OFFICIAL

Western Australian Planning Commission

Our Ref : 200246
Previous Ref :
Your Ref : 8894/24
Enquiries : Gary James (6551 9350)

14 May 2024

Application No: 200246 - [redacted] Merredin

The Western Australian Planning Commission has received an application for planning approval as detailed below. Plans and documentation relating to the proposal are attached. The Commission intends to determine this application within 90 days from the date of lodgement.

Please provide any information, comment or recommended conditions pertinent to this application by 25 June 2024 being 42 days from the date of this letter. The Commission will not determine the application until the expiry of this time unless all responses have been received from referral agencies. If your response cannot be provided within that period, please provide an interim reply advising of the reasons for the delay and the date by which a completed response will be made or if you have no comments to offer.

Referral agencies are to use the Model Subdivision Conditions Schedule (1 January 2024) in providing a recommendation to the Commission. Non-standard conditions are discouraged, however, if a non-standard condition is recommended additional information will need to be provided to justify the condition. The condition will need to be assessed for consistency against the validity test for conditions. A copy of the Model Subdivision Conditions Schedule can be accessed: http://www.dplh.wa.gov.au

Please send responses via Planning Online Portal here: https://planningonline.dplh.wa.gov.au/.

This proposal has also been referred to the following organisations for their comments:
DBCA - Wheatbelt, Merredin, Shire of, Western Power, Water Corporation, Public Transport Authority and LG Merredin, Shire of.

Yours faithfully

[redacted]

Ms Sam Boucher
WAPC Secretary

APPLICATION DETAILS

Application Type	Subdivision	***Application No***	200246
Applicant(s)	Scanlan Surveys		
Owner(s)	Ross Milton Robartson		

Locality	[redacted]		
Lot No(s).	[redacted]	***Purpose***	Subdivision
Location		***Local Gov. Zoning***	RAILWAY, GENERAL FARMING, PARKS AND RECREATION
Volume/Folio No.	1695/263	***Local Government***	Merredin, Shire of
Plan/Diagram No.	67824	***Tax Sheet***	
Centroid Coordinates			
Other Factors	REMNANT VEGETATION (NLWRA), DPW ESTATE (DBCA), PTA RAILWAY, BUSHFIRE PRONE AREA N/A		

Western Australian Planning Commission

DEPARTMENT OF PLANNING, LANDS AND HERITAGE

DATE 13-May-2024

FILE 200246

Form 1A - Preliminary approval appl

Lodgement ID	2024-01572		
Date submitted	06/05/2024		
Submitted by	Kayleigh Bodycote		
Your reference	8894/24		
Location of subject property	214 Robartson Road, Merredin		
Existing tenure	Freehold (Green Title)	**Application type**	Subdivision
Proposed tenure	Freehold (Green Title)		

Applicants

Applicant (1)

Is person the primary applicant?	Yes		
Is the applicant an organisation/company?	Yes	**Is the applicant a landowner?**	No
Organisation/company	Scanlan Surveys	**ACN/ABN**	88 009 402 608
Name	Kayleigh Bodycote	**Position**	Office Administrator
Email	[redacted]		
Phone number	892502261	**Additional phone no.**	N/A
Address	PO Box [redacted] Midland MIDLAND DC 6936 Australia	**Additional phone no. type**	N/A

Certificate of Title details

Certificate of Title (1)

Volume	1695	**Folio**	263
Plan number	67824	**Lot number**	[redacted]
Part lot?	No	**Location**	N/A
Reserve number	N/A		
Address	[redacted] MERREDIN	**Nearest road intersection**	Bruce Rock Merredin Road

Landowners

Have all registered proprietors (landowners) listed on the Certificate/s of Title provided consent?	No
Are any of the landowner's names different from that shown on the certificate of title?	No

Landowner (1)

Is the landowner an organisation/company?	No	**Landowner type**	Registered proprietor
Organisation/company	N/A	**ACN/ABN**	N/A
Name	Ross Milton Robartson	**Position**	N/A
Email	[redacted]		

Phone number	N/A
Address	PO Box [redacted] MERREDIN 6415 Australia
Consent to apply:	
Has this landowner provided consent to apply?	Yes
Date of consent document	09/03/2024

Additional consent to apply

Consent to apply (1)

Is the consent to apply on behalf of an organisation/company?			No
Organisation/company		**ACN/ABN**	N/A
Name	Ross Milton Robartson	**Position**	N/A
Email	reception@scanlansurveys.com.au		
Phone number	N/A	**Additional phone no.**	N/A
Address	[redacted] MERREDIN 6415 Australia	**Additional phone no. type**	N/A
Date of consent document	08/03/2024		

Consent to apply checklist

Current copies of all records of title are attached	Yes
All registered proprietors (landowners) listed on the certificate/s of title have signed the application or an attached letter of consent. This includes landowners specified on a certificate of title for a leasehold lot	No
Consent to apply is given on behalf of landowners or tier 1 corporation	Yes
The application is by or on behalf of a prospective purchaser/s under contract of sale or offer and acceptance	No
Consent to apply is given by or on behalf of joint tenant survivors	No
Consent to apply is given by or on behalf of an executor of a deceased estate	No
This application includes land that is owned by or vested in or held by management order by a government agency or local government	No
This application includes Crown land	No

Summary of the Proposal

Existing tenure	Freehold (Green Title)	**Application type**	Subdivision
Proposed tenure	Freehold (Green Title)		
Local government where the subject land is located		Merredin, Shire of	
Additional local government/s where the subject land is located		N/A	
Have you submitted a related application?		No	
Lodgement ID of related application		N/A	
How is the application related?		N/A	

Land use and lots

Current land use	Agricultural

Total number of current lot/s subject of this application	1	**Number of proposed lot/s**	2

Proposed use/development:			
Proposed zone (1)	Rural	**Zone lot size**	Over 25 HA
		Number of zone lots	1
Proposed zone (2)	Other	**Zone lot size**	2 HA - 5 HA
		Number of zone lots	1

Reserved lots:			
Reserve lot type (N/A)	N/A	**Number of reserve lots**	N/A

Dwellings, outbuildings and structures			
Does the subject lot/s contain existing dwellings, outbuildings and/or structures?	No		
Dwellings:			
Number of dwellings	N/A	**Specify details**	N/A
Details of partially retained/ removed dwellings	N/A		
Outbuildings:			
Number of outbuildings	N/A	**Specify details**	N/A
Details of partially retained/ removed outbuildings	N/A		
Other development:			
Specify details	N/A		
Amendment			
Type 1 (a) Addition of land from outside the parcel of a strata titles scheme to common property in the scheme (but not including temporary common property)	No		
Type 1 (b) Conversion of a lot in a strata titles scheme to common property in the scheme	No		
Type 2 Removal from the parcel of a strata titles scheme of land comprised of common property	No		
Type 3 Consolidation of 2 or more lots in a strata titles scheme into 1 lot in the scheme (not affecting common property in the scheme)	No		
Type 4 Subdivision that does not involve the alteration of the boundaries of the parcel and is not a type 1, type 2 or type 3 subdivision	No		
Termination			
Strata company resolution in support of the termination proposal is available?	No		
Has an outline termination proposal been prepared?	No		
Survey-Strata or Leasehold (Survey-Strata)			
Is common property proposed?	No		
Does the plan of subdivision show the indicative internal sewer and water connections to each lot?	No		
Proposed leasehold scheme term	N/A		
Is an option for postponement of the leasehold expiry scheme proposed?	No		
What is the proposed postponement timeframe?	N/A		
Strata or Leasehold (Strata)			
Is common property proposed?	No		
Does this application relate to an approved development application?	No		

Development application approval date/s	N/A	**Development application reference number/s**	N/A
Does this application relate to an approved building permit?			No
Building permit issue date/s	N/A	**Building permit reference number/s**	N/A
Is it proposed to create a vacant strata lot by registration of the plan?			No
Number of vacant strata lot/s	N/A		
Details of restrictions to be placed on any lots on the plan	N/A		
Leasehold scheme proposed timeframe	N/A		
Is an option for postponement of the leasehold expiry scheme proposed?			No
Proposed postponement timeframe	N/A		

Subdivision details

Transport impacts	
Are there 10 - 100 vehicle trips in the subdivision's peak hour?	No
Are there more than 100 vehicle trips in the subdivision's peak hour?	No
Access to/from, right-of-way or private road	
Access is to be provided from an existing right of way or private road?	No
Road and rail noise	
Is the proposal within the trigger distance of a strategic transport route as defined by State Planning Policy 5.4?	No
Contaminated sites	
Has the land ever been used for potentially contaminating activity?	No
Does the land contain any site or sites that have been classified under the Contaminated Sites Act 2003?	No
Does the land contain any site or sites that have been reported or are required to be reported under the Contaminated Sites Act 2003?	No
Information requirements liveable neighbourhoods	
Is this application to be assessed under the Liveable Neighbourhoods policy?	No
Acid sulfate soils	
Is the land located in an area where site characteristics or local knowledge lead you to form the view that there is a significant risk of disturbing acid sulfate soils at this location?	No
Bushfire prone areas	
Is all, or a section of the subdivision in a designated bushfire prone area?	Yes
Has a Bushfire Attack Level (BAL) Contour Map been prepared?	Yes
Does the BAL Contour Map indicate areas of the subject site as BAL-12.5 or above?	Yes
Has a Bushfire Management Plan (BMP) been prepared?	Yes
On-site sewerage disposal	
Is on-site sewage disposal proposed?	No
Is it proposed to create lots of 4ha or smaller?	No
Has a site and soil evaluation been provided?	No

Final Checklist

Subdivision plans are based on an accurate and up-to-date feature survey that includes existing ground levels relative to AHD or topography of the subject lot/s. A feature survey is not required for amalgamation approval	Yes

Relevant copies of the subdivision plans and supporting documentation or accompanying information are attached	Yes
The subdivision plan is capable of being reproduced in black and white format	Yes
The subdivision plan is drawn to a standard scale (ie 1:100, 1:200, 1:500, 1:1000) at A3 or A4	Yes
All dimensions on the subdivision plan are in metric standard	Yes
The north point is shown clearly on the subdivision plan	Yes
The subdivision plan shows all lots or the whole strata or community titles (land) scheme plan (whichever is applicable)	Yes
The subdivision plan shows all existing and proposed lot boundaries	Yes
The subdivision plan shows all existing and proposed lot dimensions (including lot areas)	Yes
The subdivision plan shows the lot numbers and boundaries of all adjoining lots	Yes
Is a battleaxe lot/s proposed?	No
The subdivision plan shows the width and length of the access leg, the area of the access leg and the total area of the lot	No
The subdivision plan shows the name/s of existing road/s	Yes
Is a new road/s proposed to be created?	No
The subdivision plan shows the width of proposed road/s	No
Is the land vacant?	Yes
The subdivision plan shows all buildings and/or improvements, including driveways and crossovers (including setbacks) which are to be retained, or removed	No
Does the land contain features such as watercourses, wetlands, significant vegetation, flood plains and dams?	No
The subdivision plan shows features such as watercourses, wetlands, significant vegetation, flood plains and dams?	No
The subdivision plan shows all electrical, sewer and water infrastructure. For on-site sewage disposal, the indicative disposal areas for wastewater distribution are to be shown	Yes
Additional information required in the case of applications for residential infill subdivision within existing residential zoned areas	No

Estimated Fee & Payment Details

Estimated fee payable	$3,704.00		
Number of proposed lots	2	**Number of reserved lots**	0
Payer details			
Would you like to nominate that the invoice is sent to another party for payment?			Yes
Payer name	Merredin Big Battery Nominee Pty Ltd	**Organisation/company**	N/A
Phone number	[redacted]	**Email**	[redacted]
Postal address	[redacted]	**City/Town/Suburb**	FREMANTLE
Postcode	6160		
Submit application			
Are the payer's details correct?			Yes
Have you checked the Summary of the Proposal and acknowledged all items?			Yes

Attachments

Document type	Document
Bushfire Attack Level (BAL) assessment	169042 - Merredin Battery (BRR) v1.0.pdf
Bushfire Management Plan	169042 - Merredin Battery Facility (BMP) v1.0.pdf
Certificate of Title	Certificate of Title with Sketch 1695-263 Lot 5 On Diagram 67824 - Certificate of Title 1695-263.pdf
Covering letter	8894-24 WAPC Letter.pdf

Export PDF - Lodged application	20240506 2024-01572 No Street Address Information Available, MERREDIN - Form 1A.pdf
Other (please specify)	20240423 - Determination Letter - Lot [redacted], Merredin.pdf
Signed application form	FORM 1A CONSENT TO APPLY (Signed).pdf
Subdivision plan	8894241A.pdf
Tax Invoice	Tax Invoice - INV0000826 - 20240511.pdf
Tax Invoice - Receipt	Tax Invoice Receipt - INV0000826 - 20240513.pdf

WAPC contact information			
Infoline	1800 626 477	Planning Online	https://planningonline.dplh.wa.gov.au
Web address	www.dplh.wa.gov.au	Email	corporate@wapc.wa.gov.au
Perth	**Albany**	**Bunbury**	**Mandurah**
140 William Street Perth, 6000 Locked Bag 2506 Perth, 6001	178 Stirling Terrace PO Box 1108 Albany 6331	Sixth Floor Bunbury Tower 61 Victoria Street Bunbury 6230	Level 1 - Suite 94 16 Dolphin Drive Mandurah 6210
(08) 6551 9000	(08) 9892 7333	(08) 9791 0577	(08) 9586 4680

SCANLAN SURVEYS
LICENSED SURVEYORS

ABN 88 009 402 608
ACN 009 402 608

23 Spring Park Road, MIDLAND WA 6056
PO Box 429, MIDLAND WA 6936
(08) 9250 2261
www.scanlansurveys.com.au

DATE: 06/05/2024

WAPC
Locked Bag 2506
PERTH WA 6001

Dear Assessing Officer,

RE: PROPOSED SUBDIVISION – ROBARTSON ROAD, MERREDIN

This application is to subdivide Lot 5 on Diagram 67824 into two lots, with the land use of the large portion to remain as agricultural, while the small portion is being excised to accommodate the Merredin Battery Energy Storage System (BESS).

We understand that in general, this subdivision is contrary to policy 3.4 (subdivision of rural lands). However, we believe the proposal satisfies Section 6.2 of the policy and that the subdivision should be supported for the proposed land use, as approved by the Regional DAP – DAP Application MDPA002 (2024) (attached).

Water Corporation:

There is no reticulated sewerage to this proposal. The DAP determination has a condition that addresses the issue of the on-site effluent systems, requiring the proponent to design and locate the infrastructure to the satisfaction of the local government.

Post construction, the site will be unmanned and therefore will not require a potable water supply. A 300,000L water storage tank will be built to provide necessary water for firefighting purposes.

Western Power:

The landowner is negotiating directly with Western Power to have a direct connection to the network for Proposed Lot 201. Proposed Lot 202 will approximately be 58.1 ha, with the land use of proposed Lot remaining as agriculture. As such, no underground power supply is required to service this lot.

Local Government:

Under the Regional DAP submission, the Shire of Merredin, has reviewed the development proposal and approved the land use subject to the conditions outlined in the DAP Determination. As such, this proposal should meet the requirements of the Local authority.

JOHN SCANLAN
LICENSED SURVEYOR
BACHELOR OF SURVEYING (CURTIN)
[redacted]

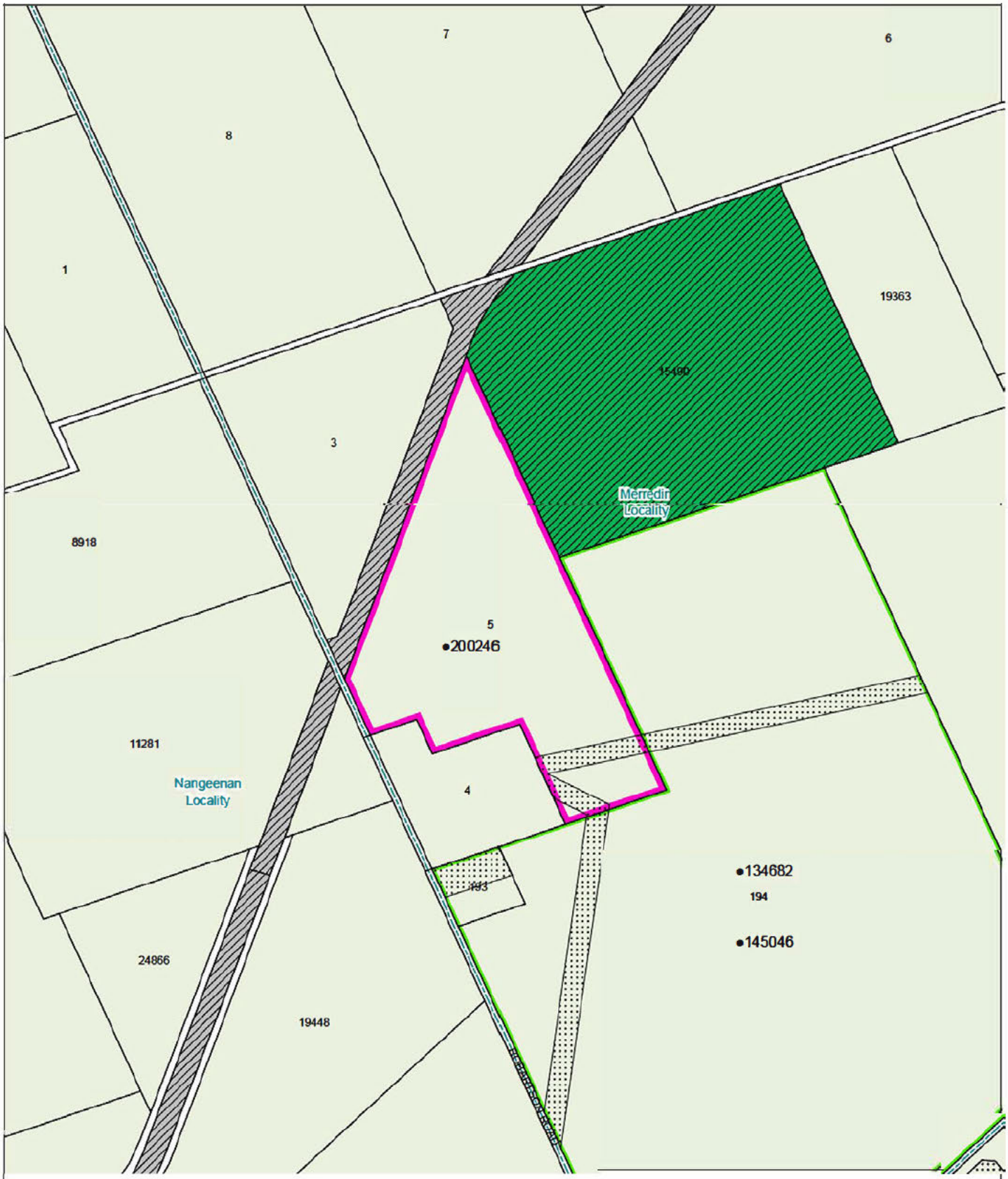
RYAN SCRIVEN
LICENSED SURVEYOR
BACHELOR OF SURVEYING (CURTIN)
[redacted]

WILLIAM SCANLAN
LICENSED SURVEYOR
M.I.S. (AUSTRALIA)
[redacted]

If you have any queries, don't hesitate to contact our office.

Yours sincerely,

Scanlan Surveys Pty Ltd



Location Plan for:
Subdivision Application

This data is to be used only for the processing of a Subdivision Application

Application Number: **200246**
Decision: Outstanding
Printed: 13/05/2024

Western Australian Planning Commission

Produced by Data Analytics,
Department of Planning, Lands and Heritage, Perth WA

Base information supplied by
Western Australian Land Information Authority SLIP 1447-2023-1

Application Status
- Approved
- Outstanding

Existing LPS Zones and Reserves
- General farming
- Parks and recreation
- Railway

Easements and Referrals
- Easements

Region Scheme Reserves

Localities & Local Government Boundaries
- Local government boundary
- Locality

N
0 110 220 330 440
metres

DEPARTMENT OF PLANNING, LANDS AND HERITAGE	
DATE 13-May-2024	FILE 200246

N

A19476
15490

310

RAILWAY

1108.78

1524.51

202
58.1104 ha

POWER POLE
O/H POWER LINES
POWER POLE
POWER POLE
O/H POWER LINES
POWER POLE

5
61.49ha

ROBARTSON ROAD

191.72
(198.22)

BOUNDARY
PROPOSED
399.98
126.49
201
3.3796 ha
139.98
119.99
259.98
6.5

310

476.51
(350.02)
304.05

194

POWER POLE

4
(POWER STATION)

WARNINGS:

1. LOT NUMBERS, DIMENSIONS AND AREAS SUBJECT TO WAPC APPROVAL, SURVEY AND LANDGATE AUDIT.

NOTE: LOT IS VACANT

SCALE 1:5000 @ A3

0m 50m 100m 150m 200m 250m

LOT	DESCRIPTION	AREA
5	ORIGINAL LOT	61.49ha
201	PROPOSED LOT	3.3796ha
202	PROPOSED LOT	58.1104ha

PLAN OF: SUBDIVISION APPLICATION (FREEHOLD)

PROJECT: LOT 5 ON D 67824 ROBARTSON ROAD, MERREDIN

CLIENT: NOMAD ENERGY

HORIZONTAL DATUM: PLANE

VERTICAL DATUM: AHD

DP/PLAN/DIAGRAM: D 67824

C/T: VOL 1695 FOL 263

LOCAL AUTHORITY: SHIRE OF MERREDIN

SCANLAN SURVEYS LICENSED SURVEYOR
PO BOX 429 MIDLAND 6936
PH: 08 9250 2261
www.scanlansurveys.com.au
reception@scanlansurveys.com.au

DRAWN BY:	LF	26/03/2024
CHECKED BY:	JS	26/03/2024
APPROVED BY:	JS	26/03/2024
DRAWING FILE: 8894241A.DWG		

REV	DESCRIPTION	BY	DATE
A	POWER LINES AND POLES AMENDED	LF	3/04/2024

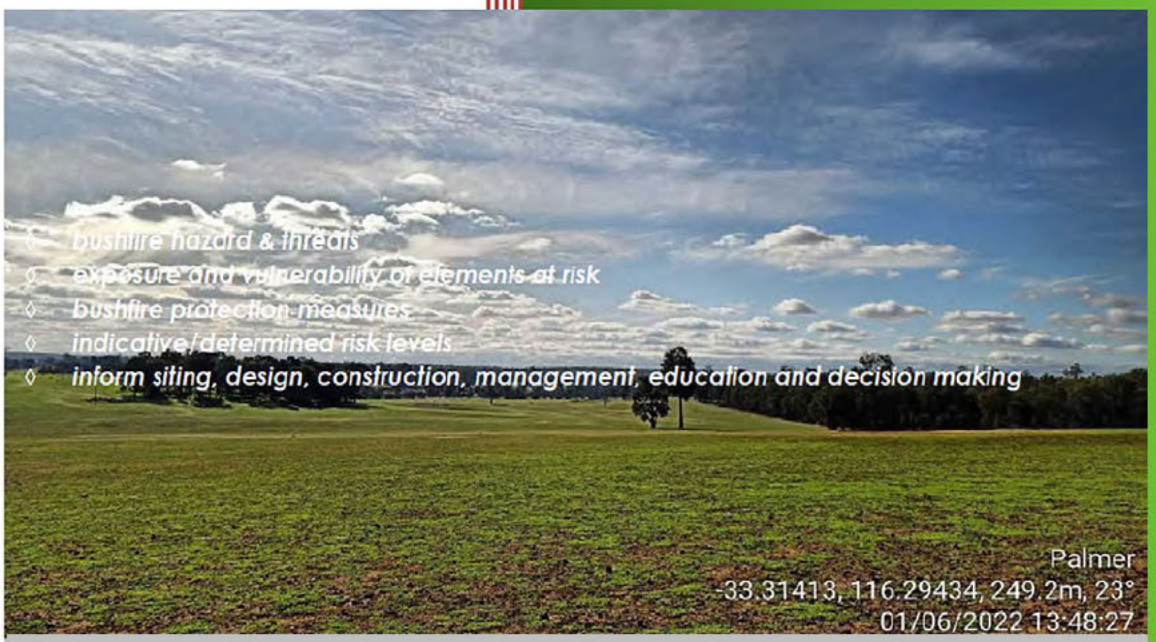
DRAWING: 8894/24/1 REV: A


A9722
A9982

BUSHFIRE PRONE PLANNING

Merredin Battery Facility

Bushfire Risk Assessment & Management Report



Produced to meet the relevant requirements of STATE PLANNING POLICY 3.7 Planning in Bushfire Prone Areas & Guidelines

Lot 5 Robartson Road, Merredin

Shire of Merredin

Job Reference No: 169042

BPP GROUP PTY LTD T/A BUSHFIRE PRONE PLANNING

ACN: 39 166 551 784 | ABN: 39 166 551 784

SUITE 11, 36 JOHNSON STREET
GUILDFORD WA 6055
PO BOX 388
GUILDFORD WA 6935

08 6477 1144 | admin@bushfireprone.com.au

BUSHFIRE PRONE PLANNING

DOCUMENT CONTROL

PREPARATION		
Author:	Mike Scott (BPAD Level 3 No. 27795)	[redacted]
Co-Author:	Neil Diamond	

VERSION HISTORY		
Version	Details	Date
1.0	Original	14 December 2023

Bushfire Risk Assessment Report Template v2.7

DISTRIBUTION					
Destination		Version	No. Copies	Hard Copy	Electronic Copy
Person	Email				
Rebekah Hampson	[redacted]	1.0	1	☐	☒

Limitations: *The protection measures contained in this Bushfire Risk – Assessment and Management Report, are considered to be minimum requirements and they do not guarantee that buildings or infrastructure will not be damaged in a bushfire, persons injured, or fatalities occur either on the subject site or off the site while evacuating. This is substantially due to the unpredictable nature and behaviour of fire and fire weather conditions. Additionally, the correct implementation of the recommended protection measures will depend upon, among other things, the ongoing actions of the landowners and/or operators over which Bushfire Prone Planning has no control.*

All surveys, forecasts, projections and recommendations made in this report associated with the proposed development are made in good faith based on information available to Bushfire Prone Planning at the time. All maps included herein are indicative in nature and are not to be used for accurate calculations.

Notwithstanding anything contained therein, Bushfire Prone Planning will not, except as the law may require, be liable for any loss or other consequences whether or not due to the negligence of their consultants, their servants or agents, arising out of the services provided by their consultants.

TABLE OF CONTENTS

List of Figures

1 REPORT USE GUIDANCE - FOR MANAGERS & DECISION MAKERS

LOCATION OF KEY INFORMATION	
The applied risk assessment process as pre-requisite reading to assist with understanding the assessments and the presentation of the results.	Section 2 and Appendix 1
The assessed bushfire risk levels and the relative contribution of each primary factor contributing to that risk.	Section 3
The recommended additional bushfire protection measures and their implementation priority rating.	Section 4.1
Any Identified additional issues and advice provided for consideration by management.	Section 4.2

SECTION 5 - THE ASSESSMENT OF BUSHFIRE RISK

For the proposed Merredin Battery proposal, the risk assessment derives defined levels of risk associated with a bushfire event within the immediate and broader surrounding landscape, to the identified elements at risk (i.e., relevant classes of persons and property).

The adopted assessment approach applies a methodology that considers bushfire risk to be determined as a consequence of the interaction of three factors:

1. The bushfire hazard (which presents varying threats and threat levels);
2. The levels of exposure of each element at risk to those threats; and
3. The levels of vulnerability of each element at risk to those threats.

The assessment considers both the current level of risk (inherent), and the potential level of risk (residual) should proactive management be able to implement the recommended additional bushfire protection measures.

The assessment is largely qualitative in nature but incorporates quantitative processes and information when relevant and available. This results in the derivation of 'indicative' bushfire risk levels.

The assessment is conducted by a bushfire planning consultant with practical bushfire event management experience and relevant accreditation. An important objective is to present understandable and practical protection measures that are able to be justifiably applied by management.

SECTION 6 - THE ASSESSMENT OF BUSHFIRE RISK MANAGEMENT

Assessments are conducted that consider how well two defined pathways for implementing both the required and any additionally recommended bushfire protection measures, are being applied. Guidance for best practice application of these measures is provided. The two pathways are:

1. The application of 'informative' risk management mechanisms which include:
    a. The organised application and maintenance of all applicable bushfire protection measures through a range of operational documents, as relevant to a site and its use; and
    b. The development and application of advice to inform management's planning of future modifications and/or development of a site and its use. This is necessary where bushfire risk mitigation measures are necessary inputs to design and construction.
2. The application of 'regulatory' risk management mechanisms that are to be complied with. These include operating and construction regulations and standards, and relevant planning authority guidelines/standards.

*****

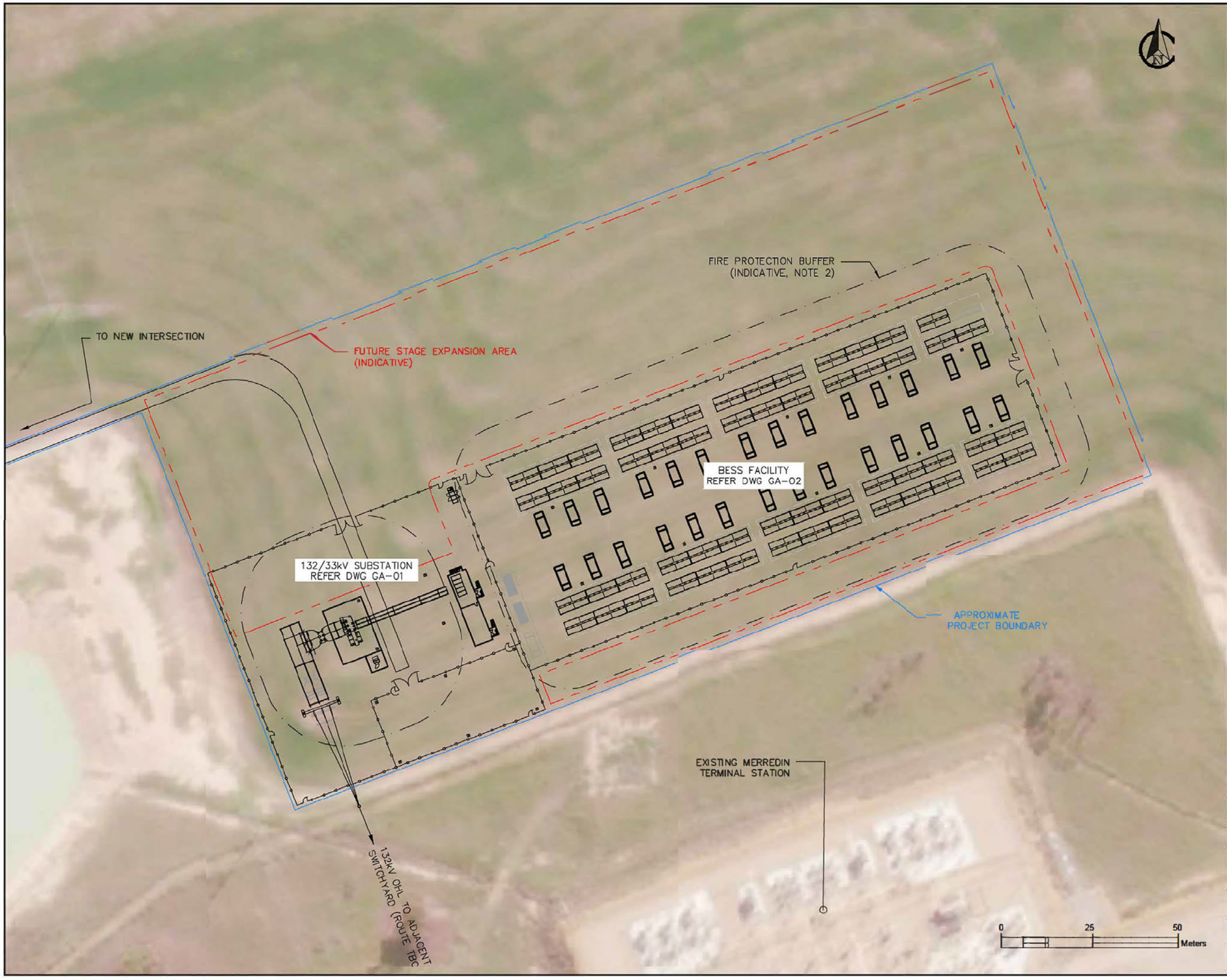
2 INTRODUCTION

2.1 THE ASSET (DEVELOPMENT) AND/OR USE SUBJECT TO ASSESSMENT

Bushfire Prone Planning has been engaged by Land Insights to produce a bushfire risk assessment and management report, specifically for the development of the Merredin Battery, a battery storage initiative proposed approximately 6.50km south west of the Merredin townsite.

The site is intended to be unstaffed, except for inspection and maintenance visits.

Merredin Battery will connect to Western Power's network via the neighbouring station to the south.



NOTES:

1. CONCEPT ONLY, SUBJECT TO CHANGE DURING DETAILED DESIGN.
2. PLANT & EQUIPMENT DIMENSIONS INDICATIVE, PROJECT AREA MAY EXPAND. SETBACKS AND OVERALL FOOTPRINT TO BE ADJUSTED WITHIN PROJECT BOUNDARY FOLLOWING DETAILED FIRE STUDY.
3. CAR PARKING, EARTHWORKS, INTERSECTION UPGRADES, DRAINAGE, EARTHING, PITS, CULVERTS, SPARE PARTS STORAGE AND TEMP CONSTRUCTION COMPOUND NOT SHOWN.
4. FIRE WATER ASSUMED CO-LOCATED WITH EXISTING SOLAR FARM.

REV:	DESCRIPTION:	BY:	DATE:
A	FIRST DRAWN (CONCEPT)	ABC	19.10.23

STATUS: NOT FOR CONSTRUCTION

BRIGHTY ENERGY

NOMAD ENERGY

PROJECT: MERREDIN BESS

TITLE: OVERALL PROJECT GENERAL ARRANGEMENT PLAN

SCALE AT A3:	DRAWN:	CHECKED:	APPROVED:
1:1000	ABC	-	-
PROJECT NO:	DRAWING NO:		REVISION:
NMD01	MBB-GA-00		A

2.2 THE RISK ASSESSMENT OBJECTIVES

Establishing the objectives directs the way the assessment process is conducted, and the type of information reported. Relevant objectives are typically determined by the applicability of one or more of the following three key factors:

1. The type of proposed or existing development. This can include:
    a) Construction or modification of buildings, structures and infrastructure assets; or
    b) Subdivision of land.
2. The type of proposed or ongoing land use. This can include:
    a) Those defined as industrial, commercial or residential; and
    b) Including those that have a planning classification of 'high risk' or 'vulnerable' - including tourism and event uses.
3. The relevant stage of planning. This can include but is not limited to:
    a) An existing development and/or use for which an assessment of the necessity for and the potential to improve bushfire resilience is conducted and the consequent lowering of the associated risks identified.
    b) At the strategic planning stage of new development/use when final details of the proposed development/use are not fully known and therefore relevant protection measures can potentially be identified and incorporated into design.
    c) At the final planning stage that requires approval or a 'decision to proceed'. All relevant details of the proposed development/use are known. The requirement at this stage is to inform decision makers by providing an assessment of the residual bushfire risk.

The primary objectives for the subject development and/or use are collated as a summary in Table 2.1.

Table 2.1: Identifying the risk assessment objectives for the subject development/use.

RISK ASSESSMENT OBJECTIVES - INFORMATION TO BE DERIVED
Identify: The types of bushfire prone vegetation (considering factors that include components, arrangement and fuel loads), that exist onsite and offsite.
Determine: The relative threat levels each bushfire hazard attack mechanism (direct and indirect) presents. Determine if the broader physical landscape surrounding the subject development/use has the potential to increase or decrease the levels of those threats.
Identify: All at risk physical elements that are exposed to the potential threats of the bushfire hazard.
Identify: Assets that owners/operators are prepared to lose from consequential fire resulting from a bushfire event, rather than apply sufficient protection measures i.e., the asset loss risk is to be retained. This may be due to cost or practicability. Consideration the consequent risk from asset abandonment and the availability of person risk mitigation measures.
Identify: All at risk human elements that are exposed to the potential threats of the bushfire hazard.
Identify: Bushfire protection measures that have or can be applied to reduce bushfire hazard threat levels to the greatest extent allowable and practicable.
Identify: Bushfire protection measures that have or can be applied to reduce the exposure and vulnerability of buildings/structures, infrastructure and other physical assets, to the potential threats of the bushfire hazard. The intent being to increase asset resilience to the threats to the greatest extent practicable.

RISK ASSESSMENT OBJECTIVES - INFORMATION TO BE DERIVED
Identify: Bushfire protection measures that have or can be applied to reduce the exposure and vulnerability of persons to the potential threats of the bushfire hazard to the greatest extent practicable.
Applicable to New Development and/or Use: Inform relevant persons (planners / designers / operators / owners), at the appropriate planning stage, of available bushfire protection measures to be incorporated into siting, design, construction, education and management, to optimise bushfire performance. Identify site specific protection measures, from the defined sets of bushfire protection measure principles, that have the potential to be applied as a package of protection measures. The intent is to achieve at least a tolerable level of risk to persons and property by ensuring that: • Buildings, structures and other physical assets are resilient against bushfire hazard threats, to the greatest extent practicable. • Persons have their exposure and vulnerability to bushfire hazard threats reduced, to the greatest extent practicable. Provide implementation advice as necessary.
Applicable to Existing Development and/or Use: Inform relevant persons (planners / designers / operators / owners), regarding the current levels of asset resilience to bushfire threats and person safety to identify the inherent level of risk from a bushfire event. Identify protection measures that can be implemented to improve resilience and safety and result in a lower residual risk. Assess the standard of the current application of any protection measures and provide recommendations to improve as necessary. Identify site specific protection measures (from the defined sets of bushfire protection measure principles) that have the potential to be applied as a package of protection measures to: • Improve the bushfire resilience of buildings, structures and other physical assets to the greatest extent practicable; and • Reduce persons exposure and vulnerability to bushfire hazard threats to the greatest extent practicable. Provide implementation advice as necessary.
Assess: The indicative residual risk levels to inform planners / designers / operators / owners and/or relevant decision makers. This is to be achieved through the application of the following information that has been established by the bushfire consultant: • The process for determining relative threat, exposure and vulnerability levels; • the indicative risk matrix; and • the risk tolerance scale. (Refer to Section 2.3.4, Appendix 2 and the glossary for additional information).

