



APPENDIX R BUSHFIRE ASSESSMENT



The Plains Wind Farm

Bushfire Risk Assessment

PREPARED FOR



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The Plains Wind Farm

Bushfire Risk Assessment

0667692



Joanne Woodhouse

Principal Consultant



Mark Davey

Partner

Environmental Resources Management
Australia Pty Ltd
Level 14, 207 Kent Street
Sydney NSW 2000
T +61 2 8584 8888

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ACRONYMS AND ABBREVIATIONS

Acronyms	Description
APZ	Asset Protection Zones
AFDRS	Australian Fire Danger Rating System
AS 3959-2018	<i>Australian Standard 3959 - 2018 Construction of Buildings in Bushfire-prone Areas</i>
BC Act	<i>Biodiversity Conservation Act 2016</i>
BOM	Bureau of Meteorology
CASA	Civil Aviation Safety Authority
EIS	Environmental Impact Statement
EP&A Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
ERM	Environmental Resources Management Australia Pty Ltd
ha	hectare
m	metres
MNES	Matter of National Environmental Significance
NSW RFS	New South Wales Rural Fire Service
PBP 2019	Planning for Bushfire Protection 2019
RF Act	<i>NSW Rural Fires Act 1997</i>
SCADA	supervisory control and data acquisition
SEARs	Secretary's Environmental Assessment Requirements
SFAZ	Strategic Fire Advantage Zone
SSD	State Significant Development
TOBAN	Total Fire Ban

Important Note:

Despite the mitigation measures and treatments that are put in place, it is noted that some bushfire risk will always remain and that some of the infrastructure may be subject to direct flame contact. The absence of any identified hazard or asset in the Project Area should not be interpreted as a guarantee that such hazards or impacts do not exist. It is also important that a Bushfire Emergency Management and Operations Plan is prepared prior to the commencement of any construction works in conjunction with relevant stakeholders, including local fire services, NSW RFS, NSW Fire and Rescue, landowners and adjoining property owners.

Important Disclaimer:

Any representation, statement of opinion, or advice expressed or implied in the bushfire assessment will be made in good faith on the basis that ERM employees and / or agents are not liable (whether by reason of negligence, lack of care or any other reason) to any person, company or their agents for any damage or loss whatsoever which has occurred or may occur in relation to that person taking (or not taking) action in respect of any representation, statement or advice provided within the bushfire assessment.

1. INTRODUCTION

Engie Australia Pty Ltd ('ENGIE' or the 'Applicant') proposes to construct, operate, maintain and decommission The Plains Wind Farm (the 'Project') located south of Hay in the Riverina Murray Region of New South Wales (NSW).

The need for a Bushfire Risk Assessment was identified within the Secretary's Environmental Assessment Requirements (SEARs), and the *Rural Fires Act 1997* imposes obligations on land occupiers to take all practicable steps to prevent the occurrence and spread of wildfire to adjoining lands from lands under their care and management.

This report identifies potential hazards and risks associated with the Project and proximity to bushfire prone land. It contains management and mitigation measures designed to address these obligations consistent with similar projects of this nature in other parts of New South Wales (NSW) / Australia and in accordance with NSW Rural Fire Service (RFS) guidelines including Planning for Bush Fire Protection (PBP) (2019) inclusive of the PBP Addendum (2022).

It does not assess the individual design or engineering components of the wind farm (or other infrastructure as described in **Section 1.1**) themselves but does consider locations of the infrastructure relative to the identified hazards and the requirements for separation distances.

1.1 DESCRIPTION OF THE PROJECT

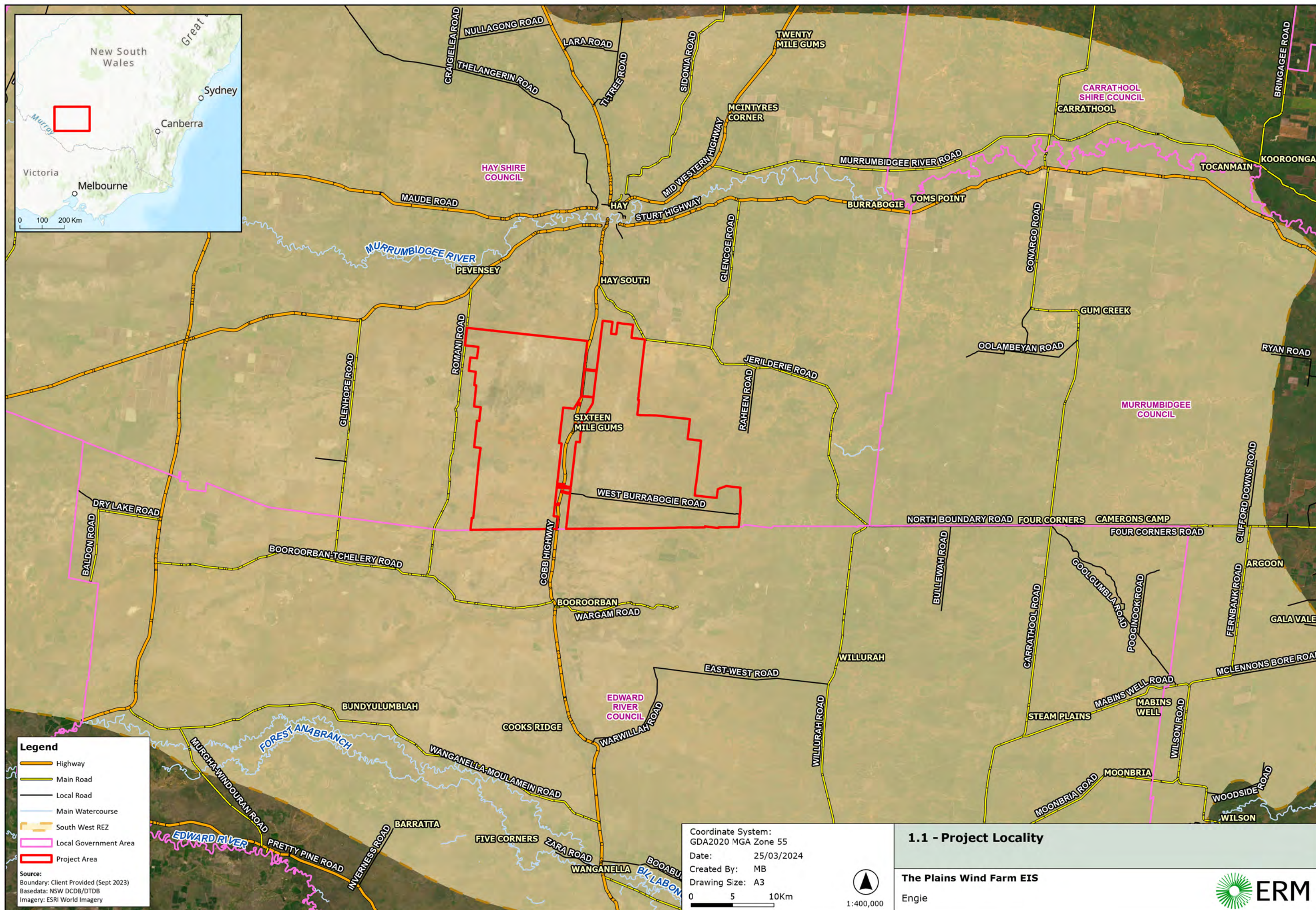
The Project is situated on Mungadal Station and neighbouring properties to the east and west of the Cobb Highway in the Riverina Murray Region of NSW. The Project Area extends across approximately 53,894 hectares (ha), over 314 freehold land parcels (and 6 parcels of Crown Land/ 'Road Casement'), in the Hay Shire Local Government Area (LGA). The Project is about 15 kilometres (km) (by road) south of Hay town centre and 10 km (by road) north of Boorooban village, via the Cobb Highway. The Project Area is located on land predominately used for agricultural activities.

Figure 1-1 shows the Project locality in a regional setting.

The Project involves the construction, operation and where relevant decommissioning of:

- 188 wind turbine generators (WTGs), with each having a hub height of up to 180 metres (m) and tip height of up to 270 m, and a total maximum capacity of up to 1,350 megawatts (MW);
- Electrical reticulation; and
- Associated and ancillary facilities.

Two accommodation compounds will be provided to accommodate the construction workforce (a peak construction workforce of approximately 700 FTE personnel with an average of 550 FTE during construction periods). Each compound will be located to the north and south of the western portion of the Project Area and will include accommodation and amenity facilities, car parking, food and catering facilities, recreational facilities, first aid facilities and telecommunication services for personal use. Accommodation facilities will consist of prefabricated demountable units, that will be delivered and installed on site.



The Project will be controlled by a remote supervisory control and data acquisition (SCADA) system housed in the control room located within the permanent site operations and maintenance facility. The SCADA system will allow remote operation of all WTGs with the ability to shut-down individual or all WTGs if required.

The Project Layout is provided in **Figure 1-2**. The final layout remains subject to further detailed design and refinement. To allow the Applicant to make general design refinements without the need to modify the application, the EIS has assessed impacts for an area that includes temporary and permanent Project infrastructure with, generally, a 100 m micro-siting buffer applied (the Project Area).

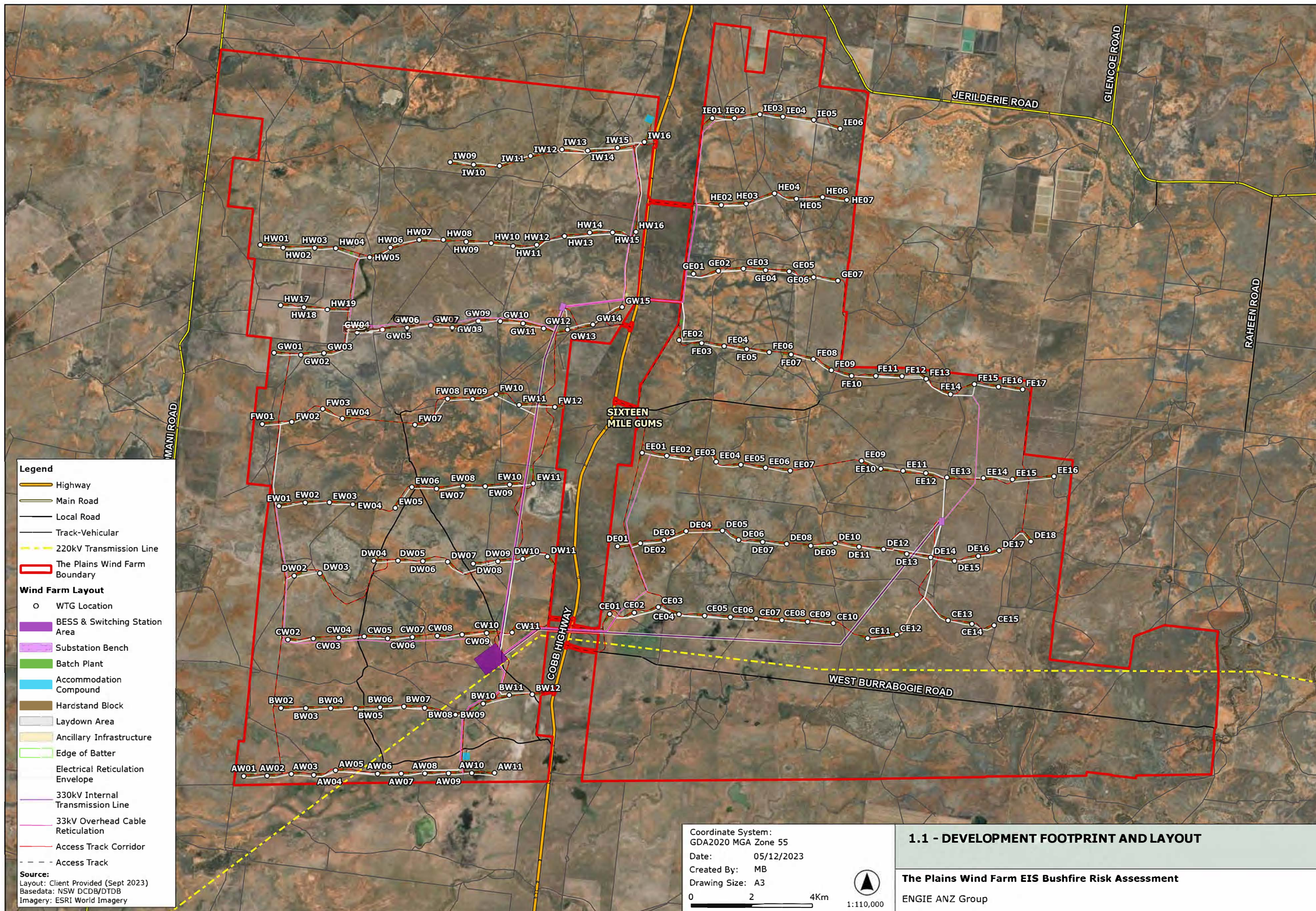
1.2 AIMS AND OBJECTIVES

Bushfire presents a threat to human life and assets and can adversely impact ecological values. Bushfire risk can be considered in terms of environmental factors that increase the risk of fire (fuel quantity and type, topography and weather patterns), as well as specific activities (such as hot works and construction activities) or infrastructure components that exacerbate combustion or ignition risks (such as transmission lines and other electrical components).

This Bushfire Risk Assessment aims to address the requirements identified by the SEARs to identify potential hazards and risks associated with bushfires / use of bushfire prone land and demonstrate that the proposed wind farm can be designed, constructed and operated to minimise ignition risks and provide for asset protection consistent with relevant NSW RFS design guidelines PBP 2019 and Standards for Asset Protection (available on the NSW RFS website www.rfs.nsw.gov.au).

The objectives of this assessment are to identify and, where possible, reduce the likelihood of a bushfire impacting the Project Area or spreading from the Project Area to surrounding properties.

Despite the mitigation measures and treatments that are put in place, it is noted that some bushfire risk will always remain and that some of the infrastructure may be subject to direct flame contact. The absence of any identified hazard or asset in the Project Area should not be interpreted as a guarantee that such hazards or impacts do not exist.



2. PLANNING FRAMEWORK

2.1 RELEVANT LEGISLATION AND GUIDELINES

Table 2-1 outlines the relevant legislation and guidelines and how they have been considered in this Bushfire Risk Assessment.

TABLE 2-1 RELEVANT LEGISLATION AND GUIDELINES

Relevant Legislation/Guideline	Description
<i>Environment Planning and Assessment Act 1979</i>	The Project was declared a State Significant Development (SSD) and will be assessed under Part 4 of the <i>Environmental Planning and Assessment Act 1979</i> (EP&A Act). The SEARs issued for this Project require an assessment of bush fire risk in accordance with PBP 2019. Section 4.41 of the EP&A Act excludes projects approved under Part 4 of the EP&A Act from requiring "a bush fire safety authority under section 100B of the <i>Rural Fires Act 1997</i> ".
<i>NSW Rural Fires Act 1997</i>	The NSW Rural Fire Service (NSW RFS) administers the <i>Rural Fires Act 1997</i> (RF Act). The RF Act was proclaimed in September 1997 and superseded the <i>Bush Fires Act 1949</i>. The RF Act is supported by the <i>Rural Fire Regulation 2013</i> and they should be read together. The wind farm is not located in a bushfire prone area (refer Section 3.3). Under Section 63 of the RF Act, owners and occupiers of land have a duty to take practicable steps to prevent the occurrence of bushfires on, and to minimise the danger of the spread of bushfires on or from, that land. This assessment considers the risk of spreading bushfires from the Project to the surrounds and provides measures to minimise the risk of bushfires. Additionally, as the occupier, in accordance with Section 64 of the RF Act, if a fire is burning on any land at any time during a bushfire danger period, the wind farm operators must: • Immediately on becoming aware of the fire and whether the occupier has lit or caused the fire to be lit or not, take all possible steps to extinguish the fire; and • If the occupier is unable without assistance to extinguish the fire and any practicable means of communication are available, ensure that the fire is reported immediately to the 000 emergency telephone number. The wind farm operators must also be aware of operations that can 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 Section 99 of the RF Act. The proposed development does not require subdivision of land and is not defined as a special fire protection purpose development under Section 100B of the RF Act. Accordingly, the Project does not require a bushfire safety authority. <u>Bushfire Management Committee</u> Set up under the RF Act, bushfire management committees (BFMCs) coordinate fire management planning, prevention and suppression in local areas. The relevant committee for the Project is the Mid Murray Zone BFMC. Each BFMC is required to prepare and submit to the Bush Fire Risk Management Plan (BFRMP). The relevant plan to the Project is the Mid Murray Zone BFRMP (2009) and has been referred to as part of this assessment (Section 3.4).

Relevant Legislation/Guideline	Description
<i>Planning for Bushfire Protection 2019</i>	Planning for Bushfire Protection 2019 (NSW RFS) (PBP 2019) is a planning document to link responsible planning and development control with the protection of life, property and the environment. PBP 2019 was legislatively adopted in the <i>Environmental Planning & Assessment Regulations</i> on 1 March 2020. The PBP Addendum (November 2022) is effective date from 1 May 2023 to coincide with adoption of the National Construction Code (NCC) 2022. Consideration has been given to the following overall aims and objectives of PBP 2019: • Afford buildings and their occupants protection from exposure to a bushfire; • Provide for a defensible space to be located around buildings; • Provide appropriate separation between a hazard and buildings which, in combination with other measures, minimises material ignition; • Ensure that appropriate operational access and egress for emergency service personnel and residents is available; • Provide for ongoing management and maintenance of bushfire protection measures; and • Ensure that utility services are adequate to meet the needs of firefighters. PBP 2019 provides specific requirements for wind farm development and notes that wind farms require special consideration and should be provided with adequate clearances to combustible vegetation as well as firefighting access and water. The following minimum standards should be provided for wind farms (noting that the recommendations of this assessment exceed these minimum standards): • 10 m Asset Protection Zone (APZ) from the structures / associated buildings / infrastructure; and • The APZ will be maintained to the standard of an inner protection area for the life of the development to provide adequate access for firefighting purposes. 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.
<i>Commonwealth Environment Protection and Biodiversity Act 1999</i>	<i>The Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) is the primary piece of Federal legislation relating to the environment. Under the EPBC Act any action that has, or is likely to have, a significant impact on a Matter of National Environmental Significance (MNES) requires approval from the Commonwealth Minister for the Environment. An action is defined as a project, development, undertaking, activity (or series of activities), or alteration to any of these. <i>Consideration of the impact of the proposed activity on MNES has been provided in The Plains Wind Farm Biodiversity Development Assessment Report (ERM, 2024).</i>

Relevant Legislation/Guideline	Description
<i>Biodiversity Conservation Act 2016</i>	The <i>Biodiversity Conservation Act 2016</i> (BC Act) requires the consideration of threatened species and their habitats in the developmental planning process and a responsibility of the proponent to determine potential impacts on listed species and Endangered Ecological Communities. Schedule 3 of the BC Act lists Key Threatening Processes for species, populations and ecological communities within NSW. 'Clearing of native vegetation', 'high frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' and 'removal of dead wood and dead trees', are listed by the TSC Act as Key Threatening Processes and need to be carefully considered and managed when implementing fire management activities. The Project Area contains threatened species that may be impacted by the Project. <i>Refer to The Plains Wind Farm Biodiversity Development Assessment Report (ERM 2024) for more detail on the habitat requirements and confirmed records of these species.</i>

2.2 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The SEARs were issued for the proposed development on 23 December 2022 (SSD-50629707). The SEARS state the following with regard to bush fire risk:

'Bushfire – identify potential hazards and risks associated with bushfires / use of bushfire prone land including the risks that a wind farm would cause bush fire and demonstrate compliance with Planning for Bush Fire Protection 2019'.

Four Government agencies provided bushfire related advice on the SEARs, as reproduced in **Table 2-2** below.

