BEMC Bushfire Environmental Management Consultancy

BUSHFIRE ASSESSMENT REPORT

Distribution Battery Energy Storage System-BESS

Hollbrook D-BESS 5MW

Hume Highway, Holbrook, 2644

FPA AUSTRALIA BRONZE MEMBER Fire Protection Association Australia

BPAD Bushfire Planning & Design Accredited Practitioner Level 3

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Abbreviations and Acronyms

APZ	Asset Protection Zone
AS/NZS 1221:1997	Australian Standard – Fire hose reels
AS1596-2014	Australian Standard – The storage and handling of LP Gas
AS2419-2021	Australian Standard – Fire hydrant installations
AS2441:2005	Australian Standard – Fire hose reels installation
AS3745:2010	Australian Standard – Planning for emergencies in facilities
BAL	Bush fire Attack Level
BCA	Building Code of Australia
BESS	Battery Energy Storage System
BFAR	Bush Fire Assessment Report
BFSS	Bush Fire Strategic Study
BPA	Bush fire Prone Area (Also Bush fire Prone Land)
BPL Map	Bush fire Prone Land Map
BPMs	Bush fire Protection Measures
BV	Biodiversity Values
EP&A Act	*NSW Environmental Planning and Assessment Act 1979*
FFDI	Forest Fire Danger Index
GFDI	Grass Fire Danger Index
ha	Hectare
HOC	Heat Of Combustion
IPA	Inner Protection Area
kJ/kg	Kilo Joules per Kilo gram
LGA	Local Government Area
LAT	Large Air Tanker
OPA	Outer Protection Area
PBP	Planning for Bush fire Protection
RF Act	*Rural Fires Act 1997*
RF Regs	*Rural Fires Regulations 2013*
RHG	Restricted Head Growth
SEED	Sharing and Enabling Environmental Data in NSW
SFR	Short Fire Run

1 EXECUTIVE SUMMARY AND RECOMMENDATIONS

BEMC Pty Ltd was engaged by ACEnergy to complete a Bush Fire Assessment on the proposed Battery Energy Storage System development at Hume Highway, Holbrook, 2644 **(Figure 1, page 7).** The proposed development includes electrical components include 10 battery containers <5MW capacity; an MPVS and high voltage switchgear and Ancillary electrical sub-transmission lines to connect the BESS to the existing powerlines. The key project infrastructure includes new driveway to a gated entry to the BESS, Security fencing and landscaping around the BESS.

BEMC has used Method 1 assessment pathway from PBP 2019 to undertake this assessment and to prepare the Bush Fire Assessment Report (BFAR).

Based upon the assessment, perusal of the site plan prepared by ACEnergy **(Appendix 1, page 28)**, and a site visit, it is recommended that development consent be granted subject to the following conditions to comply with PBP 2019:

Recommendation 1 - Asset Protection Zones

Due to the restricted size of the site, the ability to apply the 10m APZ external to the perimeter fencing and screening vegetation is limited. The perimeter vegetation screening complies with the intent of APZ standards when the following provisions are applied:

- No shrub vegetation proposed.
- Grasses maintained to 10cm height.
- All branched <2m above surface level removed.

10m APZ internal to the perimeter vegetation screening and perimeter fencing.

The entire area internal to the vegetation screening and perimeter fencing is managed as an APZ.

Prior to issuing final certification the consent authority shall ensure the APZ identified in **Figure 2, page 8** of this report is managed as an Inner Protection Area (IPA) as outlines within Appendix 4 of Planning for Bushfire Protection 2019, and NSW Rural Fire Service 'Standards for Asset Protection Zones'.

Recommendation 2 - Landscaping

A Landscaping plan is required to illustrate:

- 10m APZ internal to the perimeter vegetation screening and perimeter fencing.
- No infrastructure except for the fire trail within the 10m APZ.
- Fire trail established within APZ internal to the perimeter fencing around the compound.
- The following landscaping maintenance of the perimeter vegetation screening:
    - No shrub vegetation proposed.
    - Grasses maintained to 10cm height.
    - All branched <2m above surface level removed.

The following principles shall be applied to the landscaping features:

- Planting does not provide a continuous canopy in a line towards the facility.
- Avoid species with rough fibrous bark, or which retain/shed bark in long strips or retain dead material in their canopies.
- Use smooth bark species of trees species which generally do not carry a fire up the bark into the crown.
- Avoid planting of deciduous species that may increase fuel at surface/ ground level (i.e., leaf litter).
- Avoid climbing species. and low flammability vegetation species are used.

Recommendation 3 - Construction Standards

The BESS external construction shall be non-combustible with any vents, breathers or the like must be screened with steel, bronze, or aluminium to maximum allowable aperture of 2mm.

Where explosion vents or other penetrations are provided, ensure they are arranged and directed away from dedicated building providing support equipment and entrance to the site.

The dedicated building providing support equipment must comply with section 3 and section 5 (BAL 12.5) Australian Standard AS3959-2018 Construction of buildings in bush fire-prone areas or NASH Standard National Standard Steel Framed Construction in Bushfire Areas – 2021 as appropriate and section 7.5 of Planning for Bush Fire Protection 2019.

Recommendation 4 - Access

A perimeter road shall be located within the 10m internal APZ that shall comply with:

- The capacity of private property access of road surfaces and any bridges/ causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges and causeways are to clearly indicate load rating,
- Category 1 fire appliance to within 4m of the static water supply,
- Minimum carriageway width of 4m, with passing bay of 6m wide for 20m in length established every 200m,
- A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, and
- Curves have a minimum inner radius of 6m and are minimal in number to allow for rapid access and egress,
- The minimum distance between inner and outer curves is 6m,
- The crossfall is not more than 10°, and
- Maximum grades for sealed roads do not exceed 15° and not more than 10° for unsealed roads.

Recommendation 5 - Water Supply

For bush fire purposes, a minimum 10,000L static water is provided that can be accessed from the internal perimeter roads in accordance with Table 7.4a of PBP 2019. This includes:

- Provided near the entrance to the facility and at least 10m from any electrical substations, inverters, battery energy storage systems infrastructure and outside the 10m internal APZ.
- A connection for firefighting purposes is located within the IPA or non-hazard side and away from the structure; 65mm Storz outlet with a ball valve is fitted to the outlet,
- Ball valve and pipes are adequate for water flow and are metal,
- Supply pipes from tank to ball valve have the same bore size to ensure flow volume,
- Underground tanks have an access hole of 200mm to allow tankers to refill direct from the tank,
- A hardened ground surface for truck access is supplied within 4m,
- Above-ground tanks are manufactured from concrete or metal,
- Raised tanks have their stands constructed from non-combustible material or bush fire-resisting timber (see Appendix F AS 3959),
- Unobstructed access can always be provided,
- Static Water Supplies (SWS) are clearly marked with SWS signage place at the front gate and in location that guide responding fire agencies to the location of the water supply on site (Refer to Appendix),
- Tanks on the hazard side of a building are provided with adequate shielding for the protection of firefighters,

- All exposed water pipes external to the building are metal, including any fittings.

Recommendation 6 - Electricity services
Where practical, electricity should be placed underground.

If overhead power supply is provided, the const authority shall determine vegetation management is in accordance with Energy Australia 'Vegetation Safety Clearances' (NS179, April 2002).

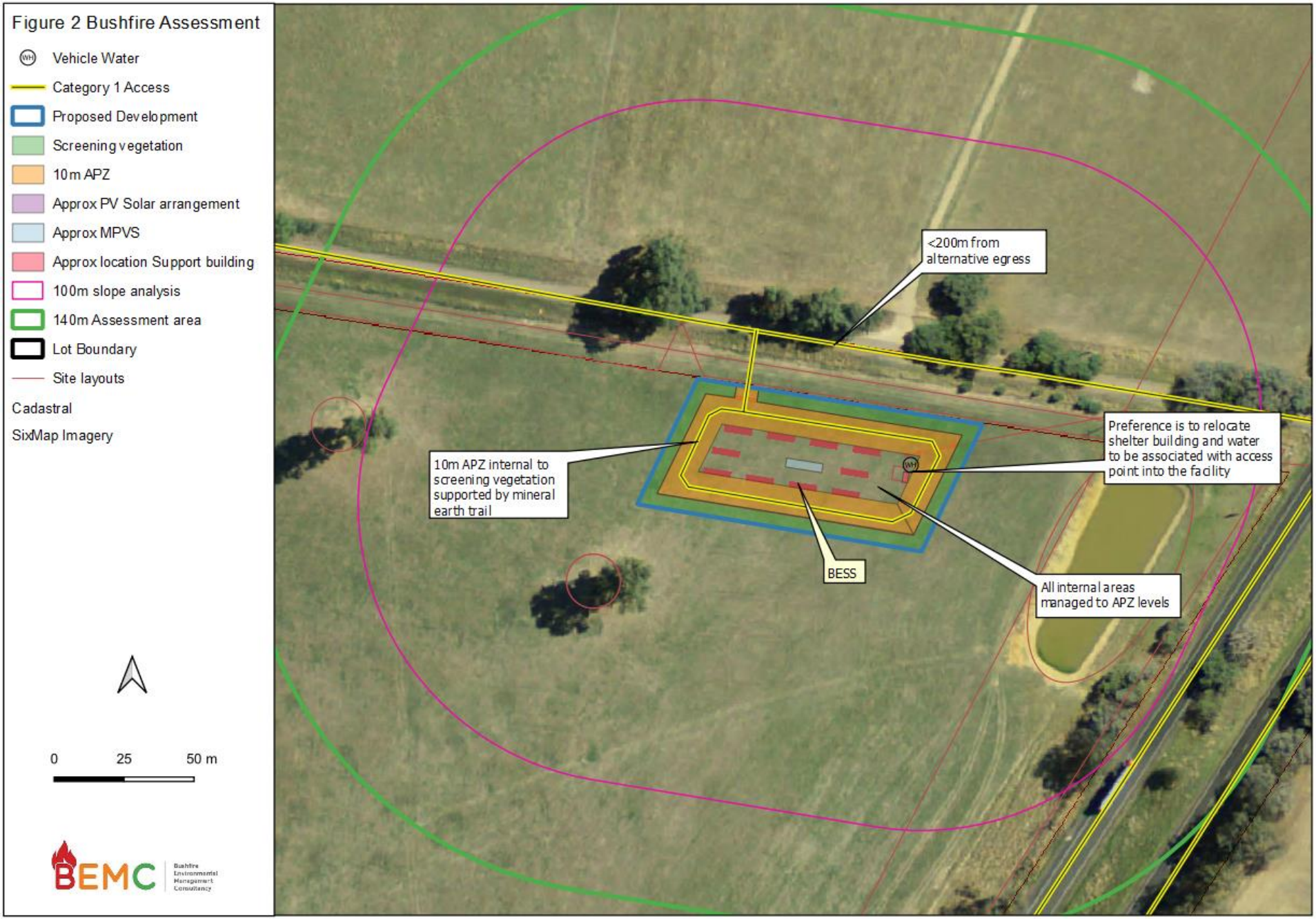
Recommendation 7 - Emergency Management
A dedicated building shall be provided with support equipment and entrance to the site. Site personnel shall be trained in the use of firefighting equipment which shall be maintained and accessible to all stages of construction and ongoing operations. Equipment should be appropriate to the activities being conducted and as a minimum must include:

- Bushfire survival kit,
- Fire pants and jacket,
- Fire extinguishers,
- Knap sacks, and
- Hand tools (e.g., fire rakes).

Finally, the implementation of the adopted measures and recommendations forwarded within this report comply with Planning for Bush fire Protection (2019) and will contribute to the amelioration of the potential impact of any bush fire upon the development, but they do not and cannot guarantee that the area will not be affected by bush fire at some time.

Figure 1 Property location of Hume Highway, Holbrook, NSW (Mecone Mosaic, 2024)

Figure 2 Bushfire Assessment



2 INTRODUCTION

BEMC Pty Ltd was engaged by ACEnergy to complete a bush fire assessment to accompany a Development Application for the BESS facility at Hume Highway, Holbrook, hereafter referred to as the 'site' (**Figure 1, page 7**).

The subject site located adjacent to the Hume Highway and Bendemeer Lane, south of Holbrook and comprises a small area contained within Lot 22 of DP809338, approximately 4.5 km south of Holbrook.