2.3 THE APPLIED RISK ASSESSMENT PROCESS

2.3.1 THE DEFINITION OF RISK

For the applied risk assessment process, the relevant risks are the potential for loss of life, injury, or destroyed or damaged assets which results in personal loss and economic loss due to disruption of services and/or repair or replacement of buildings and infrastructure. The source of the risk is either the bushfire as a natural hazard, or onsite activity/accident which may result in onsite fire.

2.3.2 THE ASSESSMENT PROCESS (FRAMEWORK)

To conduct and report the risk assessment process, Bushfire Prone Planning has adapted the understanding of disaster risk as described by the United Nations Office for Disaster Risk Reduction (UNDRR) and shown in Figure 2.2.

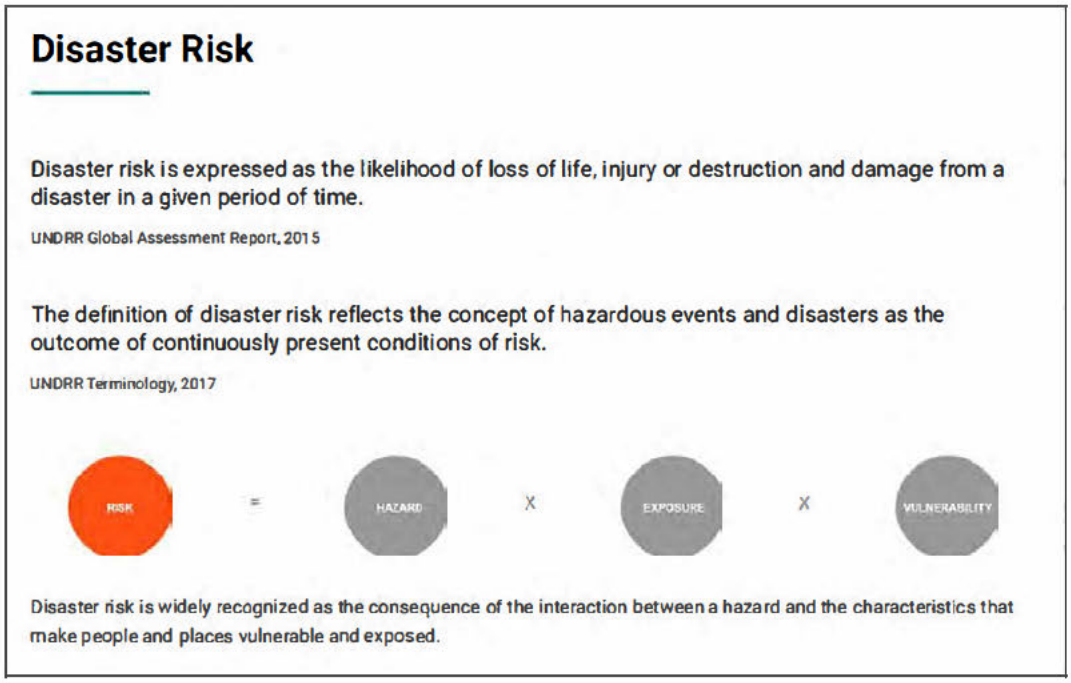


Figure 2.2: Understanding disaster risk (Source: United Nations Office for Disaster Risk Reduction [46]).

Although the UNDRR approach is designed to addresses disaster risk at large scale strategic levels, it can justifiably be applied to all scales of planning because it is focused on natural hazards and establishes a concept that can be readily adapted. The rationale for adopting this approach, rather than the methodology established by the National Emergency Risk Assessment Guidelines (AIDR 2020, NERAG), is provided in Appendix 1.

Also utilised within this assessment approach are relevant principles and measures to be applied in the development of bushfire risk mitigation strategies that are detailed in the Bushfire Verification Method Handbook [14].

PROCESS OVERVIEW

The risk presented by a natural hazard (such as a bushfire) is a consequence of the interaction between the potential threats associated with the hazard and the exposure and vulnerability of any elements at risk from those threats (the 'exposed elements').

The application of available protection measures will lower the risk by:

1. Reducing the number and/or level of the hazard threats; and/or
2. Reducing the level of exposure and/or vulnerability of the elements at risk.

Figure 2.3 illustrates the framework of the adapted risk assessment process (refer to the glossary for terminology information and Appendix 2 provides greater detail of the risk analysis component of the assessment process).

THE FRAMEWORK OF BUSHFIRE PRONE PLANNING'S APPLIED RISK ASSESSMENT PROCESS

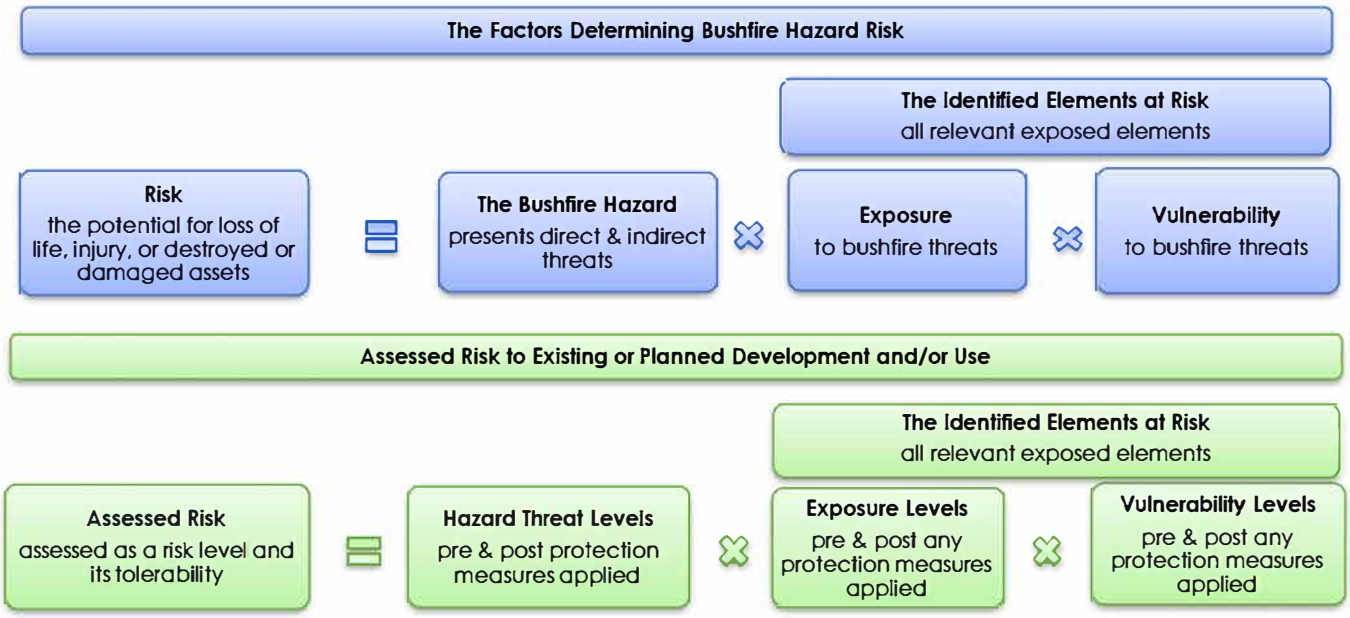


Figure 2.3: Framework of the applied risk assessment process.

2.3.3 RISK LEVEL ANALYSIS

(Refer to Appendix 2 and 3 and the Glossary for additional information.)

When the derivation of risk levels is a stated assessment objective, the risk analysis will derive a risk level as a summary outcome. The required risk level analysis can be conducted for either each exposed element separately and/or the proposed or existing development/use overall.

The risk level can be reported as either indicative or determined:

- **Indicative Risk Level**: This is derived based on a comparison of the numbers of protection measures able to be applied with the number of possible measures in the protection measure 'universe'. Appropriate weighting is given to the level of effectiveness of each of the measures. The intent is to provide a qualitative understanding of the level of risk that exists, to assist with making the required decisions.
- **Determined Risk Level**: This is derived using defined sets of risk factor criteria that correspond to each hazard threat level, exposure level and vulnerability level, for the elements at risk. Subsequently, how these defined levels are then applied to establish a determined risk level and its tolerability, is defined by an accepted risk level matrix and risk tolerance scale.

  The risk factor criteria must reflect societies preparedness to tolerate risk and should be determined by regulatory authorities exercising their responsibilities. The criteria will vary dependent on development/use type and scale.

  Consequently, the risk factor criteria (and potentially the risk level matrix and risk tolerance scale) need to be defined by the regulatory authorities before they can be applied in assessing a determined risk level.

Dependent on the stage of development/use, or to meet differing assessment objectives, the risk level can also be reported as:

- **Inherent Risk**: As the current risk when the assessment has only accounted for the bushfire protection measures that are either already in place (for existing development/use), or are planned to be incorporated into the proposed development/use; or
- **Residual Risk**: As the remaining risk when the assessment has also accounted for the application of any additional protection measures recommended by this report. If there are none, the residual risk is the same as the inherent risk.

2.3.4 USING THE ASSESSMENT PROCESS TO MEET THE STATED OBJECTIVES

The reporting objectives (established in Section 2.2) will vary for different types and stages of proposed (or existing) development/use. However, the same base framework is able to be utilised and the process can be adapted to achieve the required outcomes. An objective may not apply to a development, however whether and why/why not that objective applies must be considered.

Figure 2.4 provides further detail of the adopted assessment process, based on the framework shown in Figure 2.3.

2.3.5 BUSHFIRE PROTECTION MEASURE EFFECTIVENESS RATINGS

The following effectiveness ratings (refer to Table 2.2)are applied to the applicable bushfire protection measures, as part of the risk assessment process, and as a factor applied in deriving 'relative' threat, exposure and vulnerability levels.

The more effective a bushfire protection measure is, the greater its value in increasing bushfire resilience (buildings/structures), and/or increasing the safety of persons and in decreasing the level of risk associated with bushfire.

The effectiveness ratings incorporate the qualities of:

1. **Independence**: As a qualitative assessment of the extent to which the protection measure has the capacity to reduce threat, exposure and vulnerability levels as a standalone measure as opposed to requiring the cumulative capacity of additional protection measures (an additional one or more as a package); and
2. **Passiveness**: The capacity of protection measures to function without the active involvement of persons.

The rating assumes that the greater the independence and passiveness of a protection measure, the greater is its effectiveness.

Table 2.2: Bushfire protection measure effectiveness ratings.

THE APPLIED BUSHFIRE PROTECTION MEASURE EFFECTIVENESS RATINGS	
Rating / Descriptor	Protective Characteristics and Capability
Very High (Independent and Passive)	Very significant risk reduction as an independent (standalone) measure. Impact on risk reduction is immediate and persistent in all scenarios. Operates passively with no or minimal requirement for ongoing implementation, management and maintenance. A priority measure to be implemented wherever possible.
High (Independent and Passive)	Material risk reduction as an independent (standalone)measure; Operates passively with none or minimal requirement for ongoing implementation, management and maintenance.
Effective (Independent and Active)	Material risk reduction as an independent (standalone) measure; Effectiveness relies on active implementation, management, maintenance and/or response.
Moderate (Dependant and Passive or Active)	Alone the measure will have limited impact on risk reduction. It has additive value when combined with other protection measures to create a 'package' of bushfire protection measures. Effectiveness is achieved both passively and/or with active implementation, management, maintenance and/or response.
Not Relevant	The measure is not relevant to the type of development/use. (Note: this is different to not being able to be applied – it is just not relevant to any configuration of the subject development/use).

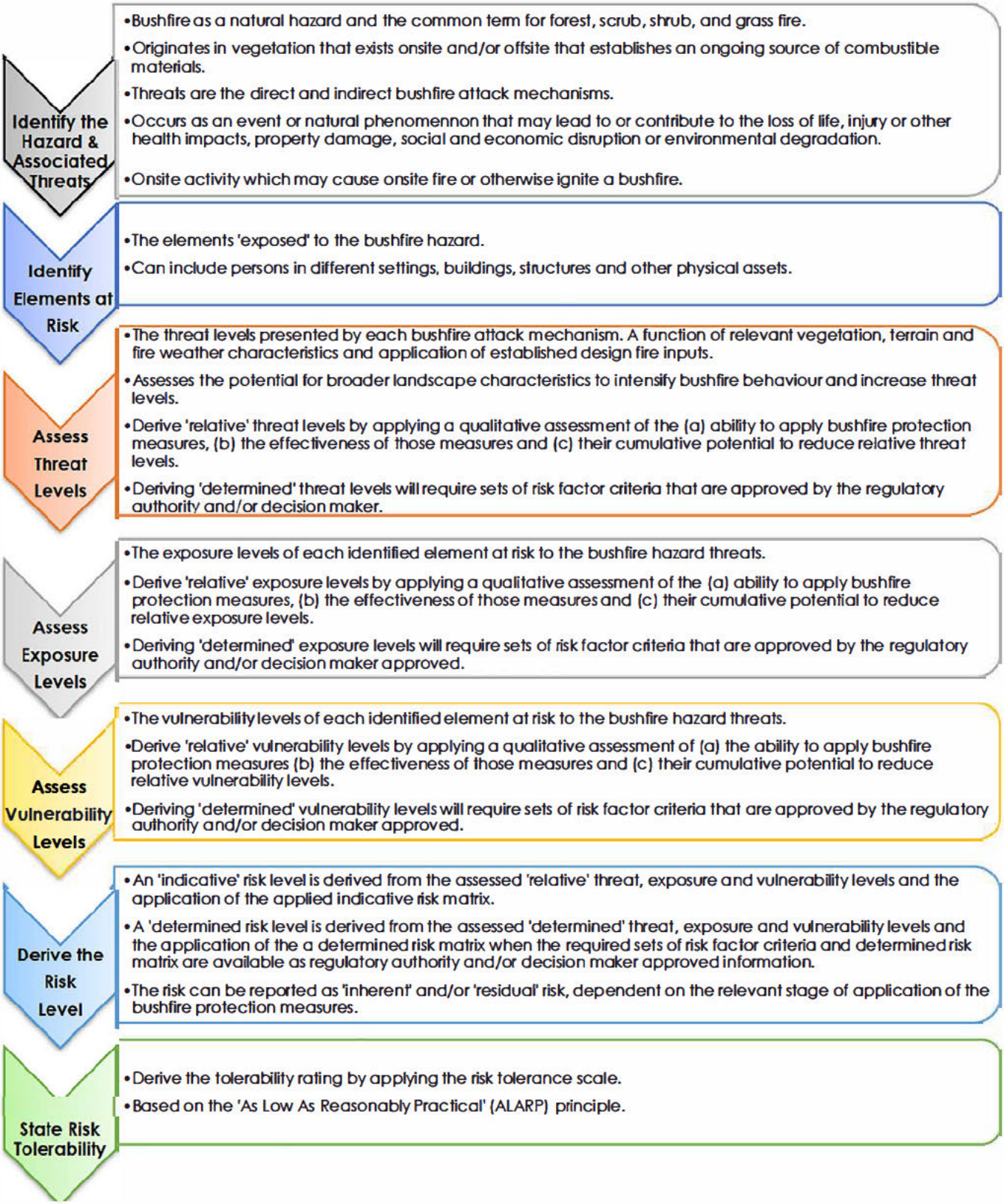


Figure 2.4: Outline of the adapted risk assessment process applied in this report.

2.4 THE BUSHFIRE HAZARD - BEHAVIOUR AND ATTACK MECHANISMS

Information regarding bushfire attack mechanisms and the potential influence of the broader landscape on the intensification of fire behaviour, is provided in Appendix 4 and 5. The content of these appendices is outlined below. Providing this information is intended to:

1. Assist those tasked with making design, construction, planning and management decisions (based on the information and assessments presented in this report), to have a better understanding of bushfire hazards where this may not be within their general field of expertise. This knowledge may also benefit development of innovative protection measures to increase the bushfire resilience of buildings/structures and/or improve persons safety and/or reduce bushfire threat levels; and
2. Assist readers understand why the assessment of the bushfire hazard threats and the presentation of the identified protection measures is organised the way it is in this report. It can also assist with guiding the search for additional information when necessary.

CONTENT OF APPENDIX 4

1. Factors Influencing Bushfire Behaviour
    - Vegetation and other fuels - key characteristics
    - Weather
    - Topography
2. Bushfire Direct Attack Mechanisms
    - Ember attack
    - Radiant heat attack
    - Bushfire flame attack
    - Surface fire attack
3. Bushfire Indirect Attack Mechanisms
    - Debris accumulation
    - Consequential fire
    - Fire driven wind
    - Tree strike and/or obstruction

CONTENT OF APPENDIX 5

1. Recent bushfire research
2. Dynamic Fire Behaviours
    - Spotting
    - Fire whirl/tornado
    - Junction fire
    - Crown fire
    - Eruptive fire
    - Fire channelling (vorticity-driven lateral spread)
    - Conflagrations
    - Downbursts
    - Pyroconvective events.
3. Drivers of deep flaming
4. Extreme bushfire events
5. Physical requirements of terrain, fuel load (and windspeed) for deep flaming.

3 ASSESSMENT SUMMARY

The assessment summary is presented in three parts:

Section 3.1 states the derived bushfire threat levels, and the exposure and vulnerability levels of each element at risk – as the factors from which the risk levels are derived.

Section 3.2 shows the type of risk level that is to be reported, states the derived risk levels and the tolerability of that risk - for each exposed element and each identified area of bushfire prone vegetation.

Section 3.3 presents a summary of the bushfire protection measures that can be applied and are currently implemented or are recommended to be implemented. The operational document in which the measures should be identified is noted.

3.1 THE ASSESSED THREAT, EXPOSURE AND VULNERABILITY LEVELS ESTABLISHING THE RISK LEVEL

Table 3.1: The assessed threat levels of the bushfire hazard.

ASSESSED HAZARD THREAT LEVELS [1]		
Bushfire Prone Vegetation Onsite and Offsite	Relative Threat Level [2]	
	Inherent	Residual
All bushfire prone vegetation within the subject lots, and within 150m of the proposed development. All vegetation within the Lot is considered onsite vegetation and vegetation beyond the Lot boundary is considered off site.	Moderate	Low
All bushfire prone vegetation within the broader locality (10km radius) including along access routes.	Low	

[1] Refer to Section 6 for detailed assessment information.

[2] Refer to Appendix 2 for explanatory information.

Table 3.2: The assessed exposure and vulnerability levels for each exposed element to the stated area of bushfire prone vegetation.

ASSESSED EXPOSURE AND VULNERABILITY LEVELS OF IDENTIFIED ELEMENTS AT RISK [1]				
Vegetation Area / Location	All bushfire prone vegetation within 100m from the Merredin Battery site.			
Elements At Risk[2]	Relative Exposure Level [3]		Relative Vulnerability Level [3]	
Description	Inherent	Residual	Inherent	Residual
Persons located onsite and temporarily offsite	Moderate		Moderate	Low
Persons on access/egress routes (in vehicles) or pathways	High		Moderate	
Buildings/Structures - NCC Classes 1-10	Moderate	Low	Moderate	Very Low
Fixed (hard) infrastructure assets – Merredin Battery (BESS units and associated infrastructure)	Moderate	Very Low	Moderate	Low

[1] Refer to Sections 7 and 8 for detailed assessment information.

[2] Refer to their identification in Section 5.

[3] Refer to Appendix 2 for explanatory information.

3.2 THE ASSESSED RISK LEVEL ASSOCIATED WITH A BUSHFIRE EVENT AND ITS TOLERABILITY

Table 3.3: Identifying the 'type' of risk level being assessed and reported in this report.

THE TYPE OF RISK LEVEL DERIVED FROM THE ASSESSMENT [1]			
Indicative Risk		Determined Risk	
Inherent	Residual	Inherent	Residual
✓	✓	☐	☐

[1] Refer to Section 2, Appendix 2 and the glossary for explanatory information (inherent/residual corresponds to the level that available protection measures have been considered in the assessment with 'residual' including recommended measures).

Table 3.4: The tolerability of the assessed risk levels for each exposed element and corresponding to the identified areas of bushfire prone vegetation.

THE ASSESSED BUSHFIRE RISK LEVEL AND TOLERABILITY [2]					
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.				
Elements At Risk [1]	Indicative Risk Level [2]		Inherent Risk Tolerability (ALARP) [3]	Residual Risk Tolerability (ALARP) [3]	Adjusted Residual Risk Tolerability (ALARP) [4]
Description	Inherent	Residual			
Persons located onsite and temporarily offsite	**M7**	**L5**	Tolerable but NOT ALARP	Acceptable	N/A
Buildings/Structures - NCC Classes 1-10	**M7**	**VL3**	Tolerable but NOT ALARP	Acceptable	N/A
Fixed (hard) infrastructure assets – Merredin Battery (BESS units and associated infrastructure)	**M7**	**VL3**	Tolerable but NOT ALARP	Acceptable	N/A
Vegetation Area / Location	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.				
Elements At Risk [1]	Indicative Risk Level [2]		Inherent Risk Tolerability (ALARP) [3]	Residual Risk Tolerability (ALARP) [3]	Adjusted Residual Risk Tolerability (ALARP) [4]
Description	Inherent	Residual			
Persons on access/egress routes in vehicles	**M7**		Acceptable as IS ALARP		Acceptable

Supporting Comments:

The inherent risk tolerability is considered to be TOLERABLE, however it is 'reasonably practical' for the inherent risk level of 'MODERATE' to be lowered with the application of the assessed available and recommended bushfire protection measures.

The residual risk tolerability is considered to be ACCEPTABLE because it is assessed as not being 'reasonably practical' for the residual risk level of 'LOW' or 'VERY LOW' to be further lowered by the application any additional bushfire protection measures.

Measures are not available to reduce the indicative inherent risk to persons on access routes. This results in an Acceptable tolerability as it is subject to the ALARP principle. The tolerability is adjusted through Section 3.3 below.

[1] Refer to their identification in Section 5.

[2] Refer to Section 2, Appendix 2 and the glossary for explanatory information (inherent/residual corresponds to the level that available protection measures have been considered in the assessment with 'residual' including recommended measures).

[3] Refer to Appendix 3 for information supporting the application of the tolerance scale.

[4] Refer to Section 3.2.1 for adjustment justification when applicable.

3.3 ADJUSTMENT OF RESIDUAL RISK TOLERABILITY

Development/use scenarios can exist where a higher level of residual risk might be considered as tolerable or acceptable. Such a situation may exist when the exposed element is not persons and the economic cost due to the loss or damage of assets and/or disruption of services, is a risk that is retained by the owners as an informed decision. Consideration of the knock-on risk implications to persons who might be associated with these elements, or other nearby elements at risk, will be part of the tolerability adjustment assessment.

There may also be isolated scenarios where the limits for tolerability of risk need to be established at lower residual risk levels i.e. an additional margin of safety is required. The rationale for any residual risk tolerance adjustment is presented below.

ELEMENTS AT RISK SUBJECT TO ADJUSTMENT OF RISK TOLERANCE	
Element At Risk [Section 5.2]	Adjustment Rationale
Persons on access/egress routes in vehicles	The site is intended to be unstaffed. It is unlikely that persons will be present during a bushfire emergency for evacuation to be necessary. Any visitors, contractors, or staff onsite will be accessing temporarily for maintenance, inspections etc and will have vehicles immediately available. The emergency procedure is to evacuate on identification of a bushfire and this has been established as a requirement of site induction.

3.4 INFORMATIVE MECHANISMS – RECOMMENDED ACTIONS

3.4.1 ADDITIONAL BUSHFIRE PROTECTION MEASURES - RECOMMENDED BY BUSHFIRE CONSULTANT

3.4.1.1 THREAT REDUCING MEASURES - BUSHFIRE HAZARD

BUSHFIRE HAZARD THREAT REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES			
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details
Prevent Bushfire ignition and/or severity by managing the fuels	1.4	Remove onsite bushfire fuel	A BAL-29 APZ is required for planning approval. A 10kW/m2 APZ is additionally required so BESS units and infrastructure (electrical components) are unlikely to be compromised due to radiant heat during a bushfire. There is no native vegetation on site, therefore permission by the decision maker and local government is not required.
	1.7	Reduce onsite consequential fire fine fuels:	It is required that all fine fuels are removed or maintained below 2t/ha within the APZ.
Prevent bushfire ignition by managing heat energy sources	1.10	Operational procedures - fire safe principles	Operating procedures have not yet been prepared. No ongoing works are proposed which could ignite a bushfire, except during an accident or component failure. It is advised that any hot/hazardous works are not undertaken during a Total Fire Ban or on a day with a Fire Danger Rating of Extreme or Catastrophic or under a Local Govt imposed Harvest, Vehicle movement and hot works ban.
Prevent bushfire ignition by managing the interactions of heat energy sources and fuels	1.16	Shielding of ignition sources	BESS units and associated infrastructure are comprised of metal exterior. Electrical cabling to and from the BESS units and associated infrastructure are underground, and any exposed cables can be shielded by non-combustible material.
	1.17	Separation of ignition sources	Fire within the facility (infrastructure, batteries or stored equipment) ignited by site operation/accident/failure may ignite vegetation. The 10kW/m2 APZ to be applied around the infrastructure is considered appropriate in reducing the risk of igniting a bushfire. The removal of consequential fire hazards within the APZ minimises the potential for spread of fire beyond the asset.
[1] The full description of each bushfire protection measure and the detail of the assessment is presented in Section 6.1.			

3.4.1.2 EXPOSURE REDUCING MEASURES – ALL STRUCTURES AND ASSETS

ALL STRUCTURES AND ASSETS EXPOSURE REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES			
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details
Establish sufficient separation from relevant bushfire hazard threats	4.1, 6.1	Siting of buildings / structures / campsites considering potential high wind exposure	An APZ is to be established around electrical components and infrastructure. This APZ will ensure exposure to the bushfire hazard threat of radiant heat will be limited to a maximum radiant heat flux of 10 kW/m2 (calculated with an assumed flame temperature of 1090K) by providing the required separation distances from the bushfire hazard. The 10m portion of the APZ immediately around BESS infrastructure must be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc). A BAL-29 APZ is required for all Class 1-10 buildings onsite. It is possible to locate the buildings within the 10kW/m2 APZ applied to BESS infrastructure such that additional vegetation clearing is not required.
	4.7, 6.7	Separation from stored and constructed combustible items (consequential fire fuels)	All non-structural combustible materials are to be removed within 10m of assets. This includes but is not limited to; waste, leaf litter, machinery, grasses, vehicles, fuel, furniture, and timber. When storage of flammable items or materials are stored on site temporarily (for maintenance etc), separation distances must be complied with. This requirement is to be included in the Site Operating Procedures document.
Establish shielding from relevant bushfire hazard threats	4.9 6.9	Constructed barrier – shielding from consequential fire	Ensure all subfloor spaces are sealed or enclosed with non-combustible solid material or ember screening mesh (corrosion-resistant steel, bronze, or aluminium with an aperture <2mm).
	6.12	Shield operation critical non-structural elements	Exposed electrical cabling to be shielded from radiant heat and consequential fire by burying underground or shielding with non-combustible material – common electrical cabling reaches its critical point at >10kWm2. Exposed plumbing (poly pipe) is to be buried or shielded with non-combustible material – maximum exposure 120 degrees Celsius.
[1] The full description of each bushfire protection measure, the detail of the assessment and any recommendation, is presented in Section 7.3.1. and Section 7.4.1.			

3.4.1.3 VULNERABILITY REDUCING MEASURES - PERSONS

PERSONS VULNERABILITY REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES			
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details
Provision of bushfire emergency information and education	Persons Located Onsite and Temporarily Offsite		
	7.5	Bushfire Protection Measures to be Implemented are Published in the Relevant Operational Documents:	The site Emergency Management Plan (document title pending), is to include responses to bushfire emergencies. The immediately procedure is to evacuate in the appropriate direction away from the fire, and inform DFES Comcen of the status of the BESS facility.
Onsite persons capable of managing a bushfire emergency are available	7.11	Onsite persons available to manage bushfire emergency procedures	The development is proposed to be unstaffed. It is recommended that the staff member managing emergency procedures has training in general bushfire emergency procedures, and has specific knowledge of the site procedures in response to bushfire. This staff member should be easily contactable.
	7.14	External emergency response services available	It is recommended that the Merredin Volunteer Fire and Rescue Service are to be invited to inspect and familiarise with the site. Provide information in site fire response procedures. This invitation may be annual or ad-hoc.
[1] The full description of each bushfire protection measure, the detail of the assessment and any recommendation, is presented in Section 8.1.1 & 8.2.1.			

3.4.1.4 VULNERABILITY REDUCING MEASURES – STRUCTURES AND ASSETS

STRUCTURES AND ASSETS VULNERABILITY REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES			
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details
Construction design and materials	9.3	Construction materials for external and internal cavity building elements	The construction of proposed structures is currently unknown. They will likely be primarily masonry, steel, aluminium and cement sheeting. It is recommended non-combustible elements are included where practical.
	11.7	Construction materials – non-structural essential elements	Use non-combustible or products with high heat ratings to assist with maintaining their operability.
	9.7, 11.7	Construction of electricity supply	Exposed electrical cabling to be shielded from radiant heat and consequential fire by burying underground or shielding with non-combustible material – common electrical cabling reaches its critical point at >10kWm2. Exposed plumbing (poly pipe) is to be buried or shielded with non-combustible material – maximum exposure 120 degrees Celsius.
	11.8	Minimise re-entrant detail to minimise debris and ember accumulation	Where the electrical cabling contacts the ground or any arrangement of associated structures creates a 'pocket' for accumulation of debris, this should be rectified by design or filling with non-combustible material such as mineral earth. Consideration should be given to making the arrangement self-cleaning through wind action to the greatest extent possible. These measures will reduce accumulation and/or make the management (clearing) of accumulated debris easier. E.g. cable raking to be ≥100mm above ground.
	9.11, 11.11	Minimise construction cavities to minimise debris and ember accumulation	Ensure all subfloor spaces are sealed or enclosed with non-combustible solid material or ember screening mesh (corrosion-resistant steel, bronze, or aluminium with an aperture <2mm).
	9.13	Screen and seal gaps and penetrations	All Class 1-10 buildings (including non-habitable structures) must have ember screening/sealants installed on any gaps and penetrations. It is recommended that ember screens are installed to BESS units and all other cabinets over intake/exhaust vents and other gaps to the interior cavity or accessing any combustible elements. Ember screening mesh is corrosion-resistant steel, bronze, or aluminium with an aperture <2mm.
	11.13	Screen and seal gaps and penetrations	The manufacturer or appropriate engineers should be contacted to enquire if it is possible to apply ember screening to intake/exhaust vents and other paths of entry to the interior cavity or accessing any combustible elements of BESS

STRUCTURES AND ASSETS VULNERABILITY REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES			
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details
			cabinets. This ember screening would be applicable to the exterior of the battery cabinet, not internal components. The intention is to prevent both ember ingress and debris accumulation. Ember screening mesh is corrosion-resistant steel, bronze, or aluminium with an aperture <2mm.
	9.16, 11.16	Landscaping construction - fences and walls:	Any security fences or other potential fuel loads should be constructed using non-combustible material.
Availability of a firefighting response capability	9.17, 11.17	Firefighting water supply	The following requirements apply to the firefighting water supply. The specifications will be confirmed at the detailed design stage. <u>Access</u> • Firefighting water access points (hydrants, hard suction, or drafting) must be clearly identifiable, visible from internal roads, and unobstructed. • The water tank(s) must be located at the vehicle access point to the development (northern entry gate). • An all-weather hardstand turnaround area meeting the requirements of the Guidelines for Planning in Bushfire Prone Areas v1.4 (Explanatory Note E3.3) must be provided within 4 metres of both the static water storage tank(s) and any independent hard suction points (hydrants). • Site Operating Procedures must include that access routes must be unobstructed at all times. <u>Siting</u> • The water tank(s) must be positioned >10m from BESS cabinets and associated infrastructure. • The water tank(s) should apply a BAL-29 APZ at a minimum. It is possible to locate the tank within the 10kW/m2 APZ applied to BESS infrastructure such that additional vegetation clearing is not required. <u>Construction</u> • The static firefighting water supply must be calculated per AS 2419. Based on the submitted layout the required supply will be 288,000L. This water supply is intended to address bushfire and non-bushfire emergencies. • The static water storage tank(s) must be an above-ground water tank constructed of concrete or steel. • An external water level indicator must be installed on static water storage tank(s) and be visible from internal roads and the adjoining turnaround area. • Signage indicating 'FIRE WATER' and the tank capacity must be fixed to each tank.

STRUCTURES AND ASSETS VULNERABILITY REDUCTION RECOMMENDED ADDITIONAL BUSHFIRE PROTECTION MEASURES			
The Protection Mechanism	Ref No	Brief Description [1]	Recommendation Details
			• The hard-suction point must be protected from mechanical damage (eg. bollards) where vehicle contact is possible. • Couplings at hard suction points are required to be 125mm Storz fittings (*Guidelines* v1.4 s2.2.2.1). DFES Built Environment and the Merredin Volunteer Fire and Rescue Service should be contacted for input on appropriate couplings and adaptors.
	11.19	Firefighting equipment passively operated	The BESS units have active monitoring and electrical fault safety devices which ensure the units only remain operational within their intended operating environment, with an automated shut-down system. It is recommended that automatic fire suppression systems are installed and maintained, as appropriate to the BESS details and recommended by the manufacturer.
	11.20	Firefighting equipment operability maintained	Operating and maintenance procedures are to be developed to ensure regular maintenance of firefighting supply and infrastructure.
[1] The full description of each bushfire protection measure, the detail of the assessment and any recommendation, is presented in Sections 8.3.1 & 8.4.1.			

4 IDENTIFICATION OF THE ELEMENTS AT RISK

Elements at risk are those exposed to the bushfire hazard threats identified in Section 5. This section establishes the generic list of possible elements at risk and identifies the exposed elements of the subject development/use.

Table 4.1: Identification of the elements at risk for which this risk assessment and management report is produced.

THE ELEMENTS AT RISK (THE EXPOSED ELEMENTS)	
Type Description	Identification of Relevant Elements
Persons located onsite: as part of site operations or visitors) and **Persons temporarily offsite as part of site operations**: (e.g. tourism day trips)	✓
Persons on Access/Egress Routes (in Vehicles): i.e., roads, driveways, access ways	✓
Buildings - NCC Class 1 & 2: residential - of a domestic nature	
Buildings - NCC Class 3: residential – of long term or transient nature, for unrelated people	
Buildings – NCC Class 5: offices for professional or commercial purposes	
Buildings – NCC Class 6: shops selling retail goods or services to the public	
Buildings – NCC Class 7: warehouses & carparks - storage – wholesale goods / vehicles	
Buildings – NCC Class 8: factory / workshop / laboratory - in which a process is carried out	
Buildings – NCC Class 9: health care / residential care / assembly	
Buildings or Structures – NCC Class 10: non-habitable – shed / carport / garage / fence / retaining wall etc.	✓
Non-Building Accommodation: caravans / camper trailers / tents etc	
Fixed (Hard) Infrastructure Assets: telecommunications / power generation / transport / water supply / waste management	✓
Livestock/Animals: as part of commercial or private operations (saleyards / events / wildlife sanctuaries).	

Table 4.2: Description of the elements at risk that are subject to assessment for the proposed/existing development and/or use.

ELEMENT AT RISK DETAIL FOR THE SUBJECT DEVELOPMENT/USE	
Elements At Risk	Element Description
Persons located onsite and temporarily offsite	The site is not expected to have permanent staffing. Regular visitation by staff will complete monitoring, cleaning and general maintenance of the Project. Major maintenance that might be required would include replacement of equipment which may include battery modules, inverters, switchgear, transformers, or other infrastructure as needed. This would involve larger numbers of personnel for limited periods as required.
Persons on access/egress routes in vehicles	Staff and/or emergency services accessing to / egressing from the facility.
Buildings/Structures - NCC Classes 1-10	The facility is expected to include maintenance and storage sheds, which may contain valuable/combustible assets. These have been assessed Class 10a buildings.

Fixed (hard) infrastructure assets	BESS developments include battery cabinets, inverters, power skid transformers, and transformers.

5 IDENTIFICATION OF THE BUSHFIRE HAZARD

ONSITE AND OFFSITE VEGETATION – RATIONALE FOR SEPARATE IDENTIFICATION

The approach adopted in this report is to separately identify onsite and offsite bushfire prone vegetation when the distinction exists, and it is necessary.

Onsite Vegetation

This is considered to be vegetation that exists on a given lot or lots or a large area of land that can be considered a tenement (e.g. a mining tenement) and for which the owner or occupier has certain rights to conduct activities upon. The 'onsite' land is the subject site on which the existing or proposed development and/or use is to be conducted.

The existence of these rights makes it more likely that an authority will exist to make and maintain any required changes to the extent and the composition of any bushfire prone vegetation that exists 'onsite'. The only constraint will be any environmental conditions established by relevant authorities.

Offsite Vegetation

This is considered to be vegetation that exists external to what can be considered 'onsite'. For these lands the owner/operator does not normally have any authority to modify or manage this bushfire prone vegetation to reduce threats and maintain that reduction in perpetuity. Rather, the authority for modifying and managing 'offsite' vegetation resides with a third party such as another landowner or a government authority.

Implications for Risk Assessment and Implementation of Relevant Protection Measures

- It is likely to be near certain that a greater number of relevant bushfire protection measures can be established on land identified as 'onsite' compared to land that is identified as 'offsite'.
- A responsibility can be established for owners and/or operators of onsite land to ensure the ongoing maintenance of those protection measures.
- In comparison, management of offsite vegetation requires the establishment of enforceable vegetation management agreements if any reduction in threat level is to be achieved and accounted for in the threat level assessment. These can be problematic to establish.

  The required assessment of the broader landscape's influence on bushfire hazard threat levels will most likely be considering vegetation and terrain that is external to the subject development/use site and therefore needs to be separately identified.

For the proposal (BESS Merredin), the risk assessment will consider the hazard posed by bushfire prone vegetation at two scales:

- The vegetation within the subject lots and within 150m of the proposed development area, which presents the direct bushfire hazard (including following AS3959 BAL Methodology); and
- The vegetation within the broader locality, nominally to a 10km radius. This vegetation impacts access routes, the severity of potential landscape-scale fires impacting the immediate (150m) surrounds, and may impact the site with medium to long range ember attack and smoke.

5.1 ONSITE/LOCAL BUSHFIRE PRONE VEGETATION

Map I.D. / Area No. / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development. Refer to Figure 5.1.		
Classification or Exclusion Clause	Class G Grassland	Effective Slope (deg)	Upslope or flat 0 Downslope >0-5
Types Identified	Sown pasture G-26 Open herbfield G-27		
Description & Classification Justification	The vegetation onsite and the surrounding areas is predominantly open herbfield (crop land) or sown pastures with very small areas mainly onsite that are native grasses and saltbush.		
Post Development Assumptions:	APZs will be established as described in the BMP, to limit radiant heat flux exposure to BESS assets to a maximum 10kW/m².		

