APPENDIX 19

Bango Wind Farm Bushfire Risk Assessment

Environmental Resource Management Australia Pty Ltd

UPDATES TO THE ENVIRONMENTAL IMPACT STATEMENT

During the preparation of this Environmental Impact Statement, a number of changes occurred.

Please consider these changes while reviewing this Appendix.

- The Assessment Type of the Bango Wind Farm has transitioned from Part 3A, after its repeal, and is now being assessed as a State Significant Development under Part 4 of the EP&A Act. Any reference to a Part 3A assessment in attached technical assessments may be disregarded, and considered as State Significant Development;

- Rugby Wind Farm, a wind farm that was proposed to the north of the Project has been withdrawn. Where references are made to cumulative impacts with the Rugby Wind Farm, please disregard these;

- Slight changes have occurred to the Rye Park Wind Farm layout, a wind farm under development to the east of the Project. The changes made to the layout are not significant and therefore sit within the cumulative impact assessment undertaken for this EIS. The revised layout has been considered in the Environmental Noise Assessment and Landscape Visual Impact Assessment. Where further references are made to the Rye Park Wind Farm layout, these will be incorporated into future documentation where required;

- Four turbines at the south east extent of the Project, situated in the Mt Buffalo cluster have been removed through consultation with landowners. This change has been highlighted in maps and a review of all technical assessments has deemed that the removal of the four turbines has resulted in a reduced. This change will be incorporated into future documentation. These wind turbines are identified as “removed wind turbines” in the Project maps in Volume 2; and

- A number of changes were made to the residence information for the Project, as a result of construction of houses and change in occupancy status of existing buildings. These changes have been incorporated into the EIS.

Bango Wind Farm

Bushfire Hazard and Risk Assessment

Wind Prospect CWP Pty Ltd

May 2013

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Bango Wind Farm

Bushfire Hazard and Risk Assessment

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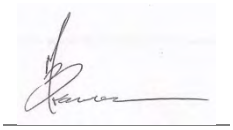
Signed:	
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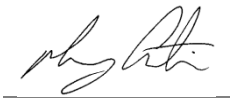
Signed:	
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FINAL REPORT

Wind Prospect CWP Pty Ltd

Bango Wind Farm
Bushfire Hazard and Risk Assessment

May 2013

Reference: 0170898_BAN_BFHA

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ABBREVIATIONS

Abbreviation	Description
°C	Degrees Celsius
AHD	Australian Height Datum
APZ	Asset Protection Zone
AS 3959:2009	Australian Standards 3959:2009 Construction of buildings in bushfire prone areas.
AS/NZS ISO 31000:2009	AS/NZS ISO 31000:2009 Risk management – Principles and guidelines.
BCA	Building Code of Australia
BFMC	Bush Fire Management Committee
BFRMP	Bush Fire Risk Management Plan
CASA	Civil Aviation Safety Authority
CMA	Catchment Management Authority
CS	Collector substation
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change (formerly DEC)
DECCW	Department of Environment, Climate Change and Water (now OEH)
DEWHA	Commonwealth Department of Department of the Environment, Water, Heritage and the Arts (now DSEWPaC)
DGRs	Director-General's requirements
DoP	NSW Department of Planning (now known as DoPI)
DoPI	NSW Department of Planning and Infrastructure
DPI	NSW Department of Primary Industries
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities.
EEC	Endangered Ecological Community
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ERM	Environmental Resources Management Australia Pty Ltd
FDI	Fire Danger Index
GIS	Geographic Information System
ha	Hectares
IBRA	Interim Biogeographic Regionalisation for Australia
km	Kilometres
kph	Kilometres per hour
kV	Kilovolt
LGA	Local Government Area
m	Metres
m/s	Metres per second
ML	Mega litres
MNES	Matters of National Environmental Significance
MW	Mega Watt
NES	National Environmental Significance
NSW	New South Wales
OEH	NSW Office of Environment and Heritage (formerly DECCW)
RF Act	Rural Fires Act 1997
RFS	Rural Fire Service
SCRA	Southern Comprehensive Regional Assessment
SS	Switching station
TSC Act	NSW Threatened Species Conservation Act 1995
Wind Prospect	Wind Prospect CWP Pty Ltd
WPCWP	Wind Prospect CWP Pty Ltd
WTG	Wind Turbine Generator

GLOSSARY OF TERMS

Term	Description
asset	Assessed as being valued by either the wind farm or the community and includes houses, crops, infrastructure, the environment, businesses, and forests, that may be at risk from bush fire.
asset protection zone	Aims to protect human life, property and highly valued public assets and values. An area surrounding an asset managed to reduce the bush fire hazard to an acceptable level.
bushfire	A general term used to describe fire in vegetation, including grass fire.
bushfire hazard	the potential severity of a bush fire, which is determined by fuel load, fuel arrangement and topography under a given climatic condition.
bushfire hazard classes	Provide a useful comparative ranking, indicating sites of higher and lower potential fire behaviour compared to others in an area. Does not indicate how often an area will receive potentially damaging fires, or the actual intensity of a fire.
bushfire prone land	An area of land that can support a bush fire or is likely to be subject to bush fire attack. In general, a bush fire prone area is an area mapped for a local government area that identifies the vegetation types and associated buffer zones.
bushfire risk	The chance of a bush fire igniting, spreading and causing damage to the community or the assets they value. The risk level is identified by combining the likelihood and consequence to provide either a low, medium, high, very high or extreme level of risk.
bushfire season	The bushfire season generally runs from October to April although persistent dry conditions have extended the season into May.
consequence	Outcome or impact of a bush fire event. There are four possible consequence ratings: minor, moderate, major and catastrophic and are generally related to the vulnerability of the asset.
defendable space	Is an area within the asset protection zone that provides an environment in which a person can undertake property protection after the passage of a bush fire with some level of safety.
likelihood	The chance of a bush fire igniting and spreading.
the Project	Includes all works and infrastructure associated with the construction and operation phases of the proposed Bango Wind Farm development.
risk assessment	The overall process of risk identification, risk analysis and risk Evaluation.
risk treatment	The process of selection and implementation of measures to modify risk.
Study Area	The "Study Area" is defined in this Bushfire Hazard and Risk Assessment as a 1 kilometre (km) buffer around all proposed infrastructure.

EXECUTIVE SUMMARY

Wind Prospect CWP Pty Ltd (WPCWP) is seeking approval to construct and operate a wind farm within the Southern Tablelands region of NSW. The Project is bordered by Boorowa to the north, Yass 20 kilometres (km) to the south, and Binalong 17km to the south-west. The Project currently comprises two potential wind turbine (WTG) layouts, one consisting of up to 122 WTGs and the other up to 96 WTGs, transmission lines and ancillary infrastructure. The Project is proposed within fifteen privately owned properties over a 25km span aligned generally north west-south east.

This Bushfire Hazard and Risk Assessment addresses the requirements under NSW Rural Fire Service (RFS) Planning for Bushfire Prone Areas 2006 (PBP 2006), the Department of Planning and Infrastructure (DoPI) Director-General's Requirements (DGR's) for the further assessment and subsequent approval of the wind farm, as well as the Draft NSW Planning Guidelines for Wind Farms (DoPI 2011). The assessment is based on the risk management process defined by AS/NZS ISO 31000:2009 'Risk management – Principles and guidelines' (Standards Australia, 2009b) and the results of the National Inquiry on Bushfire Mitigation and Management (COAG, 2004). The assessment aims to demonstrate that the proposed wind farm will be designed, constructed and operated to minimise ignition risks, provide for asset protection consistent with relevant RFS design guidelines and provide for necessary emergency management.

The proposed wind farm is set amongst a historically cleared landscape where rolling hills dominate and the majority of native vegetation has been partially or fully cleared for grazing and cropping, with only some remnant patches of open woodland vegetation remaining. Assets that occur within and surrounding the Study Area include those associated with the wind farm such as WTGs, electrical connections, collector and switching substations, site compounds and internal access roads, and also those surrounding the wind farm such as public roads, utilities (gas and electricity), residential properties and farms, and the nearest towns and localities.

There have been no significant fires recorded for the Study Area within the last five years, although relatively large fires were recorded within the district and to the east of Rye Park during the 2012 fire season. The bushfire season generally runs from October to April and prevailing weather conditions associated with the bushfire season in the South West Slope and Southern Tablelands regions are strong gusty north-north westerly to south-westerly winds accompanied by high daytime temperatures and low relative humidity. Afternoon wind changes often hamper fire fighting efforts. There are also frequently dry lightning storms occurring during the bushfire season.

Steeper slopes can significantly increase the rate of spread of fires, and slope and wind are often the major factors determining the direction of fire spread. The landscape of the Study Area is characterised by rolling to sometimes steep hills and the turbine positions of the proposed wind farm are located along ridgelines within the Project area, located at varying altitudes between 570m and 760m Australian Height Datum (AHD).

The vegetation communities within and surrounding the Study Area have been simplified in line with a methodology that groups vegetation associations into similar fine fuel characteristics based on the frequency that the vegetation community provides 'available fire fuel', the structure of the vegetation and the ability of ground level fuels to carry fire into higher vegetation levels, arrangement of the fuel within the vegetation type, and the amount of fuel that accumulates after a long period without fire.

Bushfire hazard classes were identified across the landscape by applying relative weightings to the varying fuel groups and combining them with available slope classes (i.e. <5, 5-10, 10-15, 15-20, >20 degrees) within a Geographic Information System (GIS) model. The result is the mapping of relative hazard in classes of 'Low', 'Low-Moderate', 'Moderate', 'Moderate-High' and 'High' hazard.

A bushfire risk analysis was undertaken for the Study Area that involved consideration of the causes and sources of risk, their positive and negative consequences, and the likelihood that those consequences can occur. The analysis presents the level of risk for varying bushfire impact scenarios and assets requiring protection within and surrounding the Study Area.

Finally, a bushfire risk evaluation was undertaken to assist in making decisions, based on the outcomes of risk analysis, about which risks need treatment and the priority for treatment implementation. The Study Area is mapped as predominantly Low bushfire hazard and supports generally cleared and rural developed lands. In terms of potential impacts upon the proposed wind farm assets, there will be no turbines and supporting infrastructure located within areas mapped as high hazard / bushfire behaviour potential. It is important to note that there are residential dwellings on rural properties scattered throughout the landscape that may be at risk from fire. Assuming a fire 'escapes' the development, there is a low to medium risk of fire (adversely) affecting surrounding life, property and environment.