The project comprises a BESS and associated infrastructure that will occupy an area of approximately 0.5 hectares. The proposed development will have an approximate capacity of 4.95 megawatts. The project electrical components include 10 battery containers; an MPVS and high voltage switchgear and Ancillary electrical sub-transmission lines to connect the BESS to the existing powerlines. The key project infrastructure includes new driveway to a gated entry to the BESS, Security fencing and landscaping around the BESS.

The project will be designed to provide grid flexibility services and will support the efficiency of the electrical network by charging from the grid during periods of low demand and discharging back to the grid during periods of higher demand. It would also have the capacity to charge or discharge when power system services are required to maintain the stability of the broader electricity grid. The BESS strengthens the power network by providing greater flexibility in grid management.

The identification of bush fire prone lands (BPL Map) in NSW is required under section 10.3 of the Environment Planning and Assessment Act 1979 (EP&A Act). Section 4.14 of the EP&A Act requires developments to comply with NSW Rural Fire Service, Planning for Bush fire Protection (PBP 2019) if any part of a development site is affected by a bush fire hazard as indicated within the BPL Map.

This development falls within the Bush Fire Vegetation Buffer zone on the Greater Hume Council bush fire prone land map which triggers development assessment provisions under 4.14 of the EP&A Act and compliance with PBP 2019. The consent authority may consult with the RFS under section 4.15 of the EP&A Act for development in bush fire prone lands.

The bush fire requirements of non-occupied developments need to align with the unique features of the development type. The general fire safety construction provisions of the NCC are taken as acceptable solutions however construction requirements for bush fire protection will need to be considered on a case-by-case basis.

It is important to ensure that a defendable space is provided for the size and scale of the development. Proposed measures must operate in combination to minimise the impact of bush fire and ensure that access and services are adequate. Due to the hazardous nature of some development, the *Hazardous Industry Planning Advisory Papers (HIPAPs*) should also be considered for hazardous developments in Bush fire prone lands.

It is clear from the investigation and assessment of the property that the site is located within Bush fire Prone Land.

To determine the planning and construction requirements a site assessment has been performed in February 2024 to determine the appropriate bush fire threat level, design, planning, and construction standards required to comply with PBP 2019.

The Site Plan for the property prepared by ACEnergy is provided in **Appendix 1, page 28.**

2.1 DESCRIPTION OF PROPOSED DEVELOPMENT

Table 1 *Description of Proposed development*

Boundaries	Grasslands in all directions, access lane way to the north, and Hume Highway to the east.
Topography	Flat
Type of development	Battery Energy Storage system (BESS)
Roof construction	N/A
External wall construction	Non-combustible
Landscaping plan provided	Yes
Bush fire Prone Land	Yes – Greater Hume Council – FDI – 80

The proposed location of the development is provided in **Figure 1, page 7** with further development details provided in **Appendix 1, page 28**.

2.2 OBJECTIVES OF ASSESSMENT

This assessment has been undertaken to enable council to make determination of the proposed development in consideration of the requirements of s4.14 of the Environmental Planning and Assessment Act 1979, PBP 2019 and AS 3959-2018.

In order to comply the following conditions must be met:

- satisfy the aim and objectives of PBP outlined in Chapter 1 of PBP;
- Consider any issues listed for the specific purpose for the development set out in this chapter; and
- Propose an appropriate combination of BPMs.

This report assesses to requirements of the development to meet the six objectives listed in section 1.1 of PBP 2019, which provide for the protection of human life and minimize impacts on property.

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

2.3 SPECIFIC OBJECTIVES OF OTHER DEVELOPMENTS

Whilst bush fire is not captured in the NCC for Class 5-8 buildings, the following objectives will be applied in relation to access, water supply and services, and emergency and evacuation planning:

- To provide safe access to/from the public road system for firefighters providing property protection during a bush fire and for occupant egress for evacuation.
- To provide suitable emergency and evacuation (and relocation) arrangements for occupants of the development.
- To provide adequate services of water for the protection of buildings during and after the passage of bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to a building; and
- Provide for the storage of hazardous materials away from the hazard wherever possible.

2.4 WIND AND SOLAR FARMS

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

The following should be provided for wind and solar farms:

- A minimum 10m APZ for the structures and associated buildings/infrastructure; and
- The APZ must be maintained to the standard of an IPA for the life of the development.

Infrastructure for the purposes of requiring APZ excludes:

- Road access to the site; and
- Power or other services to the site and associated fencing.

Essential equipment should be designed and housed in such a way as to minimise the impact of bush fires on the capabilities of the infrastructure during bush fire emergencies. It should also be designed and maintained so that it will not serve as a bush fire risk to surrounding bush.

A Bush Fire Emergency Management and Operations Plan should identify all relevant risks and mitigation measures associated with the construction and operation of the wind or solar farm. This should include:

- Detailed measures to prevent or mitigate fires igniting.
- Work that should not be carried out during total fire bans.
- Availability of fire-suppression equipment, access and water.
- Storage and maintenance of fuels and other flammable materials.
- Notification of the local NSW RFS Fire Control Centre for any works that have the potential to ignite surrounding vegetation, proposed to be carried out during a bush-fire fire danger period to ensure weather conditions are appropriate; and
- Appropriate bush fire emergency management planning.

It is important to be aware of operations that may be carried out on days of Total Fire Ban and any prohibited activities or exemptions that are notified by the Commissioner of the NSW RFS under the *Rural Fires Act s.99*.

2.5 AS/NZS 5139:2019 ELECTRICAL INSTALLATIONS - SAFETY OF BATTERY SYSTEMS FOR USE WITH POWER CONVERSION EQUIPMENT

This document explains restrictions which apply to locations and proximity of equipment to Battery Energy Storage Systems (BESS). BESS systems are not to be installed:

- In location where damage from external influences may be expected (vehicles).
- In a hazardous area as defined in AS/NZS 3000.
- Adjacent to habitable buildings.
- Within a passageway, walkway exits and escape or evacuation routes.

3 BUSH FIRE RISK STRATEGIC STUDY

Planning for Bushfire Protection (2019) is based on the worst-case scenarios for each of the bush fire behaviour elements of fire weather, vegetation, slope and assumes not human intervention. All development shall be assessed on an individual basis as broad-brush approaches of documents such as PBP 2019 may not be applicable in every instance.

A Bush Fire Risk Strategic Study (BFRSS) was prepared to inform the context of the Bush Fire Assessment Report (BFAR). The level of information gathered and analysis within the BFRSS depends upon the nature and scale of the development. The BFRSS provides a broad-brush approach to determine landscape wildfire risk in considerations of vegetation continuity, distribution, and proximity to development; human intervention; access and evacuation. This enables an assessment the *actual* bushfire risk, determine if strict adherence to PBP 2019 is warranted, and if a proposed development is appropriate in the bush fire hazard context.

Table 2 *Bush fire risk strategic study*

ELEMENT	Low Threat		Moderate Threat		High Threat		Extreme Threat	
Adjoining Lands	The proposed development and changing land use will have positive impacts on the ability of adjoining landowners to implement Bush fire Protection Measures	√	The proposed development and changing land use do not impact on the ability of adjoining landowners to implement Bush fire Protection Measures		The proposed development and changing land use will impact on the ability of adjoining landowners to implement Bush fire Protection Measures		The proposed development will significantly impact on the wildfire risk profile of adjoining lands.	
Surrounding infrastructure	The proposed development does not significantly impact on community water, electricity, or gas services.		The proposed development is associated with community water, electricity, or gas services but will not have significant impact.	√	The proposed development impact on community water, electricity, or gas services.		The wildfire risk profile of significant infrastructure will increase due to this development.	
Emergency services	The proposed development does not significantly impact on the ability of emergency services to plan, prepare, respond, or recover prior, during or after a bush fire event.		The proposed development is located within 30-minute flight from a Large Air Tanker (LAT) airbase and within 30-minutes of multiple fire response units.		The proposed development is located more than 30-minute flight from a Large Air Tanker (LAT) airbase and only 1 or 2 fire response units within 30-minutes.		It is unlikely emergency services will respond to wildfire in this location during extreme and catastrophic events.	√

ELEMENT	Low Threat		Moderate Threat		High Threat		Extreme Threat	
Access	Good, multiple route evacuation is possible and connects with the public road network in a direction away from the wildfire threat to shelter location.		More than one access or egress routes is provided from the property to a safer location which then can access the public road network with multiple access/egress routes o shelter location.	√	One access or egress routes is provided, which is <200m from the property to a safer location.		Only one access or egress route with no nearby safe location.	
Emergency egress	Seamless integration with existing settlement - no effect on evacuation.		Short bushland pinch points that may restrict access temporarily or carry fire across roads. Unlikely impact on evacuation.		Pinch points that are likely to restrict access along evacuation routes for short periods (15-30mins) and carry fire across roads.	√	Large areas of bushland or multiple pinch points along evacuation routes that could block evacuation routes for an extended time.	
Vegetation continuity	Forested vegetation beyond 140m form the site is scattered with low continuity due to built development.	√	Forested vegetation beyond 140m form the site is scattered and isolated, forming a dominate fast moving grassland or open woodland fire event.		Patches of forested vegetation associated riparian and isolated ridgelines beyond 140m from the site may result in localised forest fire event.		Continuous forested areas within mountainous terrain beyond 140m from the site will result in broadscale landscape emergency management operations.	
Vegetation connectiveness	Forested vegetation corridors beyond 140m are restricted and do not enable landscape fire to enter and move through the site by a continuous fire path.	√	Forested vegetation corridors beyond 140m from the site exist, although grasslands >100m provide separations between forested vegetation restricting the fire head progression of landscape fire.		Forested vegetation corridors beyond 140m from the site exist, although grasslands <100m provide separations between forested vegetation restricting the fire head progression of landscape fire.		Forested vegetation corridors beyond 140m from the site provide for passage of landscape fire to enter and move through the site.	
Vegetation Location	Wildfire within forests can only approach from one direction surrounded by a suburban, township or urban area managed in a minimum fuel condition.	√	Wildfire within forests can only approach from two directions and the site is within a suburban, township or urban area managed in a minimum fuel condition.		Wildfire within forests can approach from several directions although gaps within forested vegetation or are present.		Wildfire within forests can approach from several directions and have hours or days to grow and develop before impacting and/or site is surrounded by unmanaged vegetation.	
Separation	Hazard separation between forested hazard and buildings of greater than 100m.	√	Hazard separation between forested hazard and buildings of 50-100m		Hazard separation between forested hazard and buildings of 30-50m		Hazard separation between forested hazard and buildings of <30m	

ELEMENT	Low Threat		Moderate Threat		High Threat		Extreme Threat	
Vegetation flammability	Within the dominated fire direction, the fire fuel is restricted to surface, partially managed and separated through land use practises.		Within the dominated fire direction, the fire fuel is highly aerated, with significant separations (>50m) between these patches with partially managed vegetation between.	√	Within the dominated fire direction, the fire fuel is highly aerated, with <50m between these patches with partially managed vegetation between		Within the dominated fire direction, the fire fuel is highly aerated, continuous continuity vertically and horizontally with flammable species.	
Wildfire Behaviour	Extreme Wildfire behaviour at the site is not possible given the broader landscape.		Extreme Wildfire behaviour at the site is unlikely given the broader landscape.		Extreme Wildfire behaviour at the site is likely given the broader landscape.		Extreme Wildfire behaviour at the site is very likely given the broader landscape.	√
Overall Threat Rating:			Wildfire provides **MODERATE** threat to this proposal	√				

Where a **moderate** threat is determined strict compliance with PBP 2019 is not warranted. In these cases, meeting the broad aims and objectives and the specific objectives of other developments of PBP 2019 through providing separation between the wildfire threat and structure, vehicle access round the perimeter, access to firefighting water, and establishing adequate bushfire emergency and operations requirements is required.

4 BUSHFIRE HAZARD ASSESSMENT

This section details the site assessment methodology. It provides detailed analysis of the bushfire threat and bushfire planning requirements in and around the proposed site.

4.1 ASSESSMENT METHODOLOGY

The assessment of the vegetation, slope and other bushfire characteristics within and surrounding the site has been carried out with the aid of the follows:

- Sixmap aerial photograph Interpretation.
- LiDAR slope analysis.
- Sharing and Enabling NSW Environmental Data portal.
- Reference to regional vegetation community mapping.