Herbfield/cultivated pasture

Herbfield/cultivated pasture

Native grass and saltbush

Heavy timber (Salmon gum)

Figure 5.1

Classified Vegetation & Topography (Existing)

Lot 5 on Plan D067824, Area : 61.5116ha
Robartson Road
MERREDIN
SHIRE OF MERREDIN

AREA 1
Class (G) Grassland
Effective Slope >0-5°

Lot 5

AREA 2
Class (G) Grassland
Effective Slope 0°

AREA 3
Class (G) Grassland
Effective Slope 0°

AREA 4
Excluded

AREA 4
Excluded

AREA 3
Class (G) Grassland
Effective Slope 0°

ROBARTSON RD

304m

306m

308m

310m

312m

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

------ LEGEND ------

- Lot 5
- Battery Development Extent
- Proposed Infrastructure
- 150m Assessment Area
- Photo & Direction

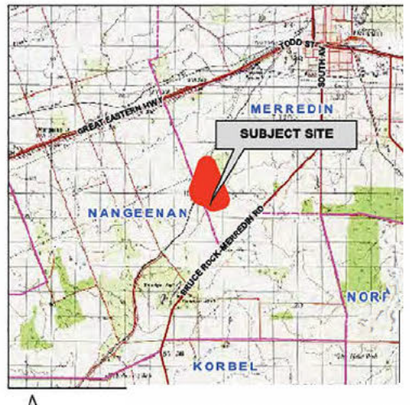
Classified Vegetation

- Class G - Grassland
- Exclusion 2.2.3.2

0 20 40 60 80 100 m

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 5
Projection: Universal Transverse Mercator Units: Metr
Map by: Elissa Edward 01-11-202
SCALE (A3): 1 : 200

BUSHFIRE PRONE PLANNING

169042_Fig-3-1-VEG_Merredin-Battery.qgz

5.2 OFFSITE/REGIONAL BUSHFIRE PRONE VEGETATION

Map I.D. / Area No. / Location	All bushfire prone vegetation within the broader locality (10km radius) including along access routes. Refer to Figure 5.2.		
Classification or Exclusion Clause	Class G Grassland Class B Woodland Class E Mallee	Effective Slope (deg)	Flat 0 Downslope >0-5
Types Identified	Open herbfield G-27	Low woodland B-07	Tall shrubland E-15
Description & Classification Justification	The vegetation onsite is largely grassland with small, fragmented sections of scrubland and or mallee. Some adjoining sections are relatively "closed" scrub with some Mallee and/or Salmon gum scattered and would not be considered to increase the threat. The proposed site is surrounded by open fields and the existing solar farm and associated infrastructure. The area is gently undulating and all areas are either upslope or 0-5 degrees downslope relative to development locations.		

Figure 5.2

Location Map

Lot 5 on Plan D067824, Area : 61.5116ha
Robartson Road
MERREDIN
SHIRE OF MERREDIN

------ LEGEND ------

- Lot 5
- Battery Development Extent
- Reserves

DFES Stations

- Bush Fire Brigade
- State Emergency Service Unit
- Volunteer Fire & Rescue Service

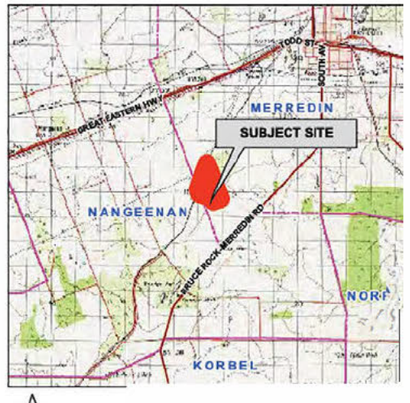
DBCA Legislated Lands and Waters

- Conservation Park
- Nature Reserve

0 1 2 3 4 km

Kilometres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 5
Projection: Universal Transverse Mercator Units: Metr
Map by: Elissa Edward 25-10-202
SCALE (A3): 1 : 7500

BUSHFIRE PRONE PLANNING

169042_Fig-1-3-LOC_Merredin-Battery.qgz

5.3 THE BROADER LANDSCAPE/ENVIRONMENT AND ITS POTENTIAL TO INTENSIFY FIRE BEHAVIOUR

More recent research into bushfire propagation has highlighted the role of environmental factors that are responsible for dynamic bushfire propagation and subsequent extreme fire development. Dynamic fire propagation arises from complex interactions between the terrain, the atmosphere and the fire. The intensified fire behaviour of an extreme bushfire event will significantly increase the threat levels generated by the bushfire attack mechanisms. Refer to Appendix 5 for an explanation of dynamic fire behaviours (DFBs) and their involvement in extreme bushfire events.

Consequently, in assessing the bushfire hazard threat levels to which the at risk elements could be exposed, the potential for dynamic bushfire propagation and subsequent development of extreme bushfire events within the broader landscape surrounding a subject site, must be assessed. The results of this assessment are incorporated into the assessed bushfire hazard threat levels for each attack mechanism is Section 5.5.

Table 5.1: Broader landscape assessment – the potential for extreme fire events to increase threat levels.

ASSESSING THE POTENTIAL FOR AN EXTREME BUSHFIRE EVENT TO DEVELOP AND INCREASE THE LEVEL OF THREATS IMPACTING THE SUBJECT SITE			
Relevant Physical Factors [1]	Factor Existence in Surrounding Landscape	Potential to Increase Bushfire Threat Levels	Assessment Comments
Physical factors more typically associated with conflagrations that are more likely to exist as large surface based bushfire events			
Large continuous areas of bushfire prone vegetation	Insignificant / Unlikely to Occur	Low	The proposed site is located in an area surrounded predominantly by open cleared pasture farm land that is managed by grazing and crops, canola and stubble to the south, west and north and the nature reserve 500 metres to the north. The reserve is predominately mulga and other acacia species, mallee and less than 10% trees. The reserve vegetation has the potential to produce short distance embers and firebrands, up to 700 metres (based on Mike Scott's experience). Ember attack will be minimal. There is minor scrub with <10% larger mallee and salmon gum timber which are scattered. Mostly surrounded by grasses and crop residues.
Heavier fuel loads	Insignificant / Unlikely to Occur		Areas on road verge and small pockets of remanent vegetation have heavier fuel loads (<20t/ha), however the surrounding vegetation, pasture and crop supports approximately 4.5t/ha, and scrub approximately <(16t/ha).
Fuel types (bark) that produce significant quantities of embers / firebrands (spotting) and can be long lasting;	Possible to Occur		The reserve vegetation has coarse tight bark and when the bark sheds from some acacias, there is potential to produce short distance embers and firebrands, up to 700 metres (based on Mike Scott's experience).

ASSESSING THE POTENTIAL FOR AN EXTREME BUSHFIRE EVENT TO DEVELOP AND INCREASE THE LEVEL OF THREATS IMPACTING THE SUBJECT SITE			
Relevant Physical Factors [1]	Factor Existence in Surrounding Landscape	Potential to Increase Bushfire Threat Levels	Assessment Comments
Sufficient area of land and vegetation to support multiple fires of scale	Possible to Occur		Significant threat being the risk of fast moving grass fires of large scale due to crop/pasture and native grasses on unmanaged land.
Terrain that can facilitate development of topographically modified winds (e.g. scarp or foehn-like)	Does Not Exist		
Strong synoptic winds (i.e., not fire driven)	Possible to Occur		The landscape is relatively flat. Strong easterly winds are common during the summer.
Physical factors with identified links to deep flaming and the development of pyroconvective, coupled atmosphere, bushfire events			
Terrain slopes of approximately 24⁰ or greater - or some degrees lower with greater wind speeds (increases potential for eruptive fire).	Does Not Exist	Low	The local topography is flat with minor undulation.
Rugged terrain with local relief in the order of at least 300m (increases potential for eruptive fire).	Does Not Exist		
Terrain with leeward slopes >20-25 degrees (increases potential for vorticity-driven lateral spread)	Does Not Exist		
Wind speed in excess of approximately 20 km/hr (increases potential for vorticity-driven lateral spread)	Likely to Occur		The wheat belt area will experience seasonal winds that could easily sustain wind speeds greater than 20 km/hr during summer.
Fuel moisture content around 5% or less (associated with vorticity-driven lateral spread)	Likely to Occur		Less than 5% moisture in any fuels will potentially increase the rate of spread.
Sufficiently sized areas (scale) of bushfire prone vegetation to potentially support deep flaming and supply the required quasi-instantaneous energy release.	Does Not Exist		Deep flaming will not be supported in the grass fuels and flat terrain.
Atmospheric instability to create opportunity for atmospheric coupling and violent pyroconvection.	Possible to Occur		It will be assumed, as a minimum, that at most locations, the potential for vertical movement of air without any resistance to that movement (e.g. temperature inversions) can always exist. That is, it is not sufficiently risk averse to assume that atmospheric instability will never exist – different temperature air masses can always interact as a consequence of the passage of different weather systems at any location.

ASSESSING THE POTENTIAL FOR AN EXTREME BUSHFIRE EVENT TO DEVELOP AND INCREASE THE LEVEL OF THREATS IMPACTING THE SUBJECT SITE			
Relevant Physical Factors [1]	Factor Existence in Surrounding Landscape	Potential to Increase Bushfire Threat Levels	Assessment Comments
[1] These are physical terrain / environment factors that are either required for certain dynamic fire behaviours or will enhance the potential for and the development of an extreme bushfire event.			

5.4 ASSESSMENT OF VEGETATION CHARACTERISTICS DRIVING BUSHFIRE ATTACK MECHANISM THREAT LEVELS

This qualitative assessment derives the **base threat levels** of identified areas of bushfire prone vegetation by accounting for:

1. Fuel types, arrangement and quantities; and
2. The existence of relevant characteristics within the broader landscape that have the potential to intensify bushfire behaviour and increase threat levels.

Note: This assessment does not account for the existence or potential application of threat reducing protection measures or the level of exposure and vulnerability of elements at risk. These are accounted for in subsequent steps of the risk assessment process that results in the derivation of inherent and/or residual risk levels.

Table 5.2: The assessed potential for bushfire attack mechanisms originating from vegetation to adversely impact exposed elements.

CHARACTERISTICS ASSESSMENT OF THE BUSHFIRE PRONE VEGETATION AND ITS POTENTIAL TO IMPACT [1] ELEMENTS AT RISK – THE BASE THREAT LEVEL		
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.	
Identified Characteristics that will Contribute to the Severity of the Attack Mechanism and Consequent Base Threat Level to All Elements at Risk		Base Threat Level (the relative potential for adverse impact on exposed elements)
Direct Bushfire Attack Mechanisms		
Ember Attack: This threat level is strongly correlated with the existence of bark fuels. The varied typical rates of spread and residence time for flame fronts in different vegetation types is also incorporated into the threat level assessment (these impact on time available to make decisions and time exposed to threats).	Ember Attack can result from both immediate and regional vegetation. Other attack mechanisms below have not considered vegetation within the broader locality. Within the subject lot: The grass type fuels are finer fuels and will produce very little, short distance small embers with short lives. The majority of these embers will be consumed as part of the flame front which will have a residence time (the flaming phase at a point on the ground) typically less than 10 seconds. Consequently these embers present a limited threat to the BESS units and associated infrastructure, and any accumulated debris. The longer distance woodland fuels present a limited threat due to their distance from the site, the impacting grassfire being unlikely to dislodge firebrands, and the bark types of the local mallee and salmon gum.	Very Low

CHARACTERISTICS ASSESSMENT OF THE BUSHFIRE PRONE VEGETATION AND ITS POTENTIAL TO IMPACT [1] ELEMENTS AT RISK – THE BASE THREAT LEVEL		
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.	
Radiant Heat Attack: This threat level is a function of fuel characteristics (size, shape, quantity, type, arrangement and moisture content) and the landscape and weather factors that can intensify fire behaviour. Larger flame sizes and higher temperatures produce higher levels of heat. The varied typical rates of spread and residence time for flame fronts in different vegetation types is also incorporated into the threat level assessment (these impact on time available to make decisions and time exposed to threats).	Fine fuel loads for the grassland (pasture) vegetation ranges from 2-4 t/ha, with 2 t/ha being more common due to livestock grazing. The location being in the eastern wheatbelt and considered marginal rainfall the grassland vegetation is unlikely to reach the levels near or above 2t/ha The modelled solid portion flame lengths for the identified grassland vegetation type, on land ranging from flat to 0-5 degrees downslope, are up to 7m to 9m. These are shorter to medium flame lengths. The potential impact of the radiant heat transfer is going to be moderated by the short residence time (the flaming phase at a point on the ground) for the flame front. For much of the identified grassland vegetation types, the residence time will typically be less than 10 seconds. The residual radiant heat after the passage of the fire front will be low. There are no areas of woodlands of concern that would have potential to impact the site or facilities/infrastructure in the event of a bush fire.	Low
Bushfire Flame Attack: This threat level is a function of potential flame lengths which are significantly influenced by fine fuel loads and the slope of the land on which the fire is burning. The varied typical rates of spread and residence time for flame fronts in different vegetation types is also incorporated into the threat level assessment (these impact on time available to make decisions and time exposed to threats).	Fine fuel loads for the identified grassland and scrub vegetation types range from 2 – 4.5 t/ha with the lower quantities typically associated with grazed grassland complex. These are low to moderate fine fuel loads. The modelled solid portion flame lengths for the identified grassland types, on land ranging from flat to 0-5 degrees downslope, are up to 7m and 9m. These are shorter to medium flame lengths. The modelled flame lengths for woodland in the same range are 12m to 16m. The setbacks from the grassland vegetation types due to both siting and APZ dimensions provided within the BMP are more than double these flame lengths (<9m length vs >20m setback).	Low
Surface Fire Attack: This threat level is a function of the existence of intermittent surface fuels surrounding and leading up to exposed elements.	Grassland does not accumulate significant surface fuels/debris. All vegetation areas have sufficient setback that this hazard is negligible.	Low
Indirect Bushfire Attack Mechanisms		

CHARACTERISTICS ASSESSMENT OF THE BUSHFIRE PRONE VEGETATION AND ITS POTENTIAL TO IMPACT [1] ELEMENTS AT RISK – THE BASE THREAT LEVEL		
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.	
Debris Accumulation: This threat level is a function of having a source of vegetative debris, its extent and proximity to exposed elements.	There will be limited debris accumulation due to predominantly grassland vegetation. Some debris will exist within treed areas.	Low
Consequential Fire: This threat level is a function of the existence of accumulated debris (fine fuels) and stored or constructed combustible / flammable items that exist either as part of the site use or operations or are adjoining/adjacent buildings/structures (heavy fuels).	The potential for debris accumulation has been assessed. There will be no stored combustible/flammable materials adjacent to the element at risk (the BESS and supporting infrastructure). There are no other structures that could become a consequential fire, excepting those to which the same bushfire protection measures will be applied (APZs, ember screening etc).	Very Low
Fire Driven Wind: This threat level is correlated with the potential for development of extreme bushfire events (refer to Appendix 5).		N/A
Tree Strike and Obstruction: This threat level is a function of the existence of trees, their proximity to exposed elements and an exposed element that can subsequently be vulnerable to other bushfire attack mechanisms due to damage or obstruction.	The proposed location of the facility is relatively clear, but some trees will exist within 50m. The element may be considered at risk where the setback from the tree is <1.5x the mature height of that tree.	N/A
[1] Refer to glossary.		

5.5 THE MODELLED BUSHFIRE - POTENTIAL RADIANT HEAT TRANSFER AND FLAME LENGTH

For the identified vegetation the modelled (design) fire will apply the most applicable fire behaviour and radiant heat models in determining the level of threat presented by the flame contact and radiant heat direct attack mechanisms of fire.

These models will be either those applied to Bushfire Attack Level (BAL) determination within AS 3959:2018 or other models as identified and justified in this report. The information in this section states the levels of radiant heat transfer at the stated distances from the element at risk in either BAL ratings or kW/m² (and flame lengths as relevant).

This information is considered in assessing threat levels in Section 5. Refer to Appendix 7 for additional information.

Table 5.3 Vegetation separation distances corresponding to radiant heat transfer levels.

THE CALCULATED VEGETATION SEPARATION DISTANCES CORRESPONDING TO THE STATED LEVEL OF RADIANT HEAT [1]									
Vegetation Classification		Separation Distances Corresponding to Stated Level of Radiant Heat (metres)							
		Bushfire Attack Level						Maximum Radiant Heat Flux	
Area	Class	BAL-FZ	BAL-40	BAL-29	BAL-19	BAL12.5	BAL-LOW	10 kW/m²	2 kW/m²
1	(G) Grassland	<7	7-<9	9-<14	14-<20	20-<50	>50	21.8	-
2	(G) Grassland	<6	6-<8	8-<12	12-<17	17-<50	>50	21.2	-
3	(G) Grassland	<6	6-<8	8-<12	12-<17	17-<50	>50	21.2	-
4	Excluded cl 2.2.3.2(e)	-	-	-	-	-	-	-	-

[1] All calculation input variables are presented in Table 3.2. A copy of radiant heat calculator output for each area of classified vegetation are presented in Appendix A2.

6 BUSHFIRE HAZARD THREAT LEVELS ASSESSMENT

SUMMARY OF THE QUALITATIVE ASSESSMENT PROCESS

1. Identify all protection measures (grouped by protection principle) that are available to reduce threat levels and rate their effectiveness;
2. Produce a numerical summary of all potential threat reducing protection measures that are available and determine their application status;
3. Assess the potential threat reducing impact of the package of protection measures that is able to be applied. The effectiveness rating weights the potential impact of an individual measure; and

1. Derive the threat level, for each identified area of bushfire prone vegetation, by accounting for:
    - The relevant characteristics of the vegetation as they influence the bushfire attack mechanisms and establish the base threat level;
    - The potential threat increasing influence of the broader landscape; and
    - The impact of the applied package of protection measures in reducing threat levels (refer to Section 2.3.3 and Appendix 2 for additional risk assessment process information).

6.1 PROTECTION MEASURES AVAILABLE TO REDUCE BUSHFIRE THREAT LEVELS AND THEIR APPLICATION STATUS

Table 6.1: For the stated area of vegetation, all available bushfire protection measures for preventing or reducing the potential for fire ignition and eliminating or reducing its threat levels.

PROTECTION MEASURES TO REDUCE BUSHFIRE THREAT LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.					
PROTECTION PRINCIPLE - PREVENT FIRE IGNITION AND/OR SEVERITY BY CONTROLLING THE FUEL: Eliminate or reduce vegetation fuel loads, modify their properties (vegetation types and the arrangement of the fuels). Maintain the measures over time to eliminate bushfire or lower the severity of fire behaviours and the consequent threat levels. The measures may conflict with desired / regulated environmental conservation outcomes and this remains a potential limitation.						
1.1	**Remove Offsite Bushfire Fuel**: Remove fuel permanently by clearing bushfire prone vegetation when an authority exists.	Very High	N/A	N/A	N/A	N/A
1.2	**Reduce Offsite Bushfire Fuel**: Programmed hazard reduction burning when an authority exists to conduct and maintain (refer to Appendix 6 for additional information).	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: Vegetation types onsite would not respond to hazard reduction burning as minimal debris can accumulate, and burning will encourage weed growth, thereby increasing the hazard.						

	PROTECTION MEASURES TO REDUCE BUSHFIRE THREAT LEVELS	Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
1.3	**Reduce Offsite Bushfire Fuel:** Mechanical fuel reduction to modify composition of vegetation types and/or the arrangement of fuels and maintain the modification over time e.g. reduce canopy, limit higher threat bark types, minimise 'ladder' fuels' - when an authority exists to conduct and maintain.	High	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: Mechanical fuel reduction (slashing/sprayed) will be required to maintain the offsite grassland to low threat.						
1.4	**Remove Onsite Bushfire Fuel:** Remove fuel permanently by clearing bushfire prone vegetation when approved.	Very High	Yes	No	Yes	Yes
Informative and/or Site Specific Comment/Assessment: A BAL-29 APZ is required for planning approval. A 10kW/m2 APZ is additionally required so BESS units and infrastructure (electrical components) are unlikely to be compromised due to radiant heat during a bushfire. There is no native vegetation on site, therefore permission by the decision maker and local government is not required.						
1.5	**Reduce Onsite Bushfire Fuel:** Programmed hazard reduction burning (refer to Appendix 6 for additional information).	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: Vegetation (grassland) onsite would not respond to hazard reduction burning as minimal debris can accumulate and burning will encourage weed growth.						
1.6	**Reduce Onsite Bushfire Fuel:** Mechanical fuel reduction to modify composition of vegetation types and/or the arrangement of fuels and maintain the modification over time e.g. reduce canopy, limit higher threat bark types, minimise 'ladder' fuels' - when approved. Refer to the planned APZ.	Effective	Yes	No	Yes	Yes
Informative and/or Site Specific Comment/Assessment: The grassland will be slashed, sprayed or grazed.						
1.7	**Reduce Onsite Consequential Fire Fine Fuels:** Apply the specifications for an Asset Protection Zone (APZ) surrounding the exposed element(s) to ensure this area contains minimal consequential fire fuels and is maintained in a low threat state. The specifications are established in the Guidelines [22] within the *Explanatory Notes for Element 2 of the Bushfire Protection Criteria and Schedule 1: Standards for Asset Protection Zones.*	Effective	Yes	No	No	Yes
Informative and/or Site Specific Comment/Assessment: It is required that all fine fuels are removed or maintained below 2t/ha within the APZ. Land management plans and procedures are to be in place to ensure ongoing compliance by regular maintenance.						
1.8	**Reduce Road Verge Fuel:** Road verges of designated evacuation routes are subject to fuel load reduction, tree management and ongoing maintenance when an authority exists to conduct and maintain.	Not Relevant	N/A	N/A	N/A	N/A
1.9	**Greater Enforcement Applied to Compliance with the Local Government's Fire Break and Fuel Load Notice:** Inform the relevant landowners of the high level of enforcement that will be applied under the authority conferred through Section 33 of the Bush Fires Act 1954, including any amendments.	Effective	Yes	No	No	No

PROTECTION MEASURES TO REDUCE BUSHFIRE THREAT LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Informative and/or Site Specific Comment/Assessment: The bushfire protection measures within the BMP far exceed that of the Firebreak Notice and it is a condition of approval that the site must be compliant with the local government firebreak Notice.						
PROTECTION PRINCIPLE – PREVENT FIRE IGNITION BY CONTROLLING HEAT ENERGY SOURCES: Fire prevention focussed on potential ignition sources from human actions and/or faulty or poorly designed equipment. Natural causes of ignition (lightning) cannot be controlled and are a limitation.						
1.10	**Operational Procedures**: Apply fire safe principles to site operation procedures including: • Eliminating or reducing the potential for open air creation of fire, embers or sparks; and • Closing identified high risk operations when a bushfire event exists. Ensure safe practices are carried out via appropriate guidelines, protocols, signage and education.	Moderate	Yes	No	No	Yes
Informative and/or Site Specific Comment/Assessment: Operating procedures have not yet been prepared. No ongoing works are proposed which could ignite a bushfire, except during an accident or component failure. It is advised that any hot/hazardous works are not undertaken during a Total Fire Ban or on a day with a Fire Danger Rating of Extreme or Catastrophic or under a Local Govt imposed Harvest, Vehicle movement and hot works ban.						
1.11	**Operational Procedures**: Ensure proper management of hazard reduction burning as an unintended ignition source.	Not Relevant	N/A	N/A	N/A	N/A
1.12	**Equipment Design**: Apply fire safe design principles to equipment, vehicles, and energy transmission etc. Design to control rate of energy release and eliminate/reduce potential for open air creation of fire, embers or sparks.	Moderate	Yes	No	Yes	No
Informative and/or Site Specific Comment/Assessment: To be included in equipment design at purchase stage. All equipment must meet minimum national standards and standards associated with BESS requirements, and this is considered adequate.						
1.13	**Legal Enforcement**: Impose restrictions on source of ignition operations by enforcing total fire bans.	Effective	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: Onsite activity capable of igniting a fire is controlled by the Standard Operating Procedures.						
1.14	**Legal Enforcement**: Reduce arson events by monitoring / enforcement / penalties.	Moderate	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: Unlikely to have any impact given the scale of relevant vegetation and the population density of the region.						
1.15	**Education**: Educate persons to reduce the occurrence of accidental ignitions in vegetation by persons and/or vehicles, particularly with regard to road reserves.	Moderate	Yes	No	No	No
PROTECTION PRINCIPLE - PREVENT FIRE IGNITION BY CONTROLLING HEAT ENERGY SOURCE AND FUEL INTERACTIONS: Fire prevention focussed on limiting potential ignition sources by preventing a source and a fuel being able to interact.						

PROTECTION MEASURES TO REDUCE BUSHFIRE THREAT LEVELS		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
1.16	**Shielding of Ignition Sources**: Utilise physical barriers (shielding) between bushfire fuels and heat energy sources such as electricity generation / transmission, fuel supplies, stored flammable products etc. Examples include appropriate walls, enclosures, and underground transmission of electricity or liquid/gas fuels.	Moderate	Yes	No	Yes	Yes
Informative and/or Site Specific Comment/Assessment: BESS units and associated infrastructure are comprised of metal exterior. Electrical cabling to and from the BESS units and associated infrastructure are underground, and any exposed cables can be shielded by non-combustible material.						
1.17	**Separation of Ignition Sources**: Establish sufficient separation distance between bushfire fuels and heat energy sources such as electricity generation / transmission, fuel supplies, stored flammable products etc.	Effective	Yes	No	Yes	Yes
Informative and/or Site Specific Comment/Assessment: Fire within the facility (infrastructure, batteries or stored equipment) ignited by site operation/accident/failure may ignite vegetation. The recommended 10kW/m2 APZ to be applied around the infrastructure is considered appropriate in reducing the risk of igniting a bushfire. The likelihood of flame contact in such an event is negligible. Radiant heat flux in battery fires is relatively low, the Victorian Big Battery Fire (July 2021) required only a 20m exclusion zone for personnel. Note the 10kW/m2 APZ proposed is also >20m. The recommendations provided include the removal of consequential fire hazards within the APZ, and thus minimising the potential for spread of fire beyond the asset.						
1.18	**Equipment Design**: Through design and materials, control heat energy transfer via conduction, convection and radiation of heat energy.	Moderate	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: The design of equipment is appropriate. Shielding cables will minimise flame length and help contain a fire.						

[1] **Protection Measure Effectiveness Rating:** Refer to section 2.3.5 for explanation and defining.

[2] **Protection Measure Application Status**:

- **Possible**: Protection measures that can potentially be applied to the proposed development/use;
- **Exists**: Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary);
- **Planned**: Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or

PROTECTION MEASURES TO REDUCE BUSHFIRE THREAT LEVELS	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend

- Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).

- **Additionally Recommend:** Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

6.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 6.2: For the stated area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

BUSHFIRE THREAT REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating [1]	Numbers of Protection Measures				
		Total Available	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Prevent Fire Ignition and/or Severity by Controlling the Fuel	Very High	1	1	-	1	-
	High	-	-	-	-	-
	Effective	3	3	-	1	2
	Moderate	-	-	-	-	-
	Not Relevant	5	-	-	-	-
Prevent Fire Ignition by Controlling Heat Energy (Ignition) Sources	Very High	-	-	-	-	-
	High		-	-	-	-
	Effective	1	1	-	-	-
	Moderate	4	3	-	1	1
	Not Relevant	1	-	-	-	-
Prevent Fire Ignition by Controlling Heat Energy Source and Fuel Interactions	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	-	-	-	-	-
	Moderate	3	3	-	2	2
	Not Relevant	-	-	-	-	-
Total Numbers	**Very High**	**1**	**1**	**-**	**1**	**-**
	High	**-**	**-**	**-**	**-**	**-**
	Effective	**4**	**4**	**-**	**1**	**2**
	Moderate	**7**	**6**	**-**	**3**	**3**
	Not Relevant	**6**	**-**	**-**	**-**	**-**
	Totals	**18**	**14**	**-**	**4**	**5**

[1] Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

[2] Protection Measure Application Status: Refer to table footnotes on previous page.

6.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (THREAT REDUCTION)

Table 6.3: The potential impact of the applied protection measures in reducing threat levels in the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (THREAT REDUCTION)								
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.							
Threat Reducing Protection Measures Applied to Assessment [1]	The Bushfire Hazard Threats [2]							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Minimal	Medium	Significant	Significant	Minimal	Medium	Minimal	Medium
	Medium				Minimal			
Existing, Planned and Recommended (applied to residual risk)	Medium	Very Significant	Very Significant	Very Significant	Significant	Significant	Minimal	Medium
	Very Significant				Significant			

[1] Corresponds to the stage at which the risk level is to be reported i.e. inherent or residual (refer to Section 2.3.3)
[2] Refer to Appendix 4 for explanatory information.

Assessment Comments:

Ember attack will likely exist regardless of the APZ due to location of the native vegetation reserve to the NNE of the site.

'Existing and Planned' measures include the acceptable solutions to the Bushfire Protection Criteria, and therefore assumes the minimum BAL-29 APZ maintained to Schedule 1 of the *Guidelines*.

6.4 ASSESSED HAZARD THREAT LEVELS

Assessed as a function of the base threat levels of the bushfire hazard (refer to Section 5.5) and the number and effectiveness of protection measures that will be applied and their ability to reduce the base levels of threat from the identified areas of bushfire prone vegetation (Note: This assessment is independent of the exposure level and vulnerability level assessments).

Table 6.4: The assessed threat levels corresponding to the stated area of bushfire prone vegetation.

ASSESSED HAZARD THREAT LEVELS								
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.							
Threat Reducing Protection Measures Applied to Assessment [1]	The Bushfire Hazard Threats [2]							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Low	Very Low	Very Low	Low	Low	Very Low	Moderate	Very Low
	Moderate							
Existing, Planned and Recommended (applied to residual risk)	Very Low	Very Low	Very Low	Very Low	Low	Very Low	Moderate	Very Low
	Low							
Vegetation Area / Location	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.							
Existing and Planned (applied to inherent risk)	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Low	Very Low
	Low							

[1] Corresponds to the stage at which the risk level is to be reported i.e. inherent or residual (refer to Section 2.3.3).
[2] Refer to Appendix 2 for explanatory information.

Assessment Comments:

As identified in Section 5.3, there are a number of protection measures that can be applied to reduce the potential bushfire threat levels presented by the bushfire prone vegetation.

The protection measures will ensure the threat levels generated by a bushfire via the direct and indirect bushfire attack mechanisms, will be reduced. This includes the proposed APZ (as described within the associated BMP) and shielding of exposed cables where possible/practical.

There is little aside from the regular removal of accumulated debris against relevant infrastructure and strict management of the APZ, that operations management can do post-construction and during operation. From a preparation as opposed to a response perspective, this will ensure the threat levels generated by a bushfire (via the direct and indirect bushfire attack mechanisms), will be reduced.

For bushfire prone vegetation within the broader locality, inherent risk only is applied as treatments are not available. The ratings are on the base hazard posed, not the exposure or vulnerability of assets to the hazard.

7 EXPOSURE LEVEL ASSESSMENT OF THE ELEMENTS AT RISK

SUMMARY OF THE QUALITATIVE ASSESSMENT PROCESS

4. Identify all protection measures (grouped by protection principle) that are available to reduce exposure levels and rate their effectiveness;
5. Produce a numerical summary of all potential exposure reducing protection measures that are available and determine their application status;
6. Assess the potential exposure reducing impact of the package of protection measures that is able to be applied. The effectiveness rating weights the potential impact of an individual measure; and
7. Derive the exposure level of the identified element at risk, to the threats presented by each identified area of bushfire prone vegetation (refer to Section 2.3.3 and Appendix 2 for additional risk assessment process information).

7.1 PERSONS ONSITE OR TEMPORARILY OFFSITE

7.1.1 PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS AND THEIR APPLICATION STATUS

Table 7.1: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: PERSONS LOCATED ONSITE AND TEMPORARILY OFFSITE						
PROTECTION PRINCIPLE – SEPARATION FROM THE HAZARD: To ensure that the persons are located or re-located at a sufficient distance from the bushfire hazard to ensure the level of exposure to the threats, and the associated risk of persons death or injury, is contained within acceptable parameters.						
2.1	**Stay Away from the Subject Site:** In response to a pre-determined fire danger rating and/or total fire ban or set months of the year (bushfire season), prevent access to, occupancy or operation of the subject site (i.e. closure of use). The relevant conditions and the requirement to stay away will be established through a Bushfire Emergency Plan.	Very High	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: The site does not have regular staffing. Suitable egress and shelter locations are available so the measure is not necessary. Local Govt. imposed Harvest and Vehicle movement, hots works bans will also need to be considered.						
2.2	**Stay Within the Subject Site – Remote Hazard:** For offsite tourism operations, all associated persons (staff, guests, visitors), in response to a pre-determined fire danger rating and/or total fire ban, will remain on-site as better communication and sheltering options exist on-site. The relevant conditions and the requirement to stay will be established through a Bushfire Emergency Plan.	Not Relevant	N/A	N/A	N/A	N/A

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
2.3	**Relocate Away from Remote Hazard - Safer Offsite Location Available**: For offsite tourism operations (where persons are to be moved offsite as part of operations e.g., tourism day trips), a suitable offsite alternative safer location(s) is identified as a destination should the subject site and/or the route back to the subject site, be impacted by a bushfire event. That is, two safer locations will exist.	Not Relevant	N/A	N/A	N/A	N/A
2.4	**Evacuate from the Subject Site: Safer Offsite Location(s) Available**: A building/area is accessible from the subject site as an evacuation destination. The offsite location exists at a sufficient distance away ensuring that the destination and the subject site are very unlikely to be simultaneously impacted by a bushfire event.	Moderate	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: The site does not have regular staffing. Any attending staff will have their own vehicle immediately available and will self-evacuate. There are multiple directions for evacuation to safer place by road.						
2.5	**Relocate Within the Subject Site - Safer Onsite Area**: Provide an accessible area located in the open (i.e. not in an enclosed building), within the subject site and on which persons can assemble and that will not be subject to radiant heat flux in excess of 2 kW/m^2 (determined using a flame temperature of 1200 K). Consideration must also be given to potential exposure to embers, adverse weather, availability of water / facilities and the relative importance of these to the specific use proposal.	Moderate	Yes	No	Yes	No
Informative and/or Site Specific Comment/Assessment: The site does not have regular staffing. No areas onsite will be subject to <2kW/m2 radiant heat flux.						
2.6	**Relocate Within the Subject Site – Pathway to Safer Onsite Area/Building:** To facilitate the lower risk movement, on foot, of persons and firefighters on the site, heavy fuels are excluded from areas adjacent to pathways used to access designated safer locations onsite. The required minimum separation distances are [13] [31]: • At least 4m from stored heavy fuels (refer to Appendix 4). • At least 6m from stored and constructed large heavy fuels (refer to Appendix 4). • At least 12m from constructed large heavy fuels that are buildings/structures other than the one being evacuated. Additionally: • The pathway/route is constructed of non-combustible materials; • No gas bottles are venting towards the pathway/route; and • Shrubs are separated from the pathway/route corresponding to a distance to minimise the threats to persons on foot with consideration of their flammability and height.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: No heavy fuels are stored onsite.						

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
2.7	**Pre-Emptively Relocate Away from the Subject Site**: In response to a pre-determined fire danger rating and/or total fire ban or other established conditions, all persons onsite will pre-emptively relocate offsite for the duration of the existence of the conditions. The relevant conditions and the requirement to pre-emptively relocate will be established through a Bushfire Emergency Plan.	Effective	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: The site does not have regular staffing. Suitable egress and shelter locations are available so the measure is not necessary. Local Govt. imposed Harvest and Vehicle movement, hots works bans will also need to be considered.						
PROTECTION PRINCIPLE – SHIELDING FROM THE HAZARD: To utilise constructed or natural shielding to reduce the exposure of persons to the flame, radiant heat, and ember attack from bushfire and consequential fire.						
2.8	**On-site Shelter Building – Community Refuge**: For a 'vulnerable land use' (defined by SPP 3.7 [43]), provide a building which is constructed in accordance with the NCC and the ABCB Design and Construction of Community Bushfire Refuges – Information Handbook [20]. Note: preferred floor area per person is an increase from 0.75 m² to 1.0 m² (Guidelines v1.4) [22].	Not Relevant	N/A	N/A	N/A	N/A
2.9	**On-site Shelter Building – No Accommodation in the Site Use**: For a 'vulnerable land use' (defined by SPP 3.7 [43]), and for which accommodation is not part of the site use, provide a building that will not be subject to radiant heat flux in excess of 10 kW/m² (determined using AS 3959 BAL determination methodology [4] and applying a flame temperature of 1200 K) and constructed to the bushfire standard corresponding to the BAL-29 rating (to provide greater resistance to consequential fire).	Not Relevant	N/A	N/A	N/A	N/A
2.10	**On-site Shelter Building – Appropriate Threat Resilience**: For other than a 'vulnerable land use' (defined by SPP 3.7 [43]), provide a building that incorporates sufficient design and construction protection measures to reduce the building vulnerability to bushfire and consequential fire threats to an appropriate level (refer to the section of this report that identifies bushfire protection measures to reduce the vulnerability of buildings/structures). Alternatively, provide a building that will not be subject to radiant heat flux in excess of 10 kW/m² (determined using AS 3959 BAL determination methodology [4] and applying a flame temperature of 1200 K) and constructed to the bushfire standard corresponding to the BAL-29 rating (to provide greater resistance to consequential fire).	Effective	N/A	N/A	N/A	N/A
2.11	**On-site Shelter Structure – Class 10c**: Provide a private bushfire shelter (Class 10c building) constructed in accordance with the NCC and the *Performance Standard – The design and construction of private bushfire shelter (ABCB 2014).* This is not a standalone measure but an additional measure as a last resort.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: The site does not have regular staffing and no habitable structures are proposed.						

