Appendix

E

E. 10 | Bushfire Assessment Report

EMM creating opportunities | SPARK RENEWABLES

Bush Fire Assessment Report

Dinawan Solar Farm

REF: W23035

Date: 23 October 2023

WARATAH BUSHFIRE

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Bush Fire Assessment Report

Dinawan Solar Farm

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BPAD Bushfire Planning & Design Accredited Practitioner Level 3

EXECUTIVE SUMMARY

Spark Renewables Pty Limited (Spark Renewables) proposes to develop the Dinawan Solar Farm, a large-scale solar photovoltaic (PV) generation facility and battery energy storage system (BESS), supported by associated infrastructure (the project). The project is located about halfway between the towns of Coleambally and Jerilderie and is located within the Murrumbidgee local government area (LGA) in New South Wales (NSW).

This bush fire assessment report forms part of the project's environmental impact statement (EIS). Approval for the project is required under Part 4, Section 4.12(8) of the *Environmental Planning and Assessment Act 1979* (*EP&A Act*).

The project is a state significant development (SSD) (SSD-50725959) with the determining authority being the NSW Minister for Planning and Public Spaces. The Secretary's Environmental Assessment Requirements (SEARs) were issued by the NSW Department of Planning and Environment (DPE) on 14 December 2022. The SEARs identified key issues for assessment, including identifying potential hazards and risks associated with bush fires and/or the use of bush fire prone land. The SEARs also require consideration of the risk of the solar farm as a source of ignition for a bush fire and to demonstrate compliance with *Planning for Bush Fire Protection, 2019 (PBP 2019)*.

The NSW Rural Fire Service (RFS) provided correspondence regarding the project, stating that the SEARs should incorporate a bush fire hazard assessment undertaken by a suitably qualified consultant to address the aims and objectives of *PBP 2019*.

This assessment has found that bush fire can potentially affect the project from the surrounding grassland and woodland vegetation.

Waratah Bushfire Planning proposes the following combination of bush fire mitigation measures to address the risk of bush fire caused by the project and to demonstrate compliance with *PBP 2019;*

- Provision of APZs for infrastructure including solar panels, BESS, staff offices, temporary worker accommodation facilities and maintenance sheds, in accordance with Appendix 4 of *PBP 2019*.
- Buildings within 100 metres of bush fire prone vegetation are constructed to comply with *AS3959:2018 – Construction of buildings in bushfire-prone areas.*
- Provision of access and water supply in compliance with *PBP 2019*.

- Maintenance and housing of infrastructure so that it will not create a source of ignition to the surrounding vegetation and grassland.
- Preparation of a Bush Fire Emergency Management and Evacuation Plan; and
- Preparation of a Fire Management Plan in consultation with the NSW RFS District Office for the Mid Murray Zone.

GLOSSARY

APZ	Asset Protection Zone
AS1596	Australian Standard – The storage and handling of LP Gas
AS3745	Australian Standard – Planning for emergencies in facilities
AS3959	Australian Standard – Construction of buildings in bushfire-prone areas 2018
BAL	Bushire Attack Level
BPL	Bush fire prone land
BCA	Building Code of Australia
BESS	Battery energy storage system
BFMOP	Bush Fire Management and Operations Plan
BPM	Bush fire protection measures
BSA	Bush Fire Safety Authority
CFA	Country Fire Authority
DPE	Department of Planning and Environment
DA	Development application
DCP	Development Control Plan
EIS	Environmental impact statement
EP&A Act	Environmental Planning and Assessment Act 1979
EP&A Regulation	Environmental Planning and Assessment Regulation 2000
FFDI	Forest Fire Danger Index
GFDI	Grassland Fire Danger Index
ha	Hectares
IPA	Inner Protection Area
LEP	Local Environmental Plan
LGA	Local government area
m	Metres
MWh	Megawatt hours
NCC	National Construction Code
NPWS	National Parks and Wildlife Service
OPA	Outer Protection Area
PCT	Plant Community Type

PCUs	Power conversion units
PHA	Preliminary Hazard Analysis
PV	Photovoltaic
PBP 2019	Planning for Bush Fire Protection 2019
REZ	Renewable Energy Zone
RF Act	Rural Fires Act 1997
NSW RFS	New South Wales Rural Fire Service
SEARs	Secretary's Environmental Assessment Requirements
SSD	State significant development
SWS	Static water supply
SVTM	State Vegetation Type Map

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1. INTRODUCTION

Spark Renewables Pty Limited (Spark Renewables) proposes to develop the Dinawan Solar Farm, a large-scale solar photovoltaic (PV) generation facility and battery energy storage system (BESS), supported by associated infrastructure. The project will have a generation capacity of up to approximately 800 megawatts (MW) (AC), equivalent to the needs of 300,000 NSW households per year.

The project is a state significant development (SSD) pursuant to schedule 1 of the *State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP 2021)* and is subject to assessment and determination by the NSW Minister for Planning and Public Spaces. This bush fire assessment report has been developed in support of the Environmental Impact Statement (EIS) for the project.

1.1 Purpose of this report

This bush fire assessment report has been prepared in accordance with the Secretary's environmental assessment requirements (SEARs) (application number: SSD-50725959) issued for the project on 14/12/2022 by the NSW Department of Planning and Environment (DPE) and the correspondence received by the NSW Rural Fire Service (RFS) on 17 March 2023 as summarised below:

Table 1-1 – SEARs and RFS assessment requirements

SEARs requirements		Section addressed
Key Issue – Hazards including:	Identify potential hazards and risks associated with bush fires/use of bush fire prone land including the risks that a solar farm would cause bush fire and demonstrate compliance with *Planning for Bush Fire Protection 2019* (PBP 2019)	Section 5.10, 5.11 and Section 6

NSW RFS requirements		Section addressed
Bush Fire Hazard Assessment - minimum requirements	The proposed development is to incorporate a bush fire hazard assessment to address the aims and objectives of PBP 2019	Section 5.8 & Section 7
	Suitable access for fire fighting vehicles, including access around structures on the site	Section 6.2.3
	Suitable static water supply (SWS) including access for fire fighting vehicles	Section 6.2.4
	Appropriate asset protection zones (APZs) and bush fire attack level (BAL)for structures, where appropriate	Section 6.2.1
	Preparation of a Bush Fire Emergency Management and Evacuation Plan in accordance with Table 6.8d of PBP2019 and be consistent with the NSW RFS document: A Guide to Developing a Bush Fire Emergency Management and Evacuation Plan	Section 6.2.8
	Provision of a Fire Management Plan that at minimum includes: o Ongoing bush fire fuel management within the site; o Site infrastructure plan; o Site access and internal road plan; o APZs and their continued maintenance; o Location of hazards (physical, chemical etc) that may impact on fire fighting operations; and o Any such additional matters as may be required by the NSW RFS District Office for the Mid Murray Zone. (Phone 03 5898 4100).	Section 6.2.7

1.2 Aims of the assessment

The aims of the bush fire assessment report are to:

- Provide recommendations for the protection of human life and to minimise impacts on property from the threat of bush fire.
- Address the bush fire risk in accordance with *PBP 2019*, through bush fire hazard identification and assessment, including a bush fire hazard site and landscape assessment.
- Reduce the occurrence and consequences of bush fires through risk-based design: and
- Enable safe and effective emergency response through the provision of fire protection systems, including:
    - safe access in and around the facility including firefighting infrastructure such as water supply,
    - management of vegetation,
    - implementation and maintenance of building construction standards,
    - prevention of fire ignition on site and prevention of fire spread between site infrastructure.

This report has been prepared following guidance from the NSW RFS document PBP 2019, as well as bush fire design guidelines developed for renewable energy generating systems, BESS facilities and electricity network operators.

1.3 Referenced documents & information collation

Assessment of the bush fire risk and measures required to mitigate this risk was performed through a desktop assessment. Documents reviewed for the preparation of this report include the following:

- SEARs Dinawan Solar Farm dated 14/12/2022.
- Correspondence from NSW RFS dated 17 March 2023, ref: DA20221116011773-SEARS-1.
- Environmental Impact Statement prepared by EMM, Job no. E220305, dated October 2023.

- Preliminary Hazard Analysis prepared by Sperpa Consulting, document number 21687-RP-001, dated 10/10/2023.
- Bush Fire Risk Management Plan prepared by the Mid Murray Bush Fire Risk Management Committee, 2009.
- Vegetation mapping by Biosis.
- State Vegetation Type Map (STVM) by DPE (SVTM_vC1.1.M1.1).
- Environmental Systems Research Institute (ESRI) aerial photography (2023).
- Planning for Bush Fire Protection 2019 (PBP), NSW RFS.
- Comprehensive Vegetation Fuel Loads, March 2019, NSW RFS.
- The Battery Energy Storage Systems Guidance Report: Australian Energy Council Limited, dated 24th March 2023 by GHD.
- Design Guidelines and Model Requirements Renewable Energy Facilities, March 2022 by the Country Fire Authority (CFA).
- Australian Standard 3959 Construction of buildings in bushfire-prone areas (2018)

1.4 Project location

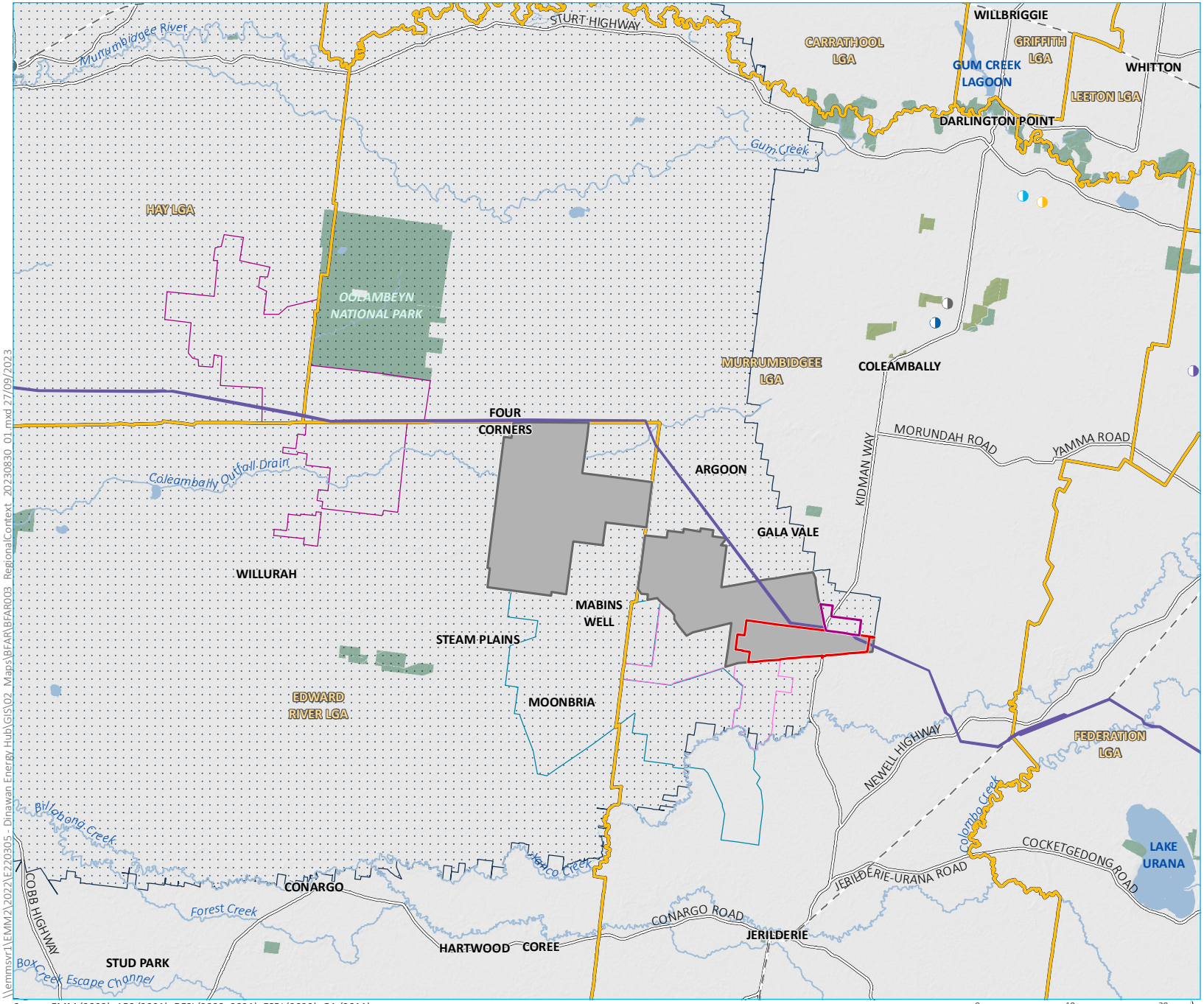
The project is located approximately halfway between the towns of Coleambally and Jerilderie and lies within the Murrumbidgee local government area (LGA) in NSW. The regional and local context of the project is shown in Figure 1-1 and Figure 1-2, respectively.

The project area is approximately 4,222 hectares (ha) and encompasses 56 land parcels. Most of the land within the project area is privately owned and is currently used for sheep and cattle grazing.

The landscape within the project area is largely flat with some minor drainage depressions that hold water during rainfall and flooding. There are five first order watercourses and one second order watercourse mapped within the project area; however, all are ephemeral. The Coleambally irrigation channel runs through the project area, east of Kidman Way.

The project is part of the Dinawan Energy Hub, a hybrid wind, solar and battery storage energy hub. The project is within the South-West Renewable Energy Zone (REZ), a region selected by the NSW Government due to its significant potential for renewable energy infrastructure and regional development.

An overhead transmission line will connect on-site project substations to the Dinawan Substation, which will be built by Transgrid as part of the Project EnergyConnect interconnector that will run between Robertstown in South Australia and Wagga Wagga in NSW.