4.2 FIRE DANGER INDEX

This assessment utilises Greater Hume Council area with a FFDI 80.

4.3 BAL ASSESSMENT

A simplified Method 1 assessment in accordance with Appendix 1 of PBP 2019 has been completed. The output of this assessment is provided in **Table 3** and illustrated in **Figure 2, page 8.**

Table 3 *BAL Assessment (Method 1 PBP 2019)*

Elements	Method (unit)	Fire Run 1
Vegetation	NSW Comprehensive Fuel Loads	Grasslands
Provided separation	Site -Laser finder (m)	10m
Effective slope	Site visit – Theodolite (°)	Level
Fire Danger Index (FFDI)	Council Area	80
OUTPUTS (Table A1.12.6)		
BAL FZ		<7m
Separation to Achieve BAL40		7 - <10m
Separation to Achieve BAL29		10 - < 14m
Separation to Achieve BAL19		14 - < 20m
Separation to Achieve BAL12.5		20 - < 100m
Bush fire Attack Level (BAL)		**BAL <29**

4.4 ASSET PROTECTION ZONE

An APZ is a buffer zone between a bush fire hazard and buildings. The APZ is managed to minimise fuel loads and reduce potential radiant heat levels, flame, localised smoke and ember attack. The appropriate APZ distance is based on vegetation type, slope and the nature of the development.

For this proposed development a 10m APZ external and internal to the perimeter vegetation screening and perimeter fencing, strict landscaping provisions to the perimeter vegetation screening and APZ standards applied to the internal compound are proposed.

4.5 LANDSCAPING

A combination of hard (materials) and soft (design) landscaping will benefit the survivability of a building during a bushfire event and vegetation screening will be applied to mitigate visual impact of the development. The type, quantity and condition of fuel has a very important effect on bushfire behaviour in proximity to a building.

Perimeter vegetation screening is proposed. This vegetation does not increase the bushfire risk if maintained to strict landscaping requirements. The following landscaping provisions are proposed:

- 10m APZ internal to the perimeter vegetation screening supported by a Fire trail.
- The following landscaping maintenance of the perimeter vegetation screening:
  - No shrub vegetation proposed.
  - Grasses maintained to 10cm height.
  - All branched <2m above surface level removed.

Due to the restricted size of the site, the ability to apply the 10m APZ external to the perimeter fencing and screening vegetation is limited, with the following principles shall be applied to the vegetation screening features:

- Located outside the 10m internal APZ.
- Planting does not provide a continuous canopy in a line towards the facility.
- Avoid species with rough fibrous bark, or which retain/shed bark in long strips or retain dead material in their canopies.
- Use smooth bark species of trees species which generally do not carry a fire up the bark into the crown.
- Avoid planting of deciduous species that may increase fuel at surface/ ground level (i.e., leaf litter).
- Avoid climbing species. and low flammability vegetation species are used.

4.6 ACCESS

Design of access roads shall enable safe access and egress for occupants attempting to leave the area while emergency service personnel are arriving to undertake firefighting operations.

For this proposed development the following access provisions are proposed:

- The capacity of private property access of road surfaces and any bridges/ causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges and causeways are to clearly indicate load rating,
- Category 1 fire appliance to within 4m of the static water supply,
- Minimum carriageway width of 4m, with passing bay of 6m wide for 20m in length established on the external fire trail on the south side of the compound,
- A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches,

- Curves have a minimum inner radius of 6m and are minimal in number to allow for rapid access and egress,
- The minimum distance between inner and outer curves is 6m,
- The crossfall is not more than 10°, and
- Maximum grades for sealed roads do not exceed 15° and not more than 10° for unsealed roads.

4.7 ELECTRICITY

Electricity should be located so as not to contribute to the risk of fire or impede the firefighting effort.

For this proposed development overhead powerline supply is associated with the project. The proposed BESS transmission line is required to comply with *ISSC 20 - Guideline for the Management of Activities Within Electricity Easements and Close to Electricity Infrastructure (ISSC, 2012)* which was written to protect public safety and electricity assets and by offering guidance on the management of activities in electricity easements including the consideration of access and safety aspects associated with the operation and maintenance, repair, replacement, upgrade or renewal of electricity infrastructure on property, whilst being mindful of the property owner's rights to maximise use and enjoyment of the land.

Lighting of fires, including planned or prescribed burns, is a controlled activity under ISSC 20 and is subject to consultation and negotiation with the network operator.

4.8 GAS

Gas should be located so as not to contribute to the risk of fire or impede the firefighting effort.

For this proposed development gas bottles are not proposed.

4.9 WATER

An adequate supply of water is essential for firefighting purposes.

BESS infrastructure maybe considered 'decentarised' (multiple BESS throughout solar panel infrastructure) or 'Centralised/Stand-Alone' (ancillary to solar facilities). Section 5 of AS 2419.1-2021: Fire hydrant installations – System design, installation and commissioning considers static water provisions when reticulated water supply is not provided. Firefighting infrastructure must be designed to allow effective response to the risks and hazards at the facility. Fire water must be provided to cover buildings, control rooms, substations and grid connections. The relevant sections of AS 2419.1-2021: Fire hydrant installations – System design, installation and commissioning have been included in this assessment of external fire (bush fire) impacting on the site, although extra water provisions (supply of 45,000L in the vicinity of the BESS) may be appropriate when considering internal structural fire, which is beyond the scope of this assessment.

For this proposed development a minimum 10,000L static water supply will support meeting the aims and objectives of PBP and mitigating bush fire risk bush fire risk with the following provisions:

- Provided near the entrance to the facility and at least 10m from any electrical substations, inverters, battery energy storage systems infrastructure.
- A connection for firefighting purposes is located within the IPA or non-hazard side and away from the structure; 65mm Storz outlet with a ball valve is fitted to the outlet,
- Ball valve and pipes are adequate for water flow and are metal,
- Supply pipes from tank to ball valve have the same bore size to ensure flow volume,
- Underground tanks have an access hole of 200mm to allow tankers to refill direct from the tank,
- A hardened ground surface for truck access is supplied within 4m,

- Above-ground tanks are manufactured from concrete or metal,
- Raised tanks have their stands constructed from non-combustible material or bush fire-resisting timber (see Appendix F AS 3959),
- Unobstructed access can always be provided,
- Static Water Supplies (SWS) are clearly marked with SWS signage place at the front gate and in location that guide responding fire agencies to the location of the water supply on site (Refer to Appendix),
- Tanks on the hazard side of a building are provided with adequate shielding for the protection of firefighters,
- All exposed water pipes external to the building are metal, including any fittings.

4.10 Construction Standards

The NCC does not provide for any bush fire specific performance requirements for these particular structures. As such AS 3959 and the NASH Standard are not considered as a set of Deemed to Satisfy provisions, however compliance with AS 3959 and the NASH Standard must be considered when meeting the aims and objectives of PBP.

Due to the separations to vegetation, ample access, water provisions, placement, or absence of hazardous materials (gas), no near-by occupied structures the appropriate construction standards to mitigate bush fire risk are all construction shall be non-combustible with any vents, breathers or the like must be screened with steel, bronze, or aluminium to maximum allowable aperture of 2mm.

4.11 Hazardous Industry

Some developments are considered by their very nature to be hazardous, as much for their ability to start bush fires as their susceptibility to bush fire impacts. Fire hazards at facilities with battery energy storage systems include:

- Electrical hazards, such as battery faults; overcharging; rapid discharge; loss of remote monitoring systems; internal short circuits; overheating; water ingress; lightning strike (leading to thermal events/runaway).
- Chemical hazards, such as the inherent hazards of the stored dangerous goods; spills and leaks of transformer oil/diesel, refrigerant gas/coolant; chemical reactions.
- Explosions, from ignition of venting gases.
- Potential fire spread due to proximity of batteries (and containers/enclosures) to each other, on-site infrastructure, and vegetation (including screening vegetation).
- Mechanical damage to battery containers/enclosures due to vehicular impact.
- Landscape hazards, such as bushfire/grassfire ignition from fire within the facility, or external ignition of site infrastructure from embers, radiant heat, and flame contact.

The proposed development is considered Hazardous Industry, and a Preliminary Fire Hazard Assessment is required to assess internal structural fire risk. A preliminary bush fire hazard assessment provided in **Chapter 6, page 22** of this report.

4.12 FM GLOBAL PROPERTY LOSS PREVENTION DATA SHEETS

FM Global Property Loss Prevention Data Sheets provide standards help you reduce the chance of property loss due to fire, weather conditions, and failure of electrical or mechanical equipment, which can be applied to bush fire risk mitigation.

Data sheet 5-33: Electrical Energy Storage Systems has been reviewed with the following recommendations incorporated into this risk analysis:

- Locate energy storage systems away from surrounding critical buildings and equipment.
- Establish a dedicated building with support equipment away from the energy storage system.
- Where explosion vents or other penetrations are provided, ensure they are arranged and directed away from dedicated building with support equipment and entrance to the site.
- Ensure bush fire water supply is quarantined from water supply that is required for automatic sprinkler systems for the Energy Storage Systems.

Data Sheet 9-19, Wildland Fire has been reviewed with the following recommendations incorporated into this risk analysis:

- Strips of vegetation less than 20 m wide perpendicular to the exposed building wall and not within 20 m of the building or other vegetation is not considered a bushfire threat (such as perimeter screening vegetation).
- Apply construction schedules to protect built assets from direct flame, radiant heat, and embers.
- Remove all combustible elements (vegetation, wooden fencing, and landscaping) within 1.5m of the built asset.

Data Sheet 1-20, Protection Against Exterior Fire Exposure has been reviewed with the following recommendations incorporated into this risk analysis:

- Provide a water supply capable of providing a minimum duration of 60 minutes to a specific application design within automatic-type sprinklers, water-spray nozzles, corrosion-resistant pipe and fittings and various other requirements.

Data Sheet 3-29, Reliability of Fire Protection Water Supplies

FM Global client loss history in sprinklered buildings shows that lack of adequate valve supervision, impairment handling, and lack of adequate testing and maintenance cause approximately 80% of sprinkler system failures. A further 16% of sprinkler system failures are attributed to prematurely shutting off the sprinkler system during a fire event. There is almost no history of uncontrolled fire losses at adequately sprinklered properties where a single water supply exists that is properly designed, installed, maintained, and tested. For this reason, FM Global recommends a single adequate and reliable fire protection water supply. Additional considerations, such as facility size/value, business continuity, occupancy, arrangement and condition of water supply and geographic location may drive the need for higher levels of reliability and water supply duplication.

5 BUSHFIRE ASSESSMENT AND PERFORMANCE MEASURES

This section assesses Bushfire Performance Measures (BPMs) for the proposed development at Hume Highway, Holbrook in consideration of the aims and objectives and Chapter 8 of Planning for Bushfire protection 2019.