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
2.12	**Constructed Barrier – Shield Persons in the Open**: Construct walls / fences / landforms as shielding structures that are not buildings, applying appropriate fire resistant / non-combustible construction materials (e.g. masonry, steel, earthworks). These are to withstand the impact of direct bushfire attack mechanisms for the required period of time and provide the required reduction in threat levels to persons in the open. Construction requirements will correspond, as a minimum, to the BAL-FZ requirements for walls as established by AS 3959:2018 [4] and/or the NASH Standard [33] and additionally informed by the research report 'Research and Investigation into the Performance of Residential Boundary Fencing Systems in Bushfires' [29].	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: The site does not have regular staffing and safe (early) evacuation will be the bushfire response.						
2.13	**Natural Barrier – Shield Persons in the Open**: Utilise natural landforms that have the potential to shield persons from the bushfire and consequential fire threats.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: No such landforms exist.						
2.14	**Constructed/Natural Barrier – Shielding for Persons on Pathways to Safer Onsite Area/Building: W**here possible, alongside pathways to an on-site shelter building/area, utilise walls / fences / landforms as shielding structures constructed using fire resistant / non-combustible construction materials (e.g. masonry, steel, earthworks). These are to withstand the impact of direct bushfire attack mechanisms for the required period of time and provide the required reduction in threat levels to persons (including firefighters) traversing the pathway. Construction can be informed by the BAL-FZ requirements for walls as established by AS 3959:2018 [4] and/or the NASH Standard [33] and additionally informed by the research report 'Research and Investigation into the Performance of Residential Boundary Fencing Systems in Bushfires' [29].	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: No safer onsite location has been identified.						

[1] **Protection Measure Effectiveness Rating**: Refer to section 2.3.5 for explanation and defining.

[2] **Protection Measure Application Status**:

- **Possible**: Protection measures that can potentially be applied to the proposed development/use;
- **Exists**: Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary);
- **Planned**: Protection measures that:
    - Are incorporated into the site plans;

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
• Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or • Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP. These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary). • **Additionally Recommend:** Protection measures that: • Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or • Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP. These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).					

7.1.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 7.2: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

EXPOSURE REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Persons located onsite and temporarily offsite					
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating [1]	Numbers of Protection Measures				
		Total Available	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Separation from the Hazard	Very High	1	1	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	-	-
	Moderate	2	2	-	1	-
	Not Relevant	3	-	-	-	-
Shielding from the Hazard	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	-	-	-	-	-
	Moderate	-	-	-	-	-
	Not Relevant	7	-	-	-	-
Total Numbers	**Very High**	1	1	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	-	-
	Moderate	2	2	-	1	-
	Not Relevant	10	-	-	-	-
	Totals	14	4	-	1	-

[1] Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

[2] Protection Measure Application Status: Refer to table footnotes on previous page.

7.1.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (EXPOSURE REDUCTION)

Table 7.3: For the stated element at risk, The potential impact of the applied protection measures in reducing exposure levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (EXPOSURE REDUCTION)								
Element at Risk	Persons located onsite and temporarily offsite							
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.							
Exposure Reducing Protection Measures Applied to Assessment [1]	The Bushfire Hazard Threats [2]							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accum.	Conseq. Fire	Fire Driven Wind	Tree Strike / Obstruct
Existing and Planned (applied to inherent risk)	Minimal	Medium	Significant	Medium	Minimal	Medium	Minimal	Medium
	Medium				Medium			

[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3

[2] Refer to Appendix 4 for explanatory information.

7.1.4 ASSESSED EXPOSURE LEVELS

Assessed as a function of the capacity to apply sufficient exposure reducing protection measures, their individual effectiveness and their combined impact in reducing the exposure of the identified element at risk (Note: This assessment is independent of the threat level and vulnerability level assessments).

Table 7.4: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED EXPOSURE LEVELS	
Element at Risk	Persons located onsite and temporarily offsite
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.
Exposure Reducing Protection Measures Applied to Assessment [1]	Relative Exposure Level [2]
Existing and Planned (applied to inherent risk)	Moderate

[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3

[2] Refer to Appendix 2 for explanatory information.

Assessment Comments: A shelter building/location has not been identified or recommended as the site is unstaffed.

7.2 PERSONS ON ACCESS/EGRESS ROUTES IN VEHICLES

7.2.1 PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS AND THEIR APPLICATION STATUS

Table 7.5: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: PERSONS ON ACCESS/EGRESS ROUTES IN VEHICLES						
Access/Egress Route ID:	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.					
PROTECTION PRINCIPLE - SEPARATION FROM ALL BUSHFIRE THREATS: To utilise distance away from all relevant bushfire hazard threats (direct and indirect attack mechanisms) while traversing an access/egress route in a vehicle to lower the exposure of persons to the threats for the expected time on the route.						
3.1	**Locating Routes Away from Adjacent Hazards:** Existing or to be installed vehicular access/egress route components (roads, access ways, and driveways) are positioned to maximise the distance away from any adjacent bushfire prone vegetation where possible.	Not Relevant	N/A	N/A	N/A	N/A
3.2	**Egress Routes Located to Ensure Driving Away from Hazard:** Existing or to be installed vehicular access/egress route components (roads, access ways, and driveways) are positioned so that the direction of egress is away from the hazard into lower threat areas.	Not Relevant	N/A	N/A	N/A	N/A
3.3	**Greater Road Width:** Wider roads will allow for a greater separation distance between traversing vehicles and the bushfire hazard. The incorporation of non-vegetated and trafficable road verges/shoulders and adjacent footpaths can also safely increase effective separation for slower moving vehicles.	Not Relevant	N/A	N/A	N/A	N/A
3.4	**Reduce and Maintain Road Verge Fuel to Low Threat State:** Road verges, or part off, have vegetation removed or reduced to a minimal fuel, low threat state annually to increase the separation distance from the bushfire hazard. This is practical when an authority exists to conduct the management and will have greater impact as a protection measure if there is certainty it will be carried out.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: The measures are not under the control of the developer.						
PROTECTION PRINCIPLE - SHIELDING FROM ALL BUSHFIRE THREATS: To utilise constructed or natural shielding to reduce the exposure of persons traversing the access/egress routes to the direct attack mechanisms of bushfire. To assist with ensuring the level of exposure to the threats is survivable for the expected time on the route while travelling in a vehicle.						

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
3.5	**Vehicle Type – Protection Level**: People can only tolerate low levels of radiant heat without some protection. Vehicles provide some protection from low intensity fires (if they stay on cleared area and remain in the vehicle) but they will not protect people in moderate to intense grass fires or in any location where scrub or forest adjoin the road. Protection provided by vehicles with predominantly metal bodies (including roof) and able to be enclosed (glass window), while limited is also still significant. It is particularly significant when compared to other potentially available modes of transport on roads (e.g. open top/backed vehicles, motorbikes, bicycles and being on foot). The availability such vehicles of required capacity can contribute to reduced exposure to the bushfire threats for persons on access/egress routes.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: Most evacuees vehicles will have an enclosed cabin, but it is unreasonable for this to be assumed, expected, or required.						
3.6	**Shelter in Place Procedure**: In most situations, safe (early) evacuation is considered the emergency procedure which poses the least risk to occupants. In some situations, Shelter-in-place may be considered the safer procedure, particularly where: • The type or number of occupants makes evacuation time consuming or otherwise difficult; • The evacuation route(s) available are not suitable for the volume of evacuees; • The route(s) available have poor visibility, gradients, surface quality etc, or; • The routes(s) available are bounded by bushfire prone vegetation of an unacceptable hazard and/or extent.	Very High	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: Two appropriate access/egress routes are available and any potential occupants (staff) will have local awareness and transportation available. The access/egress routes run through farm land and adjacent to the existing solar installation with Robartson Rd access/egress in a north direction towards the Great Eastern Highway and the town of Merredin, and south direction for approx. 750m before meeting the Bruce Rock – Merredin Rd in an east or west direction. *Safe (early) evacuation is the primary procedure for occupants (staff) during bushfire emergencies. Shelter in place has not been established as a secondary procedure as a suitable open location or building is not available.*					

[1] **Protection Measure Effectiveness Rating:** Refer to section 2.3.5 for explanation and defining.

[2] **Protection Measure Application Status**:

- **Possible**: Protection measures that can potentially be applied to the proposed development/use;
- **Exists**: Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary);
- **Planned**: Protection measures that:
  - Are incorporated into the site plans;

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
• Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or • Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP. These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary). • **Additionally Recommend:** Protection measures that: • Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or • Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP. These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).					

7.2.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 7.6: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

EXPOSURE REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Persons on access/egress routes in vehicles					
Access/Egress Route ID	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.					
The Protection Principle	Effectiveness Rating [1]	Numbers of Protection Measures				
		Total Available	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Separation from the Bushfire Hazard	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	-	-	-	-	-
	Moderate	-	-	-	-	-
	Not Relevant	4	-	-	-	-
Shielding from the Bushfire Hazard	Very High	1	1	-	-	-
	High	-	-	-	-	-
	Effective	-	-	-	-	-
	Moderate	-	-	-	-	-
	Not Relevant	1	-	-	-	-
Total Numbers	**Very High**	1	1	-	-	-
	High	-	-	-	-	-
	Effective	-	-	-	-	-
	Moderate	-	-	-	-	-
	Not Relevant	5	-	-	-	-
	Totals	6	1	-	-	-

[1] Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

[2] Protection Measure Application Status: Refer to table footnotes on previous page.

7.2.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (EXPOSURE REDUCTION)

Table 7.6: For the stated element at risk, The potential impact of the applied protection measures in reducing exposure levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (EXPOSURE REDUCTION)								
Element at Risk	Persons on access/egress routes in vehicles							
Access/Egress Route ID	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.							
Exposure Reducing Protection Measures Applied to Assessment [1]	The Bushfire Hazard Threats [2]							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Minimal	Minimal	Minimal	Medium	N/A	N/A	Medium	Minimal
	Minimal				Medium			

[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3

[2] Refer to Appendix 4 for explanatory information.

7.2.4 ASSESSED EXPOSURE LEVELS

Assessed as a function of the capacity to apply sufficient exposure reducing protection measures, their individual effectiveness and their combined impact in reducing the exposure of the identified element at risk (Note: This assessment is independent of the threat level and vulnerability level assessments).

Table 7.7: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED EXPOSURE LEVELS	
Element at Risk	Persons on access/egress routes in vehicles
Access/Egress Route ID	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.
Exposure Reducing Protection Measures Applied to Assessment [1]	Relative Exposure Level [2]
Existing and Planned (applied to inherent risk)	High

[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3

[2] Refer to Appendix 2 for explanatory information.

Assessment Comments: The local and regional road network and its proximity to bushfire prone vegetation is not under the control of the landowner. No recommendations have been applied as the development is intended to be unstaffed.

Safe (early) evacuation is the primary procedure for any potential occupants (staff) during bushfire emergencies.

The access/egress routes run through farm land and adjacent to the existing solar installation with Robartson Rd access/egress in a north direction towards the Great Eastern Highway and the town of Merredin, and south direction for approx. 750m before meeting the Bruce Rock – Merredin Rd in an east or west direction.

7.3 BUILDINGS AND STRUCTURES NCC CLASSES 1-10

7.3.1 PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS AND THEIR APPLICATION STATUS

Table 7.8 All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: BUILDINGS/STRUCTURES - NCC CLASSES 1-10						
PROTECTION PRINCIPLE – SEPARATION FROM ALL BUSHFIRE THREATS (SITING): To locate (site) the buildings and attached/adjacent structures at distances away from the direct and indirect attack mechanisms of bushfire (the hazard threats) to reduce their exposure. The required distances will be dependent on the relative threat levels and the degree of bushfire resilience that is or is planned to be incorporated into the exposed elements through design and construction.						
4.1	**Asset Protection Zone (APZ)**: Ensure an APZ can be established surrounding the exposed element(s) to create the required separation distance from the bushfire hazard and its threats (the direct and indirect attack mechanisms). This is to be an area containing minimal fire fuels and maintained in a low threat state. The *Explanatory Notes for Element 2 of the Bushfire Protection Criteria and Schedule 1: Standards for Asset Protection Zones* established in the Guidelines [22] provides the key requirements for establishing and maintaining an APZ. Additional requirements may exist within a relevant local governments firebreak notice, or the responsibilities established by an applicable Bushfire Management Plan (BMP). The required dimensions of the APZ will correspond to the maximum level of radiant heat the exposed element is to be exposed to – or a greater distance if it is stipulated by a different authority (e.g. firebreak notice of BMP). As a minimum avoid dimensions (separation distances) that correspond to BAL-FZ and BAL-40 ratings for any given site/vegetation combination of relevant the parameters (Note: this will also apply to BAL-29 separation distances if flame length modelling indicates potential contact due to specific site and effective slope configurations). The APZ should be contained solely within the boundaries of each lot, except in instances where the neighbouring lot(s) or adjacent public land will be managed in a low-fuel state on an ongoing basis, in perpetuity. ***Note that the APZ does not provide separation from the consequential fire attack mechanism. Separation from consequential fire fuels requires additional assessment and management.***	Effective	Yes	No	Yes	Yes
Informative and/or Site Specific Comment/Assessment: A BAL-29 APZ can be established for all Class 1-10 buildings onsite. The BESS cabinets and associated infrastructure within the facility are required to establish a <10kW/m2 APZ. This will result in a BAL-12.5 APZ being established around most (if not all) Class 1-10 buildings, exceeding the BAL-29 'Planning' APZ.						
4.2	**Siting of Buildings/Structures - Wind**: Site the buildings and attached/adjacent structures in locations that have lower wind exposure. Avoid the top and sides of ridges which are especially vulnerable to fire driven winds as well as topographically	Not Relevant	N/A	N/A	N/A	N/A

	EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
	influenced winds. Winds can directly or indirectly (carrying materials/debris) cause damage to the external building envelope potentially allowing flame, radiant heat and ember entry.					
Informative and/or Site Specific Comment/Assessment: Not possible as the local area has consistent topography.						
4.3	**Use of Non-Vegetated Areas and/or Public Open Space**: Reduce exposure by increasing separation from APZ landscaping vegetation and/or the bushfire hazard by incorporating these lowest threat areas adjacent to buildings/structures and/or adjacent to the bushfire hazard. These lowest threat components of the APZ include non-vegetated areas (e.g. footpaths, paved areas, roads, parking, drainage, swimming pools), formally managed areas of vegetation (public open space and other recreation areas) and services installed in a common section of non-vegetated land. These elements create robust and easier managed asset protection zones.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: There are few such areas existing or proposed.						
4.4	**Landscaping - Tree Location**: Use separation to minimise the potential for debris accumulation and tree strike damage to the building envelop potentially allowing flame, radiant heat and ember entry to internal spaces. • The buildings/structures are separated from trees (or trees from buildings) by a distance of at least 1.5 times the height of the tallest tree. • Trees that produce significant quantities of debris (fine fuels) during the bushfire season should be located a sufficient distance away from vulnerable exposed elements to ensure debris cannot Drop and accumulate within at least 4m of buildings/structures or be likely to be relocated by wind to closer than 4m to buildings / structures. • If the minimum distance cannot be achieved with an existing tree either remove the tree or at least ensure tree branches are sufficiently separated from buildings and attached/adjacent structures (at a minimum to not overhang) to ensure branches cannot fall onto or be blown onto the buildings/structures.	Moderate	Yes	Yes	Yes	No
Informative and/or Site Specific Comment/Assessment: Trees are not proposed within the APZ.						
4.5	**Separation of Stored Flammable Products - Gas in Cylinders**: To reduce the potential for gas flaring or explosion (consequential fire), installation of LPG cylinders is to apply as a minimum, the principles and requirements established in AS 1596 and LP Gas cylinder safety in bushfire prone areas (Energy Safety – Govt. of WA). Otherwise, the required separation distance is 6m from any combustible materials.	Not Relevant	N/A	N/A	N/A	N/A

	EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
	Heat from bushfire or consequential fire can be sufficient to cause cylinder pressure to reach critical levels and the pressure relief valve release large quantities of gas (flare). If the cylinder falls over the pressure relief valve may not function correctly, and the cylinder may rupture (explosion).					
Informative and/or Site Specific Comment/Assessment: No gas storage will be on site.						
4.6	**Separation from Stored Flammable Products – Fuels / Other Hazardous Materials:** Establish sufficient separation distance between the consequential fire fuels and buildings/structures. The required separation distance will be dependent on the fuel and storage type.	Moderate	Yes	Yes	No	No
Informative and/or Site Specific Comment/Assessment: The BESS units will be installed to manufacturers specification, including separation distances. Fuels and other hazardous material will not be stored on site.						
4.7	**Separation from Stored and Constructed Combustible Items:** These consequential fire fuels include: • Stored Combustible Items - Heavy Fuels e.g. building materials, packaging materials, firewood, sporting/playground equipment, outdoor furniture, rubbish bins etc: • Stored Combustible Items – Large Heavy Fuels e.g. vehicles, caravans, boats and large quantities of dead vegetation materials stored as part of site use. • Constructed Combustible Items – Heavy Fuels e.g. landscaping structures including fences, screens, walls, plastic water tanks. • Constructed Combustible Items – Large Heavy Fuels e.g. adjacent buildings/structures including houses, sheds, garages, carports. (Note: If the adjacent structure is constructed to BAL-29 requirements or greater and can implement a significant number of additional bushfire protection measures associated with reducing exposure and vulnerability, these minimum separation distances could be reduced by 30%) [31]. *Apply the rule of thumb [13] "assume flames produced from a consequential fire source will be twice as high as the object itself … where the consequential fire source is a structure, then the maximum eave height is a reasonable measure of maximum height".* Apply the following separation distances from the subject building/structure as a multiple of the height of the consequential fire source and dependent on the construction standard applied to the building/structure [13 and 31]: • At least six times the height when the building/structure construction incorporates design and materials that is only intended to resist low levels of radiant heat up to 12.5 kW/m^2) and no flame contact;	Moderate	Yes	No	No	Yes

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
	• Between 4 and 6 six times the height when the building/structure construction incorporates design and materials intended to resist radiant heat up to 29 kW/m² and no flame contact. • Between 2 and 4 times the height when the building/structure construction incorporates design and materials intended to resist up to 40kW/m² and potential flame contact. • Less than 2 times the height when the building/structure construction incorporates design and materials intended to resist extreme levels of radiant heat and flame contact. • Zero separation distance is required if the building/structure is separated by a non-combustible FRL 60/60/60 rated wall or the potential consequential fire source is fully enclosed by the building/structure.					
Informative and/or Site Specific Comment/Assessment: When storage of flammable items or materials are stored on site temporarily (for maintenance etc), separation distances must be complied with.						
PROTECTION PRINCIPLE – SHIELDING FROM ALL BUSHFIRE THREATS: To shield buildings and attached/adjacent structures (or other consequential fire fuels) from the direct bushfire attack mechanisms of flame, radiant heat, surface fire and surface migration of embers. To also reduce exposure to the indirect attack mechanism of debris accumulation against buildings/structures and other consequential fire fuels and wind attack.						
4.8	**Constructed Barrier – Shielding from Bushfire**: Walls, fences and/or landforms to shield the subject building/structure from direct and indirect bushfire attack mechanisms and reduce the potential impact of these threats to vulnerable exposed elements. Must be constructed using appropriate fire resistant / non-combustible construction materials (e.g. masonry, steel, earthworks). These are to withstand the impact of direct bushfire attack mechanisms for the required period of time. Apply the bushfire construction standards for external walls subject to the assessed level of radiant heat or flame contact to which the barrier will be exposed (or otherwise to BAL-FZ requirements). These are established by AS 3959:2018 [4] and/or the NASH Standard [33] and additionally informed by the research report 'Research and Investigation into the Performance of Residential Boundary Fencing Systems in Bushfires.' [29]	High	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: The measure is not cost-effective or necessary where greater separation distance can be achieved.						
4.9	**Constructed Barrier - Shielding from Consequential Fire**: Applicable to all consequential fire fuel sources. Install a non-combustible barrier (including complete enclosure when appropriate), of required robustness, that can perform the following as relevant: • Reduce the exposure of the subject building/structure to the threats of consequential fire; and/or • Reduce the exposure of the consequential fire fuels to the bushfire hazard.	Moderate	Yes	No	No	Yes

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Informative and/or Site Specific Comment/Assessment: Ensure all subfloor spaces are sealed or enclosed with non-combustible solid material or ember screening mesh (corrosion-resistant steel, bronze, or aluminium with an aperture <2mm).						
4.10	**Natural Barrier - Landforms:** Use existing natural landforms to reduce buildings/structures exposure to radiant heat, and lower wind speeds (prevailing synoptic and/or fire driven).	Not Relevant	N/A	N/A	N/A	N/A
4.11	**Planted Barrier - Vegetation Barrier:** Use appropriate hedges and trees strategically to reduce (to varying extents) buildings/structures exposure to radiant heat, to filter/trap embers and firebrands, and to lower wind speeds (prevailing synoptic and/or fire driven).	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: Sufficiently low radiant heat flux can be achieved through separation distance.						
4.12	**Shield Non-Structural Essential Elements:** These are elements essential to the continued operation of the building/structure which are potentially exposed to fire attack mechanisms of both bushfire and consequential fire. They include cabling and plumbing associated with power / data transmission and water / fuel transport. When the use of fire rated materials to the degree necessary is not possible or practical, the application of non-combustible shielding can be applied to reduce exposure to the bushfire threats. Shielding includes underground installation.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: The building(s) are unlikely to have external essential elements, other than those related to Merredin BESS operation (addressed as a Fixed (Hard) Infrastructure Asset).						

[1] **Protection Measure Effectiveness Rating:** Refer to section 2.3.5 for explanation and defining.

[2] **Protection Measure Application Status:**

- **Possible:** Protection measures that can potentially be applied to the proposed development/use;
- **Exists:** Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary);
- **Planned:** Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
• Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP. These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary). • **Additionally Recommend**: Protection measures that: • Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or • Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP. These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).					

7.3.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 7.9: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

EXPOSURE REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Buildings/Structures - NCC Classes 1-10					
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating [1]	Numbers of Protection Measures				
		Total Available	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Separation from the Hazard	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	1	1
	Moderate	3	3	2	1	1
	Not Relevant	3	-	-	-	-
Shielding from the Hazard	Very High	-	-	-	-	-
	High	1	1	-	-	-
	Effective	-	-	-	-	-
	Moderate	1	1	-	-	1
	Not Relevant	3	-	-	-	-
Total Numbers	**Very High**	-	-	-	-	-
	High	1	1	-	-	-
	Effective	1	1	-	1	1
	Moderate	4	4	2	-	2
	Not Relevant	6	-	-	-	-
	Totals	12	6	2	1	3

[1] Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

[2] Protection Measure Application Status: Refer to table footnotes on previous page.

7.3.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (EXPOSURE REDUCTION)

Table 7.10: For the stated element at risk, The potential impact of the applied protection measures in reducing exposure levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (EXPOSURE REDUCTION)								
Element at Risk	Buildings/Structures - NCC Classes 1-10							
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.							
Exposure Reducing Protection Measures Applied to Assessment [1]	The Bushfire Hazard Threats [2]							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accum.	Conseq. Fire	Fire Driven Wind	Tree Strike / Obstruct
Existing and Planned (applied to inherent risk)	Medium	Medium	Medium	Significant	Significant	Medium	Medium	Medium
	Medium				Medium			
Existing, Planned and Recommended (applied to residual risk)	Significant	Very Significant	Very Significant	Very Significant	Significant	Significant	Significant	Very Significant
	Very Significant				Significant			
[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 [2] Refer to Appendix 4 for explanatory information.								

Assessment Comments: The comparison considers the BAL-29 APZ required for planning approval, against the recommended setbacks and additional measures. Objects should be positioned away from relevant assets to reduce the capacity for consequential fire spread.

7.3.4 ASSESSED EXPOSURE LEVELS

Assessed as a function of the capacity to apply sufficient exposure reducing protection measures, their individual effectiveness and their combined impact in reducing the exposure of the identified element at risk (Note: This assessment is independent of the threat level and vulnerability level assessments).

Table 7.11: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED EXPOSURE LEVELS	
Element at Risk	Buildings/Structures - NCC Classes 1-10
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.
Exposure Reducing Protection Measures Applied to Assessment [1]	Relative Exposure Level [2]
Existing and Planned (applied to inherent risk)	Moderate
Existing, Planned and Recommended (applied to residual risk)	Low
[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 [2] Refer to Appendix 2 for explanatory information.	

7.4 FIXED (HARD) INFRASTRUCTURE ASSETS

7.4.1 PROTECTION MEASURES AVAILABLE TO REDUCE EXPOSURE LEVELS AND THEIR APPLICATION STATUS

Table 7.12: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: FIXED (HARD) INFRASTRUCTURE ASSETS						
PROTECTION PRINCIPLE – SEPARATION FROM ALL BUSHFIRE THREATS (SITING): To locate (site) the buildings and attached/adjacent structures at distances away from the direct and indirect attack mechanisms of bushfire (the hazard threats) to reduce their exposure. The required distances will be dependent on the relative threat levels and the degree of bushfire resilience that is or is planned to be incorporated into the exposed elements through design and construction.						
6.1	**Asset Protection Zone (APZ)**: Ensure an APZ can be established surrounding the exposed element(s) to create the required separation distance from the bushfire hazard and its threats (the direct and relevant indirect attack mechanisms). This is to be an area containing minimal fire fuels and maintained in a low threat state. The *Explanatory Notes for Element 2 of the Bushfire Protection Criteria and Schedule 1: Standards for Asset Protection Zones* established in the Guidelines [22] provides the key requirements for establishing and maintaining an APZ. Additional requirements may exist within a relevant local governments firebreak notice, or the responsibilities established by an applicable Bushfire Management Plan (BMP). The required dimensions of the APZ will correspond to the maximum level of radiant heat the exposed element is to be exposed to – or a greater distance if it is stipulated by a different authority (e.g. firebreak notice or BMP). As a minimum avoid dimensions (separation distances) that correspond to BAL-FZ and BAL-40 ratings for any given site/vegetation combination of the relevant parameters. Note that this will also apply to BAL-29 separation distances if flame length modelling indicates potential contact due to specific site and effective slope configurations. The APZ should be contained solely within the boundaries of each lot, except in instances where the neighbouring lot(s) or adjacent public land will be managed in a low-fuel state on an ongoing basis, in perpetuity. ***Note that the APZ does not provide separation from the consequential fire attack mechanism. Separation from consequential fire fuels requires additional assessment and management.***	Effective	Yes	No	Yes	Yes
Informative and/or Site Specific Comment/Assessment: The required separation distance is a function of the relevant levels of the bushfire threats (attack mechanisms) presented by the vegetation and the relevant vulnerabilities of the identified elements at risk (the BESS System and associated infrastructure).						

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
The relevant threats are the flame lengths and the potential for radiant heat transfer as determined from the design fire modelling for the vegetation types that have been identified. BESS technologies are continuing to develop and the critical heat flux thresholds of assets may vary slightly between engineering designs. The exterior and structural components of battery cabinets are non-combustible, generally being metal, fibrous cement, mineral wool etc. A battery cabinet is a sea container-sized with a series of battery racks installed. A single battery rack consists of battery cells (each cell connected into a module), and a control box with chiller. Power and computer cabling is associated within and between racks. These are the relevant components regarding potential for fire. • The individual batteries have been found to be highly resistant to conductive heat. Applied temperatures exceeding 400 degrees Celsius destroyed, but did not ignite, running battery cells. See *UL 9540A Test Method for Evaluating Thermal Runaway Fire Propagation in Cell Energy Storage Systems, Third Edition* (UL LLC; 8 July 2020). Other trigger/failure conditions must be met for battery cells to ignite (mechanical rupture, flame contact, product failure etc). • Control boxes are computers which will apply thermal throttling and thermal shutdown if internal temperatures exceed a determined threshold. Once a computer system is shut down in this scenario, the threshold is expected to be that of the cabling (below). • Associated cabling (both power transmission and computer). Common electrical cabling reaches its critical point at >12kWm2 (Kaczorek-Chrobak et al. 2007) [49]. Electrical cabling and components are expected to exceed this standard, being industrial and high capacity, however the 12kW threshold is adopted for the highest potential vulnerability. **Recommendation**: An APZ is to be established around electrical components and infrastructure. This APZ will ensure exposure to the bushfire hazard threat of radiant heat will be limited to a maximum radiant heat flux of 10 kW/m2 (calculated with an assumed flame temperature of 1090K) by providing the required separation distances from the bushfire hazard. The 10m portion of the APZ immediately around the assets must be entirely and permanently non-vegetated (sealed, compacted limestone, gravel, mineral earth etc).						
6.2	**Siting of Buildings/Structures - Wind**: Site the buildings/structures/infrastructure in locations that have lower wind exposure. Avoid the top and sides of ridges which are especially vulnerable to fire driven winds as well as topographically influenced winds. Winds can directly or indirectly (carrying materials/debris) cause damage to the external building envelope potentially allowing flame, radiant heat and ember entry.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: Not possible as the proposed facility is extensive and the topography is consistent (flat to very gentle slope).						
6.3	**Use of Non-Vegetated Areas and/or Public Open Space**: Reduce exposure by increasing separation from APZ landscaping vegetation and/or the bushfire hazard by incorporating these lowest threat areas adjacent to buildings/structures and/or adjacent to the bushfire hazard. These lowest threat components of the APZ include non-vegetated areas (e.g. footpaths, paved areas, roads, parking, drainage, swimming pools), formally managed areas of vegetation (public open space and other recreation areas) and services installed in a common section of non-vegetated land. These elements create robust and easier managed asset protection zones.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: There are no such areas existing or proposed.						

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
6.4	**Landscaping - Tree Location:** Use separation to minimise the potential for debris accumulation and tree strike damage to the building envelop potentially allowing flame, radiant heat and ember entry to internal spaces. • The buildings/structures are separated from trees (or trees from buildings) by a distance of at least 1.5 times the height of the tallest tree. • Trees that produce significant quantities of debris (fine fuels) during the bushfire season should be located a sufficient distance away from vulnerable exposed elements to ensure debris cannot drop and accumulate within at least 4m of buildings/structures or be likely to be relocated by wind to closer than 4m to buildings / structures. • If the minimum distances cannot be achieved with an existing tree either remove the tree or at least ensure tree branches are sufficiently separated from buildings and attached/adjacent structures (at a minimum to not overhang) to ensure branches cannot fall onto or be blown onto the buildings/structures.	Moderate	Yes	Yes	Yes	No
Informative and/or Site Specific Comment/Assessment: Trees are not proposed within the <10kW/m2 APZ.						
6.5	**Separation from Stored Flammable Products - Gas in Cylinders:** To reduce the potential for gas flaring or explosion (consequential fire), installation of LPG cylinders is to apply as a minimum, the principles and requirements established in AS 1596 and LP Gas cylinder safety in bushfire prone areas (Energy Safety – Govt. of WA). Otherwise, the required separation distance is 6m from any combustible materials. Heat from bushfire or consequential fire can be sufficient to cause cylinder pressure to reach critical levels and the pressure relief valve release large quantities of gas (flare). If the cylinder falls over the pressure relief valve may not function correctly, and the cylinder may rupture (explosion).	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: No gas storage will be on site.						
6.6	**Separation from Stored Flammable Products – Fuels / Other Hazardous Materials:** Establish sufficient separation distance between the consequential fire fuels and buildings/structures. The required separation distance will be dependent on the fuel and storage type.	Moderate	Yes	Yes	No	No
Informative and/or Site Specific Comment/Assessment: The BESS units will be installed to manufacturers specification, including separation distances. Fuels and other hazardous material will not be stored on site.						
6.7	**Separation from Stored and Constructed Combustible Items:** These consequential fire fuels include: • Stored Combustible Items - Heavy Fuels e.g. building materials, packaging materials, rubbish bins etc:	Moderate	Yes	No	No	Yes

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
• Stored Combustible Items – Large Heavy Fuels e.g. vehicles, caravans and large quantities of dead vegetation materials stored as part of site use. • Constructed Combustible Items – Heavy Fuels e.g. landscaping structures including fences, screens, walls, plastic water tanks. • Constructed Combustible Items – Large Heavy Fuels e.g. adjacent buildings/structures including houses, sheds, garages, carports. (Note: If the adjacent structure is constructed to BAL-29 requirements or greater and can implement a significant number of additional bushfire protection measures associated with reducing exposure and vulnerability, these minimum separation distances could be reduced by 30%) [31]. *Apply the rule of thumb [13] "assume flames produced from a consequential fire source will be twice as high as the object itself … where the consequential fire source is a structure, then the maximum eave height is a reasonable measure of maximum height".* Apply the following separation distances from the subject building/structure as a multiple of the height of the consequential fire source and dependent on the construction standard applied to the building/structure [13 and 31]: • At least six times the height when the building/structure construction incorporates design and materials that is only intended to resist low levels of radiant heat up to 12.5 kW/m^2) and no flame contact; • Between 4 and 6 six times the height when the building/structure construction incorporates design and materials intended to resist radiant heat up to 29 kW/m^2 and no flame contact. • Between 2 and 4 times the height when the building/structure construction incorporates design and materials intended to resist up to 40kW/m^2 and potential flame contact. • Less than 2 times the height when the building/structure construction incorporates design and materials intended to resist extreme levels of radiant heat and flame contact. • Zero separation distance is required if the building/structure is separated by a non-combustible FRL 60/60/60 rated wall or the potential consequential fire source is fully enclosed by the building/structure.					
Informative and/or Site Specific Comment/Assessment: All non-structural combustible materials are to be removed within 10m of assets. This includes but is not limited to; waste, leaf litter, machinery, grasses, vehicles, fuel, furniture, and timber. When storage of flammable items or materials are stored on site temporarily (for maintenance etc), separation distances must be complied with. This requirement is to be included in the Site Operating Procedures document.					
PROTECTION PRINCIPLE – SHIELDING FROM ALL BUSHFIRE THREATS: To shield buildings and attached/adjacent structures (or other consequential fire fuels) from the direct bushfire attack mechanisms of flame, radiant heat, surface fire and surface migration of embers. To also reduce exposure to the indirect attack mechanism of debris accumulation against buildings/structures and other consequential fire fuels and wind attack.					

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
6.8	**Constructed Barrier – Shielding from Bushfire**: Walls, fences and/or landforms to shield the subject building/structure from direct and indirect bushfire attack mechanisms and reduce the potential impact of these threats to vulnerable exposed elements. Must be constructed using appropriate fire resistant / non-combustible construction materials (e.g. masonry, steel, earthworks). These are to withstand the impact of direct bushfire attack mechanisms for the required period of time. Apply the bushfire construction standards for external walls subject to the assessed level of radiant heat or flame contact to which the barrier will be exposed (or otherwise to BAL-FZ requirements). These are established by AS 3959:2018 [4] and/or the NASH Standard [33] and additionally informed by the research report 'Research and Investigation into the Performance of Residential Boundary Fencing Systems in Bushfires.' [29]	High	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: The measure is not cost-effective or necessary where greater separation distance can be achieved.						
6.9	**Constructed Barrier - Shielding from Consequential Fire**: Applicable to all consequential fire fuel sources. Install a non-combustible barrier (including complete enclosure when appropriate), of required robustness, that can perform the following as relevant: • Reduce the exposure of the subject building/structure to the threats of consequential fire; and/or • Reduce the exposure of the consequential fire fuels to the bushfire hazard.	Moderate	Yes	No	No	Yes
Informative and/or Site Specific Comment/Assessment: Ensure all subfloor spaces are sealed or enclosed with non-combustible solid material or ember screening mesh (corrosion-resistant steel, bronze, or aluminium with an aperture <2mm).						
6.10	**Natural Barrier - Landforms**: Use existing natural landforms to reduce buildings/structures exposure to radiant heat, and lower wind speeds (prevailing synoptic and/or fire driven).	Not Relevant	N/A	N/A	N/A	N/A
6.11	**Natural Barrier – Vegetation**: Use appropriate hedges and trees strategically to reduce (to varying extents) buildings/structures exposure to radiant heat, to filter/trap embers and firebrands, and to lower wind speeds (prevailing synoptic and/or fire driven).	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: Sufficiently low radiant heat flux can be achieved through separation distance.						
6.12	**Shield Non-Structural Essential Elements**: These are elements essential to the continued operation of the built asset which are potentially exposed to fire attack mechanisms of both bushfire and consequential fire. They include cabling and plumbing associated with power / data transmission and water / fuel transport. When the use of fire rated materials to the degree necessary is not possible or practical, the application of non-combustible shielding can be applied to reduce exposure to the threats. Shielding includes underground installation.	Moderate	Yes	No	Partly	Yes

EXPOSURE REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
Informative and/or Site Specific Comment/Assessment: Exposed electrical cabling to be shielded from radiant heat and consequential fire by burying underground or shielding with non-combustible material – common electrical cabling reaches its critical point at >10kWm2. *Exposed plumbing (poly pipe) is to be buried or shielded with non-combustible material – maximum exposure 120 degrees Celsius.*					

[1] **Protection Measure Effectiveness Rating:** Refer to section 2.3.5 for explanation and defining.

[2] **Protection Measure Application Status:**

- **Possible:** Protection measures that can potentially be applied to the proposed development/use;
- **Exists:** Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary);
- **Planned:** Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

  These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- **Additionally Recommend:** Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

  These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

7.4.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 7.13: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

EXPOSURE REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Fixed (hard) infrastructure assets					
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating [1]	Numbers of Protection Measures				
		Total Available	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Separation from the Hazard	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	1	1
	Moderate	3	3	2	1	1
	Not Relevant	3	-	-	-	-
Shielding from the Hazard	Very High	-	-	-	-	-
	High	1	1	-	-	-
	Effective	-	-	-	-	-
	Moderate	2	2	-	1	2
	Not Relevant	2	-	-	-	-
Total Numbers	**Very High**	-	-	-	-	-
	High	1	1	-	-	-
	Effective	1	1	-	1	1
	Moderate	5	5	2	2	3
	Not Relevant	5	-	-	-	-
	Totals	12	7	2	3	4

[1] Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

[2] Protection Measure Application Status: Refer to table footnotes on previous page.

7.4.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (EXPOSURE REDUCTION)

Table 7.14: For the stated element at risk, The potential impact of the applied protection measures in reducing exposure levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (EXPOSURE REDUCTION)								
Element at Risk	Fixed (hard) infrastructure assets							
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.							
Exposure Reducing Protection Measures Applied to Assessment [1]	The Bushfire Hazard Threats [2]							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Medium	Significant	Medium	Significant	Significant	Medium	Medium	Medium
	Medium				Medium			
Existing, Planned and Recommended (applied to residual risk)	Very Significant	Very Significant	Very Significant	Very Significant	Significant	Very Significant	Significant	Very Significant
	Very Significant				Significant			
[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 [2] Refer to Appendix 4 for explanatory information.								

Assessment Comments: The BAL-29 APZ required for planning approval limits potential exposure to bushfire impacts. However, the assessed vulnerability of the Merredin BESS (Section 8.4) necessitates a greatly reduced exposure.

7.4.4 ASSESSED EXPOSURE LEVELS

Assessed as a function of the capacity to apply sufficient exposure reducing protection measures, their individual effectiveness and their combined impact in reducing the exposure of the identified element at risk (Note: This assessment is independent of the threat level and vulnerability level assessments).