Source: EMM (2023); ABS (2021); DFSI (2020, 2021); ESRI (2023); GA (2011)

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Regional context

Dinawan Solar Farm
Bushfire assessment report
Figure 1.1

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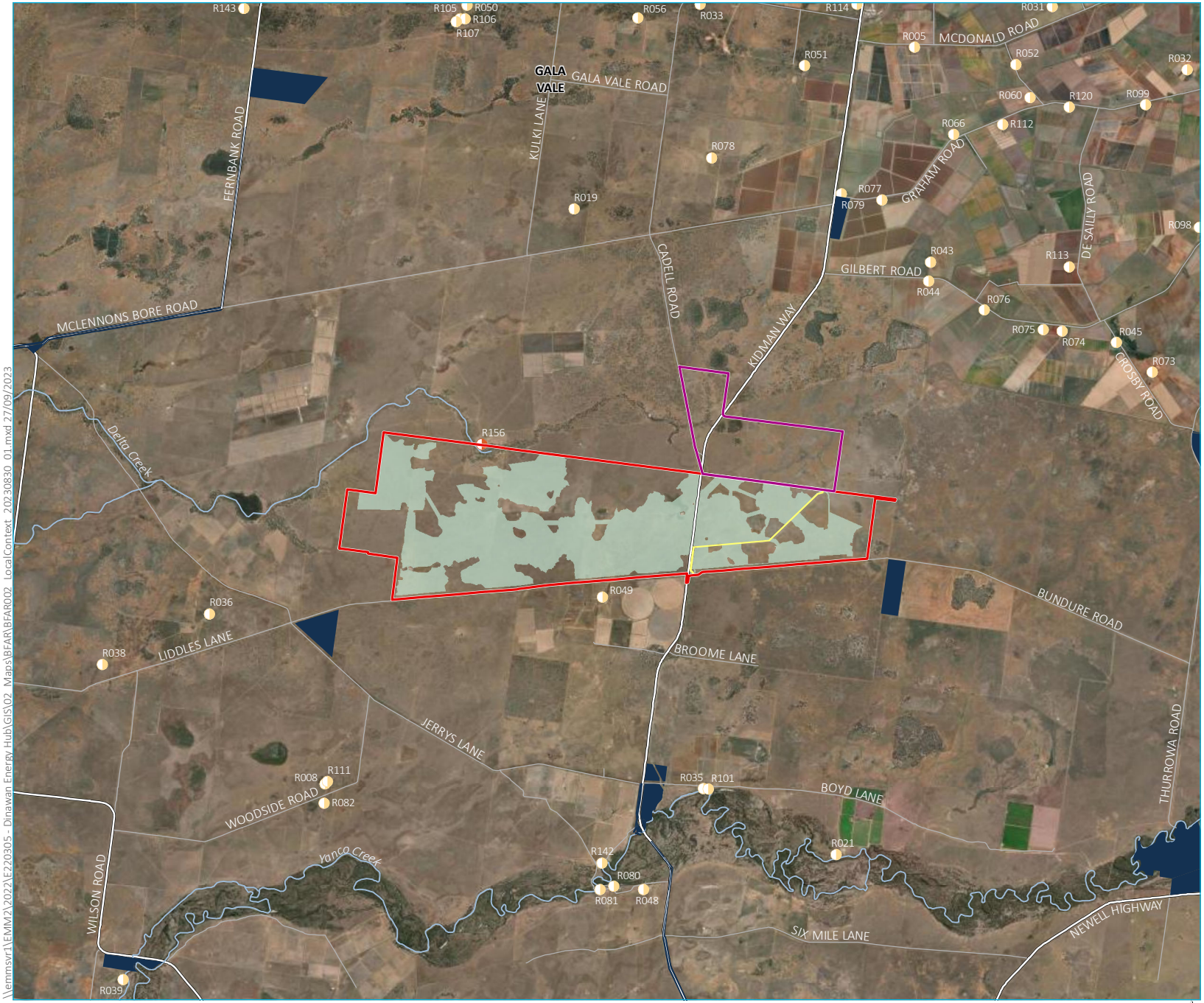

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Source: EMM (2023); DFSI (2020, 2021); ESRI (2022); GA (2011)

Local context

Dinawan Solar Farm
Bushfire assessment report
Figure 1.2

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2. PROJECT DESCRIPTION

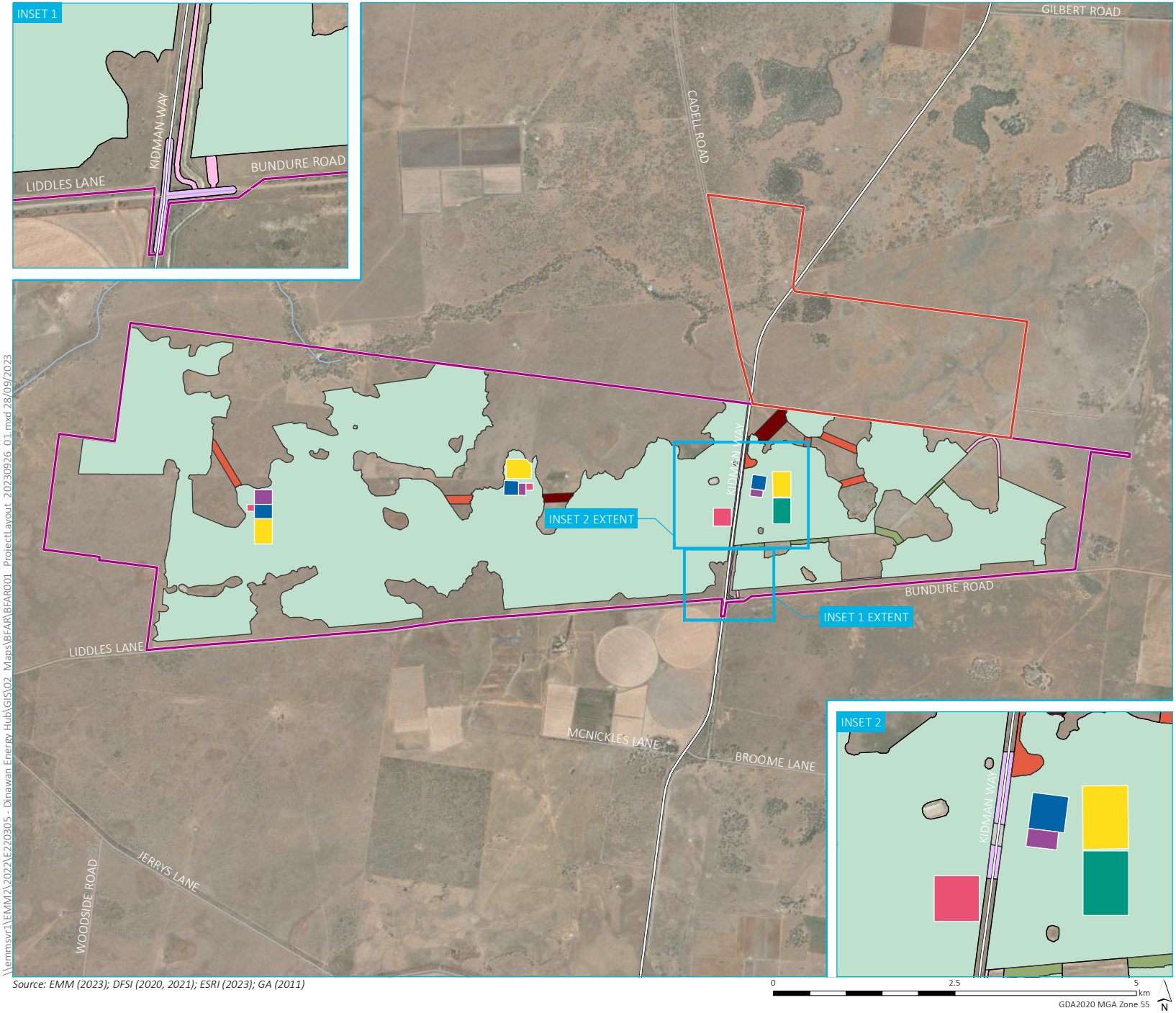
2.1 Overview

The project comprises a large-scale solar PV generation facility, BESS and supporting infrastructure (Figure 2-1). The project will have a generation capacity of up to 800 MW (AC). The BESS will have a capacity of up to 300 MW (AC or DC coupled) and will have provision for up to 2 hours of storage (600 megawatt hours (MWh)). A project summary is provided in Table 2-1.

Table 2-1 – Project summary

Project element	Summary
Project area	Approximately 4,222 ha, comprised of 56 land parcels
Development footprint	Approximately 2,499 ha
Generation capacity	Up to 800 MW (AC)
Storage capacity	300 MW (AC coupled), up to 2 hours of storage (600 MWh).
Key infrastructure	• approximately 2 million PV modules and associated infrastructure • power conversion units (PCUs) • BESS and associated infrastructure • electrical collection system, substations and control room • transmission line infrastructure connecting the project substations to the Dinawan Substation • operations and maintenance infrastructure, including: – site offices and amenities – equipment and maintenance sheds – water tanks – laydown, storage and parking areas • temporary construction facilities, including: – construction compounds – site offices and amenities

Project element	Summary
	– laydown areas – construction materials storage – water tanks – storage and parking areas – temporary worker accommodation facility.
Workforce	Approximately 400 personnel during peak construction. Up to 10 full-time employees and varying numbers of contractors during operations.
Hours of operation	Standard day time construction hours (7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm Saturday). Once operational, the project will operate continuously, 24 hours per day, 7 days per week.
Roads	Upgrades to the local road network, including: • a new four-way intersection on Kidman Way • upgrades to the intersection of Kidman Way and Bundure Road. Site access points will be on Kidman Way and Bundure Road. An internal network of access tracks within the development footprint, including: • access to the eastern and western sections of the project from Kidman Way • access to the eastern sections of the project from Bundure Road.
Subdivision	Subdivision of the following may be required to create new allotments for the construction, operation and maintenance of substations: • Lot 6 of DP 594041 • Lot 125 of DP 75644 • Lot 22A of DP 756444 • Lot 28 of DP 756444



KEY

- Project area
- Development footprint

Project elements

- Solar array
- Electrical cabling
- Electrical cabling/ site access
- Public road upgrades
- Public road upgrades / Electrical cabling
- Restricted development area (irrigation)
- Site access
- Development footprint
- BESS
- Substation
- Switchyard
- Construction compound
- Construction compound and accommodation facility

Existing environment

- Watercourse (third order and higher)
- Major road
- Minor road

Project EnergyConnect (Transgrid)

- Dinawan Substation

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Source: EMM (2023); DFSI (2020, 2021); ESRI (2023); GA (2011)

0 2.5 5 km

GDA2020 MGA Zone 55

N

Indicative project layout

Dinawan Solar Farm
Bushfire assessment report
Figure 2.1

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2.2 Solar farm

The solar farm generation capacity will be up to 800 MW (AC). The solar farm will include PV modules mounted on single-axis tracking systems, configured in rows positioned to maximise the use of the solar resource. Approximately 2 million PV modules will be installed. However, the final design will depend on a range of factors including module technology, available grid capacity, economics, grid connection and environmental constraints. Further details on the design and spacing of the PV modules and power conversion units is provided in Chapter 3 of the EIS.

Photo 1: Example of a PV module layout

2.3 Electrical collection system

Groups of PV modules will be connected to PCUs, and groups of PCUs will be connected to one of the on-site substations by underground or aboveground cables. Connections will include power, earthing, and communications cables. Cabling will be underground or aboveground depending on a range of technical factors including distance to the substation, existing landscape features and geotechnical conditions.

The exact routes of overhead and underground lines within the development footprint will be determined as part of detailed design.

Underground cables will be installed at a minimum depth of 600 millimetres below ground level.

Power poles carrying 33 kilovolt lines within the development footprint are expected to be between 10–20 metres (m) tall. The distance between power poles will be dependent on the type used.

The eastern and western sections of PV module arrays will be connected via an underground or overhead line crossing Kidman Way.

2.4 On-site substations

There will be up to three on-site substations that would convert the electricity generated from 33 kV to 330 kV or 500 kV for export to Dinawan Substation. The on-site substations will each contain a 330/33 kV transformer along with the necessary switchgear, located in an adjacent switchyard.

The on-site substations will be located on both the eastern and western side of Kidman Way as shown in Figure 2-1. The substations and switchyards will have a footprint of up to 5 ha each. In addition, PV modules and other ancillary infrastructure may be placed within that area, subject to detailed design.

The substations will have lightning protection.

2.5 Battery Energy Storage System

The BESS will mitigate the natural fluctuations of solar generation by storing electricity and dispatching it when required. The BESS will have a capacity of up to approximately 300 MW (AC coupled) and will have provision for up to 2 hours of storage (600 MWh).

Three locations have been selected for the BESS adjacent to each of the proposed on-site substations. Each BESS will have a footprint of up to 9 ha. PV modules and ancillary infrastructure may also be placed within the BESS sites.

The major components of each BESS will be:

- batteries to store electricity – most likely a lithium-ion technology
- bi-directional inverters to convert DC current to AC current (when exporting electricity) and vice versa (when importing electricity)

- transformers to step up the voltage – skid-mounted transformers will be installed adjacent to each inverter
- heating ventilation air conditioning to maintain the batteries at a temperature that will optimise their lifetime and performance
- fire protection – the BESS will have an active gas-based fire protection system with thermal sensors and smoke/gas detectors connected to a fire control panel.

Due to rapidly evolving technology, the final choice of battery storage technology, capacity and housing will be determined as part of the detailed design. The batteries are likely to be housed in self-contained steel enclosures (resembling shipping containers), or within a building resembling a large industrial shed.

2.6 Network connection

An overhead 330 kV or 500 kV transmission line will connect the on-site substations to the Dinawan Substation. The transmission towers are expected to be between 40–80 m tall. The indicative grid connection corridor is provided on Figure 2-1. The design and precise location of the overhead transmission line will be determined as part of the detailed design.