The highest risk rating scored was medium, being:

- *the possible chance of fatalities or major injuries to life within or surrounding the wind farm; and*

- *the possible chance of widespread damage to infrastructure within or surrounding the wind farm.*

It is these identified bushfire risks that require specific management and mitigation (treatment) measures as outlined within AS/NZS ISO 31000:2009 and the NSW Bushfire Co-ordinating Committee Guidelines (2008). This assessment recommends mitigation measures based upon these requirements. The risk assessment and associated mitigation measures are also a response to the requirements of PBP 2006, which requires adequate protection be implemented for all new development on bushfire prone land and should be considered conditions of development approval.

1 INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was commissioned by Wind Prospect CWP Pty Ltd (WPCWP) to prepare a Bushfire Hazard and Risk Assessment for the proposed construction, operation and maintenance of the Bango Wind Farm, located in the Southern Tablelands region of NSW.

In their comments on the draft Director-General's Requirements (DGRs) for the Bango Wind Farm Project, the Boorowa Council expressed concern over the use of bushfire prone land. Bushfire Prone Land Mapping within the Study Area triggers the need to assess the proposed development against the bushfire protection provisions under *Planning for Bushfire Prone Areas 2006* (PBP 2006) (NSW Rural Fire Service (RFS) 2006).

The need for a Bushfire Risk Assessment was also identified within the Department of Planning and Infrastructure (DoPI) DGRs for the further assessment and subsequent approval of the wind farm as well as the Draft NSW Planning Guidelines for Wind Farms (DoPI 2011).

The *Rural Fires Act 1997* imposes obligations on land managers to take all reasonable measures to prevent the occurrence and spread of wildfire to adjoining lands from lands under their care and management. This report contains management and mitigation measures designed to address these obligations.

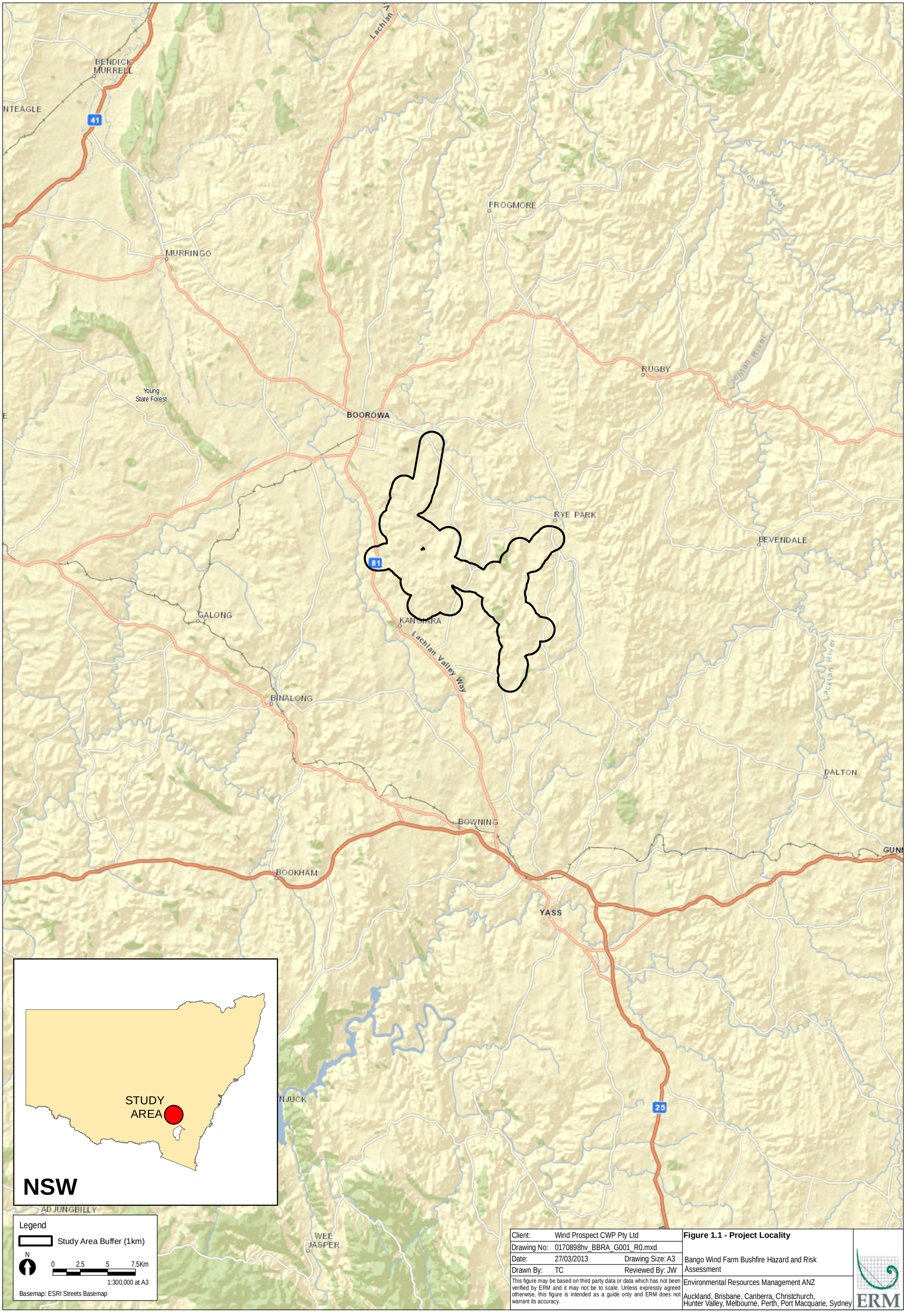
1.1 LOCATION

The proposed Bango Wind Farm is located within the Southern Tablelands region of NSW. The Project is bordered by Boorowa to the north, Yass 20 kilometres (km) to the south, and Binalong 17km to the south-west. *Figure* 1.1 shows the locality of the Project.

The Project spans two local government areas (LGAs): Boorowa LGA and Yass Valley LGA and one Catchment Management Authority (CMA) area: Lachlan-Upper Slopes CMA.

Fifteen privately owned properties will host the wind turbines and associated infrastructure, with the turbines extending over a 25km span aligned generally in north west-south east. The individual turbine positions will be positioned along ridgelines within the Study Area, located at varying altitudes between 570 metres (m) to 760m Australian Height Datum (AHD).

The wind farm will be accessed from the existing local road network and access routes have been designed to achieve practical transport paths that minimise disruption to local traffic and environmental impacts. Locations for site access are the Boorowa Road, Lachlan Valley Way, Rye Park – Dalton Road and Wargeila Road.



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Drawn By:	TC	Reviewed By: JW

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 1.1 - Project Locality

Bango Wind Farm Bushfire Hazard and Risk Assessment

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Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

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1.2 DESCRIPTION OF THE PROJECT

The Project includes the construction and commissioning of up to 122 wind turbine generators (WTGs) for the purpose of renewable electricity generation; connecting to the TransGrid transmission line to the south and west of the Study Area.

The Project currently comprises two potential wind turbine layouts; one consisting of up to 122 WTGs (Layout Option 1) and the other up to 96 WTGs (Layout Option 2). Layout options have been refined through an iterative design process and adjustments made with respect to social, environmental and/or engineering constraints. One or a combination of these WTG locations will be used in the construction of the Project, to be determined following final WTG selection post-consent.

In summary, the Project will consist of the following components:

- the installation of up to 122 WTGs (Layout Option 1) or up to 96 WTGs (Layout Option 2) with a maximum blade tip height of 192m;
- a collector substation (CS) comprising cable marshalling, switchgear, high voltage transformers and associated protection and communications assets;
- a switching station (SS) comprising switching and protection devices, busbars, circuit breakers, isolators and communication assets;
- approximately four separate site compound and lay down areas (part temporary, part permanent), including site operations facilities and services buildings;
- underground transmission lines (up to 132 kilovolt (kV)) and control cables within and between each of the wind turbines and clusters, connecting to the CS and SS;
- overhead transmission lines (up to 132kV double circuit) and control cables within and between the wind turbines and clusters, in single or multiple lines, connecting to the CS and SS;
- at least four separate on-site access roads from the public road network;
- crane hardstand areas, turning heads and passing bays for the erection, assembly, commissioning, maintenance, recommissioning and decommissioning of the wind turbines;
- up to six permanent wind monitoring masts (potentially including the retention of existing temporary monitoring masts);
- appropriate wind farm signage both during the construction and operational phases of the proposed development; and

- ancillary facilities.

Figure 1.2 shows the layout of the proposed Bango Wind Farm.

1.3 OBJECTIVES OF BUSHFIRE HAZARD AND RISK ASSESSMENT

In accordance with the Draft NSW Planning Guidelines for Wind Farms (DPI 2011) the assessment aims to demonstrate that the proposed wind farm will be designed, constructed and operated to minimise ignition risks, provide for asset protection consistent with relevant RFS design guidelines (PBP 2006 and Standards for Asset Protection) and provide for necessary emergency management.

The objectives of this plan are that:

- no human life is lost or person injured as a result of bushfire arising from the construction, operation and maintenance of the wind farm; and
- infrastructure and property off site is not significantly damaged from bushfire arising from the construction, operation and maintenance of the wind farm.

Boorowa
Langs Creek Cluster
Lachlan Valley Way
Boorowa Road
Rye Park
Harrys Creek Road
Rye Park-Dalton Road
Kangiara Cluster
Tangmangaroo Road
Kangiara
Wargeila Road
Moorsby Lane
Mt Buffalo Cluster
Laverstock
Laverstock Road

Legend
- Study Area Buffer (1km)
- Nearest Towns and Localities

Wind Farm Layout:
- Wind Turbines Layout 1
- Wind Turbines Layout 2
- Overhead Electrical Lines
- Access Tracks
- Substation Options
- Site Compounds
- Wind Farm Cluster
- Sealed Road
- Unsealed Road

N
0 0.5 1 1.5Km
1:75,000 at A3

Windfarm Layout: Wind Prospect CWP
Roads: Geoscience Australia
Basemap: Bing Maps

Client:	Wind Prospect CWP Pty Ltd	
Drawing No:	0170898hv_BBRA_G002_R0.mxd	
Date:	27/03/2013	Drawing Size: A3
Drawn By:	TC	Reviewed By: JW

Figure 1.2 - Proposed Wind Farm Layout

Bango Wind Farm Bushfire Hazard and Risk Assessment

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM

2 PLANNING FRAMEWORK

This chapter outlines the relevant legislation and planning controls and how they have been considered within this Bushfire Hazard and Risk Assessment.

2.1 NSW RURAL FIRES ACT 1997

The main objectives of the *Rural Fires Act 1997* (RF Act) are to:

- prevent, mitigate and suppress bush and other fires in NSW;
- co-ordinate bushfire fighting and bushfire prevention throughout the State;
- protect people from injury or death and property from damage as a result of bushfires; and
- protect the environment.