Table 7.15: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED EXPOSURE LEVELS	
Element at Risk	Fixed (hard) infrastructure assets
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.
Exposure Reducing Protection Measures Applied to Assessment [1]	Relative Exposure Level [2]
Existing and Planned (applied to inherent risk)	Moderate
Existing, Planned and Recommended (applied to residual risk)	Very Low
[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 [2] Refer to Appendix 2 for explanatory information.	

Assessment Comments: The applied APZ and additional restrictions on combustible materials greatly reduces relative exposure.

8 VULNERABILITY LEVEL ASSESSMENT OF THE ELEMENTS AT RISK

SUMMARY OF THE QUALITATIVE ASSESSMENT PROCESS

1. Identify all protection measures (grouped by protection principle) that are available to reduce vulnerability levels and rate their effectiveness;
2. Produce a numerical summary of all potential vulnerability reducing protection measures that are available and determine their application status;
3. Assess the potential vulnerability reducing impact of the package of protection measures that is able to be applied. The effectiveness rating weights the potential impact of an individual measure; and
4. Derive the vulnerability level of the identified element at risk, to the threats presented by each identified area of bushfire prone vegetation (refer to Section 2.3.3 and Appendix 2 for additional risk assessment process information).

8.1 PERSONS ONSITE OR TEMPORARILY OFFSITE

8.1.1 PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS AND THEIR APPLICATION STATUS

Table 8.1: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: PERSONS LOCATED ONSITE AND TEMPORARILY OFFSITE						
PROTECTION PRINCIPLE – TRANSPORT AND MULTIPLE EVACUATION DESTINATIONS AND ROUTES AVAILABLE						
7.1	**Sufficient Evacuation Transport Available**: Ensure that all persons likely to be on site have access to transport. This can be through own vehicles, facility vehicles, a formal arrangement with an external provider or a combination of these.	Effective	Yes	Yes	No	No
Informative and/or Site Specific Comment/Assessment: The location is relatively remote from settlements (no public transport). All visitors must necessarily have their own transport.						
7.2	**Multiple Safer Offsite Locations Available**: Increasing the route and destination options decreases vulnerability of persons as the exposed element. Multiple buildings/areas are accessible from the subject site as evacuation destinations. The offsite locations exist at a sufficient distance from the subject site ensuring that the destination and the subject site are very unlikely to be simultaneously impacted by a bushfire event. For the most robust scenario:	Very High	No	Yes	No	No

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
	• Multiple access/egress route are available to the safer locations from the subject site; • The entirety of at least two routes is unlikely to be simultaneously impacted by a bushfire event; and • The availability of water and amenities corresponding to person numbers increases the effectiveness of the measure.					
Informative and/or Site Specific Comment/Assessment: Two-way access/egress is available. The access/egress routes run through farm land and adjacent to the existing solar installation with Robartson Rd access/egress in a north direction towards the Great Eastern Highway and the town of Merredin, and south direction for approx. 750m before meeting the Bruce Rock – Merredin Rd in an east or west direction. *Safe (early) evacuation is the primary procedure for any occupants (staff) during bushfire emergencies.*						
PROTECTION PRINCIPLE – PROVISION OF BUSHFIRE EMERGENCY INFORMATION AND EDUCATION						
7.3	**Bushfire Emergency Plan:** Is produced and appropriately located within the site of the subject development/use. It is an operational document that details site specific preparation, response, recovery and review procedures. It is produced for use by the site owners, managers, operators and occupants (as relevant).	Effective	Yes	No	No	No
7.4	**Bushfire Emergency Poster**: A poster is prominently displayed, for the attention of all persons onsite. It presents the key emergency contacts, information sources and response procedures in the event of a bushfire event. It has increased value attached to its display when there are no bushfire emergency trained persons onsite or no persons that are familiar with the site and local area.	Moderate	Yes	No	No	No
7.5	**Bushfire Protection Measures to be Implemented are Published in the Relevant Operational Documents:** The relevant documents can include the Bushfire Management Plan (BMP), the Bushfire Emergency Plan (BEP), the Site Emergency Plan (as required to be developed by the operators of 'high risk' land uses), and any relevant documents associated with a projects design phase. The purpose of this measure is to ensure the application of relevant protection measures, that have been identified in this Bushfire Risk Assessment and Management Report, will be acted upon through responsibilities created by the operational documents.	Effective	Yes	No	No	Yes
Informative and/or Site Specific Comment/Assessment: The development is proposed to be unstaffed. Visitors will be inducted staff/contractors familiar with emergency procedures and preparation/display of separate bushfire emergency procedures is not necessary. Additionally, evacuation (in the direction away from the bushfire) is the only bushfire response procedure. *The site Emergency Management Plan (document title pending), is to include responses to bushfire emergencies. The immediately procedure is to evacuate in the appropriate direction away from the fire, and inform DFES Comcen of the status of the BESS facility.*						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
7.6	**Prominent Display of Information Stating Safe Early Evacuation is the Primary Procedure**: For the subject development/use evacuation in the event of a bushfire within the locality has or is likely to be determined as the primary response procedure and that it must be conducted early. This option is available. The emphasis on early rather than a late evacuation is important. Analysis of past events identify that most people who die in bushfires are caught in the open, either in vehicles or on foot, because they have left their property too late. For evacuation to provide the safest response for occupants, it must be conducted early. Being on roads when a bushfire is close is a high risk action. Otherwise, sheltering-in-place is likely to provide greater protection to persons – particularly when a suitable onsite shelter place is identified.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: Occupants will be site staff only, who will be aware of the emergency response procedure.						
7.7	**Egress Pathway Signage**: Where pathways exist onsite for occupants to relocate to an identified safer onsite location, appropriate signage to guide unfamiliar persons can reduce their vulnerability.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: Staff will be familiar with the site. The safer onsite location is obvious.						
7.8	**Trained Personnel Onsite**: Operational persons (staff) are provided with bushfire emergency management training, aligned with the subject site's prepared Bushfire Emergency Plan (BEP). The intent also includes identifying the specific roles and persons to fill any required responsibilities that have determined through the BEP construction process.	Moderate	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: The development is proposed to be unstaffed.						
7.9	**Build Community Resilience Through Education**: When relevant to the type and scale of proposed development/use, the delivery of effective education programs can result in lowering the vulnerability of the community to a bushfire event, once the information has been acted upon and packages of protection measures put in place. Local government develops an ongoing program of innovative and leading edge community and landowner education that builds on the information presented within this Bushfire Risk Assessment and Management Report. Subsequent implementation of recommended/required protection measures can be encouraged through legislation, education, audits, enforcement and penalties as appropriate. Examples of such community education programs exist in various jurisdictions. The CSIRO (2020) Climate and Disaster Resilience Overview Report in 'Recommendation No. 5' [18] encourages collaboration with research agencies on the issue of building community resilience.	Not Relevant	N/A	N/A	N/A	N/A
7.10	**Encourage 'Property Bushfire Resilience Assessments'**: Local government to promote (and potentially incentivise) the conducting of these assessments and the implementation of any recommendations. These assessments address bushfire	Not Relevant	N/A	N/A	N/A	N/A

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
	hazard threat levels and the level of exposure and vulnerability of buildings and persons. It identifies appropriate protection measures to increase bushfire resilience.					
PROTECTION PRINCIPLE – A BUSHFIRE EMERGENCY FIREFIGHTING CAPABILITY EXISTS (RESPONSE)						
7.11	**Personnel Onsite Can Manage Bushfire Emergency Procedures**: Different categories of persons can perform this role in different scenarios, with potentially varying levels of expertise and effectiveness. These include: • Appropriately trained person(s) will be onsite at all times, or able to be onsite at short notice. They are trained in bushfire emergency procedures in general and have specific knowledge of site preparation, response and recovery procedures from the required Bushfire Emergency Plan), and the environment in which the development/use exists. This person(s) may have the official title of fire warden. • An untrained person familiar with the local area will be onsite at all times. They have knowledge and instruction gained from the required Bushfire Emergency Plan for the subject development/use and will ensure the preparation, response and recovery procedures established by the required Bushfire Emergency Plan are conducted appropriately and provide emergency event guidance to any other persons onsite.	Effective	Yes	No	No	Yes
Informative and/or Site Specific Comment/Assessment: The development is proposed to be unstaffed. It is recommended that the staff member managing emergency procedures has training in general bushfire emergency procedures, and has specific knowledge of the site procedures in response to bushfire. This staff member should be easily contactable.						
7.12	**Personnel Onsite Can Operate Firefighting Equipment**: Such person(s) is suitably capable of maintaining and operating any installed firefighting water supply and associated pumps, hoses/nozzles and sprinklers.	Moderate	Yes	No	Yes	No
Informative and/or Site Specific Comment/Assessment: Staff will receive basic instruction on operation of firefighting equipment and procedures for suppression or prevention of fire spread associated with BESS facilities.						
7.13	**Locations of Vulnerable Persons are Registered**: Relevant department of local government and their emergency services maintains a register of the location of land uses that are likely to result in a number of 'vulnerable' persons residing onsite, so that their needs can be addressed as a priority in a bushfire emergency. The subject development/use would exist on that register.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: No vulnerable persons will be onsite.						
7.14	**External Emergency Services Available**: An emergency service with a bushfire response capability is located within a realistic operational distance of the subject development/use. Bushfire services include volunteer bushfire brigades, volunteer fire and emergency services, DFES career fire and Rescue Service or Parks and Wildlife.	Effective	No	Yes	No	Yes

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
Even if an emergency service response capability exists, effectiveness will be limited by number of resources and their availability likelihood at the crucial time. *Bushfire Verification Method – Handbook s6.6 [14] states "During significant bushfires, there will be conflicting demands on fire brigade resources and reliance should not be placed on fire brigade intervention to protect a specific property.* *Prior to the 2009 Black Saturday fires, an early evacuation or stay and defend policy was in place and data from major fires indicated that the presence of occupants significantly increased the probability of house survival (refer Table 7.1). However, in response to the subsequent Royal Commission findings there is now a greater emphasis on early evacuation. Whilst this is expected to reduce fatalities by reducing the numbers of people at risk, a negative consequence will be an increase in property losses for buildings constructed to similar standards. It should therefore be assumed that there will be no fire brigade or occupant intervention with respect to protecting a specific property."*					
Informative and/or Site Specific Comment/Assessment: It is recommended that the Merredin Volunteer Fire and Rescue Service are to be invited to inspect and familiarise with the site. Provide information in site fire response procedures. This invitation may be annual or ad-hoc.					

[1] **Protection Measure Effectiveness Rating:** Refer to section 2.3.5 for explanation and defining.

[2] **Protection Measure Application Status:**

- **Possible:** Protection measures that can potentially be applied to the proposed development/use;
- **Exists:** Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary);
- **Planned:** Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

  These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- **Additionally Recommend:** Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
• Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP. These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).					

8.1.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 8.2: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

VULNERABILITY REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Persons located onsite and temporarily offsite					
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating [1]	Numbers of Protection Measures				
		Total Available	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Transport and Multiple evacuation destinations and routes available	Very High	1	-	1	-	-
	High	-	-	-	-	-
	Effective	1	1	1	-	-
	Moderate	-	-	-	-	-
	Not Relevant	-	-	-	-	-
Provision of bushfire emergency information and education	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	2	2	-	-	1
	Moderate	2	2	-	-	-
	Not Relevant	4	-	-	-	-
A bushfire emergency firefighting capability exists (response)	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	2	1	1	-	2
	Moderate	1	1	-	1	-
	Not Relevant	1	-	-	-	-
Total Numbers	**Very High**	**1**	**-**	**1**	**-**	**-**
	High	**-**	**-**	**-**	**-**	**-**
	Effective	**5**	**4**	**2**	**-**	**3**
	Moderate	**4**	**3**		**1**	**-**
	Not Relevant	**5**	**-**	**-**	**-**	**-**
	Totals	**14**	**7**	**3**	**1**	**3**

[1] Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

[2] Protection Measure Application Status: Refer to table footnotes on previous page.

8.1.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (VULNERABILITY REDUCTION)

Table 8.3: For the stated element at risk, The potential impact of the applied protection measures in reducing vulnerability levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (VULNERABILITY REDUCTION)								
Element at Risk	Persons located onsite and temporarily offsite							
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.							
Vulnerability Reducing Protection Measures Applied to Assessment [1]	The Bushfire Hazard Threats [2]							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	N/A	Significant	Significant	N/A	Minimal	Significant	N/A	N/A
	Significant				Medium			
Existing, Planned and Recommended (applied to residual risk)	N/A	Significant	Significant	N/A	Significant	Very Significant	N/A	N/A
	Significant				Very Significant			
[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 [2] Refer to Appendix 4 for explanatory information.								

Assessment Comments: Persons are not vulnerable to direct ember attack or surface fire impacts. Recommendations are for training and site responses.

8.1.4 ASSESSED VULNERABILITY LEVELS

Assessed as a function of the capacity to apply sufficient vulnerability reducing protection measures, their individual effectiveness and their combined impact in reducing the vulnerability of the identified element at risk (Note: This assessment is independent of the threat level and exposure level assessments).

Table 8.4: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED VULNERABILITY LEVELS	
Element at Risk	Persons located onsite and temporarily offsite
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.
Vulnerability Reducing Protection Measures Applied to Assessment [1]	Relative Vulnerability Level [2]
Existing and Planned (applied to inherent risk)	Moderate
Existing, Planned and Recommended (applied to residual risk)	Low
[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 [2] Refer to Appendix 2 for explanatory information.	

Assessment Comments: After training and response procedures are made available to staff/visitors and emergency services are familiar with the site, there is little more that can be done to improve vulnerability.

8.2 PERSONS ON ACCESS/EGRESS ROUTES (IN VEHICLES) OR PATHWAYS

8.2.1 PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS AND THEIR APPLICATION STATUS

Table 8.5: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK:	**PERSONS ON ACCESS/EGRESS ROUTES IN VEHICLES**					
Access/Egress Route ID:	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.					
PROTECTION PRINCIPLE – APPLY BEST (SAFER) ROAD DESIGN AND CONSTRUCTION (MATERIALS): The application of as many of the following protection measures as possible ensures a greater level of safety for users and lowers the associated risk when roads need to be used to evacuate to a safer offsite location in potentially high stress situations within a threatening environment. Safety for persons using the route is increased through reducing the likelihood of vehicle/terrain or vehicle/vehicle accidents and the ability to maintain travelling speed.						
8.1	**Road Width:** Ensure appropriate width roads are installed. Wider roads allow safer passing of the anticipated traffic that can be travelling in both directions (e.g. emergency services travelling towards the emergency event). The effectiveness of road width to reduce vulnerability is also a function of the required carriage capacity - which may be increased by the proposed development/use when it will increase traffic intensity. The incorporation of non-vegetated and trafficable road verges/shoulders and adjacent footpaths can also be considered to increase effective width for slower moving vehicles (providing additional separation from the hazard and passing opportunities).	High	No	Yes	No	No
Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. The access/egress routes run through farm land and adjacent to the existing solar installation with Robartson Rd access/egress in a north direction towards the Great Eastern Highway and the town of Merredin, and south direction for approx. 750m before meeting the Bruce Rock – Merredin Rd in an east or west direction. Both roads are approx. 8-10m wide giving safe passage for evacuation and emergency responding vehicles.						
8.2	**Road Gradient:** Ensure appropriate road gradients are available. Lower gradients ensure traction and speed can be maintained and can also be associated with driver visibility. Appropriate gradients will depend on the constructed surface materials and the weights and tractive capability of expected vehicle types.	High	No	Yes	No	No
Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. The local topography is gently undulating rather than rugged.						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
8.3	**Road Clearance**: Ensure appropriate clearance can exist and is established. Sufficient horizontal and vertical clearances from obstructions ensure unhindered movement of all possible vehicle types;	High	No	Yes	No	No
Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. The minimum horizontal clearance is the road width of 8m and generally 10m. Trees and powerlines do not overhang the road, so vertical clearance is unrestricted.						
8.4	**Road Surface Materials**: Ensure that roads are constructed of materials that will provide the necessary traction (also a function of gradient), can support the weight of all expected vehicle types and remain operational in all weather. The required supportive capacity also applies to associated structures such as bridges.	High	No	Yes	No	No
Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. Robartson Rd and Bruce Rock -Merredin Rd are designed to carry heavy and industrial vehicles. There is no limitation for the residential vehicles (<2 ton) used by site staff.						
8.5	**Driver Visibility and Road Ahead Signage**: Ensure that road design provides high levels of visibility ahead (at least in the absence of smoke and embers) and informative signage indicating relevant 'up ahead' route information (includes information stating distance to turnaround area for narrow roads in more remote locations). Good visibility is associated with the avoidance 'blind' corners and crests to the greatest extent possible.	High	No	Yes	No	No
Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. Robartson Rd and Bruce Rock- Merredin Rd have long straight sections (>1km) and gentle curves (<30 degrees).						
8.6	**Road / Pathway Length**: Shorter distances to safer locations reduce the length of time persons remain vulnerable to bushfire threats.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. Robartson Rd and Bruce Rock- Merredin Rd are >10km to a safer offsite location (Merredin Townsite)or to a westerly direction through farmland. This is addressed in Section 7.2.1.						
8.7	**Interconnected Roads**: Ensuring that the design of the road network provides through roads and avoids dead-end roads, provides the choice of alternative routes for drivers to minimise close contact with a bushfire event. Otherwise vehicles and persons can be trapped.	High	No	Yes	No	No
Informative and/or Site Specific Comment/Assessment: The measure is not under the control of the landowner/developer. Some minor side roads in the area are no through-roads. All major roads are through-roads.						
PROTECTION PRINCIPLE – EVACUEES SELF-SUFFICIENT (LOCAL AWARENESS AND TRANSPORT): The 'type' of persons that will be present on the site of the proposed development/use influences their degree of vulnerability to both bushfire threats and to risk associated with vehicular accidents in a stressful environment. Persons that have local knowledge, are self-supportive, have their own transport and are physically and mentally capable present the lowest degree of vulnerability for this factor.						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
This contrasts with persons who meet the SPP 3.7 definition of 'vulnerable' where the most vulnerable are likely to be less effective at making the required decisions and carrying out the required actions in the timeframe required. They are likely to be dependent on others for both information and transport and will not have any local knowledge.						
8.8	**Self Sufficient Persons with Local Awareness**: These are the type of persons that will be present on the site of the proposed development/use.	Effective	Yes	Yes	No	No
8.9	**Persons Onsite Have Own Transport**: There is no need to have arrangements in place for external provision of evacuation vehicles.	Effective	Yes	Yes	No	No
Informative and/or Site Specific Comment/Assessment: Staff must necessarily have their own transport to access the site.						

[1] **Protection Measure Effectiveness Rating**: Refer to section 2.3.5 for explanation and defining.

[2] **Protection Measure Application Status**:

- **Possible**: Protection measures that can potentially be applied to the proposed development/use;
- **Exists**: Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary);
- **Planned**: Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

  These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- **Additionally Recommend**: Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

  These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

8.2.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 8.6: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

VULNERABILITY REDUCING PROTECTION MEASURES – SUMMARY NUMBERS							
Element at Risk	Persons on access/egress routes in vehicles						
Access/Egress Route ID	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.						
The Protection Principle	Effectiveness Rating [1]	Numbers of Protection Measures					
		Total Available	Application Status [2]				
			Possible	Exists	Planned	Additionally Recommend	
Road Design and Construction (Materials)	Very High	-	-	-	-	-	
	High	6	-	6	-	-	
	Effective	-	-	-	-	-	
	Moderate	-	-	-	-	-	
	Not Relevant	1	-	-	-	-	
Evacuees Self-Sufficient in Transport and Local Knowledge	Very High	-	-	-	-	-	
	High	-	-	-	-	-	
	Effective	2	2	2	-	-	
	Moderate	-	-	-	-	-	
	Not Relevant	-	-	-	-	-	
Total Numbers	**Very High**	**-**	**-**	**-**	**-**	**-**	
	High	**6**	**-**	**6**	**-**	**-**	
	Effective	**2**	**2**	**2**	**-**	**-**	
	Moderate	**-**	**-**	**-**	**-**	**-**	
	Not Relevant	**1**	**-**	**-**	**-**	**-**	
	Totals	**9**	**2**	**8**	**-**	**-**	

[1] Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

[2] Protection Measure Application Status: Refer to table footnotes on previous page.

8.2.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (VULNERABILITY REDUCTION)

Table 8.7: For the stated element at risk, the assessed impact of the applied protection measures corresponding to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (VULNERABILITY REDUCTION)								
Element at Risk	Persons on access/egress routes in vehicles							
Access/Egress Route ID	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.							
Vulnerability Reducing Protection Measures Applied to Assessment [1]	The Bushfire Hazard Threats [2]							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Minimal	Medium	Significant	Significant	N/A	N/A	Minimal	Significant
	Medium				Medium			

[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3

[2] Refer to Appendix 4 for explanatory information.

Assessment Comments: No recommendations are applicable. The inherent and residual risk are the same. The combination of suitable transportation, awareness, and quality of egress route(s) is weighed against the landscape-scale forests bounding the route and length of route to a low threat destination (>13km).

8.2.4 ASSESSED VULNERABILITY LEVELS

Assessed as a function of the capacity to apply sufficient vulnerability reducing protection measures, their individual effectiveness and their combined impact in reducing the vulnerability of the identified element at risk (Note: This assessment is independent of the threat level and exposure level assessments).

Table 8.8: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED VULNERABILITY LEVELS	
Element at Risk	Persons on access/egress routes in vehicles
Access/Egress Route ID	All bushfire prone vegetation within the broader locality (10km radius) including along access routes.
Vulnerability Reducing Protection Measures Applied to Assessment [1]	Relative Vulnerability Level [2]
Existing and Planned (applied to inherent risk)	Moderate

[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3

[2] Refer to Appendix 2 for explanatory information.

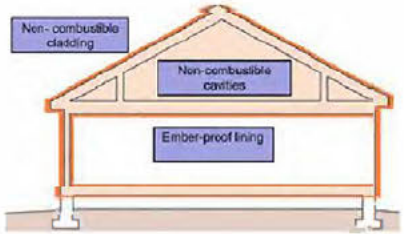
Assessment Comments: The vulnerability of persons on access routes is assessed as Moderate and cannot be practically improved.

8.3 BUILDINGS AND STRUCTURES NCC CLASSES 1-10

8.3.1 PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS AND THEIR APPLICATION STATUS

Table 8.9: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

	VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: BUILDINGS/STRUCTURES - NCC CLASSES 1-10						
	PROTECTION PRINCIPLE – DESIGN AND CONSTRUCTION (MATERIALS): Increase bushfire resilience through the application of beneficial design and construction, including using non-combustible materials and minimising the use of vulnerable materials, to the greatest extent possible. Practicality and cost will be key considerations in determining the viability of applying protection measures in differing scenarios, but this should be determined with due consideration of threat levels and the importance of the elements at risk. The constructed systems should utilise the following properties to the greatest extent possible: **reliability** (which requires their durability over time, low maintenance and being unlikely to change over time), **robustness** (which limits damage spread from minor sources, continue to protect when thermally loaded and protects vulnerable elements), **resilience** (which enables their return to a functional state following an overload) and **redundancy** (which ensures the fate of the subject building/structure is not reliant on the effective performance of a single element). Refer to the glossary for additional explanation. The principle is also applicable to constructed consequential fire fuels.					
9.1	**Construction to a Standard - AS 3959:2018 [4]:** Apply the specified requirements to construction. These are intended to reduce the risk of building ignition from bushfire direct attack mechanisms. Note that the indirect attack mechanisms and the threats presented by consequential fire fuels are not specifically considered. *"The standard is primarily concerned with improving the ability of buildings ... to better withstand attack from bushfire thus giving a measure of protection to the building occupants (until the fire front passes), as well as to the building itself".* The AS 3959 approach adopts a strategy that relies on the integrity of the building's exterior envelope (i.e., the cladding of roof/wall/eaves, floor supporting structures/flooring and all penetrations) to resist all bushfire exposure conditions and environmental actions thereby protecting all structural construction elements behind it, including allowable combustible materials. It provides protection by: • Using specified materials that provide ignition resistance (tolerance of radiant heat and flames). Higher BAL ratings impose increased construction requirements for these exterior envelope materials; • Specifying precise gap control (applicable to all bushfire attack levels) for the exterior envelope of the building to prevent ember entry); and • Attached and adjacent structures (within 6m) must also comply with the Standard.	High	N/A	N/A	N/A	N/A
	Informative and/or Site Specific Comment/Assessment: Structures (storage sheds and switchrooms etc) do not have a general structure which can comply with AS 3959 or NASH.					

	VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionaly Recommend
9.2	**Construction to a Standard – NASH Standard [33]:** Apply the specified requirements to construction. The Standard: *"Sets out acceptable construction requirements for residential and low-rise buildings in bushfire prone areas to reduce the risk of ignition from bushfire attack involving embers, radiant heat and direct flame impingement using non-combustible materials. Buildings constructed in accordance with this Standard are intended to provide a sheltering envelope during the passage of a bushfire flame front. They do not constitute 'last resort' private bushfire shelters as defined in the NCC. The Standard is based on achieving ignition resistance through non-combustible construction using conventional building materials and a level of redundancy to provide a high level of performance in extreme bushfire events and an increased probability that unattended buildings will survive such events."* Key attributes of the Standard include: • Materials used anywhere on the building envelope (see shaded part of diagram below), must be non-combustible except for a small amount allowed externally that includes flooring, window frames, doors and external decorative trim. The building envelope is comprised of a framed roof/ceiling system, an external wall system and a floor system;  • The same construction requirements apply for all BAL ratings up to BAL-40 (except for external doors and windows which apply AS 3959 requirements). An additional benefit of this is the built in resistance to the direct attack mechanisms of consequential fire when lower BAL ratings apply. • It does not rely on eliminating ember entry to the roof space, wall cavities and floor system as these are non-combustible construction. Embers only need to be kept from entering the internal living/operating spaces. • It is ember tolerant without unrealistic workmanship, supervision and maintenance requirements; • The combination of a non-combustible cladding and cavities is a robust solution that enables the building to be configured so that failure or damage to one element does not lead to the inevitable failure of the building or a breach of the habitable envelope; and • Attached and adjacent structures (within 6m) must also comply with the Standard.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: Structures (storage sheds and switchrooms etc) do not have a general structure which can comply with AS 3959 or NASH.						

	VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
9.3	**Construction Materials – External And Internal Cavity Building Elements**: Excluding internal living or operation spaces, to the degree necessary, utilise materials resistant to fire attack mechanisms of flame and radiant heat (preferably non-combustible) for all relevant building elements, including wall, roof, floor, supporting structures and framing systems.	Very High	Yes	Unknown	No	Yes
Informative and/or Site Specific Comment/Assessment: The construction of proposed structures is currently unknown. They will likely be primarily masonry, steel, aluminium and cement sheeting. It is recommended non-combustible elements are included where practical.						
9.4	**Construction Materials – Consequential Fire Fuels**: For constructed large consequential fire fuels, construct using non-combustible materials to the fullest extent possible. These include: • Surrounding landscaping items - fences/screens, retaining walls, gazebos, plastic water tanks etc; • Attached structures - decks, verandahs, stairs, carports, garages, pergolas, patios, etc; • Adjacent structures - houses, sheds, garages, carports, etc. Structure to structure fire is a common cause of overall building loss in post bushfire event assessments [9].	Very High	Yes	Yes	No	No
Informative and/or Site Specific Comment/Assessment: Adjoining heavy constructed fuels are not proposed as part of the relevant buildings.						
9.5	**Construction – Resistant To High Wind**: Apply construction measures to prevent the type of building damage from wind that will open or create gaps (from the wind itself or carried projectiles) and allow the entry of embers, radiant heat and flames. This type of damage is typically superficial damage. Building codes relating to wind (e.g., cyclones) do not necessarily address this superficial type of impact. Additional fixings for building envelope claddings and protection of the most vulnerable elements, such as glazing, from debris impact, are key considerations. Consider applying the principles of the NASH Standard [33] design solution to construction. "Potential wind effects directly associated with bushfire events have been considered in this Standard. Wind actions may affect houses subject to a bushfire attack in various ways including: • The intensity of flame front activity may produce locally high wind pressures on parts of the building; • In the post fire phase, some weakened components on the building envelope may be vulnerable to normal design pressures; and • Wind can drive embers into the building envelope." Most applicable when the physical requirements exist for the development of an extreme bushfire event within the surrounding broader landscape.	High	Yes	Unknown	No	No

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
9.6	**Construction – Gas Supply**: All gas cylinders are installed and maintained in accordance with AS 1596. This standard includes requirements for small portable cylinders and larger cylinders used for domestic house supply. These include: • Safety release valve shall be directed away from the building and persons access/egress routes; • Metal piping and fittings shall be used on all piping inside the building's cavities and enclosable occupied spaces and the high pressure side of any gas regulators; and • Tethers securing cylinders are to be non-combustible. The objective is to reduce the risk of local fire against a building and reduce the risk of death or injury, from gas flaring or explosion. The rationale is gas cylinders which have either flared or ruptured are commonly found in post bushfire surveys [9]. The heat from the bushfire or consequential local fire has been sufficient to cause their pressure to reach critical levels beyond which their pressure release valve releases large quantities of LP gas. If these gas cylinders fall over, this pressure release valve may no longer function correctly, meaning that the gas cylinder may continue to increase in pressure with continued heating until the cylinder ruptures. The resulting explosion includes a pressure wave and large ball of flame which can threaten nearby life and buildings.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: No gas storage will be on site.						
9.7	**Construction - Electricity Supply**: Cabling to be shielded (includes installing underground within subject property boundary) from applicable bushfire attack mechanisms. The objective is to assist with continuity of supply for essential site operations and/or electrically driven firefighting pumps. It also reduces the risk of electrocution to any persons onsite and reduces potentially additional sources of fire ignition. It is common in bushfires for power infrastructure to burn and collapse or be impacted by falling trees or branches while power lines are still live. Removing this risk may be appropriate for some sites.	Moderate	Yes	No	Partly	Yes
Informative and/or Site Specific Comment/Assessment: Exposed electrical cabling to be shielded from radiant heat and consequential fire by burying underground or shielding with non-combustible material – common electrical cabling reaches its critical point at >12kWm2. *Exposed plumbing (poly pipe) is to be buried or shielded with non-combustible material – maximum exposure 120 degrees Celsius.*						
9.8	**Minimise Debris and Ember Accumulation – Re-Entrant Detail:** Avoid or minimise the accumulation of unburnt debris and embers by avoiding re-entrant details and/or adopting aerodynamic forms that will self-shed windblown debris and embers. For example: • Simple building/structure footprints that avoid re-entrant corners in access ways, at wall/floor, wall/ground, roof/wall junctions and around doors, vents, windows; and • Simple roof layouts that avoid valleys and minimise the number of ridges that need protection details (e.g. skillion roofs).	High	Yes	Unknown	No	No

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
9.9	**Minimise Debris and Ember Accumulation – Trapping Surfaces:** Avoid or minimise the use of exposed combustible surfaces that can trap and accumulate embers. These can include: • Horizontal, or shallow angle surfaces e.g. exposed wall/roof framework, roofs, decking, verandahs, steps, windowsills; and • Vertical surfaces with rough textured cladding (e.g. sawn timber).	Moderate	Yes	Unknown	No	No
Informative and/or Site Specific Comment/Assessment: The design of Class 1-10 buildings is unknown at this stage, but are likely to be simple rectangular structures without complex features.						
9.10	**Minimise Debris and Ember Accumulation – Roof Plumbing:** All roof plumbing (gutters, valleys) is protected from the accumulation of debris and embers that can result in direct fire attack mechanisms immediately adjacent to any combustible elements within the roof cavity.	Moderate	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: There will be few to no trees within the APZ and leaf litter accumulation will be very slow.						
9.11	**Minimise Debris and Ember Accumulation – Construction Cavities:** Apply designs that lower the potential for accumulation of embers and debris within cavity spaces of buildings/structures. Examples include concrete floor slab on the ground and solid masonry walls.	Moderate	Yes	Unknown	No	Yes
Informative and/or Site Specific Comment/Assessment: Ensure all subfloor spaces are sealed or enclosed with non-combustible solid material or ember screening mesh (corrosion-resistant steel, bronze, or aluminium with an aperture <2mm).						
9.12	**Minimise Flame/Radiant Heat/Ember/Debris Entry - External Openings:** Limit potential sites for entry through the external envelope to internal spaces and combustible materials within (as consequential fire fuels).	High	Yes	No	Yes	No
9.13	**Screening and Sealing - Gaps and Penetrations:** Apply fire rated sealants and/or install metal screening (corrosion resistant steel, bronze, aluminium <2mm aperture). All external construction and penetration gaps with apertures greater than 2mm will allow ember entry (and potentially debris) to internal cavities and combustible materials within (as consequential fire fuels). This includes gaps in roofs, walls, doors, windows and their surrounding trims – including those associated with penetrations, vents, weepholes, poor workmanship and material deterioration and movement over time (maintenance). Internal fire is difficult to see and extinguish.	Moderate	Yes	No	Yes	Yes
Informative and/or Site Specific Comment/Assessment: All Class 1-10 buildings (including non-habitable structures) must have ember screening/sealants installed on any gaps and penetrations.						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
9.14	**Screening - External Doors and Windows:** Metal screens (corrosion resistant steel, bronze, aluminium <2mm aperture) installed over non-openable and/or openable parts of windows and doors to prevent ember entry to internal spaces containing combustible materials (consequential fire fuels) and reduce radiant heat load on vulnerable surfaces.	Moderate	Yes	No	No	No
9.15	**Shutters - External Doors and Windows:** Fire rated shutters Installed to significantly increase bushfire resistance of the vulnerable building elements. Any requirement for onsite manual activation is a potential limitation to effectiveness.	Moderate	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: The measures are excessive for the radiant heat flux exposure of <10kW/m2.						
9.16	**Landscaping Construction - Fences and Walls:** Non-combustible materials are used for fences, walls (including retaining walls), screens, garden edging, play equipment and other built structures - as potential consequential fire fuels. Where relevant, the capacity to resist high winds, to minimise potential for impact damage to subject building/structure, should also be incorporated.	Moderate	Yes	No	No	Yes
Informative and/or Site Specific Comment/Assessment: Any security fences or other potential fuel loads should be constructed using non-combustible material.						
PROTECTION PRINCIPLE – FIREFIGHTING CAPABILITY: Provide sufficient, reliable and bushfire resilient water supply and delivery capability as is necessary for active and/or passive systems.						
9.17	**Firefighting Water Supply:** Have a dedicated static supply of firefighting water for the protection of buildings/structures before and after the passage of a bushfire front. Adequate water supply is critical for any firefighting operation, particularly where property protection is the intent. This is necessary when: • A water supply additional to a reticulated water supply is required to counter the loss of firefighting water as a protection measure, should the reticulated supply be interrupted; • It is the only source of firefighting water. All tanks shall be non-combustible. Aside from losing water, failure of combustible tank can provide an additional heat or load to a vulnerable building element. Metal piping and fittings shall be used for any above ground components. The limitation to the effectiveness of the measure is the requirement for persons to be present and have the minimum required operational knowledge and/or access to appropriate information.	Very High	Yes	No	Yes	Yes
9.18	**Firefighting Equipment – Active Operation:** In addition to a dedicated water supply, appropriate firefighting equipment is installed (pumps, hoses, sprinklers etc). These will be resilient to bushfire impact, to the extent necessary, through the application of appropriate equipment materials and protection (shielding or separation from the hazard). The limitation to the effectiveness of the measure is the requirement for persons to be present and have the minimum required operational knowledge and/or access to appropriate information.	Not Relevant	N/A	N/A	N/A	N/A

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Informative and/or Site Specific Comment/Assessment: Measure 11.18 discusses firefighting water supply to the site. The Merredin Battery facility will be supplied with a minimum 288kL firefighting water supply. This will provide an ample supply for any Class 1-10 buildings. *The design and bushfire protection measures assumes no active defence of the site. Attendance of emergency services or response by site staff would be additional to the protection measures applied.*						
9.19	**Firefighting Equipment – Passive Operation:** In addition to a dedicated water supply, appropriate water dispensing apparatus are installed (e.g. pumps, plumbing and sprinklers) that are automatically activated. These will be resilient to bushfire impact, to the extent necessary, through the application of appropriate equipment materials and protection (shielding or separation from the hazard).	Not Relevant	N/A	N/A	N/A	N/A
9.20	**Firefighting Equipment – Maintain Operability:** Where water pumps, shutters or other active/passive protection measures rely on the continued supply of electricity, establish barriers (shielding) or separation from potential damaging factors (e.g. falling trees/branches, fire, or other impact sources). For example, bury transmission systems to the greatest extent possible.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: Passive operations are not proposed for Class 1-10 buildings.						
9.21	**Firebreaks – Primarily for Access:** Installation and maintenance of firebreaks to remove vegetation, limit surface fire progression and facilitate firefighting access / backburning.	Moderate	Yes	Yes	No	No
Informative and/or Site Specific Comment/Assessment: The site is currently compliant with the Shire of Merredin Firebreak Notice.						
PROTECTION PRINCIPLE – MANAGEMENT AND MAINTAINING EFFECTIVENESS OF APPLIED PROTECTION MEASURES: To ensure the retention of the level of bushfire resilience that has been established through the implementation of appropriate bushfire protection measures, formal and enforceable responsibilities are created.						
9.22	**Formal Management/Maintenance Plan – Actions and Responsibilities:** Through a bushfire management plan, site operations emergency plan, bushfire emergency plan, operational annual works plan and/or a 'firebreak' notice, a mechanism is put in place to ensure that: • The required management and maintenance of applied bushfire protection measures is conducted on a regular basis – with the interval dependent on the necessary frequency that will maintain full effectiveness; and • The relevant protection measures are known and understood; and • Responsibilities are created The different documents will be able to satisfactorily perform this function to differing extents.	Effective	Yes	No	No	Yes

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend
Informative and/or Site Specific Comment/Assessment: The different documents will be able to satisfactorily perform this function to differing extents.					

[1] **Protection Measure Effectiveness Rating:** Refer to section 2.3.5 for explanation and defining.

[2] **Protection Measure Application Status:**

- **Possible:** Protection measures that can potentially be applied to the proposed development/use;
- **Exists:** Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary);
- **Planned:** Protection measures that:
  - Are incorporated into the site plans;
  - Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.

  These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
- **Additionally Recommend:** Protection measures that:
  - Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  - Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.

  These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).