TABLE 2-2 SEARs AGENCY ADVICE

Agency	Date	Advice	Where addressed
NSW Rural Fire Service	17 March 2023	The NSW Rural Fire Service advises that any SEARs for the proposed development should incorporate a bush fire hazard assessment undertaken by a suitably qualified consultant to address the aims and objectives of Planning for Bush Fire Protection 2019. At a minimum, the report should address the following considerations: • Suitable access for fire fighting vehicles, including access around structures on the site; • Suitable SWS including access for fire fighting vehicles; • Appropriate APZs and BALs for structures, where appropriate; • Preparation of a Bush Fire Emergency Management and Evacuation Plan in accordance with Table 6.8d of Planning for Bush Fire Protection 2019 and be consistent with the NSW RFS document: A Guide to Developing a Bush Fire Emergency Management and Evacuation Plan. • Provision of a Fire Management Plan that at minimum includes; ◦ Ongoing bush fire fuel management within the site; ◦ Site infrastructure plan; ◦ Site access and internal road plan; ◦ APZs and their continued maintenance; ◦ Location of hazards (physical, chemical etc) that may impact on fire fighting operations; and ◦ Any such additional matters as may be required by the NSW RFS District Office for the MIA.	This report
Fire and Rescue NSW	24 November 2022	There is currently insufficient information available regarding the fire safety and emergency response management aspects of the project. FRNSW requests to be consulted and given the opportunity to review and provide comment regarding the proposed fire and life safety systems at the preliminary and final design phases of the project.	Section 2.3
Edward River Council	9 Dec 2022	Bushfire risks associated with the construction and operation of the development need to be carefully considered in the EIS. Noting that the portion of the site within Edward River Council area is Bushfire Prone Land [<i>note that revised project layout is no longer in the Edward River LGA</i>]. Of specific concern is the large expanses of grassland and the remoteness of this areas. Adequate resources would be required to protect these areas in the event of fire outbreak as there are extended response times and limited access to adequate resources for fire defence.	This report
Biodiversity and Conservation Division (BCD)	30 November 2022	The assessment must include all ancillary infrastructure associated with the project such as roads, water and power supplies, and Rural Fire Service requirements for asset protection.	This report

2.3 CONSULTATION

To inform the preparation of this bushfire risk assessment, ERM consulted with key local stakeholders to gain a better understanding of the local fire conditions and to ensure that management and mitigation measures are developed to meet the needs of those on the ground. All these stakeholders have been provided an opportunity to review the draft project layout (sent via email on 22 June 2023) and have been invited to provide input into the development of the recommended mitigation strategies. No responses have been received to date.

A summary of the consultation is provided in **Table 2-3** below. A detailed consultation log is included within the EIS.

TABLE 2-3 SUMMARY OF KEY CONSULTATION

Contact	Summary	Key Response/Action
NSW Rural Fire Service	22 June 2023. Current project layout and ERM contact details inviting comments provided via email.	No comments received
FRNSW	22 June 2023. Current project layout and ERM contact details inviting comments provided via email.	No comments received

3. EXISTING CONDITIONS

A desktop assessment was completed for the Project area and the following steps were undertaken in the assessment process:

- Determine whether the development area has been mapped as bushfire prone land (**Figure 3-1**) and whether the Project is in compliance with NSW RFS guidelines including PBP 2019;
- Identification of the assets within and surrounding the Project Area requiring protection (**Section 3.6**);
- Identification of the bushfire risk factors such as bushfire history and known bushfire behaviour in the Project Area and within the surrounding lands (**Section 5**);
- Consideration if the Project would cause any increased bush fire risk noting the existing hazards and risk already present across the grassy landscape (**Section 5**); and
- Produce risk mitigation and management treatments to satisfy PBP 2019 requirements (**Section 6**).

Climate data was sourced from the Bureau of Meteorology (BoM) for stations at Hay (Miller Street) (Station No: 075031) and Hay (CSIRO AWS) (Station No: 075175) or as otherwise indicated in text.

Bushfire prone land mapping was sourced from the NSW RFS Bush Fire Prone Land dataset, accessed from The Sharing and Enabling Environmental Data (seed) Portal.

Vegetation data was sourced from the Plains Windfarm Biodiversity Development Assessment Report (ERM 2024).

3.1 LOCAL CONTEXT

The Project Area is situated in the Hay LGA within the Riverina Murray Region of NSW. The Hay LGA covers a total area of 11,326 km² and has a population of 2,882 (ABS, 2021). The LGA is serviced by the Sturt Highway, Mid-Western Highway, and Cobb Highway, which intersect within the township of Hay. The key land uses within the region are agriculture and food production, and its economy is reliant on tourism, agriculture and associated industries (DPE, 2023).

The Project Area is zoned in its entirety as RU1 – Primary Production under the Hay Local Environmental Plan 2011 (LEP). The existing land uses surrounding the Project Area are predominantly agricultural and primarily used for irrigated cropping and grazing.

3.2 RESIDENTIAL LANDUSE

For the purposes of the EIS and relevant technical studies the following two categories of dwellings were identified:

- 'Associated' (or 'involved') dwellings – dwellings located within the Project Area and/ or whose owners are hosting Project infrastructure or have entered into an agreement in relation to the Project; and
- 'Non-associated' (or 'non-involved') dwellings – all other dwellings outside the Project Area but within 8 km of a WTG.

There are:

- Zero associated dwellings located within the Project Area;
- Four associated dwellings outside of the Project Area but within 8 km of a WTG; and
- Five non-associated dwellings within 5 km of a WTG; and
- Two non-associated dwellings between 5 km and 8 km of a WTG.

3.3 BUSHFIRE PRONE LAND

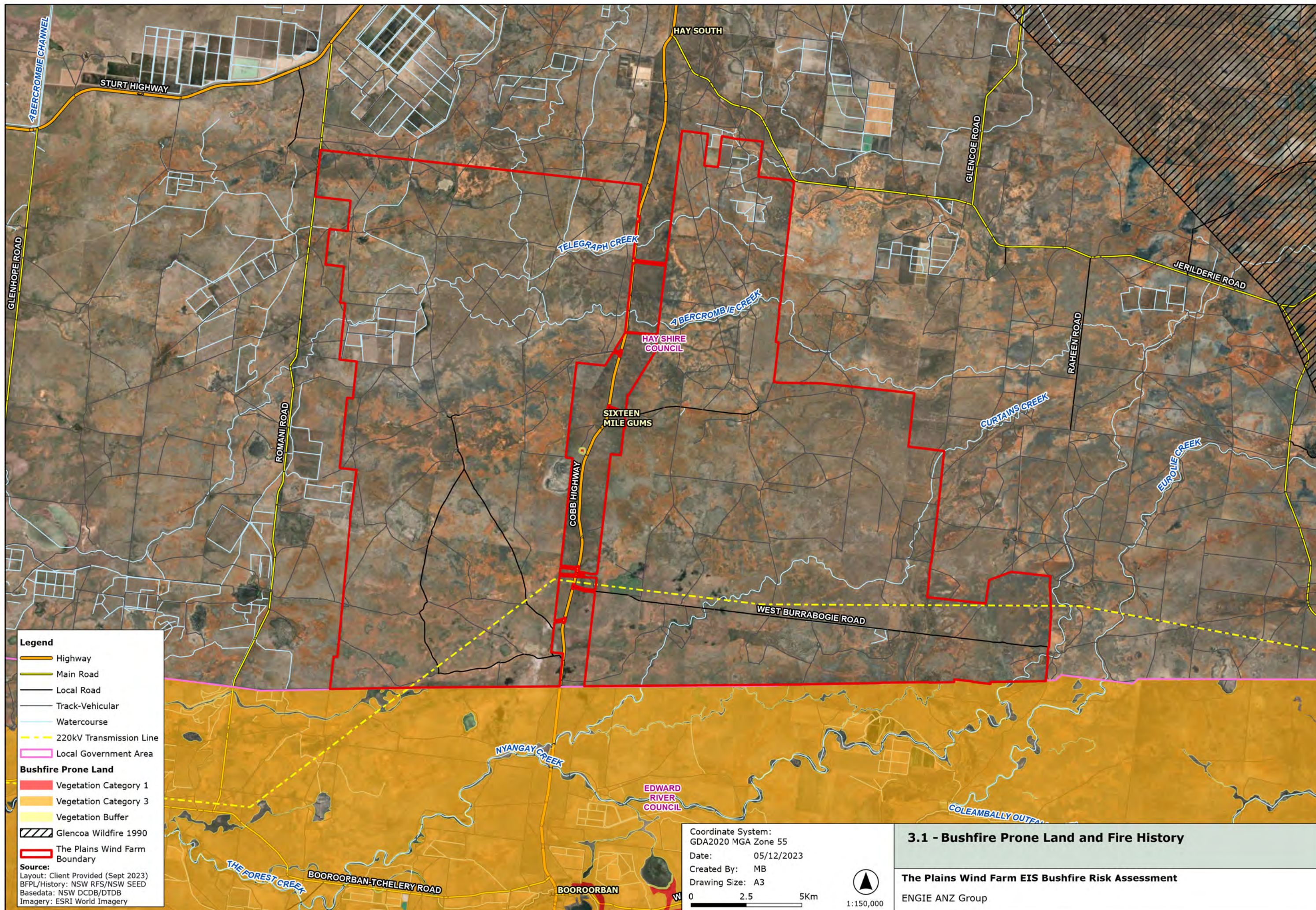
A review of the NSW RFS Bushfire Prone Land mapping confirms that the Project Area is not currently recognised as being bushfire prone (refer **Figure 3-1**).

Vegetation Category 3 bushfire prone land is located immediately south, outside of the Project Area boundary and presents a medium bushfire risk. The Project is located entirely within the Hay LGA although it is recognized that Edward River Council has noted concern that the Project Area is located on grassland in a remote area. NSW RFS has advised during preparation of the separate Plains Windfarm EIS that this grassland vegetation is considered a hazard and the land may be added to the bushfire prone land mapping in the future.

3.4 CURRENT BUSHFIRE MANAGEMENT CONTROLS

The existing land uses surrounding the Project Area are predominantly agricultural and primarily used for irrigated cropping and grazing. Current bushfire control is limited general land management practices including maintenance of access tracks and consideration of fire danger ratings and total fire bans.

The relevant BFRMP for the Project is the Mid Murray Zone BFRMP (2009). The Project Area is not mapped as a bushfire management zone under this plan. The closest asset to the Project Area identified in the plan is the township of Booororban which is 10 km south of the wind farm development footprint. Booororban is identified as having an unlikely likelihood of a bushfire event; however, a bushfire event would have a moderate consequence. Treatment strategies applied in this area include hazard reduction (e.g., ploughing, slashing, grading or grazing), community education, and ignition management.



3.5 FIRE HISTORY

The NSW Government Central Resources for Sharing and Enabling Environmental Data (SEED) provides information on wildfires that have occurred in the vicinity of the Project Area. No fires have been reported within the Project Area.

The closest reported fire (15km to the east of the Project Area) is the Glencoa wildfire which occurred in November 1990 and consumed 181,148 ha of prime grazing land, destroyed 100,000 sheep and hundreds of kilometres of fencing. No other fires have been reported within 20 km of the Project Area.

3.6 CLIMATE AND FIRE WEATHER

Weather conditions influence the size, intensity, speed, and predictability of bushfires and how dangerous they can be to the community. While bushfires can happen at any time of the year in Australia, the time of peak bushfire activity varies across the country with the changes in the seasonal weather patterns. Within the region, the bushfire season generally runs from October-November through to March-April depending on seasonal conditions (Mid Murray Zone BFMC, 2009). This is consistent with the statutory Bush Fire Danger Period which generally runs from 1 October to 31 March each year.

As described by the Bureau of Meteorology (BOM, 2024), as grass and forests dry during summer and autumn, southeast Australia becomes vulnerable to the threat of bushfire. During late spring and early summer grass and forest fuels hold some moisture but fires can occur on hot days with strong winds. Fuels dry out in mid and late summer but winds are typically not as strong. Early autumn sees a transition to cooler conditions and generally lighter winds.

Prevailing weather conditions associated with the bushfire season as reported by the Mid Murray Zone Bush Fire Management Committee (BFMC) (2009) are winds from the west around to the north accompanied by high daytime temperatures and low relative humidity. Dry lightning storms occur frequently during the bushfire season often starting forest and grass fires.

Data from the BOM weather station at Hay (Miller Street) (Station No: 075031) and Hay (CSIRO AWS) (Station No: 075175) confirms that both low humidity and high temperature occur within the bushfire season and would contribute to the fire hazard within this region (refer **Figure 3-2**).

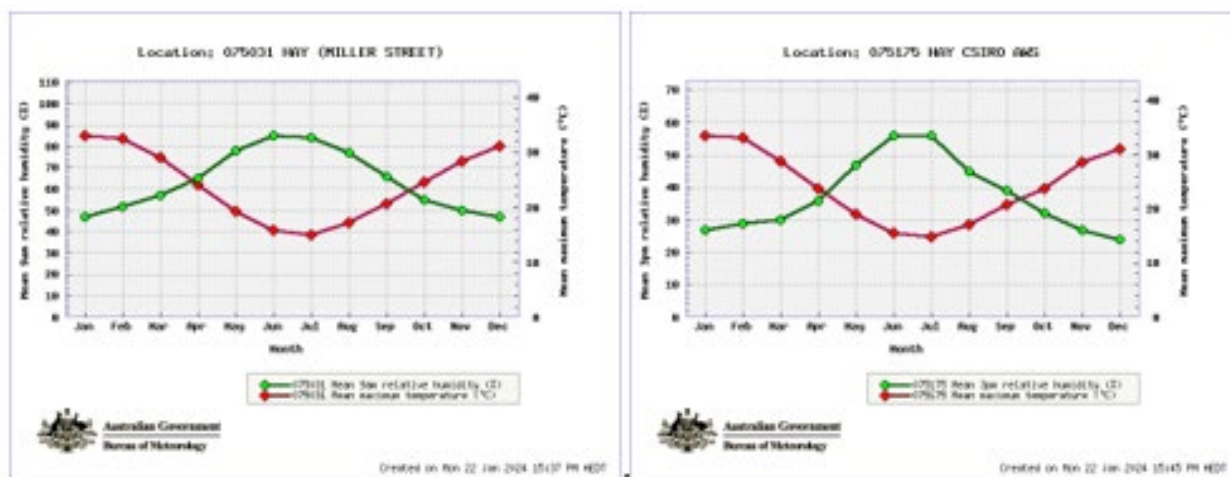


FIGURE 3-2 LOW HUMIDITY AND HIGH TEMPERATURE WITHIN THE BUSHFIRE SEASON (BOM 2024)

Strong gusty winds help fan the flames and cause a fire to spread faster across the landscape. Strong winds can carry hot embers long distances - these can start spot fires many kilometres ahead of the main fire front. Data from the BOM weather station at Hay (Miller Street) (Station No: 075031) suggest that strong westerly and south westerly winds (moving to southerly winds in late summer) are common during the bushfire season.

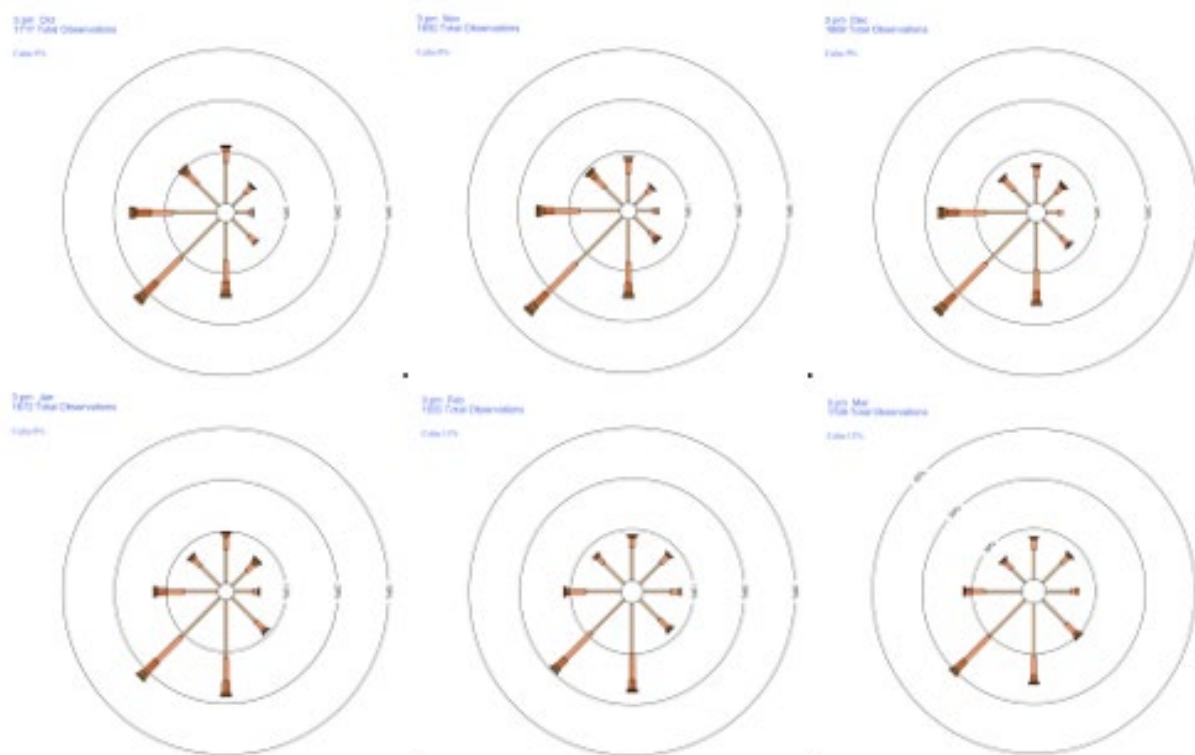


FIGURE 3-3 ROSE OF WIND DIRECTION VERSUS WIND SPEED IN KM/H WITHIN THE BUSHFIRE SEASON (BOM 2024)

The exposure to wind effects will not vary across the Project Area due to the gently undulating nature of the landscape although strong winds will rapidly spread fires across the open landscape.

3.7 TOPOGRAPHY

The Project Area is characterised by a relatively flat topography with low relief and slight variation to elevations, it generally differs by only a few metres. Hay Plains area has gently west sloped topography.

3.8 VEGETATION HAZARD

Descriptions of the vegetation types including species composition and structural diversity are provided in The Plains Wind Farm Biodiversity Development Assessment Report (ERM, 2024).

Vegetation growth can be encouraged by periods of wet weather, increasing the amount of fuel available (grass, leaf litter, twigs, bark). When the weather is hot, the humidity is low and there's been little recent rain, this vegetation dries out and becomes more flammable. A fire is more likely to start, and continue to burn, in hot, dry and windy weather.

For the purposes of this bushfire risk assessment, the vegetation has been simplified in line with the vegetation formations as per Keith (2004).

The vegetation classifications are shown in **Table 3-1** and **Figure 3-4**. The dominant vegetation types across the Project Area that would influence fire behaviour are Chenopod shrublands and Riverine grasslands, with isolated pockets of Sandhill woodlands. Chenopod shrublands are less flammable than most other vegetation and are fire-sensitive.

Most of the Project Area has some level of management by grazing, the success of this management practice can vary depending on the amount of rainfall in the spring period leading to abundant growth of grasses in summer. Fuel load is also dependent on the stock loading across the various paddocks which will vary across years and seasons.

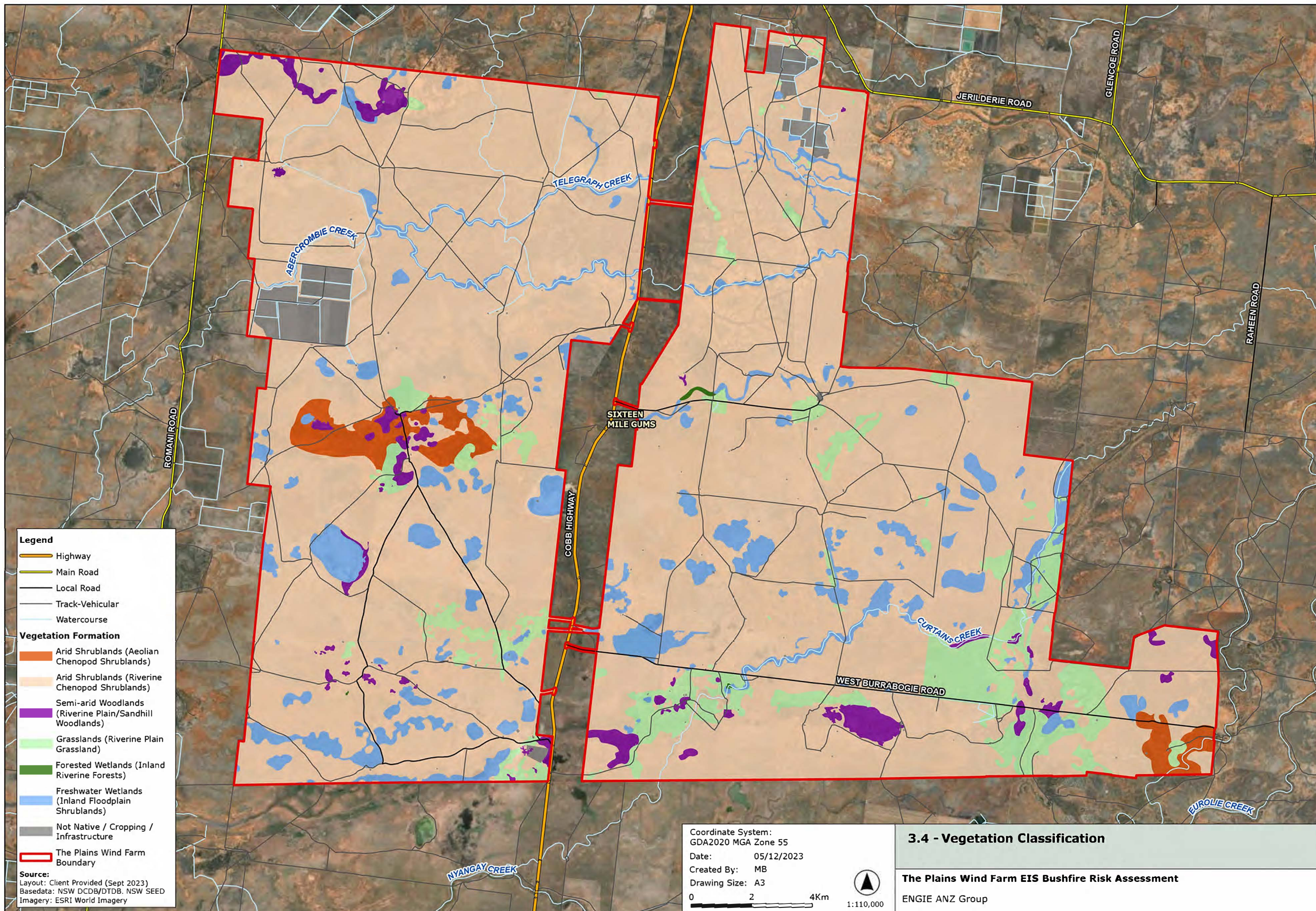
The assessment of dominant fuel hazard will be determined for grazed grassland across the entire Project Area. The smaller patches of woodland, whilst recognized as a higher hazard vegetation, are not the dominant vegetation type that would carry a fire across this site.