The proposed development does not require subdivision of land and is not defined as a special fire protection purpose (SFPP) development under Section 100B of the RF Act. Accordingly, the proposal does not require a bushfire safety authority.

It is also noted that 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 minimize the danger of the spread of bushfires on or from, that land. This bushfire hazard assessment considers the risk of spread of bushfires from the Study Area to the surrounds and provides measures to minimize the risk of bushfires.

The RF Act also places emphasis on cooperative fire management and wildfire suppression planning between the various organisations involved in fire management (through the Bushfire Management Committees and by the preparation and implementation of a Bushfire Risk Management Plan).

2.2 PLANNING FOR BUSHFIRE PROTECTION 2006

Planning for Bushfire Protection 2006 (NSW RFS) (PBP 2006) is a planning document to link responsible planning and development control with the protection of life, property and the environment. PBP 2006 applies to all development applications on land that is classified as bushfire prone land on a council's Bushfire Prone Land Mapping.

In their comments on the draft DGRs for the Bango Wind Farm Project, the Boorowa Council expressed concern over the use of bushfire prone land. Bushfire Prone Land Mapping within the Study Area triggers the need to assess the proposed development against the bushfire protection provisions under PBP 2006. Therefore, consideration must be given to the following overall aims and objectives of PBP 2006:

- afford occupants of any building adequate protection from exposure to a bushfire;
- provide for a defendable space to be located around buildings;
- provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition;
- ensure that safe operation access and egress for emergency service personnel and residents is available;
- provide for ongoing management and maintenance of bushfire protection measures, including fuel loads in the asset protection zone (APZ); and
- ensure that utility services are adequate to meet the needs of fire fighters (and others assisting in bushfire fighting).

PBP 2006 provides an assessment framework for the potential impacts of bushfire upon the proposed new assets and establishes six key bushfire protection measures that are to be addressed and collectively form an effective mitigation strategy in order to reduce the bushfire impacts. These six key bushfire protection measures are:

- the provision of clear separation of buildings and bushfire hazards, in the form of a fuel-reduced Asset Protection Zone (APZ);
- construction standards and design;
- appropriated access standards for residents, fire fighters, emergency service workers and those involved in evacuation;
- adequate water supply and pressure;
- emergency management arrangements for fire protection and/or evacuation; and
- suitable landscaping, to limit fire spreading to a building.

For the purposes of this assessment and in keeping with PBP 2006 guidelines, the Study Area is considered to be 'other development', as the Project is not a residential subdivision, residential infill, or Special Fire Protection Purpose (SFPP). For Class 5, 6, 7, 8 and 10 buildings (which include offices, factories, warehouses and other commercial or industrial facilities) as defined by the Building Code of Australia (BCA), the BCA does not provide for any bushfire specific performance requirements. Therefore the Australian Standard 3959 - 2009 Construction of Buildings in Bushfire-prone Areas does not apply as a set of 'deemed to satisfy' provisions. General fire safety construction provisions are taken as acceptable solutions, but the aims and objectives of PBP 2006 apply in relation to other matters such as access, water and services, emergency planning and landscaping/vegetation management.

To satisfy the objectives of PBP 2006, an acceptable solution would be to provide an Asset Protection Zone as for residential subdivision to prevent flame contact and ignition of external building materials. The proposed mitigation measures as appropriate for the wind farm proposal are discussed in *Section 7* of this report.

2.3 NSW THREATENED SPECIES CONSERVATION ACT 1995

Projects determined by a statutory authority of the NSW State Government are required to be assessed in accordance with the EP&A Act, as amended by the *Threatened Species Conservation Act 1995 (*TSC Act).

The TSC Act lists threatened species, populations and ecological communities under Schedules 1 and 2 of the Act, that are priorities for conservation within NSW. The TSC 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 (EECs).

Schedule 3 of the TSC 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 Study Area contains threatened species and ecological communities that may be impacted by the proposal (refer to *Section 4.1*).

2.4 *COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY ACT 1999*

The *Environment Protection and Biodiversity Conservation Act 1999 (*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 (NES) requires approval from the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities. An action is defined as a project, development, undertaking, activity (or series of activities), or alteration to any of these. Matters of NES include:

- World Heritage properties;
- National Heritage places;
- Ramsar wetlands of international importance;
- listed threatened species and communities;
- internationally protected migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park; and
- nuclear actions.

The Project is not located within a World Heritage area, Ramsar wetland or Commonwealth marine environment. The Study Area also does not contain National Heritage Places, or involve nuclear actions. The Study Area contains threatened species and ecological communities, which may be impacted by the proposal (refer to *Section 4.1*).

2.5 *ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979*

The Project Proposal is to be assessed under Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

The State Government imposed Part 3A in an attempt to streamline the development application process for major projects and remove the need for numerous integrated approvals by placing the consent authority role with the Minister for Planning (assessment is the responsibility of the Department of Planning and Infrastructure (DoPI)).

As the Proposal is to be assessed under Part 3A of the EP&A Act, it does not require Integrated Approvals under Section 91 of the EP&A Act, which falls under Part 4. If bushfire is considered an issue with the development, the NSW RFS is involved but as an advisory role only and not as a concurrence. Proponents should consult PBP 2006 when selecting sites for the development and undertaking environmental assessments. The requirement for a Bushfire Risk Assessment was also identified within the DGRs (issued by DoPI, under Section 75F, Part 3A of the EP&A Act).

2.6 OTHER CONSIDERATIONS

2.6.1 Director-General's Requirements

The Department of Planning (DOP) (now known as DoPI) issued DGRs for the Project on 31 March 2011.

The DGRs prepared in consultation with government authorities identify a number of key assessment requirements with respect to bushfire impacts. These requirements and comments on where they are addressed within the Bushfire Hazard and Risk Assessment are identified in *Table 2.1*

Table 2.1 Director-General's Requirements

Director Generals Requirements		Addressed
Key Assessment Requirements	Hazard/Risks– the EA must include an assessment of the potential impacts on…bushfires/use of bushfire prone land.	This Bushfire Hazard and Risk Assessment has been prepared to meet this requirement, specifically *Table 6.5* and *Table 7.1*.
Consultation Requirements	The Proponent must undertake a consultation programme as part of the environmental assessment process, including consultation with, but not necessarily limited to, the … NSW Rural Fire Service.	Consultation with the Boorowa Fire Control Centre was undertaken on 13 March 2013.

2.6.2 Draft NSW Planning Guidelines for Wind Farms

The *NSW Draft Planning Guidelines for Wind Farms* have been prepared in consultation with the community and energy industry to provide a regulatory framework to guide investment in wind farms across NSW, while minimising and avoiding any potential impacts on local communities. The purpose of the guidelines is to:

- provide a clear and consistent regulatory framework for the assessment and determination of wind farm proposals across the state;
- outline clear processes for community consultation for wind farm developments; and

- provide guidance on how to measure and assess potential environmental noise impacts from wind farms.

Specific requirements that relate to the assessment of bushfire hazard and risk are identified in *Table 2.2.*

Table 2.2 Draft NSW Planning Guidelines for Wind Farms

Draft NSW Planning Guidelines for Wind Farms		Addressed
Section 2.2	State authorities which may need to be consulted for advice or an approval are summarised as NSW Rural Fire Service (re: Bushfire Safety).	Consultation with the Boorowa Fire Control Centre was undertaken on 13 March 2013.
Appendix A	Bushfire hazards and risks should be assessed. Relevant issues include:	*Table 6.4* and *Table 6.5*
	• the risk that a bushfire will damage a wind turbine if the wind farm is located in or near a bushfire prone area	
	• the risk that the construction and / or operation of the wind farm will create a fire that could spread to nearby areas	*Table 6.4* and *Table 6.5*
	• the potential for the wind farm to impact on aerial fighting of bushfires	*Table 6.4* and *Table 6.5*
	• fire safety for workers and visitors during the construction and operation phase, ensuring there is appropriate fire fighting equipment and water supplies on site to respond to a bush fire.	*Table 6.5* and *Table 7.1.*
	Proponents should consult with the NSW Rural Fire Service.	Consultation with the Boorowa Fire Control Centre was undertaken on 13 March 2013.
	The assessment should demonstrate that the proposed wind farm will be designed, constructed and operated to minimise ignition risks, provide for asset protection consistent with relevant RFS design guidelines including Planning for Bushfire Protection 2006 and Standards for Asset Protection and provide for necessary emergency management. The assessment should demonstrate how a turbine fire would be managed so as prevent fire spreading to surrounding areas, such as through providing an outline emergency response plan.	This Bushfire Hazard and Risk Assessment has been prepared to meet this requirement, specifically *Table 6.5* and *Table 7.1.*

3 *ASSESSMENT METHODOLOGY*

The Bushfire Hazard and Risk Assessment is based on the risk management process defined by AS/NZS ISO 31000:2009 'Risk management – Principles and guidelines' (Standards Australia, 2009b) and the results of the National Inquiry on Bushfire Mitigation and Management (COAG, 2004) which recommends an assessment process for:

- analysis and evaluation of bushfire risk; and
- acceptable risk treatments that will avoid the risk, reduce the likelihood, reduce the consequences, accept the risk, transfer the risk and retain the risk.

The following steps were undertaken in the assessment process:

- determine whether the development area has been mapped as bushfire prone land and requires compliance with PBP 2006 (*Section 2*);
- identify the assets within and surrounding the Study Area requiring protection (*Section 4*);
- identify the bushfire risk factors such as bushfire history and known bushfire behaviour in the study area and within the surrounding lands (*Section 5*);
- map the bushfire hazard at a site specific scale following the relevant guidelines and compare with bushfire prone area mapping (*Section 5*);
- assess (likelihood and consequence) and evaluate bushfire risk to and from the development following AS/NZS ISO 31000:2009 risk management process. Link PBP 2006 findings with this process (*Section 6*); and
- produce risk mitigation and management treatments and satisfy PBP 2006 requirements (*Section 7*).

4 IDENTIFICATION OF ASSETS

The proposed wind farm is set amongst a historically cleared landscape where rolling hills dominate and the majority of native vegetation has been partially or fully cleared for grazing and cropping. Amongst the predominately cleared farmlands, some remnant patches of open woodland vegetation remain scattered across the landscape and are generally restricted to poorer soils.

The following section describes the assets that occur within and surrounding the Study Area, and also describes the locality of the identified assets in terms of the bushfire hazard present (as identified in *Section 5.6*).

4.1 ASSETS WITHIN THE STUDY AREA

Turbines

The proposed wind farm incorporates the construction and commissioning of up to 122 WTGs, scattered reasonably evenly across the entire wind farm layout, as shown in *Figure 1.2.*

The Project layout has been modelled using a range of wind turbines that have rotor diameters up to 144m, with nominal capacities from 1.5MW upwards based on available technology in the market. Wind turbines in this range include tower heights (or hub heights) of up to 120m.