2.7 Temporary worker accommodation facility

The facility will accommodate up to 400 workers (including parking). The nominated (indicative) footprint for the facility is approximately 8.9 ha and includes land required for both the facility and a construction compound.

2.8 Construction works

Temporary construction infrastructure will include construction compounds, laydown areas and internal access tracks.

Site preparation works will include:

- site survey to confirm infrastructure placement
- construction of access tracks
- upgrading the bridge across the Coleambally Irrigation Channel (if required)
- installation of boundary fences
- establishment of temporary construction areas, including:

- construction compound(s)
- temporary worker accommodation facility
- laydown and parking areas
- construction materials storage areas
- installation of temporary construction offices and buildings
- ongoing geotechnical investigations to confirm the ground conditions.

Laydown areas; waste handling; and fuel and chemical storage areas will be strategically placed to minimise potential environmental impacts during construction.

Construction activities will include:

- installation of solar panel piles
- installation of PV mounting structures and tracker tubes
- securing PV modules to tracker tubes
- installation of electrical cabling
- installation of PCUs
- erection of power poles and transmission towers
- stringing of lines and/or trenching and line installation
- installation of substations
- installation of BESS
- testing and commissioning of project infrastructure.

The majority of infrastructure will be prefabricated off-site, delivered and assembled on-site.

Plant and equipment required for the construction of the project will include:

- earthmoving plant
- cable trenching and laying equipment
- pile-driving equipment
- material handling equipment (forklifts and cranes)
- machinery and equipment for connection infrastructure establishment and installation of battery and energy storage devices
- water trucks for dust suppression
- light vehicles for personnel transport.

Construction materials and infrastructure will be transported to the development footprint via road. Heavy vehicles up to 26 m in length will require access to the

development footprint. Construction materials and infrastructure delivered to the development footprint will include:

- PV modules
- piles
- tracking tubes and associated tracker equipment
- electrical infrastructure including cabling and PCUs
- BESS components
- infrastructure to support the temporary worker accommodation facility
- construction and permanent buildings and associated infrastructure
- earthworks, lifting machinery and associated equipment.

Oversize, overmass vehicles will deliver on-site substation transformers and switchgear.

2.9 Construction program & staging

Project construction is expected to commence in 2025, subject to receiving the required approvals. Construction of the project is expected to be completed over approximately 18–36 months.

The project will operate continuously, 24 hours per day, 7 days per week.

Sequencing is likely to include overlap between activities but indicatively will involve the following steps:

1. construction of supporting infrastructure and grid connection works
2. construction of solar farm and associated infrastructure
3. construction of BESS and associated infrastructure

The concurrent construction of Dinawan Solar Farm and part of Dinawan Wind Farm has been assessed as it would have the greatest construction workforce demands and vehicle movements.

Subsequent stages will be:

4. operations
5. decommissioning

2.10 Operations

The facility will require regular maintenance throughout its operational life, including:

- vegetation maintenance
- weed and pest management
- fence and access road management
- drainage management
- landscaping (if required)
- servicing PV modules, inverters, transformers, the BESS, on-site substation, and other infrastructure, with repair or replacement of components where required.
- PV modules may need to be washed periodically, depending on rainfall quantities on-site. Water for panel cleaning will be brought to the site. Washing will not require any detergent or cleaning agents.

Light vehicle access and occasional heavy vehicle access will be required during operations.

Sheep may be grazed across the development footprint following the completion of project construction.

The operational workforce will also be responsible for ongoing security monitoring. Perimeter security cameras may be utilised to assist in monitoring project infrastructure.

2.11 Decommissioning

Operations are expected to be in excess of 25 – 35 years. Once the project reaches the end of its operational life, a decision will be made to either decommission or re-power the facility, subject to approval requirements.

Decommissioning will involve the removal of all above ground project structures and the land disturbed by the project will be rehabilitated, generally to its pre-existing land use, as far as practicable.

If subdivision occurs for the construction and maintenance of the substations, it is envisaged that the subdivided lots would be consolidated back into a single lot at the end of the operational life of the substations.

3. LEGISLATIVE AND POLICY REQUIREMENTS

3.1 Environmental Planning and Assessment Act 1979

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

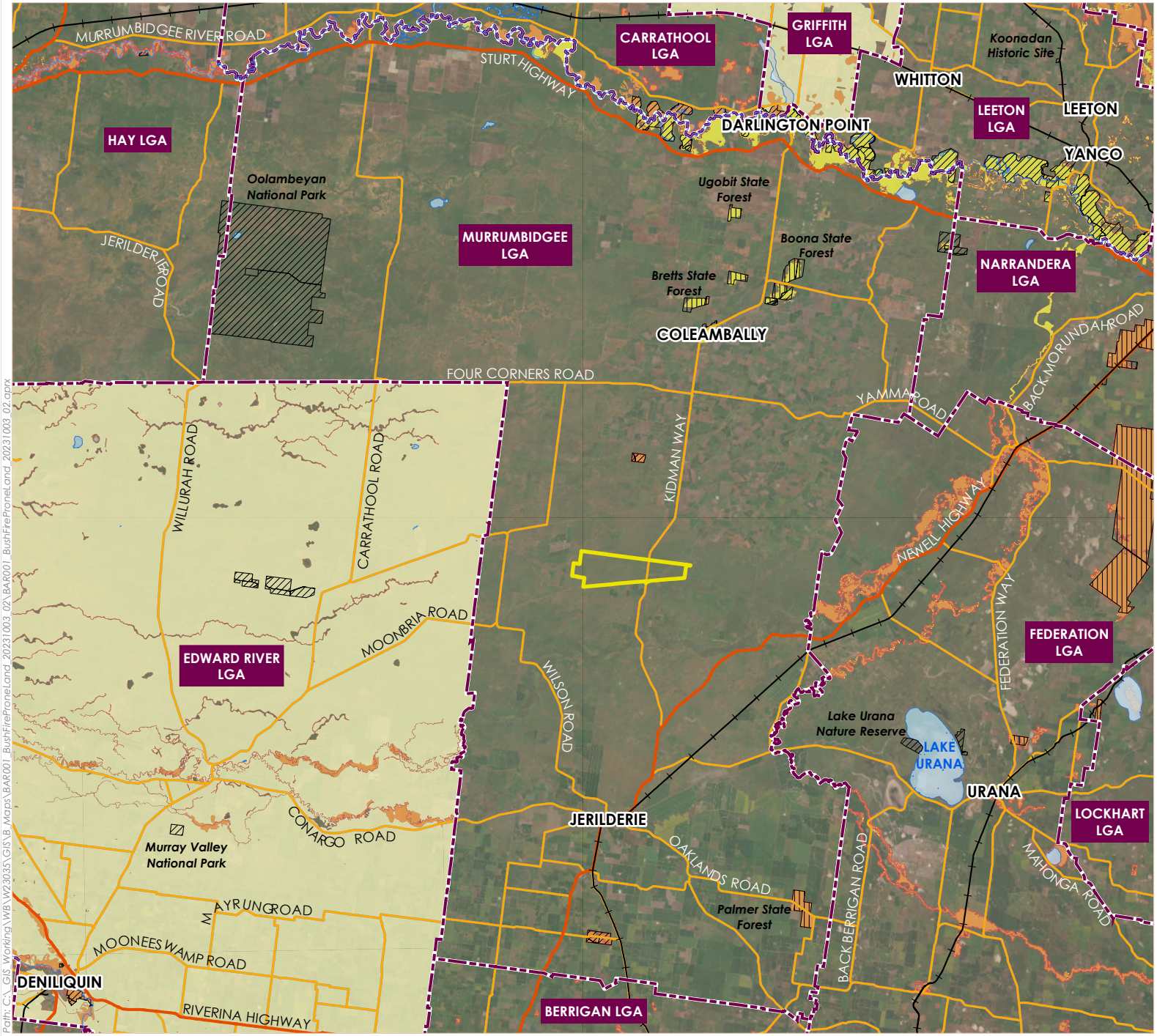
3.1.1 Bush Fire Prone Land Mapping

The *EP&A Act 1979* requires that any development on bush fire prone land (BPL) for any purpose complies with PBP 2019. Councils maintain and update BPL maps according to the NSW RFS *Guide for Bush Fire Prone Land Mapping* and then they are certified by the NSW RFS. BPL maps are based on the vegetation types present which are classified into one of four categories, as follows:

- Category 1: which includes areas of forest, woodland, heath, forested wetland and timber plantation. Highest risk category.
- Category 2: rainforests and "lower risk vegetation parcels". These parcels contain remnant vegetation that is limited in its connectivity to larger areas and land parcels with land management practices that actively reduce bush fire risk (and are subject to a bush fire plan or similar).
- Category 3: which includes grasslands, freshwater wetlands, semi-arid woodlands, alpine complex and arid shrublands. Moderate risk category; and
- Exclusion: Areas of vegetation less than 1 ha and greater than 100 m separation from category 1, 2 or 3 vegetation; small patches or strips of remnant vegetation; managed grasslands; agricultural cropland; gardens; and mangroves are not mapped as bush fire prone.

BPL is defined as land with category 1, 2 or 3 vegetation and land within 100 m of category 1 or within 30 m of category 2 or 3 vegetation.

As depicted in Figure 3-1 the project area and surrounding land is not mapped as bush fire prone by Murrumbidgee Council, however the SEARs and the RFS response did identify key issues such as hazards, including the requirement to demonstrate compliance with *PBP 2019* based on the surrounding woodland and grassland vegetation.



LEGEND

- Project area
- Rail
- Major road
- Minor road
- Murrumbidgee River
- Named waterbody
- National park/reserve
- State forest
- Local government area

Bush fire prone land (RFS, 2022)

- Vegetation Buffer
- Vegetation Category 1
- Vegetation Category 2
- Vegetation Category 3

Figure 3.1 – Bush fire prone land map

Dinawan Solar Farm

03/10/2023 (v2) 1:700,000 @A4 GDA2020 MGA Zone 55

0 10 20
kilometres

Disclaimer: mapping is indicative only and the data shown has an inherent level of inaccuracy that is dependent on the data source. The location of all mapped features and boundaries should be confirmed by a registered surveyor.

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Data source: WBP (2023); EMM (2023); DCSSS (2023); ESRI (2023); RFS (2023); GA (2011)

Path: C:_GIS_Working\WBW23035\GIS\B_Maps\BAR001_BushFireProneLand_20231003_02\BAR001_BushFireProneLand_20231003_02.aprx

3.2 Rural Fires Act 1997

The objectives of the *Rural Fires Act 1997* are to provide:

- the prevention, mitigation and suppression of fires
- coordination of bush fire fighting and prevention
- protection of people and property from fires; and protection of the environment.

In relation to the management of bush fire fuels on public and private lands within NSW, sections 63(1) and 63(2) of the *Rural Fires Act 1997* require public authorities and owners/occupiers of land to take all practicable steps to prevent the occurrence of bush fires on their land, and to minimize the danger of the spread of bush fires.

3.3 Planning for Bush Fire Protection 2019

The NSW RFS document PBP 2019 provides and explains the legal requirements, framework and protection measures needed for all types of development on bush fire prone land in NSW. Section 8.3.5 of PBP 2019 specifically addresses bush fire planning and protection for wind and solar farms, however it does not specifically address other renewable energy facilities, such as BESS.

Section 8.3.5 of PBP 2019 states that specific consideration should be provided for wind and solar farms with adequate clearance to combustible vegetation, firefighting access and water supply. The following should be provided:

- A minimum 10m APZ for structures and associated buildings/infrastructure.
- The APZ must be maintained to the standard of an inner protection area (IPA) for the life of the development.
- Essential equipment should be designed and housed in such a way to minimise the impact of bush fires on the infrastructure and should be designed and maintained so it will not create a source of ignition to the surrounding vegetation and grassland.
- A bush fire emergency management and operation plans (BFMOP) should identify relevant risks and mitigation measures associated with the construction and operation of the wind and solar farm.

Section 8.3.9 of PBP 2019 provides guidelines for hazardous industry. Whilst this section does not specifically include BESS infrastructure, this type of development should be

considered for its ability to start a bush fire as well as its susceptibility to bush fire impacts.

3.4 Other guidelines relevant to renewable energy projects

The CFA, in conjunction with industry and regulatory authorities, has developed the *Design Guidelines and Model Requirements for Renewable Energy Facilities* (March 2022) to support designers and operators of facilities to consider and mitigate fire risk. This includes fires which originate within the facility itself as well as bush fire impact on the site from external factors.

While these were developed in a Victorian context, CFA expertise and the guidelines have been sought for supporting fire safety at renewable energy facilities across Australia and internationally. The CFA guidance represents the current leading practice and has been utilised within this document as it builds upon the principles and knowledge from recent fires at large-scale renewable energy facilities.

Network Standard NS187 Passive Fire Mitigation Design of Major Substations is an Ausgrid document that details the minimum levels for passive fire protection systems at Ausgrid's major substations (sub-transmission and zone substations). The recommended mitigation measures provided in this document have been applied to guide the design of the three on-site substations (and associated switchgear). Substation design should aim for a high level of bush fire protection for critical assets and a rapid return to service following a bush fire event.

In addition*, The Battery Energy Storage Systems Guidance Report: Australian Energy Council Limited,* dated 24th March 2023 by GHD, has also been referenced within the report as it provides a guide and resource highlighting key areas for consideration for grid-scale BESS facilities, with a focus on lithium-ion and vanadium chemistries.