Table 4 *Planning for bushfire protection compliance (PBP 2019)*
Section 8.3.1 – Buildings of Class 5 to 8 under NCC on bushfire prone lands

	PERFORMANCE CRITERIA	COMPLIANCE for Hume Highway, Holbrook
Aims and Objectives of PBP	Afford buildings and their occupants protection from exposure to a bush fire	• No occupied buildings are proposed. • A 10m APZ be established internal to the perimeter vegetation screening and fence supported by fire trail within the APZ. • The entire area internal to the perimeter fence is managed to APZ standards. • Vehicle access to alternative evacuation routes is provided.
	Provide for a defendable space to be located around buildings	• A 10m APZ be established internal to the perimeter vegetation screening and fence supported by fire trail within the APZ. • The entire area internal to the perimeter fence is managed to APZ standards.
	Provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent the likely fire spread to buildings	• A 10m APZ be established internal to the perimeter vegetation screening and fence supported by fire trail within the APZ. • The entire area internal to the perimeter fence is managed to APZ standards. • A fire trail internal to the perimeter fence shall be provided.
	Ensure that appropriate operational access and egress for emergency service personnel and occupants is available	• A 10m APZ be established internal to the perimeter vegetation screening and fence supported by fire trail within the APZ. • The entire area internal to the perimeter fence is managed to APZ standards. • Static water supply shall be available to the internal fire trails.
	Provide for ongoing management and maintenance of BPMs	• Bush fire emergency and operations plan includes annual audit reviews. Specific attention shall be afforded to: ○ Ensuring any future installed/established landscaping features comply with bush fire requirements. ○ Asset Protection Zones are maintained (vegetation management) to the required fire fuel loads, removing the ability for vegetation and accumulation creep over time. ○ Fire trail conditions and capacity are maintained. ○ Review of bush fire emergency management arrangements

	Ensure that utility services are adequate to meet the needs of firefighters	• Where practical, electricity placed under ground. • No bottle gas provided. • Minimum 10,000L static water supply shall be available for bush firefighting purposes to the internal fire trail.
Specific Objective off Class 5-8 Buildings	To provide safe access to/from the public road system for firefighters providing property protection during a bush fire and for occupant egress for evacuation	• No occupied buildings are proposed. • A 10m APZ be established internal to the perimeter vegetation screening and fence supported by fire trail within the APZ. • Vehicle access to alternative evacuation routes is provided.
	To provide suitable emergency and evacuation (and relocation) arrangements for occupants of the development	• Evacuation and emergency management arrangements prior to and during bushfire events within the NSW RFS district shall be included in the facilities Bush fire emergency and operations plan. This will include: ○Bush fire decision triggers. ○action require at each decision trigger. ○responsibilities to implement the actions
	To provide adequate services of water for the protection of buildings during and after the passage of bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to a building	• Where practical, electricity placed under ground. • No bottle gas provided. • Minimum 10,000L static water supply shall be available for bush firefighting purposes to internal fire trail.
	Provide for the storage of hazardous materials away from the hazard wherever possible	• Where practical, electricity placed under ground. • No bottle gas provided. • Strict landscaping requirements applied to perimeter vegetation screening.

6 HAZARDOUS INDUSTRY

Some developments are considered by their very nature to be hazardous, as much for their ability to start bush fires as their susceptibility to bush fire impacts. New developments of this nature should be avoided on bush fire prone land. However, where hazardous industries are proposed, in preparation of a bushfire assessment, the Fire Safety Study prepared under the *DPIE Hazardous Industry Planning and Assessment Papers* (HIPAPs) should be considered.

This study provides details of all credible fire hazards and the associated fire prevention and mitigation measures for the development. The bush fire assessment must address the appropriate protection measures to be provided commensurate with the bush fire hazards and associated risks. Care should also be taken to ensure that such facilities do not impact on existing developments.

Preliminary Hazard Analysis is required to be completed by an appropriately qualified fire engineer to assess the internal fire ignition of the site. The bush mitigation measures will assist in the control and spread of fire from the site, although further structural fire mitigation measures may be required.

Table 5 *DPIE Hazardous Industry Planning and Assessment Papers*

HIPAP	Bush fire considerations
Industry Emergency Planning Guidelines	Evacuation and emergency management arrangements prior to and during bushfire events within the NSW RFS district shall be included in the facilities Bush fire emergency and operations plan. This will include: • Bush fire decision triggers. • action require at each decision trigger. • responsibilities to implement the actions. A bushfire emergency and operations plan has been developed for the site.
Fire Safety Study Guidelines	This bush fire assessment report forms one element in the safety assurance process. The application of the recommendations within this report will mitigate the risk of a bushfire impacting on the site to acceptable levels.
Risk Assessment	This bush fire assessment report forms one element in the risk assessment process. The application of the recommendations within this report will mitigate the risk of a bushfire impacting on the site to acceptable levels.
Risk Criteria for Land Use Planning	The land use and siting of this development is appropriate for bush fire protection requirements.
Hazard Audit Guidelines	Bush fire emergency and operations plan includes annual audit reviews. Specific attention shall be afforded to: • Ensuring any future installed/established landscaping features comply with bush fire requirements. • Asset Protection Zones are maintained (vegetation management) to the required fire fuel loads, removing the ability for vegetation and accumulation creep over time. • Fire trail conditions and capacity are maintained. • Review of bush fire emergency management arrangements
Guidelines for Hazard Analysis	This bush fire assessment report forms one element in the hazard analysis process. The application of the recommendations within this report will mitigate the risk of a bushfire impacting on the site to acceptable levels.

Construction Safety Studies	The Construction Safety Study identifies all hazards which are specific to demolition, construction and commissioning activities associated with proposed development. This analysis is outside the requirements of bush fire planning.
HAZOP Guidelines	The HAZOP process is used to identify potential hazards and operational problems in terms of plant design and human error. This analysis is outside the requirements of bush fire planning.
Safety Management System Guidelines	Evacuation and emergency management arrangements prior to and during bushfire events within the NSW RFS district shall be included in the facilities Safety Management System (SMS), supported by the Bush fire emergency and operations plan.
Land Use Safety Planning	This bush fire assessment report forms one element in the land use safety planning process. The application of the recommendations within this report will mitigate the risk of a bushfire impacting on the site to acceptable levels.
Route Selection	These guidelines provide an overall integrated framework for the assessment of road transport routes for the transportation of hazardous materials. This analysis is outside the requirements of bush fire planning.
Hazards-Related Conditions of Consent	The application of the recommendations within this report will mitigate the risk of a bushfire impacting on the site to acceptable levels.

7 CONCLUSION AND RECOMMENDATIONS

In accordance with the provisions of PBP 2019, the recommendations outlined within this assessment will reduce the risk of damage and/or harm in the event of a bushfire event to acceptable levels. Compliance with the below recommendations can be achieved or practically implemented without substantial change to the proposed layout or construction methodology. It is recommendations that development consent be granted subject to the following conditions:

Asset Protection Zones

Due to the restricted size of the site, the ability to apply the 10m APZ external to the perimeter fencing and screening vegetation is limited. The perimeter vegetation screening complies with the intent of APZ standards when the following provisions are applied:

- No shrub vegetation proposed.
- Grasses maintained to 10cm height.
- All branched <2m above surface level removed.

10m APZ internal to the perimeter vegetation screening and perimeter fencing.

The entire area internal to the vegetation screening and perimeter fencing is managed as an APZ.

Prior to issuing final certification the consent authority shall ensure the APZ identified in **Figure 2, page 8** of this report is managed as an Inner Protection Area (IPA) as outlines within Appendix 4 of Planning for Bushfire Protection 2019, and NSW Rural Fire Service 'Standards for Asset Protection Zones'.

Landscaping

A Landscaping plan is required to illustrate:

- 10m APZ internal to the perimeter vegetation screening and perimeter fencing.
- No infrastructure except for the fire trail within the 10m APZ.
- Fire trail established within APZ internal to the perimeter fencing around the compound.
- The following landscaping maintenance of the perimeter vegetation screening:
    - No shrub vegetation proposed.
    - Grasses maintained to 10cm height.
    - All branched <2m above surface level removed.

The following principles shall be applied to the landscaping features:

- Planting does not provide a continuous canopy in a line towards the facility.
- Avoid species with rough fibrous bark, or which retain/shed bark in long strips or retain dead material in their canopies.
- Use smooth bark species of trees species which generally do not carry a fire up the bark into the crown.
- Avoid planting of deciduous species that may increase fuel at surface/ ground level (i.e., leaf litter).
- Avoid climbing species. and low flammability vegetation species are used.

Construction Standards

The BESS external construction shall be non-combustible with any vents, breathers or the like must be screened with steel, bronze, or aluminium to maximum allowable aperture of 2mm.

Where explosion vents or other penetrations are provided, ensure they are arranged and directed away from dedicated building providing support equipment and entrance to the site.

The dedicated building providing support equipment must comply with section 3 and section 5 (BAL 12.5) Australian Standard AS3959-2018 Construction of buildings in bush fire-prone areas or NASH Standard National Standard Steel Framed Construction in Bushfire Areas – 2021 as appropriate and section 7.5 of Planning for Bush Fire Protection 2019.

Access

A perimeter trail shall be located within the 10m internal APZ that shall comply with:

- The capacity of private property access of road surfaces and any bridges/ causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges and causeways are to clearly indicate load rating,
- Category 1 fire appliance to within 4m of the static water supply,
- Minimum carriageway width of 4m, with passing bay of 6m wide for 20m in length established every 200m,
- A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, and
- Curves have a minimum inner radius of 6m and are minimal in number to allow for rapid access and egress,
- The minimum distance between inner and outer curves is 6m,
- The crossfall is not more than 10°, and
- Maximum grades for sealed roads do not exceed 15° and not more than 10° for unsealed roads.

Water Supply

For bush fire purposes, a minimum 10,000L static water is provided that can be accessed from the internal perimeter roads in accordance with Table 7.4a of PBP 2019. This includes:

- Provided near the entrance to the facility and at least 10m from any electrical substations, inverters, battery energy storage systems infrastructure and outside the 10m internal APZ.
- A connection for firefighting purposes is located within the IPA or non-hazard side and away from the structure; 65mm Storz outlet with a ball valve is fitted to the outlet,
- Ball valve and pipes are adequate for water flow and are metal,
- Supply pipes from tank to ball valve have the same bore size to ensure flow volume,
- Underground tanks have an access hole of 200mm to allow tankers to refill direct from the tank,
- A hardened ground surface for truck access is supplied within 4m,
- Above-ground tanks are manufactured from concrete or metal,
- Raised tanks have their stands constructed from non-combustible material or bush fire-resisting timber (see Appendix F AS 3959),
- Unobstructed access can always be provided,
- Static Water Supplies (SWS) are clearly marked with SWS signage place at the front gate and in location that guide responding fire agencies to the location of the water supply on site (Refer to Appendix),
- Tanks on the hazard side of a building are provided with adequate shielding for the protection of firefighters,
- All exposed water pipes external to the building are metal, including any fittings.

Electricity services

Where practical, electricity should be placed underground.

If overhead power supply is provided, the const authority shall determine vegetation management is in accordance with Energy Australia ‘Vegetation Safety Clearances’ (NS179, April 2002).

Emergency Management

A dedicated building shall be provided with support equipment and entrance to the site. Site personnel shall be trained in the use of firefighting equipment which shall be maintained and accessible to all stages of construction and ongoing operations. Equipment should be appropriate to the activities being conducted and as a minimum must include:

- Bushfire survival kit,
- Fire pants and jacket,
- Fire extinguishers,
- Knap sacks, and
- Hand tools (e.g., fire rakes).