The wind turbines will be automated to face into the wind with cut-in and cut-out speeds dependent on the model of turbine selected. Typically, a turbine will begin generating around 4 metres per second (m/s) and shut down around 25m/s to avoid damage to the equipment and prevent unsafe operation.

The majority of the proposed wind turbines (approximately 93) are in areas identified as 'Low' and 'Low-Moderate' bushfire hazard. Approximately 28 turbines are in areas identified as 'Moderate' and 'Moderate-High', and no turbines are proposed for areas mapped as 'High' bushfire hazard. Further assessment of bushfire hazard and how it relates to the infrastructure is discussed in *Section 6*.

Electrical Connection, Collector and Switching Substations

The individual turbines will be connected to the collector and switching substations by underground and overhead electrical interconnection lines and control cables.

The proposed layout shows three substation options (each with main collector substation and switching substation connected) in the centre of the proposed wind farm, adjacent to Tangmangaroo Road (*Figure 1.2*). Connecting to the high voltage grid will require a switching substation to be constructed close to the point of connection with the existing transmission line. External overhead electrical interconnection lines and associated communications cables between the main collector substation and the switching substation would also be required if they are constructed separately from each other. The three proposed substation options are in areas identified as Low-Moderate bushfire hazard.

Underground and overhead transmission lines (up to 132kV double circuit) and control cables will be within and between the WTGs and Clusters, in single or multiple lines, connecting to the collector substation and switching station. *Figure 1.2* shows the location of the proposed underground and overhead electricity transmission lines within the Study Area. All proposed transmission lines are in areas identified as Low and Low-Moderate bushfire hazard.

Compounds

Approximately four separate Site Compounds and lay down areas (part temporary, part permanent), including site operations facilities and services buildings will be required during the life of the wind farm.

The current wind farm layout proposes six Site Compound areas, as shown on *Figure 1.2.* Two of the proposed six Site Compounds are in areas identified as Low bushfire hazard and the remaining four are in areas identified as Low-Moderate bushfire hazard.

Public Roads

Access routes have been designed to achieve practical transport paths that minimise disruption to local traffic and environmental impacts. Four access points from public roads will be needed to access the wind farm and are proposed as follows:

- Boorowa Road: access to the Langs Creek Cluster;
- Lachlan Valley Way: access to the Kangiara Cluster;
- Rye Park – Dalton Road: access to the northern section of the Mt Buffalo Cluster; and
- Wargeila Road: access to the southern section of the Mt Buffalo Cluster.

Internal Access Roads

Access tracks up to 10m wide will be required between each of the WTG sites, the collector and switching substations and facilities building. The transport of materials and equipment to site during the construction phase will involve a temporary increase in local traffic volume.

There are a number of locked farm gates across the properties involved in the wind farm project, some of which are along proposed internal access roads for the wind farm (for example, the Mt Buffalo access). Locked gates may result in limited access and egress for fire fighting vehicles and the requirement for improved access for RFS is considered in *Table 7.1*.

Figure 1.2 shows the location of the proposed access routes from public roads, the proposed access tracks between turbines and other infrastructure sites within the wind farm layout.

The majority of the proposed internal access roads are in areas identified as Low and Low-Moderate bushfire hazard. There are some small sections of access roads though areas identified as Moderate bushfire hazard.

Utilities – Electricity, Gas, Water

The existing transmission lines within the Study Area are the two 132 kV Yass-Cowra (circuits 999 and 973) power lines. These lines traverse the Study Area in a north to south direction, roughly dividing the Mt Buffalo Cluster in the east and the Langs Creek and Kangiara Clusters in the west, as shown in *Figure 4.1*.

An underground High Pressure Gas Pipeline, operated and maintained by APA Group Transmission (NSW), runs in a south east to north west direction just north of the Mt Buffalo and Langs Creek Clusters. The underground pipeline crosses under the proposed access road to the Mt Buffalo cluster (in the north), Harrys Creek Road and the proposed access road to the Langs Creek Cluster and is located approximately 200m away from the nearest WTG, as shown in *Figure 4.1*.

The existing overhead transmission lines within the Study Area cross areas that are identified as Low, Low-Moderate, Moderate and Moderate-High bushfire hazard. It should be noted that the vegetation clearance (the easement) around these lines would be maintained by Essential Energy, as part of their own Vegetation Management Plan. The underground high pressure gas pipeline crosses areas that are identified as Low, Low-Moderate, and Moderate bushfire hazard within the Study Area.

Biodiversity

Although the proposed wind farm is set amongst a landscape where the majority of native vegetation has been partially or fully cleared for grazing and cropping, there are patches of remnant vegetation and numerous other habitat values within the Study Area. A number of threatened species and one threatened vegetation community, listed under either state or Commonwealth legislation (or both), have been recorded within the Study Area (refer to *Table 4.1*).

Table 4.1 Threatened Species and Ecological Communities Recorded within the Study Area.

Threatened Species or Ecological Community [1]	Location in Study Area (with reference to mapped bushfire hazard) [1]	Vulnerability to bushfire [2, 3]
Ammodium craspediosdes (Yass Daisy)	This species has been recorded in the south of the Study Area within an area of open woodland. This area is recognised as having medium to high bushfire potential based on fuel type and slope classes.	No specific information in regards to this species' response to fire although it is likely to be impacted by high intensity and /or frequent fire events.
Synemon plana (Golden Sun Moth)	This species has been recorded within the south of the Mt Buffalo Cluster, in the centre of the Study Area near Tangmangaroo Rd, within the north of the Kangiara Cluster, and within the south of the Langs Creek Cluster. The areas in which the species was recorded are identified as Low-Moderate and Moderate bushfire potential based on fuel type and slope classes.	This species is vulnerable to high intensity and frequent fire events, particularly during and immediately following the flying season (late October to early January). The larvae should be largely resistant to fire as they are located underground.
Polytelis swainsonii (Superb Parrot) *Pomatostomus temporalis temporalis* (Grey Crowned Babbler) *Circus assimilis* (Spotted Harrier) *Climacteris picumnus victoriae* (Brown Treecreeper) *Petroica boodang* (Scarlet Robin) *Daphoenositta chrysoptera* (Varied Sitella) *Stagonopleura guttata* (Diamond Firetail) *Pyrrholaemus sagittata* (Speckled Warbler)	The eight species of birds were identified in a variety of habitats across the Study Area. The Diamond Firetail and Superb Parrot were the most commonly encountered species. The areas in which the birds were recorded are identified as Low, Low-Moderate, Moderate and Moderate-High bushfire potential based on fuel type and slope classes.	Frequent, high intensity fires may cause the degradation of breeding and foraging habitats although mobile species such as birds are less likely to be impacted by bushfire as they are able to escape the direct impacts of flame and smoke.

Threatened Species or Ecological Community [1]	Location in Study Area (with reference to mapped bushfire hazard) [1]	Vulnerability to bushfire [2, 3]
Petaurus norfolcensis (Squirrel Glider)	Squirrel Glider was identified in mature Box Gum Woodland adjacent to Tangmangaroo Road in the centre of the Study Area, a few hundred metres from an area with many hollow bearing trees. This area is recognised as having low-moderate to moderate bushfire potential based on fuel type and slope classes.	Removal of understorey food plants (Banksias and Acacias) by frequent, high intensity fire is a potentially significant threat to Squirrel Glider habitat. Surveys in the coastal plains of NSW have revealed that gliders are scarce or absent from habitats burnt within the previous 12 months.[4]
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland	This community was recorded as remnant patches across all three clusters, with the majority of the community within the Study Area being within the Kangiara Cluster. The areas in which the community was recorded are identified as Low, Low-Moderate, and Moderate bushfire potential based on fuel type and slope classes.	Altered fire regimes have the potential to detrimentally affect the integrity of this ecological community in the long term.

1. Refer to *Bango Wind Farm Ecological Assessment (ERM 2013)* for more detail on the habitat requirements and confirmed records of these species.
2. *NSW OEH (2013) Threatened Species Profiles*
3. *DSEWPC (2013) Species Profile and Threats Database*
4. *Smith (2002) Squirrel Glider Conservation Plan, Wyong Shire Council, November 2002.*

4.2 ASSETS SURROUNDING THE STUDY AREA

Residential Properties and Farms

The majority of properties surrounding the Study Area are privately owned rural farming properties. There are 13 residential dwellings located on the properties where the wind farm is proposed, and many additional residential dwellings on surrounding lands that are not directly involved with the wind farm development. There are also farm sheds, shearing sheds, machinery sheds, silos and a range of other structures associated with farming, scattered in the lands surrounding the Study Area (refer to *Figure 4.1).*