8.3.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 8.10: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

VULNERABILITY REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Buildings/Structures - NCC Classes 1-10					
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating [1]	Numbers of Protection Measures				
		Total Available	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Design and Construction (Materials)	Very High	2	2	1	-	1
	High	4	3	-	-	-
	Effective	-	-	-	-	-
	Moderate	8	8	-	1	4
	Not Relevant	2	-	-	-	-
Firefighting Capability	Very High	1	1	-	1	1
	High	-	-	-	-	-
	Effective	-	-	-	-	-
	Moderate	1	1	1	-	-
	Not Relevant	3	-	-	-	-
Management and Maintaining Effectiveness of Applied Protection Measures	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	-	1
	Moderate	-	-	-	-	-
	Not Relevant	-	-	-	-	-
Total Numbers	**Very High**	**3**	**3**	**1**	**1**	**1**
	High	**4**	**4**	**-**	**1**	**1**
	Effective	**1**	**1**	**-**	**-**	**1**
	Moderate	**9**	**9**	**1**	**1**	**4**
	Not Relevant	**5**	-	-	-	-
	Totals	**22**	**17**	**2**	**3**	**7**

[1] Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

[2] Protection Measure Application Status: Refer to table footnotes on previous page.

8.3.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (VULNERABILITY REDUCTION)

Table 8.11: For the stated element at risk, The potential impact of the applied protection measures in reducing vulnerability levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (VULNERABILITY REDUCTION)								
Element at Risk	Buildings/Structures - NCC Classes 1-10							
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.							
Vulnerability Reducing Protection Measures Applied to Assessment [1]	The Bushfire Hazard Threats [2]							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Minimal	Significant	Significant	Medium	Significant	Medium	Medium	Medium
	Medium				Medium			
Existing, Planned and Recommended (applied to residual risk)	Very Significant	Significant	Significant	Very Significant	Very Significant	Significant	Significant	Medium
	Very Significant				Significant			
[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 [2] Refer to Appendix 4 for explanatory information.								

Assessment Comments: The protection measures concentrate on reducing the vulnerability of building(s) to Ember Attack, including ember screening, construction materials, enclosing subfloor cavities, and preventing leaf litter/debris accumulation.

8.3.4 ASSESSED VULNERABILITY LEVELS

Assessed as a function of the capacity to apply sufficient vulnerability reducing protection measures, their individual effectiveness and their combined impact in reducing the vulnerability of the identified element at risk (Note: This assessment is independent of the threat level and exposure level assessments).

Table 8.12: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED VULNERABILITY LEVELS	
Element at Risk	Buildings/Structures - NCC Classes 1-10
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.
Vulnerability Reducing Protection Measures Applied to Assessment [1]	Relative Vulnerability Level [2]
Existing and Planned (applied to inherent risk)	Moderate
Existing, Planned and Recommended (applied to residual risk)	Very Low
[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 [2] Refer to Appendix 2 for explanatory information.	

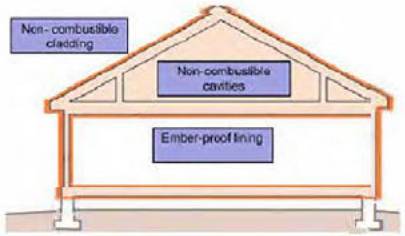
Assessment Comments: Class 1-10 buildings will be robust against bushfire impacts.

8.4 FIXED (HARD) INFRASTRUCTURE ASSETS

8.4.1 PROTECTION MEASURES AVAILABLE TO REDUCE VULNERABILITY LEVELS AND THEIR APPLICATION STATUS

Table 8.13: All available protection measures to reduce exposure of the stated element at risk to bushfire hazard threats and their application to the subject development/use.

	VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
ELEMENT AT RISK: FIXED (HARD) INFRASTRUCTURE ASSETS						
PROTECTION PRINCIPLE – DESIGN AND CONSTRUCTION (MATERIALS): Increase bushfire resilience through the application of beneficial design and construction, including using non-combustible materials and minimising the use of vulnerable materials, to the greatest extent possible. Practicality and cost will be key considerations in determining the viability of applying protection measures in differing scenarios, but this should be determined with due consideration of threat levels and the importance of the elements at risk. The constructed systems should utilise the following properties to the greatest extent possible: **reliability** (which requires their durability over time, low maintenance and being unlikely to change over time), **robustness** (which limits damage spread from minor sources, continue to protect when thermally loaded and protects vulnerable elements), **resilience** (which enables their return to a functional state following an overload) and **redundancy** (which ensures the fate of the subject building/structure is not reliant on the effective performance of a single element). Refer to the glossary for additional explanation. The principle is also applicable to constructed consequential fire fuels.					
11.1	**Construction to a Standard - AS 3959:2018 [4]:** Use the principles and requirements established in the Standard, for buildings in general, and apply to the infrastructure assets where they have merit. These are intended to reduce the risk of building ignition from bushfire direct attack mechanisms. Note that the indirect attack mechanisms and the threats presented by consequential fire fuels are not specifically considered. Key attributes of the Standard that may have relevance to other built assets include: • The AS 3959 strategy that relies on the integrity of the building's exterior envelope (i.e., the cladding of roof/wall/eaves, floor supporting structures/flooring and all penetrations) to resist all bushfire exposure conditions and environmental actions thereby protecting all structural construction elements behind it, including allowable combustible materials. • Using specified materials that provide ignition resistance (tolerance of radiant heat and flames). Higher BAL ratings impose increased construction requirements for these exterior envelope materials; • Specifying precise gap control (applicable to all bushfire attack levels) for the exterior envelope of the building to prevent ember entry); and • Attached and adjacent structures (within 6m) must also comply with the Standard.	Not Relevant	N/A	N/A	N/A	N/A
11.2	**Construction to a Standard – NASH Standard [33]:** Use the principles and requirements established in the Standard, for residential and low-rise buildings, and apply to the infrastructure assets where they have merit.	Not Relevant	N/A	N/A	N/A	N/A

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
	Key attributes of the Standard that may have relevance to other built assets include: • Materials used anywhere on the building envelope (see shaded part of diagram below), must be non-combustible (except for a small number of smaller building elements). The building envelope is comprised of a framed roof/ceiling system, an external wall system and a floor system;  • The same construction requirements apply for all BAL ratings up to BAL-40 (except for external doors and windows which apply AS 3959 requirements). An additional benefit of this is the built in resistance to the direct attack mechanisms of consequential fire when lower BAL ratings apply. • It does not rely on eliminating ember entry to the roof space, wall cavities and floor system as these are non-combustible construction. Embers only need to be kept from entering the internal living/operating spaces. • It is ember tolerant without unrealistic workmanship, supervision and maintenance requirements; • The combination of a non-combustible cladding and cavities is a robust solution that enables the building to be configured so that failure or damage to one element does not lead to the inevitable failure of the building or a breach of the habitable envelope; and • Attached and adjacent structures (within 6m) must also comply with the Standard.					
11.3	**Construction Materials – External and Internal Cavity Building Elements**: Excluding internal living or operation spaces, to the degree necessary, utilise materials resistant to fire attack mechanisms of flame and radiant heat (preferably non-combustible) for all relevant building elements, including wall, roof, floor, supporting structures and framing systems.	Not Relevant	N/A	N/A	N/A	N/A
11.4	**Construction Materials – Consequential Fire Fuels**: For constructed large consequential fire fuels, construct using non-combustible materials to the fullest extent possible. These can include attached structures, adjacent structures and surrounding landscaping items.	Very High	Yes	Partly	Partly	Yes
Informative and/or Site Specific Comment/Assessment: • Battery modules will be self-contained through highly insulated steel encasing used to encapsulate modules. • Cabinets and fencing will be non-combustible (metal or mineral).						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
•	Installation of thermally insulated steel vents within the thermal roof protecting the units from flame impingements and hot gas intrusion.					
11.5	**Construction – Resistant To High Wind**: Apply construction measures to prevent the type of building damage from wind that will open or create gaps (from the wind itself or carried projectiles) and allow the entry of embers, radiant heat and flames. This type of damage is typically superficial damage. Building codes relating to wind (e.g., cyclones) do not necessarily address this superficial type of impact. Additional fixings for building envelope claddings and protection of the most vulnerable elements, such as glazing, from debris impact, are key considerations. Consider applying the principles of the NASH Standard [33] design solution to construction. "Potential wind effects directly associated with bushfire events have been considered in this Standard. Wind actions may affect buildings subject to a bushfire attack in various ways including: • The intensity of flame front activity may produce locally high wind pressures on parts of the building; • In the post fire phase, some weakened components on the building envelope may be vulnerable to normal design pressures; and • Wind can drive embers into the building envelope." Most applicable when the physical requirements exist for the development of an extreme bushfire event within the surrounding broader landscape.	High	Yes	Yes	No	No
Informative and/or Site Specific Comment/Assessment: The BESS units and associated structures are fixed to the ground and have limited vulnerabilities.						
11.6	**Construction – Gas Supply**: All gas cylinders are installed and maintained in accordance with AS 1596 (for domestic house supply) as a guide. The requirement of the standard includes: • Safety release valve shall be directed away from the building and persons access/egress routes; • Metal piping and fittings shall be used on all piping inside the building's cavities and enclosable occupied spaces and the high pressure side of any gas regulators; and • Tethers securing cylinders are to be non-combustible. The objective is to reduce the risk of local fire against a building and reduce the risk of death or injury, from gas flaring or explosion. The rationale is gas cylinders which have either flared or ruptured are commonly found in post bushfire surveys [9]. The heat from the bushfire or consequential local fire has been sufficient to cause their pressure to reach critical levels beyond which their pressure release valve releases large quantities of LP gas. If these gas cylinders fall	Not Relevant	N/A	N/A	N/A	N/A

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
	over, this pressure release valve may no longer function correctly, meaning that the gas cylinder may continue to increase in pressure with continued heating until the cylinder ruptures. The resulting explosion includes a pressure wave and large ball of flame which can threaten nearby life and buildings.					
11.7	**Construction Materials – Non-Structural Essential Elements**: Utilise fire/radiant heat rated products (rated to the level determined as necessary), for the construction of non-structural elements that are essential to the continued operation of the built asset and are exposed to a bushfire hazard. These include cabling and plumbing associated with power / data transmission and water / fuel transport.	High	Yes	No	No	Yes
Informative and/or Site Specific Comment/Assessment: Use non-combustible or products with high heat ratings to assist with maintaining their operability. Recommend shielding - These include cabling and plumbing associated with power / data transmission.						
11.8	**Minimise Debris and Ember Accumulation – Re-Entrant Detail**: Avoid or minimise the accumulation of unburnt debris and embers by avoiding re-entrant details and/or adopting aerodynamic forms that will self-shed windblown debris and embers. For example: • Simple building/structure footprints that avoid re-entrant corners in access ways, at wall/floor, wall/ground, roof/wall junctions and around doors, vents, windows; and • Simple roof layouts that avoid valleys and minimise the number of ridges that need protection details (e.g. skillion roofs).	High	Yes	Yes	No	Yes
Informative and/or Site Specific Comment/Assessment: The structure design and construction allow for little debris accumulation. Where the electrical cabling contacts the ground or any arrangement of associated structures creates a 'pocket' for accumulation of debris, this should be rectified by design or filling with non-combustible material such as mineral earth. Consideration should be given to making the arrangement self-cleaning through wind action to the greatest extent possible. These measures will reduce accumulation and/or make the management (clearing) of accumulated debris easier. E.g. cable raking to be 100mm above ground.						
11.9	**Minimise Debris and Ember Accumulation – Trapping Surfaces**: Avoid or minimise the use of exposed combustible surfaces that can trap and accumulate embers. These can include: • Horizontal, or shallow angle surfaces e.g. exposed wall/roof framework, roofs, decking, verandahs, steps, windowsills; and • Vertical surfaces with rough textured cladding (e.g. sawn timber).	Not Relevant	N/A	N/A	N/A	N/A

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
11.10	**Minimise Debris and Ember Accumulation – Roof Plumbing**: All roof plumbing (gutters, valleys) is protected from the accumulation of debris and embers that can result in direct fire attack mechanisms immediately adjacent to any combustible elements within the roof cavity.	Not Relevant	N/A	N/A	N/A	N/A
11.11	**Minimise Debris and Ember Accumulation – Construction Cavities**: Apply designs that lower the potential for accumulation of embers and debris within cavity spaces of buildings/structures. Examples include concrete floor slab on the ground and solid masonry walls.	Not Relevant	N/A	N/A	N/A	N/A
Informative and/or Site Specific Comment/Assessment: The battery modules are contained within simple structures without the above components.						
11.12	**Minimise Flame/Radiant Heat/Ember/Debris Entry - External Openings:** Limit potential sites for entry to internal spaces through the external envelope and combustible materials within (as consequential fire fuels).	High	Yes	No	No	Yes
11.13	**Screening and Sealing - Gaps And Penetrations**: Apply fire rated sealants and/or install metal screening (corrosion resistant steel, bronze, aluminium <2mm aperture). All external construction and penetration gaps with apertures greater than 2mm will allow ember entry (and potentially debris) to internal cavities and combustible materials within (as consequential fire fuels). This includes gaps in roofs, walls, doors, windows and their surrounding trims – including those associated with penetrations, vents, weepholes, poor workmanship and material deterioration and movement over time (maintenance). Internal fire is difficult to see and extinguish.	Moderate	Yes	No	No	Yes
Informative and/or Site Specific Comment/Assessment: The manufacturer or appropriate engineers should be contacted to enquire if it is possible to apply ember screening to intake/exhaust vents and other paths of entry to the interior cavity or accessing any combustible elements of BESS cabinets. This ember screening would be applicable to the exterior of the battery cabinet, not internal components. The intention is to prevent both ember ingress and debris accumulation. Ember screening mesh is corrosion-resistant steel, bronze, or aluminium with an aperture <2mm.						
11.14	**Screening - External Doors and Windows**: Metal screens (corrosion resistant steel, bronze, aluminium <2mm aperture) installed over non-openable and/or openable parts of windows and doors to prevent ember entry to internal spaces containing combustible materials (consequential fire fuels) and reduce radiant heat load on vulnerable surfaces.	Moderate	Yes	No	No	No
11.15	**Shutters - External Doors and Windows**: Fire rated shutters installed to significantly increase bushfire resistance of the vulnerable building elements. Any requirement for onsite manual activation is a potential limitation to effectiveness.	Moderate	Yes	No	No	No
Informative and/or Site Specific Comment/Assessment: Any doors/windows will not be open during a bushfire event.						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
11.16	**Landscaping Construction - Fences and Walls:** Non-combustible materials are used for fences, walls (including retaining walls), screens and other built structures - as potential consequential fire fuels. Where relevant, the capacity to resist high winds, to minimise potential for impact damage to subject building/structure, should also be incorporated.	Moderate	Yes	No	Partly	Yes
Informative and/or Site Specific Comment/Assessment: Any security fences or other potential fuel loads should be constructed using non-combustible material.						
PROTECTION PRINCIPLE – FIREFIGHTING CAPABILITY: Provide sufficient, reliable and bushfire resilient water supply and delivery capability as is necessary for active and/or passive systems.						
11.17	**Firefighting Water Supply**: Have a dedicated static supply of firefighting water for the protection of buildings/structures before and after the passage of a bushfire front. Adequate water supply is critical for any firefighting operation, particularly where property protection is the intent. This is necessary when: • A water supply additional to a reticulated water supply is required to counter the loss of firefighting water as a protection measure, should the reticulated supply be interrupted; • It is the only source of firefighting water. All tanks shall be non-combustible. Aside from losing water, failure of combustible tank can provide an additional heat or load to a vulnerable building element. Metal piping and fittings shall be used for any above ground components. The limitation to the effectiveness of the measure is the requirement for persons to be present and have the minimum required operational knowledge and/or access to appropriate information.	Very High	Yes	No	Yes	Yes
11.18	**Firefighting Equipment – Active Operation**: In addition to a dedicated water supply, appropriate mobile firefighting appliances are available quickly and/or fixed firefighting equipment is installed (pumps, hoses, sprinklers etc). Where equipment is installed, this will be resilient to bushfire impact, to the extent necessary, through the application of appropriate equipment materials and protection (shielding or separation from the hazard). The limitation to the effectiveness of the measure is the requirement for persons to be present and have the minimum required operational knowledge and/or access to appropriate information.	Very High	Yes	No	No	Yes
Informative and/or Site Specific Comment/Assessment: Battery Energy Storage Systems do not have an applicable firefighting water supply under the state or national requirements. A nominal supply of 50,000L would meet the planning requirements for the proposal under SPP 3.7. The State of Victoria Country Fire Authority has produced an applicable document, which is being used as the source of the appropriate water supply for the Merredin Battery project. The Design Guidelines and Model Requirements – Renewable Energy Facilities (CFA March 2022) does not lay out these specifications in a single format and some criteria are applicable to the Victorian planning system. A summary of all applicable measures to align with the document are provided below.						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Informative and/or Site Specific Comment/Assessment: The following requirements apply to the firefighting water supply. The specifications will be confirmed at the detailed design stage. Access Firefighting water access points (hydrants, hard suction, or drafting) must be clearly identifiable, visible from internal roads, and unobstructed. The water tank(s) must be located at the vehicle access point to the development (northern entry gate). An all-weather hardstand turnaround area meeting the requirements of the Guidelines for Planning in Bushfire Prone Areas v1.4 (Explanatory Note E3.3) must be provided within 4 metres of both the static water storage tank(s) and any independent hard suction points (hydrants). Site Operating Procedures must include that access routes must be unobstructed at all times. Siting The water tank(s) must be positioned >10m from BESS cabinets and associated infrastructure. The water tank(s) should apply a BAL-29 APZ at a minimum. It is possible to locate the tank within the 10kW/m2 APZ applied to BESS infrastructure such that additional vegetation clearing is not required. Construction The static firefighting water supply must be calculated per AS 2419. Based on the submitted layout the required supply will be 288,000L. This water supply is intended to address bushfire and non-bushfire emergencies. The static water storage tank(s) must be an above-ground water tank constructed of concrete or steel. An external water level indicator must be installed on static water storage tank(s) and be visible from internal roads and the adjoining turnaround area. Signage indicating 'FIRE WATER' and the tank capacity must be fixed to each tank. The hard-suction point must be protected from mechanical damage (eg. bollards) where vehicle contact is possible. Couplings at hard suction points are required to be 125mm Storz fittings (*Guidelines v1.4* s2.2.2.1). DFES Built Environment and the Merredin Volunteer Fire and Rescue Service should be contacted for input on appropriate couplings and adaptors.						
11.19	**Fire Fighting Equipment – Passive Operation:** In addition to a dedicated water supply, appropriate water dispensing apparatus are installed (e.g. pumps, plumbing and sprinklers) that are automatically activated. These will be resilient to bushfire impact, to the extent necessary, through the application of appropriate equipment materials and protection (shielding or separation from the hazard).	High	Yes	No	Yes	Yes
Informative and/or Site Specific Comment/Assessment: *The BESS units have active monitoring and electrical fault safety devices which ensure the units only remain operational within their intended operating environment, with an automated shut-down system.*						

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES		Effectiveness Rating [1]	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
*It is recommended that automatic fire suppression systems are installed and maintained, as appropriate to the BESS details and recommended by the manufacturer. This measure is not applied to reduce the vulnerability or risk posed, as the methodology for this Risk Assessment **assumes** that fire occurs.*						
11.20	**Fire Fighting Equipment – Maintain Operability:** Where water pumps, shutters or other active/passive protection measures rely on the continued supply of electricity, establish barriers (shielding) or separation from potential damaging factors (e.g. falling trees/branches, fire, or other impact sources). For example, bury transmission systems to the greatest extent possible.	Moderate	Yes	No	No	Yes
Informative and/or Site Specific Comment/Assessment: Operating and maintenance procedures are to be developed to ensure regular maintenance.						
11.21	**Firebreaks – Primarily for Access:** Installation and maintenance of firebreaks to remove vegetation, limit surface fire progression and facilitate firefighting access / backburning.	Moderate	Yes	Yes	No	No
Informative and/or Site Specific Comment/Assessment: The site is currently compliant with the Shire of Merredin Firebreak Notice.						
PROTECTION PRINCIPLE – MANAGEMENT AND MAINTAINING EFFECTIVENESS OF APPLIED PROTECTION MEASURES: To ensure the retention of the level of bushfire resilience that has been established through the implementation of appropriate bushfire protection measures, formal and enforceable responsibilities are created.						
11.22	**Formal Management/Maintenance Plan – Actions and Responsibilities:** Through a bushfire management plan, site operations emergency plan, bushfire emergency plan, operational annual works plan and/or a 'firebreak' notice, a mechanism is put in place to ensure that: • The required management and maintenance of applied bushfire protection measures is conducted on a regular basis – with the interval dependent on the necessary frequency that will maintain full effectiveness; and • The relevant protection measures are known and understood; and • Responsibilities are created The different documents will be able to satisfactorily perform this function to differing extents.	Effective	Yes	No	No	Yes
Informative and/or Site Specific Comment/Assessment: The different documents will be able to satisfactorily perform this function to differing extents.						

[1] **Protection Measure Effectiveness Rating:** Refer to section 2.3.5 for explanation and defining.

[2] **Protection Measure Application Status:**

- **Possible:** Protection measures that can potentially be applied to the proposed development/use;
- **Exists:** Protection measures already implemented by existing components of the proposed development/use. These measures are accounted for in assessing 'inherent' risk levels (refer to Glossary);

VULNERABILITY REDUCING PROTECTION MEASURES – ALL AVAILABLE MEASURES	Effectiveness Rating [1]	Application Status [2]			
		Possible	Exists	Planned	Additionally Recommend

• **Planned:** Protection measures that:
  • Are incorporated into the site plans;
  • Exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), alternative solutions and any additional recommended protection measures - for which a responsibility for their implementation has been created and approved; and/or
  • Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and are comprised of the applicable acceptable solutions (established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), that can be met and for which a responsibility for their implementation can be created in the BMP.
These planned measures are accounted for in assessing 'inherent' risk levels (refer to Glossary).
• **Additionally Recommend:** Protection measures that:
  • Exist in a yet to be submitted Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and comprise alternative solutions and/or additional recommended protection measures (that can and should be implemented in the opinion of the bushfire consultant), and for which a responsibility for their implementation can be created in the BMP; and/or
  • Are developed in the process of producing this risk assessment and management report and for which a responsibility for their implementation can be created in the BMP.
These additionally recommended measures, along with existing and planned measures, are accounted for in assessing 'residual' risk levels (refer to Glossary).					

8.4.2 NUMBER ANALYSIS OF AVAILABILITY VERSUS APPLICATION OF PROTECTION MEASURES

Table 8.14: For the stated element at risk and area of bushfire prone vegetation, the summarised number of bushfire protection measures that can be applied (and their corresponding effectiveness rating), is compared to the number available.

VULNERABILITY REDUCING PROTECTION MEASURES – SUMMARY NUMBERS						
Element at Risk	Fixed (hard) infrastructure assets					
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.					
The Protection Principle	Effectiveness Rating [1]	Numbers of Protection Measures				
		Total Available	Application Status [2]			
			Possible	Exists	Planned	Additionally Recommend
Design and Construction (Materials)	Very High	1	1	1	-	-
	High	4	4	2	-	3
	Effective	-	-	-	-	-
	Moderate	4	4	-	-	2
	Not Relevant	6	-	-	-	-
Firefighting Capability	Very High	2	2	-	1	2
	High	1	1	-	1	1
	Effective	-	-	-	-	-
	Moderate	2	2	1	-	1
	Not Relevant	1	-	-	-	-
Management and Maintaining Effectiveness of Applied Protection Measures	Very High	-	-	-	-	-
	High	-	-	-	-	-
	Effective	1	1	-	-	1
	Moderate	-	-	-	-	-
	Not Relevant	-	-	-	-	-
Total Numbers	**Very High**	**3**	**3**	**1**	**1**	**2**
	High	**5**	**5**	**2**	**1**	**4**
	Effective	**1**	**1**	**-**	**-**	**1**
	Moderate	**6**	**6**	**1**	**-**	**3**
	Not Relevant	**7**	**-**	**-**	**-**	**-**
	Totals	**22**	**15**	**4**	**2**	**10**

[1] Protection Measure Effectiveness Rating: Refer to section 2.3.5 for explanation and defining.

[2] Protection Measure Application Status: Refer to table footnotes on previous page.

8.4.3 ASSESSED IMPACT OF APPLIED PROTECTION MEASURES (VULNERABILITY REDUCTION)

Table 8.15: For the stated element at risk, The potential impact of the applied protection measures in reducing vulnerability levels to the stated area of bushfire prone vegetation.

ASSESSED IMPACT OF APPLIED MEASURES (VULNERABILITY REDUCTION)								
Element at Risk	Fixed (hard) infrastructure assets							
Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.							
Vulnerability Reducing Protection Measures Applied to Assessment [1]	The Bushfire Hazard Threats [2]							
	Direct Attack Mechanisms				Indirect Attack Mechanisms			
	Embers	Radiant Heat	Flame	Surface Fire	Debris Accumulation	Consequential Fire	Fire Driven Wind	Tree Strike / Obstruction
Existing and Planned (applied to inherent risk)	Medium	Medium	Medium	Medium	Medium	Medium	N/A	N/A
	Medium				Medium			
Existing, Planned and Recommended (applied to residual risk)	Very Significant	Very Significant	Significant	Significant	Significant	Significant	N/A	N/A
	Very Significant				Significant			

[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3

[2] Refer to Appendix 4 for explanatory information.

Assessment Comments:

The most significant of the available vulnerability reducing protection measures are associated with:

- Ensuring that the design and construction of the BESS units and associated structures can limit locations for accumulation of debris and facilitates self-cleaning by the wind;
- Ensuring that the design and the materials used in the construction of any structures adjacent to the BESS units and associated infrastructure are non-combustible to the greatest extent possible, to remove the threat of consequential fire from this source; and
- Having firefighting resources available (reticulated supply, hydrant and tank) to extinguish consequential fires and cool battery cabinets.
- Having the BESS units fitted with active monitoring and electrical fault safety devices which ensure the units only remain operational within their intended operating environment, with an automated shut-down system.

The package of protection measures play a significant role in changing the vulnerability of the Merredin Battery infrastructure.

8.4.4 ASSESSED VULNERABILITY LEVELS

Assessed as a function of the capacity to apply sufficient vulnerability reducing protection measures, their individual effectiveness and their combined impact in reducing the vulnerability of the identified element at risk (Note: This assessment is independent of the threat level and exposure level assessments).

Table 8.16: For the stated element at risk, the assessed exposure level corresponding to the stated area of bushfire prone vegetation.

ASSESSED VULNERABILITY LEVELS	
Element at Risk	Fixed (hard) infrastructure assets

Vegetation Area / Location	All bushfire prone vegetation within the subject lots, and within 150m of the proposed development.
Vulnerability Reducing Protection Measures Applied to Assessment [1]	Relative Vulnerability Level [2]
Existing and Planned (applied to inherent risk)	Moderate
Existing, Planned and Recommended (applied to residual risk)	Low
[1] Corresponds to the stage of risk level being reported i.e. inherent or residual. Refer to Section 2.3.3 [2] Refer to Appendix 2 for explanatory information.	

Assessment Comments: The Merredin Battery as the element at risk is not vulnerable to the impacts of radiant heat and flame contact. The protection measures available to reduce the Merredin Battery vulnerability are robust and materially address the direct attack mechanisms of bushfire.
Consequently, for this scenario, considering the bushfire protection measures, the relative residual vulnerability level is Low.

APPENDIX 1: RATIONALE FOR THE SELECTION OF THE APPLIED RISK ASSESSMENT PROCESS

The following information regarding the selection and adaptation of the risk assessment process applied in this report is presented to help inform persons tasked with understanding this report.

KEY DRIVERS

Bushfire Prone Planning has considered the following key drivers in determining the most appropriate risk assessment process to apply:

1. **The relevant hazard types.**

   Bushfire hazards are a natural hazard rather than a human-induced hazard (refer to glossary and see limitations of ISO 31000 in the next section). Natural processes and phenomena present unique types of threats.

   Consequently, the assessment process needs to be able to specifically deal with the unique characteristics of bushfire hazards in a way that derives meaningful risk-based information that can be readily interpreted and applied.

   A logical framework is needed around which the development of bushfire protection measures (risk treatments) can be constructed, assessed and understood by those tasked with making decisions based on the provided information.

2. **The relevant risks to be addressed.**

   The specific risks are limited to the potential loss of life, injury, or destroyed or damaged assets that are associated with a bushfire hazard. These originate from the hazard's direct and indirect bushfire attack mechanisms and the response of persons and property to these threats.

3. **The complexity and/or scale of proposed development/use.**

   For different development/use proposals, there are significant differences in the types of information required for the hazard risk assessments and the derivation of operationally useful information that is to be applied to mitigating the associated risks.

   These differences include scale e.g. from development or activities on a single lot to development or activities within a region.

   Also, different uses may be able to tolerate different levels of risk. For example the Guidelines v1.4 cl 5.5.2 establish that "different tourism land uses … may require different levels of risk management".

   Consequently, the applied risk management process needs to be able to accommodate these differences and remain both logical, useable and efficient to compile. It needs to be capable of being relatively easy to scale up or down to provide a relevant and actionable report.

LIMITATIONS OF ISO 31000:2018 AND NERAG

The approach adopted by Bushfire Prone Planning (BPP) contrasts with the typical approach historically used in various Australian jurisdictions. This historical approach conducts the risk management process by applying the *National Emergency Risk Assessment Guidelines (AIDR 2020, NERAG)*.

However, the considered view of BPP is that the *NERAG* approach is unable to effectively provide (a) the required assessment methodology for assessing risk associated with a bushfire hazard or (b) evaluate the impact of specific bushfire protection measures - to the level of detail and relevance required for the planning of development and uses. That is, the key drivers determining the suitable methodology cannot be satisfied.

It is not practical to fully justify the above statement here, but the following is noted:

The determination of pre and post treatment risk levels is a key objective of NERAG. These are determined as the product of consequence and likelihood ratings. These ratings have the following inherent weaknesses in meeting the risk assessment requirements for a natural bushfire hazard:

1. Consequence ratings are derived from a set of established qualitative and quantitative criteria - which are very broad based and have less relevance at smaller scales of development/use. No direct link between the application of a risk treatment(s) and how they can justifiably be assessed as being able to alter a consequence level is established; and

2. Likelihood ratings of both the emergency event and the consequences are difficult to separate. They are derived from a set of established quantitative (probability) criteria. They also typically look backward and not forward and their determination is problematic with respect to sourcing relevant and sufficient data.

   Varying the levels of likelihood has limited applicability when the pragmatic requirement is to assume an emergency event will occur. The level of risk to which the at risk elements are exposed and vulnerable when a bushfire does occur, should have the most relevance to planning its location, design and construction, or allowing it.

   The determination of level of relevant risks by relying on the accuracy and relevance of the probability of the bushfire occurring should be given much less weighting. A more robust reduction in risk will result from being protected by something more physical/tangible than probability.

Also relevant is that the *NERAG* state they are "primarily focussed on assessing emergency risks" and that they are "structured to align broadly with relevant sections of *ISO 31000:2018 – Risk Management Guidelines*".

ISO 31000:2018 states that its intended use is "... to provide guidelines on managing risk faced by organisations".

The key point is that organisational risk is derived from a 'human-induced hazard' rather than a natural hazard (refer to the glossary). However, it is the bushfire natural hazard that is the source of risk being addressed by requirements established by SPP 3.7 and the associated Guidelines.

Consequently, it is BPP's considered opinion that applying *ISO 31000:2018* and *NERAG* (in its current form) to assessing risk associated with a bushfire hazard has significant application and relevance limitations.

THE APPLIED ADAPTED RISK ASSESSMENT APPROACH

In acknowledging the key drivers, and the limitations of the risk management process developed by ISO 31000 and adapted by NERAG, Bushfire Prone Planning has adapted the understanding of disaster risk that is used by the United Nations Office for Disaster Risk Reduction (UNDRR).

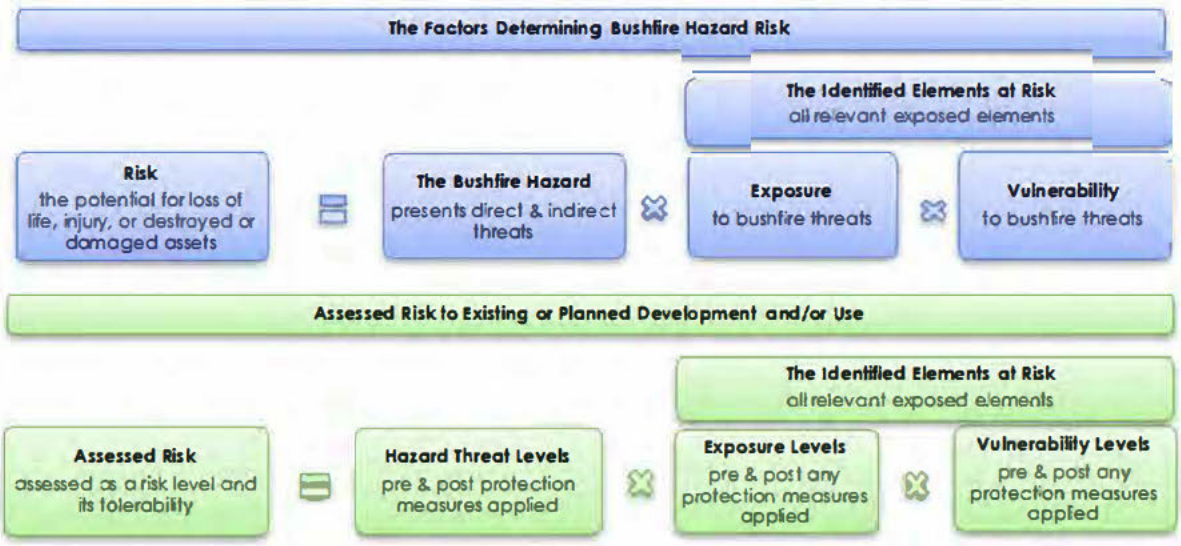
Although the UNDRR approach is designed to addresses disaster risk at large scale strategic levels, it can justifiably be applied to all scales of planning because it is focused on natural hazards and establishes a concept that can be readily adapted.

The risk assessment report that is developed applying this process presents relevant, logical, comprehensive and practical facts, to appropriately inform those persons tasked with either:

- Planning the siting, design, construction and management of development/use to ensure an appropriate level of bushfire resilience is achieved and limiting associated risks to tolerable levels; or
- With making pragmatic planning approval decisions.

The Figure below (copy of Figure 2.3) illustrates the framework of the adapted risk assessment process (refer to the glossary for terminology information and Appendix 2 provides greater detail of the risk analysis component of the assessment process).

THE FRAMEWORK OF BUSHFIRE PRONE PLANNING'S APPLIED RISK ASSESSMENT PROCESS



APPENDIX 2: RISK LEVEL ANALYSIS – ADDITIONAL EXPLANATION

INDICATIVE RISK LEVELS

Justification for reporting indicative risk levels is based on the following factors:

1. There is a finite 'universe' of bushfire protection measure principles that can be applied to reducing hazard threats and the exposure and vulnerability of at risk elements;
2. There will be a range of development/use specific protection measures associated with each protection measure principle. The number of available protection measures will vary dependent on the type and scale of development/use, but effectively there will also be a practical limit; and
3. Bushfire protection measures will vary in their standalone effectiveness at mitigating risk (refer to section 2.3.5);

Consequently, an indication of the level of risk – for a given development/use - can be gained by:

1. Assessing 'relative' threat levels.
2. Deriving 'relative' exposure and vulnerability levels by:
    a) Assessing how many protection measure principles and associated measures are applicable and can be applied;
    b) Assessing the relative effectiveness of each protection measure; and
    c) Comparing the numbers of applied protection measures with the number of possible measures in the protection measure 'universe'.
3. Making a qualitative assessment of the potential impact of the applied protection measures (including appropriate weighting given to their individual effectiveness) that can reduce the relative threat, exposure and vulnerability levels.
4. Derive the indicative risk level by applying the risk matrix shown as Table A2.1 and establish the tolerability of the risk by applying the risk tolerance scale of Table A3.2, Appendix 3.

Providing an indicative risk level establishes a qualitative understanding of the level of risk that potentially exists and is intended to inform and assist with making various planning decisions.

Deriving indicative risk levels is essentially a compilation and assessment of physical facts rather than determinations of what is to constitute different levels of threat, exposure and vulnerability and subsequently intolerable, tolerable and acceptable levels of risk for every development/use scenario.

An indicative risk level can be derived from an assessment of the site, the planned development/use and the knowledge and experience of the bushfire practitioner – such that an opinion can be provided regarding risk levels.

DETERMINED RISK LEVELS

Reporting determined risk levels will require reference information being available to the assessor so that 'determined' levels of threat, exposure and vulnerability can be established (this contrasts with the 'relative' levels required in deriving an indicative risk level).

The required reference information are the risk factor criteria, the risk level matrix and the risk tolerability scale.

Risk Factor Criteria

The required risk factor criteria will establish:

- What factors are to define the different 'determined' levels of hazard threats;
- What factors are to define the different 'determined' levels of exposure of elements at risk; and
- What factors are to define the different 'determined' levels of vulnerability of elements at risk.

Risk Level Matrix

The matrix will establish how the 'determined' levels of threat, exposure and vulnerability are to be applied in deriving the 'determined' risk level. Different sets of matrices to account for different development types, uses and scales will be required. The rationale for this statement includes:

- Different development types, uses and scales are potentially capable of tolerating different levels of risk and still be considered by the relevant authority (who are reflecting the understood society/community position), to remain acceptable;
- Recognition that different levels of risk can be tolerated by different development, use and scale is indicated in the Guidelines v1.4 where cl 5.5.2 establishes that "different tourism land uses ... may require different levels of risk management"; and
- To account for the variation, one risk level matrix could establish a moderate determined risk level for a given development type/use/scale and combination of threat, exposure and vulnerability levels.

  For the same combination of threat, exposure and vulnerability levels but for a different development type/use/scale, a different risk level matrix could establish an extreme determined risk level; and

Risk Tolerance Scale

After the 'determined' risk level has been derived from the risk assessment process, a methodology is required to classify the risk level as either unacceptable, tolerable or acceptable. Currently Bushfire Prone Planning is applying the ALARP principle and associated risk tolerance scale (refer to Appendix 3).

The Current Limitations to Deriving a Determined Risk Level

The required reference information (i.e. the risk factor criteria, sets of risk matrices and the risk tolerance scale) is necessarily required to be provided by the relevant regulatory authorities /decision makers. The rationale for this statement is:

1. The information must reflect the expectations and understanding and accepting of risk as held by society and communities, and directed through its governing bodies;
2. The information must be standardised to the greatest extent possible so that it provides an acceptable and trusted basis on which the determined risk level can be derived and be relied upon in making decisions.
3. Properly establishing the reference information cannot be justifiably relegated to individual assessors with varied expertise, qualification and without any approved responsibility to provide such information. Their expertise might more appropriately be utilised in assisting the responsible authorities to establish the information.