4. RISK ASSESSMENT METHODOLOGY

A risk assessment has been undertaken using the procedures and considerations outlined in *AS/ISO 31000:2018 Risk Management - Guidelines*. This is the same process used by the NSW RFS in the development of bush fire risk management plans across NSW. This process involves:

1. *Risk identification* – understand the potential sources of fire which include
    - Landscape hazards, such as bush fire/grass fire ignition from fire within the facility, or external ignition of site infrastructure from embers or radiant heat.
    - Electrical hazards, such as panel/combiner box/inverter electrical faults; power surges; lightning strikes; water ingress; retained DC electricity in solar panels after shut-down/isolation.
    - Potential fire spread and limited emergency response due to proximity of panel blocks to each other, on-site infrastructure and vegetation (including screening vegetation).
    - BESS - production and accumulation of flammable gases in battery enclosures with ignition resulting in fire or explosion and thermal runaway.
2. *Risk analysis and risk evaluation* – involves identifying the nature of risk and its characteristics and identifying evidence-based controls for risks based on industry good practice.

Bush fire risk is defined as the chance of a bush fire igniting, spreading and causing damage to assets of value. The project is considered an economic asset within the subcategory of critical infrastructure.

The bush fire risk level is assessed by combining the likelihood and consequence to provide low, medium, high, very high or extreme levels of bush fire risk. This matrix is provided in Table 4-1.

Consequence is the outcome or impact of a bush fire event. The assessment process for consequence is subjective and includes consideration of hazard, vulnerability and other issues such as level of impact and recovery costs. There are four possible consequence ratings: minor, moderate, major and catastrophic.

The consequence rating of 'Moderate' has been determined for the project based on the bush fire hazard (High) and vulnerability (Moderate). This consequence rating will reduce to 'Minor' as the surrounding area is progressively developed and the bush fire mitigation measures recommended in section 6 of this document are implemented.

Likelihood is described as the potential for a bush fire to ignite, spread and impact on an asset. There are four possible likelihood ratings: Unlikely, Possible, Likely and Almost Certain.

A review of NPWS Fire History – Wildfire and Prescribed Burns (downloaded on 13/03/2023 and depicted in Figure 5-1) suggests that fires occur infrequently in the area. Anecdotal evidence provided by the local community has been provided to Spark Renewables during the consultation process which acknowledges that there is evidence of additional fires as recently as 1-2 years ago. As a result the likelihood rating is determined as 'Almost Certain'.

Table 4-1 – Determining the Risk Rating

Likelihood	Consequence				
		Minor	Moderate	Major	Catastrophic
	Almost Certain	High	Very High	Extreme	Extreme
	Likely	Medium	High	Very High	Extreme
	Possible	Low	Medium	High	Very High
	Unlikely	Low	Low	Medium	High

Source: Bush Fire Risk Management Planning Guidelines for Bush Fire Management Committees 2008

When applying the process used by the NSW RFS in the development of bush fire risk management plans the risk rating for assets within 30m of vegetation (in this case woodland) is determined as 'Very High' with the risk rating reducing the further away the asset is from the bush fire hazard. Assets within 30 – 100m of classified vegetation is determined as 'High' with assets over 100m – 400m considered to have a 'Medium' risk rating.

3. *Risk Treatment* – this involves the selection and implementation of bush fire mitigation controls to treat and reduce the risk identified. There is not one bush fire protection measure that can effectively eliminate the bush fire risk. Section 6 of this document outlines a suite of bush fire protection measures recommended to mitigate this risk in line with the requirements outlined in PBP 2019.
4. *Monitoring and review, recording and reporting* - involves a regular review of risks and controls and monitoring of site hazards, systems and processes to ensure that emerging risks are identified, and existing risks are controlled.

5. BUSH FIRE RISK FACTORS

To assess the bush fire threat, an assessment of the potential hazardous vegetation and the effective slope within the vegetation is required, as well as a review of the likelihood of bush fire and potential fire behaviour.

5.1 Current bush fire management controls

The project area comprises 56 land parcels of privately held land with historical grazing use. The Mid Murray Zone Bush Fire Risk Management Plan does not identify the area as an asset or apply any specific treatment strategies.

However, the following programs and activities are examples of current local government-wide controls and have been considered:

- the declaration and management of burning restrictions, such as Total Fire Bans, Restricted Burning Times, Prohibited Burning Times and Harvest and Vehicle Movement Bans to reduce ignition risk.

The area is also relatively well-served by fire response services. The nearest volunteer fire brigade is Argoon Rural Fire Brigade located approximately 7km to the south of the project area, followed by Emery Rural Fire Brigade located 13km to the north.

5.2 Climate and bush fire season

As outlined in the Bush Fire Risk Management Plan, the Mid Murray Zone is warm temperate with predominately winter rainfall.

Rainfall is spread across the year although peaking in late winter and spring. Average annual rainfall is generally low in the 350mm to 450mm range with summer rainfall between 20mm and 30mm per month and winter rainfall between 30mm and 40mm per month. Annual variations can be extreme producing droughts or floods. Summer rainfall is usually as a result of thunderstorms.

The start date for the Bush Fire Danger period generally runs from October – November through to March – April, adjusted according to seasonal conditions. Fire weather conditions are usually associated with winds from the west around to the north accompanied by high daytime temperatures and low relative humidity. Dry lightning storms occur frequently during the bush fire season often starting forest and grass fires.

Weather extremes do occur in summer with temperatures up to 45 degrees, low humidity (5%) and strong winds (+60kph) which have combined potential for disastrous results.

5.3 Fire ignition

Bush fires within the region are typically started by natural causes (i.e. lightning), unattended camp fires, power lines, machinery and traffic, escapes from agricultural burns and use of cutting and welding equipment.

Earth moving equipment, power tools (e.g., welders, grinders), mowers and slashers are known for starting bush fires under conditions of high temperature, low humidity and high wind. Therefore, hot works or use of machinery that could cause a spark within the project area will be a potential source of ignition during the bush fire danger season (typically November to the end of March).

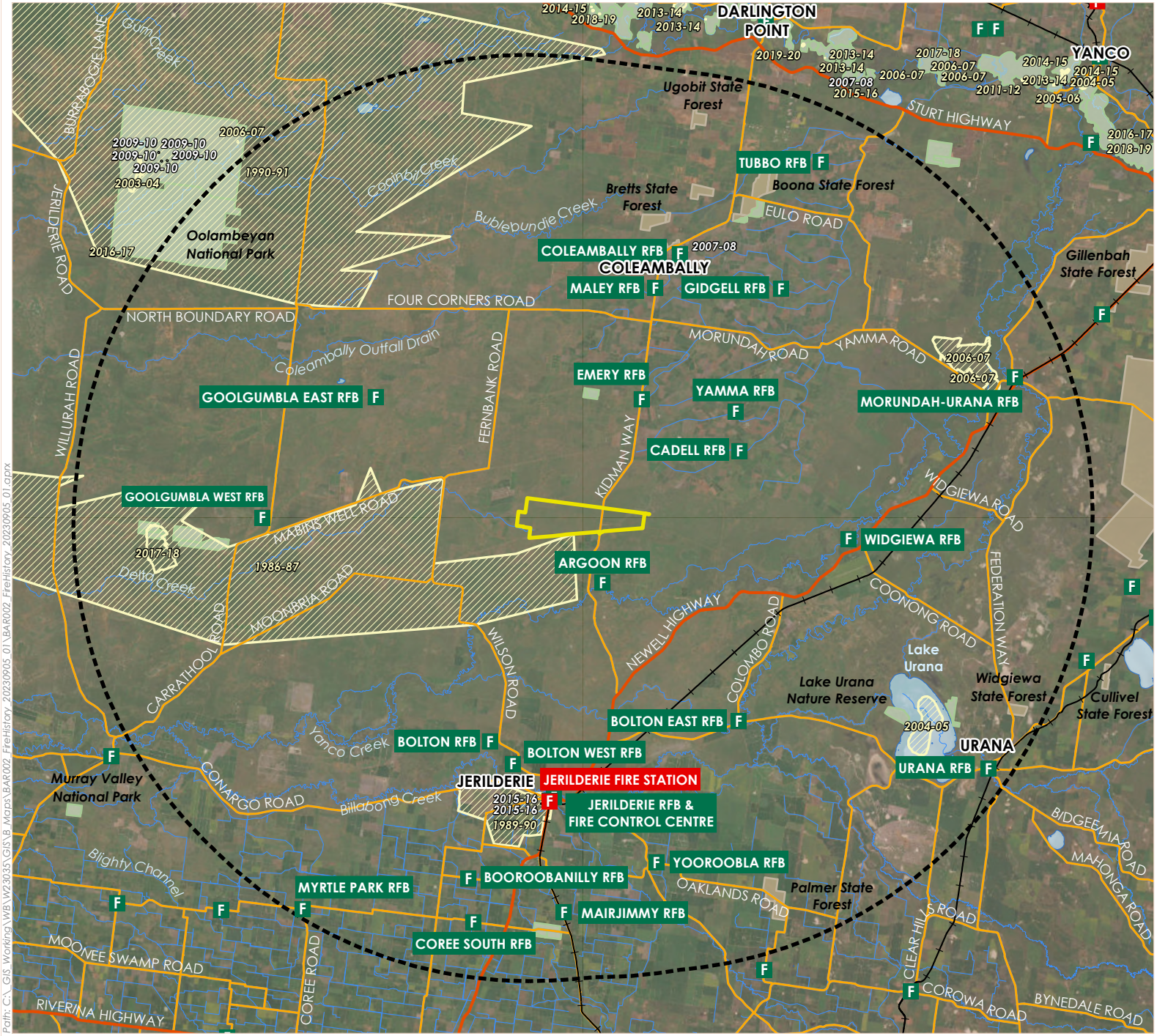
5.4 Fire history

The Mid Murray Zone Bush Fire Management Committee (BFMC) area has on average 250 bush fires per year of which 6-10 on average are considered a major fire (BFMC, 2008).

Potential major risk seasons follow significant periods of high vegetation growth from high winter rainfall. These seasons allow build-up of fine fuels and create the potential for a major fire seasons across the whole of the Mid Murray Zone when this vegetation material cures. Over the last 50 years, these potential major fire seasons have been 1956/57, 1974/75, 1975/76, 1989/90, all of these seasons have followed significant high winter rainfall.

NPWS fire history data has been reviewed which suggests that there have been no fires recorded within the project area. A wildfire was recorded to the south of the project area in 1986-87 (92 ha). The recorded cause of the fire was a lightning strike. A wildfire in 1990 – 91 was also recorded approximately 30km to the north-west (181ha) with the cause recorded as a motor vehicle.

Anecdotal evidence provided by the local community to Spark Renewables during the consultation process also acknowledges that there is evidence of additional fires in the general area as recently as 1-2 years ago.



LEGEND

- Project area
- Project area buffer – 50 km
- Rural fire service
- Fire and rescue
- Rail
- Major road
- Minor road
- Named watercourse
- Named waterbody
- State forest
- National park/reserve

NPWS fire history

- Wildfire
- Prescribed burn

Figure 5.1 – Fire history and location of emergency services

Dinawan Solar Farm

05/09/2023 (v1) 1:625,000 @A4 GDA2020 MGA Zone 55

0 10 20
kilometres

Disclaimer: mapping is indicative only and the data shown has an inherent level of inaccuracy that is dependent on the data source. The location of all mapped features and boundaries should be confirmed by a registered surveyor.

WARATAH BUSHFIRE
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Data source: WBP (2023); EMM (2023); DCSSS (2023); ESRI (2023); DPE (2023); GA (2011)

Path: C:_GIS_Working\WBW23035\GIS\B_Maps\BAR002_FireHistory_20230905_01\BAR002_FireHistory_20230905_01.aprx

5.5 Fire behaviour potential

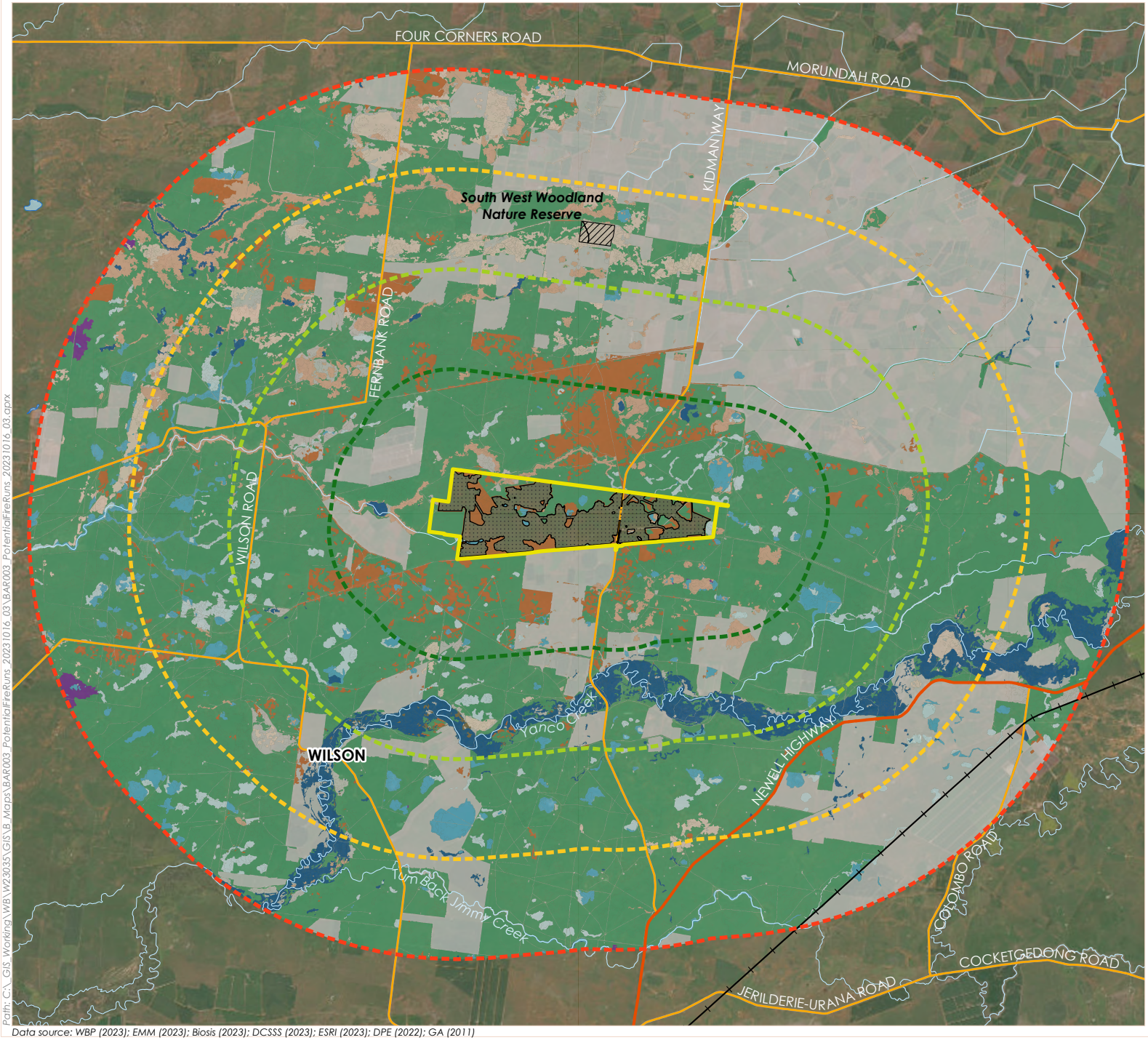
Grassland (subject to grazing and cropping), woodland, forested and freshwater wetland communities (within drainage depressions) surround the project area and make up the predominant fuel for bush fire. Potential fire runs of more than 20km extend to the northwest and west, south and east and predominantly relate to the connectivity of grassland communities within the region (Figure 5-2).