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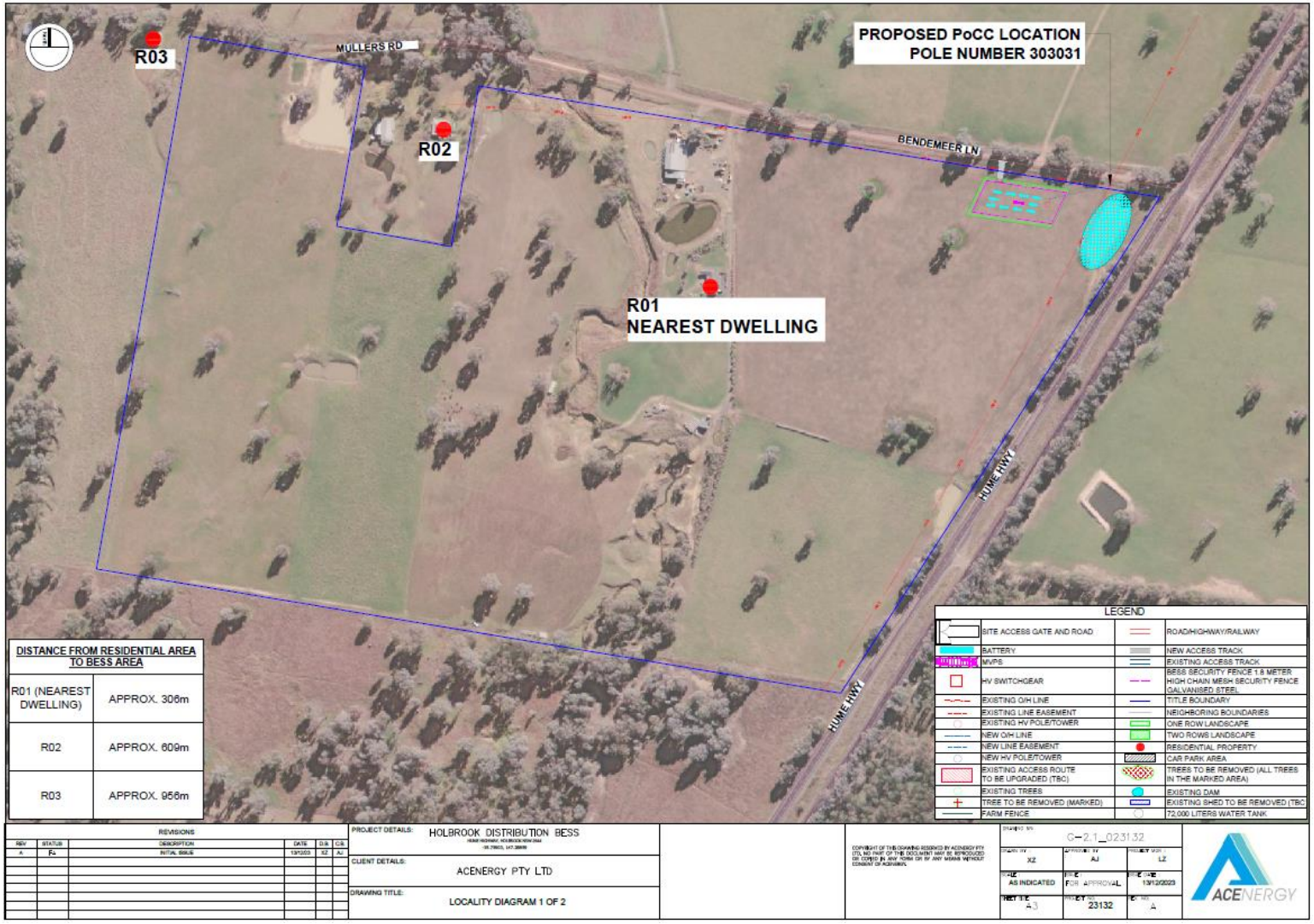
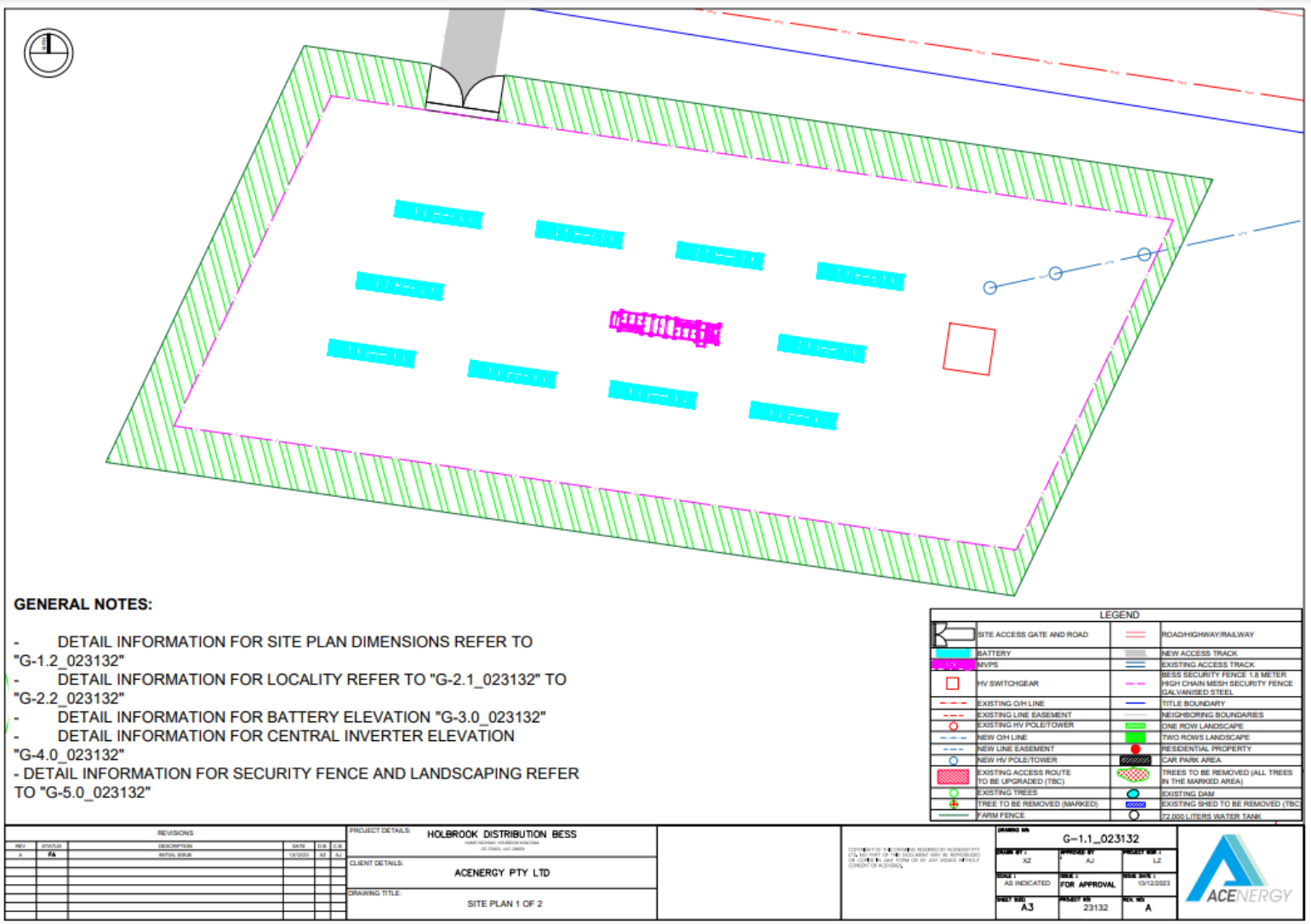
9 APPENDIX 1 SITE LAYOUT PLANS

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- DETAIL INFORMATION FOR LOCALITY REFER TO "G-2.1_023132" TO "G-2.2_023132"
- DETAIL INFORMATION FOR BATTERY ELEVATION "G-3.0_023132"
- DETAIL INFORMATION FOR CENTRAL INVERTER ELEVATION "G-4.0_023132"
- DETAIL INFORMATION FOR SECURITY FENCE AND LANDSCAPING REFER TO "G-5.0_023132"
LEGEND
SITE ACCESS GATE AND ROAD
ROAD/HIGHWAY/RAILWAY
BATTERY
NEW ACCESS TRACK
MVPS
EXISTING ACCESS TRACK
HV SWITCHGEAR
BESS SECURITY FENCE 1.8 METER HIGH CHAIN MESH SECURITY FENCE GALVANISED STEEL
EXISTING O/H LINE
TITLE BOUNDARY
EXISTING LINE EASEMENT
NEIGHBORING BOUNDARIES
EXISTING HV POLE/TOWER
ONE ROW LANDSCAPE
NEW O/H LINE
TWO ROWS LANDSCAPE
NEW LINE EASEMENT
RESIDENTIAL PROPERTY
NEW HV POLE/TOWER
CAR PARK AREA
EXISTING ACCESS ROUTE TO BE UPGRADED (TBC)
TREES TO BE REMOVED (ALL TREES IN THE MARKED AREA)
EXISTING TREES
EXISTING DAM
TREE TO BE REMOVED (MARKED)
EXISTING SHED TO BE REMOVED (TBC)
FARM FENCE
72,000 LITERS WATER TANK
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CLIENT DETAILS: ACENERGY PTY LTD
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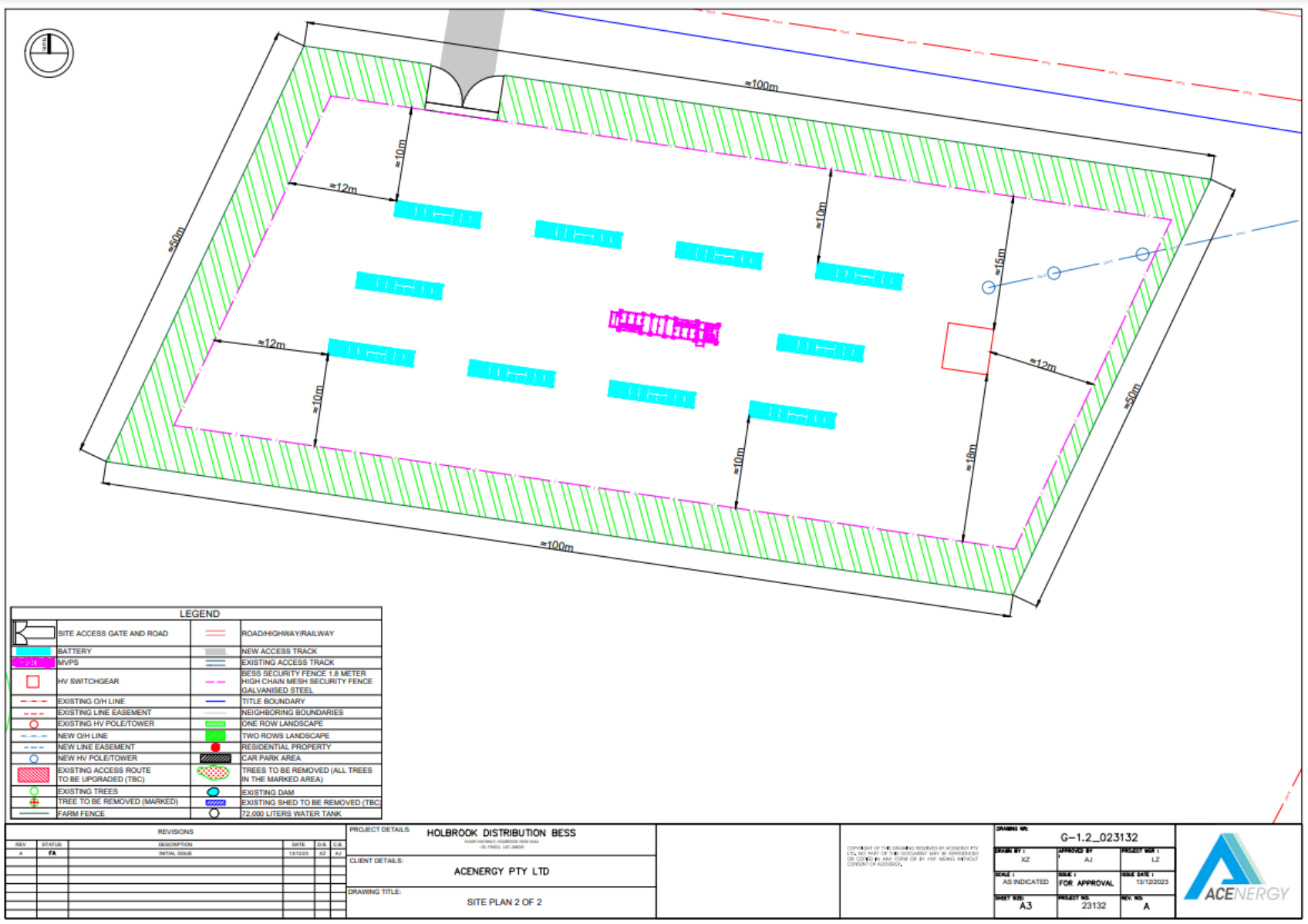
DRAWN BY: XZ
APPROVED BY: AJ
PROJECT MGR: LZ
SCALE: AS INDICATED
FOR APPROVAL
13/12/2023
SHEET SIZE: A3
PROJECT NO: 23132
REV. NO: A
ACENERGY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BATTERY
NEW ACCESS TRACK
MVPS
EXISTING ACCESS TRACK
HV SWITCHGEAR
BESS SECURITY FENCE 1.8 METER HIGH CHAIN MESH SECURITY FENCE GALVANISED STEEL
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10 APPENDIX 2 PLATES (PHOTOGRAPHS)

Plates 1 –5 depict the elements in and around the site that are considered within the bush fire hazard assessment.

Plate 1 *(P1) Access along access lane and entrance to site*

Plate 2 *(P2) Vegetation to the west*

Plate 3 *(P3) Vegetation to the east*

Plate 4 *(P4) View of the site from the south-west*

Plate 5 *(P5) Vegetation to the north*

11 APPENDIX 3 BUSH FIRE PROTECTION MEASURES

The following information on building survivability and the application of Bushfire Protection Measures should be considered continually for the life of the development. These measures facilitate meeting the aims and objectives of PBP 2019 and mitigating bushfire risk and are provided to inform the client.