The proposed Accommodation Compounds are located greater than 1km to areas of mapped woodland vegetation and the dominant vegetation affecting this infrastructure is also noted to be grazed grassland and Chenopod Shrubland.

TABLE 3-1 DESCRIPTION AND CHARACTERISTICS OF FUEL GROUPS WITHIN THE PROJECT AREA

Vegetation Formation^{1, 2}	Area within the Project Area	Bushfire Characteristics³	Overall Fuel Load⁴
Arid Shrublands (Aeolian Chenopod Shrublands)	1,008.37 ha	Mid-high open shrubland generally less than one meter high dominated by Black Bluebush on this site. This community is rarely burnt and intense fire may kill bluebush.	3.2 t/ha
Arid Shrublands (Riverine Chenopod Shrublands)	43,364.24 ha	Arid shrublands occur in arid and semi-arid regions of western NSW, where limited, sporadic rainfall and low soil moisture are unable to support tree-dominated vegetation. Chenopod shrublands have low flammability, although occasional summer wildfires occur after spring rain. They are considered extremely fire-sensitive. Chenopod species are mostly obligate seeders with only local seed dispersal and no effective post-fire seedbank.	3.2 t/ha
Forested Wetlands (Inland Riverine Forests)	20.26 ha	Open eucalypt forest located on fertile alluvium subject to frequent flooding on the sandy banks of major inland rivers and the beds of intermittent streams, billabongs and channelled floodplains.	15.1 t/ha
Freshwater Wetlands (Inland Floodplain Shrublands)	3,973.55 ha	Freshwater wetlands are ecosystems that are affected by permanent or temporary inundation. There is considerable floristic variation across its range and soils are red-grey compact clay or sandy clay that crack very little. These soils form claypans that pond from local runoff after rain. Little ground cover is present to carry a fire - dense stands may occasionally burn.	4.4 t/ha
Grasslands (Riverine Plain Grassland)	3,494.59 ha	Typically displays as a grassland, with a species-rich, moderately dense shrub layer and ground cover that is predominantly native forbs and a mix of native and exotic grasses. Grazing and fire affects species composition and abundance. Species composition alters with the seasons and from year to year depending on rainfall. Legumes such as Swainsona appear to germinate profusely after fire but intense frequent fire is likely to eliminate some chenopod shrubs. All grasslands are capable of sustaining a fire. They are unpredictable, can start easily and spread quickly.	6 t/ha
Semi-arid Woodland (Riverine Sandhill Woodlands)	1,003.92 ha	Open woodland dominated by cypress pines with scattered eucalypts and an open shrub stratum. Intense fire may kill Callitris. Fire rarely burns remnants due to lack of ground cover and fragmentation of remnants.	14.5 t/ha

1. Keith (2004) From ocean shores to desert dunes: the vegetation of New South Wales and the ACT.
2. DPE (2023) Online Vegetation Formation Profiles. <https://www.environment.nsw.gov.au/threatenedSpeciesApp/>
3. DPE (2023) Bionet Vegetation Classification Database. <https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/nsw-bionet/about-bionet-vegetation-classification>
4. Fuel loads are expressed in tonnes per hectare as per NSW RFS – Comprehensive Vegetation Fuel Loads (NSW Rural Fire Service, 2019)



3.9 INDICATIVE FIRE BEHAVIOUR

While not identified on the current bushfire prone land mapping, grassfires should not be underestimated and can start and spread quickly. It should be assumed that, under the most extreme weather, a fire would spread even in heavily grazed pastures and embers may breach any APZ. For this reason, we have considered all the native vegetation communities across the Project Area as a bushfire hazard and minimum APZ have been recommended for all wind farm infrastructure. **Potential fire runs of more than 20km extend in all directions and predominantly relate to the connectivity of grassland communities within the region.**

Grassfires are the main bushfire risk at this site due to the dominance of Chenopod shrublands and Riverine Plain grassland and can travel up to 25 km per hour and pulse even faster over short distances. As described by Sullivan et al. (2012), grass is a fine, high surface area to volume ratio fuel with high thermal conductivity, low density and vertical orientation, which rapidly ignites (and rapidly burns out). Grassfires are also generally more open to wind than forest fuels (Cheney and Sullivan 2008) making them unpredictable. Grassfires tend to be less intense and produce fewer embers than bushfires, but still generate enormous amounts of radiant heat. Grassfires can also start earlier in the day than bushfires because grass dries out more quickly when temperatures are high and humidity is low.

As described by AFAC (2022) grass fuel load has a strong influence on flame size, flaming duration, radiation output and suppression difficulty. Grass fuel types are divided into three main fuel conditions in the Australian Fire Danger Rating System (AFDRS) system:

1. Undisturbed or natural (i.e. uncut and/or ungrazed);
2. Grazed or cut; and
3. Eaten-out or very heavily grazed grasslands.

The Fire Behaviour Index (FBI) assists operational decision making and provides a scale of potential fire danger (should a fire start) based on the predicted rate of fire spread. Based on the overall fuel load and reduced flammability of the Chenopod shrublands as identified in **Table 3-1** and **Table 3-2**, the Wind Farm Project Area has a low to moderate bushfire danger rating.

TABLE 3-2 FIRE BEHAVIOUR INDEX, GRAZED PASTURE

Dominant Vegetation Formation ¹	Overall Fuel Load ²	Fire Behaviour Index ³	Fire Danger Rating ³
Grasslands (Riverine Plain Grassland)	6 t/ha	15	Moderate
Arid Shrublands (Chenopod Shrublands)	3.2 t/ha	11	Low

1. Keith (2004) From ocean shores to desert dunes: the vegetation of New South Wales and the ACT.
2. Fuel loads are expressed in tonnes per hectare as per NSW RFS – Comprehensive Vegetation Fuel Loads (NSW RFS 2019)
3. CSIRO Grassland Fire Spread Model available online <https://aurora.landgate.wa.gov.au/fbc/#!/csiro-grass>. Input values: grass continuity: discontinuous; temperature 30 °C; relative humidity 30%; windspeed at 10m height 20 km/h; curing 60%; slope 0 degrees.

TABLE 3-3 GRASSLAND, FIRE BEHAVIOUR INDEX

Fire Behaviour Index	Fire Danger Rating ³	Fire Suppression and Containment	Potential for Impact
0-5	Low	Fire difficult to ignite and sustain. Fires generally unlikely to spread and likely to self-extinguish.	Community losses are unlikely.
6-11	Low	Fire easily sustained. Typically wind driven fires that can spread quickly. Fires usually contained within road networks and fuel breaks	Community losses are unlikely however unattended infrastructure may be at risk.
12-23	Moderate	Typically wind driven and rapidly spreading fires with the potential to gain size quickly. Fires typically controlled within established road networks and fuel breaks together with using direct, indirect or parallel attack suppression strategies.	Possible agricultural/pasture/crop/stock losses together with loss of rural assets such as fencing, machinery and buildings. Unattended infrastructure may be at risk.
24-49	High	Wind driven, rapidly spreading fires with potential for development into large fire area/size and with the potential for short distance spotting and long flame lengths. Increasing focus on defensive suppression strategies.	High likelihood of agricultural/pasture/crop/stock losses together with loss of rural assets such as homesteads, fencing, machinery and buildings.
50-99	Extreme	Extremely rapid fire growth and increasing likelihood of large final fire area/size. Possibility for fire behaviour to become erratic and plume driven. High levels of threat to life and property. Elevated risk to firefighter safety	Increasingly high likelihood of agricultural/pasture/crop/stock losses together with loss of rural assets such as homesteads, fencing, machinery and buildings. Limited visibility due to smoke and dust. High risk to the community related to inappropriate pre-considered plans, inadequate sheltering. Strong winds are likely to impact infrastructure (e.g. power lines) and fall trees increasing the likelihood of obstructed roads and power outages.
100+	Catastrophic	Extremely rapid fire growth and high likelihood of large final fire area/size. Possibility for fire behaviour to become erratic and plume driven. Fire control is extremely difficult and unlikely until conditions ease.	High probability of loss of life and property

Source: <https://www.afac.com.au/docs/default-source/afdrs/afdrs-quick-guide---grassland.pdf>

4. HISTORY OF FIRE AND WIND FARMS IN AUSTRALIA

A review of available literature identifies that there have been seven reported fires involving wind farms in Australia:

- Ten Mile Lagoon in Western Australia in the mid-1990s. Damage limited to the relevant turbines, no damage to surrounding environment. Involved technology that is now redundant;
- Lake Bonney in South Australia in 2006. This fire was related to maintenance works during a shutdown. Damage limited to the relevant turbines, no damage to surrounding environment (Renate Metzger, 2011);
- The Star Fish Hill Wind Farm near Cape Jervis in South Australia experienced a turbine fire in October 2010. The turbine was damaged and surrounding spot fires were extinguished. The blades did not cease rotating in this instance, compounding the firefighting response due to the exclusion perimeter that was established and the spot fires due to flames coming off the rotating blades (The Courier, 2012);
- The Currandooley Fire in January 2017 was caused when a crow connected with overhead electrical infrastructure, caught alight and dropped into dry foliage underneath a power line that transfers electricity from Woodlawn Wind Farm to a substation at their Capital Wind Farm in NSW. The fire burnt approximately 3,400 hectares and was subject to a class action (The Canberra Times, 2017);
- The Cullerin Wind Farm near Gunning, NSW in January 2023 was caused by an electrical fire in the turbine generator. The RFS were immediately notified and attended the scene until the fire was safely extinguished later that morning (ABC, 2023);
- Turbine fires occurred at Cathedral Rocks Wind Farm, South Australia, in February 2009 and January 2023. In the 2009 event, the turbine was damaged and surrounding spot fires required extinguishing (Parsons Brinckerhoff, 2012). The motor of the wind turbine is believed to have been the ignition point of the 2023 event, with two blades also burning. Debris from the turbine sparked a small grass fire approximately 150 m in length below (CFS SA, 2023); and
- In February 2024, a turbine fire detected at Clements Gap Wind Farm in South Australia. Smoke from the turbine was spotted by a maintenance crew and emergency services were alerted to the incident immediately. Firefighters were required to put out multiple spot fires caused by falling debris which burnt around 30 ha of grassland. The cause of the fire has not yet been reported.

Another example of a fire that impacted on a wind farm (as opposed to the previous seven examples that involved wind farm infrastructure) is that a bushfire started on a paddock near the Waterloo Wind Farm in South Australia. Fanned by gusty westerly and north westerly winds, the fire quickly spread through the area and raced up the ridge where the wind farm was located. Two-hundred Country Fire Service volunteers were involved in firefighting operations and were supported by three water bombing aircraft. The wind farm operator confirmed that there was no damage to any wind farm infrastructure and no danger at any time to human life as a result of the fire. Normal wind farm operations resumed once the Country Fire Service advised the operator that it was safe to do so. Similarly, Pacific Hydro reported that a bushfire near Taralga Wind Farm in January 2018 was attended by NSW RFS firefighting teams on the ground, supported by firefighting aircraft and heavy plant. Turbines were shut down to assist aerial firefighting and no injuries to staff or damage to the wind farm was reported.

Animal interactions and overhead electrical infrastructure can also cause ignition, as evidenced by the Currandooley Wind Farm Fire in January 2017. The fire ignited when a crow connected with overhead electrical infrastructure caught alight and dropped into dry foliage underneath a power line. The fire burnt approximately 3,400 hectares and was subject to a class action.

Several learnings for emergency management procedures and protocols in relation to wind farms and bushfires have been reported by AFAC (2018) and Clean Energy Council (2017).

These include:

- The wind farm's access roads were beneficial in helping fight the bushfire on the ground and provided an effective firebreak;
- The wind farm's turbines did not present a hazard to aerial firefighting and the turbines were clearly visible to the pilots involved in operations. However, transmission infrastructure, transmission lines and meteorological masts were difficult to see by pilots and did pose a safety risk;
- To maximise air space for firefighting between the turbines, turbines should be locked in the 'Y' position;
- Improved communication protocols need to be in place between wind farm operators and fire and land management agencies to direct turbine shut-down procedures in an emergency situation and initiate emergency response plans;
- Wind farm operators should ensure that they have the capacity to respond to emergency events; and
- Additional precautionary measures should be considered to allow for aerial identification of meteorological masts (measurement towers), guy wires and other infrastructure such as transmission lines that are not easily visible from air.

The Australia Institute (2006) describe the fire risk associated with wind farms as minuscule provided the wind farm is properly constructed and managed. They determine fires caused by wind turbines are very rare and pose little risk to surrounding property. While it is possible for a catastrophic failure to cause fire within the turbine mechanism, the system is designed to contain fire and the likelihood of fire commencing from a tower equipment failure is much lower than from a faulty header or other farm machinery. The Government of South Australia (2004) also concluded that with normal maintenance and servicing practices in place, a wind farm will not pose an increased fire hazard to the host community and further that there has never been an incident involving a member of the public during normal operation.

Sophisticated monitoring technology is used to ensure that electrical, mechanical and hydraulic systems are functioning correctly and to isolate equipment if operating thresholds such as temperature or blade speed are reached (Government of South Australia 2004). Instances of extreme wind have been linked to wind turbine fire due to friction generated by the excessive speed of the blades (Government of South Australia 2004). Fire hazards can present when turbine bearings wear out, crankcases run out of lubricant, cables are damaged during rotation, there are electrical shorts or electrical arcing occurs in the transmission and distribution facilities (Government of South Australia 2004). This highlights the importance of scheduled and preventative maintenance routines as well as monitoring systems.

5. BUSHFIRE RISK CONTEXT

5.1 CLIMATE CHANGE AND BUSHFIRES

Eastern Australia is documented to be one of the most bushfire-prone areas in the world. As reported by the BOM (2024), human induced climate change is influencing the frequency and severity of dangerous bushfire conditions in Australia and other regions of the world, influencing temperature, environmental moisture, weather patterns and fuel conditions. Observed changes in southern and eastern Australia include more extreme conditions during summer, as well as an earlier start to the bushfire season with dangerous weather conditions occurring significantly earlier in spring than they used to. The frequency of dangerous fire weather days has increased significantly in recent decades. These increases are particularly evident during spring and summer and are associated with an earlier start to the southern fire weather season. The 2019–20 Black Summer fire season was the most severe ever recorded in NSW, and as the climate warms and dries such fire patterns are likely to become more frequent.

While climate change might not ignite the fire, it is giving fires the chance to turn into catastrophic fires by creating warmer temperatures, increasing the amount of fuel (dried vegetation) available, and reducing water availability due to higher evaporation. In relation to fire ignition, there is some indication that human induced climate change could also influence the risk of ignitions from dry-lightning (i.e., lightning that occurs without significant rainfall). Additionally, there has recently been several devastating fire events in Australia associated with extreme pyroconvection (including thunderstorm development in a fire plume), with recent research indicating a long-term trend towards increased risk factors associated with pyroconvection in southeast Australia.

Bushfire weather conditions in future years are projected to increase in severity for many regions. This will result in:

- An earlier start to the bushfire season;
- Reduced opportunities for fuel reduction burning;
- Management of fire risk to property, people and biodiversity will become increasingly challenging; and
- An increase in the number of extreme fire danger days.

5.2 FIRE IGNITION

Bushfires have occurred in most years in this bushfire management district, and natural ignitions such as lightning strikes are likely and historically common across the region. Human induced ignitions (both accidental and arson) are also known to occur across the region. Extreme heat can cause equipment to deteriorate. Other factors such as damaged equipment and poor installation can also contribute to the ignition of a fire.

The risk of fire starting because of a lightning strike may be reduced by the presence of wind turbines (AFAC, 2018). Wind turbines include an in-built lightning protection system which safely dissipates the electricity from the blades or the nacelle to the ground, although there are no ignition occurrence records for the Project Area that provide statistical validity or a guide to likelihood of ignition.

Wind turbines also have a variety of on-board control systems specifically designed to mitigate the risk of fire. Each wind turbine is connected to a control centre which constantly monitors the wind turbine and shuts down the turbines if there is a risk of overheating. Turbines also automatically shut down if they are close to functioning outside their design conditions such as wind speeds greater than 25 m/s. The risk that a wind farm itself will cause a fire is considered low given appropriate protection measures (AFAC, 2018) (refer to Mitigation Strategies in **Section 6**). The WTG towers are also made from non-combustible material.

Earth moving equipment, power tools (e.g., welders, grinders), mowers and slashers are well known for starting bushfires under conditions of high temperature, low humidity and high wind. Therefore, construction and ongoing maintenance of the wind farm will be a potential source of ignitions. However, the level of risk from faults cannot be assessed at this stage because there is no case history available, and it is not possible to compare the existing ignition risk from farm operations relative to wind farm operation.

As evidenced by the Currandooley fire in 2017 (refer **Section 4**), bird flashover faults on high voltage power lines can also cause bushfires when fuel conditions beneath the fault location are conducive to fire ignition and spread. This risk can be reduced by maintaining reduced fuel loads beneath transmission lines and will be the responsibility of the asset owner.

5.3 ASSETS AT RISK

The following assets are located on site or within 2 km of the proposed wind farm:

- Project Infrastructure;
- Temporary Accommodation Compounds;
- Residential Properties and Farms;
- Stock (sheep and cattle); and
- Fences.

All these assets, including the wind farm infrastructure may be exposed to bushfire impacts.

Assets within and surrounding the Project Area are shown in **Figure 1-1** and **Figure 1-2** and described in **Table 5-1** below. A detailed description of the Project components is provided in Section 3 of the EIS (ERM, 2024), noting that this assessment does not address the individual design or engineering components of the turbines (or other infrastructure).

Electrical hazards including battery fires and transformer fires are addressed separately as part of the Preliminary Hazard Assessment (Riskcon,2024) and are not included here.

TABLE 5-1 IDENTIFICATION OF ASSETS

Asset	Description
Assets within the Project Area	
Project Infrastructure	<u>Wind Turbine Generators</u> • 188 WTGs, with a 7.2 MW capacity each • Maximum installed capacity up to 1,350 MW • Hub height of up to 180 m • Tip height of up to 270 m • Blade Length of up to 90 m • Hardstand of 3.6 ha per WTG required for construction.
	<u>Obstacle Lighting</u> Aviation hazard lights can also be fitted to the top of the nacelle; however, these are not currently proposed based on the outcomes of the Aviation Assessment (refer Appendix O of the EIS). If required, obstacle lighting will be installed on top of the nacelle in accordance with Civil Aviation Safety Authority (CASA) requirements and the conditions imposed on any development consent granted.
	<u>Meteorological Monitoring Mast</u> Up to 10 permanent met masts The met masts consist of a buried concrete base foundation and guy wires which are attached to buried anchor points. These will be marked using three-dimensional coloured objects attached to the wire or cables (for example spheres or pyramids) if necessary.
	<u>Permanent Operations and Maintenance Facilities (O&M facilities)</u> The O&M facility with carparks will be constructed in proximity of the proposed main substation location within the central part of the Project Area.
	<u>Electrical Reticulation Infrastructure</u> • One main 330 kV substation including switchyard, transformers, voltage controls, storage units control room and potentially power quality control equipment. • Up to three 132 kV collector substations. • 33 kV medium-voltage underground and occasionally overhead lines connecting WTGs to collector substations. • 330 kV high-voltage (HV) overhead lines connecting collector substations to main substations and to the switchyard. • Direct grid connection to existing 220 kV or EnergyConnect.
Site Access and Internal Access Tracks	Access to the east and west portions of the Project Area during construction and operations is proposed via up to 8 access points off Cobb Highway. The ongoing maintenance of the Project will be accessed through the construction of approximately 237.25km of new private access tracks. The internal access tracks will be connected to existing public roads and will be up to 6 m trafficable width, with localised widening on curves and where required to support transportation of the over-dimensional component vehicles. The internal access tracks will be constructed with dirt, sand, gravel or sealed pavement with the final design based on material in proximity to site.
Temporary Facilities	A temporary construction compound including storage areas, material stockpile, and temporary power supply for construction will be available for the Project construction. Up to two temporary concrete batching plants and rock-crushing facilities will be established within the Project Area. While the exact details of the facilities will be determined closer to construction, the area required for the plant and storage of materials are estimated to be approximately 10.3 ha, located within the Development Footprint.