Nearest Towns and Localities

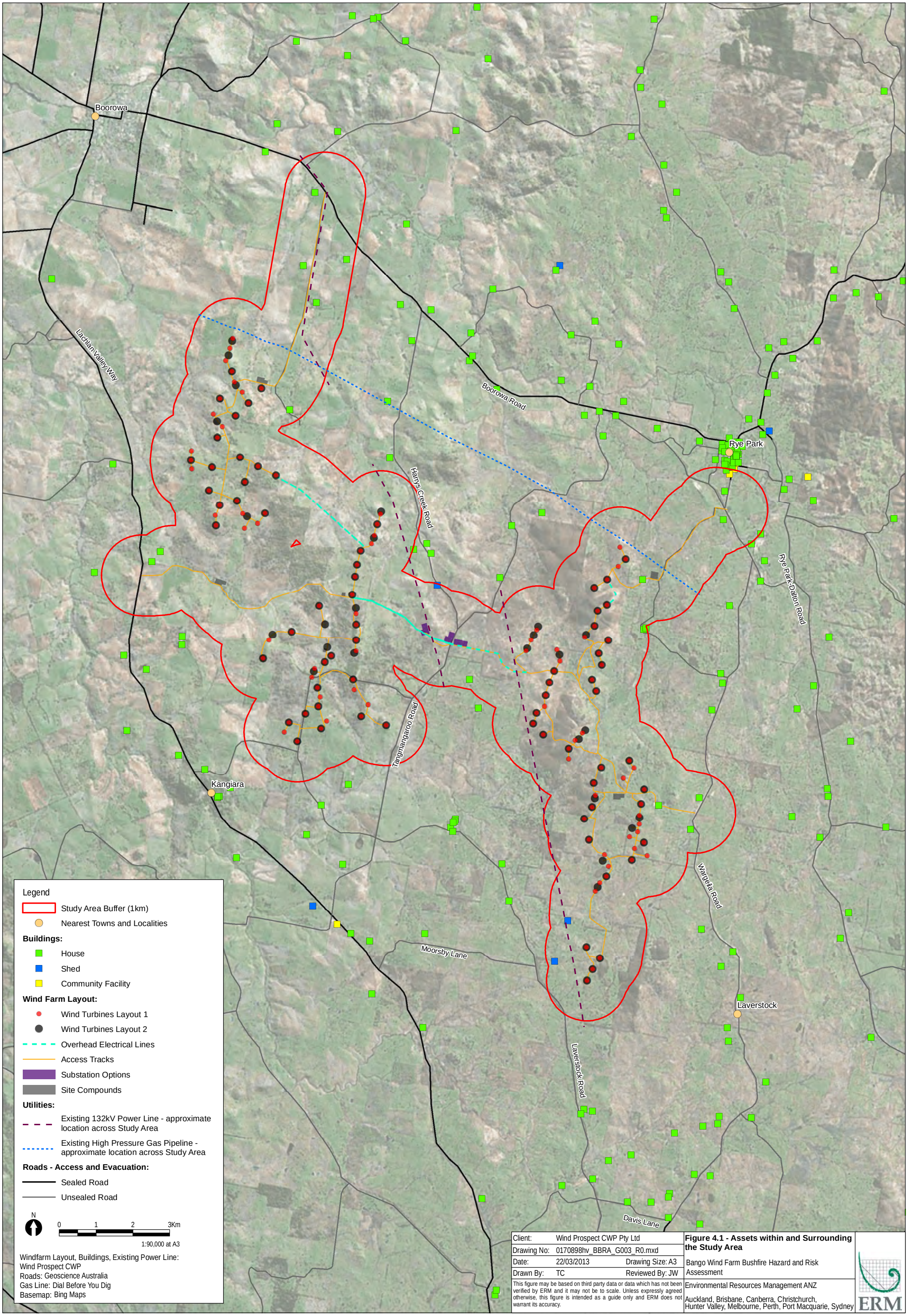
The nearest major communities are the townships of Boorowa, approximately 7km to the north west, and Yass, approximately 20km to the south. The Study Area is also surrounded by the small townships of Rye Park, located approximately 2km to the north east, and Binalong located approximately 15km to the south west. Other communities within 10km of the proposed wind farm are Kangiara to the south west and Laverstock to the south east. *Figure 4.1* shows the location of the nearest towns and localities.

Public Roads

The existing local road network surrounding the Study Area consists of the Lachlan Valley Way to the west, Boorowa Road and Harrys Creek Road to the north, Rye Park-Dalton and Wargeila Roads to the east, Laverstock Road, Davis Lane to the south and Moorsby Lane to the south. Tangmangaroo Road runs through the centre of the Study Area. These roads provide access and egress for different areas within and surrounding the Study Area (refer to *Figure 4.1).*

Utilities – electricity, gas, water

Two existing transmission lines traverse the Study Area. These transmission lines run north and south of the Study Area to Cowra and Yass respectively. An underground High Pressure Gas Pipeline, operated and maintained by APA Group Transmission (NSW), runs in a south east to north west direction just north of the Study Area. *Figure 4.1* shows the location of the existing overhead transmission lines and the existing underground High Pressure Gas Pipeline, where they intersect the Study Area.


Boorowa
Lachlan Valley Way
Boorowa Road
Rye Park
Harrys Creek Road
Rye Park-Dalton Road
Tangmangaroo Road
Kangiara
Wargela Road
Moorsby Lane
Laverstock
Laverstock Road
Davis Lane
Legend
Study Area Buffer (1km)
Nearest Towns and Localities
Buildings:
House
Shed
Community Facility
Wind Farm Layout:
Wind Turbines Layout 1
Wind Turbines Layout 2
Overhead Electrical Lines
Access Tracks
Substation Options
Site Compounds
Utilities:
Existing 132kV Power Line - approximate location across Study Area
Existing High Pressure Gas Pipeline - approximate location across Study Area
Roads - Access and Evacuation:
Sealed Road
Unsealed Road
N
0 1 2 3Km
1:90,000 at A3
Windfarm Layout, Buildings, Existing Power Line:
Wind Prospect CWP
Roads: Geoscience Australia
Gas Line: Dial Before You Dig
Basemap: Bing Maps
Client: Wind Prospect CWP Pty Ltd
Drawing No: 0170898hv_BBRA_G003_R0.mxd
Date: 22/03/2013 Drawing Size: A3
Drawn By: TC Reviewed By: JW
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
Figure 4.1 - Assets within and Surrounding the Study Area
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Environmental Resources Management ANZ
Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney
ERM

5 BUSHFIRE RISK FACTORS

5.1 REGIONAL FIRE HISTORY

The South West Slopes region covers the northern portion of the Study Area and has on average 49 bushfires per year, of which two on average can be considered to be major fires (South West Slopes Zone Bushfire Risk Assessment, 2011).

The Southern Tablelands region covers the southern portion of the Study Area and has on average 265 bushfires per year, of which five on average can be considered to be major fires (Southern Tablelands Zone Bushfire Risk Assessment, 2009).

The main sources of ignition in the region, as identified within the South West Slopes Zone Bushfire Risk Assessment (2011) and Southern Tablelands Zone Bushfire Risk Assessment (2009), are:

- Harvest and Farm Machinery - Fires associated with harvesting and farm activities are normally due to mechanical failure or poor maintenance activities of machinery used in harvest activities. Equipment used in repair work such as welders and angle grinders, vehicles operated in cured fuel areas are also a cause of ignition;

- Lightning Strikes - Lightning ignitions occur predominantly in the summer months of January and February. Summer storms normally form in the north west to the south west of the region and lightning occurs over the entire region;

- Escapes from Legal and Illegal Burning - This activity results from land holders and land managers lighting fires on their own land or neighbouring land, where the fire has not been properly extinguished or is unattended or there has been unsuitable weather conditions at the time of the burn;

- Accidental - Arcing of high voltage electrical power lines in high winds and slashing within the summer months can result in the accidental ignition of fire; and

- Arson - This activity occurs mainly in the summer months usually on high fire danger days. There has been an increase of arson in recent years (South West Slopes Zone Bushfire Risk Assessment, 2011).

There have been no significant fires recorded for the Study Area within the last five years, although relatively large fires were recorded within the district and to the east of Rye Park during the 2012 fire season (*pers. com.* Boorowa Fire Control Centre).

5.2 *REGIONAL FIRE WEATHER*

An analysis of the fire weather experienced in the locale and the surrounding region provides insight into bushfire behaviour potential. A Fire Danger Index (FDI) of 100 has been used to inform bushfire behaviour on the Study Area.

The bushfire season generally runs from October to April although persistent dry conditions have extended the season into May. Prevailing weather conditions associated with the bushfire season in the South West Slopes region are strong gusty north-westerly to south-westerly winds accompanied by high daytime temperatures and low relative humidity, while in the Southern Tablelands Zone the winds are predominantly north-north westerly. Afternoon wind changes often hamper fire fighting efforts. There are also frequently dry lightning storms occurring during the bushfire season (South West Slopes Zone Bushfire Risk Assessment, 2011 and Southern Tablelands Zone Bushfire Risk Assessment, 2009).

5.3 *SLOPE*

Steeper slopes can significantly increase the rate of spread of fires, and the relationship of the steepness of slope, and whether a fire moves upslope or downslope, is vital to understanding bushfire behaviour potential. Slope and wind are often the major factors determining the direction of fire spread.

The landscape is characterised by rolling to sometimes steep hills and the turbine positions of the proposed wind farm are located along ridgelines within the project area, located at varying altitudes between 570m and 760m AHD. The slope map produced for the topography within and surrounding the study area is included as *Figure 5.1*.

As shown in *Figure 5.1*, the ridgelines on which the turbines are located vary in gradient from less than 5° in some areas to over 20° in others. The majority of the slopes leading up to the turbines are in a range of less than 5° to 10° gradient. As the turbines are specifically located along ridgelines, all directly adjacent lands are on a downslope gradient away from the turbines.

5.4 *VEGETATION*

The extent of modification varies across the Study Area, from pockets of largely intact native vegetation to scattered paddock trees and croplands. Woodland and open forest areas still remain, however the understorey and groundcover layers have been substantially modified.

ERM (2013) have undertaken vegetation mapping within the Study Area and the results are shown in *Figure 5.2*. Vegetation in the southern and eastern sections of the Study Area has previously been mapped in 2005 as part of the Southern Comprehensive Regional Assessment (SCRA) (Gellie 2005) and Native Vegetation of the Boorowa Shire mapping (NPWS 2002). Vegetation as mapped by Gellie (2005) and NPWS (2002) for areas not covered in ERM's mapping are shown in *Figure 5.3*.

Detailed descriptions of the vegetation communities including species composition and structural diversity is provided in the Bango Wind Farm Ecological Assessment (ERM 2013).

Legend

Study Area Buffer (1km)

Wind Turbines Layout 1

Wind Turbines Layout 2

Overhead Electrical Lines

Access Tracks

Substation Options

Site Compounds

Contours (10m intervals)

Slope

<5 degrees

5 - 10 degrees

10 - 15 degrees

15 - 20 degrees

>20 degrees

N

0 1 2 3Km

1:75,000 at A3

Windfarm Layout: Wind Prospect CWP
Basemap: Bing Maps

Client:	Wind Prospect CWP Pty Ltd	
Drawing No:	0170898hv_BBRA_G004_R0.mxd	
Date:	02/04/2013	Drawing Size: A3
Drawn By:	TC	Reviewed By: JW

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 5.1 - Slope Classes within the Study Area

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ERM

Legend

- Box Gum Woodland - Moderate to Good Condition and Derived Native Grassland (DNG) - Commonwealth Listed
- Box Gum Woodland - Moderate to Good Condition and DNG - State Listed
- Box Gum Woodland - Low Condition and DNG - State Listed
- Box Gum Woodland - Low Condition - State Listed
- Red Stringybark Open Forest - Low Condition and DNG
- Red Stringybark Open Forest - Moderate to Good Condition and DNG
- Pasture
- Cropping
- Pines
- Planted Native Vegetation
- Road
- Study Area Buffer (1km)
- Wind Turbines Layout 1
- Wind Turbines Layout 2
- Overhead Electrical Lines
- Access Tracks
- Substation Options
- Site Compounds

N

0 1 2 3Km

1:75,000 at A3

Windfarm Layout: Wind Prospect CWP
Basemap: Bing Maps

Client:	Wind Prospect CWP Pty Ltd		
Drawing No:	0170898hv_BBRA_G005_R0.mxd		
Date:	27/03/2013	Drawing Size: A3	
Drawn By:	TC	Reviewed By: JW	

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Figure 5.2 - Vegetation Communities (ERM 2013)

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ERM

Legend

Native Vegetation of the Boorowa Shire mapping (NPWS 2002)