These lands particularly to the north, northwest, west and south may be subject to further renewable energy development (including Dinawan Wind Farm, Yanco Delta Wind Farm and Argoon Wind Farm) which could reduce the potential fire run from these directions in the future.

Until the adjoining lands are developed and subject to an ongoing management regime there will be periods when the adjoining grazing and cropping lands are non-flammable due to climatic and agricultural practices. There will also be periods when these grassland and woodland areas are cured and highly flammable.

An ignition point takes some time to build to a quasi-steady state rate of spread, however, under extreme weather conditions a grass fire can be expected to reach maximum rate of spread within 30 minutes or even less (Cheney and Sullivan, 2008), by which time the fire is likely to be uncontrollable.

It should also be assumed that, under the most extreme weather, a fire can spread even in heavily grazed grass and embers may breach any APZ. The residence time for flames in heavily grazed pasture is likely to be very short (less than five seconds) (Cheney and Sullivan, 2008), so the project area will have a similarly short time of exposure to high radiant heat under such a scenario.



LEGEND

- Project area
- Development footprint
- Rail
- Major road
- Minor road
- Named watercourse
- Named waterbody
- National park/reserve

Site boundary/project area buffer

- 5 km
- 10 km
- 15 km
- 20 km

Vegetation formation and class

- Not classified

Arid Shrublands

- Riverine Chenopod Shrublands

Forested Wetlands

- Inland Riverine Forests

Freshwater Wetlands

- Inland Floodplain Shrublands
- Inland Floodplain Swamps

Grasslands

- Riverine Plain Grasslands

Grassy Woodlands

- Floodplain Transition Woodlands

Semi-arid Woodlands

- Riverine Plain Woodlands
- Semi-arid Sand Plain Woodlands
- Inland Floodplain Woodlands
- Riverine Sandhill Woodlands

Figure 5.2 – Potential fire runs (landscape scale)

Dinawan Solar Farm

16/10/2023 (v3) 1:275,000 @A4 GDA2020 MGA Zone 55

0 5 10
kilometres

WARATAH BUSHFIRE
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Path: C:_GIS_Working\WBW\W23035\GIS\B_Maps\BAR003_PotentialFireRuns_20231016_03\BAR003_PotentialFireRuns_20231016_03.aprx

Data source: WBP (2023); EMM (2023); Biosis (2023); DCSSS (2023); ESRI (2023); DPE (2022); GA (2011)

5.6 Predominant vegetation

PBP 2019 guidelines require the identification of the predominant vegetation formation in accordance with the publication *Ocean Shores to Desert Dunes* (David Keith, 2004) if using the simplified acceptable solutions. The hazardous vegetation is calculated for a distance of at least 140m from a proposed building envelope. The vegetation posing a bush fire threat to the project area and development footprint (including solar array, BESS, substations and workers accommodation) includes:

Table 5-1 – Vegetation

Plant Community Type (PCT) mapping (Biosis 08/08/2023)	**Vegetation class / comprehensive fuel loads (t/ha) (NSW RFS 2019)**	***Vegetation formation***	***Acceptable solution fuel loads (t/ha) (PBP 2019)***
Weeping Myall open woodland (PCT 26)	Riverine Plain Woodland 5.9/9	Semi-arid Woodlands	10.5/20.2
Black Box – Lignum Woodland wetland (PCT 13)	Inland Floodplain Woodland 5.9/9	Semi-arid Woodlands	10.5/20.2
Black Box – grassy open woodland (PCT 15)	Inland Floodplain Woodland 5.9/9	Semi-arid Woodlands	10.5/20.2
Lignum shrubland wetland (PCT 17)	Inland Floodplain Shrublands 4.4/4.4	Freshwater Wetlands	4.4/4.4
Plains grass grassland (PCT 45)	Riverine Plain Grasslands 6/6	Grasslands	6/6
Curly Windmill Grass (PCT 46)	Riverine Plain Grasslands 6/6	Grasslands	6/6

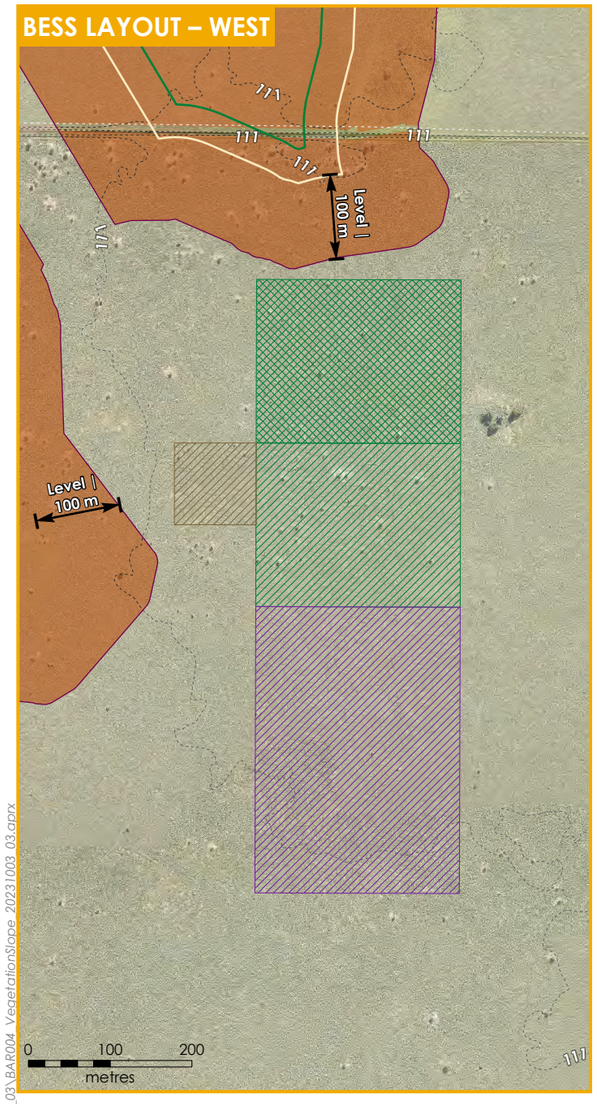
The PCT mapping within the development footprint (plus 50m buffer) has been confirmed by Biosis during their field survey. Vegetation mapping beyond the 50m buffer is sourced from State Vegetation Type Map by DPE (2022, version C1.1M1.1).

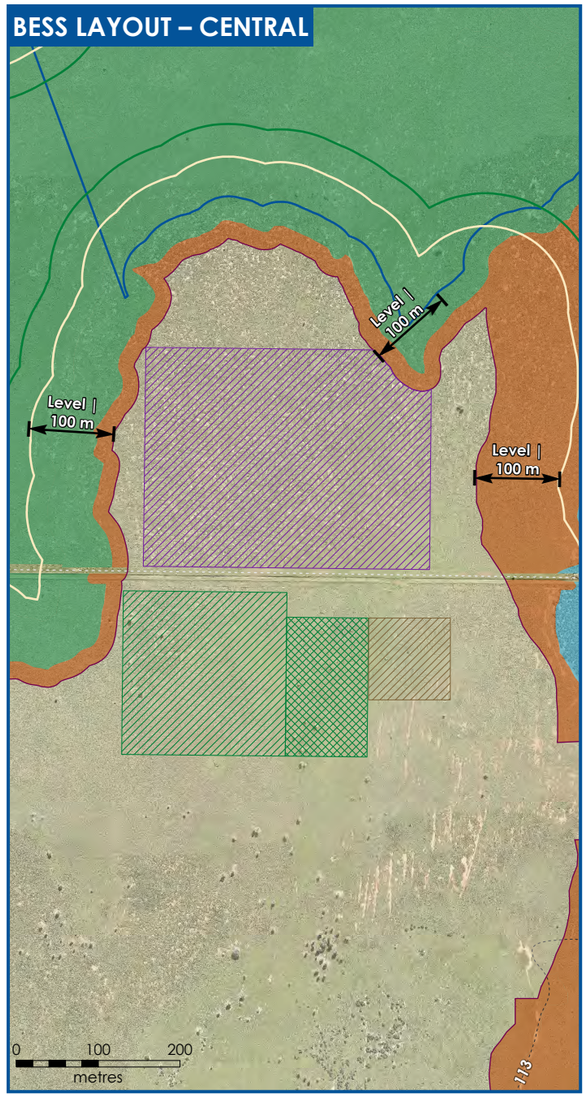
5.7 Effective slope

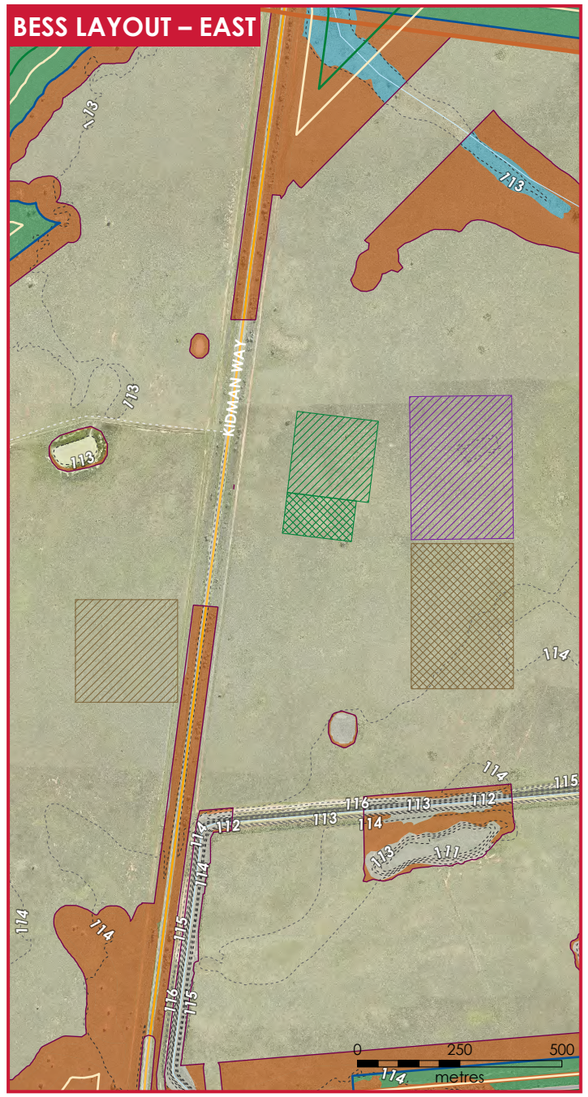
Topography has a significant effect on bush fire behaviour and therefore can increase the risk to assets. For example, fire travels faster when moving uphill when

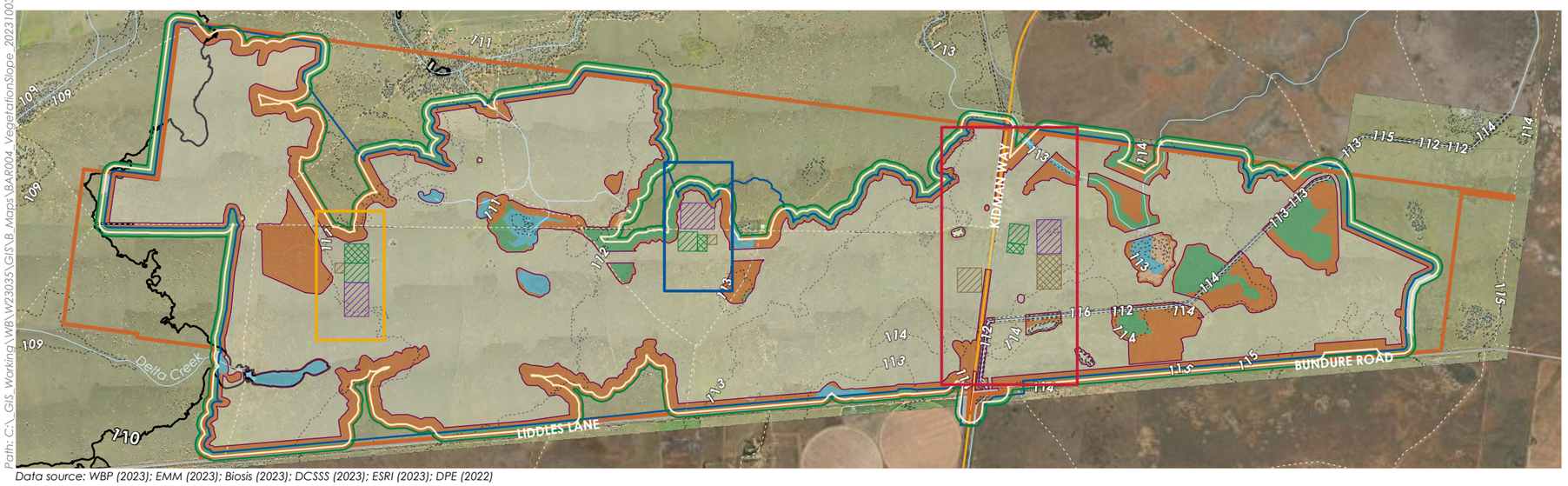
compared to downhill. For every 10 degrees slope, the fire will double its speed and increase in intensity.