Asset	Description
Temporary Accommodation Compounds	Two accommodation compounds will be provided to accommodate the construction workforce required for both Projects. Each compound will be located to the north and south of the western portion of Project Area, with a total area of approximately 6.5 ha and 6.5 ha, respectively. Each compound will include accommodation and amenity facilities, car parking, food and catering facilities, recreational facilities, first aid facilities and telecommunication services for personal use. Accommodation facilities will consist of prefabricated demountable units, that will be delivered and installed on site.
Residential Properties and Farms	For the purposes of the EIS, dwellings whose owners are hosting Project infrastructure or have entered into an agreement in relation to the Project are referred to as 'associated' dwellings with all other dwellings within the relevant assessment area (generally up to 8.0 km) to a WTG referred to as 'non-associated' dwellings. There are no associated dwellings located within the Project Area.
Assets Surrounding the Project Area	
Residential Properties and Farms	There are 5 non-associated dwellings within 5 km of a WTG; and 5 non-associated dwellings between 5 km and 8 km of a WTG.

5.4 FIREFIGHTER AND PUBLIC SAFETY

The firefighters likely to respond to a bushfire in this area would be volunteers from the NSW RFS and / or individual property owners. The remoteness and expanse of the wind farm also makes it hard for firefighting brigades to access the area.

The materials for individual components within the wind farm infrastructure have not yet been finalised, therefore, the flammability and toxicity of burning components have not been determined in detail, although this information may form part of the recommended Bushfire Emergency Management and Operations Plan that will be developed prior to construction. The risks to firefighter safety associated with a fire burning the turbines and associated equipment include inhalation of potentially toxic fumes and smoke from any plastic components such as cables (although the main structure of the WTG will be steel or concrete/steel hybrid) or other decomposed products (Allianz Risk Consulting, 2012).

Any volunteer firefighters from the NSW RFS, NPWS or property owners from neighbouring farms attending bushfires in this area may not be trained in structural and electrical firefighting. The Bushfire Emergency Management and Operations Plan will detail appropriate risk control measures that would need to be implemented to safely mitigate potential risks to the health and safety of the firefighters and first responders. At least two copies of the Emergency Management and Operations Plan will be stored in an Emergency Information Cabinet located at the main entrance points and will be accessible to all first responders. Two copies of the Emergency Management and Operations Plan will also be stored within the operations facilities and one at the NSW RFS Hay Brigade office.

As reported by AFAC (2018) wind farms can interfere with local and regional radio transmissions by physical obstruction and radio frequency electromagnetic radiation (Australian Wind Energy Association, 2004). The risk of radio communications affecting emergency response operations has been assessed in the Electro-Magnetic Interference (EMI) Assessment prepared by Middleton Group and provided as Appendix N to the EIS. Based on assessment, the Project is not expected to have a material impact on telecommunication services.

The combination of dense smoke and hot gases generated by a large fire directly under or near a high voltage power line can create a conductive path that increases the potential for a 'flashover'. The National Guidelines on Electrical Safety for Emergency Personnel provide critical information relating specifically to fire control near high voltage power lines, including the special conditions that apply to the use of water in fire control activities near power lines. This industry code will be considered in the preparation of the Bushfire Emergency Management and Operations Plan.

The increased risk of arcing in dense smoke has been considered. In terms of arcing potential, the WTGs will have a detection system that protects them from surges, arcing and other electrical hazards. Arcing would be detected, and electrical systems shut off if these persisted over several split seconds.

Most of the electrical reticulation will be underground however in areas where overhead transmission is required, similar detection systems to the above will be installed to monitor changes over split seconds and within tight bands. Automatic Circuit Breakers at either end of the lines would open to stop transmission of electricity if any arcing is detected.

If a fire does breach any containment lines and threatens the wind farm assets, it is possible that the windfarm infrastructure will sustain direct flame contact and that firefighting will require aerial support. Aerial support was used during the catastrophic 2019/2020 fires across NSW and Aviation Projects (2024) recommends that the Proponent consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for their safe operation within the Project site.

Wind turbines, similar to high voltage transmission lines, are part of the landscape and would be considered in the incident action plan and NSW RFS would be provided with maps and GPS coordinates of the final wind turbine layout and identification information for individual wind turbine sites for their internal response planning. Any risk of wake turbulence from wind turbines influencing fire behaviour will be mitigated through the shutting down of wind turbines in a bushfire event.

In the unlikely event that a fire did spread from the wind farm to surrounding properties, the turbines would not limit aerial firefighting capabilities on other properties in the surrounding area.

5.5 SUMMARY OF BUSHFIRE RISK FACTORS

The Project Area and the surrounds does not have a history of bushfire (refer **Section 3.3**), and the risk that a wind farm itself will cause a fire is considered low given appropriate protection measures (refer **Section 6**).

If a fire does breach any containment lines and threatens the wind farm assets, it is possible that the wind farm infrastructure will sustain direct flame contact and that firefighting will require aerial support. As the WTG towers are made from non-combustible material and do not present a significant risk, efforts would be concentrated on defending those assets that could contribute to widespread fire and controlling on spot fires on the ground.

It is therefore important that key assets such as the accommodation compound, switching station, substations and O&M buildings all have adequate defendable space all sides, and that suitable access is provided across the entire windfarm in accordance with PBP 2019. These will be considered in the Bushfire Emergency Management and Operations Plan to be prepared in consultation with key stakeholders.

6. MITIGATION STRATEGIES

As identified within Section 8.3.5 of PBP 2019, wind farms require special consideration and should be provided with adequate clearances to combustible vegetation as well as firefighting access and water. Mitigation will be a combination of complementary strategies, all of which are required to provide the best possible protection outcome for the wind farm and the community.

In terms of design principles to minimise risk, the wind farm layout will be designed to:

- Provide a defensible space around infrastructure (refer **Section 6.1** below); and
- Ensure that appropriate access, egress and manoeuvrability within the wind farm is provided for first responders (refer **Section 6.4**).

6.1 ASSET PROTECTION ZONE

An APZ is typically designed to separate a vulnerable asset from the bushfire hazard (vegetation/fuel). APZs do not eliminate the fire risk but may lower it to an extent where fire control is more feasible or damage to the asset is reduced or eliminated. The ongoing maintenance of APZs are recognised under the *Rural Fires Act 1997* and are supported in 2.8(1)(d) of the *Biodiversity Conservation Act 2016*.

Understanding the value and limitations of APZ is important, as is the understanding that bushfires attack built assets by either flame contact, radiant heat or burning debris. An APZ can be used to lower or eliminate the bushfire attack from flame contact and radiant heat around all built assets, but under strong winds or during a major fire event burning debris can result in a fire breaching an APZ.

A minimum 10m APZ is required to comply with Section 8.3.5 of PBP 2019 and must be established on all sides of the WTG, substations, switching station, and O&M Buildings.

For the Accommodation Compounds, a minimum APZ of 24m is required in accordance with Table 6.8a and Table A1.12.1 of PBP 2019. This will ensure that radiant heat levels do not exceed critical limits for firefighters and other emergency services personnel undertaking operations, including supporting or evacuating occupants. Construction standards for BAL-12.5 apply.

Note: In line with PBP 2019, Table 6.8a, this APZ can be reduced to 10m, consistent with the other associated infrastructure provided that the construction standards meet BAL-29 as a minimum standard.

The specifications recommended for the APZ are as follows:

- All APZ are to be managed as an inner protection zone (IPA) for the life of the development as outlined within Appendix 4 of PBP 2019, and NSW RFS 'Standards for Asset Protection Zones';
- APZ will not extend beyond the property boundary or rely on actions being undertaken by adjacent landowners; and
- No trees and shrubs are to be planted within the APZ.

6.2 WINDFARM CONSTRUCTION

As considered in **Section 3.9**, human induced climate change is influencing the frequency and severity of dangerous bushfire conditions in Australia including an earlier start to the bushfire season with dangerous weather conditions occurring significantly earlier in spring than they used to. The following measures are recommended to be implemented during the entire period of construction:

- The access roads will be constructed prior to the installation of any WTG or related infrastructure (in advance of each development stage);
- Ensure appropriate bunding in areas where there is potential for flammable fuels and oils to leak and create bushfires or other environmental risks;
- Install appropriate signs to assist emergency response crews determine track names, and location of infrastructure;
- Ensure that appropriate permits have been issued for work during the Fire Danger Period, and that any conditions on permits are adhered to;
- Adhere to restrictions on Total Fire Ban or days of high fire danger;
- Suitable firefighting equipment (specific requirements to be confirmed in consultation with NSW RFS) is present onsite;
- Carry fire extinguishers or firefighting equipment in vehicles;
- Carry emergency communications equipment;
- Where practicable, site vehicles during the construction phase will have diesel engines and/or will use the site access roads (if available) to minimise the likelihood of igniting dry grass;
- Restrict smoking to prescribed areas, and provide suitable ash and butt disposal facilities;
- All plant, vehicles and earth moving machinery are cleaned of any accumulated flammable material (e.g., vegetation); and
- On days when Very High fire danger or worse is forecast, the "fires near me" app is to be checked hourly for the occurrence of any fires likely to threaten the Project Area.

6.3 WINDFARM OPERATION

Fuel Reduction

It is recommended that vegetation fuels throughout the windfarm are maintained in a minimal condition by grazing, or with additional slashing or mowing if required. This will minimise the radiant heat exposure to infrastructure and reduce the risk of a fire spreading beyond the windfarm.

Days of Very High or Worse Fire Danger

Fire Danger Ratings give you an indication of the consequences of a fire if one was to start. The higher the fire danger, the more dangerous the conditions. These forecasts are updated daily during the fire danger season and are available on the NSW RFS website (<http://www.rfs.nsw.gov.au/fire-information/fdr-and-tobans>) and the BOM website (<http://www.bom.gov.au/nsw/forecasts/fire-danger-ratings.shtml>).

To reduce the risk of fires damaging or destroying life, property and the environment the NSW RFS Commissioner may also declare a Total Fire Ban (TOBAN). In a Total Fire Ban no fire may be lit in the open and all fire permits are suspended. No general-purpose welding, grinding, soldering or gas cutting can be done in the open.

Emergency Management and Operations Plan

An Emergency Management and Operations Plan should be prepared for the windfarm in accordance with Section 8.3.5 and Table 6.8d of PBP 2019. The management plan will also be prepared with consideration of the NSW RFS document: A Guide to Developing a Bush Fire Emergency Management and Evacuation Plan and Australian Standard 3745: Planning for emergencies in facilities.

The Emergency Management and Operations Plan will provide the following:

- A site plan showing infrastructure, site access and the internal road layout;
- A detail site plan identifying, using GPS coordinates, each turbine tower location;
- Wind turbines are shut down immediately during emergency operations – where possible, blades should be stopped in the 'Y' or 'rabbit ear' position, as this positioning allows for the maximum airspace for aircraft to manoeuvre underneath the blades and removes one of the blades as a potential obstacle;
- Control and coordination arrangements for emergency response (e.g., triggers for pre-emptive closures, evacuation procedures, emergency assembly areas and procedures for response to hazards);
- Protocols should be explicit about what party has the authority to direct turbine shut-down procedures;
- Construction of asset protection zones and their continued maintenance;
- Location of all fire control advantages within the Project Area (e.g., access road, gates, water points);
- Agreed roles and responsibilities of onsite personnel (e.g., equipment isolation, liaison, evacuation management);
- Up-to-date contact details including alternative telephone of site personnel and any relevant offsite personnel who could provide technical support during an emergency, including a 24/7 contact;
- A manifest (and safety data sheets) for any battery, diesel or other dangerous goods storage/handling, including the class identification, quantity, type (bulk or packaged) and location. Appropriate material (including absorbent, neutralisers, equipment and personal protective equipment) for the clean-up of spills is to be provided and available onsite;
- Minimum evacuation zone distances;
- Fire reporting and response to formal emergency alerts;
- Activation of water spray/foam systems and any other response/protection measures; and
- Any other risk control measures required to be followed by firefighters.

Two copies of the Emergency Management and Operations Plan should be permanently stored in a prominent 'Emergency Information Cabinet' to be located at each vehicle entrance point to the windfarm, external to any security fence or locked gate, and a copy provided to local emergency responders. Two copies of the Emergency Management and Operations Plan will also be stored within the operations facilities and one at the local NSW RFS Brigade office.

The Emergency Information Cabinets will be clearly visible, installed at a height of 1.2 m - 1.5 m and accessible by all emergency services.

A schedule for ongoing site familiarisation to account for changing personnel, site infrastructure and hazards should be developed in conjunction with NSW RFS.

6.4 ACCESS ROADS AND ROAD NETWORK

Access to the Project Area is proposed via Cobb Highway. The ongoing maintenance of the Project will be accessed through internal access roads within the Project Area that will be connected to existing public roads (refer **Figure 1-2**).

The tracks will provide ongoing access to the WTG, substation and associated infrastructure.

The internal access roads will be up to 6 m trafficable width, with localised widening on curves. The internal access roads will be constructed using gravel or sealed pavements.

Site access points will be constructed as the first stage of development and the final design of access roads will enable safe access and egress for residents attempting to leave the area at the same time that emergency service personnel are arriving to undertake firefighting operations.

Site access points will be maintained for the life of the Project and include appropriate signs throughout the windfarm to assist emergency response crews determine track names and location of any locked gates.

All access roads will be upgraded to provide sufficient width and other dimensions to ensure safe unobstructed access and allow firefighting crews to operate equipment around the vehicle. Dead-end roads should be avoided. However, where they are present, they will incorporate a sufficient turn-around area to minimise the need for vehicles to make multipoint turns. As a minimum, and to enable access for RFS all roads will be maintained to the minimum standards as outlined within the NSW RFS Fire Trail Standards and the NSW RFS Fire Trail Design, Construction and Maintenance Manual (refer to Appendix A).

This includes:

- The trafficable surface has a width of four (4) metres except for short constrictions to 3.5 metres for no more than 30 metres in length where an obstruction cannot be reasonably avoided or removed;
- Trail surfaces and crossing structures can carry vehicles with a gross vehicle mass of 15 tonnes and an axle load of nine (9) tonnes;
- The maximum grade of a trail is not more than 15 degrees. Any localised sections of road with steeper grades will be designed to meet performance criteria in consultation with the NSW RFS and clearly sign posted to ensure that the roads provide for traction and safe working angles within the physical operational capability of the firefighting vehicles;
- The cross fall of the trail surface is not more than six (6) degrees;

- Drainage structures, feature crossings, or other significant changes in the grade of the trail are in accordance with the NSW RFS Fire Trail Design, Construction and Maintenance Manual;
- A minimum vertical clearance of four (4) metres is provided above the surface of the trafficable surface clear of obstructions;
- Capacity for passing is provided every 250 m; and
- A turning area is provided at the termination of a trail and every 500 m.

Where practicable site vehicles during the construction phase will have diesel engines and/or will use the site access roads (if available) to minimise the likelihood of igniting dry grass.

6.5 WATER STORAGE

Reticulated water supply is not provided to the site. The availability of water is a critical element in the control of a bushfire. Water for the project will likely be supplied by truck (or on-site bore water) and stored in an on-site water tank, which will be available for firefighting if required. The volume and location of the tanks will be confirmed in consultation with the NSW RFS, although it is likely to require minimum 50,000 litre tanks, based on refilling six tanker units (4,000 litres) twice each.

The control room will contain an office, communications equipment, and staff amenities (toilet, kitchen, first aid, potable water supply, etc.). The compound will also include a static water supply for firefighting/bushfire management (may be part of above water supply) as well as a septic system. The control room, switch room and storage shed will each contain essential fire safety equipment, including fire extinguishers and hose reels.

6.6 TOTAL FIRE BANS

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 section 99 of the RF Act.

Under Section 63 of the RF Act it is the responsibility of the landowner to limit the ignition and prevent the spread of fires from the property. On days declared Total Fire Ban you cannot light, maintain or use a fire in the open, or carry out any activity in the open that has the potential for a fire to develop. General purpose hot works (such as welding, grinding or gas cutting or any activity that produces a spark or flame) are not to be done in the open.

Fire permits are also suspended on days of total fire ban. Permits may resume after the Total Fire Ban is lifted, as long as the permit has not expired. The NSW RFS Commissioner is responsible for exemptions to Total Fire Bans. These exemptions are detailed in the NSW Government Gazette each time a Total Fire Ban is declared under the RF Act section 99.

6.7 CUMULATIVE IMPACTS

The proximity of multiple construction and/or operational projects provides opportunity for potential cumulative impacts. The cumulative impacts related to bushfire mitigation are as follows:

- Volunteer fire-fighter workload – Response call outs should not significantly increase because the ignition risk will be very low. There will, however, be an ongoing requirement for briefing on the Emergency Management and Operations Plan;
- Construction stage transport and road use – The bushfire mitigation will add a small percentage to the total construction traffic and road use; and
- Ongoing operations – there would not be any cumulative operational impacts.

The proximity of multiple projects actively managing fire risk could assist in management responses and may create a positive cumulative impact, in comparison with existing conditions. In consultation with key stakeholders, the preparation of the Emergency Management and Operations Plan will consider the most current information available regarding fire risk from and to surrounding land uses.

7. CONCLUSION

The risk that the windfarm itself will cause a fire is minimal and the proposed development is not located within a bushfire prone landscape (based on the current bushfire prone land mapping). While not identified as a bushfire prone vegetation community within the current bushfire prone land mapping, fires within grasslands and arid shrublands should not be underestimated and can start and spread quickly. For this reason, we have considered these as a bushfire hazard. Mitigation measures and treatments will include a combination of complementary strategies, all of which are required to provide the best possible protection outcome for the windfarm and the community.

Despite the application of mitigation measures, bushfire risk will remain and it is therefore important that a Bushfire Emergency Management and Operations Plan is prepared in conjunction with relevant stakeholders, including NSW RFS, NSW Fire and Rescue, landowners and adjoining property owners.

Should a fire breach containment lines and threaten the windfarm assets, windfarm infrastructure may sustain direct flame contact. While this event would not be the result of the windfarm itself, it is recognised that the windfarm would result in additional assets that would need to be protected.

The detailed mitigation measures outlined in the bushfire risk assessment have been developed to meet the relevant provisions outlined in Section 8.3.5 of PBP 2019 and to ensure that the windfarm development does not present any increased risk of widespread fire across the landscape. These mitigation measures will be applied for the life of the Project and have been summarised in **Table 7-1**.

TABLE 7-1 SUMMARY OF RECOMMENDED MITIGATION STRATEGIES AND ACTIONS

Mitigation Strategy	Section of Report	Action	Timing
Asset Protection Zone (APZ)	6.1	A <i>minimum</i> 10 m APZ is to be established on all sides of the WTG, substations, switching station and O&M Buildings. A <i>minimum</i> 24 m APZ is to be established on all sides of the accommodation compounds. All APZ are to be managed as an inner protection zone (IPA) as outlined within Appendix 4 of PBP 2019, and NSW RFS 'Standards for Asset Protection Zones'. APZ will not extend beyond the property boundary or rely on actions being undertaken by adjacent landowners.	The APZ will be constructed as the first stage of development and maintained for the life of the Project.
Windfarm construction	6.2	The following measures are recommended to be implemented during the entire period of construction: - The access road will be constructed prior to the installation of any WTG or related infrastructure (in advance of each development stage); - Ensure appropriate bunding in areas where there is potential for flammable fuels and oils to leak and create bushfires or other environmental risks;	During Construction

Mitigation Strategy	Section of Report	Action	Timing
		• Install appropriate signs to assist emergency response crews determine track names, and location of infrastructure; • Ensure that appropriate permits have been issued for work during the Fire Danger Period, and that any conditions on permits are adhered to; • Adhere to restrictions on Total Fire Ban or days of high fire danger; • Suitable firefighting equipment (specific requirements to be confirmed in consultation with NSW RFS) is present onsite; • Carry fire extinguishers or firefighting equipment in vehicles; • Carry emergency communications equipment; • Where practicable, site vehicles during the construction phase will have diesel engines and/or will use the site access roads (if available) to minimise the likelihood of igniting dry grass; • Restrict smoking to prescribed areas, and provide suitable ash and butt disposal facilities; • All plant, vehicles and earth moving machinery are cleaned of any accumulated flammable material (e.g., vegetation); and • On days when Very High fire danger or worse is forecast, the "fires near me" app is to be checked hourly for the occurrence of any fires likely to threaten the Project Area.	
Windfarm ongoing operations	6.3	• The Project will be controlled by a remote supervisory control and data acquisition (SCADA) system from a control room located within the permanent site operations and maintenance facility. The SCADA system will allow remote operation of all WTGs with the ability to shut-down individual or all WTGs if required; • NSW RFS and CASA will be provided with maps and GPS coordinates of the final wind turbine layout and identification information for individual wind turbine sites for their internal response planning; • Liaise with local aerial agricultural and aerial firefighting operators to develop procedures for their safe operation within the Project site; • Safe working and emergency response procedures for all work tasks will be developed and implemented; • The control room, switch room and storage shed will each contain essential fire safety equipment, including fire extinguishers and hose reels; and • Vegetation fuels throughout the windfarm are to be maintained in a minimal condition by grazing, or with additional slashing or mowing if required.	Maintained for the life of the Project.