- Blakleys Red Gum - Yellow Box Grassy Woodland
- Red Stringybark - Joycea Tussock Grass Dry Shrub Open Forest
- Red Stringybark Dry Shrub Forest
- River Red Gum Riparian Grassy Forest
- Tableland Woodland/Forest
- Themeda - Bothriochloa Grassland/Open Woodland
- Unmapped (assigned bushfire fuel group based on interrogation of aerial imagery & surrounding mapped vegetation types)
- Study Area Buffer (1km)

Southern Comprehensive Regional Assessment (SCRA) (Gellie 2005)

- Tableland Dry Grassy Woodland
- Tablelands and Slopes Dry Herb-Grass Woodland
- Northern SC Hinterland Heath DryShrub Forest
- Northern Slopes Dry Grass Woodland
- Northern Tablelands and Slopes Dry Shrub-Grass Forest
- Western Slopes Herb-Grassy Woodland

Wind Farm Layout:

- Wind Turbines Layout 1
- Wind Turbines Layout 2
- Overhead Electrical Lines
- Access Tracks
- Substation Options
- Site Compounds

N

0 1 2 3Km

1:75,000 at A3

Windfarm Layout: Wind Prospect CWP
Basemap: Bing Maps

Client:	Wind Prospect CWP Pty Ltd		
Drawing No:	0170898hv_BBRA_G006_R0.mxd		
Date:	27/03/2013	Drawing Size: A3	
Drawn By:	TC	Reviewed By: JW	

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 5.3 - Regional Vegetation Mapping outside ERM Vegetation Mapping (Gellie 2005, NPWS 2002)

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5.5 *FUEL*

The vegetation associations described above have been simplified in line with a methodology devised by the Southern Regional Fire Association (1994). This methodology involved the grouping of vegetation associations into similar fine fuel characteristics. The vegetation communities have been classified into fuel groups using the following parameters:

- frequency that the vegetation community provides 'available fire fuel';
- structure of the vegetation and the ability of ground level fuels to carry fire into higher vegetation levels e.g. from understorey into crown fire;
- arrangement of the fuel within the vegetation type, e.g. fine fuels that are elevated, such as in heath, contribute more to fire intensity than a similar quantity of leaf litter fuel; and
- amount of fuel that accumulates after a long period without fire.

Table 5.1 describes the categorised fuel groups and their respective definitions. Estimates of potential fire behaviour, based on fuel groups, for each of the vegetation communities within the Study Area is identified in *Section 5.6*.

Table 5.1 Description and Characteristics of Fuel Groups

Fuel Group	Characteristics	Relevance to the Study Area	ERM (2013) Vegetation Mapping (*Figure 5.2*)	Gellie (2005) Vegetation Mapping (*Figure 5.3*)	NPWS (2002) Vegetation Mapping (*Figure 5.3*)
High (4)	Continuous fuels, higher quantity, available to burn during average seasons (higher fire intensity expected e.g. woodland and forest fuels)	Good Condition Forest Communities	• *Red Stringybark Open Forest (moderate to good condition)*	• *Northern Tablelands and Slopes Dry Shrub/Grass Forest* • *Northern SC Hinterland Heath Dry Shrub Forest*	• *Red Stringybark – Joycea Tussock Grass Dry Shrub Open Forest* • *Red Stringybark Dry Shrub Open Forest (Red Stringybark - Red Box Open Forest)* • *Tableland Woodland/Forest*
Medium (3)	Less continuous fuels, medium level quantity, available to burn during average seasons but may be less often than high (medium or high fire intensity expected).	Good Condition Open Woodland.	• *Box Gum Woodland (moderate to good condition)* • *Planted Native Vegetation* • *Pines*	• *Tableland Dry Grassy Woodland* • *Northern Slopes Dry Grass Woodland* • *Tableland and Slopes Dry Herb–Grass Woodland* • *Western Slopes Herb-Grass Woodland*	• *Blakely's Red Gum – Yellow Box Grassy Woodland*
Low (2)	Possibly discontinuous fuels, low-medium fuel quantity, moister fuels unlikely to contribute to high intensity fires in average season, fuel structure facilitates easier control, (fire intensities expected range from low-high and generally regarded as easier to control e.g. moist and wet forests)	Poor Condition Woodlands and Native Grassland	• *Red Stringybark Open Forest (low condition)* • *Box Gum Woodland(low condition)*		• *Themeda – Bothriochloa Grassland/Open Woodland* • *River Red Gum Riparian Grassy Forest*
Minimal (1)	Unlikely to burn or always burn within controllable limits.	Improved Pasture and Cropping Land	• *Pasture* • *Cropping*		

5.6 BUSHFIRE HAZARD CLASS

Bushfire hazard classes were identified across the landscape by applying relative weightings to the varying fuel groups (see *Table 5.1*) and combining them with available slope classes (i.e. <5, 5-10, 10-15, 15-20, >20 degrees) within a Geographic Information System (GIS) model. The result is the mapping of relative hazard in classes of 'Low', 'Low-Moderate', 'Moderate', 'Moderate-High' and 'High' hazard (refer to *Figure 5.4).*

This analysis does not indicate how often an area will receive potentially damaging fires, or the actual intensity of a fire. It does, however, provide a useful comparative ranking, indicating sites of higher and lower potential fire behaviour compared to others in an area.

Based on the information provided in the fire weather and fire hazard analysis above, likely fire behaviour can be predicted. The evaluation of existing bushfire behaviour within the Study Area shows that the greatest hazard is a combination of undesirable fire weather (i.e. hot and dry westerly winds during summer) and the potential for a fire to spread towards farm assets in the surrounding area. A fire under the influence of wind may travel fast in an easterly direction, reaching assets before fire fighters can attend the scene.

Legend

Study Area Buffer (1km)

Wind Turbines Layout 1

Wind Turbines Layout 2

Overhead Electrical Lines

Access Tracks

Substation Options

Site Compounds

Contours (10m intervals)

Bushfire Hazard Rating

1 - Low

2 - Low to Moderate

3 - Moderate

4 - Moderate to High

5 - High

N

0 1 2 3Km

1:75,000 at A3

Windfarm Layout: Wind Prospect CWP

Basemap: Bing Maps

Client:	Wind Prospect CWP Pty Ltd		**Figure 5.4 - Bushfire Hazard Classes**
Drawing No:	0170898hv_BBRA_G007_R0.mxd		
Date:	27/03/2013	Drawing Size: A3	Bango Wind Farm Bushfire Hazard and Risk Assessment
Drawn By:	TC	Reviewed By: JW	

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5.7 *HISTORY OF FIRE AND WIND FARMS IN AUSTRALIA*

The risk of fire from wind farms is low and based on a literature review there have been four reported fires involving wind farms within Australia:

1. 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;

2. 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;

3. 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 fire fighting response due to the exclusion perimeter that was established and the spot fires due to flames coming off the rotating blades; and

4. A turbine fire occurred at Cathedral Rocks Wind Farm, South Australia, in February 2009. The turbine was damaged and surrounding spot fires required extinguishing (Parsons Brinkerhoff, 2012).

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 conclude 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.

As indicated by CFA (2007) and The Australian Institute (2006), the low incidence of fire is likely to be attributable to a number of factors. Firstly, wind turbines are a relatively passive technology that uses few flammable materials. Secondly, although turbines do attract lightning, their design minimises the associated fire risks. Turbine lightning protection systems are now used that extend from the blade to the bottom of the tower and dissipate lightning into the ground. Thirdly, wind turbines are generally placed in open areas, limiting the chance of fires spreading when they do occur. Finally, due to the financial cost associated with wind farm developments, operators generally manage the sites in a manner that minimises the risk to the turbines and surrounding property.

The method of dealing with fire in a turbine nacelle is to isolate it electrically, immobilise it mechanically, and wait for fire to burn out before replacing the damaged or defective parts. There is limited material available to burn, but the role of the RFS would be to attend nearby and contain/extinguish fires arising from burning material striking the ground below and downwind of the tower. This is exactly the same scenario as a burning hollow tree which cannot be felled in safety, the differences being that the increased height of the tower fire means that it could throw fire further, but burning material is more likely to burn out before reaching the ground (Fenwick, undated).

Sophisticated monitoring technology is utilised 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) and 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.

5.8 EXISTING BUSHFIRE PROTECTION MEASURES

The Study Area is covered by the South West Slopes Zone Bushfire Risk Management Plan (2011) and the Southern Tablelands Zone Bushfire Risk Management Plan (2009). These plans were prepared by the South West Slopes Zone Bushfire Management Committee (BFMC) and Southern Tablelands Zone BFMC, and together provide a platform to manage bushfire risk across the district. The study area and Project specific protection measures outlined below have been incorporated into the design of the wind farm.

5.8.1 Turbine Design

It is not yet known which model of wind turbine will be used for the Project, however, the wind turbines that will potentially be used for the Project include the following features which will assist in reducing the risk of fire and isolating any issues in the unlikely event of a fire:

- wind turbines begin to generate energy at wind speeds in the order of 3.5 to 4m/s (approximately 13 kilometres per hour (kph)) and shut down (for safety reasons) in wind speeds greater than 25m/s (or 90kph);

- wind turbine blades are typically made from glass fibre reinforced with epoxy or plastic attached to a steel hub, and include lightning rods for the entire length of the blade;

- the supporting structure is comprised of a reducing cylindrical tower made out of either a welded steel shell or a concrete steel hybrid; and

- the nacelle is the housing constructed of steel and fibreglass that is mounted on top of the tower. It encloses the gearbox, generator, transformers, motors, brakes, electronic components, wiring and hydraulic and lubricating oil systems. Weather monitoring equipment located on top of the nacelle will provide data on wind speed and direction for the automatic operation of the wind turbine.

5.8.2 Location of Wind Turbines

Under Visual Flight Rules, pilots must have good visibility, fly at subsonic speeds and must not fly lower than 500 feet (152m) above the highest point of the terrain or any object on it (AusWEA, undated). Fire suppression aircraft only operate in areas where there is no smoke and during daylight hours. Wind turbines, similar to high voltage transmission lines, are part of the landscape and would be considered in the incident action plan. Aircraft would therefore not fly within close proximity to the wind farm in smoky conditions and the turbines are not considered to pose any increased risk to aerial fire fighting capabilities.

5.8.3 Remote Monitoring and Automatic Shutdown

Wind turbines 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 25m/s.

5.8.4 Lightning Dispersal Technology

The risk of fire starting as a result of a lighting strike is actually reduced by the presence of wind turbines. A built-in lightning protection system safely dissipates the electricity from the blades or the nacelle into the ground.