Where the required reference information has not been established and provided by the responsible authorities, determined risk levels cannot be the final outcome when using this risk assessment process. Currently, this reference information does not exist.

HOW THE LIKELIHOOD OF A BUSHFIRE EVENT OCCURRING HAS BEEN DEALT WITH

The approach taken with the applied risk assessment process is to apply the pragmatic assumption that a bushfire will occur. It is assumed it can occur within any timeframe and could result in loss or life or injury, or unacceptable damage to property and or unacceptable disruption to services. This approach accepts that the requirements for fire of fuel, ignition source and oxygen will always exist. That is:

- The fire fuels being considered will always be there unless physically removed permanently;
- A potential ignition source will always exist through lightning and/or human activities; and
- The potential for adverse fire weather conditions to exist at some point within each year will always be present.

This contrasts with applying a quantitative approach based on the historical record of past bushfire event and determining the mathematical probability of a future event. This approach is problematic to achieving increased bushfire resilience at all stages of existing or proposed development/use for these reasons:

- Historical data may not be available or have enough data sets to be accurate. It cannot account for future changes in climate that may result in a different occurrence period. Consequently, further assumptions need to be made;
- Siting, design and construction of development to resist bushfire threats is much easier, more practical (and likely economical), to incorporate at initial planning stages rather than the retro-establishment of protection measures when circumstances change or tolerance of risk decreases;

- Time spent conducting historical research, performing statistical calculations and modifying risk levels, apart from being costly, is likely better spent assessing potential threat, exposure and vulnerability levels and developing appropriate protection measures; and
- The likelihood of occurrence cannot modify the levels of hazard threats, exposure or vulnerability. It can only be applied to reduce the overall risk level. That is, it would be applied as a modifying factor via the established risk level matrix and not the established risk factor criteria. The validity of incorporating such a factor may be indicated when, despite the existence of vegetation that can burn, there are other mitigating physical conditions that exist at the specific site that make the likelihood of ignition and severity of bushfire behaviour very low. How this is applied would need to be established by the authority establishing the relevant risk level matrix.

Table A2.1: Risk matrix for deriving indicative risk levels from the assessed relative levels of threat, exposure and vulnerability.

INDICATIVE RISK LEVEL MATRIX						
Relative Threat Level (a)	**Relative Exposure Level (b)**	**Relative Vulnerability Level (c)**				
		Very Low (1)	**Low (2)**	**Moderate (3)**	**High (4)**	**Extreme (5)**
Very Low (1)	**Very Low (1)**	VL1	VL2	VL3	L4	L5
	Low (2)	VL2	VL3	L4	L5	L6
	Moderate (3)	VL3	L4	L5	L6	M7
	High (4)	L4	L5	L6	M7	M8
	Extreme (5)	L5	L6	M7	M8	H9
Low (2)	**Very Low (1)**	VL2	VL3	L4	L5	6
	Low (2)	VL3	L4	L5	L6	M7
	Moderate (3)	L4	L5	L6	M7	M8
	High (4)	L5	L6	M7	M8	H9
	Extreme (5)	L6	M7	M8	H9	H10
Moderate (3)	**Very Low (1)**	VL3	L4	L5	L6	M7
	Low (2)	L4	L5	L6	M7	M8
	Moderate (3)	L5	L6	M7	M8	H9
	High (4)	L6	M7	M8	H9	H10
	Extreme (5)	M7	M8	H9	H10	H11
High (4)	**Very Low (1)**	L4	L5	L6	M7	M8
	Low (2)	L5	L6	M7	M8	H9
	Moderate (3)	L6	M7	M8	H9	H10
	High (4)	M7	M8	H9	H10	H11
	Extreme (5)	M8	H9	H10	H11	E12
Extreme (5)	**Very Low (1)**	L5	L6	M7	M8	H9
	Low (2)	L6	M7	8M	H9	H10
	Moderate (3)	M7	M8	H9	H10	H11
	High (4)	M8	H9	H10	H11	E12
	Extreme (5)	H9	H10	H11	E12	E13

Indicative risk level key: VL = very low, L = low, M = moderate, H = high, E = extreme.
The qualitative relative levels are assigned a numerical value.
The indicative risk value is calculated as = (a + b + c) – 2 and range from 1 (lowest) to 13 (greatest).
The indicative risk levels are derived from an assigned a numerical range: very low = 1-3, low = 4-6, moderate = 7-8, high = 9-11, extreme = 12-13.

APPENDIX 3: THE ALARP PRINCIPLE AND THE RISK TOLERANCE SCALE APPLIED

The following information is intended to provide an understanding of the ALARP principle and provide justification for its application in this risk assessment report.

THE ALARP PRINCIPLE

The As Low as Reasonably Practicable (ALARP) principle is based on the belief it is not possible to completely eliminate all risk involved, there will always be a certain level of risk remaining known as residual risk. The term is used to express the expected level of residual risk within a system, activity or, relevant to this document, within a proposed development/use, when good practice, judgement and duty of care are applied to decisions and operations.

The origins of the ALARP (As Low as Reasonably Practicable) principle are from United Kingdom case law and their regulatory framework. It is applied by their Health and Safety Executive (HSE) and is used by regulators and companies around the world as it provides a logical basis for managing risks – including its adaption for use in the following Australian guidelines:

- Australian Institute for Disaster Resilience, 2020; Land use Planning for Disaster Resilient Communities;
- WA Department of Mines, Industry Regulation and Safety, 2020; Petroleum safety and major hazard facility – guide. ALARP demonstration;
- NOPSEMA (Australia's offshore energy regulator), 2020; ALARP and risk assessment guidance notes;
- Department of Planning Lands and Heritage (DPLH), 2019; Coastal hazard risk management and adaptation planning guidelines;
- Planning Institute of Australia, 2015; National Land Use Planning Guidelines for Disaster Resilient Communities; and
- NERAG 2010, an earlier version of NERAG 2020, applied the ALARP Principle.

The ALARP principle has been defined by the United Kingdom Health and Safety Executive (HSE-UK, 2001) to depict the concept that efforts to reduce risk should be continued until the incremental cost in doing so is grossly disproportionate to the value of the incremental risk reduction achieved (see figure). Incremental cost is defined in terms of time, effort, finance or other expenditure of resources – including loss of natural resources. Usually, each incremental reduction in risk will require a greater expenditure of resources.

This concept is depicted in Figure A3.1 where the triangle represents the decreasing risk and the diminishing proportional benefit as risk is reduced. There are also three regions shown in the figure into which general levels of residual risk can fall. The residual risk should fall either in the broadly acceptable region, or near the bottom of the tolerable region. This approach allows higher levels of safety to be provided where it is feasible.

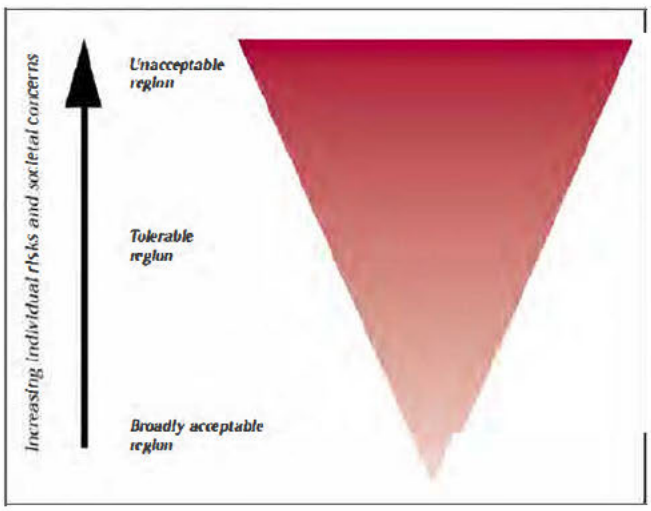


Figure A3.1: HSE framework for the tolerability of risk (source: HSE-UK, 2001)

Moving up the triangle from the region considered broadly acceptable, through a tolerable region (for which a greater range of risk can be considered), to an unacceptable region, represents increasing levels of 'risk' for a particular hazard or hazardous activity (determined through relevant risk analysis). Table A3.1 describes the risks that define each region.

Table A3.1: The risks associated with the risk tolerance regions (adapted from HSE-UK, 2001)

THE ALARP PRINCIPLE – DEFINING THE REGIONS OF RISK TOLERANCE	
Unacceptable Region	For practical purposes, a particular risk falling into this region is regarded as unacceptable whatever the level of benefits associated with the activity. Any activity, practice or use of land giving rise to risks falling in this region would, as a matter of principle, be not approved unless the activity or practice can be modified to reduce the degree of risk so that it falls in one of the regions below, or there are exceptional reasons for the activity, practice or use to be retained.
Tolerable Region	Risks in this region are typical of the risks from activities that people are prepared to tolerate in order to secure benefits, in the expectation that: • The nature and level of the risks are properly assessed, and the results used properly to determine control measures. The assessment of the risks needs to be based on the best available scientific evidence and, where evidence is lacking, on the best available scientific advice; • The residual risks are not unduly high and kept as low as reasonably practicable. This is the region to which the ALARP principle applies; and • The risks are periodically reviewed to ensure that they still meet the ALARP criteria, for example, by ascertaining whether further or new control measures need to be introduced to take into account changes over time, such as new knowledge about the risk or the availability of new techniques for reducing or eliminating risks. • In practice and where possible, the intent should be that residual risk continues to be driven down the tolerable range so that it falls either in the broadly acceptable region or is near the bottom of the tolerable region, in keeping with the duty to ensure health, safety and welfare so far as is reasonably practicable as per the ALARP principal.
Broadly Acceptable Region	Risks falling into this region are generally regarded as insignificant and adequately controlled. Regulators would not usually require further action to reduce risks unless reasonably practicable measures are available. The levels of risk characterising this region are comparable to those that people regard as insignificant or trivial in their daily lives. They are typical of the risk from activities that are inherently not very hazardous or from hazardous activities that can be, and are, readily controlled to produce very low risks.
Note: The risk tolerability framework is a conceptual model. The factors and processes that ultimately decide whether a risk is unacceptable, tolerable or broadly acceptable are dynamic in nature and are sometimes governed by the particular circumstances, time and environment in which the activity, practice or use occurs or is proposed. Standards change and public expectations vary between societies and change with time.	

RISK TOLERANCE SCALE

The application of a risk tolerance scale is necessary to:

1. Identify which exposed elements must be given priority for the development and application of bushfire protection measures; and

2. Where planning approval is being sought, identify if the determined residual risk levels can be considered as tolerable or acceptable and therefore capable of being approved for this factor, or not.

The risk tolerance scale to be applied within the risk assessment report, when the required risk factor criteria and risk level matrix are available, is established in Table A3.2.

Table A3.2: The applied risk tolerance scale

APPLIED RISK TOLERANCE SCALE - INCORPORATING THE ALARP PRINCIPLE			
Indicative / Determined Risk Level	**Tolerability Description and Action Required**		**Risk Tolerance Level[1]**
Extreme	The risks are unacceptable and require immediate implementation of risk management measures to eliminate or reduce risk to tolerable or acceptable levels. Proposed development giving rise to risks in this region would not be approved unless there are exceptional reasons for the development to proceed.		**Unacceptable**
High	The risks are the most severe that can be tolerated but not unduly high. They require monitoring in the short term as risk management measures are likely to be needed in the short term given the intent should be to drive residual risk lower down the tolerable range where possible.	**Tolerance Regions Subject to ALARP Principle**	**Intolerable** - if not ALARP- **Tolerable** - if ALARP -
Moderate	The risk is approaching an acceptable level. It can be tolerated and requires monitoring in the short to medium term. Need to consider potential changes over time in the risk and/or techniques for reducing/eliminating risk. Risk management measures may be needed to reduce risk to more acceptable levels where possible – or accept the risk.		**Tolerable** - if not ALARP - **Acceptable** - if ALARP -
Low **Very Low**			**Acceptable**
[1] Refer to the glossary for definitions of the tolerance levels.			

APPLICATION JUSTIFICATION

The following is taken from the 'National Land Use Planning Guidelines for Disaster Resilient Communities' (Planning Institute of Australia, 2015) and is also referred to in the document 'Land use Planning for Disaster Resilient Communities' (Australian Institute for Disaster Resilience, 2020).

> *Of relevance to planners in the NERAG is the ALARP principle and how it is used in evaluating risks. According to NERAG, the ALARP principle is applied to define boundaries between risks that are generally intolerable, tolerable or broadly acceptable. The ALARP principle will help to prioritise a risk hierarchy and determine which risks require action and which do not. Those that are broadly acceptable naturally require little, if any, action while risks that are at an intolerable level require attention to bring them to a tolerable level.*
>
> *According to NERAG, it is entirely appropriate and accepted practice that risks may be tolerated, provided that the risks are known and managed.*

The ALARP principle is particularly relevant to planners and other built environment professionals as it provides the means to categorise risks according to their severity, and to assign risk treatment options accordingly.

It is important to note that the effect each hazard has on a community and its settlement is different, and therefore land use planning and building responses may not always be appropriate to treat the risk borne by a particular hazard. Equally, the effectiveness or strength of response provided by land use planning or building may not be sufficient to fully address the risk.

In addition, it is likely that through a normal natural hazard management process a range of treatment measures will be proposed, tested and implemented to provide a comprehensive approach to risk treatment that may involve other measures working in concert with land use planning or building responses.

The manner in which land use planning and building responses are deployed to treat specific instances of natural hazard risk will vary depending on location, information availability, community views, broader development intent for the settlement under analysis and the effect of complementary risk treatment measures.

However, the ALARP principle provides a good reference for demonstrating the land use responses for the various ALARP risk categories. Generally speaking, in areas of intolerable risk the strongest land use planning and building responses should apply. Conversely, in areas of acceptable risk only minimal controls should apply, if at all.

The most complex risk category for which to prescribe treatment from a land use and building perspective is those areas of tolerable risk. Such risks in existing settlements may not be sufficiently concerning to warrant severe use restrictions or relocation, however they will need treatment over time to ensure the risk does not increase. Treatment options in this instance may include limiting vulnerable uses in this area, restricting significant intensification of development, and promoting resilient urban design. Such areas of tolerable risk are also best avoided from a greenfield perspective to limit increases in future risk and costs associated with infrastructure failure in these locations that could otherwise been avoided.

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APPENDIX 4: THE BUSHFIRE HAZARD – BEHAVIOUR AND ATTACK MECHANISMS

FACTORS INFLUENCING BUSHFIRE BEHAVIOUR

There are three primary factors that influence the intensity, speed and spread of a bushfire. Any increase in these behaviours will result in greater threat levels, to exposed elements, from the bushfire attack mechanisms.

1. **VEGETATION AND OTHER FUELS:** Key characteristics that will influence fire behaviour include:
    - **Fuel size and shape** – anything less than 6mm diameter/thickness is considered a fine fuel and will ignite and burn quickly. Larger/heavier fuels take longer to ignite but burn for longer, so the threat exists for longer;
    - **Fuel load** – the quantity of available fuel (t/ha) will influence the size of the fire. In particular it is the fine fuel load that determines the intensity of the bushfire and the flame sizes. Vegetation type and period over which it can accumulate will determine fuel loads;
    - **Vegetation type** – this influences the size, shape and quantity of available fuels. For bushfire purposes vegetation types include the classifications of forest, woodland, scrub, shrubland and grassland (with total fuel loads typically decreasing in that order);
    - **Fuel arrangement** – will influence two factors of fire behaviour (1) the speed and intensity of burning and (2) how much of the total fuels are likely to be involved in the fire simultaneously. The first factor is a function of how densely packed or aerated the fuels are with the more available arrangement burning with greater intensity. The second factor is a function of the availability of 'ladder' fuels (i.e. near surface, elevated and bark fuels) to carry fire up the vegetation profile, and the continuity of fuels to carry the fuel across the land; and
    - **Fuel moisture content** – drier fuels will ignite easily and burn quickly. The inherent moisture content of the vegetative fuels is a function of the vegetation type and arrangement and/or the positioning of the vegetation complex near readily available sources of moisture.

    Greater quantities of finer, dryer, aerated and connected fuels will result in more severe behaviours and elevated bushfire threat levels. Large extents of vegetation (broader landscape scale) can have additional implications for the development of extreme bushfire events and the consequent increase in bushfire threat levels (refer to Appendix 5 for additional information).

2. **WEATHER:** Adverse fire weather that results in more severe behaviours and elevated threat levels includes strong winds, high temperatures, low relative humidity and extended periods of these factors.

    Weather events at the broader landscape scale can have implications for the development of extreme bushfire events and consequent increase in bushfire threat levels (refer to Appendix 5 for additional information).

3. **TOPOGRAPHY:** The physical terrain can influence the severity of fire behaviour. At a local scale, it is the influence of ground slope on the rate a fire spreads, that is most relevant. Fire travels faster up slopes (rule of thumb is a doubling of speed for every 10 degrees increase in slope). Greater rates of spread increase fire intensity and the resultant threat levels.

    At the broader landscape scale, the impact of topography can be significant and includes establishing the potential for development of certain dynamic fire behaviours that can lead to extreme bushfire events and elevated threat levels (refer to Appendix 5 for additional information).

BUSHFIRE DIRECT ATTACK MECHANISMS

EMBER ATTACK: Ember attack is the most common way for structures to ignite in a bushfire. Scientific research indicates that at least 80% of building losses from past Australian bushfires can be attributed to ember/firebrand attack (mostly in isolation but also in combination with radiant heat), and the resultant consequential fires. (Leonard J.E. et.al; 2004 – Blanchi R. et.al. 2005 - Blanchi R. et.al. 2006).

Embers are the primary ignition source for consequential fire:

- They accumulate around and on vulnerable parts of structures (roofs, gutters, doors, windows, re-entrant corners)
- They enter gaps in structures envelopes to vulnerable internal cavities and spaces.
- They ignite surface materials such as walls and decks and any accumulated vegetative debris.

Embers can attack structures for a significant length of time before and after the passage of the fire front, as well as during. This potential length of exposure is an important factor in the consideration of the level of threat embers present.

An ember is a small particle of burning material that is transported in the winds that that accompany a bushfire (larger particles can exist as firebrands from certain vegetation types). Typically these consist of plant materials such as bark, leaves and twigs that exist as part of the standing vegetation or has collected or been placed on the ground.

Of the plant materials, bark is the predominant source of embers but built timber elements will also produce embers.

Bark is the primary source of embers and spotting in Australian eucalypt forests due to the key attributes of ease of ignition, extended burnout time and the favourable size to weight ratio and aerodynamic properties. Differences in these attributes strongly influence the spotting potential from different forest types – and therefore the potential hazard rating of the bark.

The type of tree bark will determine the size, shape and number of embers/firebrands which, along with the prevailing fire behaviour and weather conditions will dictate the spotting distances and density of ignitions.

Fine fibrous barks - including stringybarks (e.g. jarrah), have loosely attached fibrous flakes and can produce massive quantities of embers (prolific spotting) for shorter (up to 0.75 km) and medium distances (up to 5 km).

Short distance spotting (including ember showers) are generally the result of embers and firebrands blown directly ahead of the fire with little or no lofting. Density tends to decrease with distance from the fire front.

Medium distance spotting results from embers and firebrands that are lofted briefly in a convection column or blown from an elevated position (e.g., from tree tops on ridges). With sufficient density and coalescing spot fires, this can rapidly increase the size of a fire (deep flaming) leading to dynamic fire behaviours and extreme fire events.

Ribbon/candle type barks - have longer burnout time, extended flight paths and are more likely to be responsible for longer distance spotting > 5 km (with up to 30 km having been authenticated). This results from significant lofting of large firebrands (e.g. curled hollow tubes of bark that can burn for 40 minutes) in well-developed convection columns. These develop as separate, independent fires. Very long distance spotting requires intense fire, maintenance of a strong convection column (to lift firebrands aloft) and strong winds aloft (to transport the firebrands).

Other bark types - that include coarsely fibrous (e.g. marri) / slab or smooth / platy and papery barks - produce lower quantities of embers and shorter distance spotting. Their highest bark hazard ratings that are lower than fine fibrous or ribbon barks.

(Sources: CSIRO Climate and Disaster Resilience Report 2020 and Overall Fuel Hazard Assessment Guide 4th edition July 2010, Victoria DSE and Cruz, MG (2021) The Vesta Mk 2 rate of fire spread model: a user's guide. CSIRO).

The importance of establishing protection measures to mitigate the potential impact of consequential fire ignited by the ember attack mechanism, cannot be overstated.

RADIANT HEAT ATTACK: This heat radiates in all directions from a bushfire and can potentially be felt hundreds of meters away. The amount of heat that a flame can transfer to other objects is influenced by the flame size and its temperature. These are a function of the characteristics of the fuels being burnt including fuel size, dryness, structure, arrangement and quantity. The bushfire is additionally influenced by the weather and topography factors that can intensify fire behaviour (described at end of this section).

Radiant heat:

- Can damage or destroy elements that are vulnerable to higher levels of heat;
- Can dry and heat vegetation and other fuels (combustible materials such as timber) to a temperature at which they ignite or are more easily ignited by existing flames or embers; and
- Is an extremely significant threat to people when they are not physically shielded. Protective clothing can provide only limited protection.

BUSHFIRE FLAME ATTACK: When flames make contact with structures they can flow over, under and around – impacting surfaces not directly facing the bushfire.

Flames will be longer when fine fuel loads are higher and will move faster up slopes and generally, slower down slopes.

Flame temperatures are highest in the lower parts of the flame and decrease towards the tip. The flame has two distinct regions - the lower solid body flame and the upper part that is a transitory flame (intermittently present). Both flame regions can damage structures.

Note: AS 3959:2018 *Construction of buildings in bushfire prone areas*, establishes both the construction requirements corresponding to each Bushfire Attack Level (BAL) and the methodology for determining a BAL. For a bushfire modelled using this methodology, the derived flame length only provides an estimate of the solid body flame length.

SURFACE FIRE ATTACK: These are low intensity fires (less than 0.5m high) burning along the ground consuming mostly intermittent fine fuels such as vegetation debris, litter, and mulches. They are typically patchy and erratic in their direction and short lived (<40 seconds) when burning in the absence of heavier fuels.

Typically these fires will be on the land immediately surrounding buildings and associated structures and other heavy fuels. Their importance as a threat is the bringing of direct flame contact, higher radiant heat and embers closer to these exposed elements.

BUSHFIRE INDIRECT ATTACK MECHANISMS

DEBRIS ACCUMULATION: The relevant debris are combustible fine fuels that can accumulate (by falling or being windblown) in close proximity to subject structures and their surrounding structures and other heavy fuels. This makes the burning of these structures/fuels much easier and more likely through the ignition of the accumulated debris by ember attack.

This debris can accumulate over long time periods (years) in locations such as:

- On horizontal or close to horizontal surfaces and rough timber surfaces;
- Within re-entrant corners and roof gutters/valleys;
- Against vertical surfaces; and
- Within internal spaces /cavities and under sub-floors when gaps are present.

The potential threat level will be determined by:

- The presence of vegetation types that produce quantities of debris with those that produce in the driest and hottest part of the year presenting a greater threat;
- The extent of this vegetation; and
- The proximity of this vegetation to the exposed and vulnerable structures.

CONSEQUENTIAL FIRE:

Consequential fire is the burning of vulnerable (combustible/flammable) materials, items and structures that exist within the area surrounding the subject building or structure – the surrounding vulnerable elements.

The burning of these surrounding vulnerable elements can result in the subject building/ structure being exposed to the direct fire attack mechanisms (threats) of flame, radiant heat, embers and surface fire from a close distance.

These are threats that are separate from and additional to the threats generated by the bushfire front itself - which can be and often is, a considerable distance away.

The importance of establishing protection measures to mitigate the potential impact of consequential fire cannot be overstated.

Consequential fire fuels consist of both fine and heavy fuels.

Fine fuels:

- Dead plant material such as leaves grass, bark and twigs thinner than 6mm (or live material less than 3mm thick that can be consumed in a fire involving dead material); and
- Originate from the indirect bushfire attack mechanism of 'debris accumulation' and potentially from other areas of landscaped vegetation.

Heavy and Large Heavy Fuels:

- **Stored combustible / flammable items:**
    - Building materials, packaging materials, firewood, sporting/playground equipment, outdoor furniture, matting, rubbish bins etc;
    - Large quantities of dead vegetation materials stored as part of site use;

- Liquids and gases; and
- Vehicles, caravans and boats, etc.

- **Constructed combustible items**:
  - Surrounding landscaping items - fences/screens, retaining walls, gazebos, plastic water tanks etc;
  - Attached structures - decks, verandahs, stairs, carports, garages, pergolas, patios, etc;
  - Adjacent structures - houses, sheds, garages, carports, etc. Structure to structure fire is a common cause of overall building loss in post bushfire event assessments [9].

FIRE DRIVEN WIND: Severe bushfires are commonly accompanied by high winds due to the prevailing weather conditions. Localised high winds can be induced by the bushfire. When the required factors exist, the bushfire can couple with the atmosphere (pyro-convective) resulting in extreme bushfire events and gusty, severe windspeeds.

These winds can directly damage the external envelope of a building or structure by pressure (low and high) or the carriage of varying types of solid debris. This provides openings for other bushfire attack mechanisms to enter and ignite internal cavities.

TREE STRIKE/OBSTRUCTION: Branches or trees, subject to strong winds and/or tree burnout, can:

- Damage the envelope of a structure creating openings for direct attack mechanisms of bushfire (or consequential fire) to ignite internal cavities or living space:
- Fall and obstruct access to or egress from, a structure or site being impacted by bushfire.

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APPENDIX 5: THE BROADER LANDSCAPE AND EXTREME BUSHFIRE EVENTS

The content of this appendix is an overview of information that supports the assessment approach of section 5.4 of this report. It considers the risk implications arising from what is being learnt from the latest research work within the bushfire science of dynamic fire propagation and extreme fire development.

Any potential for extreme fire events to develop in the broader landscape surrounding the subject site, will result in increased in bushfire hazard threat levels to exposed elements and must be accounted for in the risk assessment.

The selected compilation of information is taken from various sources including peer reviewed research papers [references 1-3, 12, 15, 21, 27, 28, 41, 42].

RECENT BUSHFIRE RESEARCH

Traditionally, bushfire modelling conducted to determine rates of spread, intensity, flame lengths, radiant heat etc and provide measurements of threat levels, has been based on the quasi-steady fire state (i.e. a fire propagating under constant and uniform fuel, weather and topography – after it has finished its growth phase).

More recent research has provided important insights into the dynamic nature of fire spread in the landscape and identified local drivers of bushfire risk and highlighted the role of environmental factors that are significant for large and extreme fire development.

These environmental factors include aspects of the vertical structure of the atmosphere, meso-scale fire weather processes (e.g., sea breezes, cold fronts, squall lines, convective complexes), interactions between the fire and the atmosphere, and the modification of fire weather and fire behaviour due to the local topography.

From this work, a number of processes that can contribute significantly to the level of risk posed by a bushfire have been identified. These include:

- Extreme fire weather processes;
- Dynamic fire propagation; and
- Violent pyroconvection and pyrogenic winds.

Of particular relevance to this risk assessment are the topographic aspects of the broader landscape surrounding the subject site and the potential it might present for dynamic fire propagation, development of extreme fire events and therefore increased bushfire hazard threat levels and consequent risk.

DYNAMIC FIRE BEHAVIOURS

Dynamic fire behaviours (DFBs) result from interactions between the physical factors of fuel, terrain, fire weather conditions, atmosphere and different parts of the bushfire itself. They are physical phenomenon that involve rapid changes of fire behaviour and occur under specific conditions.

Certain DFBs occur at various scales and time frames (e.g. spotting), others only at large scales (e.g., conflagrations and pyroconvective events) and others at small scales and short time spans (e.g. junction fires, fire whirls). The following fire behaviours are considered DFBs:

Spotting

The production of embers/firebrands, carried by the wind/convective currents that ignite spot fires ahead of the bushfire front. Under extreme conditions, with the necessary fuels, mass spotting events can occur. Dependent on fuel types, winds and convective currents, embers can be consumed by the fire front itself or travel tens of kilometres. Spot fire occurrence can be so prevalent that spotting becomes the dominant propagation mechanism – with the fire spreading as a cascade of spot fires forming a 'pseudo' front.

Fire Whirl / Tornado

Various sized (<1m - >150m) spinning vortices of ascending hot air and gases that carry smoke, debris, and flame. The intensity of larger whirls compares to tornados. Can induce fire spread contrary to prevailing wind and ignite spot fires away from the fire front.

Junction Fire

Is associated with merging fire fronts that produces very high rates of spread and have the potential to generate fire whirls / tornadoes.

Crown Fire

Types of tree crown fires have been categorised according to their degree of dependence on the surface fire phase - passive, active, independent - with the last two being considered dynamic fire behaviour.

Active crown fire is "a fire in which a solid flame develops in the crowns of trees, but the surface and crown phases advance as a linked unit dependent on each other."

Independent crown fires "advance in the tree crowns alone, not requiring any energy from the surface fire to sustain combustion or movement."

For a crown fire to start, a surface fire of sufficient intensity is first necessary. The distance between the heat source at the ground surface and the canopy-fuel layer will determine how much of the surface fire's energy is dissipated before reaching the fuels at the base of the canopy. The higher the canopy base, the lower the chance of crowning.

The existence of trees themselves, separated from surface fuels, can offer a degree of protection by absorbing radiant heat, trapping embers and shielding from winds. Necessary considerations include:

- Eliminating understorey fuels;
- Species Issue: Understanding the extent to which the trees will contribute to fuels (leaves/bark/twigs etc) that accumulate on the ground and when moved (wind) become involved in consequential fire away from the tree during the fire season. This needs to be considered against the maintenance capability (regular removal of material) of the responsible entity; and
- Species / Positioning Issue: Requirements include not being highly flammable, no loose stringy bark, less able to trap embers, not being prone to branches breaking in high winds potentially causing structural damage to buildings (allowing ember entry) and keeping crowns separated as an additional measure of safety and allow wind to permeate rather than be totally blocked.

Eruptive Fire

Behaviour where the head fire accelerates rapidly on sufficiently steep terrain with sufficiently strong wind – as a result of fire plume attachment to the surface, bathing it in flames ahead of the front (pre-heating).

Fire Channelling / VLS (vorticity-driven lateral spread)

Behaviour where rapid lateral fire spread, in generated vortices, occurs across a sufficiently steep leeward slope in a direction approximately transverse to the prevailing winds. This results in the rapid increase in width of the fire front. VLS are highly effective at producing mass spotting events.

Conflagrations

These are large, intense, destructive fires. They have a moving front as distinguished from a fire storm (blow up / pyroconvective fire). With sufficient vegetation extent, fuel loads and the development of dynamic fire behaviours, the large amounts of heat and moisture released can cause its plume to rise into the atmosphere and develop large cumulus or cumulonimbus flammagenitus cloud (pyrocumulus or pyrocumulonimbus). Where the extent of vertical development is limited (e.g. a stable atmosphere, or insufficient flaming zone), the fire is likely to remain a surface based event.

Downbursts

These are strong wind downdrafts associated with convective columns of heated air (and associated cloud forms). The consequent falling columns of cooled air induce an outburst of strong winds on or near the ground that radially spread causing fire spread in directions contrary to the prevailing wind.

Pyroconvective Event

A pyro-convective event is an extreme manifestation of a conflagration that develops in an unstable atmosphere and can transition into a towering pyrocumulus or a pyrocumulonimbus (pyroCb's) that can extend to the upper troposphere or lower stratosphere. With the fire/atmosphere coupling, it has evolved beyond a purely surface based fire into dynamic fire propagation rather than quasi-steady propagation. In the violent pyroconvective system:

- As a fire's plume reaches higher into the atmosphere, larger scale mixing can cause drier and higher-momentum upper air to be transferred back to the surface, thereby further exacerbating the potential for more intense fire behaviour, including fire spread contrary to the prevailing wind direction;
- Pyrogenic winds can cause considerable damage to structures, directly or indirectly, increasing their vulnerability to bushfire attack mechanisms; and

- The pyroCb's carry dense ember loads, fire and other burning debris and generate lightning, all with very little rain or hail that would typically occur with an ordinary thunderstorm.

DRIVERS OF DEEP FLAMING

Deep flaming is the fire condition when the active flaming zone is unusually large and flame-front intensity is simultaneously great, resulting in large quasi-instantaneous energy release.

Deep flaming can be produced by numbers of mechanisms on varying terrain (flat, undulating of rugged) when a large enough area of sufficiently heavy fuels is present. These mechanisms include:

- Very strong winds – so the head fire advances more rapidly than the back of the flaming zone;
- Change in wind direction – so the long flank of a fire is transformed into a fast running head fire;
- Eruptive fire behaviour – where steep slopes can cause a fire to accelerate rapidly;
- Vorticity-driven lateral spread (wind channelling) – where strong winds and steep terrain interact to rapidly drive a fire laterally, accompanied by downwind mass spotting and consequent coalescing of spot fires forming large areas of flame (can include the DFB of 'junction fire').

Research has identified strong links between:

- Eruptive fire behaviour, VLS and the occurrence of deep flaming; and
- The development of deep flaming and extreme bushfire events.

EXTREME BUSHFIRE EVENTS

Extreme bushfire events create disproportionate risks to human and environmental. Their development is affected by dynamic feedback processes that result in unpredictable behaviour, and the worsening of rates of spread and intensities - even when environmental conditions are consistent.

The term 'extreme bushfire' is applied in the recent bushfire science literature in two ways:

1. Where it refers to large, intense bushfires in which one or more DFBs are simultaneously involved; and
2. Where it more specifically refers to a fire that exhibits deep or widespread flaming in an atmospheric environment conducive to the development of violent pyroconvection, often manifesting as towering pyrocumulus (pyroCu) or pyrocumulonimbus (pyroCb) storm(s) – also referred to as blow-up fire event(s).

   A distinguishing feature of these types of fires is that they involve a coupling of the fire with an unstable atmosphere to a much greater vertical extent, well above the mixed layer, which modifies or maintains the fire's propagation (e.g. through mass spotting, blustering winds and lightning);

Relevance to Risk Assessment: Given that this risk assessment is concerned with identifying the potential for the broader landscape surrounding the subject site to increase bushfire risk, the following common aspects of the two above descriptions are relevant:

- An extreme fire is a large intense fire, so it requires a sufficient area and sufficient fuels in which to develop; and
- An extreme fire of scale requires the formation of deep flaming to develop.

Consequently, the risk assessment is primarily focused on the extent and fuel types/loads of bushfire prone vegetation and the existence of terrain (topography) properties necessary for the relevant dynamic fire behaviours - rather than the potential for adverse fire weather / atmospheric conditions - whose likely occurrence can be assumed as possible.

Note also that the second description requires an unstable atmosphere - to enable deep/violent pyroconvection and subsequent significant cloud formation and latent heat release. This is not essential for the first. Consequently, this identifies a potential difference between the two defined extreme bushfire events to be considered when assessing risk:

- Large, intense bushfires can occur without deep convective column development. These fires remain as surface fires (essentially wind-driven fires), with a greater predictability of behaviour; and
- Large, intense bushfire that couple with an unstable atmosphere are no longer surface based. They are associated with a higher level of energy, chaos, and nonlinearity due to the enhanced (fire-induced)

interaction between the boundary layer and the free troposphere, which may introduce factors that act to maintain or enhance widespread flaming. The fire behaviour is much more unpredictable.

PHYSICAL REQUIREMENTS OF TERRAIN, FUEL LOAD (AND WINDSPEED) FOR DEEP FLAMING

The dynamic fire behaviours of eruptive fire and VLS and associated mass spotting, along with potential for topographically modified winds to develop, are strongly linked with the development of deep flaming, which is a prerequisite for extreme bushfire events.

There are certain environmental thresholds that are required to be met for these dynamic fire behaviours to occur. These are described below and form part of the assessment of the bushfire hazard in Section 5.5.

Eruptive Fire Behaviour

Eruptive fires are characterised by a rapid acceleration of the head fire rate of spread (exponential increases in rate of spread have been observed). It results in a rapid deepening of the flaming zone (larger area of active flame), from which heat is released into the atmosphere.

Eruptive fire results from the interaction between the slope of the terrain and the fire's plume. In the absence of wind, plume attachment can be expected on terrain that is inclined at roughly 24° or more and the effects of wind could cause plume attachment on slopes inclined at angles of 24° or lower. Consequently, the primary topographic requirement for eruptive fire is sufficiently steep terrain and sufficiently strong wind.

"This mode of fire propagation is completely contrary to that expected under the quasi- steady fire spread paradigm … eruptive fire behaviour poses a serious threat to the successful containment of a bushfire and provides a mechanism that can substantially elevate the risk posed by a bushfire in areas that are prone to its occurrence".

Rugged terrain (areas with local topographic relief >300m), is particularly prone to eruptive fire (and dynamic fire behaviours in general).

Fire Channelling (Vorticity-Driven Lateral Spread)

Fire channelling (VLS) exists when a fire exhibits rapid spread in a direction transverse to the synoptic winds as well as in the usual downwind direction. It is characterised by intense lateral and downwind spotting and production of extensive flaming zones.

VLS is highly effective at producing mass spotting events. A link between deep flaming events caused by VLS and the formation of pyroCb has been demonstrated. Under extreme conditions, spot fire occurrence can be so prevalent that spotting becomes the dominant propagation mechanism.

VLS can only be expected to occur on parts of the landscape, and under certain fire weather conditions. VLS occurrence depends critically on the following:

- Leeward slopes greater than 20-25° are required;
- Wind direction must be within 30-40° of the topographic aspect;
- Wind speed in excess of about 20 km h-1 are required;
- Generally VLS is only observed in heavy forest fuel types with load in excess of 15-20 t ha; and
- Fuel moisture content – dense spotting and downwind extension of the flaming zone are far more likely when fuel moisture contents are around 5% or less.

Topographically Modified Surface Winds - Downslope Winds

In WA the scarp winds are the well-known local occurrence of downslope winds. Similar meteorological phenomena (typically as foehn winds) occur in the lee of mountain ranges in many parts of the world, particularly on ranges with gentle windward and steep leeward slopes.

Scarp winds are nocturnal, strong and gusty winds that develop near the base of the scarp through summer months. The local mechanism is for a synoptic easterly flow, causing air to rise to the top of the scarp from further inland, at which point it is cooler and denser than the surrounding airmass. This produces an unstable situation and consequently the air flows down the scarp as a turbulent density current.