The topography within the project area is generally flat with minor undulations associated with the creek corridors. The effective slope has been assessed within the vegetation up to 100m from the development footprint to determine the minimum APZs required and the expected radiant heat output in a bush fire event. This is described in detail within Table 5-2 and Figure 5-3 below.









LEGEND

- Project area
- Slope buffer (100 m)
- Vegetation buffer (140 m)
- Biosis PCT mapping extent

Development footprint

- Development footprint (extent)
- Substation
- Switchyard
- Construction compound
- Construction compound and temporary worker accommodation facility
- BESS

Existing environment

- Minor road
- Local road
- Vehicular track
- Watercourse/drainage line
- Topographic contour (1 m)
- Topographic contour (10 m)

Vegetation formation and class

- Not classified

Freshwater Wetlands

- Inland Floodplain Shrublands
- Inland Floodplain Swamps

Grasslands

- Riverine Plain Grasslands

Semi-arid Woodlands

- Riverine Plain Woodlands
- Inland Floodplain Woodlands

Figure 5.3 – Vegetation and slope assessment

Dinawan Solar Farm

03/10/2023 (v3) 1:55,000 @A3 GDA2020 MGA Zone 55

0 1 2
kilometres

WARATAH BUSHFIRE
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Data source: WBP (2023); EMM (2023); Biosis (2023); DCSSS (2023); ESRI (2023); DPE (2022)

Path: C:_GIS_Working\WB\W230305\GIS\B_Maps\BAR004_VegetationSlope_20231003_03\BAR004_VegetationSlope_20231003_03.aprx

5.8 Bush fire attack assessment

The following assessment has determined the APZ and radiant heat levels (expressed in BAL thresholds BAL 29, BAL 19 & BAL 12.5) using Table A1.12.6 of PBP 2019 (deemed to satisfy).

A fire danger index (FDI) of 80 has been used to calculate bush fire behaviour on the project area based on its location within the Southern Riverina region.

Table 5-2 – Bush fire attack assessment

Aspect	Vegetation Formation within 140m	Effective Slope	Minimum APZ recommended (avoid flame contact)	*BAL thresholds*
Solar array				
All aspects	Grassland / woodland	0-5^0	10 m	< BAL 40
BESS, substation & switchyard (west)				
North & west	Woodland	Level	8 m	BAL 40 (8-<11 m) BAL 29(11-<16 m) BAL 19(16-<22 m) BAL 12.5 (22-<100 m)
South, east and west	Managed land/ surrounding infrastructure & solar array	N/A	Refer Note 1	
BESS, substation & switchyard (central)				
North, east and west	Woodland Refer note 2	Level	8 m	BAL 40 (8-<11 m) BAL 29(11-<16 m) BAL 19(16-<22 m) BAL 12.5 (22-<100 m)

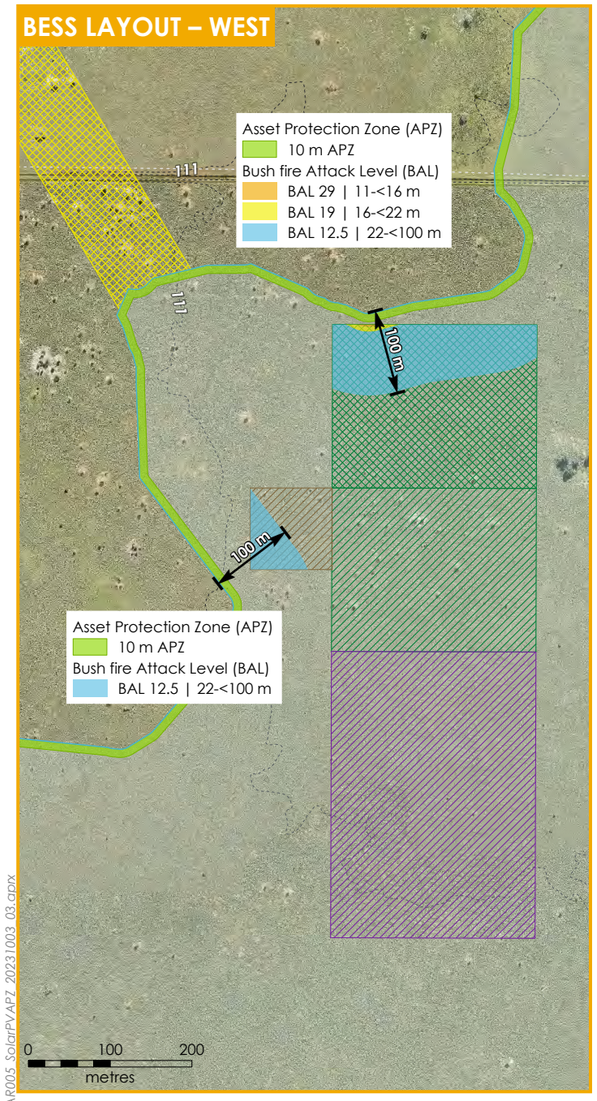
Aspect	Vegetation Formation within 140m	Effective Slope	Minimum APZ recommended (avoid flame contact)	*BAL thresholds*
South	Managed land/surrounding infrastructure & solar array	N/A	Refer Note 1	
BESS, substation & switchyard (East)				
North, south, east and west	Managed land/surrounding infrastructure & solar array	N/A	Refer Note 1	
Temporary workers accommodation				
North, south, east & west	Managed land/surrounding infrastructure & solar array	N/A	>100 m	BAL Low

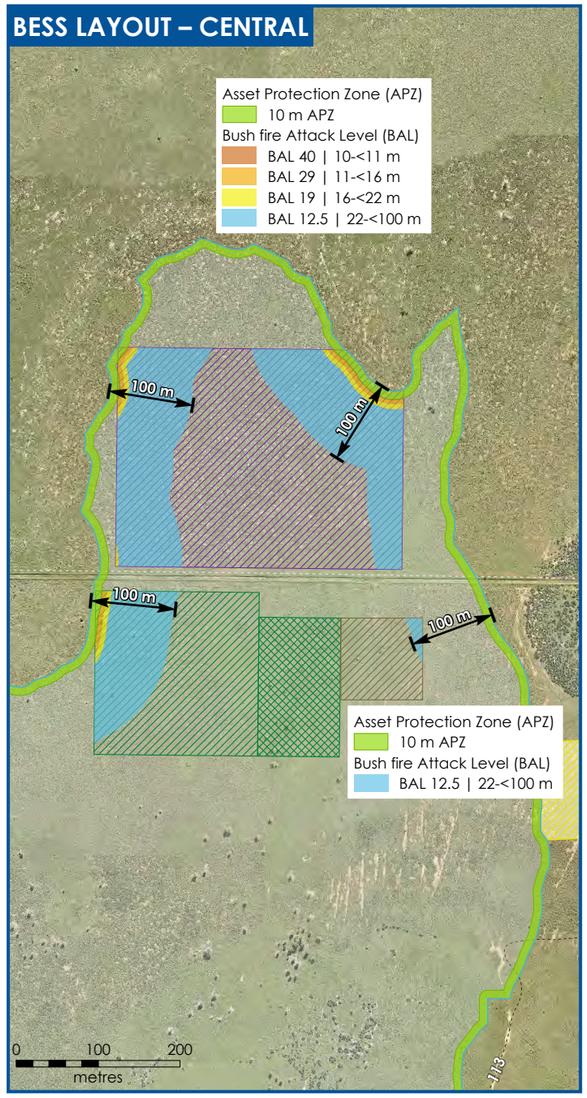
Note 1 – The Preliminary Hazard Analysis (PHA) prepared by Sherppa Consulting provides a recommended indicative separation distance of 8m between the BESS and adjacent infrastructure, (i.e., solar panel blocks) to prevent the potential for ignition of the adjacent infrastructure. However, as the BESS equipment manufacturer will not be finalised prior to approval, the PHA states the following;

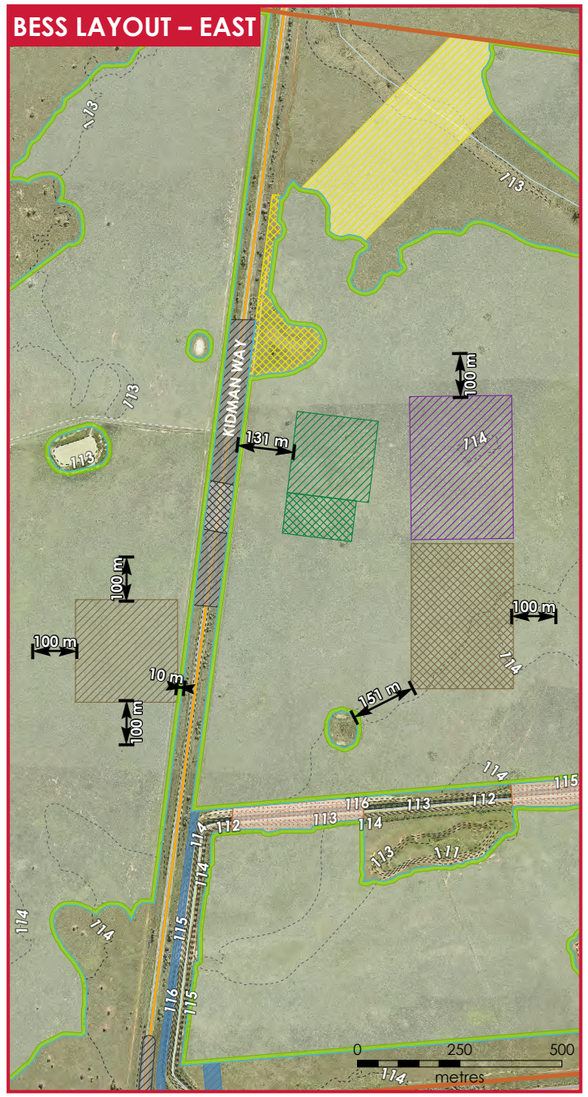
- The indicative configuration of the battery units has been designed including clearances specified by the equipment manufacturer, and consistent with the clearances implemented in the UL 9540A unit level test. Once the preferred equipment manufacturer has been selected, the required clearances should be reviewed, and layout revised where necessary.
- Based on the propagation characteristics determined from the UL 9540A test and in combination with the proposed APZ, in the event of thermal runaway and/or fire, propagation is not expected to affect other onsite receptors.

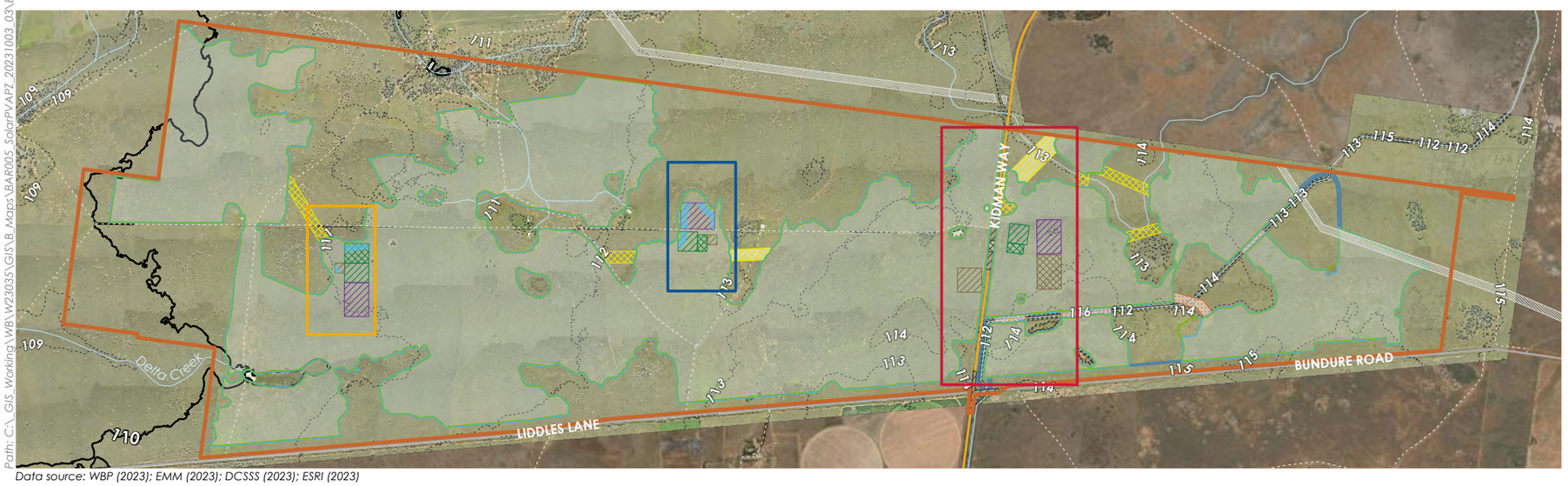
Note 2 – The predominant vegetation has been determined as woodland. Whilst the site contains a large amount of grassland derived from woodland, where mixes of

vegetation formations are located together, the vegetation formation providing the greater hazard shall be used for the purpose of assessment. The fuel loads associated with the woodland community are higher than those for grassland and freshwater wetland and therefore the predominant vegetation has been determined as woodland.