5.8.5 Improved Access

Wind farm projects generally require upgrades to existing road infrastructure, increasing the accessibility of farms to emergency vehicles should a bushfire break out in the vicinity of the wind farm. A Fire Management and Emergency Response Plan will be prepared, in consultation with the local RFS, including an assessment of the existing road network and adequacy of the existing fire breaks. As a minimum, and to enable access for RFS all roads will be maintained to the following minimum standards:

- constructed roads should be a minimum of 4.5m in trafficable width (with 1m clearance each side) with a 4m vertical clearance for the width of the formed road surface;

- roads should be constructed to a standard so that they are accessible in all weather conditions and capable of accommodating a vehicle of 15 tonnes for the trafficable road width;

- the average grade should be no more than 1 in 7 (14.4% or 8.1^{o}) with a maximum of no more than 1 in 5 (20% or 11.3^{o}) for no more than 50m; and

- passing bays should be located every 200m on access tracks (CFA 2012 and PBP 2006).

All site vehicles during the construction phase will have diesel engines and will use the site access roads to minimise the likelihood of igniting dry grass.

5.8.6 Fuel/Vegetation Management

Turbine towers will be secured on a roughly circular concrete foundation of approximately 25m diameter. The hardstand will remain in situ after construction to allow for future maintenance and provides a minimum 10m wide fuel free zone surrounding each tower (based on a tower base of 4.5m diameter). The wind turbine assembly and hardstand areas immediately adjacent to turbines provide an additional 25m x 60m fuel free zone providing a possible 60m of defendable space at each turbine and meets, if not exceeds the objectives of PBP 2006.

A minimum 20m defendable space (fuel reduced zone) will also be maintained around each of the collector substations and compounds.

5.8.7 Water Access Points

Appropriate location of water access points will assist safe, effective and timely fire suppression activities. To ensure adequate access to water for RFS and fire fighting crews, the allocation of static water supplies is necessary and will be further detailed in the Bushfire Management and Emergency Response Plan. As a minimum, 30,000 litre water tanks, dams or other static water supplies will be provided across the Study Area. The exact number and location will be confirmed in consultation with the local RFS.

6 BUSHFIRE RISK ANALYSIS

6.1 INTRODUCTION

The following methodology was used in development of bushfire risk management plans in NSW by the Rural Fire Service (NSW RFS 2008) and follows the procedures and considerations of *AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines* (Standards Australia 2009a).

The likelihood of bushfire risk is defined as the chance of a bushfire igniting and spreading. There are four possible likelihood ratings: unlikely, possible, likely and almost certain. It is often challenging to determine the likelihood rating for assets. This is mainly due to a lack of fire history records. Where data is not available, subjective estimates may be used which reflect the likelihood that a bushfire will occur. Likelihood should be considered in the context of long term planning, not just the likelihood of a bushfire occurring in the next few years.

Table 6.1 outlines the process for determining likelihood.

Table 6.1 Likelihood Ratings for Assessing Bushfire Risk

	Fires are expected to spread and reach assets	**Fires are not expected to spread and reach assets**
Fires occur frequently	Almost certain	Possible
Fires occur infrequently	Likely	Unlikely

NSW Rural Fire Service, 2008

Consequence is the outcome or impact of a bushfire event. The assessment process for consequence is subjective and includes consideration of threat, vulnerability and other issues such as level of impact and recovery costs. There are four possible consequence ratings: minor, moderate, major and catastrophic. A description of each is provided in *Table 6.2*.

Table 6.2 Consequence Ratings for Assessing Bushfire Risk

Consequence Rating	Descriptions
Minor	• No fatalities. • Some minor injuries with first aid treatment possibly required. • No persons are displaced. • Little or no personal support (physical, mental, emotional) required. • Inconsequential or no damage to an asset. • Little or no disruption to community. • Little or no financial loss.
Moderate	• Medical treatment required but no fatalities. Some hospitalisation. • Localised displacement of persons who return within 24 hours. • Personal support satisfied through local arrangements. • Localised damage to assets that is rectified by routine arrangements. • Community functioning as normal with some inconvenience. • Local economy impacted with additional financial support required to recover. • Small impact on environment / cultural asset with no long term effects.
Major	• Possible fatalities. • Extensive injuries, significant hospitalisation. • Large number of persons displaced (more than 24 hours duration). • Significant resources required for personal support. • Significant damage to assets that requires external resources. • Community only partially functioning, some services unavailable. • Local or Regional economy impacted for a significant period of time with significant financial assistance required. • Significant damage to the environment/cultural asset which requires major rehabilitation or recovery works. • Localised extinction of native species (this may range from loss of a single population to loss of all of the species within the BFMC area (for a species which occupies a greater range than just the BFMC area).
Catastrophic	• Significant fatalities. • Large number of severe injuries. • Extended and large number requiring hospitalisation. • General and widespread displacement of persons for extended duration. • Extensive resources required for personal support. • Extensive damage to assets. • Community unable to function without significant support. • Regional or State economy impacted for an extended period of time and financial assistance required. • Permanent damage to the environment. • Extinction of a native species in nature (This category is most relevant to species that are restricted to the BFMC area, or also occur in adjoining BFMC areas and are likely to be impacted upon by the same fire event). In nature means wild specimens and does not include flora or fauna bred or kept in captivity.
NSW Rural Fire Service, 2008	

The risk level is identified by combining the likelihood (see *Table 6.1)* and consequence (see *Table 6.2*) to provide either a low, medium, high, very high or extreme level of risk using the matrix described in *Table 6.3.*

Table 6.3 Matrix to Determine Level of Bushfire Risk

	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

NSW Rural Fire Service, 2008

6.2 BUSHFIRE RISK ASSESSMENT

Risk analysis involves consideration of the causes and sources of risk, their positive and negative consequences, and the likelihood that those consequences can occur. *Table 6.4* presents the level of risk for varying bushfire impact scenarios and assets requiring protection within and surrounding the Study Area. *Table 6.5* provides the results of the risk assessment.

Table 6.4 Bushfire Risk Factors

Risk Factor	**Analysis of Risk Factor**
Likelihood of human and natural fire ignitions, as influenced by time, space and demographics.	Natural ignitions are possible and historically common across the district (refer to *Section 5.1*). Human induced ignitions (both accidental and arson) are known to occur across the district (refer to *Section 5.1*). The risk that wind farm will cause a fire is minimal (refer to *Section 5.7*).
The potential spread and severity of a bushfire as determined by fuel, topography and weather conditions	The low availability of fuels across the landscape combined with the dominance of cleared grazing land and numerous roads (which act as fire breaks) would reduce the likelihood of a severe or widespread fire. The most significant risk would be a fire starting near Lachlan Valley Way travelling east, upslope towards the wind farm and surrounding properties rather than from the wind farm itself (*pers. com.* Boorowa Fire Control Centre).
The risk that the construction and / or operation of the wind farm will create a fire that could spread to nearby areas	There is a relatively low density of residential (farm house) and communities within and adjacent to the Study Area. The risk that the wind farm will cause a fire is minimal (refer to *Section 5.7*) and the dominance of cleared grazing land and numerous roads (which act as fire breaks) would reduce the likelihood of a widespread fire.
The vulnerability of assets, or their capacity to cope with, and recover from bushfire.	Stock and crops are vulnerable to fire. Houses are also potentially vulnerable although the remaining built assets identified in *Section 4* are less vulnerable to the impacts of fire. Threatened species and ecological communities reported to occur within the Study Area may be at risk from frequent or high intensity fires.

Risk Factor	Analysis of Risk Factor
The risk that a bushfire will damage a wind turbine or other infrastructure if the wind farm is located in or near a bushfire prone area.	Wind turbine monitoring technology is utilised 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. Wind turbines are a relatively passive technology that use few flammable materials and together with the maintenance of an adequate defendable space results in a low risk of damage to the turbines in the event of a bush fire within the surrounding lands. The substations and compounds are also constructed of non-flammable materials and have defendable space.
Fire safety for workers and visitors during the construction and operation phase.	The safety of workers and visitors is central to bushfire management and emergency response. Provided that appropriate fire fighting equipment, training in initial response and water supplies are maintained on site the likelihood of fire adversely impacting the safety of site personnel is very low although the potential consequences are recognised as being major.
The potential for the wind farm to impact on aerial fighting of bushfires.	While installation of wind turbines may remove the option of aerial suppression of fires over the wind farm itself, the alternative management practices as recommended will take advantage of some of the wind farm infrastructure features and aim to improve the overall fire control capabilities. In the unlikely event that a fire did spread from the wind farm to surrounding properties, the turbines would not limit aerial fire fighting capabilities on other properties in the surrounding area.

Table 6.5 Detailed Bushfire Risk Assessment

Risk Factor	Description of Risk	Analysis of the Risk	Risk	Potential to mitigate impact and reduce risk?
Loss of Life	Populated Area	Assuming that a fire escapes the development, there is a low to medium risk of fire (adversely) impacting on the surrounding life, property and environment. Residential assets in proximity to the project are generally not vulnerable to bushfire due to their location in low hazard areas although the risk to like cannot be discounted. *Likelihood: Unlikely; Consequence: Major*	Medium	• Prepare a Bushfire Management and Emergency Response Plan in consultation with the RFS and other relevant stakeholders prior to the commencement of any construction works.
	Aerial Fire Fighters	Unless they are constructed on or located near airports, wind farms are unlikely to impact on the safety of commercial and domestic air transport. Under Visual Flight Rules, pilots must have good visibility, fly at subsonic speeds and must not fly lower than 500 feet (152m) above the highest point of the terrain or any object on it (AusWEA, undated). Fire suppression aircraft only operate in areas where there is no smoke and during daylight hours. Wind turbines, similar to high voltage transmission lines, are part of the landscape and would be considered in the incident action plan, thus not resulting in any increased risk to aerial fire fighters. *Likelihood: Unlikely; Consequence: Moderate*	Low	• As part of the Bushfire Management and Emergency Response Plan, the RFS should be provided with maps of the final wind turbine layout and identification information for individual wind turbine sites for their internal response planning. • Liaise with the Civil Aviation Safety Authority (CASA) and the RAAF Aeronautical Information Service, which maintains a database of structures on behalf of CASA. • Consideration will be given to painting the turbines white for increased visibility although would need to be consistent with the visual amenity of the landscape.
	Workers and Visitors	Both the likelihood and consequences of a fire will be reduced by the development and implementation of safe working and emergency response procedures for all work tasks. All employees and visitors involved in the operation and maintenance of the wind farm will be routinely trained. Construction and maintenance staff will also be trained in the basic first response fire fighting techniques and appropriate communication and fire fighting equipment will be maintained on site. *Likelihood: Unlikely; Consequence: Major*	Medium	• Develop and strictly implement safe working and emergency response procedures for all work tasks; and • Provide and maintain fire fighting equipment capable of controlling and suppressing small initial outbreaks of fire.