Why do buildings burn during bush fires?

Research has been undertaken to over the last decades to analysis and determine the elements that determine the survivability of a building during a bush fire event. As the research is validated, these elements are incorporated into planning documentation that guides construction in bush fire prone areas, such as Australian Standard 3959 and NSW RFS Planning for Bushfire Protection.

Research has illustrated that there are three ways a bush fire impacts a building:

1. Direct flame contact,
2. Radiant heat from the bush fire, and
3. Embers generated by the bush fire.

Most people expect direct flame contact to be the biggest risk to homes in a bush fire, but this is not the case. Over 80% of house loss during bush fires occurs because of ember attack; the burning firebrands of bark, leaves and twigs with winds drive away from the main fire front. They find weaknesses in houses such as gaps, cracks to combustible construction materials and can quickly lead to ignition of the building.

Significantly, vegetation that is established adjacent to the building and within the Asset Protection Zone following the construction of the building, which provides fuel for burning embers to ignite and increase the ignitability of the building. It is critical that the Asset Protection Zone are maintained throughout the life of the property, so that wildfire is not encouraged closer to the building.

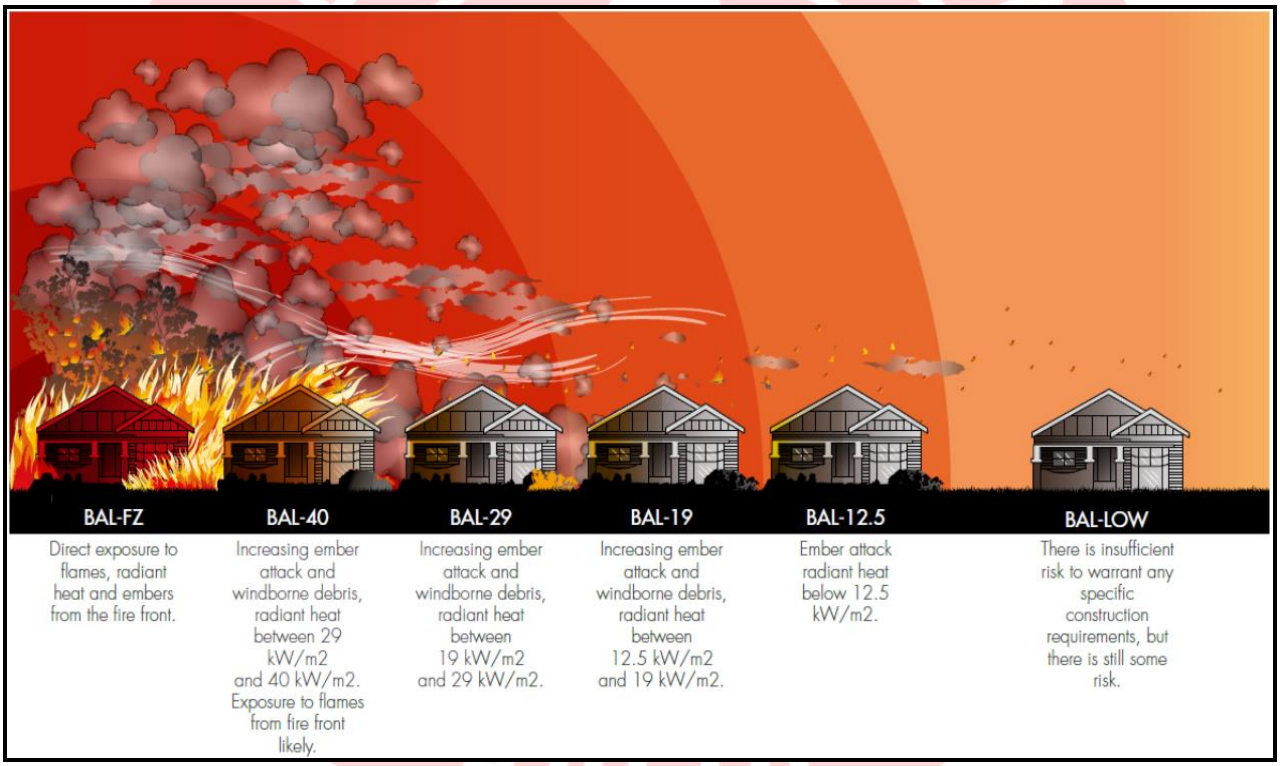
The research has illustrated the separation between the bushfire threat and building; and the construction standards of the building are the principal elements to building survivability. It is critical that:

1. Any future alterations and additions to the building are undertaken with materials that comply with the relevant BAL of the building.
2. The separations between the building and bush fire threat (known as the Asset Protection Zones (APZ)) are maintained to low flammability. This means restricted gardens and combustible elements, such as timber landscaping and furnishings. It is critical to maintain '*fire hygiene'* around the building.

Australia Standard 3959 Construction of buildings in Bush fire prone areas and Bush fire Attack Level (BAL)

Bush fire Attack Level (BAL) ratings refer to the fire intensity your house is likely to be subjected to in a bush fire, expressed in terms of radiant heat. The BAL assessment forms the construction component of the bush fire assessment process. The other component is the Bush fire planning, which includes Asset Protection Zones (APZ), separation to provide defendable spaces, access, water, electricity, gas, landscaping and emergency management.

Furthermore, the measures contained in the *Australian Standard 3959 Construction of buildings in Bushfire Prone Areas* for each BAL construction level are not for fire resistance. The building will burn. The construction standards are aimed at slowing the ignition and fire spread of the building to provide adequate time to enable occupants to shelter within the building as the bushfire front passes. The degree of vegetation management within the APZ, the unpredictable nature of behaviour of fire, and extreme weather conditions make building adjacent to vegetation very dangerous.



Relationship between fire behaviour and BAL (WA Guidelines for Planning in Bush fire Prone Areas, 2017)

Design and Siting

The design and siting of a building can be of critical importance during bush fire attack event. The appropriate design and siting can reduce the impact of bush fire attack mechanisms of direct flame, radiant heat, ember attack, smoke, and wind. Key principles to consider when designing and siting a new development include the following:

- Avoid building on ridges, saddles and build on level ground wherever possible.
- Utilise cut-in benches, rather than elevating the building when building on sloping land.
- Avoid raised floors and protect the sub-floor areas by enclosing or screening.

- Provide an appropriate shelter room that is located on the lowest or non-bush fire hazard side of the building, near building exits and provides the occupant views of the outside environment.
- Reduce bulk of building, limit re-entrant corners, and incorporate simplified roof that are able to self-clean of debris.
- No gutters on second or consecutive storeys of building and avoid box gutters.
- If gutters are installed, incorporate gutter guards with a flammability index more than 5 when tested to AS1530.2, or aluminium, bronze, or stainless steel with maximum aperture of 5mm.
- Limit glazing elements on the sides of the building exposed to the bush fire threat and use shutters to protect glazing elements.
- Carparking provided in a location that does not interfere with escape routes.
- Position development so any gas supplies and overhead electricity are positioned not to impede egress to and from the site.
- Class 10a buildings (such as shed, carport, and garages) should be a minimum of 6m away from any other building. Consider the storage of hazardous materials (petrol, kerosene, alcohol, LPG, natural gas, acetylene, vehicle, machinery etc.) within Class 10a buildings when siting in proximity to Class 1a occupied building and escape routes.
- Provide unobstructed access around the entire building supported by a minimum 1m wide concreted path to the external wall.

Asset Protection Zones

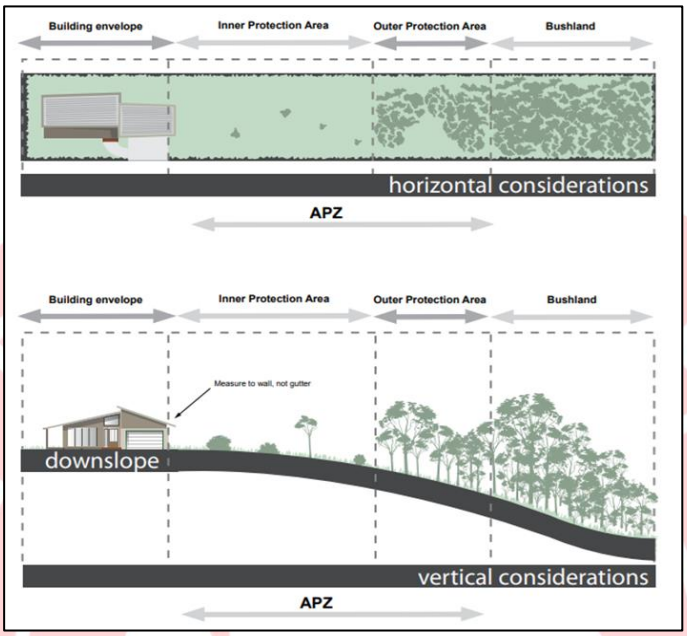
An APZ is an area surrounding a development that is managed to reduce the bushfire hazard to an acceptable level to mitigate the risk to life and property. The required width of the APZ varies with slope and the type of hazard. An APZ should be maintained in perpetuity to ensure ongoing protection from the impact of bush fires. Maintenance to the below standards should be undertaken on an annual basis, in advance of the fire season, as a minimum.

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

An APZ can consist of both an Inner Protection Area (IPA) and an Outer Protection Area (OPA) as indicated below. An APZ can include the following:

Footpaths	Driveways
Lawns	Unattached non-combustible garages as long as suitably separated
Discontinuous gardens	Open space / parkland
Swimming pools	Car parking

Isolated areas of shrub and timbered vegetation are generally not a bush fire hazard as they are not large enough to produce fire of an intensity that will threaten dwellings. These areas include narrow strips of vegetation along road corridors.



Components of an APZ (Figure A4.1 - PBP 2019)

Any areas that are designated Asset Protection Zones, should be delineated by rural fencing, signposted or bollards (whatever is practical in the circumstances) to ensure vegetation creep does not occur and further landowners and ground management are aware that the area is to be maintained for Bush fire protection purposes. Examples are provided below:

Inner Protection Area (IPA)

The IPA extends from the edge of the OPA to the development. The IPA is the area closest to the asset and creates a fuel-managed area which can minimise the impact of direct flame contact and radiant heat on the development and be a defendable space. The intent of an IPA is to stop the transmission of flame and reduce the transmission of radiant heat by the elimination of available fire fuel. This area also allows

airborne embers to fall safely without igniting further outbreaks and provides a safer firefighting position and is operationally important for implementation of clear fire control lines.

In practical terms the IPA is typically the curtilage around the dwelling, consisting of a mown lawn and well-maintained gardens. When establishing and maintaining an IPA the following requirements apply:

- Vegetation within the IPA should be kept to a minimum level. Litter fuels (leaves and vegetation debris) within the IPA should be continually removed and kept below 1cm in height and be discontinuous. There is minimal fine fuel at ground level which could be set alight by a bushfire.
- Canopy cover should be less than 15% (at maturity). Trees (at maturity) should not touch or overhang the building and should be separated by 2 to 5m.
- Lower limbs of canopy trees should be removed up to a height of 2m above ground.
- Preference should be given to smooth barked and evergreen trees.
- Large discontinuities or gaps in the shrub vegetation shall be established to slow down or break the progress of fire towards buildings.
- Shrubs should not be located under trees and not form more than 10% ground cover
- Clumps of shrubs should be separated from exposed windows and doors by a distance of at least twice the height of the vegetation.
- Grasses should be kept mown (as a guide grass should be kept to no more than 100mm in height), and
- Woodpiles, wooden sheds, combustible material storage areas, large areas / quantities of garden mulch, stacked flammable building materials etc. are not permitted in the IPA.

Outer Protection Area (OPA)

An OPA is located between the IPA and the unmanaged vegetation. Vegetation within the OPA can be managed to a more moderate level. The reduction of fuel in this area substantially decreases the intensity of an approaching fire and restricts the pathways to crown fuels, reducing the level of direct flame, radiant heat and ember attack on the IPA.