LEGEND

- Project area

Asset Protection Zone (APZ)
- 10 m APZ (minimum setback for solar PV modules)

Bush fire Attack Level (BAL)
- BAL 40 | 10-<11 m
- BAL 29 | 11-<16 m
- BAL 19 | 16-<22 m
- BAL 12.5 | 22-<100 m

Development footprint
- Electrical cabling
- Electrical cabling/site access
- Public road upgrades
- Public road upgrades/electrical cabling
- Restricted development area (irrigation)
- Site access
- Solar array
- Substation
- Switchyard
- Construction compound
- Construction compound and temporary worker accommodation facility
- BESS

Existing environment
- Minor road
- Local road
- Vehicular track
- Topographic contour (1 m)
- Topographic contour (10 m)
- Watercourse/drainage line
- Easement

Figure 5.4 – Bushfire Attack Level

Dinawan Solar Farm

03/10/2023 (v3) 1:55,000 @A3 GDA2020 MGA Zone 55

0 1 2
kilometres

WARATAH BUSHFIRE
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Data source: WBP (2023); EMM (2023); DCSSS (2023); ESRI (2023)

Path: C:_GIS_Working\WBW23035\GIS\B_Maps\BAR005_SolarPVAPZ_20231003_03\BAR005_SolarPVAPZ_20231003_03.aprx

5.9 Bush fire risk created by the project

Fire risks have been identified and must be effectively managed during the construction and commissioning of the project.

5.9.1 Assessment of bush fire risk during construction and decommissioning

The potential sources of ignition of bush fires resulting from the construction of the project and decommissioning include:

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

In general, the risk of bush fire impact during construction and decommissioning is rated high to extreme and is dependent on factors such as fuel loads, weather and the scale (size) of fires which may occur. There is a threat to construction personnel or firefighters from fast moving bush fire events which may impact the project area.

Mitigation measures required to manage and minimise these risks are outlined in Section 6.

5.9.2 Assessment of bush fire risk during operation

The potential sources of ignition of bush fires resulting from the operation of the project include:

- Landscape hazards, such as bush fire/grass fire ignition from fire within the facility, or external ignition of site infrastructure from embers, radiant heat and flame contact.
- Potential fire spread and limited emergency response due to proximity of panel blocks (solar) and proximity of batteries to each other, on-site infrastructure and vegetation (including screening vegetation).
- Production and accumulation of flammable gases in battery enclosures with ignition resulting in fire or explosion and thermal runaway.
- Electrical hazards associated with the operation of the BESS, such as battery faults; overcharging; rapid discharge; loss of remote monitoring systems; internal short circuits; overheating; water ingress; lightning strike (leading to thermal events/runaway).
- Chemical hazards, such as the inherent hazards of the stored dangerous goods; spills and leaks of transformer oil/diesel spills/leaks, refrigerant gas/coolant; chemical reactions from ignition.
- Potential fire spread due to proximity of batteries (and containers/enclosures) to each other, on-site infrastructure and vegetation (including screening vegetation).
- Mechanical damage to battery containers/enclosures due to vehicular impact.
- Electrical hazards associated with the solar panels, such as panel/inverter electrical faults; power surges; lightning strikes; water ingress; retained DC electricity in solar panels after shut-down/isolation.

With the implementation and maintenance of the mitigation measures outlined in Section 6 the bush fire risk from the project to the surrounding environment (and vice versa) is rated low to moderate.

6. BUSH FIRE MITIGATION MEASURES

Bush fire mitigation measures have been developed for construction, operational and decommissioning phases of the project, based on guidance from NSW RFS guidelines, *PBP 2019,* electrical network industry sources and best practice design guidelines prepared by the CFA (2022). Adoption of these measures is expected to reduce, to an acceptable level, both the risk of bush fire ignition by construction and/or operation of the assets and the risk that bush fires in the landscape pose to the assets.

6.1 During construction and decommissioning

Construction and decommissioning activities may pose a potential for on-site ignitions which may result in a fire escaping to the surrounding private land. These mainly arise from hot work, fire risk work, vegetation clearing and management and use of vehicles on site. It is recommended that contractors incorporate the following bush fire mitigation measures to ensure the risk is appropriately managed.

- The use of construction equipment, slashers and mulching machines in areas where rock is known to occur shall be accompanied by a fire-fighting appliance such as a 4-wheel drive (4WD) Striker with 'slip-on' fire-fighting unit or tanker trailers, equipped with diesel pump and hose. This work should not occur during periods of Total Fire Ban and Catastrophic Fire Weather Days.
- Precaution should be used during all external hot works with shielding and a water supply (i.e., nine kilogram water fire extinguisher) provided. No external hot works should be undertaken during periods of Total Fire Ban and Catastrophic Fire Weather Days. Contractors must be aware of prohibited activities or exemptions that are notified by the Commissioner of the NSW RFS under the RF Act s99.
- Emergency external hot works undertaken during periods of Total Fire Ban and Catastrophic Fire Weather Days are to have a NSW Rural Fire Service fire-fighting appliance on stand-by at the works.
- Motor vehicles should not be driven across long cured (dry) vegetation (grass & crops) and should be equipped with a nine kilogram water fire extinguisher.
- Operators of diesel-powered trucks should be made aware of the risk of ignition of vegetation posed by the exhaust emission system. These trucks should be equipped with a nine-kilogram water fire extinguisher.

- Electrical equipment should be checked weekly for potential faults.
- All chemicals should be managed and stored in accordance with safety data sheet requirements.
- Management protocols should be introduced to reduce the risk of ignition from external cooking fires and ignition from discarded cigarettes.
- Consider engaging appropriate security measures to monitor the actions of unauthorised persons within the project area during the bush fire danger period to minimise the risk of an arson attack being successful.
- Fire detection and suppression systems should be installed at the earliest stage of construction for BESS infrastructure.
- Provide first-aid equipment, such as fire extinguishers (and where possible, portable fire hose reels at all construction portables/buildings on site), in the vicinity of all construction activities and in site-based vehicles.

6.2 During operation (permanent mitigation measures)

Section 8.3.5 of PBP outlines the following requirements for solar farms;

- A minimum 10m APZ for the structures and associated buildings/infrastructure (excluding roads, fences and power or other services to the development footprint).
- The APZ must be maintained to the standards of an IPA for the life of the development.
- 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 vegetation.
- Preparation of a BFMOP or a Fire Management Plan as outlined in the NSW RFS correspondence.

6.2.1 Asset protection zones

A 10m APZ has been defined around the development footprint/solar array as shown in Figure 5-4 and in accordance with PBP 2019. No plant or equipment of any kind is to be stored within the 10m APZ.

The APZ must be effectively managed for the duration of the operational life of the project.

The effective management of vegetation and fuel can reduce both the risk of fire entering the development footprint, and the consequences of fire. The following measures are recommended:

- Vegetation management within the development footprint (especially during the fire danger period).
- Long grass and deep leaf litter must not be present in areas where heavy equipment will be working.
- Grass maintained under solar panels during the Fire Danger Period.
- Remove any accumulation of combustible materials (including leaf litter) in or within 10m of any BESS and related infrastructure.
- The entire substation/s must be surfaced to eliminate all vegetation including grasses. Substations must be inspected and cleaned regularly to prevent the build-up of any combustible matter: and
- Landscape screening (if required) should occur outside of the APZ and consider the potential increase in fire risk due to the type (species), density, height, location and overall width of the vegetation screening.

Where screening or other vegetation is a width of 20m or less (open density as per AS 3959-2018), or 15m or less (closed density as per AS 3959-2018), a fire break of 10m may be appropriate to prevent radiant heat from vegetation fully involved in fire becoming an ignition source for on-site infrastructure (CFA, 2022).

Outside of these parameters, separation must be at least the distance where radiant heat flux (output) from the vegetation does not create the potential for ignition of on-site infrastructure (CFA, 2022).

Substation & switchyard APZs

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

Network Standard NS187 Passive Fire Mitigation Design of Major Substations is an Ausgrid document that details the minimum levels for passive fire protection systems at Ausgrid's major substations (sub-transmission and zone substations).

Radiant heat is the most likely cause of damage to switchyard equipment and structures. Therefore, it is recommended that switchyard equipment is adequately set back from bush fire prone vegetation. Other causes of fire spread are embers to combustibles in the switchyard. Therefore, consideration shall be given to the protection of combustible switchyard equipment against ember damage.

The radiant heat exposure limits for critical substation structures and high voltage components are provided in Table 6-1. Critical elements are those deemed to be essential for return to service following a bush fire event.

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

Table 6-1 – Radiant heat exposure limits for switchyard equipment (Ausgrid 2020)

Item	*Maximum allowable radiant heat flux (RHF) (kW/m2)*	*Comment*
Cable	12.5	Polyvinyl chloride cables begin to distort and may ignite
	20	Ignition of cross-linked polyethylene cables between 85 and 550 seconds
Steel support structure	35	To 60% of yield strength after a maximum duration of 5 minutes. This applies where elastic deflections due to elevated temperatures are not critical
Porcelain bushing/insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 1
Polymeric bushing/insulators	>30	Damage may occur requiring replacement or in extreme case resulting in catastrophic failure. See Note 1

Item	*Maximum allowable radiant heat flux (RHF) (kW/m2)*	*Comment*
Aluminium busbar	20	Based on 250°C after a maximum duration of 5 minutes. Comparable to withstand temperature under fault conditions
Copper busbar	25	Busbars may undergo significant distortion and impose significant stresses on rigid insulators
Transformer tank	>35 (see Note 2)	Refer to above regarding bushings and cables
Combustibles	12.5	Piloted ignition may occur on timber

Note 1: Detailed information on radiant heat exposure limits is not available. However, in service applications exposed to bush fire indicate a high radiant heat limit and low risk of damage or failure.

Note 2: Transformers always have some more vulnerable components such as bushings and cables.

Ideally, the APZ should be wide enough to reduce radiant heat flux from any bush fire burning in nearby vegetation to less than that which may be tolerated by the most sensitive component (polymeric bushing/insulators; maximum allowable radiant heat flux of 12.5 kW/m^2). This would require a separation (of the more sensitive components) from bush fire prone vegetation of 22m (calculated using AS5339-2018 Construction of buildings in bush fire-prone areas).

While the actual location of heat-sensitive components will not be confirmed until detailed design, the allowable setbacks (i.e. >22m) will be large enough in most circumstances to allow placement of the substation and switchyard components so that radiant heat exposure is 12.5kW/m^2 or lower (refer Figure 5-4, subfigure BESS Layout -West). BAL 12.5 is depicted in blue and corresponds to a radiant heat flux of 12.5kW/m^2 or lower at a distance of 22-<100m from the outer edge of the development footprint.

6.2.2 Building construction

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.

The temporary worker accommodation facility is shown in Figure 5-4 (BESS Layout -East inset) and is proposed to the south of the BESS. This layout is indicative, and will be located greater than 100m from bush fire prone vegetation and greater than 100 m from BESS infrastructure. In accordance with AS3959 (2018), the facility is BAL Low and therefore there is insufficient risk to warrant specific bush fire construction requirements.

While the actual location of other buildings (such as site offices, amenities, and material storage) will not be confirmed until the detailed design, the APZ will be large enough in most circumstances to allow placement of these buildings so that radiant heat exposure is 12.5kW/m^2 (and BAL Low in most cases). It is recommended that buildings within 100m of bush fire prone vegetation are constructed to comply with *AS3959 – Construction of buildings in bushfire-prone areas*.

Each BESS must be regularly serviced to manufacturers' specifications and regularly inspected for signs of mechanical damage to external containers/enclosures. It is recommended that BESS infrastructure is:

- Installed on a non-combustible surface such as concrete.
- Fencing and retaining are constructed from fire-resistant materials.
- All buildings are designed for adequate fire protection.
- Position and design air conditioning vents on BESS cabinets to prevent debris building up and fire propagation.
- Insulation around the battery module to limit heat effects.
- Investigate designing louvres and shields on air intakes to batteries.
- Provided with suitable ember protection to prevent embers from penetrating battery containers/enclosures, particularly for any BESS within 100m of bush fire prone vegetation; and
- Provided with enclosed wiring and buried cabling, except where required above-ground for grid connections.

6.2.3 Access for firefighting operations

Public road upgrade works are required on Kidman Way and Bundure Road and will facilitate access to the development footprint. From the project access points, private internal roads will be used to traverse the development footprint.

Access to the site will be provided from the:

- North – travelling south along Kidman Way.
- East – travelling west along the Sturt Highway before turning onto Kidman Way.
- South –travelling north along the Newell Highway before turning onto Kidman Way.

A new four-way intersection will be constructed on Kidman Way at the project access point. This will provide access to the eastern and western parts of the development footprint. Bundure Road will provide access to the eastern part of the development footprint.

An internal network of access tracks will also be established to enable responding emergency services to access all areas of the facility, including fire service infrastructure (water tanks), buildings, BESS and related infrastructure. Subject to detailed design, internal access tracks will include:

- A perimeter track (within the APZ) up to 6m-wide.
- A minimum 6m separation should be strategically located between solar panel blocks to allow for safe and effective firefighting operations. This design will be confirmed during detailed design phase.

All internal access tracks will be unsealed. The internal tracks will provide access during construction, for maintenance during operations, and for emergency response.

Access to the development footprint complies with the acceptable solutions outlined in Table 6-2 below.