Risk Factor	Description of Risk	Analysis of the Risk	Risk	Potential to mitigate impact and reduce risk?
Damage to infrastructure within the Study Area	Extensive and widespread loss of infrastructure	The design and layout of the wind farm will assist in reducing the risk of fire and isolating any issues. In the unlikely event of a widespread fire some external assistance may be required to recover in the short term. *Likelihood: Unlikely; Consequence: Major*	Medium	• construction and maintenance staff should be trained in the basic first response fire fighting techniques; • provide and maintain fire fighting equipment capable of controlling and suppressing small initial outbreaks of fire; • ensure adequate access to water for RFS and fire fighting crews and provide static water supplies; and • provide all weather access for heavy fire fighting vehicles, including RFS Category 1 fire tankers.
	Localised damage to infrastructure	The design and layout of the wind farm will assist in reducing the risk of fire and isolating any issues. In the unlikely event of a localised fire no external assistance would be required to recover in the short-term and any damage would be rectified during routine maintenance. *Likelihood: Unlikely; Consequence: Moderate*	Low	• Provide and maintain fire fighting equipment capable of controlling and suppressing small initial outbreaks of fire.
Damage to surrounding properties	Extensive and widespread loss of infrastructure and or property	There is a relatively low density of residential (farm house) and communities within and adjacent to the Study Area and some external assistance may be required to recover in the short term. The risk that wind farm will cause a fire is minimal and the dominance of cleared grazing land and numerous roads (which act as fire breaks) would reduce the likelihood of a widespread fire. *Likelihood: Unlikely; Consequence: Major*	Medium	• construction and maintenance staff should be trained in the basic first response fire fighting techniques; • provide and maintain fire fighting equipment capable of controlling and suppressing small initial outbreaks of fire; • ensure adequate access to water for RFS and fire fighting crews and provide static water supplies; and • provide all weather access for heavy fire fighting vehicles, including RFS Category 1 fire tankers.

Risk Factor	Description of Risk	Analysis of the Risk	Risk	Potential to mitigate impact and reduce risk?
	Localised damage to infrastructure and or property	Again, the risk that wind farm will cause a fire is minimal and the dominance of cleared grazing land and numerous roads (which act as fire breaks) would reduce the likelihood of a fire spreading to surrounding properties. Localised damage is unlikely to require external assistance to recover in the short-term. *Likelihood: Unlikely; Consequence: Moderate*	Low	• Provide and maintain fire fighting equipment capable of controlling and suppressing small initial outbreaks of fire.
Damage to ecological values/assets	Threatened species and ecological communities	Again, the risk that wind farm will cause a fire is minimal and the dominance of cleared grazing land and numerous roads (which act as fire breaks) would reduce the likelihood of a widespread or high intensity fire. The wind farm is also unlikely to increase the frequency of fires across the landscape resulting in any local extinction and any impacts to ecological values would be short term only. *Likelihood: Unlikely; Consequence: Moderate*	Low	• Long term flora and fauna monitoring will be undertaken in accordance with a site specific biodiversity management plan (to be confirmed with WPCWP).

6.3 BUSHFIRE RISK EVALUATION

The purpose of the bushfire risk evaluation is to assist in making decisions, based on the outcomes of risk analysis, about which risks need treatment and the priority for treatment implementation.

The Study Area is mapped as predominantly Low bushfire hazard and supports generally cleared and rural developed lands. It is important to note that there are residential dwellings on rural properties scattered throughout the landscape that may be at risk from fire.

In terms of potential impacts upon the proposed wind farm assets, there will be no turbines and supporting infrastructure located within areas mapped as high hazard / bushfire behaviour potential.

Approximately 28 WTGs and associated access tracks are in areas identified as Moderate and Moderate-High bushfire hazard, and no turbines are proposed for areas mapped as High bushfire hazard (see *Figure 5.4*).

Assuming a fire 'escapes' the development, there is a low to medium risk of fire (adversely) affecting surrounding life, property and environment.

The highest risk rating scored (refer to *Table 6.5*) was medium, being:

- the possible chance of fatalities or major injuries to life within or surrounding the wind farm; and
- the possible chance of widespread damage to infrastructure within or surrounding the wind farm.

It is these identified bushfire risks that require specific management and mitigation (treatment) measures as outlined in *Section 7*.

7 *MANAGEMENT AND MITIGATION*

The purpose of management/mitigation measures (risk treatments) is to reduce the likelihood and/or consequences of a potential fire to the community and environment. There are six broad groups of risk treatment options as described by AS/NZS ISO 31000:2009 and the NSW Bushfire Co-ordinating Committee Guidelines (2008):

- Avoid the Risk;
- Reduce the Likelihood;
- Reduce the Consequence;
- Accept the Risk;
- Transfer the Risk; and/or
- Retain the Risk.

The risk assessment and associated mitigation measures are also a response to the requirements of PBP 2006, which requires adequate protection be implemented for all new development on bushfire prone land. The mitigation (bushfire protection) measures required by PBP 2006 should be considered conditions of development approval and are included in the recommended risk treatments listed in *Table 7.1*

Table 7.1 Bushfire Management and Mitigation Measure

Risk Treatment Option	Management Action	Responsibility	Timing
Avoid the Risk	Fire Weather to be monitored daily at the NSW Rural Fire Service website.	Site Manager	Daily during construction and operation
	Ignition creating activities such as welding should not be undertaken outside on days of total fire ban.	Site Manager	Total Fire Ban Days
	Locate electricity services to limit the possibility of ignition of surrounding bushland or the fabric of buildings and undertake regular inspections of lines to ensure they are not fouled by branches, as per the performance criteria and acceptable solutions of PBP 2006.	Site Manager	During construction and operation
Reduce the Likelihood	Maintained fuel reduced zones for all overhead transmission lines in consultation with TransGrid/Essential Energy.	Site Manager	During construction and operation
	Maintain a reduced fuel zone (APZ or defendable space) around each turbine to ensure adequate defendable space in accordance with the performance criteria and acceptable solutions of PBP 2006.	Site Manager	During construction and operation
	Safe working procedures and emergency response procedures should be developed and strictly implemented for all work tasks, with all employees and visitors involved in the operation and maintenance of the wind farm routinely trained in the safe operating procedures and emergency response.	Site Manager	Operation and maintenance
	Construction and maintenance staff should be trained in the basic first response fire fighting techniques including: • communication and reporting requirements such as alerting emergency crews (000) and reporting details of location, size, proximity to assets and access capabilities. Reporting procedures and mechanisms should be efficient and simple to ensure that potential issues are identified, inspected and rectified in a timely manner; • maintaining provision for mobile telephone and UHF radio communications; • use of 4WD striker unit (to be available on site daily during the construction and maintenance phases of the development, particularly during the bushfire season); • use of a dedicated 10,000 litre tanker (to be available on site daily during the construction phase of the development, particularly during the bushfire season or when high risk activities such as welding are being undertaken); and	Site Manager	Prior to construction and during contractor inductions.

Risk Treatment Option	Management Action	Responsibility	Timing
	• use and location of extinguishers, knap-sacks and hoses.		
	Maintain a 10 m wide fuel reduced zones around construction activities that may result in ignition of a fire .i.e. welding.	Site Manager	During construction and operation
	Maintain roads to 6m wide, with a 4m vertical clearance to provide all weather access for heavy fire fighting vehicles, including RFS Category 1 fire tankers. Signs should be installed where a fire or access road is not accessible by a Category 1 tanker.	Site Manager	During construction and operation
	Appropriate location of water access points will assist safe, effective and timely fire suppression activities. To ensure adequate access to water for RFS and fire fighting crews, the allocation of static water supplies is necessary and will be further detailed in the Bushfire Management and Emergency Response Plan. A water supply reserve dedicated to fire fighting purposes should be installed and maintained as per the performance criteria and acceptable solutions of PBP 2006. It is recommended that as a minimum 30,000 litre water tanks, dams or other static water supplies are to be provided across the Study Area. The exact number and location will be confirmed in consultation with the local RFS.	Site Manager	During construction and operation
	All site vehicles during the construction phase will have diesel engines and will use the site access roads to minimise the likelihood of igniting dry grass.	Site Manager	During construction
Accept the Risk	Provide and maintain fire fighting equipment capable of controlling and suppressing small initial outbreaks of fire. Equipment should include (but not be limited to) a 4WD Striker with slip on water unit equipped with diesel pump, hoses, extinguishers, knap sacks and hand tools as well as the availability of a 10,000 litre water tanker.	Site Manager	Initial fire response and suppression of small fires.
	Provide and maintain public and property access roads as per the performance criteria and acceptable solutions of PBP 2006. This includes, but is not limited to ensuring that fire fighters are provided with safe all weather access to structures, that public road widths, design and capacity allow for fire fighter access and resident evacuation, and that roads are clearly signposted.	Site Manager	During construction and operation
	Ensure that property maintenance is undertaken, especially in advance of the bushfire season, as per the bushfire provisions in PBP 2006 (*Appendix 5*).	Site Manager	During construction and operation
	As part of the Bushfire Management and Emergency Response Plan, the RFS will be provided with the following information to assist with their internal response planning: • a construction works schedule;	Site Manager	Prior to construction

Risk Treatment Option	Management Action	Responsibility	Timing
	• maps of the final wind turbine layout and identification information for individual wind turbine sites; • on-site access road plans and locations of access gates; • security information such as location of locked gates and restricted access areas; and • location of any additional water supplies installed for construction activities. Liaise with the Civil Aviation Safety Authority (CASA) and the RAAF Aeronautical Information Service, which maintains a database of structures on behalf of CASA.	Site Manager	Prior to construction
Transfer the Risk	Insurance and Public Liability Insurance Policies	Site Manager	Prior to construction
Retain the Risk	Despite the treatments that are put in place (above) some bushfire risk will remain (residual risk) and it is important that an Emergency Response Plan is prepared in accordance with the 'Guide to Developing a Bushfire Evacuation Plan' (RFS 2004) and the AS 3745:2010 'Planning for Emergencies in Facilities'. The emergency plan should be developed in conjunction with relevant stakeholders, including local fire services, adjoining property owners and employees.	Site Manager	

8 *MONITORING AND REVIEW*

A detailed monitoring and review process will be included within the Bushfire Management and Emergency Response Plan to be prepared and approved prior to any vegetation clearing or construction works and will include as a minimum:

- monitor against the aims and objectives of this assessment;
- update the assessment based on current best practice guidelines;
- assess the risk, obligations and management measures against any new legislative changes;
- ensure the reporting of any fires including ignition source, location, size, properties or assets impacted, response and suppression activities and if RFS or other emergency services attended is captured in the updated fire history; and
- review and update of the risk register and management actions should be undertaken annually at the end of each bushfire season (April-May).

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