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

In practical terms the OPA is an area where there is maintenance of the understorey and some

separation in the canopy. When establishing and maintaining an OPA the following requirements apply:

- Tree canopy cover should be less than 30%, canopies should be separated by 2 to 5m
- Shrubs should not form a continuous canopy and form no more than 20% of ground cover
- Grasses should be kept to no more than 100mm in height with leaf and other debris should be mown, slashed or mulched.

Furthermore, the edge of the APZ should be clearly delineated to ensure vegetation creep does not occur over time, reducing the separation between the bushfire hazard and building.

Gardens and vegetation within the APZ

All vegetation will burn under the right conditions.

In choosing plants for landscaping consideration should be given to plants that possess properties, which help to protect buildings. If the plants themselves can be prevented from ignition, they can improve the defence of buildings by:

- Filtering out wind-driven burning debris and embers.
- Acting as a barrier against radiation and flame, and
- Reducing wind forces.

Consequently, landscaping with vegetation of the site should consider the following:

- Meet the specifications of an Inner Protection Area (IPA) detailed in PBP 2019.
- Priority given to retaining or planting species which have a low flammability and high moisture content.
- Priority given to retaining or planting species which do not drop much litter in the bushfire season, and which do not drop litter that persists as ground fuel in the bush fire season, and
- Create discontinuous or gaps in the vegetation to slow down or break the progress of fire towards the dwellings.
- Avoid gardens within 10m of the exterior building envelop.
- Trees and shrubs within 40m are not continuous, but instead arranged as discrete patches separated by a ground layer with low fuel hazard, such as mown grass.
- Position courtyards, gardens, and grassed areas in locations that facilitate the protection of the building.
- Install pebble/rock garden beds avoiding the use of mulch and wood chip.

Consideration should be given to vegetation fuel loads present on site. Careful thought must be given to the type and physical location of any proposed site landscaping.

Inappropriately selected and positioned vegetation has the potential to 'replace' any previously removed fuel load.

Whilst it is recognised that fire-retardant plant species are not always the most aesthetically pleasing choice for site landscaping, the need for adequate protection of life and property requires that a suitable balance between visual and safety concerns be considered. The below list of well know ground fire-retardant plants is intended as a guide only, check with your local council for information more specific to your area.

Lomandra longifolia	*Dampiera*
Lomandra hystrix	*Scaevola aemula*
Anigozanthos hybrids	*Succulents (most)*
Agapanthus orientalis	*Carpobrotus (Pigface)*
Liriope muscari	*Cotyledon*
Carpobrotus glaucescens	*Ajuga australis*
Casuarina glauca	*Myroporum*
Ajuga	*Nepeta* (catmint)
Brachyscome	*Mesembryanthemum*

Strategically positioned elevated vegetation (fire-retardant tree and shrub species) can act as 'windbreaks' and 'ember filter', reducing wind velocities and suppressing the density of embers attacking a building. It is critical that this vegetation is:

- On flat ground place >30m from the building (ideally 40m forming the outer perimeter of the IPA).
- >20m separation from the hazardous vegetation.
- Located on the side of the bush fire hazard.
- No gardens of shrubs under the trees.
- Shrub patches no greater than $10m^2$.

The below list of well know fire-retardant trees and shrubs is intended as a guide only, check with your local council for information more specific to your area:

Melia azederach (Cape Lilac)	*Citrus trees*
Brachychiton aecerifolius (Flame tree)	*Loquot*
Magnolia grandiflora	*Arbutus Quercus (only the deciduous oak)*
Pyrus (most ornamental pears)	*Feijoa*
Magnolia Little Gem	*Gleditzia*
Ulmus chinensis (Chinese Elm)	*Ficus (all including edible)*
Acacia howitii	*Aloe (all)*
Cercis (Judus Tree)	*Correa*
Acmena smithii (Lilypily)	*Acacia iteaphyla*
Prunus (all including ornamental)	*Scaevola crassifolia*
Cupaniopsis anacardiopsis (Tuckeroo)	*Viburnum tinus*
Malus (apple trees)	*Atriplex (saltbush)*
Eleocarpus	*Escallonia*
Mullbery	*Maireana (Cottonbush)*
Eremophila (Emu bush)	*Leucophyta brownii*
Melaleuca nodosa	*Plectranthus*
Syzygium (lilypilly)	*Santolina*
Photinia	*Coprosma*
Rhagodia (saltbush)	*Strelitzia*
Acacia Cyclops	*Senna (Silver Cassia)*

Recent post-fire research from the 2019/20 bushfire season suggests greenness factor (the extent to which plants are actively growing) had an impact on building survivability to a bushfire, indicating that maintained green grasses and landscape watering features are beneficial during a bushfire.

It is essential that any vegetation and landscaped areas and surrounds are subject to ongoing fuel management and reduction to ensure that fine fuels do not build up.

Landscaping features within the APZ

A combination of hard (materials) and soft (design) landscaping will benefit the survivability of a building during a bushfire event. The type, quantity and condition of fuel has a very important effect on bushfire behaviour in proximity to a building. Poorly located vegetation that burns readily may expose a house to increased levels of radiant heat and flame contact.

- Non-flammable features such as tennis courts, swimming pools, dams, patios, driveways or paths should be incorporated into the proposal, especially on the northern and western sides of the proposed building.
- Remove other flammable objects from around the house. These include sheds, caravans, outdoor furniture, barbeques, gas bottles, wood piles and organic mulch.
- Avoid flammable mulches within the APZ. Alternatives include gravel, scoria, pebbles, shells or recycled crushed bricks.
- Use non-combustible, moveable containers and pots that can be relocated in the summer.
- Restrict the use of door mats and place firewood stacks >10m from building.
- Restrict the use of timber and use materials such as brick, earth, stone, concrete and galvanised iron
- Metal screens can help to shield your house from radiant heat, direct flame contact and ember attack.
- An intensive area of planting centred on a contoured garden mound provide an effective screening.
- Fencing in BAL 29 or within 6m of a building should be of non-combustible materials.
- Establish a path immediately around the external wall of the building. Do not place garden beds adjacent to the external fabric of the building and under windows.
- Clumping shrubs and trees so they do not form a continuous canopy and are separated by areas of low fuel (maintained green grass lawn).

Further information can be found here - Landscaping for bushfires

Access Requirements

In the event of a serious bushfire threat to the proposed development, it will be essential to ensure that adequate ingress/ egress and the provision of defendable space are afforded in the development/building design.

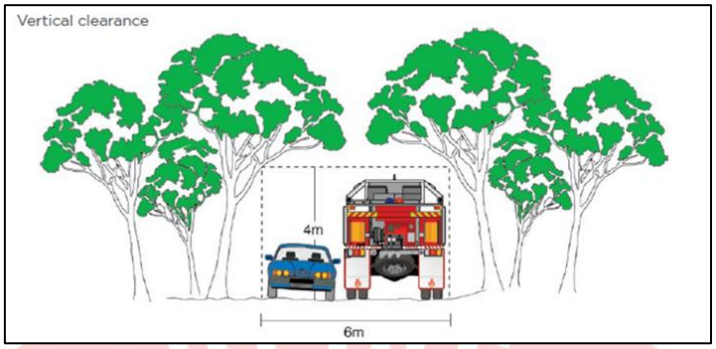
Local Area Traffic Management (LATM)

The objective of LATM is to attain an acceptable level of speed, volume, and composition of traffic within a local area and reduce the number of road accidents. This is achieved by modifying the street environment through the installation of various traffic control devices. LATM devices by their nature are designed to restrict and or impede the movement of traffic, especially large vehicles, which conflicts with the intent for access required by the NSW RFS and may significantly increase response times for emergency services.

Where LATM devices are provided they are to be designed so that they do not impede fire vehicle access.

Vertical clearance

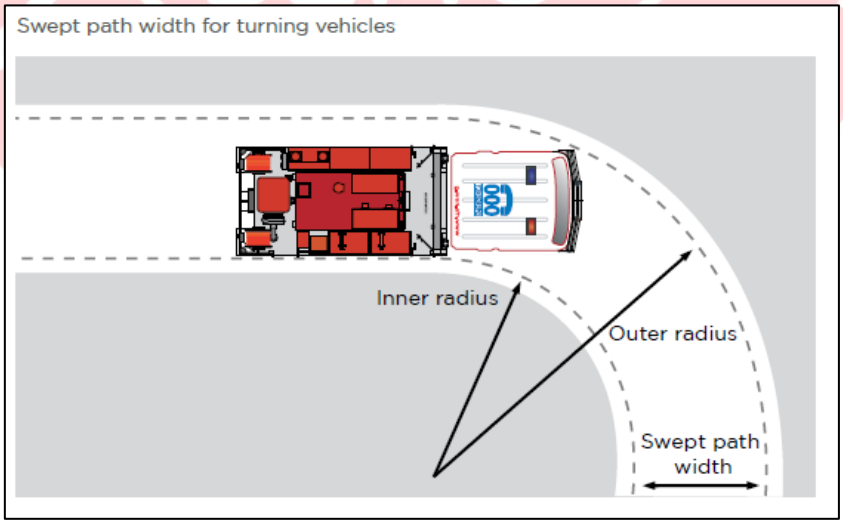
An unobstructed clearance height of 4 metres should be maintained above all access ways including clearance from building construction, archways, gateways/doorways, and overhanging structures (e.g., ducts, pipes, sprinklers, walkways, signs and beams). This also applies to vegetation overhanging roads and fire trails.

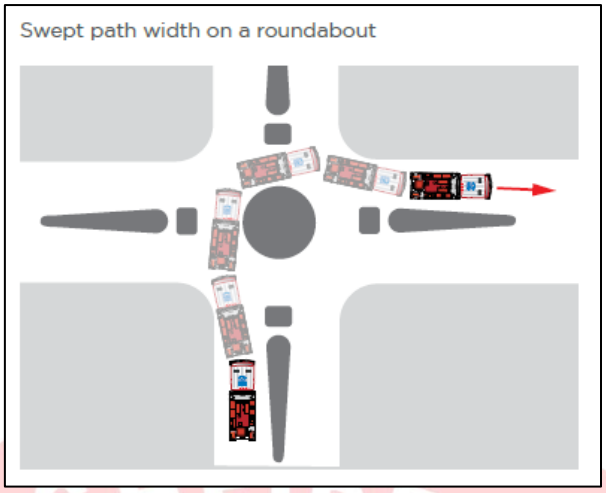


Vehicle Turning Requirements

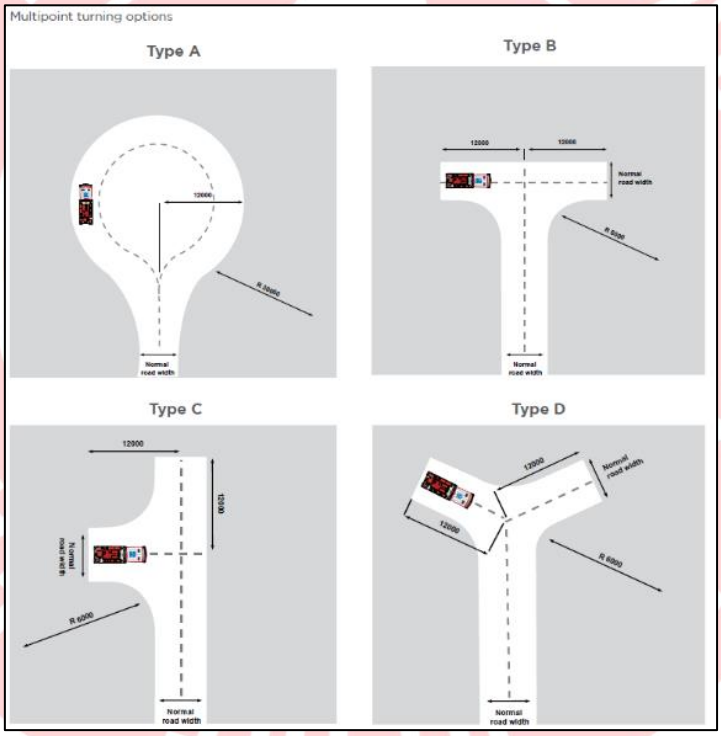
Fire crews must have rapid access and egress for vehicles, therefore curved carriageways should be constructed using the minimum swept path. The below diagrams from PBP2019 provide indication of the requirements to be achieved.