Mitigation Strategy	Section of Report	Action	Timing
Fire preparedness and response	6.3	Prior to construction, an Emergency Management and Operations Plan will be prepared for the windfarm that provides the following: • A site plan showing infrastructure, site access and the internal road layout; • Blades should be stopped in the 'Y' or 'rabbit ear' position; • Control and coordination arrangements for emergency response and who has the authority to direct turbine shut-down procedures; • Hazard reduction strategies; • Fire suppression equipment details; • Location of all fire control advantages and APZ; • Flammable materials storage requirements; • Minimum evacuation zone distances • Fire reporting and response to formal emergency alerts; and • Any other risk control measures required to be followed by firefighters.	Prior to construction
Maintain emergency access/egress for fire fighters and site personnel	6.4	Access to the Project Area is proposed via Cobb Highway. The ongoing maintenance of the Project will be accessed through internal access roads within the Project Area. All access roads will be upgraded to provide sufficient width and other dimensions to ensure safe unobstructed access and allow firefighting crews to operate equipment around the vehicle and will be maintained to the minimum standards as outlined within the NSW RFS Fire Trail Standards and the NSW RFS Fire Trail Design, Construction and Maintenance Manual. Site access points will be constructed as the first stage of development and the final design of access roads will enable safe access and egress for residents attempting to leave the area at the same time that emergency service personnel are arriving to undertake firefighting operations.	Site access points will be constructed as the first stage of development and maintained for the life of the Project.
Water storage	6.5	Reticulated water supply is not provided to the site. The volume and location of static water tanks will be confirmed in consultation with the NSW RFS, although it is likely to require minimum 50,000 litre tanks, based on refilling six tanker units (4,000 litres) twice each. The control room, switch room and storage shed will each contain essential fire safety equipment, including fire extinguishers and hose reels.	Maintained for the life of the Project.

Important Note:

Despite the mitigation measures and treatments that are put in place, it is noted that some bushfire risk will always remain and that some of the infrastructure may be subject to direct flame contact. The absence of any identified hazard or asset in the Project Area should not be interpreted as a guarantee that such hazards or impacts do not exist. It is also important that a Bushfire Emergency Management and Operations Plan is prepared prior to the commencement of any construction works in conjunction with relevant stakeholders, including local fire services, NSW RFS, NSW Fire and Rescue, landowners and adjoining property owners.

Important Disclaimer:

Any representation, statement of opinion, or advice expressed or implied in the bushfire assessment will be made in good faith on the basis that ERM employees and / or agents are not liable (whether by reason of negligence, lack of care or any other reason) to any person, company or their agents for any damage or loss whatsoever which has occurred or may occur in relation to that person taking (or not taking) action in respect of any representation, statement or advice provided within the bushfire assessment.

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APPENDIX A NSW RFS FIRE TRAIL STANDARDS



RFS

NSW Fire Trail Standards

November 2023
Version 2.0



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1. Introduction

1.1. Background

Bush fires have been a natural part of the landscape for many thousands of years. As communities have developed and properties and towns have been established, the risk of bush fires impacting on communities has increased.

Throughout NSW there are approximately 1.3 million properties on bush fire prone land. Firefighters rely on roads, trails and other tracks on public and private land to access the landscape to prevent, fight, manage and contain bush fires. It is critical to identify and maintain an effective network of accessible fire trails that suit the firefighting operations conducted across NSW.

Historically, decisions regarding the establishment and maintenance of fire trails have rested with land managers, guided by a cooperative framework established by the NSW Bush Fire Co-ordinating Committee (BFCC). A need for a different approach was identified to achieve a more consistent and strategic outcome across all the various land managers.

The *Rural Fires Act 1997 (NSW)* (the Act) was amended to provide a legislative basis for the establishment and maintenance of an enhanced network of fire trails and to create the ability for the RFS Commissioner (the Commissioner) to make fire trail standards.

This document constitutes the Fire Trail Standards (the Standards) made by the Commissioner pursuant to section 62K of the Act.

These Standards primarily define the criteria for development and certification of Strategic Fire Trails and aspects of these Standards may be applied differently in accordance with different influencing factors. The Standards also serve as a benchmark to inform the design and construction of all fire trails on land throughout the State.

These Standards should be read in conjunction with the *NSW Rural Fire Service Fire Trail Design, Construction and Maintenance Manual*.

1.2. Definitions

Terms and expressions as defined in the Act apply to the Standards. Key additional terms relevant to the Standards are included below:

- **Acceptable Solution:** The primary standard specified by the Commissioner for the certification of fire trails. All Strategic Fire Trails are to, as far as reasonably possibly, conform to the Acceptable Solution as outlined in these Standards.
- **Asset Attributes:** Physical attributes of fire trails that have less direct impact on operational factors of appliances.
- **Asset Performance Solution Criteria:** means the criteria of function that forms the basis for a Performance-Based Solution for the Asset Attributes.
- **BFCC:** Bush Fire Co-ordinating Committee.
- **BFMC:** Bush Fire Management Committee.
- **FAFT:** Fire Access and Fire Trail.
- **Land manager:** any person or agency who is legally responsible for the maintenance, use and development of resources for a section of land or piece of property. For the purposes of these Standards the RFS is the designated land manager for fire trails located on private land.
- **Operational Capability:** The ability to safely access an appliance's cabin and equipment and undertake firefighting operations.

- **Operational Confidence Attributes:** Fire trail attributes that directly impact on the operational factors applicable to fire trails. These attributes directly impact the movement of appliances.
- **Operations Performance Solution Criteria:** The three criteria that make up a Performance Solution for the Operational Attributes, namely Accessibility, Operations and Safety, and Environmental and Cultural.
- **Performance-Based Solution:** Supporting performance requirements that are acceptable under circumstances where the Acceptable Solution cannot be met. Performance-Based Solutions are the responsibility of the land manager, and the onus is on the land manager to maintain the specified performance level and provide evidence of conformance to these solutions.
- **Strategic Fire Trail:** A fire trail on any tenure identified by a BFMC during the FAFT planning process, or by the Commissioner, to be of significant value in the suppression or management of fire within the landscape. These may include multi-purpose trails.
- **Tactical Fire Trail:** A fire trail on any tenure identified by a BFMC during the FAFT planning process, or by the Commissioner, that supports the prevention and suppression of fire. These may include multi-purpose trails.
- **Track/Other:** means vehicular tracks (other than Strategic and Tactical Fire Trails), within the landscape that may be used in the event of a fire.
- **VCC:** stands for Vehicle Carrying Capacity and relates to the highest expected appliance category to safely traverse the fire trail (refer Appendix A for details).

1.3. The operating environment for fire trails

There are several key considerations that have been included in the development of these Standards that relate to the operating environment for the prevention and suppression of bush fires in NSW.

These include:

- the safety and protection of firefighters;
- the nature of incident management procedures in NSW and the use of Australasian Inter-service Incident Management System (AIIMS) across NSW, especially in relation to management of field operations;
- the nature of the fleet that provides primary response, ongoing firefighting and bush fire mitigation activities; and
- the ability of these assets in supporting effective firefighting operations in support of community protection.

Fire trail design should give consideration to the operational nature of the asset and how that can be maximised, whether through provision of attributes that support effective operations (water points, control points, staging areas) or the logistical ability to manage the movement of heavy plant.

Consideration should also be given to ensuring that the design and construction requirements are suitable for the firefighting capability within NSW. Matching these Standards with capability will ensure the most effective firefighting operations can be conducted. Across all combat agencies in NSW, the predominance of first response and ongoing ‘campaign’ firefighting is through the use of Category 1 (or equivalent) appliances. Given this, the design and construction of fire trails that allow for the passage of Category 1 (or equivalent) appliances should seek to meet the Standards for Category 1 VCC as a foundation, noting environmental and strategic limitations to some trails and the primary use of Category 7 and/or Category 9 appliances in appropriate locations (e.g. remote areas).

1.4. What is a fire trail for the purpose of these Standards?

There are a range of access ways across the landscape available for use by firefighters. These include public roads, tracks and trails or other roads used for land management, asset management or recreational purposes. The purpose of these Standards is to define criteria for the development and maintenance of fire trails for appliance use identified through the processes established by the Act and deemed necessary for the protection of the community and its assets.

These trails will be identified at a local level by the BFMC and recorded in a Fire Access and Fire Trail (FAFT) Plan, or 'Designated' by the Commissioner.

While these Standards are principally concerned with fire trails identified as 'Strategic' within FAFT Plans, it is recognised that other fire trails and access ways will continue to exist and serve an important role in bush fire suppression and bush fire management.

Generally, a Strategic trail holds the highest level of priority and value in the suppression and/or management of bush fires in a region. These trails are vital in accessing bush fires from key staging areas. This document prescribes the standards for the design, construction and maintenance of Strategic Fire Trails.

Tactical trails support the prevention and suppression of bush fires by allowing access to localised areas. Tactical trails do not require certification, but landowners are required to maintain their level of operational confidence. These Standards should be used to inform the design, construction and maintenance of Tactical trails.

These Standards are also to be used as a guide for the design, construction and maintenance of track/other trails identified in the FAFT Planning process.

1.5. Directions issued under s62L of the Act

Under s62L of the Act, the Commissioner may give a Direction, in writing, that a fire trail be established and maintained on specified public land in accordance with particulars deemed appropriate by the Commissioner. This may apply to a new and/or existing fire trail.

If a Direction under section 62L of the Act applies to a fire trail, the relevant public land manager must establish and maintain the fire trail in accordance with that Direction. For the avoidance of doubt, the particulars provided in a Direction issued under section 62L of the Act take precedence over any particulars provided for that fire trail in a FAFT Plan, including where a Direction is made after a FAFT Plan is approved.

2. Objectives of the Fire Trail Standards

2.1. Scope

These Standards provide requirements for identified fire trails on land throughout NSW, and in particular, to provide, as far as possible, a practical network of fire trails.

These Standards are to be used by organisations and land managers across NSW responsible for undertaking Fire Access and Fire Trail planning, design, construction and maintenance of fire trails.

The objectives of these Standards, in accordance with Section 62K of Act are (without limitation):

- to set out the structure and form of FAFT Plans, including to outline a process for recording changes to the FAFT Plans between the five-year rolling periods;
- to require a FAFT Plan to include a Treatment Register for fire trails that is approved by the Commissioner;
- to set minimum requirements for identified fire trails on land throughout NSW including by setting standards for fire trails that:
 - allow standard off-road capable appliances to safely and effectively traverse the landscape;
 - provide a consistent level of assurance to both drivers and crew leaders of their ability to safely operate on and from each fire trail;
 - require fire trails to be of an expected standard that is known and understood by firefighters, can be readily identified (including in limited visibility conditions) and are available when required;
 - support operational activities and requirements, maximises operational effectiveness, minimises adverse impacts on the environment and delivers value for money; and
 - maximise resource allocation and the available operating window (including time and range of conditions) across each fire trail for firefighting operations.

While these Standards refer to the requirements for certification of Strategic Fire Trails, there may be considerable benefit in fire trail design and construction allowing for the Standards to be exceeded. One such example is a new crossing structure that is able to provide a higher vehicular Gross Vehicle Mass (GVM) carrying capacity to allow for potential heavy plant movements. This approach is encouraged.

2.2. Assumptions and Limitations

These Standards have been prepared based on the following assumptions:

- The identified fire trail network will be used by suitably trained and competent firefighters capable of operating in the expected physical environment; and
- The existing fleet type and make up of appliances will be retained and be driven by licenced and competent drivers in accordance with local and state procedures.

These Standards have been prepared considering the following limitations:

- Fire trails as identified in these Standards are for the purposes of bush fire suppression and other fire management purposes. While it is recognised that fire trails may also be used for other purposes (including other land management and commercial purposes, forming a part of fire break and the like), such uses do not fall within the scope of these Standards;
- The design and construction Acceptable Solutions and Performance Solutions specified in these Standards cater for standard off-road capable appliances currently used in NSW.

3. Fire Access and Fire Trail (FAFT) Planning

3.1. FAFT Plan requirements

In order to provide a consistent approach to FAFT planning across NSW, the Act requires BFMCs to prepare a draft FAFT Plan for their area. FAFT Plans must be prepared in accordance with requirements set out in these Standards, BFCC Policies and otherwise as required by the Act.

FAFT Plans are to provide a structure for the identification of an integrated and strategic network of fire trails for the protection of the community and its assets, including environmental and cultural values.

The Act adds FAFT Plans to the suite of existing fire planning activities undertaken at the local level (such as bush fire risk management planning). A FAFT Plan identifies the appropriate means of accessing land to prevent, fight, manage or contain bush fires. The FAFT planning process will consider a wide range of factors that will review the adequacy of the firefighting network for firefighting to provide access for the protection of life, property and environmental and cultural values in an area.

A FAFT Plan shall:

- be prepared having regard to the relevant Bush Fire Risk Management Plan and Plan of Operations;
- be prepared in accordance with any RFS guidelines and in a form specified by the Commissioner;
- include all identified trails that form the fire trail network, along with other access ways; and
- be prepared with a planning horizon of five years.

A FAFT Plan shall comprise:

- a map showing:
 - a base layer containing all existing vehicular tracks, trails and roads;
 - the identified fire trail network comprising:
 - all Strategic fire trails;
 - all Tactical fire trails; and
 - other fire access ways, such as existing roads, tracks and trails that may be of use for fire management, but do not form part of the fire trail network.
- a schedule of the identified fire trails that constitute the fire trail network detailing:
 - Fire Trail Name;
 - Unique Identification Number;
 - Total Trail Length (km);
 - BFMC Classification (Strategic, Tactical, etc.);
 - Vehicle Carrying Capacity (VCC);
 - Trail Status;
 - Tenure; and
 - Other matters as determined by the Commissioner.

3.2. FAFT Plan amendment process

The basis of the FAFT Plan amendment process is to cater for improvements and allow for those improvements to be collated for inclusion in future iterations. It is expected that BFMCs and firefighting agencies may identify changes that provide an overall better outcome for firefighters and the community in the period between FAFT Plans.

Amendments to FAFT Plans can arise from a variety of sources:

- incorrect data at the initial development of plan, including omitted trails;
- ground-truthing and implementation planning identifies alternatives that provide better operational outcomes;
- private land holders not agreeing to trails being located on their property;
- implementation of the fire trail raises environmental or operational constraints that necessitate a change to the fire trail;
- experience and fire history identifies opportunities to improve the network;
- the need to ensure the mapped network is a consistent and effective routable network to support dispatch arrangements;
- as a result of a Direction by the Commissioner; and/or
- identification of new trails or existing trails that have substantially changed over time.

Amendments to FAFT Plans need to be managed having regard to the following factors:

- improvements and opportunities should continually be identified and logged into a FAFT Amendment Log to ensure it is a dynamic and responsive process;
- refinements and changes are expected to occur during implementation as physical works and environmental impact assessments are undertaken;
- a FAFT Plan including the associated mapping is a BFMC plan and cannot be unilaterally changed by any single agency or member. Any significant and final changes need to be endorsed by the BFMC; and
- FAFT Plan reviews need to take into consideration any changes made and logged during implementation, as well as any new changes and opportunities identified during the review process.

Amendments to FAFT Plans, once agreed or endorsed by the BFMC, should be recorded in a FAFT Amendment Log, in a form specified by the Commissioner.

3.3. Fire trail Treatment Register

A Treatment Register shall be prepared and submitted to the Commissioner for approval concurrently with the submission of a draft FAFT Plan.

A Treatment Register shall:

- be prepared in accordance with the Guideline for Preparation of FAFT Plans and in a format specified by the Commissioner; and
- detail planned fire trail works for the nominal five-year planning horizon of the FAFT Plan to improve the network over time.

4. A Performance-Based Approach

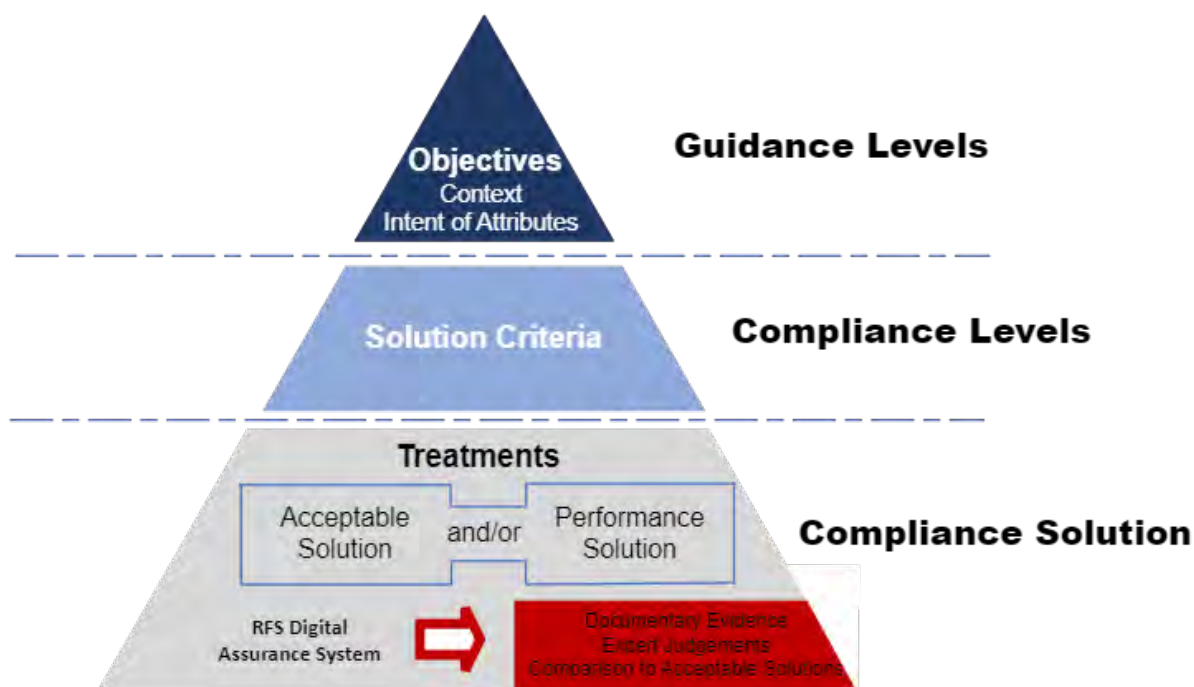
In the development of attribute solutions, this document uses a performance-based approach and identifies objectives and detailed solution criteria to satisfy the context and meet the intent for each attribute. Ultimately, any performance-based approach must demonstrate the maintenance of the safety and operational performance of firefighting resources.

This can be achieved by either applying the identified acceptable solutions, or by preparing a performance-based solution for each attribute. A performance-based solution must be designed to achieve the appropriate level of protection by tailoring an outcome that meets the relevant intent of the solution criteria.

The solution criteria can be satisfied in one of the following ways:

- adopting the acceptable solutions; or
- developing a performance-based solution; or
- a combination of the above.

The attribute solutions are described in Section 5 below.



Acceptable Solutions:

Acceptable Solutions provide a prescriptive criteria to meet the attribute context and intent (where applicable).

Performance Solutions:

Performance solutions allow flexibility and innovation in responding to site-specific opportunities and constraints while still meeting the identified solution criteria. They also allow the consideration of a broad range of issues and information, including trail accessibility, firefighting operations and safety, and environmental and cultural aspects of the trails.

When performance-based solutions are proposed, they must be considered on their merits and individual circumstances. In these circumstances, a process (through the RFS Digital Assurance System) can be undertaken, which would involve early agreement on the key elements and acceptance criteria from all stakeholders.