Table 6-2 – Performance criteria for access (PBP 2019)

Performance criteria	*Acceptable solution*	*Achievable for the project*	*Comment*
The capacity of access roads is adequate for firefighting vehicles.	The capacity of perimeter and non-perimeter road surfaces and any bridges/causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges/ causeways are to clearly indicate load rating.	☑	Can comply
Firefighting vehicles can access the development footprint and exit the property safely.	Minimum 4m carriageway width;	☑	With an additional 1m on either side clear of obstruction.
	In forest, woodland and heath situations, rural property access roads have passing bays every 200m that are 20m long by 2m wide, making a minimum trafficable width of 6m at the passing bay;	☑	Not applicable as all tracks are proposed to be 6m.
	A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches;	☑	Can comply
	Provide a suitable turning area in accordance with Appendix 3;	☑	Can comply
	Curves have a minimum inner radius of 6m and are minimal in number to allow for rapid access and egress;	☑	Can comply
	The minimum distance between inner and outer curves is 6m;	☑	Can comply
	The crossfall is not more than 10 degrees;	☑	Complies

Performance criteria	Acceptable solution	Achievable for the project	Comment
	Maximum grades for sealed roads do not exceed 15 degrees and not more than 10 degrees for unsealed roads; and	☑	Complies
Note: Some short constrictions in the access may be accepted where they are not less than 3.5m wide, extend for no more than 30m and where the obstruction cannot be reasonably avoided or removed.			

6.2.4 Water supply

In the event of a fire (structure, grass fire or bush fire), sufficient water must be available and safely accessible to emergency services to ensure fire suppression activities are safe and effective. The water supply must be provided to cover buildings, substations and grid connections.

Additional fire protection systems or equipment required under any Australian Standards for dangerous goods must be provided as prescribed.

The following outlines the performance criteria for water supply. This criterion does not necessarily relate to solar farms or BESS infrastructure in all circumstances, and therefore additional comments in relation to CFA (2022) guidelines have been incorporated where applicable.

It is recommended that water supply for firefighting purposes is located at the primary vehicle access point to the facility and elsewhere in consultation with the NSW RFS District Office for the Mid Murray Zone and Fire and Rescue NSW at the detailed design stage.

Table 6-3 – Performance criteria for water supplies (PBP 2019)

Performance criteria	*Acceptable solutions*	*Achievable for the project*	*Comment*
An adequate water supply is provided for firefighting purposes.	Reticulated water is to be provided, where available.	..	The facility is to be provided with a static water supply
	A static water supply is to be provided where no reticulated water is available	☑	
The integrity of the water supply is maintained.	All above-ground water service pipes are metal, including and up to any taps.	☑	Can comply
A static water supply is provided for firefighting purposes in areas where reticulated water is not available.	Where no reticulated water supply is available, water for firefighting purposes is provided in accordance with Table 5.3d of PBP 2019. These requirements are designed for residential development.	☑	Water requirements are to be determined in consultation with the district RFS & Fire Rescue NSW
	A connection for firefighting purposes is located within the IPA or non-hazard side and away from the structure; 65mm Storz outlet with a ball valve is fitted to the outlet	☑	CFA (2022) recommends tanks be located at vehicle access points to the facility and must be positioned at least 10m from any infrastructure (solar panels, BESS etc.)
	Ball valve and pipes are adequate for water flow and are metal	☑	Can comply
	Supply pipes from tank to ball valve have the same bore size to ensure flow volume	☑	Can comply
	Underground tanks have an access hole of 200mm to allow tankers to refill direct from the tank	☑	Can comply

Performance criteria	*Acceptable solutions*	*Achievable for the project*	*Comment*
	A hardened ground surface for truck access is supplied within 4m	☑	Can comply
	Above-ground tanks are manufactured from concrete or metal	☑	Can comply
	Raised tanks have their stands constructed from non-combustible material or bush fire-resisting timber (see Appendix F of AS 3959(2018);	☑	Can comply
	Unobstructed access can be provided at all times;	☑	Can comply
	Underground tanks are clearly marked	☑	Can comply
	Tanks on the hazard side of a building are provided with adequate shielding for the protection of firefighters	☑	Can comply
	All exposed water pipes external to the building are metal, including any fittings	☑	Can comply
	Where pumps are provided, they are a minimum 5hp or 3kW petrol or diesel-powered pump, and are shielded against bush fire attack; any hose and reel for firefighting connected to the pump shall be 19mm internal diameter	☑	Pumps are not mandatory. If provided they are to comply with the acceptable solutions

Performance criteria	Acceptable solutions	Achievable for the project	Comment
	Fire hose reels are constructed in accordance with AS/NZS 1221:1997, and installed in accordance with the relevant clauses of AS 2441:2005	☑	Fire hose reels are not mandatory. If provided they are to comply with the acceptable solutions

6.2.5 Other mitigation measures

In addition to the measures outlined above, other considerations apply to the operation of renewable energy assets to effectively manage bush fire risk. This is generally outside of the scope of this document but can be summarised as:

- The requirements of the dangerous goods legislative framework, and all relevant Australian Standards, including facilities with battery energy storage system.
- Procedure/controls for correct storage of chemicals and combustible materials on-site (away from BESS units).
- Design of battery modules to slow and limit rate of gas generation.
- Procedures to shut down BESS during conditions where fire can spread externally into the development footprint and when temperature exceeds high temperature threshold.
- Engagement with local fire authorities and other emergency services during layout design and site commissioning process to ensure sufficient spacing between batter banks for vehicle movement and static water supply requirements (location and capacity).
- Appropriate monitoring for project infrastructure, to ensure that any shorts, faults or equipment failures with the potential to ignite or propagate fire are rapidly identified and controlled, and any fire is notified to 000 immediately.
- The provision for direct alarm monitoring to the fire brigade for BESS automatic detection systems should be considered.

In particular, the safety and protective systems for BESS will vary based on battery technologies, chemistries and the preferences of manufacturers.

BESS should be equipped with the following:

- Battery management/monitoring systems for monitoring the state of battery systems to ensure safe operation.
- Detection systems for smoke, heat (thermal), fire and toxic gas (off-gassing) within battery containers.
- Suppression systems for fire within battery containers.
- Systems to prevent heat/fire spread within battery containers (such as thermal barriers, shut-down separators, isolation systems, cooling systems).
- Systems to prevent explosion within battery containers (such as ventilation, pressure relief and exhaust systems).
- Warning and alarm systems within the battery containers, and/or the facility, to enable early warning for faults, operation of the battery energy storage system above 'normal'/safe parameters, smoke, off-gassing, and fire.

6.2.6 Potential environmental impact of bush fire mitigation measures

The development footprint is the maximum extent of ground disturbing works associated with the construction and operation of the project and direct impacts within this area have been assessed as part of the EIS (EMM 2023).

All bush fire mitigation measures have been confined to the development footprint.

6.2.7 Fire management plan

A Fire Management Plan must be developed for the project, in consultation with the NSW RFS District Office for the Mid Murray Zone and Fire Rescue NSW, before construction starts. The Fire Management Plan will inform operational and emergency management practices at the facility and effectively describes all fire hazards and provides clear actions and accountabilities for their management.

The minimum requirements of a Fire Management Plan are:

- Ongoing bush fire fuel management within the development footprint.
- Site infrastructure plan.
- Site access and internal road plan.
- APZs and their continued maintenance.
- Location of hazards (physical, chemical etc.) that may impact firefighting operations: and

- Any such additional matters as may be required by the NSW RFS District Office for the Mid Murray Zone (phone: 03 5898 4100).

6.2.8 Bush fire emergency management and evacuation plan

Effective emergency planning will ensure that the facility is prepared in the event of an emergency, providing for the safety of site personnel, emergency responders and the community. A Bush fire emergency management and evacuation plan must be developed for the project.

Table 6-4 – Performance criteria for emergency management plans (PBP 2019)

Performance criteria	*Acceptable Solutions*
A bush fire emergency and evacuation management plan is prepared	A bush fire emergency management and evacuation plan is prepared consistent with the NSW RFS document: A Guide to Developing a Bush Fire Emergency Management and Evacuation Plan, and AS3745:2010.
	The Bush Fire Emergency Management and Evacuation Plan should include planning for the early relocation of occupants.
Note: A copy of the Bush Fire Emergency Evacuation Plan should be provided to the Local Emergency Management Committee for its information prior to the commencement of construction.	
Appropriate and adequate management arrangements are established for consultation and implementation of the Bush Fire Emergency Management and Evacuation Plan	An Emergency Planning Committee is established to consult with staff in developing and implementing an Emergency Procedures Manual.
	Detailed plans of all emergency assembly areas including 'on-site' and 'off-site' arrangements as stated in AS 3745 are clearly displayed, and an annual (as a minimum) trial emergency evacuation is conducted.

7. CONCLUSION & RECOMMENDATIONS

7.1 Conclusion

This bush fire assessment report has been undertaken for Dinawan Solar Farm, a large-scale solar PV generation facility, BESS and supporting infrastructure comprising 56 land parcels located approximately halfway between the towns of Coleambally and Jerilderie within the Murrumbidgee LGA.

The project is categorised by the NSW RFS as 'other development' and complies with the following aims and objectives of PBP 2019.

Table 7-1 – Aims and objective of PBP 2019

Aims and objectives	Statement of compliance
Afford buildings and their occupants protection from the exposure to bush fire	A defendable space of 10m will be provided around the boundary of the development footprint in accordance with Section 8.3.5 of PBP 2019. High risk and vulnerable infrastructure are recommended to be located in BAL 12.5 areas or less. The temporary workers accommodation facility is located in BAL Low and any buildings (staff offices or chemical storage) within 100m of bush fire prone vegetation is to be constructed to BAL 12.5.
Provide for a defendable space to be located around buildings	
Provide appropriate separation between a hazard and buildings which in combination with other measures, prevent the likely fire spread to buildings	
Ensure that appropriate operational access and egress for emergency personnel and occupants is available	An internal network of access tracks will be established to enable responding emergency services to access all areas of the facility, including fire service infrastructure (water tanks), buildings and BESS and related infrastructure. Subject to detailed design, internal access tracks will include: • A perimeter track (within the APZ) up to 6m-wide • Internal access tracks will be confirmed at detailed design stage and should

Aims and objectives	Statement of compliance
	consider a minimum 6m separation between solar panel blocks (CFA, 2022) to allow for safe and effective firefighting operations.
Provide for ongoing management and maintenance of bush fire mitigation measures.	All bush fire mitigation measures are confined to the property boundary. A Fire Management Plan is to be prepared to ensure ongoing management and maintenance.
Ensure that utility services are adequate to meet the needs of firefighters	All utility services will comply with PBP 2019. It is recommended that water supply for firefighting purposes is located at the primary vehicle access point to the facility and elsewhere in consultation with the NSW RFS District Office for the Mid Murray Zone and Fire and Rescue NSW at the detailed design stage.

The following recommendations are provided to ensure that the project has adequate clearances to combustible vegetation, firefighting access and water supplies in accordance with the requirements of *PBP 2019*.

7.2 Recommended conditions

Recommendation 1: The development footprint is maintained to the standard of an inner protection area (IPA) in accordance with the requirements of Appendix 4 of *Planning for Bush Fire Protection 2019*.

A 10m APZ is to be provided around the development footprint in accordance with PBP 2019. No plant or equipment of any kind is to be stored within the 10m APZ.

Recommendation 2: Construction of buildings within 100m of bush fire prone vegetation must comply with section 3 and section 5 (BAL 12.5) Australian Standard AS3959-2018 *Construction of buildings in bushfire-prone areas* or the relevant requirements of the *NASH Standard - Steel Framed Construction in Bushfire Areas* (incorporating amendment A - 2015). New construction must also comply with the construction requirements in Section 7.5 of *Planning for Bush Fire Protection 2019*.

Recommendation 3: Access roads are to comply with the property access road requirements as outlined in Table 7.4a of *Planning for Bush Fire Protection 2019*, with additional considerations as outlined in Section 6.2.3 of this document.

Recommendation 4: The provision of water, electricity and gas must comply with Table 7.4a of Planning for Bush Fire Protection 2019. Water supply for firefighting purposes must be located at the primary vehicle access point to the facility and elsewhere in consultation with the NSW RFS District Office for the Mid Murray Zone and Fire and Rescue NSW at the detailed design stage. Further:

- a SWS must be provided on site located within the IPA or non-hazard side and away from structures;
- unobstructed access is to be provided within 4m of the SWS at all times;
- a 65mm Storz connection with a ball valve is fitted to the outlet of the SWS;
- ball valve and pipes are adequate for water flow and are metal;
- supply pipes from tank to ball valve have the same bore size to ensure flow volume;
- underground tanks have an access hole of 200mm to allow tankers to refill direct from the tank and a hardened ground surface for truck access is supplied within 4m;
- underground tanks are clearly marked;
- above-ground tanks are manufactured from concrete or metal;
- raised tanks have their stands constructed from non-combustible material or bush fire-resisting timber (see Appendix F of AS 3959);
- tanks on the hazard side of a building are provided with adequate shielding for the protection of firefighters;
- all exposed water pipes external to the building are metal, including any fittings;
- where pumps are provided, they are a minimum 5hp or 3kW petrol or diesel-powered pump, and are shielded against bush fire attack;
- any hose and reel for firefighting connected to the pump must be 19mm internal diameter; and
- any fire hose reels are constructed in accordance with AS/NZS 1221:1997, and installed in accordance with the relevant clauses of AS 2441:2005.

Recommendation 5: A Fire Management Plan must be prepared that addresses the following (as a minimum):

- Ongoing bush fire fuel management within the development footprint;
- Site infrastructure plan;
- Site access and internal road plan;
- APZs and their continued maintenance;
- Location of hazards (physical, chemical etc.) that may impact firefighting operations; and
- Any such additional matters as may be required by the NSW RFS District Office for the Mid Murray Zone. (Phone 03 5898 4100).

Recommendation 6: Bush Fire Emergency Management and Evacuation Plan is to be in accordance with Table 6.8d of Planning for Bush Fire Protection 2019 and be consistent with the following:

- The NSW RFS document: A Guide to Developing a Bush Fire Emergency Management and Evacuation Plan;

A copy of the Bush Fire Emergency Management and Evacuation Plan should be provided to the Local Emergency Management Committee for its information prior to the commencement of construction.

8. REFERENCES

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