan is discussed in Section 7.

Table C.2: Heat radiation impact – BESS unit on fire

			Distance (m) at receptor height (1.5 m) to radiation levels		
BESS	**Dimension (mm)**	**Surface temperature (°C)**	**4.7 kW/m^2** (injury)	**12.6 kW/m^2** (fatality)	**23 kW/m^2** (structural failure)
		Front			
MP2XL	8,800 x 2,785	1000	15	9	6
		Side			
MP2XL	1,650 x 2,785	1000	7	4	3