When developing a performance-based solution, several key factors should be considered:

- **Specific Objectives:** Clearly define the objectives of the fire trail attribute.
- **Solution Criteria:** Identify how the performance criteria will be used to assess the effectiveness of the solution. These criteria should align with the objectives of this document.
- **Equivalent level of safety:** Determine if the proposed performance-based solution provides an equivalent or higher level of safety compared to acceptable solutions. It should be demonstrated that the proposed design achieves the desired intent and is at least as effective as the acceptable solution approach.
- **Stakeholder consultation:** Engage with relevant stakeholders, including landowners and other agency experts. Seek their input and expertise throughout the process to ensure a comprehensive and practical solution. Consider their feedback in refining the solution and addressing any concerns.
- **Documentation and communication:** Document the performance-based solution thoroughly through use of the RFS Digital Assurance System, including the analysis, modelling results and rationale behind the decisions. Clearly communicate the proposed treatments to all stakeholders involved, ensuring they understand the intent, objectives and any unique considerations.
- **Ongoing evaluation and maintenance:** Recognise that fire trails are a dynamic asset and should be regularly evaluated and maintained. Develop a plan for periodic reviews of the performance-based solution to address any changes in the treatment required.

By considering these factors, a comprehensive and effective performance-based solution can be developed, tailored to the specific risks and characteristic of the site.

The onus is on the land manager (subject to any written agreement with the RFS) to demonstrate compliance with relevant provisions of these Standards.

Each fire trail must be assessed by the land manager against the Acceptable Solution or demonstrate compliance with all the listed Performance Solution criteria.

Performance Solutions should be reviewed in consultation with the relevant stakeholders, such as the RFS, land managers, private landowners and any relevant third parties (e.g., fire trail construction contractors).

4.1. Attributes

The Fire Trails Standards Attributes in Section 5 have been divided into two categories, being:

- Operational Confidence Attributes; and
- Asset Attributes.

The reason for this division is to ensure that fire trails meet firefighting requirements and are available for use by firefighters on an ongoing basis.

Operational Confidence Attributes are attributes that directly impact on the operational factors applicable to fire trails. These attributes directly impact the movement of appliances. Meeting the Acceptable Solutions and Performance Solutions, where applicable, of these attributes assists in creating and maintaining the strategic operational performance of the fire trail and safety of firefighters in a fire event. The Operational Confidence Attributes are:

- Trafficable Width;
- Clearance;
- Grade;

- Crossfall;
- Horizontal Curves;
- Passing Bays;
- Turnaround Bays;
- Crossing Structures;
- Trafficable Surface; and
- Corridor Hazards.

Asset Attributes: are physical attributes of fire trails that have less direct impact on operational appliances (but are necessary for trail longevity and safety). These attributes contribute to the physical condition of the fire trail. The asset attributes are:

- Operational Support Points;
- Water Management Systems:
 - Table and Mitre Drains;
 - Cross Banks; and
 - Spoon Drains;
- Pavement Materials;
- Trail Access and Access/Egress Points;
- Trail Signage; and
- Fixed Water Points.

For certification of a fire trail under section 62N of the Act, all fire trail attributes (i.e., both Operational Confidence Attributes and Assets Attributes), must comply with either:

- the Acceptable Solution; or
- **all** the Performance Solution Criteria for the relevant Performance Solution.

See Section 6 (“Certification and Condition Monitoring”) of this document for further details.

4.2. Planning/environmental approvals

Regardless of whether Acceptable Solution or Performance Solutions are adopted, or whether works relate to Operational Confidence Attributes or Asset Attributes, fire trail works are required to be undertaken in accordance with all applicable planning, environmental and other regulatory requirements.

Some of the key planning and environment approval mechanisms for fire trails may include:

- a Bush Fire Hazard Reduction Certificate issued in accordance with the Bush Fire Environmental Assessment Code; or
- a Review of Environmental Factors (REF) under Part 5 of the *Environmental Planning and Assessment Act 1979 (NSW)*; or
- other relevant environmental approval pathways.

Works on fire trails are to be conducted in accordance with the requirements of all relevant environmental and other regulatory approvals and legislation and are the responsibility of the Land Management Authority undertaking the works.

5. Fire Trail Attributes

The Acceptable Solutions and Performance Solutions for fire trail attributes have been developed for each appliance category and each fire trail classification within NSW. The specifications outlined in each attribute are based on the appliance category details contained in Appendix A.

These Standards provide for the categorisation of fire trails based on the type of appliance required to access an area. Three categories are provided:

- Category 1: A fire trail that can be safely traversed by a Category 1 firefighting appliance.
- Category 7: A fire trail that can be safely traversed by a Category 7 firefighting appliance.
- Category 9: A fire trail that can be safely traversed by a Category 9 firefighting appliance.

The primary purpose of trail classification is to ensure the appropriate management of the fire trail and the degree to which the standards are reasonably applied. Classification allows for more efficient use of limited resources by prioritising trails. Trail classifications are to be included in the FAFT Plan prepared by a local area BFMC or as otherwise determined by the RFS Commissioner.

The fire trail classification system allows for consistent resource allocation for all trails in the network according to priority. Understanding between trail managers, the RFS Commissioner and firefighters in the context of trail classification allows for uniformity in user expectations, operational capabilities and the provisions for an overall safe and economically viable trail network.

5.1. Heavy Vehicles

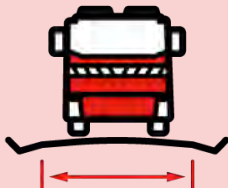
In NSW heavy vehicles are categorised dependent on the vehicle mass, dimension and configuration, or a combination of all three. While these standards do not outline the requirements for Heavy Vehicle movements on Fire Access and Fire Trails, it is acknowledged that firefighting operations can incorporate the use of heavy plant and bulk water appliances where the topography allows (including low loaders/floats). The appliance details are contained in Appendix A.

As a result, consideration should be made during design and construction of fire trails, in particular drainage structures such as cross banks (also referred to as roll overs), for the safe and effective transport of heavy vehicles, where appropriate, for the support of firefighting operations.

5.2. Operational Confidence Attributes

Trail Width

Intent: The width of the trail provides for safe, reliable and unobstructed passage for a firefighting appliance within acceptable operational limits.

Acceptable Solution			
Appliance Type:	Category 1	Category 7	Category 9
Criteria: 	Option 1: The trail must have a minimum width of 4.0m. Where there is a curve with a radius <30m, refer to Performance Solution. Option 2: If <120m linear distance from the end of a passing bay to the start of the next passing bay, the width can be reduced to 3.5m. Where there is a curve with a radius <30m, refer to Performance Solution. No more than 5% of the total length of the fire trail may be narrower than the Acceptable Solution.	Option 1: The trail must have a minimum width of 3.5m. Where there is a curve with a radius <20m, refer to Performance Solution. Option 2: If <120m linear distance from the end of a passing bay to the start of the next passing bay, the width can be reduced to 3m. Where there is a curve with a radius <20m, refer to Performance Solution.	Option 1: The trail must have a minimum width of 3.0 m. Where there is a curve with a radius <20m, refer to Performance Solution. Option 2: If <120m linear distance from the end of a passing bay to the start of the next passing bay, the width can be reduced to 2.5m. Where there is a curve with a radius <20m, refer to Performance Solution.

Performance Solution	
Accessibility 	Context: Refer to Appendix A for minimum appliance dimensions. A narrower trail increases the risk of damage to the appliance and may impede operational movement of the appliance. Criteria: The fire trail must provide a width for: – the unobstructed traversing of the terrain without damage to the appliance; – the traversing of the terrain at a speed appropriate for safe firefighting operations; and – the ability of an appliance to navigate the section without reversing manoeuvres.
Operations 	Context: A narrow trail increases the risk of: – damage to the appliance; – low speeds leading to extended reaction times or reduced operating windows; – inaccessibility leading to poor tactical response; – routes becoming inaccessible due to higher obstruction risk; and – overgrown trails rendering them inaccessible and leading to more frequent maintenance. Criteria: – the fire trail must not be of a width that impedes the tactical movement of appliances; – the fire trail must not impede firefighting personnel's access to the appliance (egress and ingress); and provides an unobstructed view for firefighters. –
Safety, Environmental and Cultural 	Context: Insufficient trail width may: – increase risk to safety of firefighting personnel; and – increase risk to environment due to inability to suppress/fight fires. Criteria: The fire trail is of a width that: – does not pose an increased risk to firefighting personnel safety in any way; – does not impact on evacuation of the area in any way; – considers any negative impacts on the surrounding environment; and – has appropriate signage (for example, longer sections of a fire trail that are narrower than the Acceptable Solution must be appropriately signposted). –

Trafficable Surface

Intent: The construction and formation of the trail is trafficable under all* weather conditions for a firefighting appliance.

Acceptable Solution

Appliance Type:	Category 1	Category 7	Category 9
Criteria: 	Trail surfaces under all* weather conditions must be able to carry: – a Gross Appliance Mass of 15 tonnes; and – an Axle Load of 9 tonnes	Trail surfaces under all* weather conditions must be able to carry: – a Gross Appliance Mass of 8 tonnes; and – an Axle Load of 6 tonnes	Trail surfaces under all* weather conditions must be able to carry: – a Gross Appliance Mass of 4 tonnes; and – an Axle Load of 2 tonnes

Performance Solution

Accessibility



Context: An unsuitable trafficable surface could:

- cause damage to the appliance;
- prevent tactical movement by rendering areas unreachable; and
- lead to appliances being rendered immobile; and
- prevent evacuation of the area in case of an emergency.

Criteria: The fire trail trafficable surface must:

- be constructed and able to be maintained such that the surface is accessible under all* conditions;
- provide sufficient traction to allow traversing of the terrain under all conditions (except for flood, storm surge and snowfall); and
- provide sufficient carrying capacity to ensure safe passage for appliances without losing traction or being rendered immobile.

Operations



Context: An unsuitable trafficable surface could:

- prevent tactical movement and manoeuvres required for effective firefighting measures;
- require re-routing and time delays of appliances; and
- increase risk to surrounding areas should operations not be able to move in a predictable manner.

Criteria: The fire trail trafficable surface must:

- be free from major defects that may interfere with appliance operational speed; and
- allow for a safe working platform for personnel to access the appliance cabin and equipment.

Safety, Environmental and Cultural



Context: An unsuitable trafficable surface could:

- pose and increased risk of damage to appliances;
- increase the risk of injury to firefighter personnel; and
- increase the propensity for accumulation of surface water if required drainage measures are not adhered to.

Criteria: The trafficable surface must:

- ensure a safe working environment for personnel and should have sufficient integrity for its expected term of use in the event of an incident;
- be free of contaminants; and
- incorporate, as far as possible local and sustainable materials.

*Expected weather conditions (i.e., not during flood, storm surge or snowfall)

Clearance

Intent: A cleared corridor is provided around the trail to permit the unobstructed passage of a firefighting appliance and enable firefighters to egress and access equipment in the vehicle. In providing clearance, consideration for vegetation regrowth is required so that a minimum 1m clearance is provided at all times (including between maintenance activities). Greater vegetation clearance should be considered at locations where visibility may be reduced.

Acceptable Solution

Appliance Type:	Category 1	Category 7	Category 9
Criteria: 	The trail must have: – an envelope free of obstructions, including dense vegetation, to allow for unimpeded operations; – a minimum vertical clearance of 4m above the trafficable surface; and – a minimum horizontal clearance of 3m from the trafficable surface centreline.	The trail must have: – an envelope free of obstructions, including dense vegetation, to allow for unimpeded operations; – a minimum vertical clearance of 4m above the trafficable surface; and – a minimum horizontal clearance of 2.75m from the trafficable surface centreline.	The trail must have: – an envelope free of obstructions, including dense vegetation, to allow for unimpeded operations; – a minimum vertical clearance of 4m above the trafficable surface; and – a minimum horizontal clearance of 2.5m from the trafficable surface.

Performance Solution

Accessibility



Context: Insufficient clearance could impede forward and night time visibility and impact on the effective movement of appliances.

Criteria: The fire trail clearance must:

- provide a cleared envelope free from obstructions preventing access or thoroughfare;
- provide sufficient clearance from protrusions that could cause damage to the appliance;
- in the event of overgrowth, be of such a nature to allow safe thoroughfare of the appliance; and
- enable clear visibility for free forward movement of appliances.

Operations



Context: Insufficient clearance could pose risk to appliances and personnel by restricting movement and introducing obstructions.

Criteria: The fire trail trafficable surface must:

- allow appliances to travel at an operational speed (inline with the conditions on the trail);
- allow personnel unimpeded access to appliance cabin and equipment; and
- afford suitable footing and freedom of movement for personnel.

Safety, Environmental and Cultural



Context: Insufficient clearance could:

- increase risk of ignition and flare up; and
- increase the risk of fire jumping over appliances and personnel;
- increase the risk of overrun.

If not managed correctly:

- increasing the trail clearance could cause loss of habitat;
- increasing trail clearance could possibly impact culturally sensitive sites; and
- trails could act as a barrier impeding wildlife movement.

Criteria: In all cases, the fire trail clearance must:

- provide sufficient space for the safe access to the appliance by personnel, except where there are significant environmental constraints. In this case, alternative clearance solutions may be considered in consultation with the RFS;
- be achieved and maintained through environmentally conscious and responsible methods; and
- be achieved and maintained in accordance with relevant environmental approvals.

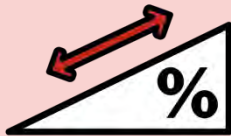
Grade

Intent: The vertical profile of the trail provides for traction and safe working angle within the physical operational capability of a firefighting appliance (including design that does not impede the undercarriage of an appliance).

Acceptable Solution

Appliance Type: All Categories

Criteria: There is no defined grade criteria, refer to Performance Solution.



Performance Solution

Accessibility



Context: Unacceptable trail grades¹ could:

- cause loss of traction and impede effective movement of the appliances; and
- cause damage to or loss of operational capability of the appliance.

Criteria: The grade of the trail must:

- provide sufficient traction for a fully laden appliance while ascending and descending;
- provide a safe working angle that does not impede physical operational capability of the appliance; and
- not exceed the physical ground clearance capabilities of the appliance.

Operations



Context: Unacceptable trail grades¹ may:

- pose an unstable working angle from which firefighters must access and operate appliance equipment;
- increase the risk of injury to personnel during egress or access to appliances; and
- reduce effective operating speeds.

Criteria: The grade of the trail must ensure that:

- a fully laden appliance is capable of traversing the terrain; and
- operational capability of the appliance and personnel are not adversely impacted.

Safety, Environmental and Cultural



Context: Poor trail grades² may:

- increase or stagnate stormwater velocity and increase the risk of erosion; and
- cause bottoming out and damage to both the appliance and the trail.

Criteria: The grade of the trail must:

- minimise impacts to the environment and reduce earthworks required; and
- possess appropriate surface water management.

¹ Unacceptable Trail Grades: The trail is badly damaged. Most, if not all, drainage structures are non-functional. Major repair or reconstruction works are now required.

² Poor Trail Grades: Trail is still usable, BUT significant reduction in trafficability. Low Range, Low gear is required. Significant evidence of compromised drainage, resulting in rutting, scouring and loss of material from the carriage way. Major repair or remediation works are now required.

Crossfall

Intent: The vertical profile of the trail provides for traction and safe working angle with the physical operational capability of a firefighting appliance (including design that does not impede the undercarriage of an appliance).

Acceptable Solution

Appliance Type: All Categories

Criteria:



Unless transitioning between cross sections, the crossfall of the trail is no more than 6 degrees (10.5%).

Performance Solution

Accessibility



Context: Inadequate crossfall may:

- increase the risk of poor traction; and
- increase the risk of rollover as quick lateral shifts can cause sloshing within the appliance's water tank.

Criteria:

- The crossfall of the trail must provide sufficient traction for fully laden appliances while ascending and descending; and
- Ensure the risk of roll over and uncontrolled movement of appliances is managed

Operations



Context: See Accessibility.

Criteria:

- Crossfall of the trail must provide a stable foundation for appliances and personnel to ensure operational capability.

**Safety,
Environmental
and Cultural**



Context: Inadequate crossfall may:

- increase the risk of rollover as quick lateral shifts can cause sloshing within the appliance's water tank;
- increase the potential for an appliance to slide sideways on the trail during wet conditions, posing risks to personnel and appliances; and.
- pose risk of injury to personnel alighting from appliances.

Criteria: The crossfall of the trail:

- must provide sufficient traction for fully laden appliances;
- ensure that the risk of rollover and uncontrolled movement of vehicles is managed; and
- safety of personnel in firefighting operations is managed.

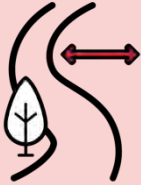
Horizontal Curves

Intent: The design of the trail provides for safe, manoeuvrable and operationally effective passage by a firefighting appliance within acceptable operational limits.

Acceptable Solution

Appliance Type: All Categories

Criteria: There is no defined criteria for horizontal curves, refer to Performance Solution.



Performance Solution

Accessibility



Context: Tight curves may not:

- allow for an appliance to manoeuvre in line with its capabilities;
- restrict visibility of oncoming traffic or personnel; and
- increase risk of roll over.

Criteria: The horizontal curves must allow the relevant appliance to navigate through a curve in a single movement without coming to a stop or having to reverse.

Operations



Context: Multiple tight curves can:

Criteria:

- impede safe travel speed, reducing operational effectiveness;
- impact hazard reduction ignition or back burning operations; and
- increase risk to personnel working on the ground, where appliances are unable to identify hazards when travelling around sharp curves.

Safety, Environmental and Cultural



Context: Poorly designed and constructed curves may:

- have an unnecessary environmental impact;
- impede appliance movement, posing a safety risk to operators during an emergency scenario; and
- impede personnel's ability to react to hazards as a result of poor visibility.

Criteria: The horizontal curves shall:

- allow for appropriate sight distances to any identified hazards; and
- minimise environmental impact by following natural contours of the land when possible.

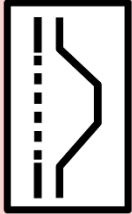
Passing Bays

Intent: The trail provides for two firefighting appliances to pass at appropriate operational and safe intervals.

Acceptable Solution

Appliance Type: All Categories

Criteria:



A passing bay is defined as a constructed bay or widening of the trafficable surface to provide access under all weather conditions and provide capability for appliance passing. Passing Bays must be constructed no more than **250m between the end of one bay and the start of another along the trail, and with one in five bays permitted to be up to 300m apart** (no two consecutive bays can be greater than 250m apart).

A passing bay must comprise:

- pavement materials to match the trafficable surface;
- an area large enough to allow the appliance to enter and exit without requiring a reversing manoeuvre; or
- where a turnaround bay is used as a passing bay, it must allow for the safe positioning of the appliance, parallel to and off the main carriageway; and
- a space that allows the safe passing of another appliance while firefighters are working.

Category 1

Capacity for passing bays is to be a widened trafficable surface of at least 6 metres.

Category 7

Capacity for passing bays is to be a widened trafficable surface of at least 5.5 metres.

Category 9

Capacity for passing bays is to be a widened trafficable surface of at least 5 metres.

Performance Solution

Accessibility



Context: Poorly constructed passing bays or inadequate spacing may:

- impede strategic movement of appliances; and
- render an appliance immovable due to insufficient structural support.

Criteria: A passing bay must:

- allow for the effective and safe passing of two appliances without avoidable delays to operations;
- be capable of supporting the required appliance mass and axle load;
- allow for the free flow of multiple appliances on the fire trail; and
- allow for the access and passing of appliances without reversing.

Operations



Context: Poorly constructed passing bays or inadequate spacing could:

- impede access to appliance equipment; and
- increase risk of appliance congestion and operational delay.

Criteria: A passing bay must:

- ensure unimpeded access to the appliance cabin and equipment off the trail and away from vegetation; and
- provide opportunities for appliances to pass at appropriate intervals for continuous operational movement.

Safety,
Environmental
and Cultural



Context: Poorly constructed or maintained passing bays could:

- have increased risk of vegetation ignition from stationary appliances;
- introduce delays of appliances using the trail as an escape route;
- pose significant risk to personnel by creating traffic jams in an emergency situation; and
- be hard to identify.

Criteria: A passing bay must be designed and constructed to minimise environmental impact.

Turnaround Bays

Intent: The trail provides for a turning manoeuvre for a firefighting appliance to return in the direction from which it came from, at appropriate intervals.