There are implications for enhanced fire activity for a fire located in a region of downslope winds, as they provide a clear mechanism for rapid, irregular direction of fire spread as well as turbulent transport of firebrands and plume development. If a 'hydraulic jump' is also present, the strong vertical motion in the jump region is a mechanism for lofting and dispersal of firebrands further ahead of the bushfire front.

APPENDIX 6: HAZARD REDUCTION BURNING – ADDITIONAL INFORMATION

The following information provides supporting guidance to the relevant bushfire protection measures that reduce bushfire hazard threat levels by reducing fuel levels.

1. SIGNIFICANT AREAS (LARGER) AREAS OF BUSHFIRE PRONE VEGETATION

Annually

Prior to the bushfire season ensure the following management of the identified areas of vegetation is conducted:

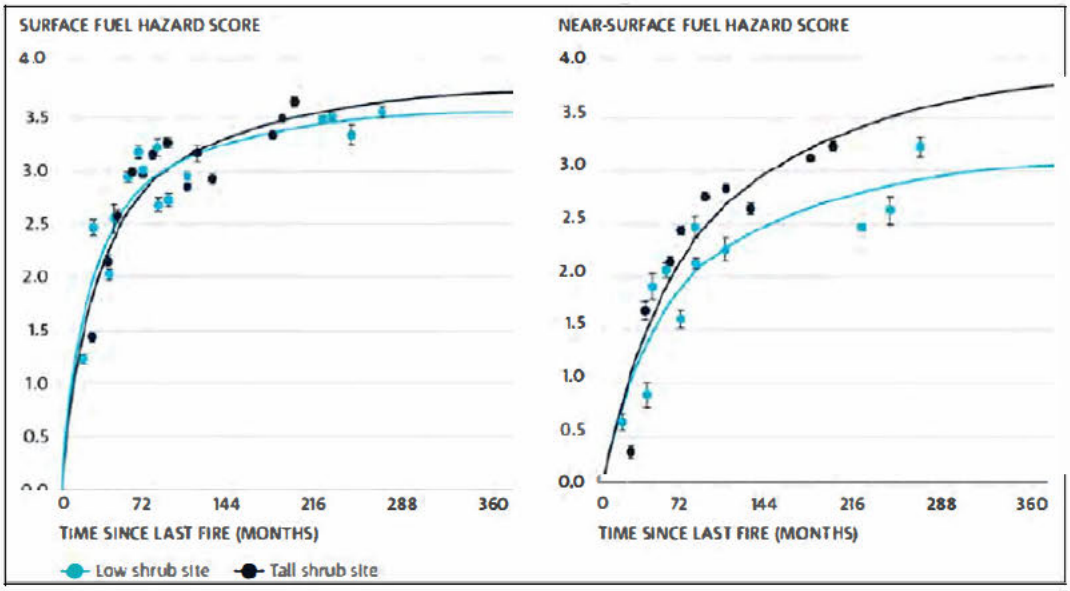
- Maintain the pruning of all trees and tall shrubs to a height of at least 2m from the ground and remove the material; and
- Remove any dead trees (that are not habitat trees), fallen branches and dead shrubs.

Burn Interval

Conduct hazard reduction burns at intervals that will ensure surface and near surface fuel loads (i.e. fine fuels – accumulated leaf litter, combustible plant materials and twigs up to 6mm diameter) remain less than 8 t/ha at all times.

It is likely the burning interval will need to be shorter than that which is typically currently conducted. The following statement and data from the Climate and Disaster Technical Report, CSIRO, 2020 [17] indicates the requirement for increased frequency of hazard reduction due to the rapid increase in surface and near surface fuel loads after hazard reduction burning.

"The only study published on the dynamics and structure of fine fuel in dry eucalypt forest following prescribed fire is that of Gould et al. (2011) utilising data to drive an exponential fuel accumulation relation for the key fuel attributes of surface fuel hazard and near-surface fuel hazard. In this study of time since fire in jarrah forest (Eucalyptus marginata), it was found that, over the 20-year period of the study (1979-1999) while surface fuel loads continued to increase indefinitely (up to and beyond 20 years), attributes such as percent cover and hazard score essentially plateaued after 6-9 years. Similarly, near-surface fuel loads were found to stop increasing significantly after 15-18 years whereas near-surface height and hazard score stopped increasing significantly after 9-12 years and 12-15 years, respectively (Figure 14). Bark hazard was found to be affected by hazard reduction burning for up to 12 years after hazard reduction burning"



"Figure 14 Recovery of surface (left) and near-surface fuel hazard (right) in Jarrah Forest following hazard reduction burning. Under these conditions these fuel attributes returned to equivalent long unburnt state after approximately 12-15 years but the response in the first few years following burning is extremely rapid, ***achieving 75% of fuel hazard within 4 years (surface) and 5-7 years (near-surface) depending on presence of shrub layer*** *(Redrawn from Gould et al. 2011)"*

2. THE BROADER LANDSCAPE

The following information has merit for consideration and is taken from the peer reviewed paper *'A framework for prioritising prescribed burning on public land in Western Australia'; Howard T. et al, DBCA and DFES; International Journal of Wildland Fire 2020, 29, 314-325.*

To develop and apply this protection measure it is likely interested entities, such as local government will need to engage and work with the relevant state government agency responsible for the identified areas of vegetation.

The collaboration will be necessary to establish the required indicators of acceptable risk - as they are determined through the application of the following published framework - and to establish a responsibility to conduct the ongoing management of these areas of vegetation to maintain compliance with the established indicators.

KEY RELEVANT POINTS FROM THE FRAMEWORK (QUOTED)

Introduction to the framework:

- *The framework provides principles and a rationale for programming fuel management with indicators to demonstrate that bushfire risk has been reduced to an acceptable level.*
- *Each bushfire risk management zone is divided into fire management areas, based on the management intent. These are areas where fuels will be managed primarily to minimise the likelihood of fire causing adverse impacts on human settlements or critical infrastructure, to reduce the risk of bushfire at the landscape scale or to achieve other land management outcomes. Indicators of acceptable bushfire risk are defined for each fire management area and are modified according to the distribution of assets and potential fire behaviour in the landscape.*
- *The framework establishes principles and a rationale for programming fuel management and, critically, provides indicators that demonstrate that bushfire risk has been reduced to an acceptable level. The acceptable level of bushfire risk is determined through a risk assessment and prioritisation process.*

Principles for managing bushfire risk applied in the framework:

- ***Consistent with international standard:*** *The regional risk framework commits to applying risk management in a manner that is consistent with AS ISO 31000: 2018 Risk management guidelines (Standards Australia 2018). This involves adherence to the principles of risk management, and applying the risk management process to the identification, assessment and treatment of risk.*
- ***Fuels are managed to reduce the harm:*** *Managing the fuel available to burn is critical to managing the threat posed by bushfire. The available fuel, and its structure, affect the speed and intensity of a bushfire, which, in turn, determine both its potential to cause damage and suppression difficulty. Done at appropriate temporal and spatial scales, managing the quantity, structure and distribution of fuel available has been demonstrated to be an effective and efficient way to reduce the severity and extent of damage by bushfires.*
- ***Fuel management does not eliminate risk:*** *Fuel management aims to reduce the negative consequences of bushfires rather than prevent their occurrence. Given the importance of fire to maintaining ecosystem health and resilience, it is neither desirable nor feasible to eliminate bushfire from natural landscapes and it is recognised that both planned and unplanned fire can have benefits. Fuel management aims to reduce risk to an acceptable level by greatly enhancing and supporting the effectiveness of other measures, including bushfire law, fire suppression, urban planning, building codes for fire-prone areas and community preparedness.*
- Fuel management is planned and integrated. Bushfire management puts people first, risk is managed at an appropriate scale and ecological requirements are considered when managing fuel.

Framework for managing bushfire risk by prescribed burning:

- The framework identifies bushfire risk management zones (BRMZ), recognises different fuel types (and associated fuel accumulation and fire behaviour models), classifies public lands within each zone into fire management areas (FMA) - with the Settlement-Hazard Separation classification being the relevant fire management area for the Mundaring town centre - and develops indicators of acceptable risk.
- ***Bushfire Risk Management Zones:*** *The framework identifies eight bushfire risk management zones (BRMZ) characterised by broad consistency of land use, asset distribution, fire environment (vegetation, fuels and climate) and fire management practices that combine to create a characteristic risk profile (Fig. 2). The Southwest zone includes the majority of the state's population, urban development and infrastructure.*
- ***Fuel Types:*** *The framework recognises 13 broad types across Western Australia. Fuel types are based primarily on structural attributes of the vegetation that influence fire behaviour. For each fuel type, best available information*

has been assembled regarding post-fire patterns of fuel accumulation, fire ecology, including the requirements of fire sensitive species and communities, harmful fire regimes and fire regimes compatible with ecosystem health. Where possible, the framework assigns each fuel type appropriate fuel accumulation and fire behaviour models and identifies the key weather attributes required to model fire behaviour. These models are used when setting indicators of acceptable bushfire risk, which are defined for different fuels according to the rates of fuel accumulation and the fire behaviour they may support.

- ***Fire Management Areas:*** *Public lands within each BRMZ are further classified into four fire management areas (FMAs) characterised as Settlement-Hazard Separation, Critical Infrastructure Buffer, Landscape Risk Reduction and Remote Area Management. These FMAs are defined by the primary intent of fuel management, which is a function of potential fire behaviour and the type and distribution of assets characteristic of the area. The framework recognises six classes of assets that may be affected by bushfire: settlements, dispersed populations, critical infrastructure, protected species and communities, economic assets and other assets (non-critical infrastructure, ecological, cultural).*
- *The Settlement-Hazard Separation FMA provides an area proximal to settlements where fuels are managed relatively intensively to minimise the likelihood of a bushfire being sustained, damaging properties or endangering people. Here, fuel management to protect settlements takes precedence over other land management objectives, though other land management outcomes can be pursued to the extent that they do not conflict with the primary management intent.*
- *The extent of the area described by each FMA varies according to the fuel type and the BRMZ in which it occurs … The breadth of the Settlement-Hazard Separation FMA is calculated to be sufficient to significantly reduce the likelihood of damage to assets from direct flame contact, radiant heat and ember attack and to provide adequate opportunity for fire suppression. This calculation is based on a combination of data derived from fire behaviour models and expert practitioner judgement. The Settlement-Hazard Separation FMAs are the largest in forest fuels that are prone to long-range spotting, severe ember storms and crown fire behaviour.*
- ***Indicators of Acceptable Bushfire Risk:*** *Are set for bushfire-prone fuel types in each FMA … Indicators are expressed in terms of the proportion of the landscape that is managed such that the treated fuels will not support a head fire of an intensity that precludes effective suppression action under weather conditions corresponding to the 95th percentile fire danger index … Weather conditions (air temperature, relative humidity, wind speed) corresponding to the 95th percentile FFDI are identified and used as inputs to fire behaviour models for calculating forward rate of spread and fire intensity (Table 1).*
- *The intent of fuel management is to reduce the quantity and alter the arrangement of fuels such that a bushfire is likely to spread more slowly, bum with lower intensity, be easier to suppress and cause less damage.*
- ***The indicators of acceptable risk for the Settlement-Hazard Separation FMA for open eucalypt forest and tall/open eucalypt forest is a target of 60% of fuel less than threshold intensity for a distance of 5km surrounding settlements.***

As an open eucalypt forest example at the Perth rural urban interface, the fuel age and load to achieve threshold fire intensity under weather conditions representing 95th percentile values of the FFDI for the Bickley location are stated as 5 years and 8 t/ha.

APPENDIX 7: BUSHFIRE ATTACK LEVELS AND BAL CONTOUR MAPS EXPLAINED

Bushfire attack levels are determined using the methodology established by AS 3959:2018 Construction of buildings in bushfire prone areas. The Standard defines a bushfire attack level (BAL) as a "means of measuring the severity of a building's exposure to ember attack, radiant heat and direct flame contact, using increments of radiant heat expressed in kW/m².."

Each BAL rating represents a set range of radiant heat flux (see table below). The amount of radiant heat and flame lengths generated by a bushfire is dependent on many factors that are modelled using the Standard's fire behaviour and flame length models. Key factors include vegetation type, terrain and a range of fire weather factors.

The variation that can exist in these factors results in different separation distances, away from bushfire prone vegetation, corresponding to a given BAL rating.

In assessing risk, knowing the separation distances away from each identified area of classified vegetation that correspond to a BAL rating, assists with evaluating threat levels from that bushfire hazard and the exposure levels of elements at risk.

Bushfire Attack Level	Explanation [Source AS3959:2018]
BAL – LOW	There is insufficient risk to warrant specific construction requirements but there is still some risk. *Important Note: For AS3959:2018 purposes, BAL-LOW will exist at 100m from classified vegetation (50m for Grassland).* *However, embers/firebrands from certain vegetation types can ignite spot fires ahead of the fire front for significant distances – short range spotting up to 740m, medium range spotting up to 5km and long range spotting has been authenticated up to 30km.*
BAL – 12.5	There is a risk of ember attack. Construction elements are expected to be exposed to heat flux not greater than 12.5 kW/m²
BAL – 19	There is a risk of ember attack and burning debris ignited by windborne embers and a likelihood of exposure to radiant heat. The construction elements are expected to be exposed to a heat flux not greater than 19 kW/m².
BAL – 29	There is an increased risk of ember attack and burning debris ignited by windborne embers and a likelihood of exposure to an increased level radiant heat. The construction elements are expected to be exposed to a heat flux not greater than 29 kW/m².
BAL – 40	There is a much increased risk of ember attack and burning debris ignited by windborne embers, a likelihood of exposure to a high level of radiant heat and some likelihood of direct exposure to flames from the fire front. The construction elements are expected to be exposed to a heat flux not greater than 40kW/m².
BAL – FZ (Flame Zone)	There is an extremely high risk of ember attack and burning debris ignited by windborne embers, and a likelihood of exposure to an extreme level of radiant heat and direct exposure to flames from the fire front. The construction elements are expected to be exposed to a heat flux greater than 40 kW/m².

THE BAL CONTOUR MAP - ILLUSTRATING THE CALCULATED SEPARATION DISTANCES CORRESPONDING TO BAL RATINGS

The BAL contour map illustrates different coloured contour intervals extending out from each different area of classified bushfire prone vegetation. The minimum and maximum distances of each contour, from each area of vegetation, is a diagrammatic representation of the calculated separation distances that correspond to each BAL rating. These take into account the specific site conditions.

Each coloured contour represents a different bushfire attack level and anything within that contour will be subject to that BAL rating and its corresponding level of radiant heat.

ADDENDUM 1

1. ADDENDUM SUB-HEADING

GLOSSARY

	APPLIED TERMINOLOGY
Consequence	The outcome of an event or situation expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain. In the emergency risk management context, consequences are generally described as the effects on persons, society, the environment and the economy. *(Source: DPLH 2019)* An impact on the natural, economic, built or social environments as a result of the hazard. The consequences are influenced by the vulnerability of elements at risk, by the exposure of elements at risk to the hazard, and by the characteristics of the hazard. *(Source: PIA, 2015)*. The outcome of an event that affects objectives. Can be a range of consequences; can be certain or uncertain; can have positive or negative effects; can be expressed qualitatively or quantitatively; can escalate through knock-on effects. *(Source: ISO Guide 73:2009)*
Controls	A measure that maintains and/or modifies risk. Controls include, but are not limited to, any process, policy, device, practice, or other conditions and/or actions which maintain and/or modify risk. *(Source: AIDR Knowledge Hub; Glossary)* A control is any measure or action that modifies or regulates risk. Controls include any policy, procedure, practice, process, technology, technique, method, or device that modifies or regulates risk. Risk treatments become controls, or modify existing controls, once they are implemented. *(Source: Praxiom)* *Note: 'Protection Measures' and 'Risk Treatments' will be alternative terms used in this risk assessment report.*
Decision Maker	The Minister for Planning, State Administrative Tribunal, Western Australian Planning Commission, Development Assessment Panel, any other State decision-making authorities, and/or the relevant local government and their delegates that make decisions regarding the application of this Policy. *(Source: SPP 3.7)* For proposed development or use that is not subject to planning approval, the relevant decision makers are those tasked with the development and management of a development or use. Typically this might be an existing development/use for which an improved bushfire performance is being sought.
Elements At Risk	The population, buildings and civil engineering works economic activities, public services and infrastructure, etc. exposed to hazards. (Australian Institute for Disaster Resilience, 2019)
Exposure	Refers to the people and things in the path of potential hazards. *(Source: AIDR* LUPDRC, *2020)* The elements within a given area that have been, or could be, subject to the impact of a particular hazard. Bushfire exposure can refer to property that may be endangered by a fire burning in another structure or by a bushfire. *(Source: AIDR Knowledge Hub; Glossary)* The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard prone areas. Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability and capacity of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest. *(Source: UNDRR, 2017)*

Hazard	A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Hazards may be natural, anthropogenic or socionatural in origin. • **Natural hazards** are predominantly associated with natural processes and phenomena (note: disasters often follow natural hazards, but there is no such thing a natural disaster); • **Anthropogenic hazards** are human-induced – being induced entirely or predominantly by human activities and choices; • **Socionatural hazards** are associated with a combination of natural and anthropogenic factors, including environmental degradation and climate change. Hazards may be single, sequential or combined in their origin and effects. Each hazard is characterized by its location, intensity or magnitude, frequency and probability. *(Source: UNDRR Terminology 2017)* A source of potential harm or a situation with a potential to cause loss. A potential or existing condition that may cause harm to people, or damage to property or the environment. A source of risk. *(Source: AIDR Knowledge Hub; Glossary)*
Hazardous Event	The manifestation of a hazard in a particular place during a particular period of time. [Severe hazardous events can lead to a disaster as a result of the combination of hazard occurrence and other risk factors.] (Source: *United Nations Office for Disaster Risk Reduction, 2017)*
Hazard Identification	The process of recognising that a hazard exists and defining its characteristics. *(Australian Institute for Disaster Resilience, 2019)*
Hazard - Bushfire	A fuel complex, defined by amount, type condition, arrangement, and location, that determines the degree of hazard. *(Source: AIDR Knowledge Hub; Glossary)* The term 'bushfire hazard' in this assessment report is intended to refer to both bushfire prone vegetation and the associated potential bushfire event itself. The term 'bushfire' is being applied as the common term for forest, scrub, shrub, and grass fire events.
Hazard - Urban Fire	1. Susceptibility of a material to burn. 2. The presence of combustible materials. 3. A process or activity posing a fire risk if not adequately controlled. *(Source: AIDR Knowledge Hub; Glossary)*
Hazardous Material	A substance or material which has been determined by an appropriate authority to be capable of posing an unreasonable risk to health, safety and property. *(Source: AIDR Knowledge Hub; Glossary)*
Impact	Describes as a quantitative or qualitative measure, the relative potential ability of a threat to adversely affect an exposed element or of a protection measure to reduce threat, exposure or vulnerability levels and consequently, risk levels.
Likelihood	Chance of something happening. The likelihood level reflects the probability of **both the emergency event and the estimated consequences** occurring as a result of the event. *(Source: AIDR NERAG, 2020)* In risk management terminology, the word 'likelihood' is used to refer to the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically - such as a probability or a frequency over a given time period. *(Source: ISO Guide 73:2009)*

	The chance of an event occurring. Likelihood may be represented as a statistical probability (such as Annual Exceedance Probability), or where this is not possible, it can be represented qualitatively using such measures as 'likely', 'possible', and 'rare'. *(Source: PIA, 2015).*
Mitigation	The lessening or minimizing of the adverse impacts of a hazardous event. The adverse impacts of hazards, in particular natural hazards, often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures include engineering techniques and hazard-resistant construction as well as improved environmental and social policies and public awareness. *(Source: UNDRR, 2017)*
Reliability	Refers to the expected reliability of a designed solution (protection measure). Over time it will be a function of: • Its Initial likely reliability; • Its durability which may or may not be a function of maintenance; • The level of maintenance required; • The likelihood of solution being modified over time; and • The influence of other adjoining/adjacent structures or stored materials that may be installed after the initial construction. (Adapted from Kelly M. et al; *Structural Design Options for Residential Buildings in Bushfire Areas,* Australasian Structural Engineering Conference November 2016)
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. *(United Nations Office for Disaster Risk Reduction, 2017)* Is that property of a building, system, or community that facilitates its return to a functional state following an overload. In the context of bushfire damage, resilience will be maximised when: • There is a high probability of an attacked building remaining fit for purpose; and • There is a low time and cost to make badly damaged buildings fit for purpose. (Adapted from Kelly M. et al; *Structural Design Options for Residential Buildings in Bushfire Areas,* Australasian Structural Engineering Conference November 2016)
Robustness	Refers to that property of structural systems that seeks to achieve proportionality of damage to the severity of an overloading event. It will be maximised when bushfire design solutions: • Have few 'weak links' that allow progressive spread of damage from minor sources; • Consist of materials and assemblies that retain physical properties when thermally loaded beyond their design capacity; and • Include protection of inherently vulnerable and brittle elements. Such as openings to internal parts of structures (including doors and windows) and essential services that maintain required functioning (e.g. cabling and plumbing). (Adapted from Kelly M. et al; *Structural Design Options for Residential Buildings in Bushfire Areas,* Australasian Structural Engineering Conference November 2016) As a design principle it means that the design and materials are not easily damaged or compromised, and do not require manual operation or intervention to work (Source: State Government of Queensland, CSIRO, 2020)

Redundancy	Refers to design that ensures the fate of the subject building/structure is not reliant on the effective performance of a single element. (State Government of Queensland, CSIRO, 2020) An example is a roof system that does not rely solely on the roof cladding to resist bushfire threats. It has additional layers of resistance including non-combustible roof/ceiling framing, insulation and ceiling lining, and the sealing/screening of gaps into internal operating spaces.
Risk	Disaster risk is the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity. *(Source: UNDRR, 2017)* Disaster risk is a product of a hazard (a sudden event or shock), exposure (the people and things in the path of potential hazards), vulnerability (the potential for those people and things to be adversely impacted by a hazard) and the capacity (the ability for those people and assets and systems to survive and adapt). *(Source: AIDR LUPDRC, 2020)* Risk is the chance of something happening that will have an impact upon objectives. It is measured in terms of consequences and likelihood. In emergency management it is a concept used to describe the likelihood of harmful consequences arising from the interaction of hazards, communities and the environment. *(Source: PIA, 2015)*
Risk Management	Disaster risk management is the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses. *(Source: UNDRR, 2017)* Coordinated activities of an organisation or a government to direct and control risk. The risk management process includes the activities of: • Communication and consultation; • Establishing the context; • Risk Assessment (risk identification, risk analysis, risk evaluation); • Risk Treatment; and • Monitoring and Review. *(Source: AIDR NERAG, 2020)*
Risk Identification	Process of finding, recognising and describing sources of risks, their causes and their potential consequences. *(Source: ISO Guide 73:2009)* It is a process used to find, recognise, and describe the risks that could affect the achievement of objectives. *(Source: Praxiom)*
Risk Source	An element which, alone or in combination, has the intrinsic potential to give rise to risk. *(Source: ISO Guide 73:2009)*
Risk Assessment	Disaster risk assessment is a qualitative or quantitative approach to determine the nature and extent of disaster risk by analysing potential hazards and evaluating existing conditions of exposure and vulnerability that together could harm people property, services and livelihoods and the environment on which they depend. Assessments include the identification of hazards; a review of the technical characteristics of hazards such as their location, intensity, frequency, and probability; the analysis of exposure and vulnerability, including the physical, social, health, environmental and economic dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities with respect to likely risk scenarios. *(Source: UNDRR, 2017)* The overall process of risk identification, risk analysis and risk evaluation. *(Source: ISO Guide 73:2009)*

Risk Analysis	The process to comprehend the nature of risk and determine the level of risk. Provides the basis for risk evaluation and decisions about risk treatment. *(Source: ISO Guide 73:2009)* Is a process that is used to understand the nature, sources, and causes of the risks that you have identified and to estimate the level of risk. It is also used to study impacts and consequences and to examine the controls that currently exist. How detailed your risk analysis ought to be will depend upon the risk, the purpose of the analysis, the information you have, and the resources available. *(Source: Praxiom)* In this risk assessment report, risk analysis is the part of the risk assessment process that assesses the hazard threat levels, identifies the protection measures (and their effectiveness) that can be applied and derives the levels of exposure and vulnerability of the identified elements at risk, based on the ability to apply protection measures. From this information indicative risk levels can be derived. Where relevant sets of risk factor criteria and a risk level matrix have been established by the relevant authorities, a determined risk level can be derived. The required risk level analysis can be conducted for either each exposed element separately and/or the proposed or existing development/use overall.
Risk Evaluation	The process used to determine risk management priorities by evaluating and comparing the level of risk against predetermined standards, target risk levels or other criteria. *(Source: PIA, 2015)* In this risk assessment report, it is the process of classifying the acceptability of the levels of risk, derived from the risk analysis, by reference to an established risk tolerance scale. The relevant tolerance scale will be that derived from the application of the 'as low as reasonably practicable' principle – 'ALARP' (refer to Appendix 3 for further information). This process can only be conducted when determined risk levels have been derived.
Risk Factor Criteria	In this risk assessment report, the risk factor criteria establish the parameters that will define the different hazard threat levels, the different levels of exposure of elements at risk and the different levels of vulnerability of elements at risk. Different sets of risk factor criteria can exist corresponding to different development types, uses and scale. They are applied as part of the risk analysis. These criteria are established by the relevant authorities as they must reflect societies preparedness to tolerate risk and be determined by those authorities exercising their responsibilities.
Risk Level Matrix	In this risk assessment report, the risk level matrix establishes how the assessed levels of hazard threats, exposure and vulnerability are to be analysed in deriving a determined risk level. It is applied as part of the risk analysis. The matrix is established by the relevant authorities as they must reflect societies preparedness to tolerate risk and be determined by those authorities exercising their responsibilities.
Risk Tolerance Scale	In this risk assessment report the applied risk tolerance scale defines the acceptability of determined risk levels based on the 'as low as reasonably practical' principle (ALARP). The risk tolerance scale can be applied within the risk assessment report when the required risk factor criteria and risk level matrix are available.
Risk - Inherent	In this risk assessment report, inherent risk is considered to be current risk after accounting for existing and any 'planned' protection measures (controls / risk treatments) but before the application of any additional protection measures that have been identified and recommended by the bushfire consultant – and which subsequently determines the residual risk (this approach is supported by the relevant information sourced from the two references below).

	'Planned' protection measures are those that are incorporated into the site development plans and those that exist in an approved Bushfire Management Plan (BMP) and/or Bushfire Emergency Plan (BEP) and for which a responsibility for their implementation has been created. If a BMP or BEP is yet to be developed or is being developed concurrently, the additional protection measures it contains (including any that are part of relevant 'acceptable solutions' established by the 'Guidelines for planning in bushfire prone areas', DPLH as amended), are considered to be additionally recommended protection measures. 1. ***Source: www.fairinstitute.org*** *"Confusion exists between Inherent Risk and Residual Risk … Here are the standard definitions of the two concepts:* • *Inherent risk represents the amount of risk that exists in the absence of controls.* • *Residual risk is the amount of risk that remains after controls are accounted for.* *Sounds straightforward. But these two terms seem to fall apart when put into practice. Applying the above definitions to the clients' scenario uncovered the fact that the 'inherent' risk being described was not a 'no controls' environment, but rather, one that only excluded some controls.* *The flaw with inherent risk is that in most cases, when used in practice, it does not explicitly consider which controls are being included or excluded. A truly inherent risk state, in our example, would assume no employee background checks or interviews are conducted and that no locks exist on any doors. This could lead to almost any risk scenario being evaluated as inherently high. Treating inherent risk therefore can be quite arbitrary. According to Jack Jones, author of Measuring and Managing Information Risk: A FAIR Approach and creator of the FAIR model, much more realistic and useful definitions would be:* • *Inherent risk is current risk level given the existing set of controls rather than the hypothetical notion of an absence of any controls; and* • *Residual risk would then be whatever risk level remain after additional controls are applied."* 2. ***Source: Wikipedia:*** *Inherent risk, in risk management is:* • *an assessed level of raw or untreated risk; that is, the natural level of risk inherent in a process or activity without doing anything to reduce the likelihood or mitigate the severity of a mishap, or the amount of risk before the application of the risk reduction effects of controls; or* • *Another definition is that inherent risk is the current risk level given the existing set of controls, which may be incomplete or less than ideal, rather than an absence of any controls.*
Risk - Residual	In this risk assessment report, residual risk is that which remains after the application of protection measures that are additional to those that already exist or are 'planned' and that establish the inherent risk (see Risk – Inherent in glossary) It is the disaster risk that remains in unmanaged form, even when effective disaster risk reduction measures are in place, and for which emergency response and recovery capacities must be maintained. The presence of residual risk implies a continuing need to develop and support effective capacities for emergency services, preparedness, response and recovery, together with socioeconomic policies such as safety nets and risk transfer mechanisms, as part of a holistic approach. *(Source: UNDRR, 2017)* It is the risk left over after you've implemented a risk treatment option. It's the risk remaining after you've reduced the risk, removed the source of the risk, modified the

	consequences, changed the probabilities, transferred the risk, or retained the risk. *(Source: Praxiom)* It is the risk remaining after any risk treatment has been applied to reduce its potential likelihood and/or its potential consequences. Residual risk can also be any risk that is chosen to be retained rather than treated *(Source: AIDR LUPDRC, 2020)* Residual risk can contain unidentified risk. Residual risk can also be known as retained risk. *(Source: ISO Guide 73:2009)*
Risk Level - Determined	Magnitude of a risk or a combination of risks. In this risk assessment report, as an outcome of the risk analysis, a determined risk level is derived from: 1. The determination of threat, exposure and vulnerability levels by reference to an established set of risk factor criteria that corresponds to each risk level (for each factor); and 2. The determination of the risk level by reference to an established risk level matrix that incorporates threat, exposure and vulnerability levels.
Risk Level - Indicative	Magnitude of a risk or a combination of risks. In this risk assessment report, as an outcome of the risk analysis, an indicative risk level is derived from analysis of the number of bushfire protection measures able to be implemented compared to the number of measures available, and the relative effectiveness of each at reducing threat, exposure and/or vulnerability levels. Overall, more applicable and applied measures is better and the measures with a higher effectiveness rating have greater weighting in the analysis.
Risk - Acceptable	Risks that do not need further treatment. The expression acceptable level of risk refers to the level at which it is decided that further restricting or otherwise altering the activity is not worthwhile e.g. additional effort will not result in significant reductions in risk levels. *(Source: DPLH, 2019)* That level of risk that is sufficiently low that society is comfortable with it. Society does not generally consider expenditure in further reducing such risks justifiable. (Source: AIDR Knowledge Hub) Acceptable risk or tolerable risk is an important sub-term (of disaster risk). The extent to which a disaster risk is deemed acceptable or tolerable depends on existing social, economic, political, cultural, technical and environmental conditions. *(Source: UNDRR, 2017)* ***Note**: It is generally accepted that nothing can be absolutely free of risk, everything under some circumstance can cause harm. There are differing levels of risk and consequently levels of safety. In practice, attaining zero risk is not possible. Nevertheless, after risk avoidance, reduction/mitigation, transfer or acceptance - the residual risk may be determined as acceptable, as judged by the participants in an activity and decision makers (who apply societies expectations). For certain land uses, the residual risk may exist at higher levels but still be judged by to be acceptable (or tolerable) on this basis.*
Risk - Tolerable	The willingness to live with a risk to secure benefits and achieve objectives, on the understanding that it is being properly controlled. 'Tolerability' does not mean 'acceptability'. Tolerating a risk does not mean that it is regarded as negligible, or something we may ignore, but rather as something that needs to be kept under review and reduced further, if deemed necessary. *(Source: DPLH, 2019)* Certain levels of risk may be tolerated, provided that the risks are known and managed. *(Source: AIDR LUPDRC, 2020)*

	Risk tolerance is defined as the organisations or stakeholder's readiness to bear the risk, after risk treatment, in order to achieve its objectives. Risk tolerance can be influenced by legal or regulatory requirements. *(Source: ISO Guide 73:2009)* A level of risk that defines the ALARP region, as risks that should be driven to the broadly acceptable region. *(Source: PIA, 2015)*
Risk - Intolerable	A level of risk that is so high that require risk treatment measures whatever their cost, or the elimination of the risk. *(Source: PIA, 2015)* Risk that is unacceptable in any circumstances or at any level. *(Source: DPLH, 2019)*
Risk Treatment	Risk treatment options available as part of the risk management process are generally categorised as follows: • Risk Avoidance: Measures taken to avoid risks from natural hazards. Can include avoiding development in hazardous areas, relocating people or assets away from hazardous areas, or developing buffer zones to the hazard; • Risk reduction/mitigation: Measures undertaken to reduce the risks from natural hazards. Includes building control and development controls; • Risk Transfer: Measures taken to transfer the risk from natural hazards from one party to another; and • Risk Acceptance: The acceptance of risk from a natural hazard. Any realised losses will be borne by those parties exposed to the hazard. This is not specifically a treatment option as no action is taken, but it is an option for addressing risk. *(Source: AIDR LUPDRC, 2020)*
Retrofitting	Reinforcement or upgrading of existing structures to become more resistant and resilient to the damaging effects of hazards. Retrofitting requires consideration of the design and function of the structure, the stresses that the structure may be subject to from particular hazards or hazard scenarios and the practicality and costs of different retrofitting options. *(Source: UNDRR, 2017)*
Structural and Non-Structural Measures	Structural measures are any physical construction to reduce or avoid possible impacts of hazards, or the application of engineering techniques or technology to achieve hazard resistance and resilience in structures or systems. Non-structural measures are measures not involving physical construction which use knowledge, practice or agreement to reduce disaster risks and impacts, in particular through policies and laws, public awareness raising, training and education. Common non-structural measures include building codes, land-use planning laws and their enforcement, research and assessment, information resources and public awareness programmes. *(Source: UNDRR, 2017)*
Threats	The mechanisms by which hazards can impact exposed elements.
Vulnerability	The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards. *(United Nations Office for Disaster Risk Reduction, 2017)* The characteristic or property of a community, system or object that makes it susceptible to the damaging effects of a specific hazard. Can be defined according to the responses of people, houses and assets in mitigating the impacts of a hazard. Specifically, it refers to the extent to which a community, building, services or location is likely to be damaged or disrupted by the impacts of a hazard, such as a bushfire.

	Building vulnerability refers to weak points in a building caused by its design, construction, use of materials and management (including maintenance). These weak points are identified in the context that they are not able to withstand the level of hazard they are exposed to. Climate and weather may directly influence the buildings vulnerability through several processes including (i) moisture content of combustible elements around and within buildings (ii) gaps between materials that may shrink and expand due to changes in moisture content and temperature (iii) wind action causing damage or dislocation of elements. *(Source: State Government of Queensland, CSIRO, 2020; Bushfire Resilient Building Guidance for Queensland Homes)*

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Peter Zenni

From: [redacted]
Sent: Thursday, 6 June 2024 4:19 PM
To: [redacted]
Cc:
Subject: Nomad Energy - Subdivision Application (WAPC REF: 200246)
Attachments: MBB Subdivision (Draft) 8894241A.pdf; 230714-1 Option Agreement - NE Robartson - Executed (redacted).pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Dear Mr Zenni,

Nomad Energy currently is in possession of an Option to Purchase (see attached) agreement with Mr Ross Robartson for the area of land stipulated in the subdivision application (WAPC Ref: 200246) that has been sent to the Merredin Shire for comment / review.

The Option to Purchase, see section 5.1, contains the necessary rights for Nomad Energy to build and construct the Access Track for the proposed BESS facility, however, to facilitate the entry/exit of construction vehicles during the Construction Phase, in accordance with the Traffic Impact Assessment undertaken by our consultants, we appreciate that some works on the Access Track will be outside of the proposed Subdivision Land. To that end, Nomad Energy intends to negotiate with the Landowner (Mr Ross Robartson) an Access & Construction Agreement which will provide Nomad Energy with the necessary rights to complete the required Access Track works.

Please see **below** an email from Mr Ross Robartson that he is aware of the requirement to grant a licence to access his land which would need to be upgraded as part of the Access Track and he is prepared to accommodate the request to grant access to enable the project to proceed and Subdivision approval to be granted.

If you required any further information, please do not hesitate to contact myself or my colleague (Jorge Quezada).

Regards
Guy

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5. LICENCE

5.1 With effect from the date of this Option Agreement and throughout the Option Period, the Landowner grants to Nomad Energy and Personnel an irrevocable licence and right to enter upon the Access Track Land to:

(a) construct and maintain the Access Track;

(b) install a gate with a dual locking system at the point where the Access Track Land converges with Robartson Road; and

(c) use the Access Track Land to access the balance of the Option Property,

subject to the terms and conditions of this Option Agreement.

Exhibit from Option to Purchase Agreement

Guy Beesley
Managing Director
Nomad Energy
[redacted]

[redacted]
w: www.nomadenergy.com.au

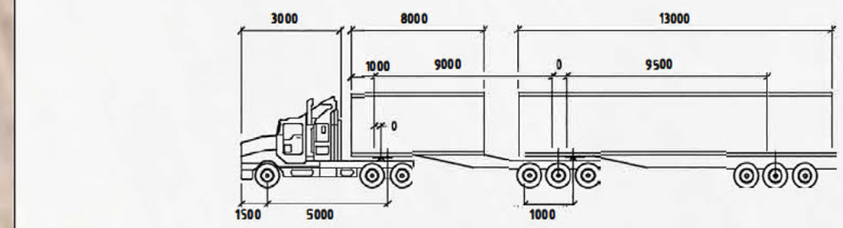
nomad energy

Please consider the environment before printing this email

[redacted]
Sent: Thursday, June 6, 2024 1:16 PM
[redacted]
Subject: RE: Access for the Battery Project

R M Robartson
[redacted]
Merredin
6th June 2024
To whom it may concern.,

Due for the need for an turning access off of Robartson road to the subdivision for the Battery Storage Site for Nomad Energy, I am forwarding this letter. I am happy to negotiate with Nomad Energy for the use of the land owned by myself, to accommodate the Truck Impact Assessment to have a Swept Path for access to the project. To advise the Merredin Shire that we will accommodate the request, so that subdivision of the site can proceed.
Yours Sincerely,
Ross Robartson



MRWA RAV2 BDOUBLE 12.5m RADIUS

mm

Tractor Width	: 2500	Lock to Lock Time	: 6.0
Trailer Width	: 2500	Steering Angle	: 26.1
Tractor Track	: 2500	Articulating Angle	: 70.0
Trailer Track	: 2500