Minimum curve radius (inside edge (m))	Swept path (m) wide
<40	4.0
40 -69	3.0
70 - 100	2.7
>100	2.5





Where a turning head is proposed the NSW RFS requires that dead ends having a length greater than 20 metres should be provided with a turning head area which avoids multipoint turns.



Passing Bays

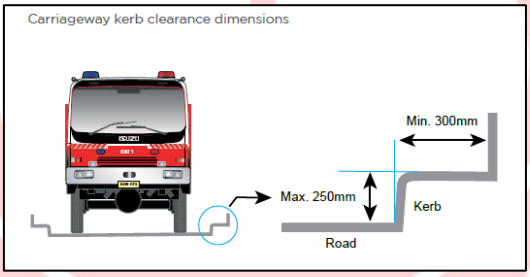
The construction of passing bays, where required, shall be 20m in length, provide a minimum trafficable width at the passing point of 6m.

Parking

Parking can create a pinch point within the road reserve. The location of parking should be carefully considered to ensure fire appliance access is unimpeded. Hydrants should be located clear of any parking areas to ensure that access is always available.

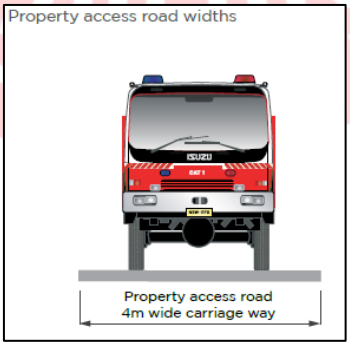
Kerb Dimensions

All kerbs constructed around access lanes should be no higher than 250mm and free of vertical obstructions at least 300mm back from the kerb face to allow clearance for front and rear body overhang.



Road Types

Property access is required to be 4m wide all-weather road. Can be sealed or unsealed.



Water Supply

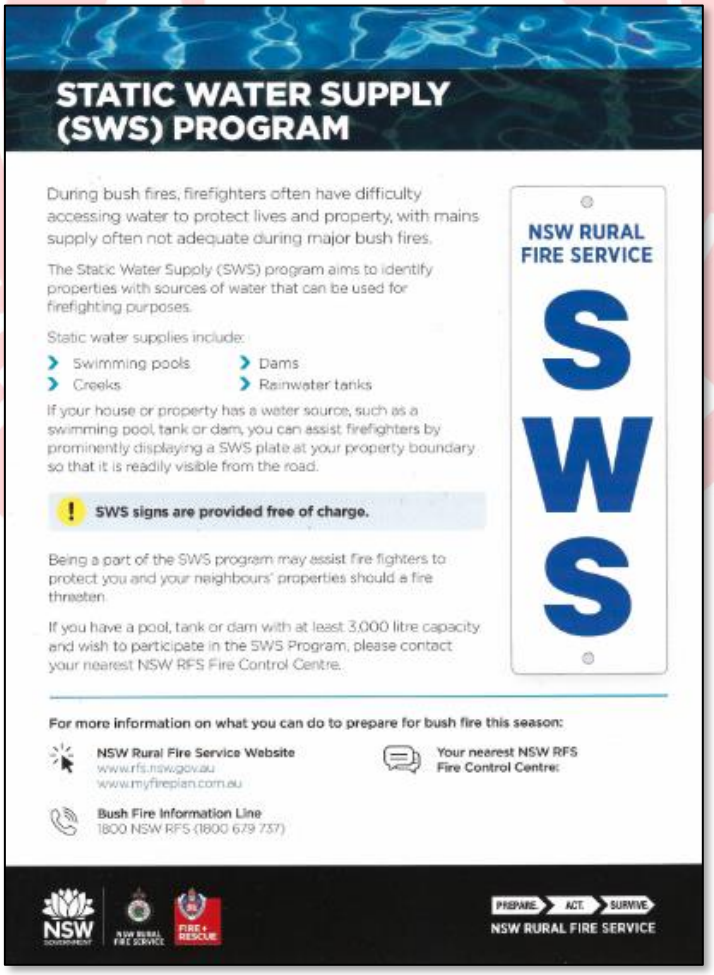
The intent of water measures is to provide adequate services of water for the protection of dwellings during and after the passage of a bush fire.

Where reticulated water supply is not provided, a static water supply for fire-fighting purposes should be above-ground, accessible, clearly marked and manufactured from concrete or metal. If raised, the tank stand should be made from non-combustible material. These static water supplies (tanks) should be positioned on the non-hazard side of the building and have 65mm Storz outlet with a ball valve fitted to the outlet within the IPA. If not appropriate, they should be appropriately shielded to protect the tank and fire fighters accessing the water. Category 1 fire appliances should be able to access within 4 m of static water supply with a hardened ground surface to support this access.

All exposed water pipes, values, taps and fittings should be metal and the supply line from tank to ball valve have the same bore size.

Where pumps are provided, they are a minimum 5hp or 3kW petrol or diesel-powered pump and are shielded against bush fire attack. Any hose and reel for firefighting connected to the pump shall be 19mm (internal diameter), and fire hose reels are constructed in accordance with AS/NZS 1221:1997 Fire hose reels and installed in accordance with AS 2441:2005 Installation of fire hose reels.

Where static water supply is provided the following signage should be installed at the front gate and at a location that is clearly visible (assume smoke) to approaching emergency services to guide them to the static water supply.



Electricity, Gas supplies and Hazardous materials

The intent of electricity, gas and hazardous material measures is to locate these utilities and materials so as not to contribute to the risk of fire to a building.

Electricity

Location of electricity services should limit the possibility of igniting the surrounding bush land or the fabric of buildings. Where practicable, electrical transmission lines are underground. If overhead, electrical transmission lines are installed with short pole spacing (30m), unless crossing gullies, gorges, or riparian areas, then no part of a tree is closer to a power line than the distance set out in accordance with the specifications in ISSC3 Guideline for Managing Vegetation Near Power Lines.

For further information visit https://www.electricitysafety.com.au/

Gas

Any reticulated or bottled gas should be installed and maintained according to the requirements of the relevant authorities and AS/NZS 1596:2014. All fixed gas cylinders are kept clear of all flammable materials to 10m and shielded on the hazard side. All above-ground pipes and connections to and from gas cylinders are metal, and polymer-sheathed flexible gas supply lines to gas meters adjacent to buildings are not permitted. Furthermore, if gas cylinders need to be kept close to the building, safety valves are directed away from the building and at least 2m away from any combustible material, so they do not act as a catalyst to combustion. Gas utilities should be positioned to not impede fire fighters accessing water supplies while undertaking suppression operations.

Hazardous Materials

Hazardous materials are any materials that can fuel the fire, such as leaf litter, grass, garden mulch and woodpiles. They can also be made up of solid combustibles or flammable liquids and gases such as petrol, kerosene, alcohol, LPG, natural gas, and acetylene. Vehicle, machinery, and other mechanical equipment that utilise fuels for operations can also be considered hazardous. The incorrect design and placement of carport and garages in residential developments could propagate fire towards the residential dwelling. Any liquids or fuels that are considered hazardous should be positioned away from the dominant bush fire threat. If located in a building/structure, it should be a minimum of 6m away from any other building. Vegetation surrounding these locations shall be maintained to IPA standards and the construction standards shall minimise the impact of ember attack to ignite the structure.

Construction Requirements

Groundwork and Sub-structure construction phase

During the ground phase potential ignition sources of the subject development may include hot works, incorrect disposal of cigarette butts and hot exhausts from vehicles, electrical failures, and sparks from metal contact.

Groundwork and Sub-structure construction phase fire management plan should be developed. Preparation of the site should include mitigating fire ignition sources. This should include vegetation management such as slashing and mowing long grasses in and around the development site, car parking

and access tracks. This is especially important during summer months where Rates of Spread of fire can significantly increase due to the prevailing weather condition.

Handheld fire extinguishers should be carried on each vehicle and on site for quick access and suppression of fires.

Where neither reticulated water nor an existing static water supply is available during the construction phase, a temporary 10,000 litre Static Water Supply within proximity of the development site shall be provided before the commencement of any construction works. This temporary supply will allow for the replenishment of attending fire services which will facilitate the rapid suppression of any potential ignitions. The temporary supply may be removed when the prescribed fire-fighting water supply is installed.

Ongoing Operations

Routine inspections of bush fire safety systems and equipment generally occur annually and are supported by a Bushfire Plan. Ideally these inspections should occur moving out of the colder months in preparation for the bushfire season. The most common types of inspections that are required are surface, near surface (grasses and debris) and elevated (shrub) fire fuel level accumulation in APZs, canopy separation reequipments in APZs, and maintaining building fire hygiene such as cleaning gutters and down pipes.

Developing and annually reviewing a bushfire plan, no matter how big or small the development, is critical to the ongoing maintenance of the Bushfire Protection Measures identified within this report.

Construction Standards

Australian Standard 3959 ''Construction of buildings in bushfire-prone areas‟ provides for six (6) levels of building construction these being BAL - Low, BAL - 12.5, BAL - 19, BAL - 29, BAL - 40 and BAL - FZ. The Australian Standard 3959 specifies construction standards for buildings within various Bushfire Attack Levels as determined by the Planning for Bushfire Protection – 2019 document.

Retrofitting

Any future alterations, extension to structures, even if they are complying, should consider the appropriate bushfire construction standards at that time. Homes built prior to August 2002 were not required to be built to meet bush fire construction standards. Constructions in Bush fire prone lands after August 2002 required bush fire construction standards, which have also changed over time.

The current construction standards are based on your Bush fire Attack Level (BAL). Evidence from large wildfire events over the last 20 years illustrate that house ignition is concentrated within 100m from the vegetation, although it can occur kilometres from the burning vegetation under worst case scenarios. Developments outside the bush fire prone area (100m from the vegetation) will benefit from increasing construction standards to withstand ember-attack to protect the building during a bush fire event.

When undertaking alterations and additions to a dwelling in Bush fire prone land only the new construction is required to conform with the current requirements, although this only partially protects your home.

Research has illustrated that ember-attack from the wildfire is the principal mechanism that ignites homes. The most vulnerable elements are timber decks, Eave fascia boards, gutters timber window frames and timber stairs. Furthermore, house-to-house fires occur following the ignition of a neighbouring

property. Appropriate amount of effort should be placed to ensure that vegetation and landscaping should be maintained to reduce the likelihood of ember attack igniting fire fuels near the house, and separation between neighbouring houses is achieved to reduce house-to-house fires. The use of non-combustible fencing and appropriately positioned windows can go a long way to reducing the risk of house-to-house fires.

While retrofitting identifies available construction protection methods as per *AS3959 – Construction of buildings in Bushfire Prone Area*, **it should be clearly understood that such building enhancements are complementary to good site preparation and vegetation management in the context of the bushfire survival plan**.

Routine maintenance is an important part of bushfire protection for your home, out-buildings and garden. For example, if a window/door metal shutter is fitted, it needs to work at the time of a bushfire threat just like your fire equipment needs to be ready to go.

Each retrofitting measure is a step towards making your home safer against the impact of embers and radiant heat in the event of a bushfire. If you want your home to be comparable to the construction requirements under AS 3959, then *ALL* the works associated with a particular BAL category will need to be undertaken.

Some of the basic retrofitting that can be undertaken:

- Enclose existing sub floors with suitable materials or construct the floor and structure with non-combustible materials
- Cover, seal, overlap, back or butt-joint all joints in the external surface material of walls to prevent gaps greater than 2mm.
- Seal vents, weepholes, breathers and openings with metal screens of aperture <2mm.
- Replace flammable external walls with non- combustible materials.
- Apply sarking-type material (flammability index >5) over the outer face of the building frame prior to re-fixing of any external cladding.
- Screen all windows and doors with metal screens of aperture <2mm and metal frames.
- Establish weather strips, draught excluders or draught seals around doors and panel lift garage doors.
- Garage roller doors could have guide tracks with a maximum gap area of 3mm and be fitted with a nylon brush in contact with the door.
- Above-ground, exposed water, gutter downpipes and gas supply pipes should be metal.
- incorporate gutter guards with a flammability index more than 5 when tested to AS1530.2, or aluminium, bronze, or stainless steel with maximum aperture of 5mm.
- Only use Bushfire resisting timber as specified in AS 3959 Appendix F.

Further information can be found at Guide-retrofit-your-home-for-better-bushfire-protection.