Acceptable Solution			
Appliance Type:	Category 1	Category 7	Category 9
Criteria: 	Turnaround bays are to be constructed as surfaces to provide access under all weather conditions and must be provided every 500m along the trail, where a trail changes VCC and at the termination of a trail. Each turnaround bay must enable the whole vehicle to be off the trafficable trail and: – be constructed with an area clear of the trafficable surface at least 6m wide and 6m deep, which is accessible for a three-point turn or u-turn; OR – have a turning circle which has a minimum outer diameter of 22m.	Turnaround bays are to be constructed as surfaces to provide access under all weather conditions and must be provided every 500m along the trail, where a trail changes VCC and at the termination of a trail. Each turnaround bay must enable the whole vehicle to be off the trafficable trail and: – be constructed with an area clear of the trafficable surface at least 5.5m wide and 6m deep, which is accessible for a three-point turn or u-turn; OR – have a turning circle which has a minimum outer diameter of 17m.	Turnaround bays are to be constructed as surfaces to provide access under all weather conditions and must be provided every 500m along the trail, where a trail changes VCC and at the termination of a trail. Each turnaround bay must enable the whole vehicle to be off the trafficable trail and: – be constructed with an area clear of the trafficable surface at least 5.5m wide and 6m deep, which is accessible for a three-point turn or u-turn; OR – have a turning circle which has a minimum outer diameter of 16m.
Performance Solution			
Accessibility 	Context: Poorly constructed turnaround bays could: – restrict tactical movement of appliances due to trail termination and insufficient turning space; and – lead to trail obstruction due to immobile appliances. Criteria: The turnaround bays must be: – large enough to allow for the relevant appliance to return in the direction from where it came through a three-point turning manoeuvre; – provide sufficient space for the relevant appliance to change direction without obstructing the fire trail; and – present at the end of each fire trail.		
Operations 	Context: Poorly constructed or inadequately spaced turnaround bays could: – restrict directional change opportunities, introducing operational delays; and – impede access to an appliance when bay is used as a passing bay. Criteria: The turnaround bays must: – provide tactical manoeuvrability locations for appliances; – provide sufficient space for personnel to access firefighting equipment and implement likely firefighting tactics; and – not prevent thoroughfare of other appliances along the fire trail.		
Safety, Environmental and Cultural 	Context: Poorly constructed, spaced or maintained turnaround bays could lead to: – delays for appliances using the trail as an escape route due to trail blockage; and – the loss of habitat and detrimental environmental impacts. Criteria: The turnaround bays must: – provide directional change opportunities particularly when an escape route is required; and – be constructed to minimise environmental impact.		

Engineered Culverts and Bridges

(Major Crossing Structures)

Intent: The structures are adequate to ensure the crossing of a drainage feature of a trail to provide safe, functional passage of firefighting appliances.

Acceptable Solution

Appliance Type:	Category 1	Category 7	Category 9
Criteria: 	Crossing structures must: – have appropriate guidepost delineation for safe visibility; and – be able to carry: – a Gross Appliance Mass of 15 tonnes; and – an Axle Load of 9 tonnes. Where new crossing structures can provide a higher vehicular GVM carrying capacity, then this is strongly encouraged.	Crossing structures must: – have appropriate guidepost delineation for safe visibility; and – be able to carry: – a Gross Appliance Mass of 15 tonnes; and – an Axle Load of 6 tonnes. Where new crossing structures can provide a higher vehicular GVM carrying capacity, then this is strongly encouraged.	Crossing structures must: – have appropriate guidepost delineation for safe visibility; and – be able to carry: – a Gross Appliance Mass of 15 tonnes; and – an Axle Load of 2 tonnes. Where new crossing structures can provide a higher vehicular GVM carrying capacity, then this is strongly encouraged.
Refer to NSW Rural Fire Service Fire Trail Design, Construction and Maintenance Manual for guidance on types of crossing structures.			

Performance Solution

Accessibility 	Context: Inadequate crossing structures could render the entire trail non-functional. Criteria: Crossing structures must: – possess adequate bearing capacity for safe crossing of appliances; – have adequate width to allow movement of the relevant appliance; and – allow for the effective strategic movement of appliances.
Operations 	Context: Inadequate crossing structures may: – provide limited options for alternative routes if closed from traffic; – impede tactical movement of appliances; and – lead to appliances being stranded on parts of a fire trail should the crossing structure be damaged and rendered un-crossable. Criteria: Crossing structures must: – not impede the operational capability of appliances; and – not affect the trail's integration with the network.
Safety, Environmental and Cultural 	Context: Poorly designed crossings could: – impede the natural flow of water, impacting the surrounding environment; and – lead to unexpected closures and isolate appliances and personnel already on the trail. Criteria: Crossing structures must: – be clearly delineated; – have appropriate guidepost delineation for safe visibility; – allow for unobstructed flow of natural watercourses (unless in accordance with a relevant water authority approval); and – not divert natural flow of the watercourse (unless in accordance with a relevant water authority approval).

Bed Level Crossings and Piped Culverts

(Minor Crossing Structures)

Intent: The structures are adequate to ensure the crossing of a drainage feature of a trail to provide safe, functional passage of firefighting appliances.

Acceptable Solution

Appliance Type: All Categories

Criteria:



Crossing structures must:

- be able to carry a Gross Appliance Mass of 15 tonnes; and
- have appropriate guidepost delineation for safe visibility.

Refer to *NSW Rural Fire Service Fire Trail Design, Construction and Maintenance Manual* for guidance on types of crossing structures.

Performance Solution

Accessibility



Context: Inadequate crossing structures could render the entire trail non-functional.

Criteria: Crossing structures shall:

- possess adequate bearing capacity for safe crossing of appliances;
- have adequate width to allow movement of the relevant appliance; and
- allow for the effective strategic movement of appliances.

Operations



Context: Inadequate crossing structures may:

- provide limited options for alternative routes if closed from traffic;
- impede tactical movement of appliances; and
- lead to appliances being stranded on parts of a fire trail should the crossing structure be damaged and rendered un-crossable.

Criteria: Crossing structures shall:

- not impede the operational capability of appliances; and
- not affect the trail's integration with the network.

**Safety,
Environmental
and Cultural**



Context: Poorly designed crossings could:

- impede the natural flow of water, impacting the surrounding environment; and
- lead to unexpected closures and isolate appliances and personnel already on the trail.

Criteria: Crossing structures must:

- have appropriate guidepost delineation for safe visibility;
- allow for unobstructed flow of natural watercourses (unless in accordance with a relevant water authority approval); and
- not divert natural flow of the watercourse (unless in accordance with a relevant water authority approval).

Corridor Hazards

Intent: The trail provides for a low safety risk to reduce obstruction or damage to firefighting appliances from uncontrolled hazards, e.g., overhanging tree limbs or rock falls.

Acceptable Solution

Appliance Type: All Categories

Criteria: There is no defined criteria for corridor hazards, refer to Performance Solution.



Performance Solution

Accessibility



Context: Uncontrolled corridor hazards can impede movement of appliances, potentially cause trail closure and potentially damage appliances.

Criteria: Corridor hazards must:

- be identified by appropriate signage or spatially; and
- be assessed for their potential risk and, if deemed significant, be rectified such that the risk for the trail becoming inaccessible is reduced to an acceptable level.

Operations



Context: Corridor hazards, such as overhanging trees or narrow passes, can impact firefighters being able to perform operations safely and effectively.

Criteria: Corridor hazards must be:

- addressed such that impacts to the whole fire trail network are minimised;
- controlled if they pose a risk to firefighters being able to perform operations safely and effectively; and
- prioritised based on the importance of the trail within the network and the severity of the hazard.

Safety,
Environmental
and Cultural



Context: Hazards increase risk of injury to firefighters and damage to appliances. A balance between safety and effectiveness of operations and environmental and cultural impact is required, and any risk to safety arising from a hazard should be identified by agencies during an incident.

Criteria: Corridor hazard management must examine:

- trees and tree limbs to extend beyond the cleared area of a fire trail, which presents a safety risk. These are generally mature trees with:
 - a lean towards the trail and weaknesses in their root structure; and/or
 - branches with weaknesses which extend over the trail; and
- mature trees (high potential) to be environmentally and culturally sensitive. Therefore, the environmental cost of removing the tree partially or fully must be considered against the safety risk; and
- areas with a history of instability such as batter failure or rock falls require inspection schedules to minimise the risk of damage to appliances and personnel.

5.3. Asset Attributes

Operational Support Points

Intent: The assets are locatable, accessible and of appropriate dimension and construction for the access and use for firefighting appliances within operational limits.

Acceptable Solution

Appliance Type:

All Categories

Criteria:



Functionally, operational support points (OSP) may include, but are not limited to, coordination, aerial support, welfare, logistics support, refuge, turning circle, communications support, bulk water points, amenities and resupply operations.

Operational support points are to be:

- identified and mapped³;
- located in strategic and accessible locations with respect to the trail network, historic fires and anticipated future operations;
- constructed with pavement materials that support the proposed usage;
- of appropriate dimensions for functional requirements (refer to Performance Solution); and
- if a trail is >10km, at least one SMALL OSP is required on the trail (strategically placed).

Performance Solution

Accessibility



Context: Poor construction and preparation of the site could lead to ineffective fire response and tactical planning.

Criteria: The operational support point must:

- comprise clear pathways for appliances to enter and exit the OSP onto the trail or road network;
- have a surface which can support the load of anticipated appliances and structures; and
- have appropriate dimensions and be strategically located for:

SMALL OSP:

- control point; or
- bulk water point; or
- staging a strike team of appliances.

MEDIUM OSP – combination of:

- control point; and/or
- helicopter point; and/or
- staging more than one strike team of appliances; and/or
- catering/amenities support.

³ This is an operational benefit for use in the FAFT spatial data overlay which can be used for operational decision making.

Water Management Systems

Intent: The trail is drained effectively to manage water flows and prevent damage to the trafficable surface.

Acceptable Solution

Appliance Type: All Categories

Criteria:

There is no defined criteria for water management systems, refer to Performance Solution.



Performance Solution

Accessibility



Context: Poor water management systems may:

- damage or destroy the trail;
- lead to damage of the trafficable surface, which can impede the movement and manoeuvrability of appliances;
- damage the surrounding area due to concentrated water flow leading to scouring and erosion;
- alter the environmental surroundings; and
- cause ponding of water on the fire trail.

Criteria: Water management systems must:

- be constructed so that appliances do not damage the trail or water management structures such as cross banks, or render the trail inaccessible after reasonable repeated use;
- not exceed the break over angle of ground clearance of appliances; and
- manage surface runoff to prevent damage to the water management systems, trafficable surface and the surrounding area.

Refer to the *Fire Trail Design, Construction and Maintenance Manual* for further guidance.

Pavement Materials

Intent: The trail surface needs to be appropriate for all* weather conditions to ensure safe, long term, operational movement of appliances.

Acceptable Solution

Appliance Type: All Categories

Criteria:



Pavement materials need to be appropriate for all* weather conditions. Refer to Performance Solutions.

Performance Solution

Accessibility



Context: The fire trail pavement materials could:

- prevent tactical movement of appliances if the trail is in poor condition due to poorly performing materials;
- result in a weak structure that can deform, posing a risk to tactical movement and fire response; and/or
- cause damage to appliances if not adequate to manage load and movement volume.

Criteria: The fire trail carriageway pavement materials must:

- provide a structure with a consistent trafficable surface;
- not deteriorate with anticipated usage under the movement of appliances across the terrain; and
- not contain environmentally damaging and/or hazardous materials.

*Expected weather conditions, i.e., not during flood, storm surge or snowfall

Trail Access and Access/Egress Points

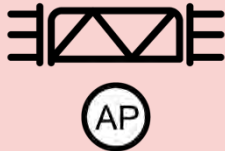
Intent: The access is provided to manage the safety of firefighters and appliances, and the accessibility to and longevity of the trail.

Acceptable Solution

Appliance Type:

All Categories

Criteria:



- Where gates are required, there must be at least one passing bay located adjacent to the access point;
- have sufficient set back and vegetation clearance around the gate and access point for safe egress into oncoming traffic; and
- Any gate or control mechanism installed across a trail shall:
 - be operable by a single person in a practical timeframe;
 - be a sufficient distance from the adjoining road edge to allow for safe parking of appliance out of traffic and for safe egress from the trail into oncoming traffic; and
 - have fencing setbacks as required around the access.

Performance Solution

Accessibility



Context: *Unauthorised closure of the fire trail may:*

- *prevent appliances from entering/exiting the trail;*
- *impede the effective tactical movement and fire response of appliances; and*
- *unauthorised access may lead to damage to the fire trail, rendering it unsafe or untrafficable.*

Criteria: Where gates are required, the fire trail entrance/exit must:

- be clearly identifiable by personnel, including having appropriate guidepost delineation for safe visibility (including during night operations);
- be a functional entry and exit point for the relevant appliance category;
- be positioned to allow for the safe refuge of an appliance from traffic;
- have sufficient set back and vegetation clearance around the gate and access point for safe egress into oncoming traffic;
- consist of a lock mechanism, which must not unreasonably impede access of appliances into the trail; and
- consist of a trail access/egress gate of sturdy construction that is both weather and vandal resistant.

Trail Signage

Intent: Signs ensure that trails are easily identified, hazards are marked in advance and critical points are subjects of focus.

Acceptable Solution

Appliance Type: All Categories

Criteria:



Standardised signs as per Appendix B should be installed and maintained throughout the fire trail network. Signs ensure that trails are easily identified, hazards are marked in advance and critical points are subjects of focus.

Signage that improves operational capability is to be installed, such as reflectors for night time operations.

Trail Signage must be placed at the last exit point of the trail for any 'no through' trail to denote a lack of alternative escape route.

Performance Solution

Accessibility



Context: Inadequate fire trail directional signage could cause extensive delay in the tactical movement of appliances.

Criteria: The fire trail signage must be:

- signposted (outlining the fire trail name) at each entry point and intersection of another fire trail;
- adequate to convey current information on the fire trail classification and warnings; and
- suitable and acceptable to private landholders to ensure privacy and reduce potential unauthorised access.

If existing signage blades with correct trail name are in place and in good condition, the addition of the appropriate "VCC Blade" only directly underneath the existing name blade is a suitable solution.

Fixed Water Points

Intent: The fixed water point assets are locatable, accessible and of appropriate dimension and construction for use by firefighting appliances within operational limits.

Acceptable Solution

Appliance Type: All Categories

Criteria:



Where fixed water points exist, they are to be:

- identified and mapped⁴;
- located in strategic locations with respect to the trail network, historic fires and anticipated future operations;
- water points must allow for safe positioning of an appliance to conduct water resupply operations;
- access to fixed water points is to be constructed with pavement materials that support the proposed usage; and
- of appropriate dimensions for functional requirements (refer to Performance Solution).

Performance Solution

Accessibility



Context: Poor construction and preparation of the site including inaccessible or elusive fixed water points could lead to ineffective operational capability.

Criteria: Fixed water points:

- must not obstruct pathways for appliances to enter and exit onto the trail or road network;
- must facilitate access using standard appliance equipment for draughting;
- must have a surface that can support the load of anticipated appliances and structures; and
- must have appropriate dimensions and be strategically located for water resupply.

⁴ This is an operational benefit for use in the FAFT Spatial data overlay which can be used for operational decision making.

6. Certification and Condition Monitoring

6.1. Certification

A fire trail may only be certified end to end (tenure blind) by the Commissioner under the Act if it fully complies with these Standards at the time of the certification.

The Commissioner may certify the following trails:

- a. a fire trail situated on public land – if the fire trail is the subject of a direction under section 62L, or
- b. a fire trail situated on private land – if the fire trail is the subject of an agreement under section 62M, or
- c. an existing fire trail situated on public land – if the fire trail is referred to in a FAFT Plan, or
- d. an existing fire trail situated on private land – if the fire trail is referred to in a FAFT Plan and the fire trail is the subject of an agreement for the establishment of a fire trail entered into before the commencement of this section.

To be eligible for certification:

- The fire trail must meet each attribute either to an Acceptable Solution or, where a performance solution is applied, this must adhere to all of the performance solution criteria for that attribute; and
- the land manager (or the RFS for private land) responsible for the fire trail must have utilised and adequately completed the relevant sections of the RFS Fire Trail Digital Assurance System (or such alternative as the RFS may advise) prior to requesting the Commissioner certify any fire trail under the Act.

6.2. Condition monitoring

Ensuring that fire trails are available for use is a key component of achieving a practical network of fire trails. Condition monitoring should therefore be undertaken regularly, and as a minimum:

- prior to bush fire season; and
- after extreme weather events such as severe storms, flooding or heavy rain, natural disaster declaration or extreme winds (for fire trails identified as likely to be affected).

A land manager shall provide to the Commissioner annually a statement as to the condition of each designated, and registered fire trail on its land, and whether each of those trails meet these Standards. The statement must be made in the form as specified by the Commissioner.

Where a fire trail is located on private land, arrangements for any inspection will be made having regard to any agreement between the Commissioner and the landowner.

The Act gives powers to the Commissioner to undertake inspections of fire trails on both public and private land. At least an annual assessment of all other fire trails (i.e., those that are not designated or registered) in a FAFT Plan should be undertaken by the responsible agency and a condition report provided to the BFMC.

6.3. Maintenance of registered fire trails

Fire trails must be maintained to the condition certified for the life of the trail, ensuring it continues to meet the selected Acceptable Solution or Performance Solutions at time of registration.

It is the duty of the owner, occupier or land manager of the land on which a designated or registered fire trail is situated to ensure ongoing availability and maintenance. In the event that the fire trail is situated on private land, the responsibility resides with the RFS.

6.4. Legacy of existing fire trails

Fire trails that are registered, or on which works have commenced at the time of publication of these standards, will be legacied and required to meet the standards at the time of registration or commencement of works. Legacy arrangements will remain in place until a time determined by the Commissioner.

7. Document Review

The Fire Trail Standards may be reviewed and amended by the Commissioner as required. A review must be undertaken within three years of publication.

Appendix A: Firefighting Appliance Specifications

Category 1 Firefighting appliance specifications

Table A.1: Category 1 Firefighting appliance specifications

Unit	Measurement
Length	8,000mm
Width	2,450mm
Mirror length	450mm
Height	3,900mm (including 600mm for aerials)
Ground clearance	380mm
Approach angle	25°
Departure angle	28°
Wheelbase	4,250mm
Turning circle – wall to wall	18m diameter
Weight	14,200kg
Maximum axle loading	9,000kg

Category 7 Firefighting appliance specifications

Table A.2: Category 7 Firefighting appliance specifications

Unit	Measurement
Length	6,250mm
Width	2,230mm
Mirror length	450mm
Height	3,350mm (including 600mm for aerials)
Ground clearance	380mm
Approach angle	25°
Departure angle	28°
Wheelbase	3,395mm
Turning circle – wall to wall	14m diameter
Weight	7,500kg
Maximum axle loading	5,600kg

Category 9 Firefighting appliance specifications

Table A.3: Category 9 Firefighting appliance specifications

Unit	Measurement
Length	5,500mm
Width	1,900mm
Mirror length	450mm
Height	2,800mm (including 600mm for aerials)
Ground clearance	320mm
Approach angle	27°
Departure angle	23°
Wheelbase	3,180mm
Turning circle – wall to wall	14m diameter
Weight	3,780kg
Maximum axle loading	2,000kg

Additional Appliances

Category 6 and 13 Firefighting appliance specifications

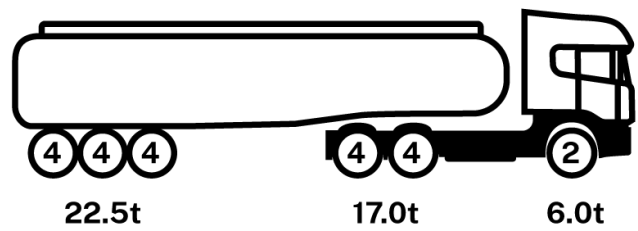
Table A.4: Category 6 and 13 Firefighting appliance specifications (Heavy Rigid Bulk Water Tanker)

Unit	Measurement
Length	8,700mm
Width	2,400mm
Mirror length	450mm
Height	3,600mm (including 600mm for aerials)
Ground clearance	300mm
Approach angle	13°
Departure angle	23°
Wheelbase	4,410mm
Turning circle – wall to wall	19m diameter
Weight	22,500kg
Maximum axle loading	16,500kg

Semi-trailer Watercart appliance specifications

Table A.5: Semi-trailer appliance specifications (Articulated Water Tanker)

Unit	Measurement
Length	Up to 19,000mm
Maximum Total Combination Mass	Up to 45,500kg

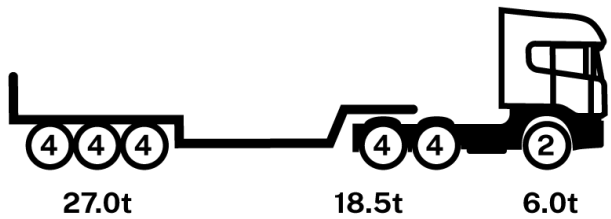


Semi-trailer appliance design example (axle masses included)

Low loader appliance specifications

Table A.6: Low loader appliance specifications (Heavy Plant Float)

Unit	Measurement
Length	Up to 30,000mm
Maximum Total Combination Mass	Up to 51,500kg

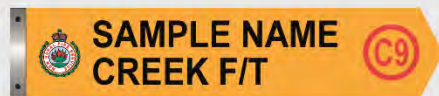


Low loader appliance design example (axle masses included)

Appendix B: Fire Trail Signage

Strategic Fire Trail Signs

Primary Fire Trail Directional Signs
– Single end mounted post



Bi-Directional Fire Trail Signs
– Centre mounted post



Certified Indicative Signs
– Single end mounted post



Tactical Fire Trail Signs

Primary Fire Trail Directional Signs
– Single end mounted post



Bi-Directional Fire Trail Signs
– Centre mounted post



Tactical Indicative Signs
– Single end mounted post

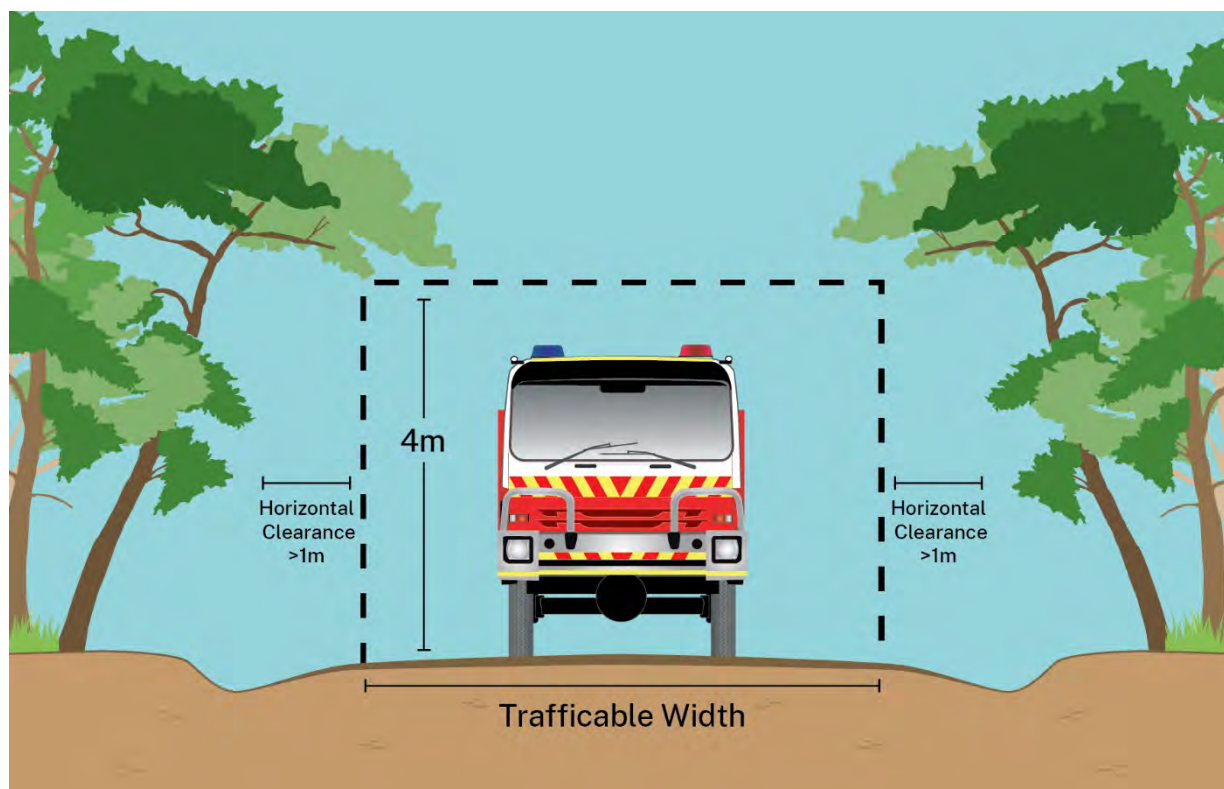


Appendix C: Attribute Considerations

This appendix is a guide to provide best practice samples and options for consideration when planning, designing and constructing fire trails to meet the Acceptable Solutions contained in this standard. This appendix provides figures to illustrate appropriate best practice techniques for identified attributes, however, given the variability in any given landscape, the figures may not cover all applications.

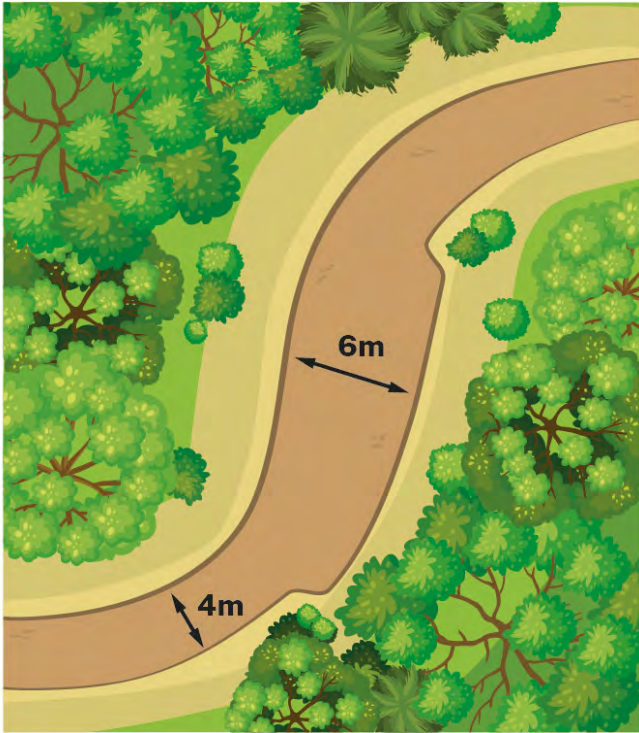
For further details, refer to the *RFS Fire Trail Design, Construction and Maintenance Manual*.

C.1. Clearance



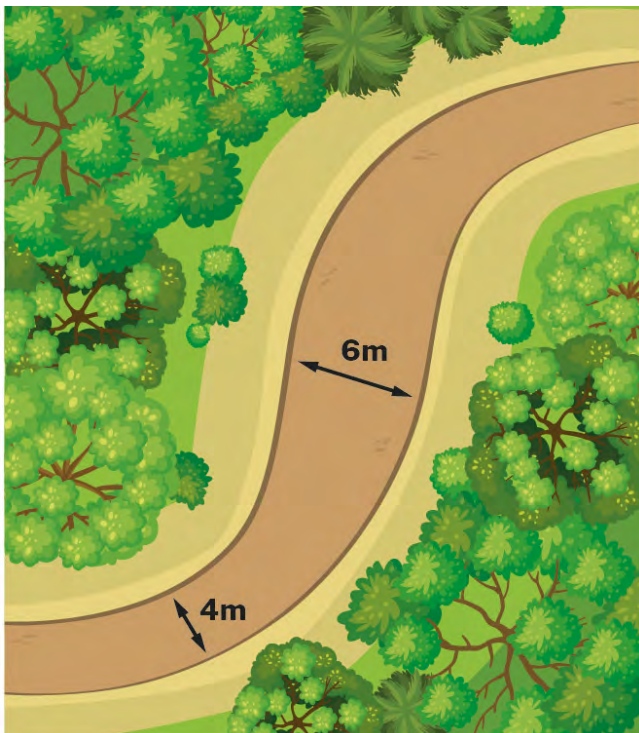
A cleared corridor around the trail is required for unobstructed passage and visibility of appliances for firefighting operations. This includes 4m above the trafficable surface and no less than 1m horizontal clearance at all times (including between maintenance activities).

C.2. Passing Bays



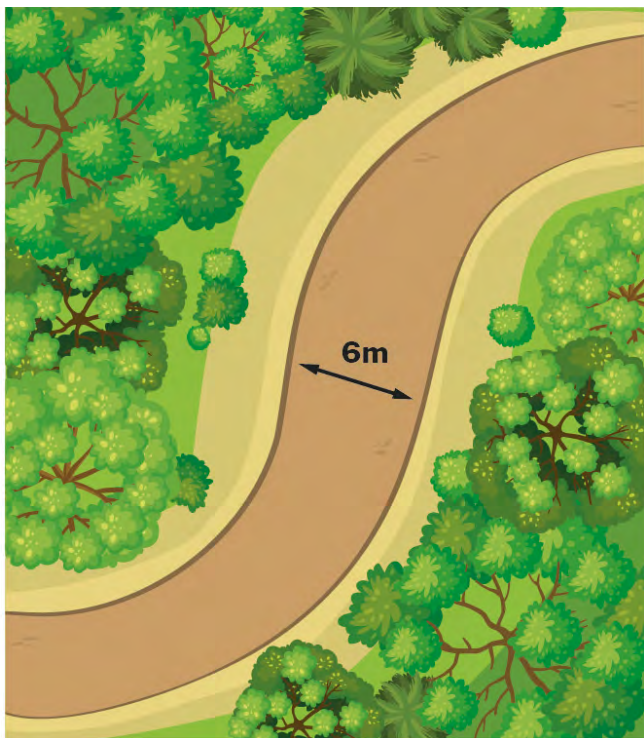
Formed Passing Bay

(e.g., Cat 1 trail dimensions)
Formed and defined bay which allows for entry and exit in a single movement.



Widened Trail

Undefined bay expressed as a widened section of trafficable surface that allows for entry and exit in a single movement.



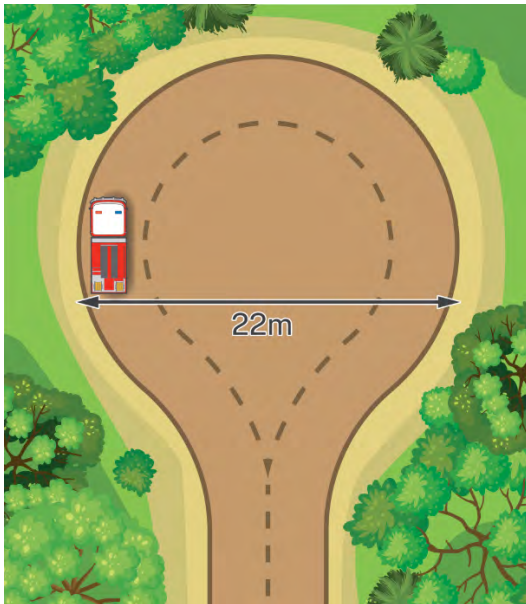
Widened Trail Width

Trafficable surface of $\geq 6\text{m}$

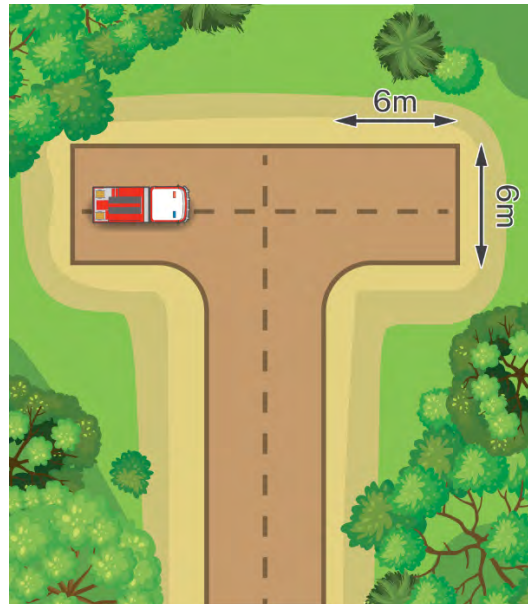
Bays are not defined but passing can occur frequently along the length of the trail.

C.3. Turnaround Bays

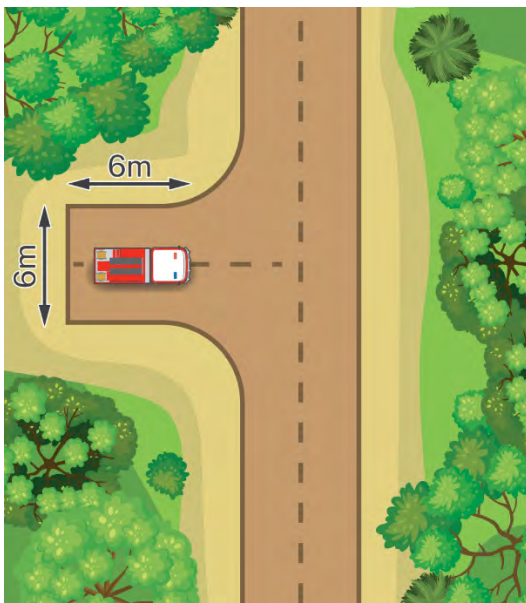
Various configurations are available to meet the attribute criteria for turnaround bays, as long as the dimension criteria are met for the Fire Trail Category. Images below represent a Category 1 Fire Trail for dimensions.



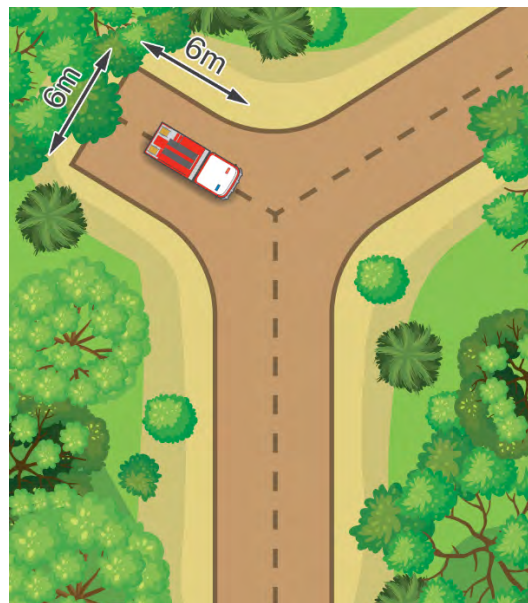
Turning Circle



T-configuration (termination of trail)



T-configuration (mid trail)



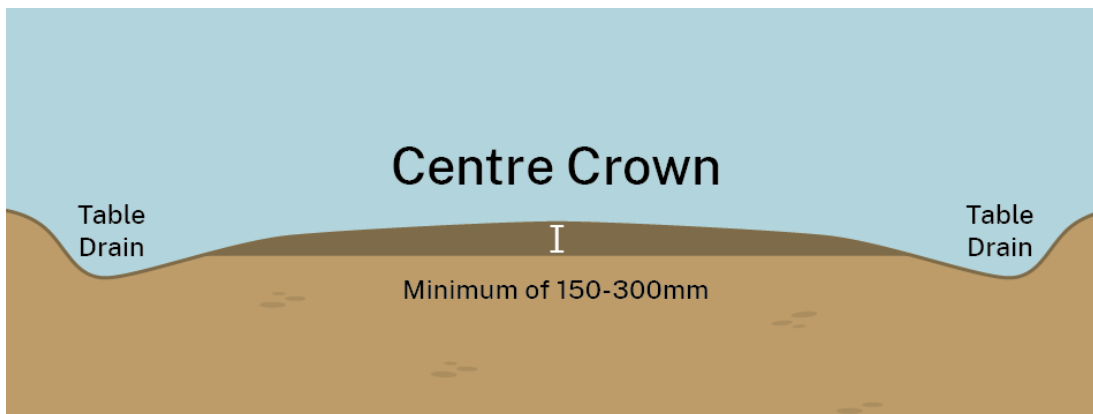
Y-configuration (mid or termination of trail)

C.4. Water Management Systems

Various aspects form the attribute for water management systems on trails. Effective surface drainage is required on fire trails to control runoff.

Crowning

Drainage is easiest on tracks that are “crowned”, as this allows water to be shed to both sides of the track.



Cross Bank Design

Cross banks (also referred to as roll overs) can be constructed across the fire trail to intercept runoff and direct it across the trail surface for drainage.

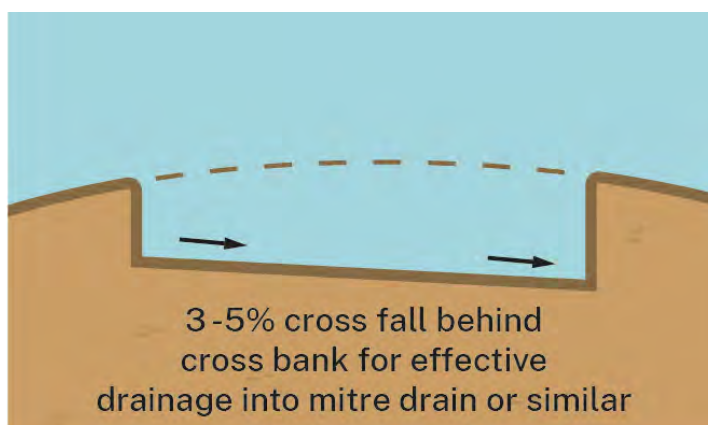
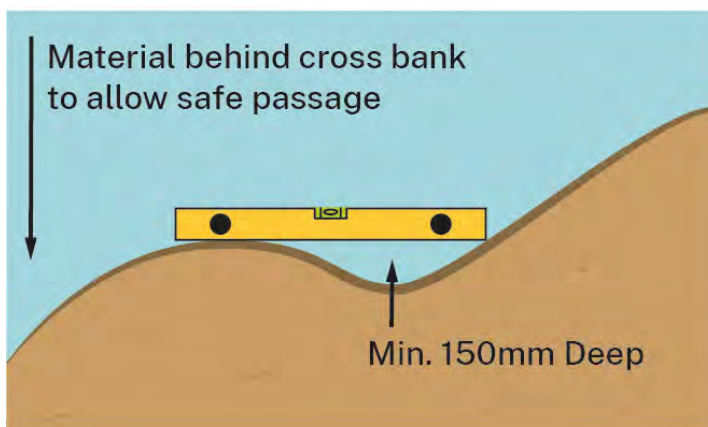
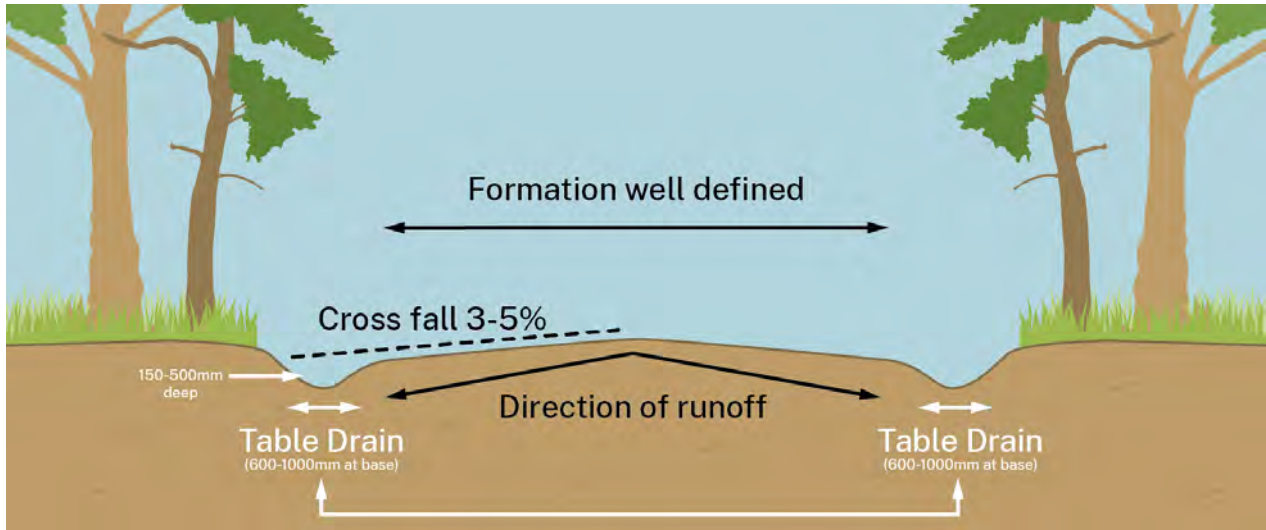


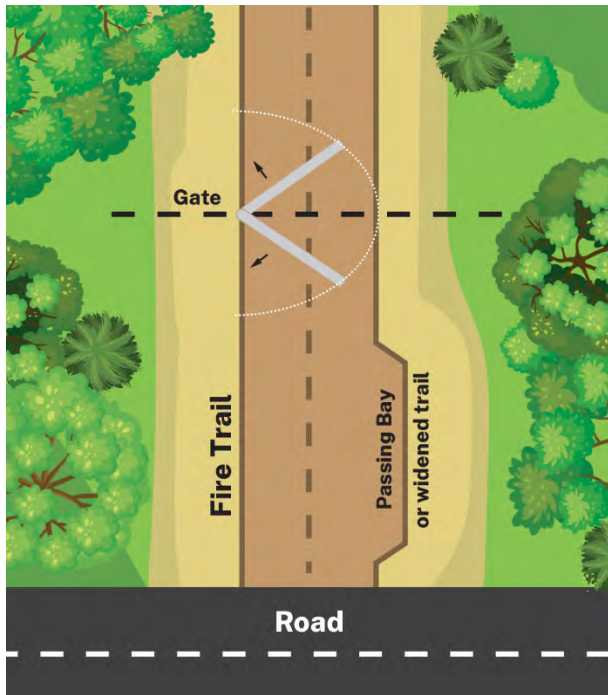
Table Drains

Table drains need to have depth and capacity to accommodate volume with frequent drainage outlets such as mitre drains.



C.5. Trail Access and Access Points

A passing bay is required to be located adjacent to a trail gate (or access point) to ensure appliance and firefighter safety, by enabling the appliance to be a sufficient distance (completely withdrawn) from the adjoining road edge during access.







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ERM's Sydney Office

Level 14, 207 Kent St
Sydney NSW 2000

T: +61 2 8584 8888

www.erm.com